WHAT ARE THE FACTORS AFFECTING THE FRAILTY OF ELDERLY PEOPLE WITH TYPE 2 DIABETES?

TİP 2 DİYABETLİ YAŞLI BİREYLERDE KIRILGANLIĞI ETKİLEYEN FAKTÖRLER NELERDİR?

Cemile İDİZ[1], Özlem YILMAZ[2], Nurdan GÜL[1], Sakin TEKİN[3], Ramazan ÇAKMAK[1], Meryem Merve ÖREN[4], Sena GÜRKAŞ[2], Mehmet Akif KARAN[2], Gülistan BAHAT[2], İlhan SATMAN[1,5]

[1]Istanbul University, Istanbul Faculty of Medicine, Department of Internal Medicine Division of Endocrinology and Metabolism, Istanbul, Turkey

[2]Istanbul University, Istanbul Faculty of Medicine, Department of Internal Medicine, Division of Geriatrics, Istanbul, Turkey

[3]Zonguldak Bulent Ecevit University, Faculty of Medicine, Department of Internal Medicine, Division of Endocrinology and Metabolism, Zonguldak, Turkey

[4]Istanbul University, Istanbul Faculty of Medicine, Department of Public Health, Istanbul, Turkey

[5]Health Institutes of Turkey, Istanbul, Turkey

ORCID IDs of the authors: C.İ. 0000-0001-6635-5996; Ö.Y. 0000-0001-9868-2828; N.G. 0000-0002-1187-944X; S.T. 0000-0002-1408-1249; R.Ç. 0000-0003-3815-7444; M.M.Ö. 0000-0002-3383-7830; S.G. 0000-0003-2387-0167; M.A.K. 0000-0002-9080-404X; G.B. 0000-0001-5343-9795; İ.S. 0000-0001-8613-1797

ABSTRACT

Objective: Our study aimed to determine the factors related to frailty in elderly adults having been diagnosed with type 2 diabetes mellitus.

Material and Method: A total of 108 people aged 65 and over, diagnosed with type 2 diabetes, were included in the study. The frailty of the participants was evaluated with the FRAIL questionnaire, their nutritional status was evaluated with the Mini Nutrition Assessment Short Form (MNA-SF), the depression status with the Patient Health Questionnaire-2 (PHQ2) and the Geriatric Depression Scale Short Form (GDS-SF), while the quality of life was evaluated with the EuroQol-5 Dimension (EQ5D) and Scoring the EQ-VAS, and personal care status were evaluated with Basic Activities of Daily Living (BADL) and Instrumental Activities of Daily Living (IADL) forms.

Results: Sleep problems, fear of falling, presence of urinary incontinence, PHQ2, GDS-SF, and EQ5D scores were significantly higher; the MNASF score was significantly lower in the frail group than the values in the non-frail group (p<0.05, for all).

Conclusion: The relationship between frailty and malnutrition, decreased quality of life, and increased depression in elderly diabetic patients was demonstrated in the present study. As all these factors have a place in the management of diabetes,

ÖZET

Amaç: Çalışmamızın amacı tip 2 diyabet tanısı almış yaşlı erişkinlerde kırılganlıkla ilgili faktörleri belirlemektir.

Gereç ve Yöntem: Çalışmaya 65 yaş ve üstü, tip 2 diyabet tanısı almış 108 kişi dahil edildi. Katılımcıların kırılganlığı FRAIL anketi ile değerlendirilmiş, beslenme durumu Mini Beslenme Değerlendirme Kısa Formu (MNA-SF) ile, depresyon durumu Hasta Sağlığı Anketi-2 (PHQ2) ve Geriatrik Depresyon Ölçeği Kısa Formu (GDS-SF) ile değerlendirilirken, yaşam kalitesi EuroQol-5 Boyut (EQ5D) ve EQ VAS puanlaması ile, kişisel bakım durumları ise Günlük Yaşamın Temel Aktiviteleri (BADL) ve Günlük Yaşamın Enstrümantal Aktiviteleri (IADL) formları ile değerlendirilmiştir.

Bulgular: Kırılgan grupta, kırılgan olmayanlara göre uyku sorunları, düşme korkusu, idrar kaçırma, PHQ2, GDS-SF ve EQ5D skorları anlamlı olarak yüksek; MNASF skoru ise anlamlı olarak düşüktü (p<0,05, tüm kıyaslamalar için).

Sonuç: Bu çalışmada yaşlı diyabetik hastalarda kırılganlık ile malnütrisyon, azalan yaşam kalitesi ve artmış depresyon arasındaki ilişki gösterilmiştir. Tüm bu faktörlerin diyabet yönetiminde bir yeri olduğu için farkındalık artırılmalı ve yaşlı diyabetlilerde kırılganlık taraması genişletilmelidir.

awareness should be raised and frailty screening should be expanded in elderly diabetics.

Keywords: Frailty, elderly, diabetes, malnutrition, depression, quality of life

Anahtar Kelimeler: Kırılganlık, yaşlılık, diyabet, malnütrisyon, depresyon, yaşam kalitesi

INTRODUCTION

Health problems occur more frequently in advanced age, and the size of the elderly population has recently been increasing in Turkey as is the case worldwide (1). The world population is expected to quadruple in the 100 years between 1950 and 2050, and the elderly population is expected to increase 10 fold (1, 2). In Turkey, the number of elderly people exceeded 6.8 million in 2017 (3). Moreover, the prevalence of diabetes mellitus is increasing due to lifestyle changes in developed, and developing countries (4). The global number of patients diagnosed with type 2 diabetes was 135 million in 1995, and the number is expected to increase to approximately 438 million by 2025 (5, 6). Type 2 diabetes is the most common type of diabetes (7) and has a higher prevalence in older people (8). Similar to the prevalence in other countries, the prevalence of type 2 diabetes is increasing tremendously in Turkey (6, 9).

The data obtained from the Turkish Epidemiology Survey of Diabetes, Hypertension, Obesity, and Endocrine Diseases (TURDEP-I) (performed in 1997–98) showed that the prevalence of type 2 diabetes in adults aged 20 years and older was 7.2%. In the TURDEP-II study conducted in 2010, the prevalence increased by 90% and reached 13.7%, of which one-third are over 65 years (9). The number of patients diagnosed with diabetes aged between 60-79 years was over 2.5 million in Turkey, according to the IDF Diabetes Atlas 6th Edition (2013) (10). According to the 8th Diabetes Atlas, in 2045, 11.2 million individuals are expected to be diagnosed with diabetes in Turkey, and Turkey is expected to be placed in the top ten countries in the world ranking for diabetes. Also, researchers suggested that in 2045, 5.3 million individuals will be aged over 65 years and Turkey will be ranked as 8th in the world ranking with the number of diabetic people in that age group (11).

With the advancing of age, frailty is defined as the weakness due to a decrease in physiological reserves in the neuromuscular, metabolic, and immune system (12). The risk of morbidity and mortality is higher in frailty (13). Diabetes is often accompanied by frailty. Both diabetes and frailty are increasingly common in elderly patients (14). There is evidence that comorbidities (such as muscle loss and cognitive impairment), which are critical features of frailty, are seen in elderly diabetic people (8). Pre-frailty and frailty were found to increase the risk of cardiovascular events and mortality in patients with type 2 diabetes and necessitated more healthcare use in one study (15). Chode et al. investigated the relationship between the presence of frailty and increased functional impairment and poor physical performance risk in middle-aged DM patients in their study (16). The number of studies investigating the factors associated with frailty in type 2 diabetes is limited. To our knowledge, no studies are investigating the relationship between frailty and diabetes in the elderly population in Turkey. Our study aimed to identify the factors associated with frailty in elderly adults (age 65 and older) with type 2 diabetes mellitus. In this context, the effects of clinical and biochemical data on the frailty of the patients will be evaluated and the relationship between nutritional status, depression, quality of life, functionality, personal care status, and frailty of elderly patients with type 2 diabetes will be examined.

MATERIAL AND METHOD

Elderly patients who were admitted to the Diabetes Outpatient department were consecutively and prospectively included in the present study. The study was conducted according to the principles of the Declaration of Helsinki and approved by the Istanbul University, Istanbul Faculty of Medicine Clinical Research Ethics Committee (Date: 27.09.2019 Number:1184). Informed consent was obtained from each patient. One hundred eight individuals diagnosed with type 2 diabetes aged 65 years and over who agreed to participate in the study by signing the consent form were included. Exclusion criteria were: the history of stroke, cardiac stents, an artificial pacemaker or other implanted metal implants, malignant tumors, patients with hepatic insufficiency, end-stage renal disease, severe thyroid gland dysfunction, arthritis, carpal tunnel syndrome or the use of protein powder in the last three months, uncooperative patients or patients who could not stand up for measurements.

A questionnaire was applied to all participants through face-to-face interviews. Demographic data, sleep problems, fear of falling, urinary incontinence, fecal incontinence, constipation, and weight loss in the last 3 months were queried in the questionnaire form. Concomitant diseases and medications were noted. Clinical and biochemical data [glycosylated hemoglobin A1c (HbA1c), Hb, and creatine values] of the patients were recorded from the patient's files. Body fat ratios of the participants were measured using the Tanita BC-420MA instrument. Height, weight, upper arm, calf circumference, waist cir-

cumference, hip circumference, and fathoms length of all participants were measured by the same investigator.

Handgrip strength

Muscle strength was assessed using a JAMAR Hydraulic Hand Dynamometer (Sammons Preston Rolyan, Chicago, IL, USA) in a standard posture recommended by the American Hand Therapist Association (ASHT). Grip strength was measured in the sitting position. Also, attention was paid to 90° flexion and wrist in a neutral position. Participants were asked to use the device three times with maximum gripping force for the right and left hand. Between each measurement, there were rest periods of at least 30 seconds. The highest value measured was accepted as handgrip strength, and was recorded.

Frailty, nutritional status, depression, quality of life, and the personal care of the participants were examined using the tests below.

Frailty

The frailty phenotype designed by Fried et al. is the most commonly used definition of frailty. However, these measurements were not chosen because they were more detailed and took more time. The FRAIL questionnaire of Morley et al. which is easy, practical, and fast to implement was used in our study (17). According to the FRAIL questionnaire, frailty was accepted as a separate geriatric syndrome with five physical phenotypic components as unintentional weight loss, exhaustion, weakness, slow walking speed, and low physical activity. According to the FRAIL questionnaire, 0 points was regarded normal, however, 1-2 points were regarded prefrail, and 3-5 points were regarded as frail (18).

The screening and assessment of nutrition

Mini Nutritional Assessment Short-Form (MNA-SF): MNA-SF is a revised form of the Mini-Nutritional Assessment (MNA) developed especially for elderly patients (>60 years). The assessment tool questions the appetite, weight loss, mobility, recent illness/stress, dementia/depression, and body mass index (BMI). They are scored between 0 and 3 points. Points over 11 indicate normal nutritional status, while 11 points and below indicate under-nutrition (at nutritional risk/malnourished) status (19).

Depression

Patient Health Questionnaire-2 (PHQ2): The patients were asked 2 closed-ended questions. First question: "Did you often feel depressed, pessimistic, and hopeless over the past month? "; the second question was: "Have you had a decrease in your interest or enjoyment of what you have done frequently in the past month? " A positive response to one of these 2 items was considered a positive screening test result (range 0 to 2) (20). Individuals who gave a negative response to both questions re-

ceived 0 points, individuals who gave a positive response to one question received 1 point, individuals who gave a positive response to 2 questions received 2 points.

Geriatric Depression Scale Short Form (GDS-SF): In 2001, Lelito et al. found that the short-form was as effective as the original form in determining depression (21). This short-form consists of 15 questions including closed-ended answers, and 1 point can be obtained from each question. The total score varied between 0-15 points. The higher score indicates the more severe depressive condition for the patient.

Quality of life

EuroQol- 5 Dimension (EQ5D) and Scoring the EQ-VAS: EQ-5D-3L consists of 5 parts including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Scoring in each section is as follows: "no problems: 1", "some problems: 2", or "extreme problems: 3" (22). Patients also assessed their health on the EQ visual analog scale (EQ-VAS). 100 mm indicates " the best imaginable health state "and 0 mm indicates "the worst imaginable health state".

Personal care-functional status

Basic Activities of Daily Living (BADL) and Instrumental Activities of Daily Living (IADL): Activities of daily living are a critical indicator to understand physical activity and daily living activities in older adults. ADL consists of basic ADL and instrumental ADL. Basic ADL examines conditions related to personal care such as bathing, personal hygiene, dressing, and transfer (23). With IADL, the participants were questioned about using the phone, shopping, preparing meals, housework, washing, going to places within walking distance, taking medication, and managing money. For each item of the scale, the answers of the individuals were scored between 1-3 (Performing the activity without help: 3 points, performing the activity with some help: 2 points, no activity at all or completely dependent on someone to do the activity: 1 point). The possible score range for BADL and IADL was between 6-18, and 8-24, respectively. A BADL score of 18 points indicated complete independence. This assessment was created by adapting the scale used in the study of Cho et al. (24).

Statistical analysis

In descriptive statistics, continuous data are given as mean, standard deviation, median, minimum and maximum values, and categorical data as a number, and percentage values.

The Chi-square test and likelihood ratio were used for categorical data in the statistical comparison of the data. The likelihood ratio test was used when the expected value was smaller than 5 in any of the cells in the probability

tables evaluated. For the continuous data, the normal distribution was evaluated by Kolmogorov Smirnov analysis, and one way ANOVA and Kruskal Wallis tests were used for the comparisons between the groups. Post hoc analysis of significance among Frail groups was performed by one way ANOVA and Tukey's post hoc test; after the Kruskal Wallis test, the Bonferroni correction and Mann Whitney U test were used. For statistical significance, a p-value less than 0.05 in the 95% confidence interval was considered significant. In Chi-square post hoc analysis, significance was accepted as significant at values below 0.0167 with Bonferroni correction, and adjusted p values were used in other posthoc evaluations. The Statistical Package for the Social Sciences (SPSS) v.21.0 (IBM Corporation, Armonk, NY, USA) was used for statistical analysis.

RESULTS

Participants were divided into groups according to their frailty: Group 1 (non-frail; n: 16). Group 2 (prefrail; n: 57), Group 3 (frail; n: 35). While 14.8% of the participants were non-frail, 85.2% were in the frail or prefrail group. The proportion of those who received undergraduate and higher education was 62.5% in Group 1, 34.5% in Group 2, and 26.5% in Group 3. The other demographic characteristics of the participants are shown in Table 1.

The medical treatment of diabetes (grouped and compared to those receiving only oral antidiabetic medication, those using insulin only, those using insulin + oral antidiabetic, and those who used no medication and only receiving medical nutrition therapy) did not affect frailty (p>0.05). No patient was on glucagon-like peptide-1 analogues (GLP-1A) therapy. Also, there was no significant difference between the three groups in terms of hypoglycemia frequency (p>0.05). Biochemical data, disease and complication status of the participants are shown in Table 2.

Nutrition, depression, quality of life, and personal care status of the patients are shown in Table 3. Sleep problems, fear of falling, and presence of urinary incontinence were significantly higher in the frail group than in the non-frail group; the MNASF score was significantly lower; PHQ2, GDS-SF and EQ5D scores were found to be significantly higher in the frail group than in the non-frail group.

DISCUSSION

The prevalence of frailty varies between 3.9% (China) and 51.4% (Cuba) in the elderly; however, the general prevalence of frailty in the elderly living in the community is considered to be 10.7% (25, 26). Researchers in one study suggested that the incidence of frailty is 3-5 times higher in diabetic patients compared to non-diabetic elderly in-

Table 1: Demographic characteristics of participants.

	Non-frail (n=16)	Prefrail (n=57)	Frail (n=35)	p
Sex (W)[a]	7 (43.8%)	36 (63.2%)	28 (80%)	**0.034**
Age	71.6±4.7	72.2±5.9	70.5±4.5	0.429
Marital status				
Single/widow (living alone)	4 (26.7%)	14 (26.9%)	10 (30.3%)	0.938
Smoking				
No	13 (81.3%)	43 (75.4%)	32 (91.4%)	
Yes	2 (12.5%)	4 (7.0%)	1 (2.9%)	0.240
Quitted	1 (6.3%)	10 (17.5%)	2 (5.7%)	
Alcohol				
No	11 (73.3%)	49 (87.5%)	31 (88.6%)	
Yes	3 (20.0%)	6 (10.7%)	3 (8.6%)	0.690
Quitted	1 (6.7%)	1 (1.8%)	1 (2.9%)	
BMI (kg/m^2)	30.0±4.7	30.0±4.6	32.7±6.8	0.059
Body fat (%)	30.1±7.2	34.4±8.6	35.9±10.5	0.128
Upper arm circumference (cm)	31.6±2.9	31.3±3.1	32.7±4.2	0.166
Calf circumference[b] (cm)	37.9±3.4	36.8±3.7	38.9±3.7	**0.032**
Waist circumference (cm)	106.9±12.9	105.9±12	106.9±12.7	0.913
Hip circumference[b] (cm)	111.1±10.2	109.1±10.7	116.5±12.5	**0.012**
Fathoms lenght (cm)	164.4±12.7	162.4±12.2	160.2±8.8	0.439

[a]There is a significant difference between group 1 and group 3, [b]There is a significant difference between group 2 and group 3, W: women, BMI: body mass index

Table 2: Biochemical data, disease and complication status of the participants (HbA1c, hemoglobin A1c).

	Non-frail (n=16)	Prefrail (n=57)	Frail (n=35)	p
Diabetes duration (years)	19.0±8.5	16.9±6.9	18.2±9.1	0.574
Hemoglobin (g/dL)	12.7±1.4	13.0±1.3	12.8±1.4	0.620
Creatinine (mg/dL)	0.9±0.3	1.0±0.3	0.9±0.3	0.633
HbA1c (%)	7.4±1.0	7.9±2.0	7.8±1.1	0.367
Number of diseases	4.4±3.8	3.5±1.5	4.3±1.8	0.140
Number of drugs	6.2±3.0	6.9±3.7	7.5±2.9	0.257
Hypertension (yes)	14 (87.5%)	45 (78.9%)	32 (91.4%)	0.240
Coronary artery disease/congestive heart failure (yes)[b]	7 (43.8%)	17 (30.4%)	21 (60.0%)	**0.020**
Osteoporosis (yes)	0 (0.0%)	2 (3.5%)	4 (11.4%)	0.126
Cerebrovascular events (yes)	2 (12.5%)	1 (1.8%)	2 (5.7%)	0.219
Chronic renal failure (yes)	1 (6.3%)	3 (5.3 %)	4 (11.4%)	0.557
Presence of complication				
Retinopathy (yes)	4 (25.0%)	14 (24.6%)	10 (28.6%)	0.910
Neuropathy (yes)[a,b]	1 (6.3%)	16 (28.1%)	18 (51.4%)	**0.004**
Nephropathy (yes)	1 (6.3%)	8 (14.0%)	8 (22.9%)	0.260
Diabetic Foot (yes)	0 (0.0%)	3 (5.3%)	1 (2.9%)	0.443

[a]There is a significant difference between group 1 and group 3
[b]There is a significant difference between group 2 and group 3

Table 3: Nutrition, depression, quality of life, and personal care status of patients.

	Non-frail (n=16)	Prefrail (n=57)	Frail (n=35)	p
Sleep problems (yes) [b,c]	2 (12.5%)	20 (35.1%)	25 (71.4%)	**<0.001**
Fall (yes)	3 (18.8%)	20 (35.1%)	15 (42.9%)	0.247
Fear of falling (yes)[b]	2 (12.5%)	15 (26.3%)	16 (45.7%)	**0.031**
Urinary incontinence (yes)[b,c]	2 (12.5%)	13 (22.8%)	17 (48.6%)	**0.008**
Fecal incontinence (yes)	0 (0.0%)	5 (8.8%)	2 (5.7%)	0.269
Constipation (yes)	1 (6.3%)	14 (25.0%)	11 (31.4%)	0.099
5% weight loss in the last 3 months (yes)	1 (6.3%)	6 (11.1%)	3 (8.8%)	0.820
10% weight loss in the last 3 months (yes)	2 (12.5%)	2 (3.6%)	2 (5.9%)	0.460
Hand grip strength (kg)	25.1±7.6	25.1±9.8	22.5±7.4	0.317
MNASF[a,b]	12.9±1.7	12.1±2.2	11.5±2.5	**0.001**
BADL	18.0±0	17.6±1.7	17.7±1.1	0.329
IADL	23.4±1.7	22.4±3.3	22.0±3.7	0.214
PHQ2[b,c]	0.2±0.4	0.7±0.9	1.2±0.9	**<0.001**
GDS-SF[b,c]	0.5±1	1.5±2.8	4.5±4.2	**<0.001**
EQ5D[a,b,c]	5.5±0.5	6.9±1.5	7.9±1.9	**<0.001**
EQ-VAS	73.6±14.8	72±16.8	64.2±22.3	0.261

[a]There is a significant difference between group 1 and group 2
[b]There is a significant difference between group 1 and group 3
[c]There is a significant difference between group 2 and group 3

dividuals (27). The prevalence of frailty in diabetic elderly people living in the community has been reported as 5-48% (28). In our study, frailty prevalence was found as 32.4%. The remarkable point in our study was that only 14.8% of the participants were in the non-frail group. It was noteworthy that the remaining participants were either in the frail or prefrail group (85.2%). More than half (52.8%) of all patients included in the study were prefrail and were in the riskiest group in terms of frailty. Prefrail patients are individuals who may become frail and are particularly cautious. Unless adequate medical intervention is performed, these patients will become frail over time, which leads to increased morbidity and mortality, as well as higher health costs. Moreover, prefrailty detection may be useful for the detection of individuals who may develop dysfunctional capacity, which is a finding that needs attention (29). Prefrail prevalence varied between countries in various studies such as in Tanzania 13.4% (25), Japan 48.1%, and Brazil 71.6% (25, 30). However, there are a limited number of studies evaluating the prevalence of prefrailty in diabetic elderly in the world and the studies are generally small scale. For example, in China, the prefrailty rate was 37.7% in a study evaluating 146 elderly people with type 2 diabetes (31). In Japan, prefrailty was found as 38.0% of 213 elderly type 2 diabetic individuals in the study of Nishimura et al. (32). In our study, it is noteworthy that the prefrail group is the largest group according to frailty analysis.

The analysis of the factors affecting the frailty showed that the rates of frailty were higher in women as in the literature (33). Similar to the literature, the fear of falling (34), sleep problems (35), and urinary incontinence (36) was found higher in the frailty group. However, the data related to these parameters are quite limited in diabetic frail elderly, and no study was found to evaluate sleep problems and urinary incontinence in diabetic frail elderly.

The Guidelines of the European Society for Clinical Nutrition and Metabolism (2002) recommended MNA for elderly patients (37). A simple, non-invasive, and inexpensive nutritional status screening test MNA-SF was developed in 2000 (38, 39). According to the results of the Singapore Longitudinal Aging Study 2, where nutritional status was assessed by MNA-SF, changes in nutritional status were associated with transitions in frailty status (40). The relationship between malnutrition and/or malnutrition risk and frailty has been demonstrated in many studies (41). According to the FRAIL survey and other definitions of frailty, one of the components of frailty is malnutrition. In our study, the MNA-SF scores of the diabetic frail group were significantly lower than the scores in the non-frail group. Recent data indicated that proper nutrition can reverse the frailty or may have a positive effect on the negative consequences of frailty (42). However, as Laur et al. emphasized, more research is needed on the prevalence of malnutrition and frailty in order to better understand potential intersections in prevalence, diagnosis, and treatment (43).

In a meta-analysis evaluating studies of frailty and depression in elderly patients, specifically emphasized that each condition was associated with the increasing prevalence and incidence of the other risk and may be a risk factor for the development of the other (44). The number of studies evaluating the relationship between depression and frailty in diabetic patients is quite limited in the literature. One of these rare studies, The Health In Men Study (HIMS), mentioned that frailty may mediate the relationship between diabetes and depression (45). In our study, both PHQ2 and GDS-SF scores were significantly higher in the frail group than in the non-frail and prefrail groups. These results suggest that the use of tests to assess the condition of depression along with frailty may help to keep the depression in older patients, especially elderly people with diabetes.

The relationship between frailty and quality of life in diabetic elderly was evaluated by EQ5D in our study. The pre-frail group was found to have significantly higher scores than the non-frail group and the frail group had significantly higher scores than both the non-frail and pre-frail groups, in which case there was an inverse relationship between the quality of life and frailty. In 2016, Kojima et al. systematic review and meta-analysis similarly emphasized that there was an inverse relationship between frailty/prefrailty status and quality of life of elderly people living in society (46). Researchers in another meta-analysis published in 2019 where the results of 22 studies were evaluated, emphasized the importance of the relationship between frailty and poor quality of life (47). As emphasized in the research, there is a need for advanced research on the causal mechanisms in this subject. In addition to the EQ5D scale, we performed EQ-VAS scoring in our study, however, no statistically significant difference was found between the groups. However, the results of a study on 1471 elderly individuals in the Korean Frailty and Aging Cohort Study were interesting. Researchers in that study suggested that EQ-VAS scoring may be an indicator for determining the frailty. In that study, the cut off EQ-VAS was reported as 72 for frailty (48). Our results support these data (EQ-VAS values> 72 in the non-frail group, <72 in the frail group), however, the difference between the groups is statistically insignificant. Larger studies are needed on this subject.

One limitation of our study is that the cause and effect relationship could not be shown due to the cross-sectional pattern of our study.

In conclusion, prefrail status was found in half of the population in the elderly with type 2 diabetes in our study. In other words, the risk of frailty is higher, which may lead to higher morbidity and even mortality, such as functional impairment and malnutrition. The prefrail group is the

group where the transition to frailty is easy if necessary precautions are not taken. Also, it is the group that can be improved when measures are taken in terms of both the quality of life of individuals and health expenditures. In this respect, it is the group that will benefit the most from medical measures in diabetic elderly. In our study, we showed the relationship between frailty and malnutrition, decreased quality of life, and increased depression in elderly diabetic patients. As all these factors have a place in the management of diabetes, awareness should be raised, frailty screening should be expanded in elderly diabetics and personalized treatment plans should be prepared for frail individuals.

REFERENCES

1. Kinsella K, Wan H. Census Bureau: International Population Reports. An Aging World: 2008, Washington: U.S. Government Printing Office, DC, (serial online) 2009 (cited 2020 January 04). Available from: URL: https://www.census.gov/prod/2009pubs/p95-09-1.pdf.

2. HelpAge International. State of the world's older people 2002, (serial online) 2002 (cited 2020 January 02). Available from: URL: http://www.helpage.org/Researchandpolicy/Stateoftheworldsolderpeople/.

3. Turkiye Istatistik Kurumu. Yıllara, Yaş grubu ve cinsiyete göre nüfus- genel nüfus sayımları, (serial online) 2019 (cited 2020 March 03). Available from: URL: http://www.tuik.gov.tr/UstMenu.do?metod:temelist/

4. Satman İ. Diabetes mellitus tanı ve izleminde yeni kriterler ve belirlenme gerekçeleri. Turkiye Klinikleri J Int Med Sci 2007;3(3):1-15.

5. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care 1998;21(9):1414-31. [CrossRef]

6. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Res Clin Pract 2010;87(1):4-14. [CrossRef]

7. Steyn NP, Mann J, Bennett PH, Temple N, Zimmet P, Tuomilehto J, et al. Diet, nutrition, and the prevention of type 2 diabetes. Public Health Nutr 2004;7(1A):147-65. [CrossRef]

8. Ikwuobe J, Bellary S, Griffiths HR. Innovative biomarkers for predicting type 2 diabetes mellitus: relevance to dietary management of frailty in older adults. Biogerontology 2016;17(3):511-27. [CrossRef]

9. Satman I, Omer B, Tutuncu Y, Kalaca S, Gedik S, Dinccag N, et al. Twelve-year trends in the prevalence and risk factors of diabetes and prediabetes in Turkish adults. Eur J Epidemiol 2013;28(2):169-80. [CrossRef]

10. International Diabetes Federation. IDF Diabetes Atlas 6th edition (serial online) 2013 (cited 2020 March 03). Available from: URL: https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/19-atlas-6th-edition.html/.

11. International Diabetes Federation. IDF Diabetes Atlas 8th edition (serial online) 2017 (cited 2020 March 03). Available from: URL: http://diabetesatlas.org/IDF_Diabetes_Atlas_8e_interactive_EN/.

12. Ozdemir S, Öztürk ZA, Türkbeyler İH, Şirin F, Göl M. Klinikte Yatan Geriatrik Hastalarda Farklı Ölçekler Kullanılarak Kırılganlık Prevalansının Belirlenmesi. KSU Medical Journal 2017;12(3):1-5. [CrossRef]

13. Casals C, Casals Sánchez JL, Suárez Cadenas E, Aguilar-Trujillo MP, Estébanez Carvajal FM, Vázquez-Sánchez MÁ. Frailty in older adults with type 2 diabetes mellitus and its relation with glucemic control, lipid profile blood pressure, balance, disability grade and nutritional status. Nutr Hosp 2018;35(4):820-826.

14. Cobo A, Vázquez LA, Reviriego J, Rodríguez-Mañas L. Impact of frailty in older patients with diabetes mellitus: An overview. Endocrinol Nutr 2016;63(6):291-303. [CrossRef]

15. Chao CT, Wang J, Chien KL. Cohort of Geriatric Nephrology in NTUH (COGENT) study group. Both pre-frailty and frailty increase healthcare utilization and adverse health outcomes in patients with type 2 diabetes mellitus. Cardiovasc Diabetol 2018;17(1):130. [CrossRef]

16. Chode S, Malmstrom TK, Miller DK, Morley JE. Frailty, diabetes, and mortality in middle-aged African Americans. J Nutr Health Aging 2016;20(8):854-9. [CrossRef]

17. Morley JE, Malmstrom TK, Miller DK. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged African Americans. The Journal of Nutrition, Health & Aging 2012;16(7):601-8. [CrossRef]

18. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001;56(3):M146-56. [CrossRef]

19. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al. Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical tool for identification of nutritional status. J Nutr Health Aging 2009;13(9):782-8. [CrossRef]

20. McManus D, Pipkin SS, Whooley MA. Screening for depression in patients with coronary heart disease (data from the Heart and Soul Study). Am J Cardiol 2005;96(8):1076-81. [CrossRef]

21. Lelito RH, Palumbo LO, Hanley M. Psychometric evaluation of a brief geriatric depression screen. Aging & Mental Health 2001;5(4):387-93. [CrossRef]

22. EuroQol Group: EuroQol--a new facility for the measurement of health-related quality of life. Health Policy 1990;16(3):199-208. [CrossRef]

23. Izumi M, Akifusa S, Ganaha S, Yamashita Y. Activities of daily living decline is a predictor of lowered coughing ability and correlates with rehabilitative effect of tongue cleaning on coughing ability. Odontology 2019;107(1):393-400. [CrossRef]

24. Cho CY, Alessi CA, Cho M, Aronow HU, Stuck AE, Rubenstein LZ, et al. The association between chronic illness and functional change among participants in a comprehensive geriatric assessment program. J Am Geriatr Soc 1998;46(6):677-82. [CrossRef]

25. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. BMJ Open 2018;8(3):e018195. [CrossRef]

26. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc 2012;60(8):1487-92. [CrossRef]

27. Saum KU, Dieffenbach AK, Muller H, Holleczek B, Hauer K, Brenner H. Frailty prevalence and 10-year survival in community-dwelling older adults: results from the ESTHER cohort study. Eur J Epidemiol 2014;29(3):171-9. [CrossRef]

28. Perkisas S, Vandewoude M. Where frailty meets diabetes. Diabetes Metab Res Rev 2016;32(1):261-7. [CrossRef]

29. Acosta-Benito MA, Sevilla-Machuca I. Using prefrailty to detect early disability. J Family Community Med 2016;23(3):140-4. [CrossRef]

30. Kojima G, Iliffe S, Taniguchi Y, Shimada H, Rakugi H, Walters K. Prevalence of frailty in Japan: A systematic review and meta-analysis. J Epidemiol 2017;27(8):347-53. [CrossRef]

31. Li Y, Zou Y, Wang S, Li J, Jing X, Yang M, et al. A Pilot Study of the FRAIL Scale on Predicting Outcomes in Chinese Elderly People With Type 2 Diabetes. J Am Med Dir Assoc 2015;16(8):714.e7-714.e12. [CrossRef]

32. Nishimura A, Harashima SI, Hosoda K, Arai H, Inagaki N. Sex-related differences in frailty factors in older persons with type 2 diabetes: a cross-sectional study. Ther Adv Endocrinol Metab 2019;10:2042018819833304. [CrossRef]

33. Gordon EH, Peel NM, Samanta M, Theou O, Howlett SE, Hubbard RE. Sex differences in frailty: A systematic review and meta-analysis. Exp Gerontol 2017;89:30-40. [CrossRef]

34. Moreira BS, Sampaio RF, Diz JB, Bastone AC, Ferrioli E, Neri AL, et al. Factors associated with fear of falling in community-dwelling older adults with and without diabetes mellitus: Findings from the Frailty in Brazilian Older People Study (FIBRA-BR). Exp Gerontol 2017;89:103-11. [CrossRef]

35. Ensrud KE, Blackwell TL, Redline S, Ancoli-Israel S, Paudel ML, Cawthon PM, et al. Sleep disturbances and frailty status in older community-dwelling men. J Am Geriatr Soc 2009;57(11):2085-93. [CrossRef]

36. Suskind AM. Frailty and Lower Urinary Tract Symptoms. Curr Urol Rep 2017;18(9):67. [CrossRef]

37. Kondrup J, Allison S, Elia M, Vellas B, Plauth M. ESPEN Guidelines for Nutrition Screening 2002. Clin Nutr 2003;22(4):415-21. [CrossRef]

38. Rubenstein L, Harker j, Salva A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). J Gerontol a Biol Med Sci 2001;56(6):366-72. [CrossRef]

39. Helminen H, Luukkaala T, Saarnio J, Nuotio MS. Predictive value of the mini-nutritional assessment short form (MNA-SF) and nutritional risk screening (NRS2002) in hip fracture. Eur J Clin Nutr 2019;73(1):112-20. [CrossRef]

40. Wei K, Thein FS, Nyunt MSZ, Gao Q, Wee SL, Ng TP. Nutritional and Frailty State Transitions in the Singapore Longitudinal Aging Study. J Nutr Health Aging 2018;22(10):1221-7. [CrossRef]

41. Lorenzo-López L, Maseda A, de Labra C, Regueiro-Folgueira L, Rodríguez-Villamil JL, Millán-Calenti JC. Nutritional determinants of frailty in older adults: A systematic review. BMC Geriatr 2017;17(1):108. [CrossRef]

42. Cruz-Jentoft AJ, Woo J. Nutritional interventions to prevent and treat frailty. Curr Opin Clin Nutr Metab Care 2019;22(3):191-5. [CrossRef]

43. Laur CV, McNicholl T, Valaitis R, Keller HH. Malnutrition or frailty? Overlap and evidence gaps in the diagnosis and treatment of frailty and malnutrition. Appl Physiol Nutr Metab 2017;42(5):449-58. [CrossRef]

44. Soysal P, Veronese N, Thompson T, Kahl KG, Fernandes BS, Prina AM, et al. Relationship between depression and frailty in older adults: A systematic review and meta-analysis. Ageing Res Rev 2017;36:78-87. [CrossRef]

45. Almeida OP, McCaul K, Hankey GJ, Yeap BB, Golledge J, Norman PE, et al. Duration of diabetes and its association with depression in later life: The Health In Men Study (HIMS). Maturitas 2016;86:3-9. [CrossRef]

46. Kojima G, Iliffe S, Jivraj S, Walters K. Association between frailty and quality of life among community-dwelling older people: a systematic review and meta-analysis. J Epidemiol Community Health 2016;70(7):716-21. [CrossRef]

47. Crocker TF, Brown L, Clegg A, Farley K, Franklin M, Simpkins S, et al. Quality of life is substantially worse for community-dwelling older people living with frailty: systematic review and meta-analysis. Qual Life Res 2019;28(8):2041-56. [CrossRef]

48. Kim S, Won CW, Kim BS, Kim S, Yoo J, Byun S, et al. EuroQol Visual Analogue Scale (EQ-VAS) as a Predicting Tool for Frailty in Older Korean Adults: The Korean Frailty an Aging Cohort Study (KFACS). J Nutr Health Aging 2018;22(10):1275-80. [CrossRef]