

T.C.  
YEDİTEPE UNIVERSITY  
INSTITUTE OF HEALTH SCIENCES  
DEPARTMENT OF NUTRITION AND DIETETICS

**COMPARISON AND CONSISTENCY OF  
MALNUTRITION INFLAMMATION SCORE WITH  
ANTROPOMETRY AND SPESIFIC MALNUTRITION  
SCREENING TOOLS FOR ADULT AND ELDER  
HEMODIALYSIS PATIENTS**

MASTER THESIS

Yeşim NEMUTLU

ISTANBUL, 2021

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**Yeşim NEMUTLU**

**Supervisor**  
**Assist.Prof.Dr. İrem Kaya Cebioğlu**

**ISTANBUL, 2021**

## THESIS APPROVAL FORM

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This study have approved as a Master Thesis in regard to content and quality by the Jury.

|                    | Title, Name-Surname (Institution)                         |
|--------------------|-----------------------------------------------------------|
| Chair of the Jury: | Prof. Dr. Murat BAŞ<br>(Acıbadem University)              |
| Supervisor:        | Assist. Prof. İrem KAYA CEBİOĞLU<br>(Yeditepe University) |
| Member/Examiner:   | Assist. Prof. Binnur OKAN BAKIR<br>(Yeditepe University)  |

### APPROVAL

This thesis has been deemed by the jury in accordance with the relevant articles of Yeditepe University Graduate Education and Examinations Regulation and has been approved by Administrative Board of Institute with decision dated ..... and numbered .....

Prof. Dr. Bayram YILMAZ  
Director of Institute of Health Sciences

## **DECLARATION**

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.



Date 12.12.2021

Yeşim NEMUTLU

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## LIST OF SYMBOLS AND ABBREVIATIONS

dL Deciliter

g Gram

IU International Units

kcal Kilocalorie

kg Kilogram

L Liter

m Meter

m<sup>2</sup> Square meters

mg Milligram

min Minutes

mL Mililiter

BMI Body Mass Index

CI Confidence Interval

CKD Chronic Kidney Disease

CVD Cardiovascular Diseases

DM Diabetes Mellitus

DMS Dialysis Malnutrition Score

EBPG European Best Practice Guidelines

ERA-EDTA European Renal Association–European Dialysis and Transplant Association

EDTNA/ERCA European Dialysis and Transplant Nurses Association/European Renal Care Association

ESDR End-Stage Renal Disease

ESPEN European Society for Clinical Nutrition and Metabolism

GFR Glomerular Filtration Rate

GNRI Geriatric Nutritional Risk Index

HD Hemodialysis

HT Hypertension  
ISRNM International Society of Renal Nutrition and Metabolism  
KDIGO Kidney Disease Improving Global Outcomes  
LBM Lean Body Mass  
MIS Malnutrition Inflammation Score  
MNA Mini Nutritional Assessment  
MUAC Mid-Upper Arm Circumference  
NKF-DOQI National Kidney Foundation Dialysis Outcomes Quality Initiative  
NRI Nutritional Risk Index  
PEW Protein Energy Wasting  
PD Periton Dialysis  
PTH Parathyroid Hormone  
RRT Renal Replacement Therapy  
SD Standard Deviation  
SGA Subjective Global Assessment  
TIBC Total Iron Binding Capacity  
URR Urea Reduction Ratio  
WHO World Health Organization  
WHR Waist-To-Hip Ratio

## ABSTRACT

**Nemutlu, Y. (2021). Comparison and consistency of malnutrition inflammation score with antropometry and spesific malnutrition screening tools for adult and elder hemodialysis patients. Yeditepe University, Institute of Health Science, Department of Nutrition and Dietetics, Master's Thesis, Istanbul.**

This study aimed to compare and contrast adult and elderly hemodialysis-treated patients with end stage renal disease using multiple specific malnutrition screening tools, nutritional index and anthropometry and to determine the best possible risk of age-specific malnutrition. Based on Malnutrition Inflammation Score (MIS), a special screening tool for dialysis patients. The study was carried out with 140 patients (n=70 adult, n=70 elder) who were treated for hemodialysis between March-June. General information from all participants in the study was obtained through a questionnaire, and biochemical data were obtained retrospectively, and anthropometry and MIS were examined. In addition 7-Point Subjective Global Assessment (SGA) and Nutritional Risk Index (NRI) in the adult group, Mini Nutritional Assessment (MNA) and Geriatric Nutritional Risk Index (GNRI) were calculated in the elderly group. In the adult group, 57.1% malnutrition risk was observed according to MIS, 24.3% mildly and moderately malnourished according to 7-Point SGA and 44.3% different stage malnutrition according to NRI. In the elderly group, malnutrition risk was observed in 67.1% according to MIS, malnutrition risk in 62.9% and severe malnutrition in 8.6% according to MNA, and different stage malnutrition in 38.3% according to GNRI. In the ROC analysis based on MIS, the 7-Point SGA in adults and GNRI in the elderly were found to have the highest concistency in predicting malnutrition. Although screening tools can be used in dialysis patients, the use of MIS may be a priority because it is both practical and more sensitive for malnutrition.

**Key words:** Malnutrition, Hemodialysis, Malnutrition Inflammation Score, Subjective Global Assesment, Mini Nutritional Assesment

## ÖZET

**Nemutlu, Y. (2021). Malnütrisyon İnflamasyon Skorunun Yetişkin Ve Yaşlı Hemodiyaliz Hastalarında Spesifik Olarak Kullanılan Malnütrisyon Tarama Araçları Ve Antropometri İle Karşılaştırılması Ve Tutarlılığı. Yeditepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Beslenme ve Diyetetik Anabilim Dalı, Yüksek Lisans Tezi. İstanbul**

Bu çalışma, son dönem böbrek hastalığı olan hemodiyaliz tedavisi gören yetişkin ve yaşlı hastalarda çoklu spesifik malnütrisyon tarama araçları, beslenme indeksleri ve antropometri kullanarak en iyi yaşa özel malnütrisyon riski belirlemeyi için karşılaştırma ve tutarlılığa bakılması amaçlandı. Diyaliz hastaları için özel bir tarama aracı olan Malnütrisyon İnflamasyon Skoru (MIS) baz alındı. Araştırma, Mart-Haziran 2021 tarihleri arasında hemodiyaliz tedavisi gören 140 hasta (n=70 yetişkin, n=70 yaşlı) ile gerçekleştirildi. Çalışmaya katılanların tamamından genel bilgileri anket yoluyla, biyokimyasal veriler ise geriye dönük elde edildi ve antropometri ve MIS bakıldı. Ek olarak yetişkin grupta 7-Puanlamalı Subjektif Global Değerlendirme (SGA) ve Beslenme Risk İndeksi (NRI), yaşlı grupta ise Mini Nütrisyonel Değerlendirme (MNA) ve Geriatrik Nütrisyonel Risk İndeksi (GNRI) bakıldı. Yetişkin grupta MIS'a göre %57,1 malnütrisyon, 7-Puanlamalı SGA'ya göre %24,3 hafif ve orta derecede malnütrisyon ve NRI'ye göre %44,3 farklı evre malnütrisyon riski gözlemlendi. Yaşlı grupta MIS'e göre %67,1, MNA'ya göre %62,9'unda malnütrisyon ve %8.6'sında ağır malnütrisyon, GNRI'ye göre %38,3'ünde farklı evre malnütrisyon saptandı. MIS baz alınarak ROC analizinde, yetişkinlerde 7- Puanlamalı SGA'nın, yaşlılarda ise GNRI'yi malnütrisyon öngörmede en yüksek tutarlılığa sahip olduğu görüldü. Diyaliz hastalarında tarama araçları kullanılabilse de, hem pratik olması hem de malnütrisyon taramasında daha hassas olması nedeniyle MIS kullanımı öncelikli olabilir.

**Anahtar Kelimeler:** Malnütrisyon, Hemodiyaliz, Malnütrisyon İnflamasyon Skoru, Subjektif Global Değerlendirme, Mini Nütrisyonel Değerlendirme

## 1. INTRODUCTION AND AIM

Chronic kidney disease (CKD) is a major public health problem with high prevalence and mortality rates worldwide, that may cause permanent changes in the health of the patient, (1) which is caused by the long-term inability of the kidneys to fully perform their functions (2). A comprehensive meta-analysis study showed that more than 600 million people worldwide have CKD, resulting in kidney failure at various stages in one of every 8 adults (3).

Knowing the risk factors is critical for patient and public health in terms of early CKD diagnosis, delaying progression, and minimizing negative consequences (4). Although there are differences in the etiology of CKD depending on race, country, and age, diabetes mellitus (DM) and hypertension (HT) are the most common risk factors that may play a role in both the cause and progression of the disease (4). A family history of CKD, fewer nephrons due to low birth weight, age-related decline in kidney function, and low socioeconomic status are some of the other risk factors for CKD (5-7). Apart from the underlying causes, the presence of long-term renal damage causes some structural changes. While sclerosis and tubulointerstitial fibrosis develop in the glomeruli, hyperfiltration and hypertrophy begin in the remaining nephrons (5). In addition to the risks of CKD, better resolution of systemic findings also helps to reduce the progression of CKD, complications, and mortality (6). Due to the high morbidity and mortality rates of CKD and its asymptomatic nature in its early stages, early diagnosis is very important to reduce the prevalence of the disease in the future (7). However, awareness rates are very low, even for Stage 4 CKD the diagnosis of the disease is less than 50% (9; 11).

The maintenance of the necessary functions by the remaining parts of the kidney delays the recognition of the disease and therefore the diagnosis. CKD progresses to end-stage renal disease (ESRD) in which the need for both dialysis and kidney transplant treatments is increasing which require high costs for the health budget, and also has higher mortality rates (8). ESRD is the stage that requires renal replacement therapy (RRT) when the glomerular filtration rate (GFR) falls below 15 mL/min/1.73 m<sup>2</sup> (9). Approximately 3 million patients worldwide receive RRT treatment and it is predicted that this situation will continue exponentially (10). The most preferred RRT method worldwide is hemodialysis

(HD) (76.1%), it is followed by kidney transplantation (19.2%) and periton dialysis (PD) (4.7%) (11; 12). Due to the increasing number of transplant candidates and the small number of donors, patients have to be treated with dialysis for a long time (13). The European Renal Association–European Dialysis and Transplant Association (ERA/EDTA) 2017 report found a significantly lower estimated life expectancy for patients receiving dialysis treatment compared to the general population (14). As the waiting transplantation time increases, patients may experience feelings of anxiety, depression, fear, helplessness, and hopelessness (13). Whereas, the cost of a kidney transplant is less than half the cost of years of dialysis (15). The preoperative condition of the patient is important for successful organ transplantation. Malnutrition causes a series of events that adversely affect kidney transplantation. It can lead to the consumption of endogenous proteins, delay in wound healing, increased risk of infection, susceptibility to hemorrhagic shock, and deterioration of cardiac and respiratory functions. Secondary to all these, prolongation of hospital stay and economic burden lead to increased morbidity and mortality. Therefore, it is important to optimize the nutritional status and regularly evaluate the malnutrition status of patients awaiting transplantation (16; 17).

Malnutrition occurs in one out of three HD patients (18). Malnutrition is prevalent in dialysis patients due to reasons including insufficient food and protein intake, slowing of kidney functions, uremia, increasing leptin level, loss of appetite, drugs that impair nutrient absorption, comorbidities, and dialysis-related nutritional losses (19; 20). Accordingly, it is important to evaluate the nutritional status of HD patients. There is no single gold standard tool or method for the diagnosis of malnutrition (21). The National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF-DOQI) guideline recommends regular assessment of nutritional status in all dialysis patients (22). Malnutrition and patients at risk of malnutrition are very important in terms of determining and evaluating nutritional risks, and there are many methods to accurately identify and treat patients (23). The screening tools for malnutrition include multiple parameters by asking the anthropometric measurements, serum levels, functional capacity, and appetite status of the person (24). However, it is important for its effectiveness to determine which one is more effective and which age group it appeals to. The main screening tools are Malnutrition Inflammation Score (MIS), Subjective Global Assessment (SGA), Mini Nutritional Assessment (MNA), Nutritional Risk

Index (NRI), and Geriatric Nutritional Risk Index (GNRI). MIS is a malnutrition screening tool that helps clinical and nutritional evaluation of patients receiving dialysis treatment (25). In most studies with dialysis patients, the SGA and MIS were associated with malnutrition and mortality rates (26; 27). Both the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines and the French National Nutrition Santé Program recommend using the MNA to screen for malnutrition risk in elderly patients (28) (29). But, the NKF-DOQI reported that more studies are needed with nutritional assessment tools for dialysis patients (22).

The aim of this study is to compare and contrast adult and elderly HD-treated patients with ESRD using multiple specific malnutrition screening tools, nutritional index, and anthropometry, and to determine the age-specific malnutrition risk in the best way possible.

## 2. LITERATURE REVIEW

### 2.1. Definition of Chronic Kidney Disease

The kidney is responsible for the execution and homeostasis of vital functions. Regulation of acid-base, water, and electrolyte balance; metabolism and excretion of waste products (urea, creatinine, uric acid, etc.); the most important of these functions are the secretion of hormones that regulate blood pressure, erythropoiesis, and bone mineral metabolism. CKD is a pathophysiological condition with progressive and irreversible loss of kidney function as before (30).

According to the Kidney Disease Improving Global Outcomes (KDIGO) 2012 guideline the CKD is defined as “abnormalities of kidney structure or function, present for >3 months, with implications for health and CKD is classified based on cause, GFR category, and albuminuria category.” The categories of CKD are shown in Figure 2.1 (31).

**Prognosis of CKD by GFR and albuminuria category**

| <b>Prognosis of CKD by GFR and Albuminuria Categories: KDIGO 2012</b>             |            |                                  |       | <b>Persistent albuminuria categories</b>                 |                                                         |                                                    |
|-----------------------------------------------------------------------------------|------------|----------------------------------|-------|----------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------|
|                                                                                   |            |                                  |       | <b>Description and range</b>                             |                                                         |                                                    |
|                                                                                   |            |                                  |       | <b>A1</b>                                                | <b>A2</b>                                               | <b>A3</b>                                          |
|                                                                                   |            |                                  |       | Normal to mildly increased<br><br><30 mg/g<br><3 mg/mmol | Moderately increased<br><br>30-300 mg/g<br>3-30 mg/mmol | Severely increased<br><br>>300 mg/g<br>>30 mg/mmol |
| <b>GFR categories (ml/min/1.73 m<sup>2</sup>)</b><br><b>Description and range</b> | <b>G1</b>  | Normal or high                   | ≥90   |                                                          |                                                         |                                                    |
|                                                                                   | <b>G2</b>  | Mildly decreased                 | 60-89 |                                                          |                                                         |                                                    |
|                                                                                   | <b>G3a</b> | Mildly to moderately decreased   | 45-59 |                                                          |                                                         |                                                    |
|                                                                                   | <b>G3b</b> | Moderately to severely decreased | 30-44 |                                                          |                                                         |                                                    |
|                                                                                   | <b>G4</b>  | Severely decreased               | 15-29 |                                                          |                                                         |                                                    |
|                                                                                   | <b>G5</b>  | Kidney failure                   | <15   |                                                          |                                                         |                                                    |

Green: low risk (if no other markers of kidney disease, no CKD); Yellow: moderately increased risk; Orange: high risk; Red, very high risk.

**Figure 2.2.11.** Prognosis of CKD by GFR and Albuminuria Categories: KDIGO 2012

## 2.2. Epidemiology

CKD is a common disease with high morbidity and mortality, lowering the quality of life, and a high economic burden (32). With a prevalence of 9.1% worldwide (33), CKD is a major public health problem for most countries (34). As a result of a comprehensive study conducted in 2017, it was found that the number of patients covering all stages of CKD in that year was 697.5 million worldwide and the number of deaths due to CKD was 1.2 million (33).

Hill et al. (2016) published a meta-analysis of 100 epidemiological studies on the prevalence of CKD involving approximately 7 million adult patients and reported that the worldwide prevalence of CKD in the adult population is 13.4% (3). The CREDIT study, which was a comprehensive, population-based study in Turkey in 2011 about CKD, concluded that the incidence in adults was 15.7%. Moreover, it has been reported that the prevalence increases with aging, reaching up to 50% in individuals over 80 years of age (32).

It is estimated that the number of patients receiving dialysis treatment for ESRD will increase to 6 million worldwide by 2030. There are several reasons for this, including improved access to maintenance dialysis, the increase in CKD in low- and middle-income countries, and the higher survival rate of dialysis patients receiving treatment (35). While the prevalence of ESRD in Turkey was 324 per million in 2001, the point prevalence increased to 1008 in 2019 (83,154,997 population of Turkey). The incidence and prevalence of ESRD requiring RRT in Turkey are shown in Figure 2.2 (36).

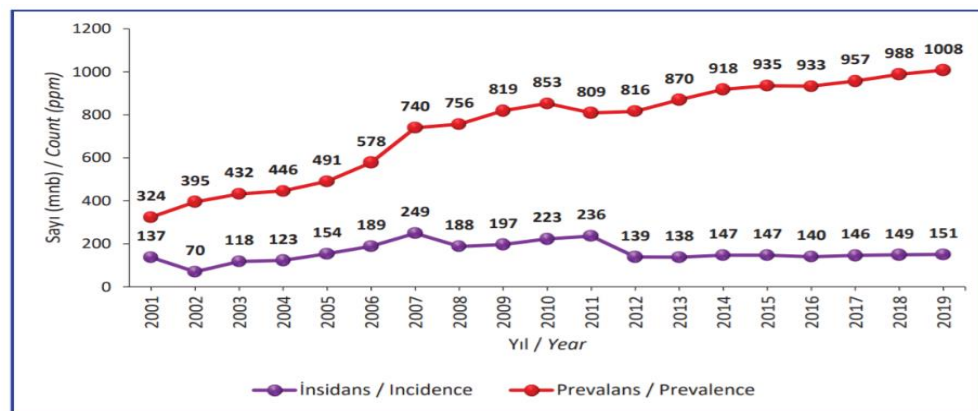


**Figure 2.2.** Incidence and Prevalence of ESRD requiring RRT in Turkey

Source, (36)

### **2.3. Risk Factors of Chronic Kidney Disease**

Many different components and conditions that lead to an increased risk for the development and negative consequences of CKD are defined as "risk factors". Knowing the risk factors is critical for patient and public health in terms of early CKD diagnosis, delaying progression, and minimizing negative consequences (4). The presence of comorbidities and risk factors in CKD may be causes and consequences of each other due to the nature of the disease (37).

Although there are differences in the etiology of CKD depending on race, country, and age, DM and HT are the most common risk factors that may play a role in both the cause and progression of the disease (4). Damage to metabolic processes in the body, increase of reactive oxygen species, and formation of inflammatory processes due to DM improve the harmful process. With DM, conditions such as basement membrane thickening, tubular atrophy, nodular glomerulosclerosis, increased albumin permeability, interstitial fibrosis, and inflammatory cell leaks are observed (38; 39). It is stated that the risk of developing kidney failure is 2.5 times higher in diabetic patients than in non-diabetic patients (40). In fact, according to the ERA-EDTA 2017 annual report, patients with DM started HD treatment more quickly and received less frequent preventive kidney transplants (18).

In a comprehensive cross-sectional analysis study conducted in the United States, HT was reported in 86.2% of different stage CKDs (41). Although a study was conducted in Turkey, in 2019, reporting that 24.9% of the patients with HD were reported to have HT in their etiology, it is still not clear whether HT is primary or secondary to CKD (36). HT is a complex condition and its primary effect elevated blood pressure leads to the development of arteriolar nephrosclerosis with deteriorating kidney function (42).

Systemic inflammation caused by obesity, hyperlipidemia, and fat around the waist causes kidney damage by creating hypervolemia, endothelial dysfunction, and adipokine disorders (43). Hyperfiltration due to increased metabolic loads in obesity, renin-angiotensin-aldosterone system activation, dyslipidemia, damage to the increase in intraglomerular pressure, risk of nephropathy development, metabolic syndrome increasing renal complications increase the risk of CKD. Obesity also poses a risk by causing DM and HT and plays a role in the development of CKD and ESRD. Moreover, family history of CKD,

fewer nephrons due to low birth weight, age-related decline in kidney function, and low socioeconomic status are some of the other risk factors for CKD (5-7).

Apart from the underlying causes, the presence of long-term renal damage may cause some structural changes. While sclerosis and tubulointerstitial fibrosis develop in the glomeruli, hyperfiltration and hypertrophy begin in the remaining nephrons. In intact nephrons replaced by sclerosing nephrons, some functional adaptive changes may occur. The increase in blood pressure and blood flow in the nephron disrupts the glomerular structure and leads to disruption of podocyte functions, destruction of the filtration barrier, and sclerosis of the remaining nephrons, rendering them nonfunctional. In addition, there is an increase in the activity of the renin-angiotensin system and causes a similar mechanism in the development of compensatory adaptive responses that lead to destruction (5).

#### **2.4. Symptoms And Findings Of Chronic Kidney Disease**

There are risk factors for CKD as well as direct kidney origin and indirect systemic findings. Even if the kidney begins to be damaged and loses its function, it has the ability to solve the existing problems with the remaining parts. As a result, kidney disease is more asymptomatic in its early stages (44). Better resolution of systemic findings helps to reduce the progression of CKD, complications, and mortality (6). However, awareness rates were found to be 2%-10% in comprehensive studies (9; 11), even for stage 4 CKD, recognition of the disease is less than 50% (6). On the other hand, differential diagnosis can be difficult at first because it has the same early symptoms as many different diseases. Laboratory evaluations, diagnostic imaging, and detailed anamnesis are important for differential diagnosis (44).

The impaired regulation of the kidney with the decrease in GFR makes the symptoms more clear (45). Many systems and organs in the body are affected by CKD (46). The first symptoms of patients are usually nocturia and weakness due to anemia that restricts patients' activities of daily living and productivity. Phosphate retention increases with decreasing nephrons and tries to be regulated by hyperparathyroidism. In the future, the increase in serum phosphorus levels may not be compensated and hypocalcemia occurs with physicochemical imbalance. Hyperparathyroidism due to serum calcium levels worsens, and bone and joint pain become common symptoms in patients due to increased osteoclastic

activity and fibrosis. On the other hand, uremia in kidney patients, frequency, and severity of skin lesions are generally directly proportional to CKD progression. Factors such as the proliferation of mast cells in the skin and increase in histamine level, hyperparathyroidism, calcium, phosphorus, magnesium imbalances, and medications are some of the causes of itching frequently observed in CKD patients (47). Some of the other common findings include glucose intolerance, increased triglyceride levels in the blood, edema, nausea, dementia, thirst, and weight loss (45).

## **2.5. Complication of Chronic Kidney Disease**

CKD has many systemic complications such as anemia, metabolic acidosis, HT, cardiovascular diseases (CVD), bone mineral disorder, and uremia. Although complications are seen with kidney loss, the same complication may not develop in every patient (48; 49).

### **2.5.1. Anemia**

Anemia, which is one of the common complications of CKD, and decreased quality of life can lead to fatigue, cognitive impairment, decreased attention, weakness, high hospitalization rates, and mortality. An increase in the incidence may be observed with the decreased rate of GFR, which can be revealed by the presence of many factors (48; 49).

Hepcidin, which acts as the main regulator of iron circulation, is filtered and broken down by the kidneys. Hepcidin is controlled by several factors in this process including inflammation, iron storage, and erythropoiesis. Increased hepcidin levels, which correlate positively with CKD, contribute to anemia (48; 50).

Decreased renal erythropoietin and shortened hemoglobin half-life may also contribute to anemia (48; 49). Inadequate food consumption, impaired intestinal iron absorption, and blood loss due to HD are other risk factors of anemia (50).

### **2.5.2. Metabolic Acidosis**

The kidney, which is important in maintaining the acid-base balance of the body, leads to a decrease in the excretion of renal ammonium, reabsorption of bicarbonate ions, and the secretion capacity of hydrogen ions with the formation of CKD (51; 52).

This process plays a role in the formation of metabolic acidosis. This causes many complications that lead to bone demineralization, protein catabolism, inflammation, skeletal muscle wasting, a decrease in kidney function, and GFR (51; 56).

### 2.5.3. Hypertension

HT can be present even in the earliest stages of CKD and is the most damaging complication in CKD (49; 53).

Activation of the renin-angiotensin system may lead to HT in CKD patients through mechanisms such as decreased nephron mass and sodium retention. All pathophysiological mechanisms are listed in Figure 2.3 (54). HT appears to accelerate mortality due to CVD in CKD (53).

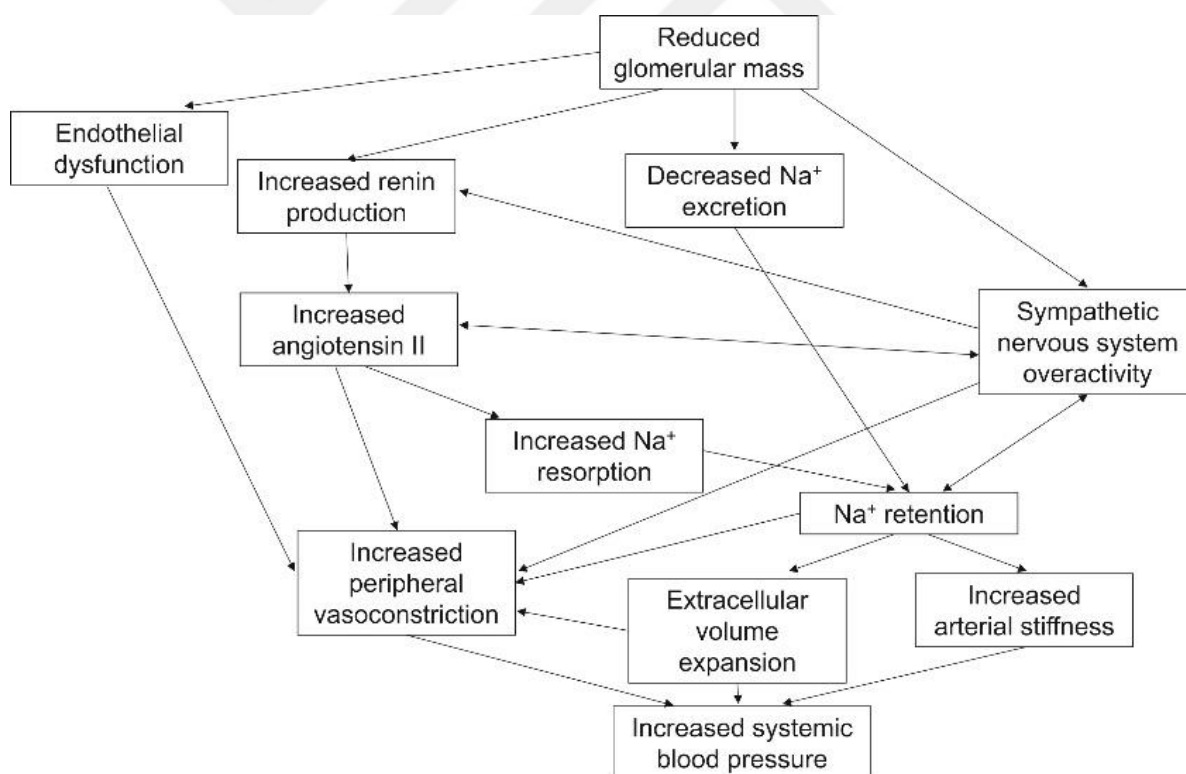


**Figure 2.3.** Pathophysiologic mechanisms of HT in CKD

Source, (54)

#### **2.5.4. Cardiorenal Syndrome**

Maintaining the homeostasis of the body, the kidney, heart, and other systems interact together. An example of this interaction is that a quarter of the heart's output goes to the kidneys. According to the Turkish Society of Nephrology, half of the patients with HD die due to CVD, and therefore, efforts should be made to minimize the causative factors during the treatment process. The pathophysiological events in this process cannot be explained by a single mechanism (5).

The main problem in cardiorenal syndromes is disturbed renal homeostasis as a result of decreased cardiac output and decreased renal blood flow and perfusion pressure. In addition, triggering of neurohumoral signaling pathways and alterations in the coagulation cascade, DM, HT, anemia, increased reactive oxygen species and inflammation, volume expansion, venous congestion, acidemia, and uremic toxins cause endothelial damage and contribute significantly to the formation of kidney and cardiac damage (5).

#### **2.5.5. Mineral-Bone Diseases**

Changes occur in calcium, vitamin D, fibroblast growth factor-23, phosphorus, and parathyroid hormone (PTH) levels in CKD patients (55; 56). There is an increase in PTH production due to impaired phosphorus and vitamin D levels. In CKD patients, the passage of calcium from the bones into the blood is accelerated. Therefore, bone fragility, soft tissue calcification, and abnormal bone structure occur. In addition, the risk of CVD may increase due to the calcium provided to the blood (60; 61).

#### **2.5.6. Uremia**

Uremia is defined as “elevated blood urea nitrogen and creatinine levels, and clinical findings and systemic biochemical abnormalities usually associated with decreased GFR”. Along with the decrease in kidney functions, metabolic and endocrine changes that also damage the parts of the kidney are involved in uremia (57).

Many symptoms such as increased inflammation, loss of appetite, nausea, restless legs syndrome, fatigue, itching, neurological changes, and weakness can be seen in CKD due to uremia. Complications such as malnutrition, osteoporosis, and CVD may be caused by the presence of systemic inflammatory disease due to uremia (49; 53).

ESRD may develop in patients in the CKD process after a while and it is recommended to initiate dialysis treatment in cases such as uncontrolled hypertension, metabolic acidosis, and uremic pericarditis (58).

## **2.6. Treatment Methods of End-Stage of Chronic Kidney Disease**

In the treatment of CKD, it is aimed to slow down the progression of the disease to ESRD, to delay RRT, to prevent complications, to increase the quality of life, and to reduce mortality and morbidity rates by reducing risk factors (59). Treatment in CKD is divided into two parts as preventive therapy and RRT. Preventive treatment includes treatment of medical (anemia, renal osteodystrophy, and blood pressure control) and diet therapy (45). In conservative treatment; if there are predisposing causes to the kidneys, aim to treat or eliminate them, slow the progression, treat the symptoms in the body system caused by uremia, and prepare to convert to RRT if necessary (46). Dietary therapy has a vital role in preventing or delaying the progression of CKD and its complications (60). Dietary therapy aims to improve the nutritional status of the patient, reduce uremic toxicity, delay the progression of damage, control dehydration, HT, or excess fluid (61). In the early stages of CKD, only medication and diet therapy may be sufficient. Preventive treatment is applied in patients who are not in the terminal phase (45). However, in addition to diet therapy, RRTs are needed in order to stop the worsening of ESRD, reduce its progression and ensure their survival (62). In addition, preventive treatment continues with RTT (45).

### **2.6.1. Renal Replacement Therapy**

RRT is applied in order to partially fulfill the functions of the kidney in CKD patients when the treatment is not sufficient (63). ESRD is the stage in which RRT is needed when the GFR falls below 15 mL/min/1.73 m<sup>2</sup> (9).

The point prevalence of ESRD who received RTT treatment in Turkey in 2019 was found to be 1007.6 per million population. RRT includes kidney transplantation and dialysis treatments (36). The increasing number of transplant candidates and the small number of donors, patients are still treated with dialysis for a long time (13). The most preferred RRT method worldwide is HD (12).

#### **2.6.1.1. Kidney Transplantation**

Kidney transplantation is the most selective treatment for advanced kidney failure (5). The prevalence of kidney transplantation worldwide in 2018 was highest in Mexico, at 128 per million. In some other countries, the prevalence per million was 68 in the United States, 47 in Turkey, and 15 in Japan. The prevalence of kidney transplantation on dialysis worldwide in 2018 was highest in Kazakhstan at 222 per million. The prevalence per million in some other countries was 147 in Norway, 60 in Turkey, and 6 in Japan (12).

Kidney transplantation is the surgical replacement of a healthy kidney from deceased or living donors by removing the kidney with loss of function in a CKD patient (64). Prior to kidney transplantation, patients undergo medical, surgical, immunological, and psychosocial evaluations (65). Dialysis treatments may replace an average of 10% of kidney functions, a temporary treatment method, and only excretory functions can be performed, whereas kidney transplantation can fully restore kidney functions and additionally perform endocrine functions (5). For this reason, "transport first" is the main goal for a suitable candidate and the quality of life increases as he can move more comfortably, without diet and fluid restriction, which reduces mortality for the patient (15). As the waiting transplantation time increases, patients may experience feelings of anxiety, depression, fear, helplessness, and hopelessness (13). Whereas the cost of a kidney transplant is less than half the cost of years of dialysis (15). To avoid the risk of postoperative complications and death, the patient should follow a diet appropriate for the type of dialysis treatment before transplantation and be protected from risks such as malnutrition, hypervolemia, and uremia (17).

#### **2.6.1.2. Dialysis Treatment**

In ESRD, due to the inability of the kidney to have adequate functions, the treatment that removes, to some extent, waste, toxins, and excess water artificially is called dialysis. The prevalence of dialysis worldwide in 2018 was highest in Taiwan with 3429 per million. The prevalence per million in some other countries was 1699 in the United States, 773 in Turkey, and 308 in Norway (12).

Dialysis treatment is based on a simple physical rule: the patient's blood and the solution, called dialysis fluid, are separated and juxtaposed by a semipermeable membrane.

While these membranes allow small molecules such as water, urea, potassium, and sodium to pass through microscopic holes called "pores," substances such as proteins with large molecules, bacteria or blood cells cannot pass through the pores. The molecules that can pass flow until the concentrations on both sides of the membrane are equal. As the patient's blood, membrane, and dialysis fluid flow, urea, creatinine, phosphorus, and many other uremic toxins not in the dialysis fluid pass through the membrane and mix with the dialysis fluid, removing them from the body. To ensure homeostasis in the blood, the concentrations of ionized calcium, sodium, and magnesium in the dialysis fluid must match the actual blood concentrations (66).

HD has a HD dialysis filter membrane, while PD has a peritoneal membrane. The removal of uremic toxins from the blood is achieved by three physically distinct mechanisms of substance transfer (66). In the first phase, the solutes in the water are in a vibrational state, and the molecules pass through the pores of the membranes and combine with the melt on the other side. As the solute concentration increases, the probability of hitting the pores and reaching the opposite side increases at the same rate (66). Diffusion is affected by the difference in concentration on either side of the membrane, the molecular weight and velocity of the solute, and the membrane resistance. In HD the principle of countercurrents is used to increase the efficiency of diffusion (67).

Urea and other small-molecule uremic toxins pass through the membrane in ultrafiltration during the dialysis process and are removed from the body by convection (5). Ultrafiltration differs due to hydrostatic pressure in HD and osmotic pressure in PD (67). In the last phase, some substances in the blood adhere to the membrane depending on the physicochemical properties of the membrane surface. However, these adhesions can sometimes cause resistance (66). Conditions in which dialysis is indicated are uremic pericarditis pleuritis and uremic encephalopathy. Fatigue, impairment of general condition, cognitive impairment, refractory hyperkalemia, hypervolemia, acidosis, hyperphosphatemia, malnutrition are relative indications. It is important to delay the transition to the dialysis phase, and early initiation of dialysis has not been shown to be beneficial (5).

In summary, in HD treatment, the blood is cleaned by the artificial kidney of a dialysis machine (12). HD procedure is RRT based on the principle of withdrawing the patient's blood

from the graft, arteriovenous fistula, or central venous catheter, pumping it to the filter in the HD set, and bringing the dialysis solution together with the HD membrane, rearranging the dissolved contents, and returning them to the patient (66).

The HD method has the advantage that the patient receives dialysis treatment 2-3 times per week for 4-6 hours, is off at other times, reduces hospitalizations, reduces uremic findings, and does not develop abdominal complications. Although HD treatment is life-saving, it causes some complications (67).

#### **2.6.1.2.A. Complications of Hemodialysis Treatment**

Many complications accompany HD patients, such as depression, cognitive impairment, anorexia, endocrine disorders, anemia, vascular calcification, dialysis amyloidosis with beta-2-microglobulin accumulation, arrhythmia, neuropathy, atherosclerosis, susceptibility to infection, and sudden death. In addition, the annual mortality rate in HD patients is over 10%. To manage these problems, most patients take medications such as phosphate binders, antihypertensives, and erythropoietin, and must follow a strict diet prepared by a specialized dietitian (5). With dialysis treatment, the patient's nutrition changes compared to the previous consumption pattern (68).

### **2.7. Nutrition In Hemodialysis**

#### **2.7.1. Energy**

Many factors such as wrong dietary restrictions, changes in the gastrointestinal system, anorexia due to uremic toxicity, changes in taste perception, and psychological problems may cause adequate energy intake and increase the risk of mortality. It is observed that patients treated with HD tend not to get sufficient energy (69). It shows that the daily energy intake of HD patients is 20-22 kcal per kg and they receive insufficient energy (70).

Hyperparathyroidism, increased inflammation, carnitine deficiency, insulin resistance, and HD treatment affect energy metabolism. In addition, rather than an increase in energy expenditure, a lack of nutrients may adversely affect energy metabolism (70).

According to the NKF-DOQI guideline, the energy requirement of HD patients is 35 kcal/kg/day in patients under 60 years of age, while it is 30-35 kcal/kg/day in patients aged

60 and over due to low physical activity (22). Ideal body weight base daily, ESPEN recommendation 35 kcal/IBW/d, European Best Practice Guidelines (EBPG) recommendation 30–40 kcal/ IBW/d, European Dialysis and Transplant Nurses Association/European Renal Care Association (EDTNA/ERCA) 35 kcal/ IBW/d is recommended as 30 kcal IBW/d for elderly and sedentary patients (75-77).

### **2.7.2. Protein**

Skeletal muscle wasting is common in HD patients. It cannot be attributed to a single cause. It is thought to be influenced by many factors. Nutritional deficiency, gastroparesis, and metabolic acidosis may count among these factors. In addition, the increase in acutely increased static muscle protein degradation markers (caspase-3 activity and polyubiquitin) and cytokines suggests that chronic inflammation is a factor in muscle wasting (71). When treated with HD, patients may experience a 20-40% decrease in amino acid concentration, which can initiate the catabolic process and cause a negative nitrogen balance (72). It has been reported that the group of dialysis patients has less muscle strength than the group of healthy people (71).

In HD sessions, an average of 6-9 g amino acids with dialysate and approximately 2 kg of lean body mass (LBM) are lost in patients who receive HD 3 sessions a week for 1 year. Positive nitrogen balance is important and it is recommended to take 1.2 g per ideal weight daily in patients with HD (at least 50% protein with high biological value) (72).

High protein consumption alone is not sufficient to prevent the formation of negative nitrogen balance. Positive nitrogen balance can be achieved by ensuring the preservation of tissue proteins with adequate energy intake in addition to adequate protein intake. In dialysis patients, a decrease in food intake may occur due to dietary restrictions not being appropriate for the patient, the perception of taste, and loss of appetite in the patient (73).

Concerning protein intake, high biological protein intakes are recommended and NKF-DOQI recommends 1.2 g/kg body weight/day (22). EDTNA/ERCA 1-1.2g/kg ideal body weight/day and EBPG at least 1.1 g/kg ideal body weight/day suggests. The ADA, on the other hand, recommends protein intake in the amount of 1.1-1.4 g/kg body weight/day for HD patients (75-77).

### **2.7.3. Carbohydrate**

Carbohydrates are of great importance in order to provide sufficient energy to the body and to maintain a positive nitrogen balance by preserving tissue protein synthesis. Glucose and insulin metabolism may be impaired, and insulin resistance is common in CKD patients. Changes in insulin metabolism occur with hepatic gluconeogenesis and chronic uremia in patients. It is recommended to get 60-65% of daily energy from carbohydrates and fiber intake is recommended as 20-25 g for HD patients (73; 74).

### **2.7.4. Fat**

Changes in cholesterol levels and hypertriglyceridemia may be observed in HD patients. Depending on the decrease in GFR, plasma lipid levels may increase and inadequate removal of triglycerides from the circulation may be observed. Other main causes are the decrease in the activities of liver enzymes and lipoprotein enzymes (73).

Regarding the fat content of the diet in HD patients, the following were indicated:

- 25-35% of the total energy intake should be provided from fats.

- The saturated fatty acid content should be limited to 7%. Unsaturated fat preference should be increased.

- Monounsaturated fatty acids should be 20% of the total energy, polyunsaturated fatty acids should be 10% of the total energy intake (73).

### **2.7.5. Electrolytes and Fluids**

#### **2.7.5.1. Potassium**

The kidney plays an important role in balancing the serum potassium level (preventing hypokalemia and hyperkalemia) (75). Potassium plays a role in cellular osmolarity, regulation of heartbeat, muscle work, and acid-base balance (76). Serum potassium levels in HD patients are affected by many factors. The degree of residual renal function may be affected by net tissue breakdown due to infections, acid-base status, dietary potassium intake, and intestinal absorption and excretion of potassium (73; 77). Some of the

potassium excretion takes place by the intestines. Preventing the patient from developing constipation/diarrhea is important to reduce the risk of developing hyper/hypocalcemia (78).

KDIGO recommends personalized diet planning for the regulation of serum potassium levels (22). The fact that HD patients are often anuric may require potassium restriction (73). In order to increase serum potassium levels, portion control should be ensured and low potassium foods should be preferred. Consumption of potassium-rich foods such as dried fruits, milk, and dairy products, cereals, and legumes should be limited (79).

#### **2.7.5.2. Phosphorus**

Phosphate excretion decreases with the decrease of kidney functions and GFR in CKD patients. Preventing hyperphosphatemia is important for CKD patients. Some of the consequences of hyperphosphatemia are CVD, hyperparathyroidism, and the formation of bone mineral diseases (78).

As a precaution, multiple methods are required, including adequate RRT, use of phosphate-binding agents at the appropriate dose and duration, and restriction of dietary phosphate. Since the restriction of phosphorus in many foods (especially meat and dairy products) may increase the risk of malnutrition in HD patients with increased protein needs, it is recommended to proceed with appropriate phosphate ratios per gram protein. It is recommended to give nutritional counseling to patients, especially under the control of a renal dietitian, rather than completely restricting them (80).

KDIGO recommends limiting the regulation of serum phosphate levels considering the bioavailability of phosphorus sources (22). 80% of dietary phosphorus is absorbed from the gastrointestinal tract, therefore, phosphorus binding drugs are needed (73). It is recommended to be taken 5-10 minutes before or after food intake (80).

EBPG 800-100 mg and EDTNA/ERCA 1000-1400 mg recommend daily phosphorus intake in HD patients (70; 78)

#### **2.7.5.3. Fluid and Sodium**

The kidney is the last essential organ involved in the maintenance of sodium homeostasis. Sodium is an important electrolyte in blood pressure and extracellular volume control. It is the main determinant of plasma osmolality (81).

The kidneys regulate the body's fluid volume through sodium and fluid excretion. It also maintains blood osmolarity. Sodium and fluid cannot be removed adequately with decreased residual function in HD patients. Therefore, dialysis treatment may become mandatory to maintain fluid balance (78). Recommended that body weight gain should not exceed 1.5-2 kg during HD (73). Prevention of interdialytic weight gain is of paramount importance, as HD makes it easier for patients to reduce thirst and adapt to the fluid restriction (78).

The water and sodium requirements for HD patients are calculated according to the amount of urine, blood pressure, and fluid balance. HD patients' daily fluid amount should be 500ml + daily urine output or around 1000-1500 ml (73). When there is a liquid restriction, it should be taken into consideration that the foods are in liquid form at room temperature, except oil (78). In order to reduce the feeling of thirst, it is recommended to eat cold sliced fruit, suck on sour candy, smash small pieces of ice in the mouth or use artificial saliva (73). In HD patients with oliguria and anuria, daily salt restriction is around 3-4 g and 1-1.5-2 g, respectively. The recommended daily sodium intake for HD patients is 2 g + 1 g per liter of urine output (77).

In sodium restriction, it is commonly recommended to prefer foods containing less than 0.5 g/100 g sodium (82). In HD patients, it is recommended to limit pickled products, sauces with high salt content, processed foods, and prepackaged products such as chips, and to use different spices to increase flavor (73).

#### **2.7.5.4. Calcium and Vitamin D**

Control of calcium and phosphorus in CKD is important to protect the bone health of patients. The conversion of vitamin D to its active form calcitriol 1,25(OH)<sub>2</sub>D<sub>3</sub> decreases with renal failure. There is a problem in controlling the absorption of calcium and phosphorus from the intestines (83; 84) and leads to bone demineralization (85). Decreased renal function

over time will lead to a decrease in vitamin D and calcium-sensing receptors and worsening of hyperphosphatemia state and secondary hyperthyroidism (86).

There is a relationship between hypocalcemia and mortality (85). With the restriction of phosphorus in the diet, it is difficult to meet the calcium requirement. There is also a risk of hypercalcemia due to calcium contained in calcium and phosphate binding drugs taken with daily foods. Therefore, daily calcium intake should not exceed 2000 mg (78).

Vitamin D supplementation reduces PTH secretion and reduces damage to the musculoskeletal system. Excessive intake of vitamin D can increase calcium absorption, which can lead to hypercalcemia. Therefore, supplementation should be given according to the patient's needs. For HD patients, an active form of vitamin D is recommended to regulate serum PTH levels (86).

#### **2.7.5.5. Other Micronutrients**

Iron deficiency is a common condition in CKD patients. Loss of iron due to dialysis treatment and decreased absorption due to gastrointestinal malabsorption are the causes (70). Anemia is seen in CKD patients as a result of the decrease in the kidney's erythropoietin production and the increase in the circulation of uremic substances and secondary destruction (87). In addition, iron, which can bind with phosphate-binding drugs, is recommended to be taken separately from the drug or between meals (88).

Problems such as skin diseases, glucose intolerance, loss of taste, loss of cognitive function, anorexia, hyperlipidemia, gastrointestinal problems, and impotence can be indicators of zinc deficiency for CKD patients. Zinc supplementation is recommended for HD patients with symptoms (70; 89). Plasma serum selenium levels were found to be low in patients with HD (90). Although selenium deficiency is seen in CKD patients, routine supplementation is not recommended. In case of symptoms due to selenium deficiency, additional supplementation is recommended. Since selenium cannot be removed by dialysis in HD patients, supplemental selenium should be monitored routinely (70).

#### **2.7.5.6. Vitamins**

Vitamin deficiency may develop in dialysis patients due to impaired renal metabolism, losses in dialysis, drug use, inadequate food consumption, and gastrointestinal

absorption disorders. Mostly water-soluble vitamins are deficient. It is emphasized by the guidelines that more studies are needed for evidence-level information on vitamins. The required doses of vitamins are found in sufficient amounts in renal multivitamin supplements. Thiamine and riboflavin deficiency are rare, although they are removed in large amounts in HD treatment (70). The need for thiamine may increase when the risk of infection in HD patients increases, excess glucose is taken, surgery and convulsions may develop (73). Pyridoxine deficiency may develop with drugs used, and increased use of erythropoietin due to erythropoiesis. It is important because of its role in amino acid and lipid metabolism (70).

Vitamin C is largely removed by dialysis, and its deficiency may occur in HD patients due to a potassium-restricted diet. Depending on the cooking method, the loss is higher in exposure to heat. With its deficiency, a mild form of scurvy may cause disturbances in amino acid and folic acid metabolism. Increased serum oxalate stones due to decreased kidney function may lead to tissue oxalate accumulation. HD patients should avoid taking excessive vitamin C supplements (70). In HD patients, folic acid deficiency may be seen due to dialysis treatment, the interaction of drugs or ethanol, and gastrointestinal absorption problems (70).

Among HD patients vitamin B12 deficiency may have harmful effects including deterioration in folate metabolism, increasing erythropoietin stimulating agent resistance, and causing nervous system demyelination with pernicious anemia (75; 97). When supplementation was given to patients with low levels of vitamin B12, it was observed that it had a positive effect on nerve conduction velocity and decreased serum homocysteinemia by 10% (70).

There is an increase in serum vitamin A levels in HD patients due to the inability to excrete vitamin A with dialysis treatment, decrease in serum retinol-binding proteins and decrease in renal destruction (91). Its deficiency is rare but the excessive intake of vitamin A may cause problems such as hypertriglyceridemia, hypercalcemia, and anemia (70).

There are studies showing that vitamin E, which is a powerful antioxidant, is beneficial for CVD in HD patients, as well as studies showing that it is not beneficial (92). According to EBPG, vitamin E is recommended to prevent muscle cramps and cardiovascular events (70).

Since vitamin K deficiency is not common among HD patients, no additional requirement is needed. Additional supplementation is considered in patients with altered coagulant activity or prolonged antibiotic therapy (70; 93).

## **2.8. Malnutrition in Hemodialysis Patients with End-Stage Renal Disease**

Malnutrition; is one of the most common complications associated with high morbidity and mortality in dialysis patients, which is a pathological process caused by nutrient deficiency and unbalanced consumption (94).

Physiological effects observed in the patients by malnutrition include a decrease in muscle mass, body weight, and energy stores, decrease in prealbumin, transferrin levels, and other visceral protein in blood serum levels (95). Malnutrition may be associated with increased risk of infection, atrophy of lymphatic tissues, suppression of immunity, delayed wound healing due to limited protein synthesis, and muscle weakness (16).

Conditions such as wrong and restrictive dietary treatments, drug side effects, depression, nausea, gastrointestinal blood loss, the catabolic effect of PTH, comorbidities, inflammation, altered intestinal flora, gastropathy, and taste anomalies due to uremia result in decreased food intake. Metabolic acidosis common in HD; is known to cause proteolysis, decrease in albumin synthesis, and suppression of insulin-like growth factors. The anorexic process with inflammation and hormonal imbalances in HD patients is quite common and its pathogenesis is still not fully resolved (96; 97).

According to Stenvinkel et al., (2000) there are at least 2 types of malnutrition in dialysis patients (98). In malnutrition associated with uremic syndrome or insufficient dialysis session type, restricted food intake and physical activity, a decrease in energy and protein intake, and a decrease in serum albumin levels are observed mostly due to uremic toxicity. In the other type defined as a malnutrition-inflammation complex syndrome, comorbid presence, hypoalbuminemia, increased energy expenditure, oxidative stress, proinflammatory cytokines, CRP and proteolysis are evident. Generally, two types are seen together in HD patients. It has been reported that uremia and accompanying symptoms lead to activation of proinflammatory cytokines and are 10 times more common than in healthy individuals (94).

### **2.8.1. Inflammation**

The body system; provides benefits by initiating inflammatory mechanisms in order to provide homeostasis, tissue repair, elimination of harmful stimuli, and protection against infections. However, out-of-control and persistent inflammation is harmful and is associated with poor outcomes such as poor quality of life, CVD risk, and mortality. A greater inflammatory response was found with increasing CKD stages and with dialysis treatment (99).

In CKD patients, chronic inflammation due to both decreased renal clearance (leading to more cytokine uptake) and uremia leads to nutritional disorders, endothelial dysfunction, osteoporosis, metabolic imbalance, and deterioration of the immune system, leading to the progression of CKD and protein-energy wasting (PEW) (105-108). In 2008, the International Society of Renal Nutrition and Metabolism (ISRNM) recommended the use of a common definition, PEW, to avoid confusing terms used in studies. ISRNM expert panel has defined PEW to describe a “state of decreased body stores of protein and energy fuels (body protein and fat masses)” (100).

Inflammation inherently and indirectly leads to muscle wasting, creating a vicious circle for PEW. Insulin resistance seen in HD patients due to increased inflammation causes muscle loss by negatively affecting the anabolic process. In the case of inflammation, resistance to other anabolic hormones may develop. In addition, activation of the ATP-ubiquitin-dependent proteolytic system contributes to PEW in HD patients (101). It induces catabolism and anorexia due to decreased muscle proteins, albumin levels, and appetite by stimulating ketoacid dehydrogenase and via the ubiquitin-proteasome pathway due to increased levels of cytokines such as TNF- $\alpha$ , IL-1, and IL-6, which are common in CKD (94). It has been reported that the hormone leptin, which is mostly excreted by the kidney and limits food consumption by providing satiety, is 16 times higher in CKD (102). In a study, 25 OH vitamin D levels were insufficient in almost all HD patients. Down-regulation of cytokine levels of vitamin D is suppressed in HD patients and inflammation is triggered (103). In a study conducted with 200 geriatric patients to evaluate the risk of malnutrition due to loss of appetite as a result of increased inflammation markers, it is seen that

inflammation has a significant relationship with food intake, and food intake is below 75% in the majority of moderately severe inflammation patients (104).

The treatment itself is an important factor in the increase of inflammation that occurs in HD patients (105). The dialysis membrane begins to increase its permeability for granulocytes due to the immunological response process given by low molecular weight substances including IgG. Thus, it causes a further increase in reactive oxygen species and impairs the cellular function response with the increase in oxidative stress with the imbalance caused by the decreased immune system. It is exacerbated by the overactivation of free radicals in cells such as kidney, vascular and glomerular cells that lose their function and increase organ failure and mortality (106). In addition to membrane incompatibility in dialysis, inflammatory mediators were more common in central venous, which is one of the preferred vascular access methods in treatment (101).

Uncontrolled HT increases inflammation and CVD in less obvious pathways such as homocysteinemia and calcification of coronary arteries, sodium retention, and volume expansion on RRT (111; 113).

In summary, the presence of malnutrition-inflammation complex syndrome in HD patients where malnutrition and inflammation are frequently seen and has been reported to be associated with poor prognosis, morbidity, high hospitalization rate, and mortality. Therefore, Zadeh KK et al. (2001) developed the MIS by creating a comprehensive scoring system with significant associations with inflammation, malnutrition, and anemia in HD patients, as well as possible hospitalization and mortality in HD patients (25). When assessing the risk of malnutrition, it is important to remember that it is a multifactorial problem. It is not sufficient to assess a single type, which depends on factors such as the type and prognosis of the disease, visceral protein, fat, and lean tissue stores. Therefore, the screening tools for malnutrition include multiple parameters by asking the body weight, serum levels, appetite status, functional capacity, and appetite status of the person (24). As the main screening tests are MIS, SGA, MNA, NRI, and GNRI.

### **2.8.2. Malnutrition Inflammation Score**

MIS; a new scale called the “Dialysis Malnutrition Score (DMS)” was created with the revision of the SGA. The assessment of acidity and edema in this scale was removed and dialysis time was added instead. Later, 7 DMS criteria were revised and three new criteria were added to make this scale more detailed and objective. In addition, the score was lowered from 5 to 4. Thus was born the new system called the MIS. These added parameters are BMI, serum albumin, and total iron-binding capacity (TIBC) (25). The increase in MIS reflects malnutrition. It is a valuable test for detecting malnutrition in patients with ESRD. MIS has been shown to be associated with length of hospital stay, anemia, inflammation, mortality, and nutrition in HD patients (107).

### **2.8.3. Other Malnutrition Screening Tools**

SGA which is a screening tool with high validity and reliability was developed to predict nutritional complications in postoperative patients undergoing gastrointestinal surgery by Detsky et al. in 1987 (108). It is advantageous for clinical and research studies as it is practical, easy to apply, reproducible, and inexpensive (109). NKF-DOQI recommends a 7-point SGA for the assessment of nutritional status in the adult dialysis population (22). SGA has the disadvantage that it ignores minor variations in nutritional status. Therefore, extended the traditional SGA tool to a 7-point scale for detecting minor variations in nutrition. The higher the 7-Point score, the higher the risk of malnutrition (110).

Both the ESPEN guidelines and the French National Nutrition Santé Program recommend using the MNA to screen for malnutrition risk in elderly patients (111; 112). MNA is one of the most commonly used nutritional screening tools among healthcare professionals, with clear cut-off points in geriatric patients (113). In 1994, Guigoz et al. MNA was first validated and published in three studies involving more than 600 elderly people. The MNA contains questions about the patient's general health, nutrition, anthropometrics, and self-assessment (114).

NRI was defined to measure the severity of postoperative complications. Additionally, it has been used to assess nutritional deficiencies among hospitalized adult

patients. It evaluates the blood albumin level and the change in body weight (115) (116).  $NRI = (1.519 \times \text{serum albumin (g/L)} + 41.7 \times (\text{present weight/usual weight}))$

GNRI is used to examine the nutritional status of the patient. Serum albumin, height, and body weight are used as parameters (117). Since NRI may be insufficient to accurately predict the normal weight in elderly patients, the index obtained by substituting the Lorentz formula for the ideal weight in the formula is called the GNRI. Dry body weight is used for dialysis patients.  $GNRI = [1.489 \times \text{albumin (g/L)}] + [41.7 \times (\text{body weight/ideal body weight})]$  It is an indicator for mortality in the elderly, based on measurements of serum albumin and weight loss (118). NKF-DOQI indicates that more research is needed for GNRI in elderly HD treated patients (22).

#### **2.8.4. Anthropometry**

It is the most basic and indirect method of evaluating body composition, which enables the comparison of the human body and its regional components, defines body mass, size, shape, and levels of obesity and thinness, is easy to apply and repeats clinically (26; 125; 124). KDOQI recommends routine nutritional screening and anthropometric measurements, especially in stage 3-5 CKD patients (22).

Body weight in CKD patients is a complex measurement that needs attention. It is stated that it can help to determine the optimal health status and to determine the risk of protein-energy malnutrition. In CKD, norms with advantages and disadvantages are used for weight calculation (22). In the Framingham Heart Study, which was followed for 18.5 years, it was observed that the risk of developing stage 3 CKD in obese individuals increased by 68% (119). However, BMI may be an advantage for survival in advanced CKD stages and HD patients. It is stated that more research is needed (120). KDOQI, BMI may not be an ideal marker for obesity, and the measurement may be misleading due to increased obesity and/or muscularity. It is stated that the use of BMI for CKD patients, which has a limited level of evidence, would be better in terms of mortality by making age-related comparisons (22). Due to the limitations of BMI as a measure of obesity, it is assumed that measurements such as waist circumference and the conicity index will yield better results (121). It is associated with subclinical inflammation independent of BMI. The substitution of waist circumference for intra-abdominal or visceral fat suggests that every 10 cm increase in waist

circumference is associated with all-cause and cardiovascular death (122). Unlike BMI, it is associated with subclinical inflammation (123). KDOQI recommends that waist circumference can be used for abdominal obesity in adults with ESRD (22). The results of several large epidemiological studies also support that the waist-to-hip ratio (WHR) increases coronary artery disease (124).

Abdominal fat, measured as waist circumference or WHR, independently of overall adiposity, is a more important predictor of CKD and cardiovascular risk in adults than BMI (125). In a study comparing the anthropometric indices of obesity in elderly CKD patients, it is stated that they concluded that WHR is better at predicting CKD (126).

In a study of 160 people receiving HD treatment, mid-upper arm circumference (MUAC) was found to be significantly lower in malnourished individuals (127).

Conicity index is a measure of visceral fat that evaluates the deviation from a cylindrical shape with a common base at the waist to a double cone shape. It is one of the indicators of systemic inflammation independent of pre-dialysis GFR and cardiovascular risk. In the Framingham study, it is stated that the taper index has the most discriminating accuracy for a 10-year cardiovascular event when compared with other obesity indices (125). KDOQI recommends its use in evaluating the nutritional status and predicting mortality in adult patients receiving HD with ESRD (22).

LBM represents "lean" muscle mass as an indicator of muscle mass and somatic protein. It is an important clinical marker in terms of being positively correlated with LBM and better clinical outcomes. It is also an important nutritional measure for HD patients. A study was conducted with 117,683 HD patients examining the relationship between race and estimated LBM. In a study conducted between African-American groups and non-Hispanic white groups, there was a negative correlation between estimated LBM increase and mortality (128).

### **3. MATERIALS AND METHODS**

The study was conducted with 140 HD patients who were treated at Istanbul Erdem Hospital Dialysis Center between March 2021 and June 2021. Participants are divided into 2 groups as adults and elderly groups. Ethical approval (Appendix -1) was obtained from Yeditepe University Clinical Research Ethics Committee on 04.03.21 for the non-interventional observational study.

#### **3.1. Criteria For Inclusion**

The inclusion criteria were determined as follows:

- Being over 18 years old,
- Receiving HD treatment in the approved dialysis center,
- Able to answer the questions asked,
- Agreeing to participate in the research,
- Do not have cancer or any other fatal condition,

"Consent Form" (Appendix -2) was signed by the patients who read and accepted the study. 140 participants agreed to participate in the study. 70 of these participants were in the adult group and 70 were in the elderly group. Old age is considered as over 65 years old; adults under the age of 65 and the elderly aged 65 and over were included in the group (129).

#### **3.2. Data Collection**

Demographic, health and nutrition information of the patients participating in the study were obtained with a data collection form (Appendix-3). Questionnaires and anthropometric measurements were made by the researcher by face-to-face interview method. The biochemical data of the patients participating in the study to be used were taken retrospectively from the most recent records between October 2020 and March 2021.

#### **3.3. Data Collection Tools**

##### **3.3.1. Anthropometric Measurements**

Certain anthropometric measurements were taken in both adult and elderly patient groups. The timing of the measurements is important. It is necessary to assume hydration

status in patients with CKD. In HD patients, it is important when anthropometric measurements are made. Measurements were taken after treatment, taking into account the hydration status (fluid-electrolyte balance may be variable) of CKD patients. Measurements are recommended when the fluid balance is achieved after treatment (22). Dry weight was used as body weight.

According to the criteria of the International Kidney Nutrition and Metabolism Association, BMI  $<23 \text{ kg/m}^2$  is considered as underweight for the study (130). It was calculated with the formula Body Mass Index ( $\text{kg/m}^2$ ) = Body Weight/ (height)<sup>2</sup>.

Waist circumference was found between the lowest rib and the crista iliac, and the circumference passing through the midpoint was calculated with a tape measure (131). Waist circumference measurements according to the WHO classification are as follows; for men patients,  $<94 \text{ cm}$  is normal,  $94\text{-}102 \text{ cm}$  is at risk, and  $\geq 102 \text{ cm}$  is a high risk, for women patients,  $<80 \text{ cm}$  is normal,  $80\text{-}88 \text{ cm}$  is at risk, and  $\geq 88 \text{ cm}$  is high risk evaluated (132).

Hip circumference was calculated by standing next to the patient and measuring the circumference from the highest point (131). The WHR was calculated by dividing waist circumference by hip circumference and classified according to WHO; values  $>0.90$  for men and  $> 0.85$  for women were considered to be risky for chronic diseases (132).

MUAC measurement was made by the researcher with an inflexible tape measure in accordance with the rules (131). MUAC value  $<22 \text{ cm}$  was accepted as a risk of malnutrition (133).

The conicity index was developed by Valdez to determine body fat distribution (134). The conicity index formula used in this study was as follows;  $- 0.109 - 1 \times \text{waist circumference (m)} \times (\text{weight [kg]}/\text{height [m]})^{-1/2}$ .

For HD patients Noori et al. (2012) developed the equation which was used to determine the LBM value without using Dual Energy X-ray Absorptiometry (135). The formula is: estimated LBM (kg) =  $0.34 \times \text{Serum Creatinine (mg/dl)} + 5.58 \times \text{sex (1 if women; 0 if male)} + 0.30 \times \text{weight (kg)} + 0.67 \times \text{height (inch)} - 0.23 \times \text{URR (URR, urea reduction ratio)} - 5.75$ .

### **3.3.2. Malnutrition Screening Tools**

MIS from malnutrition assessments was used in common to all patients. In addition, 7-Point SGA and NRI were calculated in the adult group, and MNA and GNRI were calculated in the elderly group (Appendix-4). It has been categorized according to malnutrition groupings.

#### **3.3.2.1. Malnutrition Inflammation Score**

The value of this MIS question is scored from 0 to 30. As the number increases, the severity of malnutrition also increases. There is no specific cut-off point for MIS. The cut-off value of MIS was determined as  $\geq 6.5$  (136).

#### **3.3.2.2. 7-Point Subjective Global Assessment**

Churchill et al. (1996) expanded the conventional SGA tool to a 7-point scale to compensate for differences in nutritional status (137). The total score of the 7-point SGA components ranges from 7 to 35. According to the scoring, the average of the points collected from the questions is classified as severe malnutrition between 1-2, mild-moderate malnutrition between 3-5, well-nourished between 7-6 points (110).

#### **3.3.2.3. Mini Nutritional Assessment**

Evaluation Criteria in the MNA Form were as follows: Normal nutritional status in the range of 24-30, those at risk of malnutrition who scored 17-23.5, those with 17 points or less are considered malnourished (138).

#### **3.3.2.4. Nutritional Risk Index**

Evaluation Criteria in the NRI;

- 100 No malnutrition
- 97.5-100 Mild Malnutrition
- 83.5-97.5 Moderate Malnutrition
- < 83.5 Classified as Severe Malnutrition (139).

### **3.3.2.5. Geriatric Nutritional Risk Index**

GNRI reference values;

- <82 Severe risk
- $\geq 82$ - <92 Moderate risk
- $\geq 92$ - <98 Low risk
- $\geq 98$  No risk (118).

### **3.3.3. Serum Parameters**

Serum parameters and some anthropometry measurements were also used in the index formulas included in the study. It was also categorized according to risk points for those considered as risk parameters for malnutrition (140).

Threshold serum creatinine levels were determined in a study because the distribution of muscle mass in dialysis patients varies according to age and sex. Age-related cut-off points were taken for serum albumin and serum creatinine in the study. Serum albumin and serum creatinine values for adult patients are <3.7 g/dL and <11 mg/dL, respectively, for elderly patients <3.5 g/dL and <8.9 mg/dL, respectively (141). Serum transferrin estimated by TIBC may be a marker of malnutrition in HD patients. Cut off <150 accepted (142).

All parameters used for the participants are included in the Table 3.1.

### **3.4. Statistical Analysis**

Statistical evaluation was made with SPSS 25.0 package program. Numeric variables; mean, standard deviation (SD), median, lower and upper values, and categorical variables are shown as numbers (S) and percentage (%). The results were considered statistically significant for the 95% confidence interval and  $p < 0.05$  in all analyses. Normality control of quantitative data will be done by Shapiro-Wilks test, and parametric tests were used for further analysis of data conforming to normal distribution. The Chronbach-alpha coefficient was calculated to determine the relationship between the obtained nutritional parameters. The discriminatory power of the model in predicting malnutrition of screening tools was examined by ROC curve analysis. Values with a margin of error below 5% in the evaluation

of the area under the curve were interpreted as statistically significant for the diagnostic value of the test.

**Table 3.1.** Parameters used for the participants

| <b>PARAMETERS</b>                                                                                | <b>ADULT<br/>n=70</b> | <b>ELDER<br/>n=70</b> |
|--------------------------------------------------------------------------------------------------|-----------------------|-----------------------|
| <b>Questionnaire</b>                                                                             |                       |                       |
| Demographic, Health, and Nutrition Information                                                   | +                     | +                     |
| <b>Anthropometric Measurements</b>                                                               |                       |                       |
| Height, Body Weight, BMI, Waist Circumference, Hip Circumference, WHR, MUAC, Conicity Index, LBM | +                     | +                     |
| <b>Serum Parameters</b>                                                                          |                       |                       |
| Serum albumin, serum creatinine (pre-post dialysis), TIBC, URR                                   | +                     | +                     |
| <b>Malnutrition Screening Tools</b>                                                              |                       |                       |
| MIS                                                                                              | +                     | +                     |
| 7-Point SGA                                                                                      | +                     | -                     |
| NRI                                                                                              | +                     | -                     |
| MNA                                                                                              | -                     | +                     |
| GNRI                                                                                             | -                     | +                     |

#### 4. RESULTS

Demographic characteristics of all patients participating in the study by age groups are given in Table 4.1. 41.4% of the adult patients are women, 58.6% are men, 62.9% of the elderly patients are women and 37.1% are men. According to marital status, 82.9% of adult patients are married, 17.1% are single, Regarding their working status, 5.7% of adult patients are working, while elderly patients do not have anyone working. Adult and elderly patients have insurance in 84.3% and 75.7%, respectively.

**Table 4.1.** Qualitative demographic characteristics of patients regarding two age groups

| VARIABLES                   | OVERALL<br>n=140 |      | ADULT<br>n=70 |      | ELDER<br>n=70 |      |
|-----------------------------|------------------|------|---------------|------|---------------|------|
|                             | n                | %    | n             | %    | n             | %    |
| <b>Sex</b>                  |                  |      |               |      |               |      |
| Women                       | 73               | 52.1 | 29            | 41.4 | 44            | 62.9 |
| Men                         | 67               | 47.9 | 41            | 58.6 | 26            | 37.1 |
| <b>Marital Status</b>       |                  |      |               |      |               |      |
| Married                     | 113              | 80.7 | 58            | 82.9 | 55            | 78.6 |
| Single                      | 27               | 19.3 | 12            | 17.1 | 15            | 21.4 |
| <b>Education Level</b>      |                  |      |               |      |               |      |
| Illiterate                  | 33               | 23.6 | 7             | 10   | 26            | 37.1 |
| Literate+Primary school     | 68               | 48.6 | 37            | 52.8 | 32            | 44.3 |
| Secondary school and higher | 39               | 27.8 | 26            | 37,2 | 13            | 18,6 |
| <b>Employment status</b>    |                  |      |               |      |               |      |
| Employed                    | 4                | 2.9  | 4             | 5.7  | -             | -    |
| Unemployed                  | 136              | 97.1 | 66            | 94.3 | 70            | 100  |
| <b>Social secured</b>       |                  |      |               |      |               |      |
| Yes                         | 112              | 80   | 59            | 84.3 | 53            | 75.7 |
| No                          | 28               | 20   | 11            | 15.7 | 17            | 24.3 |

The mean, standard deviation (SD), range (minimum and maximum) values of the demographic values of the patients according to age groups are given in Table 4.2. Adult patients total mean duration of education was 6.1±4.1 (range 0.0-15) years with a range of 38.0-64.0, mean time to diagnosis of kidney disease 1.0±8.0 (range 1.0-38.0), mean duration of HD (years) 6.6±6.4 (range 1.0-32), the mean number of main meals 2.3±0.5, the mean number of snacks 0.9±0.9, mean water consumption (ml) 890.4±592.5, mean tea consumption 370.0±326.6, mean total diet time 4.0±6.7 years.

Mean±SD values of elderly patients were respectively, age 73.5±6.5 with a range of 66-90, total time of education 3.9±3.8 (range 0.0-16), the total time to diagnosis of kidney disease 8.6±9.1 (range 1.0-58.0), total duration of HD 5.3±4.7 (range 1.0-23), number of main meals 2.3±0.5, number of snacks 0.7±0.8, water consumption 800±490, tea consumption 211±146, total diet time (year) 3±5.2.

There was a statistically significant difference between the groups regarding only in total education time and tea/coffee consumption depending on age ( $p < 0.05$ ).

**Table 4.2.** Quantitative demographic characteristics of patients regarding two age groups

| VARIABLES                                         | OVERALL<br>n=140        | ADULT<br>n=70           | ELDER<br>n=70       | Significance   |        |
|---------------------------------------------------|-------------------------|-------------------------|---------------------|----------------|--------|
|                                                   | Mean±SD<br>Range        | Mean±SD<br>Range        | Mean±SD<br>Range    | Z <sup>a</sup> | p      |
| Total time of education (years)                   | 5±4.1<br>0-16           | 6.1±4.1<br>0-15         | 3.9±3.8<br>0-16     | -3.297         | 0.001* |
| Total time to Diagnosis of Kidney Disease (years) | 9.3±8.5<br>1-58         | 10±8<br>1-38            | 8.6±9.1<br>1-58     | -1.538         | 0.124  |
| Total duration of HD (years)                      | 6±5.6<br>1.0-32         | 6.6±6.4<br>1-32         | 5.3±4.7<br>1-23     | -1.027         | 0.304  |
| Number of main meals                              | 2.3±0.5<br>1.0-3.0      | 2.3±0.5<br>1-3          | 2.3±0.5<br>1-3      | -1.078         | 0.281  |
| Number of snacks                                  | 0.8±0.9<br>0-4          | 0.9±0.9<br>0-3          | 0.7±0.8<br>0-4      | -1.347         | 0.178  |
| Water Consumption (ml)                            | 845.2±543.8<br>100-3000 | 890.4±592.5<br>100-3000 | 800±490<br>100-2500 | -0.788         | 0.431  |
| Tea/Coffee Consumption                            | 290.7±264.4<br>0-2000   | 370±326.6<br>0-2000     | 211±146<br>0-600    | -2.948         | 0.003* |
| Total diet time (years)                           | 3.5±6<br>0-32           | 4±6.7<br>0-32           | 3±5.2<br>0-30       | -0.508         | 0.612  |

\*  $p < 0.05$

<sup>a</sup> Z is calculated via Mann Whitney-U test.

Anthropometric characteristics of patients regarding two age groups were given in Table 4.3. Adult and elder patients antropometric results were respectively as follows; ideal body weight 63.4±6.4 kg (51.7-80.4), and 60.6±5.86 kg (51.7-77.8), BMI 26.9±5.2 kg/m<sup>2</sup> (18.4-41.8), and 25.9±5.1 kg/m<sup>2</sup> (16.3-40.) MUAC 28.8±3.5 cm (20.0-36.0), and 28.3±4.5

cm (17.0-40) waist circumference 99.4±15.3 cm (50.0-129.0), and 103.4±14.6 cm (57.0-140.0), hip circumference 104.2±9.2 cm (81.0-126.0), and 103.4±14.2 cm (56.0-139.0), WHR 0.9±0.1 (0.4-1.1), and 1.0±0.1 (0.7-1.5), conicity index 1.3±0.1 (0.7-1.7), and 1.4±0.1 and LBM 46.6±6.1 kg (35.0-63.3), and 44.4±5.8 kg (32.3-57.4).

**Table 4.3.** Anthropometric characteristics of participants regarding two age groups

| VARIABLES                       | OVERALL<br>n=140      | ADULT<br>n=70         | ELDER<br>n=70           | Significance        |         |
|---------------------------------|-----------------------|-----------------------|-------------------------|---------------------|---------|
|                                 | Mean±SD<br>Range      | Mean±SD<br>Range      | Mean±SD<br>Range        | Z or t              | p       |
| <b>Body Weight (kg)</b>         | 71.2±15<br>41-110     | 73.9±15.0<br>47-110   | 68.4±14.5<br>41.0-104.0 | 2.222 <sup>a</sup>  | 0.028*  |
| <b>Ideal Body Weight (kg)</b>   | 62±6.2<br>51.7-80.4   | 63.4±6.4<br>51.7-80.4 | 60.6±5.86<br>51.7-77.8  | -2.623 <sup>a</sup> | 0.009** |
| <b>BMI (kg/m<sup>2</sup>)</b>   | 26.4±5.2<br>16.3-41.8 | 26.9±5.2<br>18.4-41.8 | 25.9±5.1<br>16.3-40.6   | -0.946 <sup>b</sup> | 0.344   |
| <b>MUAC (cm)</b>                | 28.6±4<br>17-40       | 28.8±3.5<br>20-36     | 28.3±4.5<br>17-40       | 0.661 <sup>a</sup>  | 0.510   |
| <b>Waist Circumference (cm)</b> | 101.4±15<br>50-140    | 99.4±15.3<br>50-129   | 103.4±14.6<br>57-140    | -1.566 <sup>a</sup> | 0.120   |
| <b>Hip Circumference (cm)</b>   | 103.8±11.9<br>56-139  | 104.2±9.2<br>81-126   | 103.4±14.2<br>56-139    | 0.436 <sup>a</sup>  | 0.664   |
| <b>WHR</b>                      | 0.9±0.1<br>0.4-1.5    | 0.9±0.1<br>0.4-1.1    | 1±0.1<br>0.7-1.5        | -2.840 <sup>a</sup> | 0.005** |
| <b>Conicity Index</b>           | 1.4±0.1<br>0.7-1.8    | 1.3±0.1<br>0.7-1.7    | 1.4±0.1<br>0.9-1.8      | -4.104 <sup>b</sup> | 0.000** |
| <b>LBM (kg)</b>                 | 45.5.3±6<br>32.3-63.3 | 46.6±6.1<br>35-63.3   | 44.4±5.8<br>32.3-57.4   | 2.176 <sup>a</sup>  | 0.031*  |

\* p <0.05 \*\* p <0.01

<sup>a</sup> t is calculated via Independent T-Test

<sup>b</sup> Z is calculated via Nonparametrik Mann Whitney-U test.

The mean serum parameters of participants regarding two age groups were given in Table 4.4. All parameter values were slightly higher among the adult group but only serum creatinine pre and post-dialysis values and URR values were significantly different between the two age groups (p<0.05). The values of adult patients were as follows, serum albumin

3.5±0.3 (2.2-4.1), pre-dialysis serum creatinine 9.0±2.3 mg/dl (4.6-14.3), post-dialysis serum creatinine 3.0±1.0 mg/dl (1.3-5.7), URR 73.3±5.5 (62.0-86.0), TIBC 183.8±43.8 (61.0-320.0), while they were 3.4±0.3 g/dl (2.4-4.1), 7.6±2.0 mg/dl (3.3-12.8), 2.3±0.7 mg/dl (1.2-4.8), 75.6±4.9 (64.0-89.0), and 61.0-320 (69.0-285.0) for elder patients, respectively.

**Table 4.4.** Serum parameters analyze of patients regarding two age groups

| VARIABLES                                 | OVERALL<br>n=140    | ADULT<br>n=70        | ELDER<br>n=70        | Significance       |         |
|-------------------------------------------|---------------------|----------------------|----------------------|--------------------|---------|
|                                           | Mean±SD<br>Range    | Mean±SD<br>Range     | Mean±SD<br>Range     | Z or t             | p       |
| Serum Albumin (g/dL)                      | 3.4±0.3<br>2.2-4.1  | 3.5±0.3<br>2.2-4.1   | 3.4±0.3<br>2.4-4.1   | -1.150             | 0.250   |
| Serum Creatinine-<br>PreDialysis (mg/dL)  | 8.3±2.3<br>3.3-14.3 | 9.0±2.3<br>4.6-14.3  | 7.6±2.0<br>3.3-12.8  | 3.861 <sup>a</sup> | 0.000** |
| Serum Creatinine-<br>PostDialysis (mg/dL) | 2.7±0.9<br>1.2-5.7  | 3.0±1.0<br>1.3-5.7   | 2.3±0.7<br>1.2-4.8   | -3.586             | 0.000** |
| URR                                       | 74.5±5.3<br>62-89   | 73.3±5.5<br>62-8     | 75.6±4.9<br>64-89    | -2.438             | 0.015*  |
| TIBC                                      | 182.5±40.4<br>6-320 | 183.8±43.8<br>61-320 | 181.3±36.9<br>69-285 | 0.356 <sup>a</sup> | 0.722   |

\*: p <0.05 \*\*: p <0.01

<sup>a</sup>: t is calculated via Independent T-Test, Z is calculated via Nonparametric Mann Whitney-U test

Comparison of the demographic parameters of the adult patient group according to MIS were given in Table 4.5. In adult patients, 52.5% women and 47.5% men in the group with malnutrition risk according to MIS, 26.7% women and 73.3% men in the group without malnutrition risk according to MIS. A significant correlation was found between malnutrition grouping according to MIS and sex in adult patients. (p<0.05) 80% were married and 20% were single in the group with malnutrition risk according to MIS, 86.7% were married and 13.3% were single in the group without malnutrition risk according to MIS. There was no significant difference between malnutrition grouping according to MIS and marital status in adult patients. In the group with malnutrition risk according to MIS, 12.5% were illiterate, 52.5% were literate+primary school and 35% were secondary school and higher. According to MIS, in the group without malnutrition risk, 6.7% were illiterate, 53.3% were literate+primary school and 40% were secondary school and higher. There was no significant difference between malnutrition grouping according to MIS and education level in adult

patients. Everyone in the group at risk of malnutrition according to MIS is unemployed. According to MIS, in the group without malnutrition risk, 13.3% are working and 86.7% are unemployed. There was no significant difference between malnutrition grouping according to MIS and working status in adult patients. 77.5% have social security in the group with malnutrition risk according to MIS, while 22.5% do not have social security. According to MIS, in the group without malnutrition risk, 93.3% have social security, while 6.7% do not have social security. There was no significant difference between malnutrition grouping according to MIS and having social security in adult patients.

**Table 4.5.** Demographic characteristics of adult patients regarding MIS

|                          |                             | Malnutrition Inflammation Score |       |                     |       |          |        |
|--------------------------|-----------------------------|---------------------------------|-------|---------------------|-------|----------|--------|
| ADULTS                   |                             | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |       | $\chi^2$ | p      |
|                          |                             | n                               | %     | n                   | %     |          |        |
| <b>Sex</b>               | Women                       | 21                              | 52.5% | 8                   | 26.7% | 4.715    | 0.030* |
|                          | Men                         | 19                              | 47.5% | 22                  | 73.3% |          |        |
| <b>Marital Status</b>    | Married                     | 32                              | 80%   | 26                  | 86.7% | 0.536    | 0.464  |
|                          | Single                      | 8                               | 20%   | 4                   | 13.3% |          |        |
| <b>Education status</b>  | Illiterate                  | 5                               | 12.5% | 2                   | 6.7%  | 0.701    | 0.704  |
|                          | Literate+Primary school     | 21                              | 52.5% | 16                  | 53.3% |          |        |
|                          | Secondary school and higher | 14                              | 35%   | 12                  | 40%   |          |        |
| <b>Employment status</b> | Employed                    | -                               | -     | 4                   | 13.3% | 3.452    | 0.063  |
|                          | Unemployed                  | 40                              | 100%  | 26                  | 86.7% |          |        |
| <b>Social secured</b>    | Yes                         | 31                              | 77.5% | 28                  | 93.3% | 2.159    | 0.142  |
|                          | No                          | 9                               | 22.5% | 2                   | 6.7%  |          |        |

\*p<0.05 Employment status, social secured, and marital status - continuity correction.

The comparison of demographic parameters of the elderly patient group according to MIS is given in Table 4.6. In elderly patients, 66% women and 34% men in the group with malnutrition risk according to MIS, 56.5% women and 43.5% men in the group without malnutrition risk according to MIS. There was no significant difference between malnutrition grouping according to MIS and sex in elderly patients. In the group with malnutrition risk according to MIS, 74.5% were married and 25.5% were single. In the group without

malnutrition risk according to MIS, 87% were married and 13% were single. There was no significant difference between malnutrition grouping according to MIS and marital status in elderly patients. In the group with malnutrition risk according to MIS, 42.55% were illiterate, 42.55% were literate+primary school and 14.9% were secondary school and higher. According to MIS, in the group with malnutrition risk, 26.1% were illiterate, 47.8% were literate+primary school and 26.1% were secondary school and higher. There was no significant difference between malnutrition grouping according to MIS and education level in elderly patients. Everyone in the group with and without malnutrition is unemployed according to the MIS. 74.5% of the patients with malnutrition risk according to MIS have social security, while 25.5% do not have social security. There was no significant difference between malnutrition grouping according to MIS and having social security in elderly patients.

**Table 4.6.** Demographic characteristics of elder patients regarding MIS

|                   |                             | Malnutrition Inflammation Score |        |                |       |                |       |
|-------------------|-----------------------------|---------------------------------|--------|----------------|-------|----------------|-------|
| ELDERS            |                             | At risk (≥6.5)                  |        | No risk (<6.5) |       | χ <sup>2</sup> | p     |
|                   |                             | n                               | %      | n              | %     |                |       |
| Sex               | Women                       | 31                              | 66%    | 13             | 56.5% | 0.589          | 0.443 |
|                   | Men                         | 16                              | 34%    | 10             | 43.5% |                |       |
| Marital Status    | Married                     | 35                              | 74.5%  | 20             | 87%   | 0.785          | 0.376 |
|                   | Single                      | 12                              | 25.5%  | 3              | 13%   |                |       |
| Education status  | Illiterate                  | 20                              | 42.55% | 6              | 26.1% | 2.266          | 0.322 |
|                   | Literate+Primary school     | 20                              | 42.55% | 11             | 47.8% |                |       |
|                   | Secondary school and higher | 7                               | 14.9%  | 6              | 26.1% |                |       |
| Employment status | Employed                    | -                               | -      | -              | -     | -              | -     |
|                   | Unemployed                  | 47                              | 100%   | 23             | 100%  |                |       |
| Social secured    | Yes                         | 35                              | 74.5%  | 18             | 78.3% | 0.121          | 0.728 |
|                   | No                          | 12                              | 25.5%  | 5              | 21.7% |                |       |

*Marital status –continuity correction.*

Distribution of information on nutritional habits of adult patients according to MIS in Table 4.7. 72.5% in the group with malnutrition risk according to MIS thought they were adequately nourished, while it was 86.7% in the group without risk according to MIS. There

was no significant difference between malnutrition grouping according to MIS and thinking that they were adequately nourished in adult patients. 70% skip meals in the group with malnutrition risk according to MIS, while 56.7% skip meals in the non-risk group. There was no significant difference between malnutrition grouping according to MIS and skipping meals in adult patients. 47.5% in the malnutrition risk group and 53.3% in the non-risk group are on a disease-specific diet according to MIS. There was no significant difference between malnutrition grouping according to MIS and dieting specifically to the disease in adult patients. In the group at risk of malnutrition according to MIS, 52.5% are not on a diet, 40% are on a renal diet, 5% are on a low sodium diet, and 2.5% are on a weight loss diet. According to MIS, in the group without malnutrition risk, 46.7% are not on a diet, while 53.3% are on a renal diet. There was no significant difference between malnutrition grouping according to MIS and diet type in adult patients.

**Table 4.7.** Distribution of information on nutritional habits of adult patients regarding MIS

|                                          |                  | <b>Malnutrition Inflammation Score</b> |          |                                        |          |          |          |
|------------------------------------------|------------------|----------------------------------------|----------|----------------------------------------|----------|----------|----------|
| <b>ADULTS</b>                            |                  | <b>At risk (<math>\geq 6.5</math>)</b> |          | <b>No risk (<math>&lt; 6.5</math>)</b> |          | $\chi^2$ | <b>p</b> |
|                                          |                  | <b>n</b>                               | <b>%</b> | <b>n</b>                               | <b>%</b> |          |          |
| <b>Thinking getting enough nutrition</b> | Yes              | 29                                     | 72.5%    | 26                                     | 86.7%    | 2.043    | 0.153    |
|                                          | No               | 11                                     | 27.5%    | 4                                      | 13.3%    |          |          |
| <b>Skipping meals</b>                    | Yes              | 28                                     | 70%      | 17                                     | 56.7%    | 1.327    | 0.249    |
|                                          | No               | 12                                     | 30%      | 13                                     | 43.3%    |          |          |
| <b>Diet for Disease</b>                  | Yes              | 19                                     | 47.5%    | 16                                     | 53.3%    | 0.233    | 0.629    |
|                                          | No               | 21                                     | 52.5%    | 14                                     | 46.7%    |          |          |
| <b>Type of Diet</b>                      | Not dieting      | 21                                     | 52.5%    | 14                                     | 46.7%    | 3.033    | 0.387    |
|                                          | Renal diet       | 16                                     | 40%      | 16                                     | 53.3%    |          |          |
|                                          | Low sodium diet  | 2                                      | 5%       | -                                      | -        |          |          |
|                                          | Weight loss diet | 1                                      | 2.5%     | -                                      | -        |          |          |

Distribution of information on nutritional habits of adult patients according to MIS in Table 4.8. 80.9% in the group with malnutrition risk according to MIS think that they are adequately fed, while in the group without risk according to MIS, 91.3% think that they are

adequately fed. In elderly patients, there was no significant difference between malnutrition grouping according to MIS and thinking that they were adequately nutrition. 59.6% skip meals in the group with malnutrition risk according to MIS, while 52.2% skip meals in the non-risk group. There was no significant difference between malnutrition grouping according to MIS and skipping meals in elderly patients. 48.9% in the group with malnutrition risk and 47.8% in the non-risk group are on a disease-specific diet according to MIS. There was no significant difference between malnutrition grouping according to MIS and dieting specifically to the disease in elderly patients. 51.1% of the patients at risk of malnutrition according to MIS were not on a diet, 38.3% were on a renal diet and 10.6% were on a low sodium diet. According to MIS, in the group without malnutrition risk, 52.2% were not on a diet, 39.1% were on a renal diet and 8.7% were on a low sodium diet. There was no significant difference between malnutrition grouping according to MIS and diet type in elderly patients.

**Table 4.8.** Distribution of information on nutritional habits of elder patients regarding MIS

|                                   |                 | Malnutrition Inflammation Score |       |                     |       |          |       |
|-----------------------------------|-----------------|---------------------------------|-------|---------------------|-------|----------|-------|
| ELDERS                            |                 | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |       | $\chi^2$ | p     |
|                                   |                 | n                               | %     | n                   | %     |          |       |
| Thinking getting enough nutrition | Yes             | 38                              | 80.9% | 21                  | 91.3% | 0.607    | 0.436 |
|                                   | No              | 9                               | 19.1% | 2                   | 8.7%  |          |       |
| Skipping meals                    | Yes             | 28                              | 59.6% | 12                  | 52.2% | 0.345    | 0.557 |
|                                   | No              | 19                              | 40.4% | 11                  | 47.8% |          |       |
| Diet for Disease                  | Yes             | 23                              | 48.9% | 11                  | 47.8% | 0.008    | 0.930 |
|                                   | No              | 24                              | 51.1% | 12                  | 52.2% |          |       |
| Type of Diet                      | Not dieting     | 24                              | 51.1% | 12                  | 52.2% | 0.065    | 0.968 |
|                                   | Renal diet      | 18                              | 38.3% | 9                   | 39.1% |          |       |
|                                   | Low sodium diet | 5                               | 10.6% | 2                   | 8.7%  |          |       |

*Thinking getting enough nutrition- continuity*

In total, 94.3% of all patients in the group at risk of malnutrition according to MIS and 94.3% in the group without risk according to MIS had at least 1 comorbidity. It is shown in Table 4.9. According to MIS, 95% of adult patients in the malnutrition risk group and

96.7% in the non-risk group had at least 1 comorbidity. 93.6% of the elderly patients in the malnutrition risk group and 91.3% in the non-risk group had at least 1 comorbidity. There was no significant difference between malnutrition grouping according to MIS and having at least one comorbidity in adult and elderly patients.

**Table 4.9.** Distribution of comorbidities regarding MIS

|               |     | Malnutrition Inflammation Score |       |                     |       |          |       |
|---------------|-----|---------------------------------|-------|---------------------|-------|----------|-------|
| OVERALL       |     | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |       | $\chi^2$ | p     |
|               |     | n                               | %     | n                   | %     |          |       |
| Comorbidities | Yes | 82                              | 94.3% | 50                  | 94.3% | 0.000    | 1.000 |
|               | No  | 5                               | 5.7%  | 3                   | 5.7%  |          |       |
| ADULTS        |     |                                 |       |                     |       |          |       |
|               |     |                                 |       |                     |       |          |       |
| Comorbidities | Yes | 38                              | 95.0% | 29                  | 96.7% | 0.000    | 1.000 |
|               | No  | 2                               | 5.0%  | 1                   | 3.3%  |          |       |
| ELDERS        |     |                                 |       |                     |       |          |       |
|               |     |                                 |       |                     |       |          |       |
| Comorbidities | Yes | 44                              | 93.6% | 21                  | 91.3% | 0.000    | 1.000 |
|               | No  | 3                               | 6.4%  | 2                   | 8.7%  |          |       |

*Overall, adult, elder comorbidities- continuity correction*

For adult patients, according to MIS, 95% in the malnutrition risk group and 96.7% in the non-risk group have at least 1 comorbidity. It is shown in Table 4.10. 27.5% in the malnutrition risk group and 26.7% in the non-risk group have CVD diseases. 42.5% in the malnutrition risk group and 40% in the non-risk group have DM. 72.5% of the malnutrition-risk group and 83.3% of the non-risk group had HT. 12.5% of the malnutrition-risk group and 10.0% of the non-risk group have gastrointestinal diseases. 7.5% of the group with malnutrition risk and 3.3% of the non-risk group have respiratory diseases. While 2.5% of the malnutrition risk group had a mental illness, there was no mental illness in the non-risk group. 15% of the malnutrition risk group and 6.7% of the non-risk group have musculoskeletal diseases. While 15% of the malnutrition risk group has endocrine diseases, there is no endocrine disease in the non-risk group. While 2.5% of the malnutrition risk group had vitamin and mineral deficiency, there was no vitamin and mineral deficiency in the non-

risk group. There was no statistically significant difference between malnutrition grouping according to MIS and having different comorbidities in adult patients.

**Table 4.10.** Comparison of comorbidities regarding MIS in adult patients

|                                         |     | Malnutrition Inflammation Score |       |                     |        |          |       |
|-----------------------------------------|-----|---------------------------------|-------|---------------------|--------|----------|-------|
| ADULTS                                  |     | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |        | $\chi^2$ | p     |
|                                         |     | n                               | %     | n                   | %      |          |       |
| <b>Comorbidities</b>                    | Yes | 38                              | 95.0% | 29                  | 96.7%  | 0.000    | 1.000 |
|                                         | No  | 2                               | 5.0%  | 1                   | 3.3%   |          |       |
| <b>CVD</b>                              | Yes | 11                              | 27.5% | 8                   | 26.7%  | 0.006    | 0.938 |
|                                         | No  | 29                              | 72.5% | 22                  | 73.3%  |          |       |
| <b>DM</b>                               | Yes | 17                              | 42.5% | 12                  | 40.0%  | 0.044    | 0.834 |
|                                         | No  | 23                              | 57.5% | 18                  | 60.0%  |          |       |
| <b>HT</b>                               | Yes | 29                              | 72.5% | 25                  | 83.3%  | 1.141    | 0.285 |
|                                         | No  | 11                              | 27.5% | 5                   | 16.7%  |          |       |
| <b>Gastrointestinal diseases</b>        | Yes | 5                               | 12.5% | 3                   | 10.0%  | 0.000    | 1.000 |
|                                         | No  | 35                              | 87.5% | 27                  | 90.0%  |          |       |
| <b>Respiratory diseases</b>             | Yes | 3                               | 7.5%  | 1                   | 3.3%   | 0.050    | 0.824 |
|                                         | No  | 37                              | 92.5% | 29                  | 96.7%  |          |       |
| <b>Mental disorders</b>                 | Yes | 1                               | 2.5%  | -                   | -      | 0.000    | 1.000 |
|                                         | No  | 39                              | 97.5% | 30                  | 100.0% |          |       |
| <b>Musculoskeletal disorders</b>        | Yes | 6                               | 15.0% | 2                   | 6.7%   | 0.497    | 0.481 |
|                                         | No  | 34                              | 85.0% | 28                  | 93.3%  |          |       |
| <b>Endocrine disorders</b>              | Yes | 6                               | 15.0% | -                   | -      | 3.194    | 0.074 |
|                                         | No  | 34                              | 85.0% | 30                  | 100.0% |          |       |
| <b>Vitamin and mineral deficiencies</b> | Yes | 1                               | 2.5%  | -                   | -      | 0.000    | 1.000 |
|                                         | No  | 39                              | 97.5% | 30                  | 100.0% |          |       |

In elderly patients, according to MIS, 93.6% in the malnutrition risk group and 91.3% in the non-risk group had at least 1 comorbidity. It is shown in Table 4.11. 42.6% in the malnutrition risk group and 13% in the non-risk group have CVD. 46.8% in the malnutrition risk group and 47.8% in the non-risk group have DM. 72.3% in the malnutrition risk group and 65.2% in the non-risk group have HT. 17% of the malnutrition-risk group and 4.3% of the non-risk group have gastrointestinal diseases. 8.5% of the malnutrition-risk group and 8.7% of the non-risk group have respiratory diseases. While 4.3% of the malnutrition risk

group had a mental illness, there was no person with mental illness in the non-risk group. 27.7% of the malnutrition-risk group and 13% of the non-risk group have musculoskeletal diseases. While 2.1% of the group with malnutrition risk had endocrine diseases, there was no endocrine disease in the non-risk group. While 2% of the group with malnutrition risk has vitamin and mineral deficiency, there is no vitamin and mineral deficiency in the non-risk group. While a significant difference was found between malnutrition grouping according to MIS and having CVD in elderly patients ( $p<0.05$ ), no statistically significant difference was found with other comorbidities.

**Table 4.11.** Comparison of comorbidities regarding MIS in elderly patients

|                                         |     | Malnutrition Inflammation Score |       |                     |        |          |        |
|-----------------------------------------|-----|---------------------------------|-------|---------------------|--------|----------|--------|
| ELDERS                                  |     | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |        | $\chi^2$ | p      |
|                                         |     | n                               | %     | n                   | %      |          |        |
| <b>Comorbidities</b>                    | Yes | 44                              | 93.6% | 21                  | 91.3%  | 0.000    | 1.000  |
|                                         | No  | 3                               | 6.4%  | 2                   | 8.7%   |          |        |
| <b>CVD</b>                              | Yes | 20                              | 42.6% | 3                   | 13.0%  | 6.096    | 0.014* |
|                                         | No  | 27                              | 57.4% | 20                  | 87.0%  |          |        |
| <b>DM</b>                               | Yes | 22                              | 46.8% | 11                  | 47.8%  | 0.006    | 0.936  |
|                                         | No  | 25                              | 53.2% | 12                  | 52.2%  |          |        |
| <b>HT</b>                               | Yes | 34                              | 72.3% | 15                  | 65.2%  | 0.373    | 0.541  |
|                                         | No  | 13                              | 27.7% | 8                   | 34.8%  |          |        |
| <b>Gastrointestinal diseases</b>        | Yes | 8                               | 17.0% | 1                   | 4.3%   | 1.227    | 0.268  |
|                                         | No  | 39                              | 83.0% | 22                  | 95.7%  |          |        |
| <b>Respiratory diseases</b>             | Yes | 4                               | 8.5%  | 2                   | 8.7%   | 0.000    | 1.000  |
|                                         | No  | 43                              | 91.5% | 21                  | 91.3%  |          |        |
| <b>Mental disorders</b>                 | Yes | 2                               | 4.3%  | -                   | -      | 0.058    | 0.810  |
|                                         | No  | 45                              | 95.7% | 23                  | 100.0% |          |        |
| <b>Musculoskeletal disorders</b>        | Yes | 13                              | 27.7% | 3                   | 13.0%  | 1.871    | 0.171  |
|                                         | No  | 34                              | 72.3% | 20                  | 87.0%  |          |        |
| <b>Endocrine disorders</b>              | Yes | 1                               | 2.1%  | -                   | -      | 0.000    | 1.000  |
|                                         | No  | 46                              | 97.9% | 23                  | 100.0% |          |        |
| <b>Vitamin and mineral deficiencies</b> | Yes | 2                               | 4.3%  | -                   | -      | 0.058    | 0.810  |
|                                         | No  | 45                              | 95.7% | 23                  | 100.0% |          |        |

\* $p<0.05$

The comparison of malnutrition-related anthropometric measurements of adult and elderly patient groups according to MIS is given in Table 4.12. In adult patients, 32.5% of

the patients at risk of malnutrition according to MIS were underweight according to BMI (BMI<23), while 6.7% of the patients who were not at risk were underweight. The comparison of BMI with MIS in adult patients was found to be statistically significant (p<0.05). Elderly patients at risk of malnutrition according to MIS, according to BMI, while 29.8% were underweight, 26.7% were underweight in the non-risk group. There was no statistical difference in comparison of BMI according to MIS in elderly patients.

Patients at risk of malnutrition according to MIS, 3.3% of adult patients and 8.5% of elderly patients are in the risk group according to MUAC. In elderly patients, there is no one (<22 cm) in the group with malnutrition risk for MUAC who does not have a risk of malnutrition according to MIS. There was no statistical difference in comparison of MUAC with malnutrition risk grouping according to MIS in adult and elderly patients.

**Table 4.12.** Comparison of anthropometric measurements of patients in two age groups regarding MIS

| Malnutrition Inflammation Score |        |                |       |                |       |                |        |
|---------------------------------|--------|----------------|-------|----------------|-------|----------------|--------|
| ADULTS                          |        | At risk (≥6.5) |       | No risk (<6.5) |       | χ <sup>2</sup> | p      |
|                                 |        | n              | %     | n              | %     |                |        |
| BMI                             | <23    | 13             | 32.5% | 2              | 6.7%  | 6.795          | 0.009* |
|                                 | ≥ 23   | 27             | 67.5% | 28             | 93.3% |                |        |
| MUAC                            | <22 cm | 1              | 3.3%  | 1              | 2.5%  | 0.000          | 1.000  |
|                                 | ≥22    | 39             | 96.7% | 29             | 97.5% |                |        |
| ELDERS                          |        |                |       |                |       |                |        |
| BMI                             | <23    | 14             | 29.8% | 6              | 26.1% | 0.104          | 0.748  |
|                                 | ≥ 23   | 33             | 70.2% | 17             | 73.2% |                |        |
| MUAC                            | <22 cm | 4              | 8.5%  | 0              | 0%    | 0.797          | 0.372  |
|                                 | ≥22    | 43             | 91.5% | 23             | 100%  |                |        |

\*p<0.01

The mean $\pm$ SD and range values of anthropometric measurements of two age groups of the patients according to MIS are given in Table 4.13. According to MIS, adult and elderly patients at risk of malnutrition mean values respectively were as follows; BMI 25.7 $\pm$ 5.4 to 25.7 $\pm$ 5.4, MUAC 28.1 $\pm$ 3.0 to 27.8 $\pm$ 4.9, waist circumference 97.0 $\pm$ 14.7 to 102.9 $\pm$ 16.1, hip

circumference 102.4±8.7 to 101.7±15.0, WHR 0.9±0.1 to 1.0±0.1, conicity index 1.3±0.13 to 1.4±0.13, LBM 44.7±5.6 to 44.0±6.0. Adult and elderly patients who are not at risk of malnutrition according to MIS mean values respectively were as follows; BMI 28.4±4.6 to 26.3±4.7, MUAC 29.7±3.8 to 29.4±3.5, waist circumference 102.6±15.7 to 104.3±11.2, hip circumference 106.7±9.5 to 106.6±12.0, WHR 0.9±0.1 to 0.9±0.08, conicity index 1.3±0.15 to 1.4±0.11, LBM 49.2±5.8 to 45.3±5.3. In the elderly patients, no statistically significant difference was found between the two MIS categories regarding anthropometric measurements.

**Table 4.13.** Anthropometric measurements of patients of two age groups regarding MIS

| Malnutrition Inflammation Score |                |           |                |           |                      |         |
|---------------------------------|----------------|-----------|----------------|-----------|----------------------|---------|
| ADULT                           | At risk (≥6.5) |           | No risk (<6.5) |           | Significance         |         |
|                                 | Mean±SD        | Range     | Mean±SD        | Range     | Z or t               | p       |
| <b>BMI (kg/m<sup>2</sup>)</b>   | 25.7±5.4       | 18.4-41.8 | 28.4±4.6       | 21.6-37.5 | -2.302 <sup>b</sup>  | 0.021*  |
| <b>MUAC</b>                     | 28.1±3         | 20-33     | 29.7±3.8       | 20-36     | -1.707 <sup>b</sup>  | 0.088   |
| <b>Waist Circumference (cm)</b> | 97±14.7        | 60-120    | 102.6±15.7     | 50-129    | 1.514 <sup>a</sup>   | 0.100   |
| <b>Hip Circumference (cm)</b>   | 102.4±8.7      | 87-125    | 106.7±9.5      | 81-126    | 1.925 <sup>a</sup>   | 0.051   |
| <b>WHR</b>                      | 0.9±0.1        | 0.6-1.1   | 0.9±0.1        | 0.4-1     | 0.638 <sup>a</sup>   | 0.222   |
| <b>Conicity Index</b>           | 1.3±0.13       | 1-1.7     | 1.3±0.15       | 0.7-1.6   | 0.000 <sup>b</sup>   | 1.000   |
| <b>LBM (kg)</b>                 | 44.7±5.6       | 35-57     | 49.2±5.8       | 41.1-63.3 | 3.161 <sup>a</sup>   | 0.006** |
| <b>ELDERS</b>                   |                |           |                |           |                      |         |
| <b>BMI (kg/m<sup>2</sup>)</b>   | 25.7±5.4       | 16.3-40.6 | 26.3±4.7       | 19.8-37.7 | -0.500 <sup>b</sup>  | 0.617   |
| <b>MUAC</b>                     | 27.8±4.9       | 17-40     | 29.4±3.5       | 23-36     | -1.400 <sup>b</sup>  | 0.162   |
| <b>Waist Circumference (cm)</b> | 102.9±16.1     | 57-140    | 104.3±11.2     | 84-126    | -0.0382 <sup>a</sup> | 0.595   |
| <b>Hip Circumference (cm)</b>   | 101.7±15       | 56-131    | 106.6±12       | 86-139    | 1.362 <sup>a</sup>   | 0.290   |
| <b>WHR</b>                      | 1.0±0.1        | 0.7-1.5   | 0.9±0.08       | 0.8-1.1   | -1.274 <sup>a</sup>  | 0.240   |
| <b>Conicity Index</b>           | 1.4±0.13       | 0.9-1.8   | 1.4±0.11       | 1.3-1.7   | -0.644 <sup>b</sup>  | 0.156   |
| <b>LBM (kg)</b>                 | 44±6           | 34.7-54.4 | 45.3±5.3       | 34.7-54.4 | 0.889 <sup>a</sup>   | 0.345   |

\*: p <0.05 \*\*: p <0.01

<sup>a</sup> t is calculated via Independent T-Test,

<sup>b</sup> Z is calculated via Nonparametric Mann Whitney-U test

Comparison of malnutrition-related serum parameters of adult and elderly patient groups according to MIS is given in Table 4.14. In adult patients, 87.5% of patients with malnutrition risk according to MIS and 66.7% of patients without malnutrition risk according to MIS have a malnutrition risk of  $<3.7$  g/dL according to serum albumin levels. In elderly patients, 72.5% of patients with malnutrition risk according to MIS and 39.1% of patients without malnutrition risk according to MIS have a malnutrition risk of  $<3.5$  g/dL according to serum albumin levels. A significant correlation was found between malnutrition grouping according to MIS and serum albumin levels in adult and elderly patients. ( $p=0.036$  and  $p=0.007$ , respectively).

In adult patients, 85% of patients with malnutrition risk according to MIS and 66.7% of patients without malnutrition risk according to MIS have a malnutrition risk of  $<11$  mg/dL according to pre-dialysis serum creatinine levels. In elderly patients, 77.6% of patients with malnutrition risk according to MIS and 39.1% of patients without malnutrition risk according to MIS have a malnutrition risk of  $<11$  mg/dL according to pre-dialysis serum creatinine levels.

In adult patients, 37.5% of patients at risk of malnutrition according to MIS and 3.3% of patients without risk of malnutrition according to MIS had TIBC levels  $<150$  mg/dL. In elderly patients, 21.3% of patients at risk of malnutrition according to MIS and 13% of patients without risk of malnutrition according to MIS had TIBC levels  $<150$  mg/dL. While a high significant correlation was found between malnutrition grouping according to MIS and TIBC levels in adult patients ( $p<0.05$ ), no significant difference was found in elderly patients.

**Table 4.14.** Serum parameters of adult and elder patients regarding MIS

| Malnutrition Inflammation Score |            |                |       |                |       |        |         |
|---------------------------------|------------|----------------|-------|----------------|-------|--------|---------|
| ADULTS                          |            | At risk (≥6.5) |       | No risk (<6.5) |       | χ²     | p       |
|                                 |            | n              | %     | n              | %     |        |         |
| Serum Albumin                   | <3.7 g/dL  | 35             | 87.5% | 20             | 66.7% | 4.419  | 0.036*  |
|                                 | ≥ 3.7 g/dL | 5              | 12.5% | 10             | 33.3% |        |         |
| Serum Creatinine-PreDialysis    | <11 mg/dL  | 34             | 85%   | 20             | 66.7% | 3.268  | 0.071   |
|                                 | ≥11 mg/dL  | 6              | 15%   | 10             | 33.3% |        |         |
| TIBC                            | <150 mg/dL | 15             | 37.5% | 1              | 3.3%  | 11.349 | 0.001*  |
|                                 | ≥150 mg/dL | 25             | 62.5% | 29             | 96.7% |        |         |
| ELDERS                          |            |                |       |                |       |        |         |
| Serum Albumin                   | <3.5 g/dL  | 34             | 72.3% | 9              | 39.1% | 7.188  | 0.007** |
|                                 | ≥ 3.5 g/dL | 13             | 27.7% | 14             | 60.9% |        |         |
| Serum Creatinine-PreDialysis    | <8.9 mg/dL | 36             | 76.6% | 17             | 73.9% | 0.060  | 0.806   |
|                                 | ≥8.9 mg/dL | 11             | 23.4% | 6              | 26.1% |        |         |
| TIBC                            | <150 mg/dL | 10             | 21.3% | 3              | 13%   | 0.255  | 0.614   |
|                                 | ≥150 mg/dL | 37             | 78.7% | 20             | 87%   |        |         |

\*:  $p < 0.05$  \*\*:  $p < 0.001$  TIBC continuity connection

The mean, SD, and range values of the malnutrition screening tool according to the age groups of the patients are given in Table 4.15. Mean $\pm$ SD values of adult patients were respectively, MIS 7.2 $\pm$ 3.3, 7 Point- SGA 102.0 $\pm$ 11.5, NRI 63.4 $\pm$ 6.4. Mean $\pm$ SD values of elderly patients were respectively, MIS 8.5 $\pm$ 4.2, MNA 22.1 $\pm$ 3.6, GNRI 100.5 $\pm$ 11.2.

**Table 4.15.** Malnutrition screening tool results of patients according to the two age groups

| VARIABLES    | OVERALL<br>n=140       | ADULT<br>n=70                | ELDER<br>n=70                 | Significance |       |
|--------------|------------------------|------------------------------|-------------------------------|--------------|-------|
|              | Mean $\pm$ SD<br>Range | Mean $\pm$ SD<br>Range       | Mean $\pm$ SD<br>Range        | Z            | p     |
| MIS          | 7.9 $\pm$ 3.8<br>1-27  | 7.2 $\pm$ 3.3<br>1-15        | 8.5 $\pm$ 4.2<br>3-27         | -1.579       | 0.114 |
| 7 Point- SGA | -                      | 102 $\pm$ 11.5<br>78.8-124.5 | -                             | -            | -     |
| NRI          | -                      | 63.4 $\pm$ 6.4<br>51.7-80.4  | -                             | -            | -     |
| MNA          | -                      | -                            | 22.1 $\pm$ 3.6<br>10.5-28.5   | -            | -     |
| GNRI         | -                      | -                            | 100.5 $\pm$ 11.2<br>10.5-28.5 | -            | -     |

The frequency of adult patients according to MIS, 7-Point SGA, and NRI are given in Table 4.16. There is no risk of malnutrition in 42.9% according to MIS, 75.7% according to 7-point SGA, 55.7% according to NRI.

**Table 4.16.** Distribution of adult patients regarding MIS, 7-Point SGA, and NRI

| <b>ADULTS</b>      |                                    | <b>n</b> | <b>%</b> |
|--------------------|------------------------------------|----------|----------|
| <b>MIS</b>         | No malnutrition risk               | 30       | 42.9%    |
|                    | At malnutrition risk               | 40       | 57.1%    |
| <b>7 Point-SGA</b> | Well nourished                     | 53       | 75.7%    |
|                    | Mildly and Moderately Malnourished | 17       | 24.3%    |
|                    | Severely Malnourished              | -        | -        |
| <b>NRI</b>         | No malnutrition                    | 39       | 55.7%    |
|                    | Mild malnutrition                  | 7        | 10%      |
|                    | Moderate malnutrition              | 18       | 25.7%    |
|                    | Severe malnutrition                | 6        | 8.6%     |

Percentage ratios of elder patients according to MIS, MNA and GNRI are given in Table 4.17. There is no risk of malnutrition in 32.9% according to MIS, 28.6% according to MNA, 61.4% according to GNRI.

**Table 4.17.** Distribution of elder patients regarding MIS, MNA, and GNRI

| <b>ELDERS</b> |                            | <b>n</b> | <b>%</b> |
|---------------|----------------------------|----------|----------|
| <b>MIS</b>    | No malnutrition risk       | 23       | 32.9%    |
|               | At malnutrition risk       | 47       | 67.1%    |
| <b>MNA</b>    | Normal                     | 20       | 28.5%    |
|               | Risk for malnutrition      | 44       | 62.9%    |
|               | Malnutrition               | 6        | 8.6%     |
| <b>GNRI</b>   | No risk of nutrition       | 43       | 61.4%    |
|               | Low risk of nutrition      | 17       | 24.3%    |
|               | Moderate risk of nutrition | 5        | 7.1%     |
|               | Major risk of nutrition    | 5        | 7.1%     |

The comparison of 7-Point SGA and NRI according to MIS in adult patients is given in Table 4.18. 60% of adult patients with malnutrition risk according to MIS and 96.7% of those without risk according to MIS were well-nourished according to 7-Point SGA. 40% of adult patients at risk of malnutrition according to MIS, and 3.3% of people without risk according to MIS were mildly and moderately malnourished according to 7-Point SGA. According to MIS, no patient was severely malnourished in the group with and without malnutrition risk. A significant correlation was found between malnutrition grouping according to MIS and malnutrition grouping according to 7-Point SGA in adult patients ( $p<0.000$ ).

37.5% of those with malnutrition risk according to MIS and 80% of those without risk according to MIS had no malnutrition according to NRI. In adult patients, 10% of those at risk of malnutrition according to MIS and 10% of those without risk according to MIS had mild malnutrition according to NRI. 40% of adult patients with malnutrition risk according to MIS and 6.7% of those without risk according to MIS were moderate-malnutrition according to NRI. 12.5% of patients with malnutrition risk according to MIS and 3.3% of patients without risk according to MIS had severe malnutrition according to NRI. A significant correlation was found between malnutrition grouping according to MIS and malnutrition grouping according to NRI in adult patients. ( $p<0.002$ )

**Table 4.18.** Comparison of 7-Point SGA and NRI in adult patients regarding MIS

|                    |                                    | Malnutrition Inflammation Score |       |                     |       |          |        |
|--------------------|------------------------------------|---------------------------------|-------|---------------------|-------|----------|--------|
| ADULTS             |                                    | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |       | $\chi^2$ | p      |
|                    |                                    | n                               | %     | n                   | %     |          |        |
| <b>7 Point-SGA</b> | Well nourished                     | 24                              | 60%   | 29                  | 96.7% | 12.534   | 0.000* |
|                    | Mildly and Moderately Malnourished | 16                              | 40%   | 1                   | 3.3%  |          |        |
|                    | Severely Malnourished              | -                               | -     | -                   | -     |          |        |
|                    |                                    |                                 |       |                     |       |          |        |
| <b>NRI</b>         | No malnutrition                    | 15                              | 37.5% | 24                  | 80%   | 14.646   | 0.002* |
|                    | Mild malnutrition                  | 4                               | 10%   | 3                   | 10%   |          |        |
|                    | Moderate malnutrition              | 16                              | 40%   | 2                   | 6.7%  |          |        |
|                    | Severe malnutrition                | 5                               | 12.5% | 1                   | 3.3%  |          |        |

\*:  $p<0.001$

The comparison of MNA and GNRI according to MIS in elderly patients is given in Table 4.19. 17% of those at risk of malnutrition according to MIS and 52.2% of those without risk according to MIS were normal according to MNA. 72.3% of elderly patients with malnutrition risk according to MIS and 43.5% of those without risk according to MIS had a risk for malnutrition according to MNA. 10.6% of the elderly patients with malnutrition risk according to MIS and 4.3% of those without risk according to MIS had malnutrition according to MNA. A significant correlation was found between malnutrition grouping according to MIS and malnutrition grouping according to MNA in elderly patients. ( $p<0.009$ )

55.3% of elderly patients with malnutrition risk according to MIS and 73.9% of patients without risk according to MIS had no risk of malnutrition according to GNRI. 23.4% of elderly patients with malnutrition risk according to MIS and 26.1% of people without risk according to MIS have a low risk of malnutrition according to GNRI. 10.6% of elderly patients with malnutrition risk according to MIS are at moderate risk of nutrition, no one is at moderate risk of nutrition in the group without malnutrition risk according to MIS. 10.6% of elderly patients with malnutrition risk according to MIS are at major risk of nutrition, and no one is at major risk of nutrition in the group without malnutrition risk according to MIS.

There was no significant relationship between malnutrition grouping according to MIS and malnutrition grouping according to GNRI in elderly patients.

**Table 4.19.** Comparison of MNA and GNRI in elderly patients regarding MIS

|        |                            | Malnutrition Inflammation Score |       |                     |       |          |        |
|--------|----------------------------|---------------------------------|-------|---------------------|-------|----------|--------|
| ELDERS |                            | At risk ( $\geq 6.5$ )          |       | No risk ( $< 6.5$ ) |       | $\chi^2$ | p      |
|        |                            | n                               | %     | n                   | %     |          |        |
| MNA    | Normal                     | 8                               | 17%   | 12                  | 52.2% | 9.439    | 0.009* |
|        | Risk for malnutrition      | 34                              | 72.3% | 10                  | 43.5% |          |        |
|        | Malnutrition               | 5                               | 10.6% | 1                   | 4.3%  |          |        |
| GNRI   | No risk of nutrition       | 26                              | 55.3% | 17                  | 73.9% | 5.809    | 0.121  |
|        | Low risk of nutrition      | 11                              | 23.4% | 6                   | 26.1% |          |        |
|        | Moderate risk of nutrition | 5                               | 10.6% | -                   | -     |          |        |
|        | Major risk of nutrition    | 5                               | 10.6% | -                   | -     |          |        |

\*:  $p<0.001$

According to MIS; comparison of 7-Point SGA and NRI in adult patients, comparison of MNA and GNRI in elderly patients mean $\pm$ SD, range are given in Table 4.20.

Adult patients at risk of malnutrition according to MIS; mean values were 6.0 $\pm$ 0.4 and 5.1-7 for 7-Point SGA and 98.0 $\pm$ 11.1 and 78.8-122.3 for NRI, respectively. A statistically significant relationship was found between malnutrition grouping according to MIS and 7 Point-SGA and NRI in adult patients. (p<0.000 and p<0.001, respectively)

Elderly patients at risk of malnutrition according to MIS; mean values were 21.1 $\pm$ 3.2 and 11.5-26 for MNA and 98.9 $\pm$ 12.4 and 71.0-127.6 for NRI, respectively. A statistically significant relationship was found between malnutrition grouping according to MIS and MNA in elderly patients (p<0.001). There was no statistically significant relationship between malnutrition grouping according to MIS and MNA in elderly patients.

**Table 4.20.** Comparison of other malnutrition screening tool results of two age groups regarding MIS

| <b>Malnutrition Inflammation Score</b> |                                        |              |                                        |              |          |
|----------------------------------------|----------------------------------------|--------------|----------------------------------------|--------------|----------|
| <b>ADULTS</b>                          | <b>At risk (<math>\geq 6.5</math>)</b> |              | <b>No risk (<math>&lt; 6.5</math>)</b> |              | <b>p</b> |
|                                        | <b>Mean<math>\pm</math>SD</b>          | <b>Range</b> | <b>Mean<math>\pm</math>SD</b>          | <b>Range</b> |          |
| <b>7 Point-SGA</b>                     | 6.0 $\pm$ 0.4                          | 5.1-7        | 6.70 $\pm$ .3                          | 5.7-7        | 0.000*   |
| <b>NRI</b>                             | 98.0 $\pm$ 11.1                        | 78.8-122.3   | 107.4 $\pm$ 9.8                        | 83.2-124.3   | 0.001*   |
| <b>ELDERS</b>                          |                                        |              |                                        |              |          |
| <b>MNA</b>                             | 21.1 $\pm$ 3.2                         | 11.5-26      | 23.9 $\pm$ 3.81                        | 10.5-28.5    | 0.001*   |
| <b>GNRI</b>                            | 98.9 $\pm$ 12.4                        | 71.0-127.6   | 103.6 $\pm$ 7.6                        | 92.6-122.0   | 0.123    |

As a result of the evaluation made with ROC analysis based on MIS results, it was seen that 7-Point SGA values in the adult group had diagnostic value in predicting malnutrition status. (AUC:0.917, %95CI:0.817-1.000 p<0.000, respectively) It is shown in Figure 4.1.

7-Point SGA was found to be a suitable screening tool according to MIS to detect malnutrition status.

| TEST RESULT<br>VARIABLES: MIS | Asymptotic 95%<br>Confidence Interval |            |                |             |             |
|-------------------------------|---------------------------------------|------------|----------------|-------------|-------------|
|                               | Area                                  | Std. Error | Asymptotic Sig | Lower Bound | Upper Bound |
| 7-Point SGA                   | 0.917                                 | 0.051      | 0.000          | 0.817       | 1.000       |

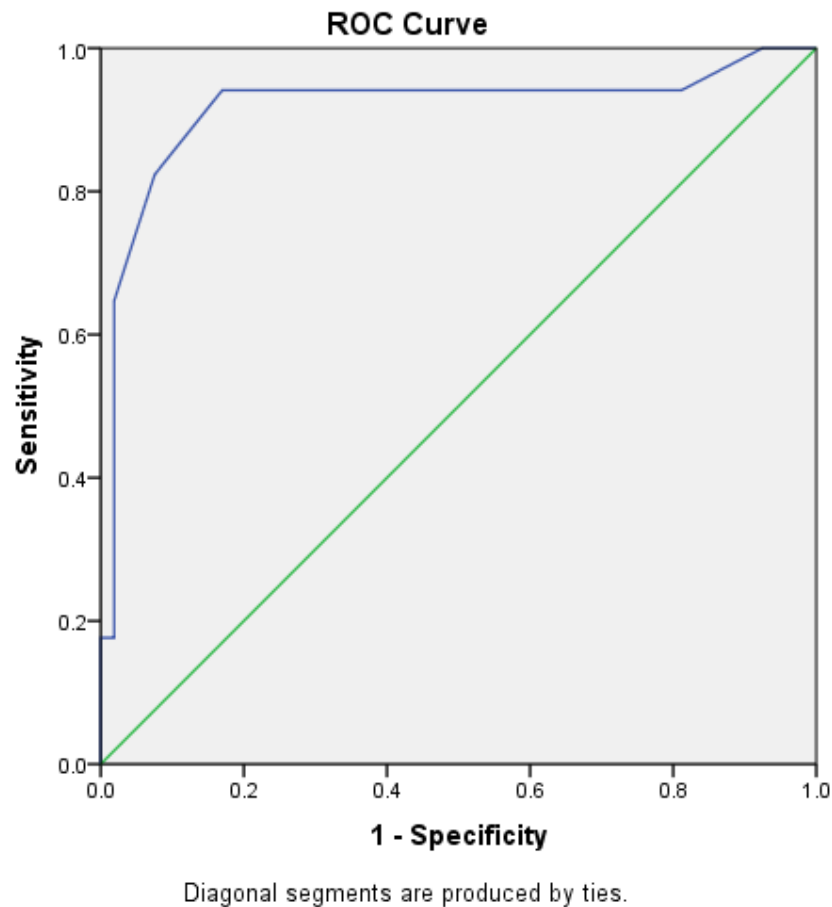


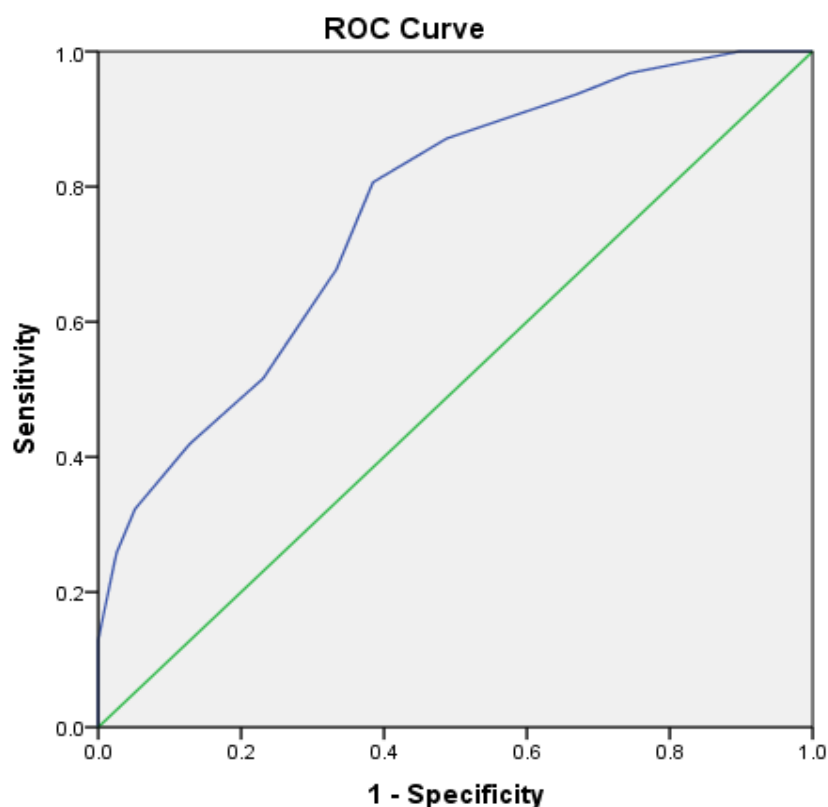
**Figure 4.21.** ROC analysis for 7-Point SGA based on MIS in the adult group

As a result of the evaluation made with ROC analysis based on MIS results, it was seen that 7-Point SGA values in the adult group had diagnostic value in predicting malnutrition status. (AUC:0.917, %95CI:0.817-1.000  $p<0.000$ , respectively) It is shown in Table 4.21.

7-Point SGA was found to be a suitable screening tool according to MIS to detect malnutrition status.

As a result of the evaluation made with ROC analysis based on MIS results, it was seen that NRI values in the adult group have diagnostic value in predicting malnutrition status. (AUC:0.763, 95%CI:0.653-0.874  $p<0.000$ , respectively) It is shown in Figure 4.2. In order to determine the malnutrition status, it was determined that NRI predicted a suitable malnutrition according to MIS. In predicting malnutrition status according to AUC values in the evaluation made by ROC analysis based on the MIS result in adult patients; The 7-Point SGA test has a strong discriminating power, while the NRI has an acceptable discriminatory power. (AUC= 0.917, AUC= 0.763,  $p<0.000$ , respectively).

| TEST RESULT<br>VARIABLES: MIS | Asymptotic 95%<br>Confidence Interval |            |                |             |             |
|-------------------------------|---------------------------------------|------------|----------------|-------------|-------------|
|                               | Area                                  | Std. Error | Asymptotic Sig | Lower Bound | Upper Bound |
| NRI                           | 0.763                                 | 0.056      | 0.000          | 0.653       | 0.874       |



Diagonal segments are produced by ties.

**Figure 4.22.** ROC analysis for NRI based on MIS in the adult group

As a result of the evaluation made with ROC analysis based on MIS results, it was seen that MNA values in the elderly group have diagnostic value in predicting malnutrition status. (AUC:0.776, %95CI:0.664-0.887  $p<0.000$ , respectively) It is shown in Table 4.23. MNA was found to be a suitable screening tool according to MIS to detect malnutrition status.

| TEST RESULT<br>VARIABLES: MIS | Asymptotic 95%<br>Confidence Interval |            |                |             |             |
|-------------------------------|---------------------------------------|------------|----------------|-------------|-------------|
|                               | Area                                  | Std. Error | Asymptotic Sig | Lower Bound | Upper Bound |
| MNA                           | 0.776                                 | 0.057      | 0.000          | 0.664       | 0.887       |

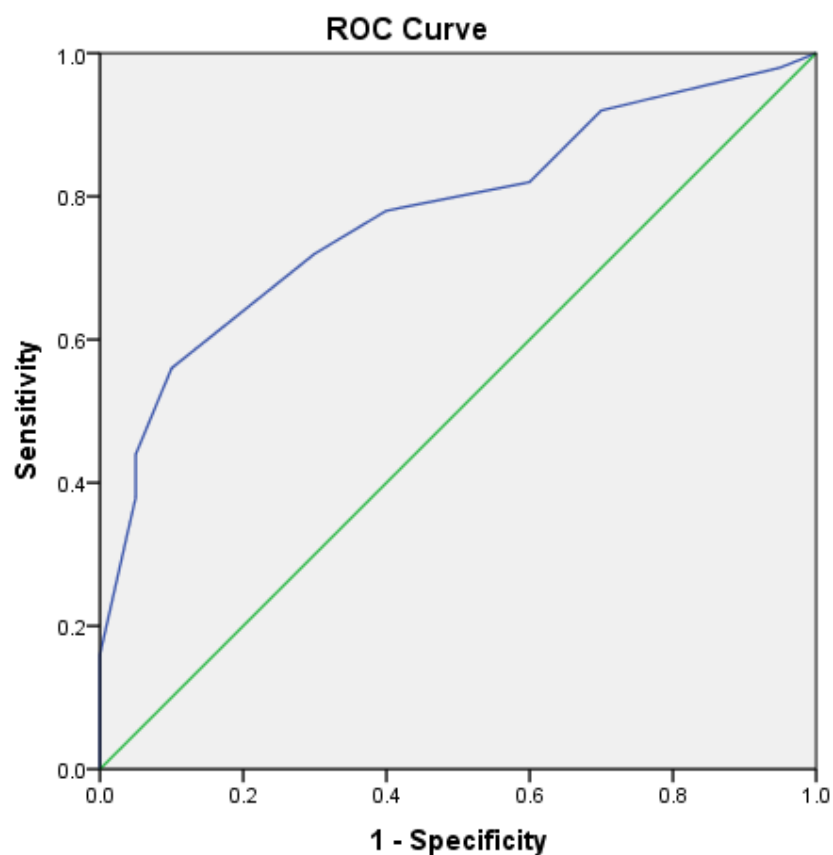


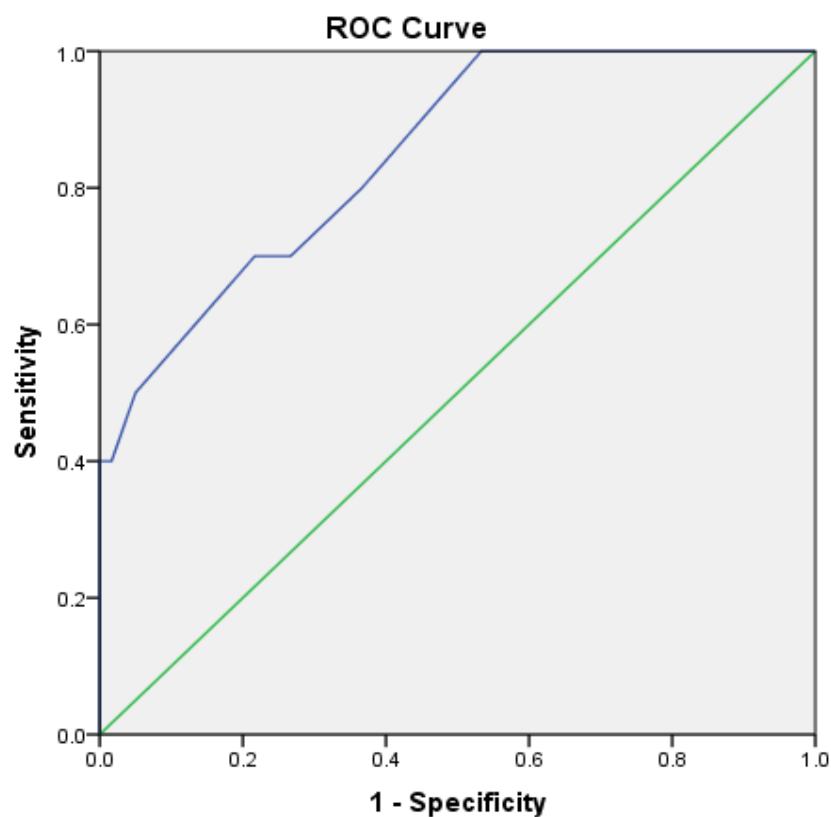
**Figure 4.23.** ROC analysis for MNA based on MIS in the elderly group

As a result of the evaluation made with ROC analysis based on MIS results, it was seen that GNRI values have diagnostic value in predicting malnutrition status. (AUC: 0.848,

95%CI: 0.726-0.970  $p<0.000$ , respectively). As shown in Figure 4.4, it has been determined that GNRI is a suitable screening tool according to MIS to detect malnutrition status. In predicting malnutrition status according to AUC values in the evaluation made by ROC analysis based on the MIS result in elderly patients; The GNRI has strong discriminatory power and the MNA has an acceptable discriminating power. (AUC= 0.848, AUC=0.776,  $p<0.000$ , respectively).

In the evaluation made by ROC analysis based on the MIS result, it was seen that 7-Point SGA had the highest accuracy in predicting malnutrition in adult patients, and GNRI in elderly patients. (AUC=0.917, AUC=0.848 respectively).

| TEST RESULT<br>VARIABLES: MIS | Asymptotic 95%<br>Confidence Interval |            |                |             |             |
|-------------------------------|---------------------------------------|------------|----------------|-------------|-------------|
|                               | Area                                  | Std. Error | Asymptotic Sig | Lower Bound | Upper Bound |
| GNRI                          | 0.848                                 | 0.062      | 0.000          | 0.726       | 0.970       |



Diagonal segments are produced by ties.

**Figure 4.24.** ROC analysis for GNRI based on MIS in the elderly group

## 5. DISCUSSION AND CONCLUSION

The study was conducted with a total of 140 patients, 70 adults and 70 elderly, receiving HD treatment. The comparison and consistency of MIS with other malnutrition screening tools and anthropometry specifically used in adult and elderly HD patients were examined.

In a study evaluating malnutrition screening tools, grouped as adult and elderly patients with 50 HD, 24% of adult patients and 18% of elderly patients were women (143). According to the Joint Report of the Turkish Society of Nephrology, 42.6% of them are women in 2019 (36). In different studies with 112 elderly HD patients and 650 HD patients, 44.6% were women (144; 145). In this study, women were more prevalent than males in both adult and elderly patient groups. It has been observed that the sex distribution may differ regardless of age.

When it is divided into adult and elderly groups, the rate of married people in both groups is quite high as in other studies and supports the studies (146; 147).

The studies reported the most common category literate+primary schools in the case of education, with generally similar results with our study (153-155). Considering the relationship between education levels and health literacy, the general result of the studies is that the education level is low. Perhaps due to low educational status, early diagnosis is delayed and the prevalence of the disease is increasing. However, even if there is education level high, health literacy may still be low, or kidney disease may be caused by genetic background.

While 88.5% of the patients in one study were not working, in another study involving elderly HD patients, 96.4% were not working (149; 156). In this study, these results were similar. A large part of the adult group, even the entire elderly group, was unemployed. In the study of Nie et al., (2020) it was observed that 35-43% of the patients who worked before starting HD treatment lost their jobs after starting the treatment (148). Compared with healthy people, HD patients show a decrease in working status. In non-working patients, it may develop loss of self-esteem, decrease in quality of life, financial difficulties, psychological and physical difficulties. The high unemployment rate in elderly patients may be due to both

age-related and treatment modalities. However, this rate is also very high in adult patients. It may mean that they may face the problem of not being able to work or find a job because HD treatment makes patients tired and they have to receive treatment 3 days a week.

In this study, the mean total time to diagnosis of kidney disease of all patients was  $9.3 \pm 8.5$  years and total duration of HD  $6.0 \pm 5.6$  years. In a study examining dialysis treatment and quality of life in adult and elderly patients, it was observed that adults thought the duration of treatment as a loss from their lives and caused a decrease in their quality of life. It has been concluded that the elderly accept this situation more than adults (149). In the study that measured the anxiety state of HD patients and observed that most of them had an anxiety state, the mean duration of HD was 36 months, and 25.07 months in another study. Contrary to our study, other studies had shorter dialysis times (150; 151). In fact, adults take on average more years of dialysis treatment than the elderly. There may be variability in the average duration of dialysis treatment according to the patient groups included in the study.

Khadka et al. (2018) the frequency of meal consumption was higher than our findings, with HD patients reporting that they consumed more than 3 meals. The rate of not having a diet suitable for the disease may have been low due to the low education level of the patients, their kidney disease and dialysis treatment for many years, and the fact that they were on a diet with constant food restriction (152).

KDOQI, BMI may not be an ideal marker for obesity, and the measurement may be misleading due to increased obesity and/or muscularity. It is stated that the use of BMI for CKD patients, which has a limited level of evidence, would be better in terms of mortality by making age-related comparisons (22). In this study, most of the participants in both adult and elderly groups were not underweight. In this study, most of the participants in both adult and elderly groups were not underweight. In Celik et al. (2011) study, body weight and BMI values of elderly patients were similar to our study in the grouping of adult and elderly HD patients (143). In this study, body weight and BMI values in adult patients are higher.

The risk of mortality increases as the MUAC value decreases (128). It has been reported that MUAC values are lower in HD patients compared to the healthy population. In the study conducted in HD patients, the mean MUAC value was found to be  $25.6 \pm 4.1$  (153). In another study, the mean was found to be  $27.5 \pm 2.9$  in women and  $29.0 \pm 4.7$  in men (154).

In our study, the findings in other studies were similar and the overall mean MUAC value of the patients was in the ideal percentile. However, a small number of patients were in the risk group for malnutrition with a MUAC value of <22 cm.

Abdominal fat, measured as waist circumference or WHR, independently of overall adiposity, is a more important predictor of CKD and cardiovascular risk in adults than BMI (125). In the study on abdominal fat accumulation, the mean value of waist circumference was found to be  $99 \pm 14$  (155). In one study, the mean WHR was  $0.95 \pm 0.08$  and half of the patients had abdominal obesity (156). While the mean WHR values in the adult and elderly groups were similar in the study that separated HD patients by age groups, the values in the elderly were statistically significantly higher in our study (143). In general, in this and other studies, the WHR ratio in HD patients was in the WHO risk category.

The distribution of fat in the body has different effects on the person. Abdominal adiposity index can be reached with conicity index. Cordeiro et.al. (2010) in the study, the mean conicity index value was  $1.42 \pm 0.12$  in HD patients, achieving similar results with our findings (155). Values of 1.38 and above were the cut-off points of the medium and high conicity index, the average conicity index values in our study are in this range.

The increase in LBM in HD patients reduces the risk of mortality. Wang et al. (2016) in the study, mean LBM values were calculated in HD patients using the same estimated LBM formula, and LBM was found to be higher than our study (128). The results of a study using a bioelectrical impedance device showed similar results to the findings in this study, and the LBM value of adult patients was significantly higher than that of elderly patients (143). In general, decrease in muscle mass can be observed with age in HD patients. However, regardless of age, the type of treatment with HD, insufficient food consumption, inactivity and absorption disorders can cause a decrease in muscle mass. The risk of malnutrition may increase with a decrease in LBM in HD patients.

Albumin, the serum protein used for malnutrition assessment, is usually low in CKD patients. Metabolic acidosis, systemic inflammation, increased energy, loss of appetite, co-morbidities and gastrointestinal losses may cause a decrease in serum albumin levels (157; 158). In one study, contrary to our study, serum albumin values were found to be statistically significant according to age (143). In a study using a different reference point for serum

albumin than our study, 60% of patients with HD were  $<4.0$  g/dl (158). In this study, the majority of both adult and elderly groups were below the specified malnutrition reference point.

Predialysis serum creatinine levels are important in assessing muscle mass (159). An increased risk of mortality was observed with serum creatinine and albumin levels  $<6$  mg/dL and  $<3.5$  g/dL, respectively (160). In one study, more than half of the patients had pre-dialysis serum creatinine levels of 7.6-12 mg/dL (161). This study showed a compatible result, even in our study, the serum levels of adult patients were much higher than the elderly group.

In Bros et al. (2009) study, TIBC values were 150- $<200$  mg/dL in the majority of patients, obtaining results similar to our findings (142). In a different study, similar to our study, TIBC values in adult and elderly patient groups were not statistically significant (162).

The worldwide prevalence of malnutrition was calculated in a comprehensive systematic review and meta-analysis study. This rate is 42.7% (163). It has been observed in studies that the mortality rate increased with the increase in MIS (164; 165). In a study that considered the MIS cut-off value  $\geq 8$  to be risky for malnutrition, malnutrition occurred in 49.7% of the elderly patients (aged over 60 years in the study) (166). In a study conducted with 204 HD patients comparing different nutritional screening tools, 70% were found to be malnourished according to MIS (167). Malnutrition was found in 85.7% of the study conducted with adult patients with an accepted MIS cut-off value of 7 (107). Avesani et al. (2021) reported that the mean MIS value was  $7.9 \pm 3.3$  in HD patients, obtaining results similar to our findings (168). In this study, although elderly patients were found to be at higher risk of malnutrition for MIS than adult patients, the rate in adult patients was considerably higher. In a different study separating adult and elderly patients, the MIS score was found to be significantly higher in elderly patients (162). Although higher malnutrition is expected in elderly patients due to the risk of sarcopenia, inactivity, dental problems and loneliness, etc., the risk of malnutrition in adult patients is as high as in the elderly. The different cut-off values of MIS present differences in the proportions of patients at risk of malnutrition. However, in any case, it is very risky in terms of malnutrition in HD patients compared to MIS.

Ekenci et al. (2020) reported that age and education status were not significant with MIS in HD patients, obtaining a result similar to our findings in getting used to (169). In addition, although it is thought that the risk may decrease as the education level increases, the reason why it was not associated with malnutrition in this study may be due to the presence of many independent factors leading to the risk of malnutrition. Although MIS was a strong predictor of malnutrition, no significant association was found between MIS and nutritional status in all patients in our study. Malnutrition rates are more than half in patients, even if the majority of the participants think that they are adequately nutrition.

Omari et al. (2019) reported that the majority of HD patients had an additional chronic disease, obtaining results similar to our findings in their study (170). Karavetian et al. (2019) reported that HT is the most common comorbidity in HD patients, followed by DM and CVD, with a similar result to our findings (171). However, no statistically significant results were found between MIS and various comorbidities in the adult patient group. In the elderly group, statistical significance was found only between MIS and CVD.

Studies have shown that there is a negative significant relationship between MIS and BMI values, showing generally similar results with our study. However, this was not valid for the elderly patient group in our study (114; 176; 179). The presence of many factors affecting BMI in the elderly patient group, regardless of malnutrition status, may have led to this result. A negative statistically significant result was found between MIS and MUAC and LBM in a large-scale cohort study (172). However, in this study, a negative significant relationship was found between MIS and LBM in adult HD patients. According to Gencer et al. (2018) reported that there is a significant negative correlation between MIS value and MUAC in adult HD patients, by obtaining the opposite result of our findings (173).

Different studies have obtained similar results with our study, and it has been reported that there is a statistically significant relationship between MIS and serum albumin in HD patients. (169; 172; 174). Rambod et al. (2009) reported that there is a statistically significant relationship between MIS and serum creatinine levels in HD patients, obtaining the opposite result of our findings (172).

Koor et.al. (2015) in their study, only 7.4% of HD patients reported that they were well-nourished compared to original SGA, obtaining the opposite result of our findings (23).

In another study, 47% of adult HD patients were well-nourished, and all the remaining patients were moderately malnourished (175). Ramayana et.al. (2018) reported that there are individuals with malnutrition to 7-point SGA in HD patients whose age range is 21-66, obtaining a result opposite to our findings (176). In a study conducted with 1601 dialysis patients, it was reported that 72% were well nourished, while 5% had severe malnutrition (177). Yılmaz et.al. (2020) reported that 26.7% of them were moderately malnourished according to the 7-point SGA, obtaining similar results with our findings (178).

In a study, it was found that MIS and SGA were significant, and negative significant correlations with MIS and SGA scores (179). This study supports other research. In a large-scale study, a high diagnostic value for MIS was found in SGA-based ROC analysis (AUC=0.994). In this study, ROC analysis was performed according to MIS results. In this study, it was found to have a high diagnostic value with AUC=0.917 for 7-point SGA, with results similar to the study mentioned (180).

Aydin et al. (2015) reported that HD patients had no malnutrition according to NRI, by obtaining a different result from our findings in their study (154). A statistically significant difference was found between MIS and NRI in this study. However, in the ROC analysis, it was seen that SGA and NRI had diagnostic power, but SGA was quite high. There are not many studies using the NRI in HD patients. In this study, it is emphasized that NRI is an index that can be used practically in adult HD patients.

Few studies have used MNA in elderly HD patients (181). In a large-scale study, 42.6% of HD patients, regardless of age, were found to be at risk of malnutrition relative to MNA (167). Arshad et al. (2020) reported that a lower mean MNA value than our findings in their study (21). Holvoet et al. (2020) in the study, 5.6% of HD patients were malnuourished according to MNA, obtaining results close to our findings (182). In this study, in the portion where the risk of malnutrition was determined for MIS, an average of 3 out of 4 patients for MNA were at risk for malnutrition. In the study conducted in patients receiving PD, a significant relationship was found between MNA and MIS (181).

There are studies showing that many risks are triggered by the decrease of GNRI in patients with HD. For example, there is an increased risk of cardiovascular, stroke, and disease-related mortality (183). For GNRI, it was found to be a predictor of mortality and a

good assessment of nutrition (184). For elderly patients, 6.9% of patients were at risk in the study, which adopted the GNRI baseline as  $\leq 91.2$  (166). Tsai et al. (2014) reported that there was a statistically significant 20% patient group in the area with  $MIS \geq 6$  and  $GNRI \leq 92$  in 150 HD patients over 60 years of age, which is similar to our study but higher (185).

Another study reported a high accuracy of GNRI based on MIS, with results similar to our findings (186). Yamada et al. (2013) reported that GNRI has the largest area for the lower part of the curve relative to MNA, obtaining the similar result in our findings (187).

In this study, a significant correlation was found for 7-point SGA and NRI for adults and for MNA for the elderly, but not for GNRI. In the MIS-based ROC analysis, the 7-Point SGA in adults and GNRI in the elderly had the highest consistency in predicting malnutrition. Although different screening tools can be used in dialysis patients, the use of MIS may be a priority as it is both practical and more susceptible to malnutrition. However, there is still no standard cut-off point for MIS. Since dialysis patients have difficulties in providing anthropometric measurement conditions after disease-specific treatment, anthropometry measurements of patients can be facilitated by developing different formulas. Further work with other different malnutrition screening tools and anthropometry by age grouping would be beneficial to measure the effectiveness of the scales.

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## 7. APPENDICES

### 7.1. Appendix-1 Ethical Approval



**Sayı :** 37068608-6100-15- 2111  
**Konu:** Klinik Araştırmalar  
Etik Kurul Başvurusu hk.

04/03/2021

İlgili Makama (Yeşim Nemutlu)

Yeditepe Üniversitesi Tıp Fakültesi Beslenme ve Diyetetik Bölümü Dr. Öğr. Üyesi İrem Kaya Cebioglu'nun sorumlu araştırmacı olduğu **“Malnütrisyon İnflamasyon Skorunun Yetişkin ve Yaşlı Hemodiyaliz Hastalarında Spesifik Olarak Kullanılan Malnütrisyon Tarama Araçları ve Antropometri İle Karşılaştırılması ve Tutarlılığı”** isimli araştırma projesine ait Klinik Araştırmalar Etik Kurulu (KAEK) Başvuru Dosyası (2081) kayıtlı Numaralı KAEK Başvuru Dosyası, Yeditepe Üniversitesi Klinik Araştırmalar Etik Kurulu tarafından 03.03.2021 tarihli toplantıda incelenmiştir.

Kurul tarafından yapılan inceleme sonucu, yukarıdaki isim belirtilen çalışmanın yapılmasının etik ve bilimsel açıdan uygun olduğuna karar verilmiştir (**KAEK Karar No: 1397**)

Prof. Dr. Turgay Çelik

Yeditepe Üniversitesi  
Klinik Araştırmalar Etik Kurul Başkanı

## 7.2. Appendix-2 Consent Form

### Bilgilendirilmiş Onam Formu

Sayın katılımcı,

Katılımınızı talep ettiğimiz bu araştırma İstanbul Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Beslenme ve Diyetetik bölümü yüksek lisans öğrencisi Diyetisyen Yeşim Nemutlu tarafından yürütülen bir araştırmadır.

Hemodiyaliz tedavisi alan hastalarda malnütrisyon tarama araçları ve antropometrik ölçümleri karşılaştırmak ve tutarlılığı incelemek amacıyla bir çalışma yürütmekteyiz. Bu çalışmayı yapmak istememizin nedeni; hemodiyaliz hastalarında malnütrisyon gelişme riski son derece yüksektir ve bu riskin erken tanımlanmasında tarama araçlarının kullanımı çok önemlidir.

Araştırmada kesinlikle yaşadıklarınız (özeliniz) sorulmayacaktır. Araştırma sırasında, size ait genel demografik özellikler, sağlık bilgileri, antropometrik ölçümler ve malnütrisyon tarama araçları için bilgiler alınacaktır.

Araştırmada alınacak tüm bilgiler araştırma kapsamı dışında hiçbir kişiyle kesinlikle paylaşılmayacaktır. Elde edilecek olan bilgiler, Etik Kurul, kurum ve diğer sağlık otoritelerinin orijinal tıbbi kayıtlarına doğrudan erişimleri olacaktır. Fakat bu gönüllü onam formunun imzalanmasıyla bu bilgiler gizli tutulacaktır.

Bu çalışmaya katılmayı reddedebilirsiniz. Çalışmanın herhangi aşamasında da katılım onayınızdan vazgeçebilirsiniz.

Araştırmaya katılımınız için sizden herhangi bir ücret istenmeyecek ve katılımınız karşılığında size herhangi bir ücret ödenmeyecektir. Sizden beklenen, bilgilendirilmiş onam formunu imzalayıp, bu araştırmaya katkı sağlamayı kabul ettikten sonra, talep edilecek olan veri formunun doldurulmasıdır.

Elde edilen veriler “Malnütrisyon İnflamasyon Skorunun Yetişkin Ve Yaşlı Hemodiyaliz Hastalarında Spesifik Olarak Kullanılan Malnütrisyon Tarama Araçları Ve Antropometri İle Karşılaştırılması Ve Tutarlılığı” araştırması için kullanılacaktır.

Sorumlu Araştırmacı: Dr. Öğr. Üyesi İrem KAYA CEBİOĞLU  
Yeditepe Üniversitesi Beslenme ve Diyetetik Bölümü Öğretim Üyesi

Araştırmacı: Dyt. Yeşim NEMUTLU  
Yeditepe Üniversitesi Beslenme ve Diyetetik Bölümü Yüksek Lisans Öğrencisi

Bilgilendirilmiş Gönüllü Olur Formundaki tüm açıklamaları okudum. Bana, yukarıda konusu ve amacı belirtilen araştırma ile ilgili açıklamalar, yukarıda adı belirtilen diyetisyen tarafından yapıldı. Araştırmaya gönüllü olarak katıldığımı, istediğim zaman gerekçeli veya gerekçesiz olarak araştırmadan ayrılabileceğimi biliyorum. Söz konusu araştırmaya, hiçbir baskı ve zorlama olmaksızın kendi rızamla katılmayı kabul ediyorum.

Ad, Soyadı:

Tarih:

İmza:

### 7.3. Appendix-3 Data Collection Form

#### Veri Toplama Formu

Malnütrisyon İnflamasyon Skorunun Yetişkin Ve Yaşlı Hemodiyaliz Hastalarında Spesifik Olarak Kullanılan Malnütrisyon Tarama Araçları Ve Antropometri İle Karşılaştırılması Ve Tutarlılığı

|                                                                                                            |               |
|------------------------------------------------------------------------------------------------------------|---------------|
| <b>Hastanın Adı Soyadı:</b>                                                                                | <b>Tarih:</b> |
| <b>İletişim:</b>                                                                                           |               |
| <b>Adres:</b>                                                                                              |               |
| <b>İmza:</b>                                                                                               |               |
| <b>GENEL DEMOGRAFİK, SAĞLIK VE BESLENME BİLGİLERİ [ ( ) alanlarını işaretleyiniz.]</b>                     |               |
| <b>1-Doğum Tarihiniz:</b> .../.../... (gün/ay/yıl)                                                         |               |
| <b>2- Cinsiyetiniz :</b> ( ) Kadın ( ) Erkek                                                               |               |
| <b>3- Medeni Haliniz:</b> ( ) Evli ( ) Bekar                                                               |               |
| <b>4- Eğitim Durumunuz:</b> ( ) Okuryazar değil ( ) Okuryazar / İlkokul ( ) Ortaokul / Lise ( ) Üniversite |               |
| <b>5- Çalışma Durumunuz:</b> ( ) Çalışıyor ( ) Çalışmıyor                                                  |               |
| <b>6- Sosyal Güvenceniz:</b> ( ) Sosyal Güvence Var ( ) Sosyal Güvence yok                                 |               |
| <b>7-Kronik böbrek yetmezliği tanısı ne zaman kondu:</b> ..... (örneğin 5 ay veya 1 yıl önce)              |               |
| <b>8-İlk diyaliz almaya ne zaman başlandı:</b> ..... (örneğin 5 ay veya 1 yıl önce)                        |               |
| <b>9-Haftanın kaç günü, kaç saat hemodiyaliz alınıyor:</b> ..... (gün) .... (saat)                         |               |
| <b>10-Tanısı konmuş başka hastalığınız var mı?</b> ( ) Evet ( ) Hayır                                      |               |
| <b>11- Tanısı konulan hastalıklarınızı işaretleyiniz.</b>                                                  |               |
| ( ) Diyabet ( ) Hipertansiyon ( ) Kalp ve Damar Hastalıkları ( ) Gastrointestinal Hastalıklar              |               |
| ( ) Solunum Hastalıkları ( ) İskelet sistemi hastalıkları ( ) Mental Hastalıklar ( ) Endokrin Hastalıklar  |               |
| ( ) Vitamin ve Mineral Eksikliği                                                                           |               |
| <b>11- Gün içerisinde gerekli besinleri alıyor musunuz?</b> ( ) Evet ( ) Hayır                             |               |
| <b>12- Günde kaç ana öğün yaparsınız?</b> .....                                                            |               |
| <b>13- Günde kaç ara öğün yaparsınız?</b> .....                                                            |               |
| <b>14- Gün içerisinde öğün atladığınız olur mu?</b> ( ) Evet ( ) Hayır                                     |               |
| <b>15-Gün içerisinde kaç su bardağı su tüketirsiniz?</b> ..... litre                                       |               |
| <b>16-Gün içerisinde kaç kupa çay/kahve/asitli içecek tüketirsiniz?</b> ..... kupa                         |               |
| <b>17-Hastalığınıza özgü diyet yapar mısınız?</b> ( ) Evet ( ) Hayır                                       |               |
| <b>18-Diyetinizin içeriği hakkında bilgi verebilir misiniz?</b>                                            |               |
| ( ) Böbrek ile uyumlu besleniyorum ( ) Kilo vermeye çalışıyorum ( ) Tuzsuz besleniyorum                    |               |
| <b>19-Diyeti ne zamandır yapıyorsunuz?</b> ..... (ay) veya .....(yıl)                                      |               |
| <b><u>Vücut Ölçümlerinizi alınarak, doldurulacaktır. Sizlerin doldurmasına gerek yoktur.</u></b>           |               |
| <b>20-Boy:</b> ..... (cm)                                                                                  |               |
| <b>21-Kilo:</b> ..... (kg)                                                                                 |               |
| <b>22-Bel Çevresi:</b> ..... (cm)                                                                          |               |
| <b>23-Kalça Çevresi:</b> ..... (cm)                                                                        |               |

**24-Bel/Kalça: ....**

**25-Üst Orta Kol Çevresi ..... (cm)**

**26-Konisite İndeksi:**  $x = \frac{\text{Bel Çevresi (m)}}{0.109 \times \sqrt{\text{Ağırlık (kg)} - \text{boy (m)}}}$

**27- Yağsız Vücut Kütlesi (kg) = 0.34\*Serum Kreatinin (mg/dl) + 5.58\*cinsiyet (kadın ise 1; erkek ise 0) + 0.30\*ağırlık (kg) + 0.67\*boy (inch)-0.23\*URR (URR, urea reduction ratio)-5.75**

**Biyokimyasal veriler geçmiş kayıtlarınızdan alınarak, doldurulacaktır. Sizlerin doldurmasına gerek yoktur.**

**28-Serum Albumin: ..... (g/dL)**

**29-Serum Kreatin- Diyaliz Öncesi: ..... (mg/dL)**

**30-Serum Kreatin- Diyaliz Sonrası: ..... (mg/dL)**

**31- URR: ..... (mg/dL)**

**32- TDBK: ..... (mg/dL)**

**33- Geriatrik Nutrisyonel Risk İndeksi:** [GNRI= 14.89 × serum albümin (g/dL) + 41.7 × Beden Kütle İndeksi/22]

**34- Nutrisyonel Risk İndeksi:** [1.519×serum albümin g/dL)+(41.7×vücut ağırlığı (kg)/ideal vücut ağırlığı (kg)]

## 7.4. Appendix-4 Malnutrition Screening Tools

### MALNÜTRİSYON İNFLAMASYON SKORU

| <b>H. MALNÜTRİSYON İNFLAMASYON SKORU (MİS)</b>                                                                        |                                                                           |                                                                            |                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| <b>(A):</b>                                                                                                           |                                                                           |                                                                            |                                                                                 |
| <b>1-Kuru ağırlıkta değişiklik (son 3-6 ay):</b>                                                                      |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Değişiklik yok ya da <0.5 kg değişiklik                                                                               | Hafif ağırlık kaybı (0.5 kg ile <1 kg)                                    | Ağırlık kaybı >1 kg, fakat toplam kilonun <%5                              | Ağırlık kaybı toplam kilonun >%5                                                |
| <b>2- Beslenme durumu:</b>                                                                                            |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| İyi iştah ve oral alımda bozulma yok                                                                                  | Hafif derecede bozulmuş katı diyet alımı                                  | İştahta orta derecede azalmadan sıvı diyet kadar                           | Hipokalorik sıvı diyetten açlığa kadar                                          |
| <b>3- Gastrointestinal semptomlar (GI):</b>                                                                           |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Şikayet yok, iştah iyi                                                                                                | Orta derecede semptomlar, azalmış iştah ve sıklıkla bulantı               | Nadiren kusma veya orta derecede GİS semptomlar                            | Sıklıkla ishal veya kusma veya anoreksi                                         |
| <b>4- Fonksiyonel kapasite (beslenme ile ilişkili fonksiyonel bozulma):</b>                                           |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Normal veya iyileşmiş fonksiyonel kapasite, iyi hissetme hali                                                         | Hareketlilikte nadiren azalma veya yorgun hissetme hali                   | Günlük aktivitelerini yerine getirmede güçlük ( yıkanma gibi)              | Yatak/tekerlekli sandalye bağımlı veya fiziksel aktivitesi çok az ya da hiç yok |
| <b>5- Yıl olarak diyalizde geçen süreyi de içeren komorbidite:</b>                                                    |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Diyaliz süresi bir yıldan az ve bunun dışında sağlıklı                                                                | Diyaliz süresi 1-4 yıl arası veya hafif derecede komorbidite (MKH* hariç) | Diyaliz süresi >4 yıl veya orta derecede komorbiditesi var (bir tane MKH*) | Şiddetli, multipl komorbidite (iki veya daha fazla MKH*)                        |
| <b>(B) Fizik muayene ( Subjektif global değerlendirme kriterlerine göre):</b>                                         |                                                                           |                                                                            |                                                                                 |
| <b>6- Vücut yağ depolarında azalma veya subkutan yağ dokusunda azalma (göğütları, triseps, biseps, göğüs kafesi):</b> |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Normal (değişiklik yok)                                                                                               | Hafif                                                                     | Orta                                                                       | Ciddi                                                                           |
| <b>7- Kas kaybı bulguları (Şakak, klavikula, skapula, interkostal, kuadriseps, diz, interosseöz):</b>                 |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Normal (değişiklik yok)                                                                                               | Hafif                                                                     | Orta                                                                       | Ciddi                                                                           |
| <b>(C) Beden Kütle İndeksi:</b>                                                                                       |                                                                           |                                                                            |                                                                                 |
| <b>8- Beden Kütle İndeksi (BKİ): BKİ = Kilo(kg) / Boy2(m)</b>                                                         |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| BKİ>20 kg/m2                                                                                                          | BKİ: 18-19.99 kg/m2                                                       | BKİ: 16-17.99 kg/m2                                                        | BKİ<16 kg/m2                                                                    |
| <b>(D) Laboratuvar parametreleri:</b>                                                                                 |                                                                           |                                                                            |                                                                                 |
| <b>9- Serum albümin:</b>                                                                                              |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| Albümin> 4.0 g/dL                                                                                                     | Albümin: 3.5-3.9 g/dL                                                     | Albümin: 3.0-3.4 g/dL                                                      | Albümin: <3.0 g/dL                                                              |
| <b>10- Serum TDBK (Total Demir Bağlama Kapasitesi):</b>                                                               |                                                                           |                                                                            |                                                                                 |
| <b>0</b>                                                                                                              | <b>1</b>                                                                  | <b>2</b>                                                                   | <b>3</b>                                                                        |
| TDBK> 250 mg/dL                                                                                                       | TDBK: 200-249 mg/dL                                                       | TDBK: 150-199 mg/dL                                                        | TDBK: <150 mg/dL                                                                |
| <b>Toplam skor yukarıdaki 10 değerin toplamı (0-30):</b>                                                              |                                                                           |                                                                            |                                                                                 |

## 7- PUANLAMALI SUBJEKTİF GLOBAL DEĞERLENDİRME

### SUBJEKTİF GLOBAL DEĞERLENDİRME –7P (SGD-7P)

Son altı aydaki ağırlık kaybı.....kg

| Sınıflandırma | Ağırlık kaybı |
|---------------|---------------|
| 7             | %0            |
| 6             | <%3           |
| 5             | 3-<%5         |
| 4             | 5-<%7         |
| 3             | 7-<%10        |
| 2             | 10-<%15       |
| 1             | ≥%15          |

Eğer son bir ay içerisinde ağırlık artışı eğilimi varsa 1 puan ekle, eğer ağırlık azalış eğilimi varsa 1 puan azalt

#### Diyet alımı (son 2 hafta)

- 7) İyi (tamamı)  
6) İyi ( >3/4 - <1 kadarı)  
5) Sınırdan (1/2-3/4 kadarı) fakat artış var  
4) Sınırdan (1/2-3/4 kadarı) değişiklik yok veya azalış var  
3) Yetersiz (<1/2 kadarı) fakat artış var  
2) Yetersiz (<1/2 kadarı) değişiklik yok veya azalış var  
1) Açlık (<1/4)

#### Gastrointestinal semptomlar (2 haftadan uzun süren)

- Bulantı:.....Kusma:.....İshal:.....  
7) Semptom yok  
6) Çok nadir aralıklı semptomlar (günde 1 kez)  
5) Bazı semptom (günde 2-3 kez)-düzelme var  
4) Bazı semptom (günde 2-3 kez)-değişiklik yok  
3) Bazı semptom (günde 2-3 kez)-kötüye gidiyor  
1-2) Bazı ya da tüm semptomlar (günde 3'den fazla)

#### Fonksiyonel durum (beslenme ile ilişkili)

- 6-7) Tam fonksiyonel kapasite  
3-5) Hafif-orta derecede güç kaybı  
1-2) Ciddi fonksiyonel kayıp (yatalak)

#### Beslenme gereksinimleri etkileyen hastalık durumu

- 6-7) Metabolik gereksinimde artış yok (stres yok ya da az)  
3-5) Metabolik gereksinimde hafif-orta derecede artış (orta düzeyde stres)  
1-2) Metabolik gereksinimde şiddetli artış (yüksek stres)

#### Kas kaybı

- (en az 3 bölgede)  
6-7) Tüm bölgelerde azalma yok  
3-5) Hafif-orta düzeyde azalma  
1-2) Ciddi azalma

#### Yag deposu

- 6-7) Tüm bölgelerde azalma yok  
3-5) Hafif-orta düzeyde azalma  
1-2) Ciddi azalma

#### Ödem

- 6-7) Ödem yok  
3-5) Hafif-orta düzeyde ödem  
1-2) Ciddi ödem

Sınıflandırma  
(her kategori için bir sınıflandırma işaretleyin)

|   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Beslenme durumu                               | İyi beslenmiş |   | / | Hafif – orta düzeyde malnütrisyon |   |   | / | Ağır malnütrisyon |
|-----------------------------------------------|---------------|---|---|-----------------------------------|---|---|---|-------------------|
| SGA sınıflandırması<br>(Bir tane işaretleyin) | 7             | 6 |   | 5                                 | 4 | 3 |   | 2<br>1            |

## MINİ NÜTRİSYONEL DEĞERLENDİRME

|           |      |              |          |        |
|-----------|------|--------------|----------|--------|
| Soyad:    | Ad:  |              |          |        |
| Cinsiyet: | Yaş: | Ağırlık, kg: | Boy, cm: | Tarih: |

Aşağıdaki soruları kutulara uygun rakamları yazarak yanıtlayın. Yazdığınız rakamları toplayın. Eğer Tarama puanı 11 veya altında ise Malnutrisyon Gösterge Puanı'nı elde etmek için değerlendirmeye devam edin.

|                                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Tamara</b><br><b>A</b> Son üç ayda iştahsızlığa, sindirim sorunlarına, çiğneme veya yutma zorluklarına bağlı olarak besin alımında bir azalma oldu mu?<br>0 = besin alımında şiddetli düşüş<br>1 = besin alımında orta derece düşüş<br>2 = besin alımında düşüş yok <input type="checkbox"/> |  | <b>J</b> Hasta günde kaç öğün tam yemek yiyor?<br>0 = 1 öğün<br>1 = 2 öğün<br>2 = 3 öğün <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| <b>B</b> Son üç ay içindeki kilo kaybı durumu<br>0 = 3 kg'dan fazla kilo kaybı<br>1 = Bilinmiyor<br>2 = 1-3 kg arasında kilo kaybı<br>3 = Kilo kaybı yok <input type="checkbox"/>                                                                                                               |  | <b>K</b> Protein alımı için seçilen besinler<br>• Günde en az bir porsiyon süt ürünü (süt, peynir, yoğurt) tüketiyor Evet <input type="checkbox"/> Hayır <input type="checkbox"/><br>• Haftada iki veya daha fazla porsiyon kuru baklagil veya yumurta tüketiyor Evet <input type="checkbox"/> Hayır <input type="checkbox"/><br>• Her gün et, balık veya beyaz et tüketiyor Evet <input type="checkbox"/> Hayır <input type="checkbox"/><br>0.0 = Eğer evet sayısı 0 veya 1 ise<br>0.5 = Eğer evet sayısı 2 ise<br>1.0 = Eğer evet sayısı 3 ise <input type="checkbox"/> <input type="checkbox"/> |  |
| <b>C</b> Hareketlilik<br>0 = Yatak veya sandalyeye bağımlı<br>1 = Yataktan, sandalyeden kalkabiliyor ama evden dışarıya çıkamıyor<br>2 = Evden dışarı çıkabiliyor <input type="checkbox"/>                                                                                                      |  | <b>L</b> Her gün iki veya daha fazla porsiyon meyve veya sebze tüketiyor<br>0 = Hayır 1 = Evet <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| <b>D</b> Son üç ayda psikolojik stres veya akut hastalık şikayeti oldu mu?<br>0 = Evet 2 = Hayır <input type="checkbox"/>                                                                                                                                                                       |  | <b>M</b> Her gün kaç bardak sıvı (su, meyve suyu, kahve, çay, süt, vb.) tüketiyor?<br>0.0 = 3 bardaktan az<br>0.5 = 3-5 bardak<br>1.0 = 5 bardaktan fazla <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                        |  |
| <b>E</b> Nöropsikolojik problemler<br>0 = Ciddi bunama veya depresyon<br>1 = Hafif düzeyde bunama<br>2 = Hiçbir psikolojik problem yok <input type="checkbox"/>                                                                                                                                 |  | <b>N</b> Yemek yeme şekli nasıl?<br>0 = Yardımsız yemek yemiyor<br>1 = Güçle kendi kendine yemek yiyebiliyor ama zorlanıyor<br>2 = Sorunsuz bir biçimde kendi kendine yiyor <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                               |  |
| <b>F</b> Vücut Kitle İndeksi (VKİ) = (Vücut ağırlığı-kg) / (Boy'un metre) <sup>2</sup><br>0 = VKİ 19'dan az (19 dahil değil)<br>1 = VKİ 19'la 21 arası (21 dahil değil)<br>2 = VKİ 21'le 23 arası (23 dahil değil)<br>3 = VKİ 23 ve üzeri <input type="checkbox"/>                              |  | <b>O</b> Beslenme durumu ile ilgili düşüncesi<br>0 = Kötü beslendiğini düşünüyor<br>1 = Kararsız<br>2 = Kendisini hiçbir beslenme sorunu olmayan bir kişi olarak görüyor <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                  |  |
| Tarama puanı (tamamı en çok 14 puan) <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                          |  | <b>P</b> Aynı yaşta ki kişilerle karşılaştırıldığında, sağlık durumunu nasıl değerlendiriyor?<br>0.0 = İyi değil<br>0.5 = Bilmiyor<br>1.0 = İyi<br>2.0 = Çok iyi <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                 |  |
| 12-14 puan: Normal nütrisyonel durum<br>8-11 puan: Malnutrisyon riski altında<br>0-7 puan: Malnutrisyonlu                                                                                                                                                                                       |  | <b>Q</b> Kol çevresi (cm)<br>0.0 = 21'den az<br>0.5 = 21-22<br>1.0 = 22 veya daha fazla <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| Daha kapsamlı bir değerlendirme için G-R sorularını cevaplayınız                                                                                                                                                                                                                                |  | <b>R</b> Baldır çevresi (cm)<br>0 = 31'den az<br>1 = 31 veya daha fazla <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| <b>Değerlendirme</b><br><b>G</b> Bağımsız yaşıyor (bakımevinde veya hastanede değil)<br>1 = Evet 0 = Hayır <input type="checkbox"/>                                                                                                                                                             |  | Değerlendirme (en fazla 16 puan) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| <b>H</b> Günde 3 adetten fazla reçeteli ilaç alma<br>0 = Evet 1 = Hayır <input type="checkbox"/>                                                                                                                                                                                                |  | Tarama puanı <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| <b>I</b> Bası yarası veya deri ülseri var<br>0 = Evet 1 = Hayır <input type="checkbox"/>                                                                                                                                                                                                        |  | Toplam değerlendirme (en fazla 30 puan) <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |