Investigation of the Relationship between Frailty, Successful Aging, and Physical Activity Levels in Older Individuals*

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Abstract

Aim: This study aimed to examine the relationship between frailty, successful aging, and physical activity levels in older individuals.

Method: Data were collected from 99 volunteer participants aged ≥65. The questionnaire was delivered online via its Google Forms link. In the study, the Tilburg Frailty Indicator (TFI) was used to evaluate participants' frailty levels, the Successful Aging Scale (SAS) was utilized to determine their successful aging status, and the International Physical Activity Questionnaire-Short Form (IPAQ-SF) was employed to measure their physical activity levels.

Results: The results of the study revealed a moderate, significant negative correlation between the TFI and SAS total scores. Additionally, a weak, significant positive correlation was found between the SAS and the IPAQ-SF total scores (s=0.982; p<0.001). A weak, negative correlation was detected between the physical component score of the TFI and the IPAQ-SF total score. There was a significant, highly negative correlation between the TFI total score and the healthy lifestyle sub-parameter score of the SAS (s=-.0634; p<0.001).

Conclusion: It has been determined that more active individuals exhibit both a healthier lifestyle and lower levels of frailty. The women have been found to be statistically more frail and less active compared to the men. It has been observed that frailty increases with age.

Keywords: Healthy aging, healthy lifestyle, frail elderly, exercise.

Yaşlı Bireylerde Kırılganlık, Başarılı Yaşlanma ve Fiziksel Aktivite Düzeyleri Arasındaki İlişkinin İncelenmesi

Öz

Amaç: Bu çalışmada amaç yaşlı bireylerde kırılganlık, başarılı yaşlanma ve fiziksel aktivite düzeyleri arasındaki ilişkiyi incelemektir.

Yöntem: Veriler, 65 yaş ve üzeri 99 gönüllü katılımcıdan toplandı. Anket, Google Forms bağlantısı aracılığıyla online olarak iletildi. Çalışmada, katılımcıların kırılganlık seviyelerini değerlendirmek için Tilburg Kırılganlık Ölçeği (TKÖ), başarılı yaşlanma durumlarını belirlemek için Başarılı Yaşlanma Ölçeği (BYÖ) ve fiziksel aktivite düzeylerini ölçmek için Uluslararası Fiziksel Aktivite Ölçeği Kısa Formu (IPAQ-SF) kullanıldı.

Özgün Araştırma Makalesi (Original Research Article)
Geliş / Received: 20.07.2024 & **Kabul / Accepted:** 11.11.2024
DOI: https://doi.org/10.38079/igusabder.1519299

* This research was presented with the title "Investigation of the relationship between frailty, successful aging, and physical activity levels in older individuals" as an oral presentation at the "12th International Gevher Nesibe Health Sciences Conference (2024).

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ETHICAL STATEMENT: Ethics committee permission for the study was obtained from Fenerbahçe University, Ethics Committee (Date: 17/01/2024, Protocol Number: 09.2024fbu). The study was conducted in accordance with the principles of the Declaration of Helsinki.

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Bulgular: Çalışmanın sonuçları, TKÖ toplam puanı ile BYÖ toplam puanı arasında anlamlı, orta düzeyde negatif bir korelasyon olduğunu ortaya koymuştur. Ayrıca, BYÖ toplam puanı ile IPAQ-SF toplam puanı arasında anlamlı, zayıf düzeyde pozitif bir korelasyon bulunmuştur (s=0,982; p<0,001). TKÖ'nün fiziksel bileşen alt parametresi ile IPAQ-SF toplam puanı arasında zayıf düzeyde negatif bir korelasyon olduğu tespit edilmiştir. Ayrıca, TKÖ toplam puanı ile BYÖ'nün sağlıklı yaşam biçimi alt parametresi arasında anlamlı, yüksek düzeyde negatif bir korelasyon bulunmuştur (s=-,0634; p<0,001).

Sonuç: Daha aktif yaşlı bireylerin, hem sağlıklı yaşam tarzına sahip olduğu hem de daha düşük kırılganlık seviyeleri sergilediği belirlenmiştir. Kadınların, erkeklere göre istatistiksel olarak daha kırılgan ve daha inaktif olduğu tespit edilmiştir. Yaş ilerledikçe kırılganlık düzeyinin arttığı gözlemlenmiştir.

Anahtar Sözcükler: Sağlıklı yaşlanma, sağlıklı yaşam biçimi, kırılgan yaşlı, egzersiz.

Introduction

The World Health Organization reports that the global population of individuals aged 60 and above is growing both in number and proportion. In 2019, there were 1 billion people aged 60 or older worldwide. This figure is anticipated to reach 1.4 billion by 2030 and 2.1 billion by 2050. This rapid growth, unprecedented in scale, is set to accelerate further in the coming decades, especially in developing nations[1].

Successful aging is defined as avoiding disease and disability, preserving cognitive and physical functions, and active participation in life[2–5]. Frailty, conversely, is the state of general weakness and impaired adaptation to daily life activities resulting from neuromuscular, metabolic, and physiological changes with advancing age, making successful aging difficult[6]. Some problems emerging in frail older individuals include weight loss, weakness, inactivity or decrease in movements, and loss of appetite[7]. Inactivity or decrease in movements that may be caused by frailty are among the situations that hinder successful aging. The World Health Organization reports that regular physical activity in adults and older adults has many benefits. These benefits include reduced risk of death from cardiovascular diseases, control of hypertension, reduced risk of developing type-2 diabetes and cancer, and improvements in mental health, cognitive functions, and sleep quality [8].

While it has been reported that there is a relationship between frailty and successful aging in geriatric individuals[9], existing literature on the relationship between physical activity, frailty, and successful aging is limited. Therefore, this study aimed to examine the relationship between frailty, successful aging, and physical activity levels in older individuals and to determine the direction of this relationship.

Material and Methods

Ninety-nine participants who were 65 years of age or older, had no physical activity disability, could read and understand Turkish, volunteered to participate in the study, gave consent, and answered all items completely were included in the study. Participants who had cognitive disorders that could cause problems in understanding the questions or were outside the specified age range were not included in the study. The ratio of the population aged ≥65 to the total population of Türkiye was calculated using the data taken from the website of the Turkish Statistical Institute[10]. The sample size of the study was calculated as 97 subjects, based on a confidence interval of 95% and a power value of 90%. Eventually, 99 subjects were included in the research. Ethical approval for the

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research was obtained from the Fenerbahçe University Non-Interventional Clinical Research Ethics Committee (Date: 17.01.2024 / Protocol Number: 09.2024fbu), and the process was conducted following the Declaration of Helsinki.

Data Collection Tools

In the study, the Tilburg Frailty Indicator was used to evaluate the participants' frailty, the Successful Aging Scale was employed to evaluate their successful aging status, and the International Physical Activity Questionnaire-Short Form was utilized to evaluate their physical activity levels.

Successful Aging Scale (SAS)

This scale was created to measure successful aging[11], and its Turkish validity and reliability study was conducted by Özsungur and Hazer[12]. The scale consists of 10 seven-point Likert-type statements, where 7=strongly agree and 1=strongly disagree, and two sub-dimensions, namely healthy lifestyle and coping with problems. Scores range between 7 and 70. An increase in the score indicates an increase in successful aging.

Tilburg Frailty Indicator (TFI)

This tool was designed to measure physical, social, and psychological frailty[13], and its Turkish validity and reliability were tested by Arslan et al[14]. It consists of two parts: Part A is about sociodemographic characteristics, and Part B has items about three separate components of frailty (physical, psychological, and social). Individuals who score ≥5 on the scale are considered "frail."

International Physical Activity Questionnaire-Short Form (IPAQ-SF)

This questionnaire was created to evaluate individuals' physical activity levels, and its validity and reliability study in Turkish was conducted in 2010[15]. The IPAQ-SF is used to evaluate individuals' physical activity levels for the past seven days. Activity levels are grouped as "inactive," "minimally active," and "highly active" by obtaining weekly MET-min values by multiplying the metabolic equation (MET) values assigned to the activities by their duration and frequency.

Statistical Analysis of Data

Statistical analyses were performed using SPSS v27 (IBM Inc., Chicago, IL, USA). The normality of quantitative variables was assessed using the Shapiro-Wilk test. Mean ± standard deviation ($\bar{X}$ ± SD) values were calculated for normally distributed data, while median (min-max) values were calculated for non-normally distributed data. Two independent groups that did not show normal distribution were compared using the Mann-Whitney U test, and more than two independent groups were compared with the Kruskal-Wallis H test. Multiple comparison results were expressed in letter notation next to medians. Multiple comparison results were expressed in letter notation next to medians. Relationships between quantitative variables were examined with Spearman's rank difference correlation coefficient for non-normal distributed data. Spearman's rank difference correlation coefficient was employed to examine the relationships between the scales for normally distributed data. The correlation coefficient was interpreted as follows: correlations <0.2 were considered very weak, 0.2-0.4 as weak, 0.4-0.6 as

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moderate, 0.6-0.8 as high, and >0.8 as very high[16]. Statistical significance was defined as p values <0.05, <0.01, and <0.001. Hypotheses were established bi-directionally.

Results

Of the 99 individuals who participated in the study, 46 (46.5%) were male and 53 (53.5%) were female. The mean age of the males was 70.41±8.01 years, 82.6% of them were married, 32.6% had a college or faculty education, 84.8% had an income above the minimum wage, 65.2% found their lifestyle healthy, 63% had a chronic disease, 43.5% had a loved one with a serious illness in the past year, and 93.5% were satisfied with the living environment at home. The mean age of the females in the study was 71.28±7.24 years. 66% of them were married, 30.2% had a college or faculty education, 77.4% had an income above the minimum wage, 52.8% found their lifestyle neither healthy nor unhealthy, 60.4% had a chronic disease, 64.2% had a loved one with a serious illness in the past year, and 90.6% were satisfied with the living environment at home.

Frailty was observed in 45.7% of the males and 66% of the females participating in the study, and 56.5% of the males and 62.2% of the females were found inactive (Table 1).

Table 1. Descriptive statistics of individuals' frailty and physical activity levels according to gender (Normality check with Shapiro-Wilk Test)

	Male (n=46)		**Female (n=53)**		**Total (n=99)**	
Frailty level	**n**	**%**	**n**	**%**	**n**	**%**
Not frail	25	54.3	18	34.0	43	43.4
Frail	21	45.7	35	66.0	56	56.6
Physical activity level						
Inactive	26	56.5	33	62.2	59	59.6
Minimally active	12	26.1	17	32.1	29	29.3
Highly active	8	17.4	3	5.7	11	11.1

n: number

In the study, significant differences were found between scores on the TFI and the sub-factors of the SAS according to participants' chronic disease status. Individuals with chronic diseases had higher median values in the TFI physical components (U=728.5; p<0.01), TFI psychological components (U=770.5; p<0.01), and the TFI total (U =671.5; p<0.001) scores. Those without chronic diseases had much higher median values in the SAS healthy lifestyle (U=802; p<0.01), SAS coping with problems (U=547; p<0.05), and the SAS total (U= 522.5; p<0.05) scores (Table 2).

Differences between SAS and IPAQ scores were determined to be significant according to the participants' frailty levels. Those who did not have frailty had higher median values in the SAS healthy lifestyle (U=421.5; p<0.001), SAS coping with problems (U=558.5; p<0.001), and the SAS total (U=486.5; p<0.001), as well as the IPAQ total (U=728.5; p<0.001) scores than individuals with frailty (Table 2).

Also, there were significant differences between participants' TFI and SAS scores according to their physical activity levels. Individuals who were grouped in the inactive group had higher median values in TFI physical components (H=10.394; p<0.01) and the TFI total (H=9.827; p<0.01) scores than those who were classified into the minimally

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active group. Individuals at a minimally active level had higher median values in SAS healthy lifestyle (H=12.135; p<0.01) and the SAS total (H=7.501; p<0.05) scores than those at an inactive level (Table 2).

Table 2. Comparison of TFI, SAS, and IPAQ scores according to individuals' demographic characteristics and health, frailty, and physical activity levels (Comparison of two independent groups: Mann-Whitney U Test, Comparison of more than two independent groups: the Kruskal-Wallis H Test)

	Physical Components	**Psychological Components**	**Social Components**	**TFI Total**	**Healthy Lifestyle**	**Coping with Problems**	**SAS Total**	**IPAQ Total**
	Median	**Median**	**Median**	**Median**	**Median**	**Median**	**Median**	**Median**
Gender								
Male	1.5	1	1	4	18	40	57.5	1422
Female	3	2	1	6	18	40	58	1002
U	1012.5	965.5	1203.5	984.5	1205	1115.5	1127	1059
P	0.142	0.062	0.904	0.098	0.921	0.467	0.518	0.259
Marital status								
Married	2	1	1	4	18	41	59	1440
Single	4	2	2	8	17	35	52	729
U	**539.5**	**570**	735	**449**	**560.5**	**522**	**512.5**	**516**
P	**<0.001*****	**0.002****	0.059	**<0.001*****	**0.002****	**<0.001*****	**<0.001*****	**<0.001*****
Income level								
Minimum wage and below	3	2	1	7	16	37	53	900
Above minimum wage	2	1	1	5	18	40	58	1422
U	562	**465**	741.5	**510.5**	**504**	**459.5**	**459.5**	613
P	0.075	**0.006****	0.855	**0.026***	**0.022***	**0.007****	**0.008****	0.189
Chronic diseases								
Yes	3	2	1	6	17	39	56	1372.5
No	1	1	1	3	18	41	59	1100.3
U	**728.5**	**770.5**	975	**671.5**	**802**	**547**	**522.5**	1139
P	**0.002****	**0.003****	0.142	**<0.001*****	**0.009****	**0.025***	**0.015***	0.885
Level of frailty								
Not frail	-	-	-	-	19	43	62	1620
Frail	-	-	-	-	17	36	53	900
U	-	-	-	-	**421.5**	**558.5**	**486.5**	**728.5**
p	-	-	-	-	**<0.001*****	**<0.001*****	**<0.001*****	**<0.001*****
Physical Activity Level								
Inactive	3^{b}	2	1	6^{b}	17^{a}	39	55^{a}	-
minimally active	1^{a}	1	1	3^{a}	19^{b}	41	59^{b}	-
Highly active	2^{ab}	2	1	4^{ab}	18^{ab}	40	59^{ab}	-
H	**10.394**	5.791	0.058	**9.827**	**12.135**	5.114	**7.501**	-
p	**0.006****	0.055	0.971	**0.007****	**0.002****	0.078	**0.024***	-

a. b: The difference between medians that do not have a common letter is significant. (p<0.05)

U: Mann-Whitney U Test; H: Kruskal-Wallis H Test

**p<0.05; **p<0.01; ***p<0.001*

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In the study, the physical components score of the TFI had a significant negative correlation with the SAS healthy lifestyle, SAS coping with problems, and the SAS total scores (p<0.001), and a weak, significant negative correlation with the IPAQ total score (p<0.05). Also, the psychological components score of the TFI had a significant negative correlation with the healthy lifestyle, fighting with problems sub-factors, and the SAS total scores (p<0.001). Additionally, a significant negative correlation was determined between the TFI total score and the SAS healthy lifestyle, SAS coping with problems, the SAS total, and the IPAQ total scores (p<0.001). A significant positive correlation was found between the IPAQ total score and the SAS healthy lifestyle, SAS coping with problems, and the SAS total scores (p<0.01), (Table 3).

Table 3. Correlations between participants' TFI, SAS, and IPAQ scores (*Spearman Rank Difference Correlation Coefficient*)

		PC	PSC	SC	TFI	HLS	CP	SAS	IPAQ
PC	**s**	1.000							
	p	.							
PSC	**s**	**0.600**	1.000						
	p	**<0.001*****	.						
SC	**s**	0.094	0.093	1.000					
	p	0.355	0.362	.					
TFI	**s**	**0.938**	**0.772**	**0.295**	1.000				
	p	**<0.001*****	**<0.001*****	**0.003****	.				
HLS	**s**	**-0.605**	**-0.454**	-0.148	**-0.634**	1.000			
	p	**<0.001*****	**<0.001*****	0.144	**<0.001*****	.			
CP	**s**	**-0.520**	**-0.418**	-0.155	**-0.557**	**0.780**	1.000		
	p	**<0.001*****	**<0.001*****	0.126	**<0.001*****	**<0.001*****	.		
SAS	**s**	**-0.562**	**-0.441**	-0.161	**-0.599**	**0.878**	**0.982**	1.000	
	p	**<0.001*****	**<0.001*****	0.112	**<0.001*****	**<0.001*****	**<0.001*****	.	
IPAQ	**s**	**-0.253**	-0.190	0.002	**-0.277**	**0.317**	**0.267**	**0.298**	1.000
	p	**0.011***	0.059	0.987	**0.005****	**0.001****	**0.008****	**0.003****	.

PC: Physical Components; PSC: Psychological Components; SC: Social Components; TFI: Tilburg Frailty Indicator; HLS: Healthy Lifestyle; CP: Coping with Problems; SAS: Successful Aging Scale; IPAQ: International Physical Activity Questionnaire

s: Spearman Rank Difference Correlation Coefficient

**p<0.05; **p<0.01; ***p<0.001*

Discussion

This study examined the relationship between frailty, successful aging, and physical activity levels in older adults. It was found that frailty levels in older adults had a moderate negative correlation with successful aging and a weak negative correlation with physical activity levels. A weak positive relationship between physical activity levels and successful aging was also observed. It was determined that older adults who were physically inactive had higher levels of frailty, and as age increased, physical activity levels decreased, leading to an increase in frailty.

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Although the relationship between physical activity and successful aging is debated in the literature, most studies have shown a positive correlation.

In a study conducted by Szychowska et al. on Australian adults, it was concluded that those with high physical activity levels were twice as likely to experience successful aging within 10 years compared to those with low physical activity levels[17]. Physical activity is considered a key component for successful aging in middle-aged and older adults[5]. Pulat Demir et al. noted that adherence to recommended physical activity levels is associated with the fundamental components of successful aging[18]. In our results, inactive geriatric individuals had lower successful aging scores compared to minimally active individuals.

International clinical guidelines strongly recommend the implementation of progressive, individualized exercise programs based on high-intensity resistance training, supported by balance and aerobic training, for frail older adults[19]. Studies have reported that exercise programs for older adults reduce the progression of frailty, decrease hospital admission rates, and prevent disease[20]. In this study, individuals classified as inactive had higher total scores on the frailty scale compared to those classified as minimally active. The presence of chronic diseases significantly contributes to biological aging and frailty[21]. Study findings showed a relationship between advanced age, the presence of chronic diseases, and high levels of frailty. Individuals without chronic diseases exhibited higher levels of successful aging compared to those with chronic conditions. Physiological processes triggered by chronic diseases, such as catabolic events, immobility, and muscle mass loss[19] may have negatively impacted the successful aging of geriatric individuals in our study.

Life expectancy is higher in developed and developing countries compared to underdeveloped nations, with women generally living 4-5 years longer than men. However, despite their longer lifespans, women have a higher prevalence of frailty (9%) compared to men (5%), likely due to societal and biological differences[22]. This study found that women had higher frailty levels and lower activity levels compared to men. The differences in societal roles and biological factors may contribute to the higher frailty and lower activity levels observed in geriatric women compared to men.

Ye et al. demonstrated a relationship between physical and psychological frailty, suggesting that older adults with higher levels of physical frailty are more likely to experience psychological frailty within a year, and vice versa. Physical difficulties such as walking impairments and decreased handgrip strength were found to contribute to psychological frailty[23]. In this study, a moderate negative relationship was observed between the physical and psychological components of the frailty scale and the successful aging scale. Physical difficulties leading to psychological frailty may negatively affect elements related to successful aging, such as life satisfaction, self-confidence, and motivation.

Limitations

The limitations of this study include a limited number of participants, the lack of evaluation of lifestyle differences, and the absence of consideration for environmental factors. Future research could address these limitations by utilizing larger samples and objective measurement methods to enhance the generalizability of the findings.

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Frailty is believed to involve a series of transitions between dynamic equilibrium states characterized by a decline in cellular, molecular, and physiological integrity before becoming clinically apparent. It has been reported that 58% of community-dwelling older adults transition between robust, pre-frailty, and frailty states over five years. These transitions also suggest that frailty can be reversed through appropriately designed, multi-component interventions based on effective exercise training, enabling individuals to transition to more robust health states[19].

Educational programs, planning, and projects aimed at increasing physical activity levels in older adults are thought to significantly enhance the quality of aging and contribute to a population that experiences successful aging. Therefore, as physiotherapists—professionals directly associated with physical activity—we recommend conducting studies in this field.

Conclusion

The results indicate that an increase in physical activity levels in older adults reduces frailty levels and that a decrease in frailty enhances successful aging. We believe it is essential to plan tailored exercise programs targeting the prevention, mitigation, and reversal of frailty in older adults.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.
Disclosure: The authors declare that this study has received no financial support.

Committee Approval: Fenerbahce University Non-Interventional Ethics Committee; Date: 17.01.2024, Protocol Number: 09.2024fbu.

Explanation: This research was presented as an oral presentation at the 12th International Gevher Nesibe Health Sciences Conference (2024).

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