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Chronic Illness and the Structural Integration of Physical Literacy, Physical Activity, and Body Composition in Older Women

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Abstract

Chronic non-communicable diseases are highly prevalent in older women and are associated with unfavorable changes in body composition (BC). Physical literacy (PL) and physical activity (PA) are key determinants of healthy aging but it remains unclear whether chronic illness modifies not only their levels but also the structural relationships among PL, PA, and BC. This study aimed to examine differences in PL, PA, and BC between older women with- and without-chronic-illness and to compare the structural organization of associations among these variables in two observed groups. The sample included 60 women aged 66.1±9.6 years, categorized in two groups, those with- (n=36) and without-chronic-illness (n=24). PL, and PA were assessed using the validated questionnaires (Perceived Physical Literacy Questionnaire for South Eastern Europe, and Nordic Physical Activity Questionnaire – short version), and BC via bioelectrical impedance analysis. Between-group differences were examined using Welch's t-tests with Cohen's d effect size (ES). Pearson correlations were calculated separately by group, and Fisher's z-tests with FDR correction were applied (91 comparisons). Correlation networks (|r|≥0.25) were constructed to assess cross-domain integration. Women with chronic illness demonstrated lower PL-competence (moderate ES) and higher PL-confidence and PL-knowledge, as well as higher moderate-to-vigorous PA (all moderate ES). No significant differences were observed in BMI, fat mass, skeletal muscle mass, or visceral fat. Prior to correction, PA showed stronger negative associations with fat mass (r=−0.54 vs. 0.11) and visceral fat (r=−0.55 vs. 0.04) in women without-, compared to women with-chronic-illness. Network analysis indicated reduced cross-domain integration between PA and BC in the chronic-illness group. Chronic illness in older women appears to modify the structural relationships among PL, PA, and BC rather than uniformly reducing their levels. The attenuated coupling between PA and BC suggests partial behavioral–physiological decoupling in the presence of chronic disease.

Keywords: *physical exercise, recreation, adaptive physical activity, body built, health, aging population, network analysis, disease*

Introduction

Chronic non-communicable diseases are becoming more prevalent as a result of population ageing, which is changing modern societies (Gianfredi et al., 2025). Cardiovascular disease, metabolic disorders, and musculoskeletal impairments are particularly common in older women (Juopperi et al., 2021). These conditions are commonly associated with negative changes in body composition (BC), such as decreased muscle mass, increased fat mass, and a decline in functional ability (Baumgartner, 2000; Rolland et al., 2008; The Lancet Healthy, 2021). Independence, mobility, and general quality of life in older age are all strongly correlated with these changes. Importantly, a substantial proportion of chronic non-communicable diseases is influenced by modifiable behavioral risk factors, including physical inactivity, sedentary behavior, poor dietary patterns, and obesity (Rahelić et al., 2024). Among these, insufficient physical activity (PA) has been consistently identified as a leading contributor to cardiometabolic risk, functional decline, and premature mortality (Rahelić et al., 2024). Consequently, identifying behavioral and psychosocial determinants that support sustained engagement in PA is essential for both prevention and management of chronic disease in aging populations.

It is commonly acknowledged that one of the best ways to maintain health in ageing populations is to engage in regular PA. In many chronic illnesses, moderate-to-vigorous PA improves BC, improves metabolic control, and slows the progression of disease (Warburton, 2006). Noteworthy, even though the benefits of regular PA are well known, PA participation rates among older population is very low globally (Piercy et al., 2025). Moreover, physical capability is not the only factor that determines PA participation. Whether or not people start and continue active lives depends on a variety of factors, including motivation, perceived competence, knowledge, and confidence. The idea of physical literacy (PL), a complete framework that encompasses these multifaceted aspects, has drawn attention in recent years. PL encompasses psychological and cognitive aspects that promote continuous PA, such as motivation, confidence, knowledge, and comprehension, in addition to motor skills (Cairney et al., 2019). Modern viewpoints characterize PL as an integrated and changing system in which physical, cognitive, and emotive components interact dynamically across time rather than seeing these components in isolation (Edwards et al., 2017). Higher PL may also boost confidence in taking part in structured exercise and community-based activity programs. In older adults, PL has been associated with functional movement capacity and perceived ability to perform everyday physical tasks (Yu et al., 2025).

PL and PA are consistently linked in a large body of research, suggesting that people who are more motivated, self-assured, perceived competent, and knowledgeable are more likely to participate in long-term physical activity throughout their lives (Cairney et al., 2019; Edwards et al., 2017). According to longitudinal and cross-sectional data, involvement in moderate-to-vigorous PA is strongly predicted by affective and cognitive aspects of physical learning, especially perceived competence and self-efficacy (Bandura, 1997; Zhang et al., 2024). Building on this connection, PA is a known factor in BC that helps older persons maintain their skeletal muscle mass, lower their adiposity, and have better metabolic health (Pedersen & Saltin, 2015). Due to postmenopausal hormonal changes, which are linked to increased fat storage and rapid muscle loss, this relationship is especially noticeable in older women (Messier et al., 2011). It has been demonstrated that regular moderate-to-vigorous PA reduces central adiposity and age-related sarcopenia, which lowers the risk of cardiometabolic disease (Villareal et al., 2011). Within this framework, PL may function as an upstream behavioral determinant that indirectly shapes BC through its influence on PA engagement.

In women living with chronic diseases, the interrelationship between PL, PA, and BC may be further influenced by disease-related physiological and psychosocial factors. Chronic diseases like heart disease, type 2 diabetes, and musculoskeletal disorders can weaken the physiological adaptations usually brought about by PA because they are frequently linked to systemic inflammation, pain, exhaustion, and decreased anabolic responsiveness (Ispoglou et al., 2023; Pedersen & Saltin, 2015). Therefore, compared to healthy persons, changes in adiposity or muscle mass may be restricted even when women with chronic illness participate in moderate-to-vigorous PA. However, managing chronic illness often entails medical follow-up, systematic rehabilitation, and health education, all of which can improve knowledge and self-regulation skills (Huang et al., 2024). The PL–PA–BC framework may partially separate behavioural and physiological components as a result of this combination of biological limitation and cognitive involvement. As a result, women with chronic illnesses may show decreased physical competence, diminished morphological reactivity to activity, and preserved or increased confidence and knowledge. Given sex-specific hormonal alterations and the high prevalence of multimorbidity affecting muscle preservation and fat distribution, it is especially critical to comprehend these altered linkages in older women (Messier et al., 2011).

According to the available data, PL, PA, and BC are all connected, although their structural linkages may change when chronic illness is present. The normal relationship between PA and obesity may be weakened by biological limitations, even if the cognitive-affective aspects of PL are untouched. It is uncommon, though, for older women to have these multifaceted patterns investigated at the same time. Thus, the purpose of this study was to compare the structural organization of the relationships between PL, PA, and BC in women with and without chronic disease. It was hypothesized that women with chronic illness would demonstrate reduced cross-domain integration due to attenuated physiological responsiveness to PA, resulting in weaker associations between PA and BC variables compared to women without chronic illness.

Materials and methods

Participants

The study included 60 women aged 66.10±9.59 years. Twenty-four participants (40%) reported no chronic illness, while 36 (60.0%) reported at least one diagnosed chronic condition. The chronic illness group was heterogeneous, including primarily cardiovascular conditions (hypertension, atrial fibrillation, arrhythmia, angina pectoris), thyroid disorders (Hashimoto's thyroiditis, hypothyroidism), musculoskeletal disorders (arthrosis, rheumatoid arthritis, discopathy), and other systemic conditions such as diabetes, asthma, and glaucoma. Several participants reported multimorbidity. To reduce potential sociocultural variability influenced by observed variables, all participants were recruited from the same geographical region. All participants were physically capable for independently visiting the testing center, indicating adequate functional mobility and independence. Participants were personally invited to take part in the study as part of a research project conducted at the Faculty of Kinesiology, University of Split. Prior to data collection, they were informed that participation was voluntary and that they could withdraw at any time without consequence. The potential benefits and risks of participation were explained, and written informed consent was obtained from all participants. The study protocol was approved by the Ethics Committee of the Faculty of Kinesiology, and it was conducted in accordance with the principles set out in the Declaration of Helsinki.

The inclusion criteria were: female sex, age 50 years or older, residence in the city of Split, sufficient functional independence to attend testing sessions independently, and adequate cognitive capacity to understand and complete PA and PL questionnaires. Exclusion criteria included age below 50 years, cognitive impairment preventing questionnaire completion, and insufficient motor function or independence to attend the testing center.

Variables and measuring procedures

This study included demographic characteristics, PL, PA, and anthropometric and BC variables.

Physical literacy was assessed using the Perceived Physical Literacy Questionnaire for South Eastern Europe (PPLQ-SEE) (Gilic et al., 2025). The instrument consists of 24 items organized into six domains: physical competence, understanding, motivation, confidence, knowledge, and physical activity behavior. Items within the competence, understanding, motivation, and confidence domains are rated on a six-point Likert scale (0–5), whereas the knowledge domain includes dichotomous true/false items. For the purposes of the present study, five domain scores (physical competence, understanding, motivation, confidence, and knowledge) were calculated and analyzed alongside a composite overall score (PL-total), representing perceived PL.

Physical activity levels were evaluated using the short version of the Nordic Physical Activity Questionnaire (NPAQ-short) (Danquah et al., 2018). Participants reported the total weekly duration of moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) performed during leisure time and transportation. Weekly minutes of MVPA and VPA were calculated and used as continuous variables in the analyses. All questionnaires were fulfilled via the online platform SurveyMonkey, and participants who had problems with reading or using technology were helped by the researchers involved in this study.

Anthropometric assessment included measurement of body height (cm) and body mass (kg). Body mass index (BMI) was calculated as body mass divided by height squared (kg/m^2). All measurements were obtained during the testing session using standardized procedures. BC was assessed using bioelectrical impedance analysis (BIA) by the Tanita bioimpendance scale. The following parameters were obtained: fat mass (%), skeletal muscle mass (%), visceral fat level, and fat-free mass. Measurements were conducted under standardized conditions according to manufacturer guidelines. Selected indices, including fat mass percentage, skeletal muscle mass percentage, and visceral fat, were used as primary BC indicators in subsequent analyses.

Statistical analysis

Descriptive statistics are presented as means and standard deviations. Between-group differences (women with vs. without chronic illness) were examined using Welch's independent samples t-tests to account for unequal variances and sample sizes. Effect sizes were calculated using Cohen's d and interpreted as trivial (<0.20), small (0.20–0.49), moderate (0.50–0.79), or large (≥0.80).

Pearson correlation coefficients were computed separately for each group to examine associations among PL, PA, and BC variables. To formally compare correlation coefficients between groups, Fisher's z transformation was applied. Given the large number of pairwise comparisons (91 in total), false discovery rate (FDR) correction using the Benjamini–Hochberg procedure was implemented to control for multiple testing. To explore higher-order structural characteristics of the relationships among PL, PA, and BC variables, correlation networks were constructed separately for each group. Edges were retained using a threshold of $|r|\geq 0.25$ to emphasize moderate and practically meaningful associations while reducing spurious connections. Network structures were visually inspected to compare cross-domain integration and clustering patterns between women with and without chronic illness.

All analyses were conducted using statistical software Statistica version 15 (TIBCO, Palo Alto, CA), and statistical significance was set at $p<0.05$.

Results

Descriptive statistics and differences between women with and without chronic disease in all study variables are presented in Table 1. Significant between-group differences were observed in specific PL domains and in PA. Women with chronic illness demonstrated lower PL-competence (moderate ES) and higher PL-confidence (moderate ES) and PL-knowledge (moderate ES). Additionally, MOD-VIG PA was higher in the chronic group (moderate ES). No other significant between-group differences were identified.

Table 1. Descriptive statistics and differences between women with- and without-chronic-illness in all study variables

Variable	Chronic-illness (n=24)	No-Chronic-illness (n=36)	Welch t	Cohen's d
Age (years)	64.78±11.22	66.61±8.38	−0.67	−0.19
PL-Physical competence (score)	74.35±18.97	59.44±25.80	2.55*	0.63
PL-Understanding (score)	93.91±9.83	97.41±6.02	−1.53	−0.45

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Table 1. Descriptive statistics and differences between women with- and without-chronic-illness in all study variables

Variable	Chronic-illness (n=24)	No-Chronic-illness (n=36)	Welch t	Cohen's d
PL-Motivation (score)	78.26±30.94	87.96±18.35	−1.35	−0.40
PL-Confidence (score)	60.43±33.16	78.19±21.12	−2.28*	−0.67
PL-Knowledge (score)	76.33±18.14	85.49±14.75	−2.03	−0.56
PL total (score)	76.66±14.77	81.70±9.14	−1.46	−0.43
MODVIG PA (min/week)	142.17±80.00	234.58±183.89	−2.64*	−0.60
VIG PA (min/week)	28.70±33.21	36.94±60.37	−0.67	−0.16
BMI (kg/m2)	26.89±4.27	27.58±5.86	−0.51	−0.13
Fat mass (%)	32.26±6.53	32.87±7.19	−0.33	−0.08
Skeletal muscle mass (%)	30.63±4.30	30.79±5.76	−0.11	−0.02
Visceral fat (%)	7.04±2.33	7.57±2.71	−0.79	−0.20

Legend. PL – physical literacy; MOD-VIG PA – moderate to vigorous physical activity, VIG PA – vigorous physical activity, BMI – body mass index, * denotes p<0.05.

In women with chronic illness (Table 2), PL domains showed small to moderate intercorrelations, particularly between PL-confidence, PL-knowledge, and PL-total. Associations between PL and PA were generally weak. BC variables (BMI, fat mass, visceral fat) were strongly interrelated, but their associations with MOD-VIG PA were minimal.

Table 2. Pearson's correlation coefficients for study variables for the women with chronic diseases

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
PL-Physical competence (1)	-												
PL-Understanding (2)	-0.03	-											
PL-Motivation (3)	-0.12	0.16	-										
PL-Confidence (4)	0.02	0.44*	0.13	-									
PL-Knowledge (5)	-0.08	0.00	0.18	0.48*	-								
PL total (6)	0.46*	0.38*	0.47*	0.73*	0.57*	-							
MOD-VIG PA (7)	0.19	-0.05	0.25	0.06	-0.10	0.19	-						
VIG PA (8)	0.31	0.04	0.13	0.12	-0.05	0.26	-0.16	-					
Body height (9)	0.05	-0.07	-0.03	0.01	0.21	0.08	-0.17	0.08	-				
Body weight (10)	-0.16	-0.18	0.01	0.21	0.14	0.04	-0.13	-0.13	0.42	-			
BMI (11)	-0.23	-0.17	0.01	0.22	0.03	-0.03	-0.10	-0.17	0.01	0.91*	-		
Fat mass (12)	-0.10	-0.14	0.06	0.14	0.06	0.04	0.11	-0.27	-0.02	0.68*	0.76*	-	
Visceral fat (13)	-0.18	-0.17	0.05	0.26	0.10	0.05	0.04	-0.26	-0.02	0.83*	0.93*	0.92*	-
Skeletal muscle mass (14)	0.09	0.20	0.05	-0.07	-0.01	0.06	0.04	0.25	-0.38*	-0.62	-0.51*	-0.69*	-0.62*

Legend. PL – physical literacy, MOD-VIG PA – moderate to vigorous physical activity, VIG PA – vigorous physical activity, BMI – body mass index, * denotes p<0.05.

In women without chronic illness (Table 3), PL domains were moderately to strongly intercorrelated. Importantly, MOD-VIG PA demonstrated moderate negative associations with BMI, fat mass, and visceral fat, indicating stronger coupling between activity and BC.

Table 3. Pearson's correlation coefficients for study variables for the women without chronic diseases

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
PL-Physical competence (1)	-												
PL-Understanding (2)	0.10	-											
PL-Motivation (3)	0.38	0.47*	-										
PL-Confidence (4)	0.24	0.16	0.50*										
PL-Knowledge (5)	-0.22	0.46*	0.03	0.31	-								
PL total (6)	0.48*	0.54*	0.81*	0.82*	0.40	-							
MOD-VIG PA (7)	0.21	0.27	0.12	0.32	0.42*	0.39	-						
VIG PA (8)	-0.07	0.23	0.21	0.29	-0.15	0.19	-0.17	-					
Body height (9)	-0.09	0.36	-0.16	-0.06	-0.03	-0.08	0.09	0.24	-				
Body weight (10)	-0.25	0.17	-0.04	0.03	0.06	-0.03	-0.45*	0.33	0.47*	-			
BMI (11)	-0.24	-0.03	0.06	0.07	0.11	0.02	-0.55*	0.21	-0.14	0.80*	-		
Fat mass (12)	-0.36	-0.17	-0.16	-0.13	0.01	-0.24	-0.54*	0.06	0.00	0.73*	0.83*	-	
Visceral fat (13)	-0.25	-0.09	-0.01	-0.05	0.07	-0.08	-0.55*	0.12	-0.13	0.75*	0.93*	0.94*	-
Skeletal muscle mass (14)	0.29	-0.10	0.13	0.03	-0.02	0.12	0.48*	-0.23	-0.46*	-0.90*	-0.72*	-0.82*	-0.74*

Legend. PL – physical literacy, MOD-VIG PA – moderate to vigorous physical activity, VIG PA – vigorous physical activity, BMI – body mass index, * denotes p<0.05.

Table 4 presents the results of Fisher's z-tests comparing correlation coefficients between women with and without chronic illness. Across the 91 pairwise comparisons examined, four correlations reached conventional statistical significance prior to adjustment for multiple testing (p<0.05). These contrasts primarily involved associations between moderate-to-vigorous physical activity and adiposity-related indices. Specifically, the relationship between MOD-VIG PA and fat mass percentage was moderately negative in women without chronic illness (r=–0.54), whereas it was negligible in women with chronic illness (r=0.11), yielding a significant between-group difference (Z=–2.51, p=0.01). A similar pattern was observed for visceral fat, with a moderate negative association in the non-chronic group (r = –0.55) and no meaningful association in the chronic group (r=0.04) (Z=–2.31, p=0.02). In addition, the correlation between MOD-VIG PA and BMI demonstrated a trend toward stronger negative association in women without chronic illness (r=–0.55) compared to those with chronic illness (r =–0.10), although this contrast did not reach conventional significance (Z=–1.83, p = .06). A further trend-level difference was observed for the association between vigorous physical activity and skeletal muscle mass percentage. However, after applying false discovery rate (FDR) correction to account for multiple comparisons, none of the between-group differences remained statistically significant.

Table 4. Between-group differences in correlation coefficients between women with and without chronic illness based on Fisher's z-tests with FDR correction

Variable 1	Variable 2	r (No Chronic)	r (Chronic)	Z	FDR p
MOD-VIG PA	Fat mass	−0.54	0.11	−2.51*	0.27
MOD-VIG PA	Visceral fat	−0.55	0.04	−2.31*	0.47
MOD-VIG PA	BMI	−0.55	−0.10	−1.83	0.82
VIG PA	Skeletal muscle mass	−0.23	0.25	−1.70	0.94

Legend. MOD-VIG PA – moderate to vigorous physical activity, VIG PA – vigorous physical activity, BMI – body mass index, * denotes p<0.05.

To examine higher-order structural characteristics of the relationships among PL, PA, and BC variables, correlation networks were constructed separately for women with and without chronic illness. Edges were retained using a threshold of $|r|\geq0.25$ to emphasize moderate and stronger associations while reducing visual and statistical noise. The resulting group-specific network structures are presented in Figure 1.

In the non-chronic group (Figure 1A), the network appears more densely connected, with clear integration between PA and BC variables, particularly linking moderate-to-vigorous activity with adiposity indices. PL domains also demonstrate cohesive internal clustering while maintaining cross-domain connections. In contrast, the chronic illness group (Figure 1B) shows a comparatively sparser structure. Although PL domains and BC variables remain internally connected, the integration between PA and adiposity-related measures is visibly attenuated. Overall, the visual comparison indicates reduced cross-domain coupling in the presence of chronic illness, particularly between activity behavior and BC.

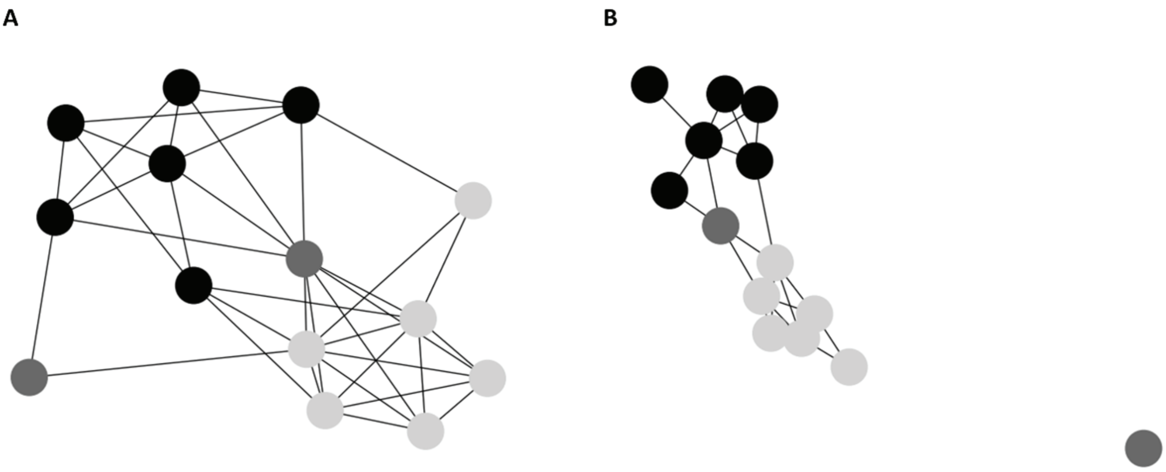

Figure 1. Correlation network structures (|r|≥0.25) in women without chronic illness (A) and women with chronic illness (B).

Note. Black nodes represent PL variables, dark gray nodes represent PA variables, and light gray nodes represent anthropometric and BC variables. Edges indicate correlations meeting the predefined threshold.

Discussion

Several important findings emerge from the present study. First, women with chronic illness demonstrated moderate differences in selected PL domains, characterized by lower PL-competence but higher PL-confidence and PL-knowledge, while reporting higher levels of moderate-to-vigorous PA. Notably, no meaningful differences were observed in BC indicators between groups. Second, clear structural patterns were found by correlation analysis. Stronger coupling between PA and adiposity-related variables was observed in women without chronic illnesses, indicating a closer behavioral–physiological connection. The chronic illness group, on the other hand, showed weaker cross-domain relationships, especially between BC measurements and PA. Network analysis revealed decreased cross-domain integration in women with chronic illness. Thus, at the structural level, our prediction about a poorer behavioral–physiological link in the presence of chronic disease was partially supported.

Differences in physical literacy, physical activity, and body composition between women with and without chronic disease

Women with chronic illnesses showed better PL-knowledge and PL-confidence but lower PL-competence, which may be a reflection of adaptive mechanisms related to long-term disease treatment. Chronic illnesses frequently necessitate repeated exposure to health-related information, systematic rehabilitation, and ongoing engagement with healthcare systems (Leite, 2025). Such experiences may contribute to increased confidence and knowledge-related aspects of PL by improving disease-specific knowledge and perceived self-efficacy (Bandura, 1997; Lorig & Holman, 2003). Physical symptoms like pain, exhaustion, joint degeneration, or mobility constraints, however, may limit functional performance and lower perceived physical competence even in the face of increasing cognitive and affective involvement (Pedersen & Saltin, 2015; Warburton, 2006).

Although it may seem contradictory at first, there are a number of reasonable explanations for the greater levels of moderate-to-vigorous PA shown in the chronic group. As part of disease preventive and management measures, people with chronic disorders are often encouraged to improve their PA (Pedersen & Saltin, 2015). Hence, engaging in organised or monitored exercise regimens may increase moderate-intensity PA levels without always enhancing perceived physical competency. Furthermore, greater participation in recommended physical exercise may result from improved health awareness and deliberate health behaviours after diagnosis (Collado-Mateo et al., 2021). Taken together, these results point to a partial separation of the cognitive-affective and embodied aspects of PL in the context of chronic illness. Physical competence may continue to be biologically limited, even when knowledge and confidence may be strengthened through self-management techniques and healthcare exposure. Current conceptualizations of PL as a multifaceted construct that integrates the physical, psychological, and cognitive domains are in line with this pattern (Edwards et al., 2017). Therefore, rather than equally decreasing all components, chronic disease may reorganise the internal structure of PL and PA.

Noteworthy, the lack of differences in BC indices corresponds with data indicating that morphological responsiveness to PA may be reduced by physiological changes related to disease (Peterson et al., 2011; Rolland et al., 2009). As a result, whereas behavioural engagement might be maintained or even increased, its physiological effects might be limited. Together, these results suggest that cognitive-affective resources, like knowledge and confidence, may help women with chronic illnesses retain their PA involvement even in the face of reduced perceived competence by partially compensating for embodied limitations.

Behavioral–physiological coupling: physical activity, physical literacy and body composition

Correlation and network analyses revealed decreased coupling between PA and adiposity-related variables in women with chronic illness, despite the fact that mean values of BC did not change across groups. Moderate-to-vigorous PA showed greater correlations with visceral adiposity, fat mass, and BMI in women without chronic illness, indicating a closer behavioral–physiological connection. The chronic group, on the other hand, showed a weaker relationship, suggesting that PA involvement was not as closely associated with morphological results. This pattern aligns with biological evidence suggesting that chronic conditions may blunt physiological responsiveness to exercise. Systemic inflammation, insulin resistance, anabolic resistance, and reduced mitochondrial efficiency have been shown to attenuate muscle hypertrophy and fat-loss adaptations in older adults with cardiometabolic and inflammatory conditions (Pedersen & Saltin, 2015; Rolland et al., 2008). Furthermore, resistance to anabolic stimuli becomes more pronounced with aging and multimorbidity, reducing the magnitude of BC changes even when exercise is performed (Peterson et al., 2011). Thus, behavioral engagement in PA may not translate proportionally into improvements in adiposity or muscle mass among women with chronic illness.

Previous studies consistently demonstrate that regular PA is associated with improved BC in healthy older populations (Villareal et al., 2011; Warburton, 2006), but fewer studies have looked at whether this association changes structurally when chronic illness is present (Galmes-Panades et al., 2021). According to our research, chronic disease may partially divide behavioural effort from physiological adaptability, although it may not always result in lower PA levels. Although PA is still behaviourally present in this situation, underlying pathophysiological mechanisms may limit its morphological influence. From a systems perspective, this attenuated coupling reflects reduced cross-domain integration within the PL–PA–BC triad. Rather than representing simple inactivity, chronic illness may reorganize the relational architecture linking behavior and physiology. Such reorganization could explain why women with chronic conditions report engagement in PA without exhibiting corresponding differences in adiposity or muscle mass. This interpretation extends previous literature by highlighting structural, rather than purely mean-level, differences in health-related systems among older women.

Looking beyond individual correlations, the network analysis offers a broader perspective on how PL, PA, and BC are interconnected in older women. In general, chronic illness appeared to influence how these domains relate to one another rather than simply lowering or raising specific scores. While BC indicators remained internally coherent, the links connecting PA to morphological outcomes seemed less tightly integrated when chronic disease was present. From a broader health-systems perspective, behavioral, cognitive, and physiological processes do not function in isolation but operate through ongoing interactions (Borsboom & Cramer, 2013). In healthy aging, PA often leads to measurable improvements in BC, reinforcing continued engagement (Warburton, 2006). However, chronic conditions may disrupt this reciprocity, which was detailly explained in previous sections. Briefly, women with chronic conditions may remain active without demonstrating markedly different BC profiles. By focusing on the structure of relationships instead of mean values alone, these findings offer a more nuanced understanding of aging with chronic illness.

Practical implications

The results of this study imply that encouraging PA in older women with chronic illnesses should go beyond merely raising activity levels. Despite the possibility of moderate-to-vigorous PA, disease-related limitations may reduce its physiological effects on BC. To guarantee significant health benefits, public health initiatives should prioritise proper intensity, progression, and long-term adherence in addition to participation. Furthermore, interventions ought to use a multifaceted strategy that builds knowledge, confidence, and physical competence all at once. Integrated health education, organised exercise programs, and community-based programs could all aid in closing the gap between physiological results and behavioural involvement. In women with chronic illness, addressing these categories together may enhance functional independence, lower cardiometabolic risk, and promote healthy ageing.

Strengths and limitations

This study has several strengths. First, it simultaneously examined PL, PA, and BC, allowing for a multidimensional assessment of health-related factors in older women. Second, the use of network analysis provided insight beyond mean-level differences, enabling exploration of structural relationships among behavioral and physiological variables. Third, the focus on older women with and without chronic illness addresses an understudied yet clinically and socially relevant population.

However, several limitations should be acknowledged. The cross-sectional design precludes causal inference and limits conclusions regarding directionality of associations. PA was assessed via self-report, which may introduce recall and social desirability bias. The sample size was modest and the chronic illness group was heterogeneous, potentially reducing statistical power and masking condition-specific effects.

Additionally, physiological mechanisms such as inflammatory markers or metabolic parameters were not directly measured, limiting mechanistic interpretation. Therefore, findings should be interpreted cautiously and confirmed in larger, longitudinal studies.

Conclusions

The present findings indicate that chronic illness in older women may modify the structural relationships among PL, PA, and BC rather than uniformly reducing their overall levels. Although women with chronic conditions reported comparable or higher engagement in moderate-to-vigorous PA and maintained stronger cognitive-affective components of PL, the integration between PA and BC appeared attenuated. This pattern suggests a partial decoupling between behavioral engagement and physiological adaptation in the context of chronic disease. Considering PL, PA, and BC as components of an interconnected system provides a more comprehensive understanding of aging with chronic illness. Beyond promoting PA participation alone, attention should be given to how effectively PA translates into meaningful BC outcomes. Future longitudinal research is warranted to clarify these relationships and to inform targeted public health strategies aimed at preserving functional capacity and metabolic health in older women.

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Conflict of Interest

Authors declare no conflict of interest.

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