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RESEARCH

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The relationship between comorbidities, physical inactivity, kinesiophobia and physical performance in hypertensive individuals: a cross-sectional study

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Abstract

Background Hypertension is a prevalent chronic condition accompanied by comorbidities that negatively affect health outcomes. Comorbid conditions in hypertensive individuals may contribute to increased physical inactivity, heightened levels of kinesiophobia, and diminished physical performance. This study aimed to investigate the relationships among Charlson Comorbidity Index (CCI). scores, kinesiophobia, physical activity levels, and physical performance in hypertensive individuals.

Methods A cross-sectional study included 186 hypertensive participants aged ≥ 40 years. CCI was utilized to assess comorbidities, and physical activity levels were evaluated with the International Physical Activity Questionnaire-Short Form (IPAQ-SF). Kinesiophobia was measured using the Tampa Kinesiophobia Scale (TKS)., and physical performance was evaluated through the 30-Second Sit-to-Stand Test (STS-30). and the Five Times Sit-to-Stand Test (FT-STS). Spearman correlation analysis was performed to assess relationships among variables.

Results The majority of participants (88.7%) exhibited kinesiophobia, and 93.5% were physically inactive. A significant but positive weak correlation were found between CCI and TKS ($r = 0.239$, $p = 0.002$). A significant but weak negative correlation were observed between CCI and STS-30 (r=-0.264, $p = 0.001$), while a weak positive correlation was observed CCI and FT-STS ($r = 0.227$, $p = 0.005$) among inactive individuals. A weak negative correlation was also found between IPAQ-SF and CCI in inactive participants (r=-0.184, $p = 0.020$). No significant correlations were found in active individuals. The effect sizes for these correlations ranged from moderate to small, suggesting a meaningful, but limited, impact of comorbidities on physical inactivity and kinesiophobia.

Conclusions Comorbidities (CCI) were significantly associated with kinesiophobia and physical performance in inactive hypertensive individuals. These findings highlight the need for patient-centered targeted interventions addressing comorbidities to enhance physical activity, management kinesiophobia and improve physical performance in this population.

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Keywords Charlson comorbidity index, Hypertension, Physical activity level, Physical performance, Sit to stand, Five times sit to stand

Introduction

Hypertension is one of the most prevalent chronic health issues of the modern era, affecting around 1.3 billions of individuals worldwide and highly related to the burden of cardiovascular disease and premature death, long years of disability and health cost [1]. 68% (68%) of those with hypertension also live with at least one comorbid condition, such as heart disease, stroke, depression, dementia, or chronic kidney disease [1]. While prevalence varies across countries and regions, the global prevalence of hypertension among individuals aged 30–79 has been reported as 32% in women and 34% in men [2]. The incidence of hypertension increases with age, with a prevalence of 31.2% reported in Turkey [3].

Comorbidities associated with hypertension, such as coronary artery disease, heart failure, and renal failure, significantly increase mortality risk [4]. Hypertension accounts for at least 45% of deaths from heart disease and 51% of deaths related to coronary heart disease [5]. The Charlson Comorbidity Index (CCI) is a widely used tool to assess the impact of comorbidities in chronic diseases [6]. Although hypertension is not directly included as one of the 19 components of the CCI, its association with other comorbid conditions may increase mortality risk and indirectly influence CCI scores [6]. The strong relationship between hypertension, cardiovascular diseases, and premature death suggests a potential parallel between CCI scores and hypertension [6]. It is well-established that hypertension is more difficult to control and manage in individuals with comorbid conditions, which also limits the effective implementation of physiotherapy interventions [7, 8]. Therefore, obtaining a clearer understanding of the role of hypertension in the context of comorbidity assessment is essential [9]. Given the commonality of comorbid conditions in hypertension, a focus on individualized health outcomes is crucial.

Physical inactivity is a modifiable risk factor for developing hypertension [10]. The World Health Organization (WHO) recommends physical activity and lifestyle modifications as a part of antihypertensive treatment strategies [10]. Evidence indicates that increased physical activity levels are linked to a lower risk of developing hypertension [11]. One significant barrier to physical activity is kinesiophobia. Kinesiophobia is defined as a condition in which a patient experiences an intense, irrational, and disabling fear of physical movement and activity, stemming from a perception of being vulnerable to painful injury or reinjury [12]. Previous researchers have reported a negative correlation between high levels of kinesiophobia and physical activity levels, alongside a positive correlation between CCI scores and kinesiophobia [13, 14]. In hypertensive individuals, kinesiophobia, reduced physical activity, decreased muscle strength in the extremities, and lower quality of life are interrelated [15]. Kocjan observed a significant correlation between high levels of kinesiophobia and increased physical inactivity in patients with hypertension [16]. High levels of kinesiophobia can act as a substantial emotional barrier, influencing an individual's intrinsic motivation to engage in physical activity, thereby adversely affecting physical performance [13]. Independent of kinesiophobia, hypertension may reduce the physical performance of individuals [16].

Poor vascular adaptations and impaired physiological responses in hypertensive individuals have been reported to negatively impact muscle strength and physical performance [17–19]. Mol et al. [20] demonstrated that hypertensive individuals experience delayed recovery due to impaired regulation of systolic blood pressure during physical activity, ultimately leading to reduced physical performance. Similarly, lower physical performance scores have been documented in hypertensive individuals compared to their normotensive counterparts [21]. This evidence highlights the impact of hypertension on physical performance. Although the effects of kinesiophobia [22], physical inactivity [23], and comorbidities [24] on physical performance has been extensively documented, studies examining these variables within hypertensive populations remain limited. The relationship between kinesiophobia, physical inactivity, physical performance, and comorbidities in hypertensive individuals needs to be further clarified for the best of practice. However, to the best of our knowledge, no studies have specifically examined the relationship between comorbidities, kinesiophobia, physical activity levels, and physical performance in individuals with hypertension.

To address this gap, the current study aims to examine the correlations among Charlson comorbidity index, kinesiophobia, physical activity levels, and physical performance in hypertensive individuals. Therefore, investigating the relationship between comorbid conditions, physical performance, and kinesiophobia may yield valuable insights into the feasibility of rehabilitation programs. We consider that this research will contribute new insights into the multifaceted effects of comorbidities on physical health outcomes in hypertension.

Materials and methods

Research framework

This was a cross-sectional study. It was conducted between November 15, 2024, and December 30, 2024. Ethical approval was issued by the Istanbul Medeniyet University Social and Human Sciences Ethics Committee (Approval no: 050.04-2400071645).

The required sample size was calculated using the G*Power software program and a linear bivariate regression analysis test on the correlation value between kinesiophobia scores and physical activity levels in hypertensive patients as reported by Nair et al. [13]. (effect size = 0.25). Using the G*Power 3.1.9.7 software, it was calculated that a minimum sample size of 164 participants would be necessary to achieve 90% power [13].

Initially, 300 individuals with arterial hypertension were invited to participate in the study through email. Of these, 200 participants attended a face-to-face meeting, and 186 were reassessed based on the inclusion and exclusion criteria before undergoing further evaluations. Fourteen participants were excluded due to advanced hearing or vision problems, a recent history of stroke, neurological impairments, or uncontrolled cardiac arrhythmia. Participants who consented completed a survey and underwent assessments under the supervision of the researcher (RKB), ensuring no data loss during the process (Fig. 1).

Participants

The inclusion criteria were as follows: [1] hypertensive individuals over 40 years of age who agreed to participate in this research, and [2] those who met the diagnostic criteria for hypertension as defined by the World Health Organization, which are a systolic blood pressure (SBP) of 140 mmHg or higher, or a diastolic blood pressure (DBP) of 90 mmHg or higher [25]. Exclusion criteria were advanced hearing and vision problems, uncontrolled tachycardia, cardiac arrhythmia, advanced heart failure, recent stroke (within six months)., and neurological conditions such as multiple sclerosis, Parkinson's disease, or amyotrophic lateral sclerosis.

Details regarding the number of participants screened, included, and excluded, along with the reasons for exclusion, are presented in Fig. 1.

Data collection

Sociodemographic questionnaire

Participants provided information on age, gender, body mass index (BMI), waist-to-hip ratio, educational status, occupation, smoking, and alcohol consumption habits. The socio-demographic questionnaire was designed to collect essential participant characteristics, including age, sex, education level, and medical history. This information allows for a comprehensive analysis of potential confounding factors and enhances the generalizability of the study findings by accounting for demographic variations within the sample.

Charlson comorbidity index

The comorbidities of the participants were assessed using the Charlson Comorbidity Index. Developed by Mary Charlson and colleagues in 1987, the Charlson Comorbidity Index (CCI) is a scoring system intended to assess the one-year mortality risk in patients with multiple comorbidities [6]. It is widely used in populations with chronic diseases. The Charlson Comorbidity Index is a valid and reliable test to assess the comorbidity burden in hypertensive patients and evaluate its impact on hypertension prognosis [6, 26]. The index comprises 19 items, scoring not only cancer-related comorbidities but also other chronic conditions. The total score is calculated by summing the individual scores of existing comorbidities and adding 1 point for every decade of age above 40. Comorbidity scores range from 1 to 6 points, depending on the severity of the disease and associated mortality risk, with the maximum possible score being 37 and the minimum score being 0. In the age-modified version of the index, additional points are assigned based on age: 1 point for individuals aged 50–59 years, 2 points for those aged 60–69 years, 3 points for those aged 70–79 years, 4 points for those aged 80–89 years, and 5 points for those aged 90–99 years. The final score is the sum of the comorbidity score and the age-adjusted score [6, 27].

TAMPA kinesiophobia scale

Kinesiophobia among the participants was evaluated using the Tampa Kinesiophobia Scale (TKS), a 17-item Likert-type instrument designed to evaluate fear of movement. The scale addresses aspects related to fear-avoidance behaviors, particularly in work-related activities. A Turkish version of the scale has undergone validation and reliability testing The TKS is a valid and reliable scale to assess kinesiophobia [28]. Each item is rated on a scale from 1 to 4, with items 4, 8, 12, and 16 being scored in reverse. Higher overall scores reflect a higher level of kinesiophobia. A score of 37 or higher is considered indicative of kinesiophobia [29].

International physical activity assessment questionnaire-short form (IPAQ-SF)

Physical activity level was assessed with the IPAQ-SF. It is a consistent and valid questionnaire that can be widely used in assessing physical activity. The IPAQ-SF is a valid and reliable scale to assess physical activity [30]. Sağlam et al. [30]. conducted a validity and reliability study of the Turkish version. Participants were asked questions about the time they spent physically sitting, walking, moderate and vigorous activities in the last 7 days. The total score

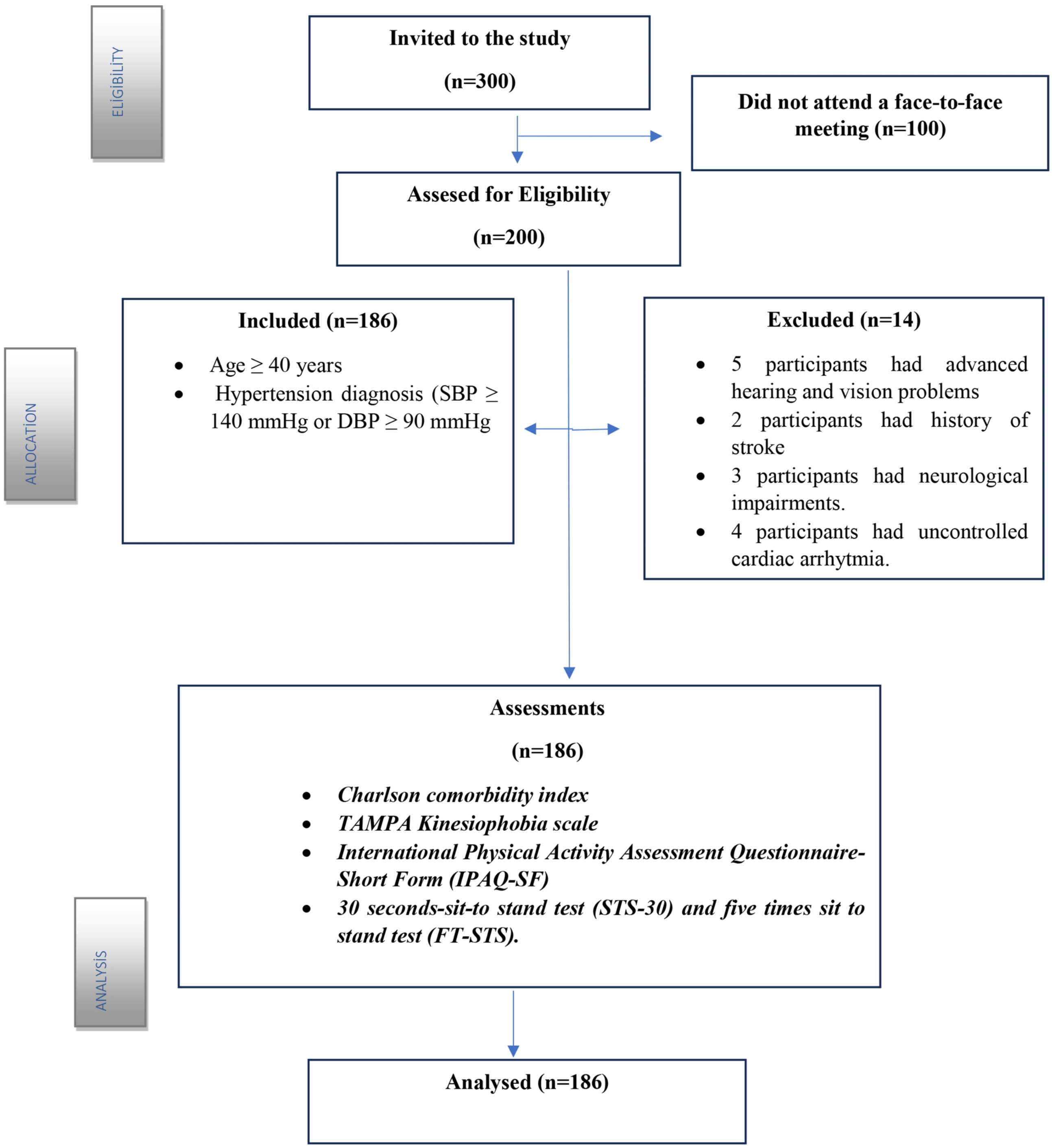

Fig. 1 Flow Chart

was calculated with the energy required for activities in MET-minutes/week score. A weekly MET score below 600 is classified as inactive, whereas a score above 600 is classified as active [30].

Physical performance

Physical performance of the participants were assessed with 30 s-sit-to stand test and five times sit to stand test.

30-seconds-sit-to stand test (STS-30) This test measures lower extremity function, with scores below normative values indicating fall risk [31]. Presented below are the normative STS-30 values and associated fall risk scores by age group.

Scoring: Below Average Scores.

Individuals aged 60 to 64 men < 14 women < 12.

Individuals aged 65–69 men < 12 women < 11.

Individuals aged 70–74 men < 12 women < 10.
Individuals aged 75–79 men < 11 women < 10.
Individuals aged 80–84 men < 10 women < 9.
Individuals aged 85–89 men < 8 women < 8.
Individuals aged 90–94 men < 7 women < 4.

A below average score indicates a risk for falls [32]. The STS-30 is a valid and reliable test to assess physical performance [33].

The test procedures followed the standardized guidelines outlined by the Centers for Disease Control and Prevention (CDC) assessment protocols [32]. In this study, participants were instructed to fully stand up from a 45 cm chair and return to a seated position within 30 s, ensuring their back made contact with the backrest as quickly as possible. The total number of complete transitions from sitting to standing was recorded. No verbal encouragement was provided to the participants during the task [34].

Five times sit-to-stand test (FT-STS)

This test evaluates lower extremity strength and balance control, recording the time required for five repetitions. It is an assessment of physical performance, frequently employed to evaluate functional mobility in older adults The test was performed according to the protocol described by Muñoz-Bermejo et al. [35]. The FT-STS is a valid and reliable test to assess physical performance [36]. To conduct the test, the participant sat on a chair with their arms crossed over the chest and their back supported by the chair's backrest. The chair had a straight back, and its height was 45 cm. Participants were instructed to fully stand up and then return to the seated position for a total of five repetitions, completing the task as quickly as possible. Time was recorded as seconds.

Table 1 Demographic characteristic of participants ($n = 186$)

Age (years). Mean ± SD	57.88 ± 13.48
BMI (kg/m^2). Mean ± SD	28.94 ± 5.58
Sex (N, %).	
Female	116 (62.4).
Male	70 (37.6).
Waist hip ratio Mean ± SD	0.85 ± 0.18
Education status N (%).	
Primary School	92 (49.5).
Secondary School	35 (18.8).
High School	37 (19.9).
University	22 (11.8).
Occupational status N (%).	
Not working	87 (46.7).
Employed (regular job).	45 (24.2).
Unemployed (no regular job).	7 (3.8).
Retired	47 (25.3).
Smoking N (%).	
Yes	59 (31.7).
No	127 (68.3).
Alcohol use N (%).	
Yes	20 (10.8).
No	166 (89.2).
Kinesiophobia N (%).	
Yes	165 (88.7).
No	21 (11.3).
Physical Activity Level N (%).	
Inactive	174 (93.5).
Active	12 (6.5).

SD: Standard deviation

Statistical analysis

SPSS version 22 statistical program was used to examine the obtained data. A $p < 0.005$ was considered statistical significance. Given that the normality tests indicated that the data did not follow a normal distribution, the relationship between the variables (CCI, TAMPA, IPAQ-SF, Physical Performance) was assessed using the Spearman correlation test, which is commonly employed in nonparametric analysis. Spearman correlation coefficient was interpreted as 0.20–0.40 as weak, 0.40–0.60 as moderate, 0.60–0.80 as strong, and 0.80–1.00 as very strong [37].

Results

Data from 186 participants were analyzed. The mean age was 57.88 ± 13.48 years, and 62.4% were female ($n = 116$). Detailed sociodemographic data are presented in Table 1. 88.7% ($n = 165$) of the participants had kinesiophobia (TKS score ≥ 37), and 93.5% ($n = 174$) were physically inactive (IPAQ-SF score < 600 MET-minutes/week), (Table 1) The mean physical performance values revealed that the participants had a mean FTSTS score of 12.68 ± 4.2, and a mean STS-30 score of 11.08 ± 5.51. However, when considering the reference values for the STS-30, it is established that physical performance is considered low for values below 14 in men and below 12 in women, even among individuals aged 60–64. Although the average age of the participants in this study was 57.88, their average physical performance was observed to be significantly below the reference values. This indicates that the physical performance of the participants is notably low. Participants' physical performance, comorbidity, kinesiophobia and physical activity scores are shown in Table 2.

In participants with kinesiophobia, a significant but weak positive correlation was identified between the CCI and TKS ($p = 0.001$; $r = 0267$). A weak, positive correlation was also observed between the CCI and FT-STS test ($p = 0.005$; $r = 0.226$). In contrast, a significant, moderate, and negative correlation was identified between the STS-30 test and the CCI ($p < 0.001$; $r = -0.401$), (Table 3).

Table 2 Total scores of measurements

Measurements	Mean ± SD Median (Min-Max).
Charlson Comorbidity index	3.75 ± 2.70
Total score	3 (0–18).
TAMPA Kinesiophobia Scale	44.72 ± 6.22
Total score	45 (29–60).
IPAQ-SF total score	188.10 ± 357.83
Total score	84.85 (0-2994).
Five times sit to stand test	12.68 ± 4.21
Total score	12.71 (0–20).
Sit to Stand test (30 s).	11.08 ± 5.51
Total score	11 (0–30).

SD: Standard Deviation; Min: Minimum; Max: Maximum

No significant correlation was observed between IPAQ-SF and CCI in participants with kinesiophobia ($p > 0.05$), (Table 3). A significant but weak positive correlation was observed between IPAQ-SF and STS-30 ($p = 0.001$; $r = 0.264$), no significant relationship was observed with FT-STS ($p > 0.05$). Additionally, in participants with kinesiophobia, a significant weak negative correlation was found between the TKS score and STS-30 ($p = 0.001$; r=-0.267), whereas a weak positive correlation was determined with the FT-STS ($p = 0.002$; $r = 0.243$), (Table 3). A notable but weak negative correlation was found between STS-30 and FT-STS, both of which are measures of physical performance ($p = 0.001$; r=-0.276). No significant relationships were determined between CCI, physical activity, or physical performance metrics. ($p > 0.05$), (Table 3).

Participants were classified as inactive and active according to IPAQ-SF. A significant but negative correlation was determined between the CCI and STS-30 ($p = 0.001$; r=-0.264). and IPAQ-SF ($p = 0.020$; r=-0.184). in inactive participants (Table 4). A significant, positive weak correlation was found between CCI and TKS ($p = 0.002$; $r = 0.239$) and FT-STS ($p = 0.005$; $r = 0.227$) in inactive participants. In inactive participants, a positive, significant weak relationship was found between the TKS and the FT-STS ($p < 0.001$; $r = 0.275$), while a negative, significant and weak relationship was found with the STS-30 ($p = 0.004$; r=-0.232). (Table-4) In inactive participants, a significant association was observed between physical activity levels (IPAQ-SF) and physical performance, but only with the STS-30 test ($p < 0.001$; $r = 0.319$). Additionally, a significant and negative correlation was determined between STS-30 and FT-STS ($p = 0.001$; r=-0.264). However, no significant relationship was found between CCI, TKS, physical performance metrics or physical activity levels in active participants ($p > 0.05$), (Table 4).The effect sizes for these correlations are moderate to small, suggesting a meaningful, but limited, impact of comorbidities on physical inactivity, physical performance, and kinesiophobia.

Discussion

In this study, the relationship between the Charlson Comorbidity Index score, kinesiophobia level, physical performance, and physical activity was investigated in patients with hypertension. Our findings show that among inactive individuals with hypertension, the Charlson Comorbidity Index exhibited a weak positive correlation with the Tampa Kinesiophobia Scale and the Five Times Sit-to-Stand test score, while showing a weak negative correlation with both the International Physical Activity Questionnaire-Short Form score and the 30-Second Sit-to-Stand test score. To the best of our knowledge, this is the first study focusing on these analyses.

The Charlson Comorbidity Index (CCI) has been extensively validated for its reliability and accuracy in

Table 3 Relationship between Charlson comorbidity index and TAMPA, IPAQ-SF, physical performance according to kinesiophobia classification

	Sit to Stand test (30 s).		Five times Sit to Stand test		TAMPA total score		IPAQ-SF total score	
Participants with kinesiophobia (*n* = 165).	***p****	***r***	***p****	***r***	***p****	***r***	***p****	***r***
Charlson Comorbidity index	**< 0.001**	-0.401	**0.005**	0.226	**0.001**	0.267	0.062	-0.151
IPAQ-SF total score	**0.001**	0.264	0.401	-0.074	0.736	-0.027	-	1.000
Sit to Stand test (30 s).	-	1.000	**0.001**	-0.276	**0.001**	-0.267	**0.001**	0.264
Five times Sit to Stand test	**0.001**	-0.276	-	1.000	**0.002**	0.243	0.401	-0.074
TAMPA total score	**0.001**	-0.267	**0.002**	0.243	-	1.000	0.736	-0.027
Participants without kinesiophobia (*n* = 21).	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***
Charlson Comorbidity index	0.106	-0.120	0.520	0.082	0.937	-0.023	0.347	0.101
IPAQ-SF total score	0.136	0.108	0.629	-0.076	0.718	-0.062	-	1.000
Sit to Stand test (30 s).	-	1.000	0.203	-0.098	0.571	-0.079	0.136	0.108
Five times Sit to Stand test	0.203	-0.098	-	1.000	0.156	0.111	0.629	-0.076
TAMPA total score	0.571	-0.079	0.156	0.111	-	1.000	0.718	-0.062

*: $P < 0.05$; r: Spearman correlation coefficient

Table 4 Relationship between Charlson comorbidity index and TAMPA, IPAQ-SF, physical performance according to physical activity level

	Sit to Stand test (30 s).		Five times Sit to Stand test		TAMPA total score		IPAQ-SF total score	
Inactive Participants (*n* = 174).	***p****	***r***	***p****	***r***	***p****	***r***	***p****	***r***
Charlson Comorbidity index	**0.001**	-0.264	**0.005**	0.227	**0.002**	0.239	**0.020**	-0.184
IPAQ-SF total score	**< 0.001**	0.319	0.249	-0.093	0.719	0.028	-	1.000
Sit to Stand test (30 s).	-	1.000	**0.001**	-0.264	**0.004**	-0.232	**< 0.001**	0.319
Five times Sit to Stand test	**0.001**	-0.264	-	1.000	**< 0.001**	0.275	0.249	-0.093
TAMPA total score	**0.004**	-0.232	**< 0.001**	0.275	-	1.000	0.719	0.028
Active Participants (***n*** = 12).	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***
Charlson Comorbidity index	0.060	-0.150	0.936	0.028	0.722	0.059	0.230	-0.085
IPAQ-SF total score	0.583	0.080	0.612	0.078	0.873	0.055	-	1.000
Sit to Stand test (30 s).	-	1.000	0.190	-0.097	0.183	-0.100	0.583	0.070
Five times Sit to Stand test	0.190	-0.097	-	1.000	0.365	0.099	0.612	0.078
TAMPA total score	0.183	-0.100	0.365	0.099	-	1.000	0.873	0.055

*: $P < 0.05$; r: Spearman correlation coefficient

multiple studies and is recognized as a robust instrument for evaluating comorbidity burden in both clinical and research contexts [38]. The Charlson Comorbidity Index is widely used to assess the comorbidity burden in hypertensive patients and evaluate its impact on hypertension prognosis. The CCI determines the risk level of a patient's other chronic conditions, with higher CCI scores indicating increased mortality risk and greater disease burden. Multiple comorbidities are frequently present in hypertensive patients, and CCI is effective in predicting the impact of these conditions, as complications associated with hypertension (e.g., cardiovascular diseases, kidney diseases). are often reflected through the CCI [39]. In a study by Kalaycı et al. [40] the age-adjusted CCI score was found to be higher in non-dipper hypertensive patients compared to dipper hypertensive patients, and CCI was shown to be an independent marker in predicting mortality in hypertension. In our study population, the average CCI score was 3.75, which is consistent with the literature, considering the comorbidities associated with hypertension. A cohort study conducted in Canada with 475.345 individuals who were newly diagnosed with hypertension showed that the prognostic accuracy of comorbidity data updated over time was higher compared to the comorbidity data obtained at baseline. It was reported that a quarter of the cohort developed at least one new comorbidity during the follow-up period after diagnosis [41]. The results of this study suggest the necessity of focusing on the evaluation of individualized health outcomes, despite the increasing comorbidity burden in hypertensive individuals.

Kinesiophobia is one of the factors contributing to physical inactivity, particularly in individuals with hypertension, considering the comorbidities. Physical activity has been reported to play an effective role in the control of hypertension [42]. Katayıfçı et al. [15] reported a high level of kinesiophobia of 78.6% in hypertensive individuals in their study comparing those with and without hypertension. In their study, Nair et al. [13] found that 78% of hypertensive individuals have high level kinesiophobia. In this study, 88.7% of hypertensive individuals exhibited high levels of kinesiophobia. Additionally, Nair et al. [13] high level of kinesiophobia were negatively correlated with physical activity levels. Contrary to the Nair et al. [13]' study, our research did not find a correlation between physical activity levels and the TKS scores, as assessed by the IPAQ-SF, among both active and inactive participants. We consider that this finding may be related to high level kinesiophobic individuals in our study population.

A 2023 study reported a moderate positive correlation between the CCI and TKS in individuals who had suffered a myocardial infarction [14]. Another study found that patients with cardiac arrhythmias had higher CCI and TKS compared to the control group [43]. In our study, a positive but weak correlation was observed between CCI and TKS in inactive individuals according to IPAQ-SF, while no correlation was found in active individuals. These results, in line with existing literature, suggest that as the comorbidity burden increases, both high kinesiophobia and movement fear are exacerbated. The lack of a significant relationship between CCI and TKS in active individuals, as assessed by IPAQ-SF, suggests that high levels of kinesiophobia may have masked the effect of CCI even in these individuals. This finding provides a new perspective in the literature. Considering both comorbidity and kinesiophobia in individuals with hypertension from a multifaceted approach may contribute to increased physical activity and exercise participation.

A 2023 review emphasized the importance of prescribing physical activity and exercise for the prevention and treatment of arterial hypertension, as well as in addressing cardiometabolic risk. It was highlighted that incorporating physical activity and exercise into the treatment plan is essential for all degrees of hypertension, as they help prevent diastolic dysfunction, atrial fibrillation, and left atrial enlargement [44]. Katayıfçı et al. [15] reported that hypertensive individuals had significantly lower IPAQ-SF scores compared to the normotensive individuals. Nair et al. [13] found that 68% of hypertensive individuals were inactive. Consistent with the existing literature, our study revealed that 93.5% of hypertensive individuals were inactive according to IPAQ-SF. While the importance of physical activity in managing hypertension is frequently emphasized in the literature, it is noteworthy that only 6.5% of hypertensive patients in our study had sufficient physical activity. This highlights the importance of physical activity promotion programs. In this research, a weak negative correlation was found between CCI and IPAQ-SF in inactive individuals, whereas no correlation was observed in active individuals. This relationship supports the idea that as the comorbidity burden increases, physical activity levels decrease. It suggests that individuals with a high comorbidity burden have lower participation in physical activity, which could increase cardiovascular risks in chronic conditions such as hypertension. Therefore, it is recommended that the negative impact of comorbidity burden on physical activity be addressed through individualized exercise programs.

Previous studies have indicated that individuals with hypertensive exhibit increased muscle sympathetic nerve activity, vasoconstriction, and reduced oxygen delivery when compared to normotensive individuals [17–19]. These physiological responses and unfavorable vascular adaptations can impair muscle blood flow and reduce muscle strength generation as a result of hypoxia. This hypoxic environment increases the production of metabolites, enhancing the effect of chemoreceptors that stimulate the cardiovascular control center. This may result in elevated blood pressure, adversely impacting exercise performance in individuals with hypertension. Katayıfçı et al. [15] reported that peripheral muscle strength and functional capacity were lower in hypertensive individuals. The STS-30 and STS-FT tests reflect lower extremity muscle strength, mobility, and balance control [31]. These tests may result in worse outcomes due to the activation of large muscle groups and the associated physiological responses.

In a 2021 study conducted by Cardozo et al. [21], the influence of resting arterial pressure on functional fitness was analyzed in hypertensive and normotensive women. The findings revealed that hypertensive women performed the number of repetitions in the STS-30 compared to normotensive women whereas no significant differences were observed in other functional tests (arm curl, sit and reach test, 8-foot-up and go). Another study found that functional performance indicators such as the Timed Up and Go and step place tests were associated with hypertension [45]. In our study, hypertensive individuals with an average age of 57.88 had a 30-second sit-to-stand test average of 11.08 ± 5.51, which is slightly below the cut off values for individuals aged 60–65 (men < 14, women < 12) [31],. For the STS-FT test, the reference value for the 60–69 age group in the literature is reported to be 11.4 s [46]. Our study's population had an average score of 12.68 ± 4.21 for the 5T-STS test, which is notably worse than the reference values for this age group.

In current study, a moderate negative correlation was observed between the CCI score and the STS-30 test in kinesiophobic hypertensive individuals. Among inactive individuals as classified by the IPAQ-SF, a weak negative correlation was observed between the CCI score and the STS-30 test score. In addition, a weak positive correlation was observed between the CCI score and the STS-FT test score. This important finding suggests that as the comorbidity burden increases in hypertension, physical performance is restricted. This highlights the importance of physical performance, fall risk management, and rehabilitation programs in hypertensive individuals.

The literature reports a lower risk of comorbidities in physically active individuals [47], as well as improvements in physical performance [48] and reductions in kinesiophobia [49]. However, in this study, no statistically significant relationship was found between the Charlson Comorbidity Index, kinesiophobia, and physical performance among physically active and non-kinesiophobic individuals. We consider that this may be due to the small number of participants in the active and non-kinesiophobic hypertensive individuals. A limited sample size may have reduced statistical power, making it difficult to detect small effects.

Despite providing valuable insights, this study has several limitations. Firstly, the cross-sectional design causality cannot be established between comorbidities, kinesiophobia, physical activity, and physical performance. Longitudinal studies are required to determine the long-term impact of Charlson Comorbidity Index on these parameters. Furthermore, future research incorporating the number of comorbidities and the duration of hypertension may offer more comprehensive and detailed insights into the topic.The study population was limited to a specific age group, which restricts the generalizability of the results. Future research that include a broader age range and diverse or spesific comorbidity profiles are recommended to expand the scope of the findings. Third, physical activity levels were assessed using the IPAQ-SF, a self-reported measure. Future studies should incorporate objective assessments such as accelerometers to enhance measurement accuracy. A key strength of this study is its comprehensive multidimensional analysis. As the first study in the literature to simultaneously examine the relationships between CCI, kinesiophobia, physical activity, and physical performance in hypertensive individuals, it makes a unique contribution to this area of research.

Conclusion

The current research has highlighted the relationships between CCI, physical activity, kinesiophobia, and physical performance in individuals with hypertension. The findings suggest that comorbidity burden is associated with kinesiophobia level, physical activity level, and physical performance. Our study emphasizes the need for individualized, patient-centered, and multifaceted approaches to reduce the impact of comorbidity burden in hypertensive patients.

This study has a specific impact on studies of individuals with hypertension. In particular, the combined evaluation of comorbidities, kinesiophobia, physical performance and physical inactivity in hypertensive individuals emphasizes the importance of multidisciplinary rehabilitation programs. Our findings shed light on future research, particularly in guiding the development of more targeted and effective medical and therapeutic interventions for the hypertensive population.

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Author contributions
RKB, OY, EM and BBK conceived the study design; RKB and OY participated in data collection and study coordination. RKB, EM, OY and BBK reviewed and edited the manuscript. All authors read and approved the final version of the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethical approval
Local Ethics Committee Approval dated 14 November 2024. Ethical approval was issued by the Istanbul Medeniyet University Social and Human Sciences Ethics Committee (Approval no: 050.04-2400071645). This study was conducted in accordance with the Declaration of Helsinki, and informed consent forms were signed by individuals who agreed to participate.

Consent for publication
Informed consent was obtained from all participants for inclusion in the online open-access publication.

Competing interests
The authors declare no competing interests.

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