# RESEARCH



# The relationship between frailty syndrome and quality of life in patients with hypertension: a multidimensional analysis

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# Abstract

**Background** Hypertension is a common condition among the elderly and is frequently accompanied by frailty syndrome (FS). The coexistence of hypertension and FS poses significant challenges in patient management and negatively impacts the quality of life (QoL). This study aimed to analyze the relationship between FS and QoL in elderly patients with suspected hypertension.

**Methods** A cross-sectional study was conducted involving 201 patients aged 65 years or older, referred to a Hypertension Clinic for diagnostic evaluation. Frailty was assessed using the Tilburg Frailty Indicator (TFI), and QoL was evaluated with the World Health Organization Quality of Life Instrument (WHOQOL-BREF). Sociodemographic and clinical data were collected, and statistical analyses were performed to identify correlations between FS and QoL.

**Results** The study found that 79.60% of the patients were identified as frail (TFI  $\ge$  5). FS was significantly negatively correlated with all domains of QoL, including physical health (r = -0.634, p < 0.001), psychological health (r = -0.675, p < 0.001), social relationships (r = -0.528, p < 0.001), and environmental factors (r = -0.626, p < 0.001). Multivariate analysis revealed that physical ( $\beta = -0.091$ , p < 0.001) and psychological components of FS ( $\beta = -0.128$ , p = 0.016), as well as age ( $\beta = -0.022$ , p = 0.004), were significant predictors of lower QoL scores. Loneliness ( $\beta = -0.235$ , p = 0.049) was also a significant predictor of lower QoL.

**Conclusions** The study demonstrated a strong association between FS and reduced QoL in elderly hypertensive patients, emphasizing the need for comprehensive assessments and personalized management strategies. Routine evaluation of frailty and the implementation of targeted interventions aimed at improving physical, psychological, and social well-being could substantially enhance QoL in this vulnerable population.

Clinical trial number Not applicable.

Keywords Hypertension, Frailty, Frailty syndrome, Quality of life, Elderly

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# Introduction

Hypertension (HT) is a prevalent condition among older adults and is often accompanied by frailty syndrome (FS), a syndrome characterized by decreased physiological reserve and increased vulnerability to stressors. The coexistence of these two conditions presents significant challenges in the management and treatment of hypertension, complicating the overall care process and negatively impacting the quality of life (QoL) of affected individuals [1, 2].

Hypertension is the leading modifiable risk factor for global all-cause morbidity and mortality The majority of patients with elevated blood pressure have essential or primary hypertension, where the exact cause is unknown [3]. In contrast, 5-10% of patients have secondary hypertension, which has an identifiable cause [4].

Hypertension is also a major risk factor for cardiovascular diseases (CVD), stroke, and renal complications, contributing significantly to morbidity and mortality in the elderly population. Effective management of hypertension typically involves lifestyle modifications and pharmacological interventions [5]. However, FS can also impede a patient's ability to adhere to these treatment regimens due to various factors such as physical limitations, cognitive decline, and the presence of multiple comorbidities [6]. As a result, frail older adults are at a higher risk of adverse health outcomes due to poor blood pressure control [7].

Although various hypertension guidelines recommend considering FS in treatment decisions, specific assessment tools and clinical criteria have not been explicitly established. Hypertension is common in frail individuals, but a direct association has not been reported [8]. Therefore, optimal blood pressure (BP) control is essential for managing CVD risk and preserving QoL in frail hypertensive patients [9]. BP typically decreases in later life or in patients dependent on nursing care. High mortality rates among frail patients with lower BP raise questions about appropriate BP targets for this population. Cognitive decline, a domain of FS, is associated with loss of autonomy, poor self-management, and reduced QoL. The benefits of antihypertensive treatment for cognitive function, especially in older individuals, remain unclear [8]. FS is also a predictor of poor postoperative outcomes, including mortality, longer in-hospital time, complications, and decline in activities of daily living (ADL) [10]. .

Despite the high prevalence of both hypertension and FS in older adults, the interplay between these conditions remains underexplored [11]. FS not only affects physical health but also has psychological and social dimensions that can influence a patient's overall well-being and capacity to manage chronic illnesses [12]. Understanding the relationship between frailty syndrome and quality of life is crucial for developing effective interventions aimed

at improving health outcomes and enhancing the QoL for this vulnerable population [13].

Several studies have investigated optimal hypertension treatment for older patients with FS [9, 14, 15]. For instance, the Hypertension in the Very Elderly Trial (HYVET) and the Systolic Blood Pressure Intervention Trial (SPRINT) have shown that intensive blood pressure control can be safely implemented in older patients, reducing the risk of major cardiovascular events [16, 17]. However, the appropriate blood pressure targets for frail patients remain a subject of debate, with some studies suggesting that lower blood pressure may be associated with higher mortality in frail patients. [18].

The primary objective of this study is to analyze the relationship between FS and QoL in patients with suspected hypertension. By examining these interconnections, the study aims to provide insights that can inform the design of targeted interventions to support frail older adults in managing their hypertension more effectively. The specific aims are to determine the prevalence of FS among older patients with suspected hypertension and evaluate how FS correlates with different aspects of QoL.

# Methodology

#### Participants

The participants in this study were patients referred to the Hypertension Clinic for diagnostic evaluation of hypertension by their primary care physicians during the period from 2016 to 2017. The study included patients aged 65 years or older, without cognitive impairment or mental disorders, who provided written informed consent to participate. The screening for eligibility included a clinical evaluation conducted by a qualified physician upon patient admission. This process involved reviewing medical records, conducting a clinical interview, and administering the Clock Drawing Test (CDT) to evaluate cognitive function. The CDT was used to confirm the absence of significant cognitive impairments that would preclude participation. The physician's decision was relied upon to exclude such cases. The study initially included 243 participants with suspected hypertension; however, only 201 participants returned all the completed questionnaires and were ultimately included in the final analysis. The average age of the participants was 71.59 years (SD = 7.55), with ages ranging from 65 to 91 years.

#### Procedure

Upon hospital admission, sociodemographic data were collected from the patients, including age, marital status, education, occupational activity, diabetes, hypercholesterolemia, coronary heart disease, kidney failure, rheumatic diseases, and body mass index (BMI). The WHO criteria were used to classify patients based on BMI:

#### Tools

## Frailty syndrome assessment

FS was assessed using the TFI. The TFI includes 15 items divided into physical, psychological, and social domains. Higher scores on the TFI indicate greater levels of frailty, with a score of 5 or above signifying the presence of FS [19, 21, 22]. The Cronbach's alpha value for the TFI in this study was 0.74, indicating good internal consistency. In this study, 160 out of 201 participants (79,60%) were identified as frail.

## Quality of life

QoL was assessed using the WHOQOL-BREF. It covers four domains: Physical Health (this includes activities of daily living, dependence on medicinal substances and medical aids, energy and fatigue, mobility, pain and discomfort, sleep and rest, and work capacity), Psychological Health (this includes bodily image and appearance, negative feelings, positive feelings, self-esteem, spirituality/religion/personal beliefs, thinking, learning, memory, and concentration), Social Relationships (this includes personal relationships, social support, and sexual activity) and Environment (This includes financial resources, freedom, physical safety and security, health and social care, home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreation/leisure activities, physical environment and transport) [20]. The Cronbach's alpha values for the Polish version of WHOQOL-BREF domains are as follows: physical health = 0.81, psychological health = 0.78, social relationships = 0.69, and environment = 0.77. These values confirm the reliability of the instrument for evaluating the quality of life in this study population [23].

# Statistical analysis

Quantitative variables were analyzed using descriptive statistics such as mean, standard deviation, median, quartiles, minimum, and maximum. Qualitative variables were analyzed by calculating absolute and percentage frequencies. Correlations between quantitative variables were analyzed using Spearman's correlation coefficient. Multivariate analysis was performed using linear regression to identify potential predictors of treatment QoL. The variance inflation factor (VIF) was used to check for multicollinearity among explanatory variables, with a VIF > 5 indicating collinearity. A significance level of 0.05 was adopted for all statistical analyses.

# Results

#### Characteristics of the study group

The study group consisted of 201 individuals. Hypertension was diagnosed in 157 patients with Stage 1 Hypertension (78.11%) and 44 patients with Stage 2 Hypertension (21.89%). Of these, 112 (55.72%) were women and 89 (44.28%) were men. The average age of the participants was 71.59 years, with a standard deviation of 7.55 years. The median age was 68 years, with an interquartile range from 65 to 77 years, and the ages ranged from 65 to 91 years. A total of 160 patients (79.60%) had frailty syndrome (FS). Detailed sociodemographic and clinical data of the participants are summarized in Table 1.

#### QoL of the participants

The QoL is rated on different scales. In the first two domains (perception of QoL and health), the QoL is expressed on a scale of 1–5. In the other domains, it is expressed on a scale of 4–20, with higher scores indicating a better QoL. The average score for the perception of QoL among participants was predominantly in the "Neither Poor nor Good" and "Good" categories. The average score for the perception of health was also predominantly in the "Neither Satisfied nor Dissatisfied" and "Satisfied" categories. Participants rated their QoL highest in the Psychological domain, slightly lower in the Environment and Social Relationships domains, and lowest in the Physical Health domain. The results of the WHOQOL-BREF questionnaire are summarized in Table 2.

## Correlation between QoL and FS

The overall TFI score and the severity of physical, psychological, and social components of FS significantly (p < 0.05) and negatively (r < 0) correlate with the perception of QoL, perception of own health, and QoL in the physical, psychological, social, and environmental domains. Detailed results of correlation between WHO-QOL-BREF and TFI are presented in Table 3.

#### Multivariate analysis of FS and QoL

Multivariate linear regression analysis revealed that the perception of QoL was significantly lowered by physical components of FS ( $\beta = -0.091$ , p < 0.001), psychological components of FS ( $\beta = -0.128$ , p = 0.016), and age ( $\beta = -0.022$ , p = 0.004). Loneliness was also a significant predictor of lower QoL scores ( $\beta = -0.235$ , p = 0.049) compared to those living in a relationship.

Regarding the perception of own health, physical components of FS ( $\beta$  = -0.078, *p*=0.015), psychological components of FS ( $\beta$  = -0.129, *p*=0.002), and age ( $\beta$  = -0.025, *p*<0.001) were significant predictors of lower scores. Obesity ( $\beta$  = -0.353, *p*=0.006) and kidney failure ( $\beta$  = -0.388, *p*=0.006) were also significant predictors of

 Table 1
 Characteristics of the Study Group

Parameter		N=201
Sex	Female	112 (55,72%)
	Male	89 (44,28%)
Age [years]	Mean (SD)	71,59 (7,55)
	Median (quartiles)	68 (65–77)
	Range	65–91
	n	201
Marital status	Married or Partnered	102 (50,75%)
	Single	15 (7,46%)
	Separated, divorced	8 (3,98%)
	Widow, widower	76 (37,81%)
Education	None or primary	55 (27,36%)
	Secondary education	96 (47,76%)
	Higher	50 (24,88%)
Work activity	Working	26 (12,94%)
	Retiree	137 (68,16%)
	Pensioner	35 (17,41%)
	Unemployed person	3 (1,49%)
SBP [mmHg]	Mean (SD)	143,13 (13,25)
	Median (quartiles)	140 (140–150)
	Range	100-183
	n	201
DBP [mmHg]	Mean (SD)	85,85 (12,51)
	Median (quartiles)	90 (80–90)
	Range	50-110
	n	201
BMI [kg/m <sup>2</sup> ]	< 18.5	6 (2,99%)
	18.5–24.9	88 (43,78%)
	25.0–29.9	76 (37,81%)
	≥30	31 (15,42%)
Duration of illness [years]	Mean (SD)	13,04 (7,57)
	Median (quartiles)	11 (7–17)
	Range	1–40
	n	201
Blood Pressure Status	Stage 1 Hypertension	157 (78,11%)
	Stage 2 Hypertension	44 (21,89%)
Comorbidities *	Diabetes	101 (50,25%)
	Hypercholesterolemia	59 (29,35%)
	Coronary Heart Disease	61 (30,35%)
	Renal Failure	19 (9,45%)
	Rheumatic Diseases	42 (20,90%)
Frailty syndrome TFI≥5	yes	160 (79,60%)

\* Multiple choice question - percentages do not sum to 100

lower scores on this scale compared to those with normal weight and without kidney failure.

The physical domain was significantly lowered by physical components of FS ( $\beta$  = -0.37, *p* < 0.001) and age ( $\beta$  = -0.107, *p* < 0.001).

The psychological domain was significantly lowered by physical components of FS ( $\beta$  = -0.301, *p* < 0.001), psychological components of FS ( $\beta$  = -0.313, *p* < 0.001), and age  $(\beta = -0.101, p < 0.001)$ . Loneliness  $(\beta = -0.76, p = 0.033)$ 

12 12 13 01 Мах 18 20 19 Min 5 5 N 80 18,91% 37,31% 37,81% 38,31% 42,29% 3,98% 1,00% %66' % Median  $\sim$ 15 15 SD 2,74 2,52 2,85 2,86 Mean 12,8 14,14 13,81 **Z** 201 201 201 201 201 201 Neither Satisfied nor Dissatisfied Perception of Own Health Social Relationships Very Dissatisfied Domains of QoL Physical Health Psychological Very Satisfied Dissatisfied Very Good Satisfied Good

16,92%

Neither Poor nor Good

Perception of QoL

WHOQoL BREF

Very Poor

Poor

 Table 2
 Results of the WHOQOL-BREF

1,49%

%

SD - standard deviation, Q1 - lower quartile, Q3 - upper quartile

Environment

4

9

23 115 116

WHOQoL BREF	Overall	Physical Components	Psychological Components	Social
	TFI Score			Components
	Spearman's correlatio	on coefficient		
Perception of QoL	r=-0,663, p<0,001 *	r=-0,615, p<0,001 *	r=-0,465, p < 0,001 *	r=-0,36, p<0,001 *
Perception of Own Health	r=-0,543, p<0,001 *	r=-0,511, p<0,001 *	r=-0,385, p<0,001 *	r=-0,285, p<0,001 *
Physical Health	r=-0,634, p<0,001 *	r=-0,61, p<0,001 *	r=-0,414, p<0,001 *	r=-0,3, p<0,001 *
Psychological	r=-0,675, p<0,001 *	r=-0,639, p<0,001 *	r=-0,476, p<0,001 *	r=-0,323, p<0,001 *
Social Relationships	r=-0,528, p<0,001 *	r=-0,491, p<0,001 *	r=-0,436, p<0,001 *	r=-0,218, p=0,002 *
Environment	r=-0,626, p<0,001 *	r=-0,579, p<0,001 *	r=-0,434, p<0,001 *	r=-0,365, p<0,001 *

Table 3 Correlation between WHOQoL-BREF and TFI

\* statistically significant correlation (p < 0.05)

was also a significant predictor of lower scores compared to those living in a relationship.

The social domain was significantly lowered by physical components of FS ( $\beta$  = -0.188, *p*=0.035), psychological components of FS ( $\beta$  = -0.431, *p*<0.001), and age ( $\beta$  = -0.103, *p*<0.001). Loneliness ( $\beta$  = -1.398, *p*=0.033) significantly reduced the scores compared to those living in a relationship. Kidney failure ( $\beta$ =1.185, *p*=0.029) was a significant predictor of higher scores.

In the environmental domain, physical components of FS ( $\beta$  = -0.288, *p*<0.001) and age ( $\beta$  = -0.122, *p*<0.001) were significant predictors of lower scores. Detailed results of the multivariate analysis are presented in Table 4.

# Discussion

Our study demonstrated a significant correlation between frailty syndrome and reduced quality of life in elderly patients with arterial hypertension. These findings underscore the clinical importance of incorporating comprehensive assessment and personalized management strategies in this population, as the primary goal of antihypertensive treatment is not only to reduce cardiovascular risk but also to enhance quality of life and extend the lifespan of these patients [24]. It is known that the occurrence of FS significantly worsens QoL [25, 26]. Moreover, FS increases the risk of insufficient adherence to recommended antihypertensive therapy, thereby increasing the cardiovascular risk of these patients [27]. Worse QoL in patients with hypertension also increases the risk of insufficient adherence to therapy [28]. The coexistence of FS and hypertension significantly increases the risk of falls (OR = 12.24) [29]. The study showed a high prevalence of FS in hypertensive patients, with 79.60% of patients diagnosed as frail. This suggests that the prevalence of FS in elderly hypertensive patients is significantly higher compared to the general elderly population [30]. This highlights the critical need to address FS in the treatment of arterial hypertension in the elderly. Arterial hypertension is one of the most common diseases in all populations, but the prevalence of arterial hypertension increases with age, hence primary care physicians should be particularly alert to those patients who are at higher risk of developing FS [24]. The occurrence of FS or prefrail in hypertensive patients aged ≥65 years increased the risk of all-cause mortality by 202% and 35%, respectively. Of particular predictive importance in this respect were such FS components as weakness (HR = 1.77), exhaustion (HR = 2.25), low physical activity (HR = 2.25), shrinking (HR = 1.48), and slowness (HR = 1.44) [31]. Hence, in elderly patients with arterial hypertension, broad FS prevention should be carried out and those with risk factors for its occurrence (age, female sex, depression, and previous hospitalizations) should be identified [32]. In this context, it is worth emphasizing that one of the very important ways of FS prevention is good blood pressure control (people with well-controlled blood pressure are characterized by a 32% lower risk of FS) [33]. Moreover, in patients with arterial hypertension and FS (frailty status was a marker of high cardiovascular risk in this patients), antihypertensive treatment should not be feared, because its use reduces the risk of major cardiovascular events (MACE) up to the age of 85 and is not associated with a higher risk of adverse events [34, 35]. In patients with FS, in order to reduce the number of tablets taken, it seems particularly beneficial to use therapy based on single-pill combination (SPC), which significantly improves compliance with recommendations and thus contributes to the optimization of cardiovascular risk [36]. To be as effective as possible, antihypertensive treatment should be carried out in accordance with the principle proposed by Surma and Oparil based on the current guidelines: "the earlier the better", "the lower the better, but not lower than <120/70 mmHg" and "the longer the better" [37]. A personalized approach is needed in the management of hypertension in older persons, focusing on hypotension, co-morbidities, and adherence/persistence to medical prescriptions, while considering the specific frailty deficits [38]. Physical activity is the basis of a healthy lifestyle and the treatment of many diseases, including arterial hypertension [24]. In the context of FS prevention, regular physical activity should be encouraged, because it reduces the odds of frailty by 41%.<sup>39</sup> We have shown that patients with arterial hypertension

				1)/ 5	/										
	Perception o	fQoL		Perception of Ow Health	'n	Physical <b>E</b>	Jomain	Psychological Do	nain	Social Dom	lain	Envi	ronmenta	l Domain	
Feature	Parameter	95%CI p		Pa- 95%Cl	٩	Pa- 95%	%CI p	Pa- 95%CI	٩	Pa- 95%	٩	-Pa-	95%CI	٩	
				ram- eter		eter		ram- eter		ram- eter		eter			
Physical Components	-0,091	<( 0.135 0.047 *	0,001	-0,078 0.131 0.02	0,005	-0,37 - 0.51	- <0,001 18 0.223 *	 0.301 0.432 0.171	< 0,001	 0.188 0.355	- 0,02 5 0.021 *	29 - 0.288		<pre>&lt; 0,001</pre>	_
Developmente	0,100		* 210	0100	0044	20			* ^ * 0 0			02/0	12 10 0	0000 0910	
Components	-0,120			-0,129 - 0,253 0,00	0,0 * 4C	 0,087 0,45	0,209 0,024 33	0,02 - 0,313 0,006	0,047	 0,431 0,824	- u,u. 1 0,038 *	- cc 0,169	9 0,508	67C'N 601'r	
Social	-0,112	- 0,011 0,0	075	-0,079 - 0,06	59 0,295		0,271 0,501	0,267	, 0,595	0,321 -	0,789 0,16	' ന	-	),045 0,083	
Components		0,235		0,228		0,142 0,55	54	0,099 0,466		0,147		0,359	9 0,763		
Sex Female	eref.			ref.		ref.		ref.		ref.		ref.			
Male	0,005	- 0,178 0,5 0,168	956	-0,052 - 0,1 <sup>±</sup> 0,261	57 0,626	0,175 - 0,40	0,757 0,555 36	0,055 - 0,57 <sup>-</sup> 0,461	0,836	0,088 - 0,572	0,748 0,75 2	94 0,38	4 - ( 0,184	),953 0,187	
Age [years]	-0,022	0,C 0,038 0,007	004 *	-0,025 0,043 0,00	0,008 37 *	0,107 0,15	- <0,001 58 0,057 *	 0,101 0,146 0,055	< 0,001	0,161 0,103 0,161	- 0,0( 1 0,046 *	01 - 0,122	 2 0,172 0	<pre>&lt; 0,001 %)072 *</pre>	_
Mari- In a re- tal lation- Status ship	- ref.			ref.		ref.		ref.		ref.		ref.			
Single	-0,235	0,C 0,468 0,003	049 *	-0,267 - 0,0° 0,547	13 0,064	 0,621 1,40	0,159 0,121 01	-0,76 1,452 0,067	, 0,033 *	 1,398 2,284	- 0,0( 1 0,513 *	0,61 <sup>°</sup>	- ( 1 1,375	),152 0,118	
Edu- None	ref.			ref.		ref.		ref.		ref.		ref.			
ca- or pri- tion mary															
Sec- ond-	-0,075	- 0,146 0,5 0.296	508	-0,015 - 0,2 <sup>1</sup> 0.282	51 0,91	0,303 - 0.43	1,045 0,423 38	0,554 0104 0762	1 0,758	 0.209 1.051	0,632 0,62	27 - 0.248	- ( 0.073	),478 0,504	
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Highe	r 0,032	- 0,302 0,5 0,239	819	-0,078 - 0,2 <sup>z</sup> 0,403	47 0,639	0,332 - 0,57	1,238 0,473 74	0,149 - 0,953 0,655	3 0,717	0,21 - 0,815	1,238 0,65 3	9 - 0,014	- 4 0,901	),872 0,975	
Oc- Unem cupa- ploved	- ref.			ref.		ref.		ref.		ref.		ref.			
tional Em- Activ- ployec	-0,015	- 0,245 0,5 0,275	91	-0,026 - 0,28 0,339	86 0,869	0,522 - 0,34	1,394 0,242 49	0,287 - 1,06′ 0,486	0,467	0,659 - 0,329	1,648 0,15	93 0,239	9 - 0,614	,091 0,584	
ity BMI 18.5– Ilva/ 24.9	ref.			ref.		ref.		ref.		ref.		ref.			
m <sup>2</sup> ] < 18.5	0,188	- 0,693 0,4 0,318	468	0,248 - 0,8 <sup>1</sup> 0,361	57 0,425	1,128 - 0,56	2,824 0,194 57	0,242 - 1,747 1,263	7 0,753	0,37 - 1,554	2,294 0,7( 1	J6 0,959	6 -0'2	2,619 0,259	
25.0- 29.9	-0,158	- 0,043 0,1 0,359	125	-0,219 - 0,0, 0,461	23 0,078	 0,157 0,83	0,517 0,648 32	0,367 0,232 0,831	7 0,449	 0,451 1,217	0,315 0,2 <sup>5</sup>	5 - 0,149	- 0,809	),512 0,659	
≥ 30	-0,173	- 0,088 0,1 0,433	196	-0,353 0,666 0,05	0,029 39 *	 0,368 1,24	0,505 0,41 42	0,117 0,658 1,434	2 0,098	 0,483 1,474	0,508 0,3 <sup>2</sup>	41 - 0,109	- 9 0,964	),746 0,803	
Disease Dura- tion [years]	0	- 0,012 0,5 0,012	967	-0,002 - 0,0' 0,016	13 0,823	0,01 -0,C	3 0,05 0,64	0,007 - 0,042 0,029	2 0,706	0,07 0,025	0,021 0,28	35 - 0,007	-0,04 (	),039 0,973	

	Ľ	<sup>p</sup> erception o	of QoL		ЧЧ Ч	erceptic salth	on of Ow	Ę	Physic	al Doma	i	Psyc	chologica	Domain	Soc	ial Doma	. <u>e</u>	En	ironmer	ital Don	lain
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ة: 4 ـَ ـ = ن	in- /per- n-	),028	- 0,182	0,237 0,3	-0-	.225 - 0;	0,02	27 0,082	- 0,456	-1,16 0	,248 0,20	6 0,09	8 - 0,527	0,723 0,75	9 0,13	- 0,668	0,929 0,	749 0,29	0,439	0,938	0,479
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betes <sub>Yí</sub>	SS C	0,132	-0,04	0,305 0,	135 0,0	0, 0,	0,2 <u>5</u> 161	55 0,657	- 0,172	- 0 0,752	,407 0,56	0,27	1 - 0,243	0,785 0,30	3 0,32	9 - 0,328	0,986 0,	327 - 0,12	- 27 0,693	0,44	0,662
Hy- N	л С	ef.			ref				ref.			ref.			ref.			ref.			
per- Y, cho- les- terol- emia	S	0,114	- 0,305	0,077 0,	-0,	.041 0,	0,15	0,731	0,043	- 0	,684 0,89	6 - 0,46	- 5 1,036	0,103 0,11	- 0,14	-0,87	0,586 0,	702 - 0,12	- 23 0,751	0,505	0,702
Coro- N	ы С	ef.			ref				ref.			ref.			ref.			ref.			
nary Y <sub>i</sub> Heart Dis- ease	r S	-0,022	- 0,216	0,171 0,8	822 -0,	- 12 0,	0,1 <sup>.</sup>	3 0,314	-	- 0 0,748	,55 0,76	5 0,03	6 -0,54	0,612 0,90	3 - 0,03	- 6 0,772	0'0	924 0,15	59 - 0,476	0,794	0,623
Kid- N	с С	ef.			ref				ref.			ref.			ref.			ref.			
ney Y <sub>í</sub> Failure	T Se	-0,017	- 0,304	0,271 0,9	91 -0,	388 - 0,	- 734 0,04	0,029 .2 *	- 0,959	- 0 1,922	,005 0,05	3 - 0,24	- 4 1,099	0,611 0,57	7 1,18	5 0,092	2,278 0, *	035 - 0,40	- 1,345	0,541	0,404
Rheu- N	л С	ef.			ref	. ·			ref.			ref.			ref.			ref.			
matic Y <sub>í</sub> Dis- eases	S	0,036	- 0,245	0,173 0,:	735 -0,	.239 - 0,	0,0 <sup>~</sup> 491	2 0,063	- 0,463	- 0 1,163	,237 0,19	·7 - 0,52	- 4 1,146	0,097 0,1	- 0,14	- 8 0,942	0,646 0,	715 - 0,48	- 31 1,166	0,204	0,171
p - multivi	ariate lin€	ear regression	ı; * statistic	cally signifi	icant corre	ation (	<i>v</i> < 0.05); 5	D - stand	ard devia	tion; Cl - c	confidence	interval; E	MI - body	mass inde							

Table 4 (continued)

and FS were characterized by a deterioration in the QoL domain related to physical activity. This is consistent with existing literature, which suggests that frail people experience more severe physical limitations, which reduces their ability to effectively cope with hypertension. Physical activity, including simple exercises such as daily walking, reduces the risk of all-cause and cardiovascular mortality [39, 40]. Physical therapy programs are effective in decreasing levels of physical frailty older adults [41].

We also found that FS significantly reduced both psychological and social components of QoL. The psychological burden of frailty, combined with reduced social interactions and support, exacerbates the challenges faced by these patients. Psychological support can alleviate the symptoms of FS and should therefore be strongly recommended in this group of patients [42]. It is worth emphasizing here that good control of blood pressure and lipid profile can reduce the risk of dementia, which can significantly worsen social aspects of QoL [43].

Age and loneliness were significant predictors of lower QoL scores in many domains. Older age inherently reduces physiological reserves, while loneliness increases the psychological and social effects of frailty. Conditions such as obesity and renal failure were also significant predictors of lower QoL scores. These comorbidities additionally complicate the treatment of arterial hypertension and FS, indicating the need for comprehensive care approaches. A patient with arterial hypertension and FS is a patient of special care and should be provided with multidimensional health care [44]. A very important aspect is to increase awareness of FS and methods of its prevention already at early stages of life [44, 45]. It is important to remember that improving QoL in patients with arterial hypertension and FS is determined by many factors, not only blood pressure control. Knowledge about the patient's well-being is especially important in the case of chronic diseases such as arterial hypertension, in which treatment lasts many years and often a lifetime. Frailty and hypertension are common in older people and are closely related and have a synergistic effect on QoL deterioration.

The results of our study have important clinical implications including: (1) targeted Interventions: the findings suggest a need for targeted interventions that address not only the physiological aspects of arterial hypertension but also the psychological and social dimensions of FS. Programs aimed at improving social support and mental health could significantly enhance QoL for these patients; (2) comprehensive assessments: incorporating comprehensive assessments of frailty in clinical practice is crucial. Tools like the Tilburg Frailty Indicator (TFI) can aid in identifying patients at higher risk of poor outcomes, allowing for more tailored treatment plans, and (3) holistic management: effective management of arterial hypertension in frail elderly patients requires a holistic approach. This includes lifestyle modifications, pharmacological treatments, and interventions aimed at enhancing physical, psychological, and social well-being.

#### **Study limitation**

Despite the significant findings of this study, several limitations must be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between frailty syndrome and quality of life in hypertensive patients. Second, the study population was limited to patients from a single clinical setting, which may reduce the generalizability of the findings to other populations. Additionally, self-reported data on quality of life and frailty could be subject to bias, potentially affecting the accuracy of the results. Future research should consider longitudinal designs and include a more diverse patient population to confirm and extend these findings.

# Conclusion

This study revealed a significant association between frailty syndrome and reduced quality of life in elderly patients with hypertension. The findings indicate that frailty syndrome is highly prevalent in this group, highlighting the need for routine assessment of frailty in the diagnosis and treatment of hypertension in older patients. Furthermore, it was found that the physical, psychological, and social components of frailty syndrome significantly impact all aspects of quality of life studied, underscoring the necessity for personalized interventions. Such an approach should not only focus on blood pressure control but also include support for physical activity, mental health, and social interactions. Developing and implementing programs aimed at improving these aspects could substantially enhance the quality of life in this vulnerable population. Future research should focus on evaluating the effectiveness of these interventions and their application in broader, more diverse patient populations.

#### Abbreviations

FS	Frailty syndrome
QoL	Quality of life
HT	Hypertension
CVD	Cardiovascular diseases
TFI	Tilburg frailty indicator
WHOQOL	BREF-world health organization quality of life instrument
ADL	Activities of daily living
BMI	Body mass index
SPC	Single-pill combination
MACE	Major cardiovascular events
SD	Standard deviation
VIF	Variance inflation factor
BP	Blood pressure
OR	Odds ratio
HR	Hazard ratio
CI	Confidence interval

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#### Author contributions

BU, Conceptualization, Methodology, Validation, Writing – original draft, Writing – review & editing; AC, IU;: Methodology, Validation, Writing – original draft, Writing – review & editing, Data curation, Project administration; RG, GK, PG, SS, DB-C, MC: Formal analysis, Writing – original draft, Writing – review & editing; All authors reviewed the manuscript.

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#### Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

# Declarations

#### Ethics approval and consent to participate

The research protocol received approval from the Local Bioethics Committee at Wroclaw Medical University, Poland (decision no KB-144/2016). Informed consent was obtained from all participants. Emphasis was placed on each participant's right to withdraw from the study at any time and the confidentiality of their responses. The study adhered to the principles of the Declaration of Helsinki and the guidelines of Good Clinical Practice.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

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