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ORIGINAL ARTICLE

Association between physical activity and physical functioning in community-dwelling older adults

Hadeel Halaweh^{a,b}, Carin Willén^a and Ulla Svantesson^a

^aDepartment of Physiotherapy, Institute of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden; ^bDepartment of Physiotherapy & Rehabilitation, Health Professions College, Al-Quds University, Palestine

ABSTRACT

Aim: To evaluate the association between level of physical activity (PA) and physical functioning among community-dwelling older adults.

Methods: A total of 176 older adults were assessed with a PA socio-cultural adapted questionnaire (PA-SCAQ), the participants were categorized into three PA groups (low, moderate and high). Physical functioning was examined by using: Hand Grip Strength (HGS), Timed Up and Go (TUG) and Short Physical Performance Battery (SPPB). Statistical analyses were performed to determine differences between the groups according to age, gender and PA level. Spearman's correlation was used to examine the association between the PA level and physical functioning values.

Major findings: Older adults who participated in moderate-intensity aerobic PA for ≥ 150 min/week have recorded higher values of physical functioning than older adults who were classified as low physically active ($p < 0.001$). PA levels were positively correlated with HGS and SPPB and negatively correlated with TUG ($p < 0.001$).

Conclusion: There were strong associations between higher levels of PA and levels of physical functioning ($p < 0.001$). Moderate to high level of PA may contribute to maintain physical functioning among community-dwelling older adults.

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Moderate-intensity aerobic physical activity; functional performance; older adults; physiotherapy

Introduction

Physical inactivity has been identified as the fourth leading risk factor for global mortality.[1] Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that requires energy expenditure.[2] Participating in regular moderate-intensity PA (e.g. walking, cycling and swimming) has significant benefits for health, including improved treatment of many diseases.[3–7] The evidence of health benefits of PA is stronger for adults above 65 years old than any other age group, since the consequences related to inactivity are more severe in this age group.[8] Active older adults have lower rates of all-cause mortality and better muscular fitness compared to less active older adults.[8,9]

With ageing, components of physical functioning (strength, balance, coordination, flexibility and endurance) are negatively influenced by changes occurring in the skeletal muscles and body composition.[10–13] Muscle strength is an important component in maintaining physical function, mobility and vitality in old age.[14,15] The progressive loss of muscle strength and other systems may lead to functional decline with advanced age.[11,14,16] PA appears to have a beneficial effect on the dynamics of physical functioning,[17] relatively regular moderate-intensity PA can help older adults prevent a decline in physical functioning.[18–21]

Furthermore, level of engagement in PA is an important predictor of physical function; older adults who have higher levels of PA have better overall physical function than those who perform lower level of PA.[22,23]

In older adults, PA includes leisure time, transportation (e.g. walking or cycling), household chores, sports, planned exercise as well as family and community activities.[8] The WHO [8] recommends the adults aged 65 years and above do at least 150 min of moderate-intensity aerobic physical activity (MIA-PA) throughout the week. Aerobic PA is known as “activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Examples include walking, running, swimming, and bicycling”.[24] “On a scale relative to an individual's personal capacity, moderate-intensity PA is usually a 5 or 6 on a scale of 0–10”.[24]

Worldwide, walking is one of the most recommended and popular forms of PA among older adults and it can easily be adapted into daily lifestyle.[25] Daily walks for at least 30 min have shown to be positively related to leg muscle strength and self-rated physical fitness.[26,27] Ambulatory activity (walking) contributes to the maintenance of leg strength and muscle quality [28] and attaining recommended levels of walking is positively associated with physical and functional well-being in community-dwelling older adults.[29,30]

Patterns of PA may change with ageing,[31] and may differ between different populations. In the West Bank

(Palestine), the prevalent domain of PA among older adults revolves around activities such as walking, gardening and household chores mainly among women.[32] The number of older adults in Palestine is continuously increasing, a population age group that requires further studying and researching.[33] To our knowledge, this is the first study assessing the association between PA and physical functioning among the older adults in Palestine. Thus, the aim of this study was to assess the association between PA and physical functioning in community-dwelling older adults ≥ 60 years old in the West Bank/Palestine.

Materials and methods

This is a cross-sectional study of PA and physical functioning in community-dwelling older adults.

Participants

A volunteer sample of 176 community-dwelling older adults was recruited (115 women and 61 men; mean age $=68.15 \pm 6.74$). Recruitment procedure was arranged through coordination with different community and physiotherapy centres in the West Bank (Palestine). Data were collected between April 2013 and August 2014. All tests and interviews were conducted at the participants' homes or at the community centres. All tests and interviews were performed by the first author. The inclusion criteria were community-dwelling older adults (aged ≥ 60 years) living in the West Bank (Palestine) and who were independent in walking with or without walking aids. Exclusion criteria for the older adults included diagnosis of a severe disease (e.g. presence of specific neurological or any other muscle diseases), that would make investigations impossible and communication deficits such as could not answer questions about age, children, and current location, time, season and year. Parts of the data in the present study have been published.[30,34]

The study received ethical approval from the research ethics committee of Al-Quds University, Palestine (Ref No.: 1/REC/13), which complies with the Declaration of Helsinki. All participants were informed about the aim of the study and have provided informed consent. The participants were ensured confidentiality and informed that their participation was voluntary and that they could drop out of the study at any time.

Measurements

Background Characteristics Questionnaire (BCQ)

Demographic clinical descriptive data on age, gender, marital status, diagnosed disease (cardiovascular, musculoskeletal, hypertension and others) and sensory functions (visual, hearing and speech) were registered. Anthropometric measurements (weight and height) were also recorded.

Measure of activities of daily living (ADL)

The Katz Index was used to assess personal ADL. The index has been described as a valid and reliable measure to

determine independency level in performing ADL.[35] The assessment is based on the ability to perform an activity without assistance from another person. The Katz Index of ADL includes six basic ADL (BADL): bathing, dressing, toileting, transferring, continence and feeding. The ability in performing each activity was assessed using a two-point categorical scale: 1 = independence and 0 = dependence. The total score ranged from 0 (low function, dependent) to 6 (high function, independent).

Measure of PA

A PA socio-cultural adapted questionnaire (PA-SCAQ) was used to measure PA in this study. The PA-SCAQ includes the following questions: How often do you take outdoor walks? How long are your walks? What household activities and other activities (e.g. yard work gardening) do you do? In addition to a categorical question about self-rated fitness: (how you evaluate your physical fitness?). The question had five answer alternatives: (1 = very poor; 2 = poor; 3 = quiet good; 4 = good and 5 = very good).

The structure of the PA-SCAQ concerning PA domains, duration and frequency was constructed based on the WHO global recommendations,[8] as well as by considering some culturally applicable items of the valid PA measures for elderly persons.[36,37] Accordingly, the participants were categorized into three groups based on their MIA-PA (walking) throughout the week: low PA (less than 150 min/week), moderate PA (between 150 and 300 min/week) and high PA (more than 300 min/week).[8]

The PA-SCAQ was pilot tested with 10 community-dwelling older adults in the West Bank with different levels of education (six women and four men between 62 and 83 years old). All questions and response categories were considered comprehensible, so the piloted version was not subjected to any additional modification, and was used in this study as PA-SCAQ.

Measures of physical functioning Hand Grip Strength (HGS).

The participant was tested in sitting position, shoulder adducted and neutrally rotated with the elbow flexed at 90° . The forearm was placed in a neutral position and the wrist was placed between 0° and 30° dorsiflexion and between 0° and 15° ulnar deviation. The participant was asked to squeeze the handle of the Jamar[®] Hydraulic Hand Dynamometer apparatus as hard as possible for five seconds and then relax.[38] The best value out of three for each hand was registered in kilograms. Hand grip has been described as a valid measure and good marker of physical performance among older adults,[39–41] and has very high test–retest reliability.[42]

Timed Up and Go (TUG). The person being tested started in a sitting position on a regular chair. The person stands up without using arms, walks 3 m, turns around, walks back to the chair and sits down again. The time it takes to complete the activity was registered in seconds.[43]

Short Physical Performance Battery (SPPB). The SPPB [44] consists of three components of lower body function tests (balance, gait speed and five times sit-to-stand test).

The balance tests include side-by-side stand, semi-tandem stand and tandem stand. Gait speed was tested using a 4-m gait speed; the participant was asked to walk at a self-selected speed for 4 m. This test was repeated twice at the participant's usual pace, and the shorter time of the two tests was recorded in seconds. The third component of SPPB is the five times chair stands test. The participant was instructed to stand up straight as quickly as possible for five times without stopping in between, while keeping arms folded across the chest. The time taken to accomplish the test was registered in seconds. Each SPPB component test (balance, gait and chair stand) was scored from 0 to 4 with a score of 0 indicating not attempted or could not do the test and a score of 4 indicating the highest category of performance. The total score of SPPB ranges from 0 (low performance) to 12 (high performance).[44] The SPPB was described as a valid and reliable measure of muscle strength and physical performance in community-dwelling older people and it has been tested for validity and reliability in diverse populations.[45,46]

Statistical analysis

Descriptive statistics were used to characterize the sample. Between groups comparisons were calculated. Age groups were categorized into (1 = 60–64 years old, 2 = 65–74 years, 3 = 75–84 years and 4 \geq 85 years old). ANOVA post hoc multiple comparisons tests were performed to determine differences between the groups according to age, gender and PA level.

Values of physical functioning in both men and women were calculated as mean (SD) among the three PA groups (low, moderate and high) according to SPPB scores, TUG and HGS.

Spearman's rank correlation coefficient was used to examine the correlation between the PA level and HGS, TUG, and total SPPB score as well as self-rated fitness. Statistical significance was set at $p < 0.05$. Data were analysed using the Statistical Package for the Social Sciences (SPSS) package, version 20 (SPSS Inc., Chicago, IL).

Results

A number of 162 (92%) of the participants were fully independent in the BADL, and 14 (8%) were partially independent according to the Katz Index. The majority of the participants 152 (86%) were able to walk without an assistive device (cane). A percentage of 73% of the age group (75–84 years) was categorized in the low PA group, compared to 24% of the age group (60–64 years), and 42% of the age group (65–74 years). All participants (100%) \geq 75 years old had a diagnosed disease, compared to 80% of the participants in the age group of 60–64 and 86% in the age group of 65–74 years. Demographic and clinical characteristics of the participants are illustrated in Table 1.

Results showed that participants in the higher age groups recorded lower level of PA in terms of walking minutes/week. Significant differences of the mean values of PA were

Table 1. Demographic and clinical characteristics of the participants ($n = 176$).

Variable	All ($n = 176$)	Women ($n = 115$)	Men ($n = 61$)
<i>N</i> (%)			
Age (years)			
60–64	63 (36)	44 (38)	19 (31)
65–74	77 (44)	48 (42)	29 (47)
75–84	34 (19)	22 (19)	12 (20)
≥ 85	2 (1)	1 (1)	1 (2)
Marital status			
With family	136 (77)	79 (69)	56 (92)
Living alone	40 (23)	36 (31)	5 (8)
Diagnosed disease			
Yes	152 (86)	101 (78)	51 (84)
No	24 (14)	14 (22)	10 (16)
Cardiovascular	39 (22)	22 (19)	17 (28)
Hypertension	86 (49)	57 (50)	29 (48)
Diabetes	54 (31)	36 (31)	18 (30)
Musculoskeletal	95 (54)	70 (61)	25 (41)
Osteoporosis	30 (17)	28 (24)	2 (3)
Using assistive devices			
Glasses	109 (63)	66 (57)	43 (71)
Hearing aids	4 (2)	3 (2)	1 (2)
Cane	24 (14)	12 (10)	12 (20)
Self-rated fitness			
Very poor	6 (3)	4 (3)	2 (3)
Poor	38 (22)	25 (22)	13 (21)
Quiet good	58 (33)	46 (40)	12 (20)
Good	54 (31)	30 (26)	24 (39)
Very good	20 (11)	10 (9)	10 (17)
Physical activity level			
Low	74 (42)	57 (50)	17 (28)
Moderate	85 (48)	52 (45)	33 (54)
High	17 (10)	6 (5)	11 (18)

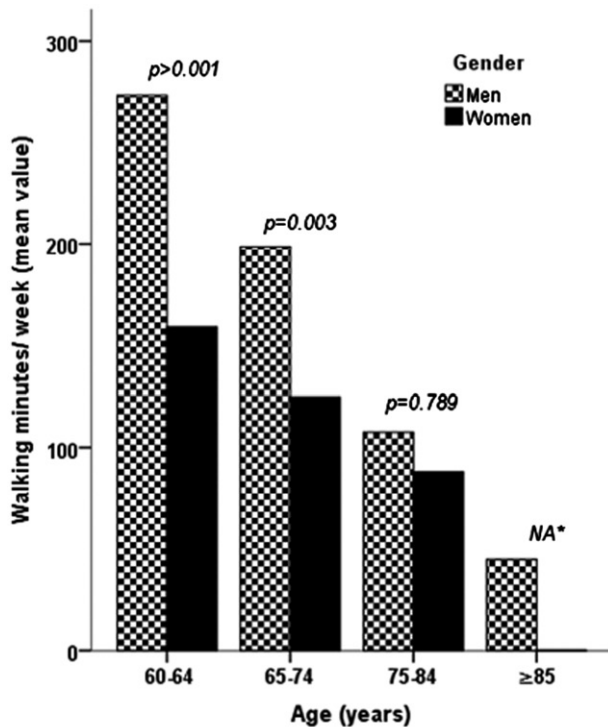
recorded between the age groups of 60–64 years, 65–74 years old and all other age groups ($p < 0.05$). Significant differences according to gender were recorded on PA level among the age groups of (60–64 and 65–74 years old), and no significant differences were recorded according to gender among the older age groups (Figure 1).

Values of physical functioning measures were significantly different among the four age groups, lower age groups recorded higher values on all physical functioning measures including TUG and SPPB ($p < 0.001$), as well as the HGS ($p = 0.002$).

Results showed that the mean values of self-rated fitness were significantly higher in the moderate and high PA groups compared to low PA group ($p < 0.001$), and in the high PA group compared to moderate PA group ($p = 0.024$). In addition, strong correlation was recorded between higher levels of PA and higher self-rated fitness values ($r_s = 0.657$, $p < 0.001$).

No significant differences were recorded on physical functioning values between the two genders except on the HGS values, where men recorded higher scores ($p < 0.001$). In addition, significant differences on all physical functioning values were recorded among different age groups in each gender ($p < 0.05$) (Figure 2).

Results of physical functioning tests among both genders showed that all participants both women and men in the moderate and high PA groups recorded better scores in all physical functioning tests compared to those in the low PA group ($p < 0.05$). No significant differences were recorded between moderate and high PA groups, except on the HGS tests among women ($p < 0.05$). Values of physical functioning among PA groups are illustrated in Table 2.



*NA= Not applicable

Figure 1. Mean values of PA level (walking minutes/week) among age groups according to gender (n = 176).

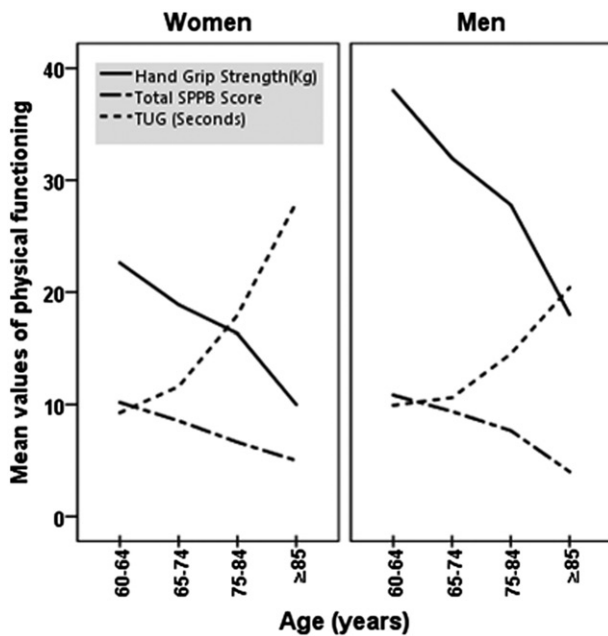


Figure 2. Mean values of physical functioning among different age groups according to gender (n = 176).

Among the low PA group, significant differences were recorded on TUG scores between the age groups of 60–64 years, 65–74 years old and the other older age groups ($p < 0.05$), and on SPPB score between the age groups of 60–64 years and the other older age groups ($p < 0.05$). No significant differences were recorded among different age groups on physical functioning values in the moderate and high PA groups ($p > 0.05$), except on the values of the HGS between the two age groups of 60–64 and 75–84 years old (Figure 3).

Significant correlations were recorded between all physical functioning measures and level of PA in terms of walking minutes ($p < 0.001$) (Table 3).

Discussion

Though patterns of PA may change with ageing,[31] and may differ between different populations, still walking remains as one of the most recommended and popular forms of PA among older adults.[25] Since walking is the most prominent pattern of PA among the older adults in Palestine; this study addresses PA in terms of walking as a MIA-PA based on the WHO recommendations.[8] Determining a precise measurement to assess PA in older adults is very challenging due to physiological and cognitive changes that occur with aging.[47] This challenge can be more difficult in a circumstance where the available valid measures for assessing PA in older adults [36,37] cannot be entirely applied according to different domains of PA within diverse cultural contexts.[24] Therefore, this study used an adapted questionnaire that considers social and cultural issues. Findings of the PA-SCAQ pilot testing revealed that walking was the most prevalent domain of PA among the older adults Palestinians. Within the scope of this study, we believe that the PA-SCAQ had good face validity and enabled us to obtain the required descriptive statistics about PA domains among the older adults in the West Bank/Palestine.

At least 60% of the global population fails to achieve the minimum recommendation of 30 min moderate-intensity PA daily.[48] The target of 30 min PA daily might be viewed reasonable to health professionals and the public. However, many people, especially in older age groups are not able to achieve it.[49] This is in accordance with our results which showed that participants in the higher age groups recorded lower level of PA. This might be attributed to decreased level of PA with advanced age.[50]

Since, physical functioning tests in general,[51] and the used physical functioning tests in this study particularly,

Table 2. Values of physical functioning measures among physical activity groups (low, moderate, high) (n = 176).

Variable	Women (n = 115)			Men (n = 61)		
	Low (n = 57)	Moderate (n = 52)	High (n = 6)	Low (n = 17)	Moderate (n = 33)	High (n = 11)
<i>Mean (SD)</i>						
Hand Grip (kg)						
Right hand	18.0 (5.51)	20.9 (5.08)	25.5 (7.36)	26.0 (9.13)	35.0 (9.29)	36.3 (6.80)
Left hand	15.7 (5.19)	18.5 (5.11)	21.0 (6.16)	23.9 (8.70)	31.0 (7.36)	33.8 (5.87)
Timed Up & Go (s)	15.4 (7.96)	8.8 (1.39)	8.2 (2.07)	18.2 (8.43)	8.6 (1.39)	8.8 (2.71)
Total SPPB score	6.8 (2.63)	10.6 (1.23)	10.5 (1.37)	5.5 (2.69)	10.9 (1.15)	10.7 (1.00)

$p < 0.05$ for all variables, comparisons between Low and Moderate, and Low and High PA groups.

may allow having normative gender differences. For example, HGS may vary significantly between women and men.[52] Though, gender difference is not a research focus of this study, we thought that it might be vital to report findings related to gender differences in this study, as this comparison may give a clearer descriptive statistics of our results. A recent similar study [53] indicated that men consistently had higher levels of PA than women for all PA measures. This corresponds with our results regarding PA levels among the age groups of (60–64 and 65–74 years old). However, this difference according to gender was not significant among the older age groups of 75 and older.

Attaining recommended levels of walking is positively associated with physical and functional well-being.[29,30] PA can help older adults reclaim or maintain a healthy aging process.[54,55] In this study, results showed that the low PA group ($n = 74$), representing 42% of the participants recorded higher prevalence of chronic diseases (97%) including hypertension (64%) and diabetes (50%). Several studies have shown that regular moderate-intensity PA such as walking has significant benefits for health and for the treatment of a number of diseases,[4,5,56] results that were supported in this study as well.

Our results revealed that a percentage of 73% of the age group (75–84 years) was categorized in the low PA group, and all participants ≥ 75 years old had a diagnosed disease. Though these results might be related to frailty which is theoretically defined as a clinically recognizable state of increased vulnerability resulting from aging-associated decline in reserve and function.[57] Further studies are needed to address aging-associated decline and frailty among the older adults in Palestine.

Though evidence have shown that loss of muscle strength may lead to functional decline with advanced age.[11,14,16] PA appears to have a beneficial effect on the physical functioning in older adults.[17] Our results have shown that there were no significant differences among different age groups in both moderate and high PA groups except on the HGS values. These findings are consistent with similar studies that

have shown that PA may help older adults preventing a decline in physical functioning.[18–21]

Self-rated fitness is considered as a reliable indicator of mental and physical health status in older adults, and higher levels of PA appear to be associated with better self-rated fitness.[58] Physically active walkers older adults have expressed a more positive attitude towards PA as well as a higher estimation of their own physical fitness than non-walkers.[26] These findings are corresponding with our results which showed that participants in the high and moderate PA groups recorded higher values on self-rated fitness compared to those in the low PA group.

As the exercise capacity of older adults tends to decrease with advanced age; older adults may have lower exercise capacities than younger persons. Hence, they may need a PA plan that is of lower absolute intensity and amount but similar in relative intensity and amount, since relative intensity takes into account or adjusts to an individual’s exercise capacity.[8] Evidence suggests that both moderate-intensity and vigorous-intensity activity provide similar health benefits in both adult age groups.[9,59,60] Results of the physical functioning tests in the present study showed a significant difference with respect to total SPPB score and TUG between the low and moderate and between the low and high PA groups ($p < 0.05$). However, no significant differences were recorded between the moderate and high PA groups. These findings are vital especially in the older adults population, where it might be appropriate to encourage a moderate-intensity PA,

Table 3. Correlation between level of physical activity and physical functioning measures ($n = 176$).

Variable	r_s	95% Confidence Interval	
		Upper	Lower
Hand grip (kg)			
Right hand	0.466	0.346	0.609
Left hand	0.453	0.320	0.587
Timed Up & Go (s)	-0.645	-0.659	-0.381
Total SPPB score	0.751	0.533	0.762

p Value < 0.001 for all variables.

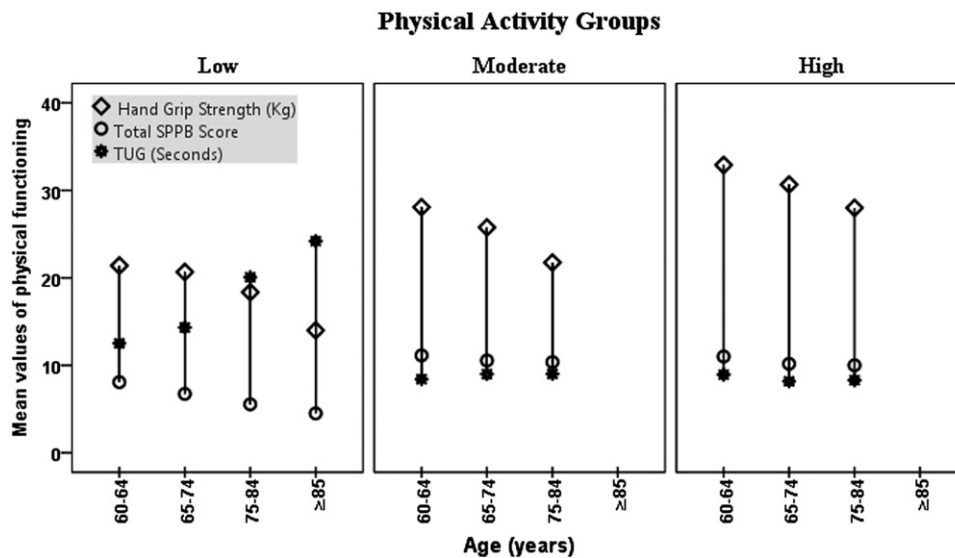


Figure 3. Comparisons of physical functioning values among PA groups according to age ($n = 176$).

even though the older adults should be encouraged to gradually progress from moderate to high PA.[8] Further investigations are needed to address PA intensity among older adults.

Physiotherapy has an important role in maximizing function and preventing functional decline in older adults.[61] In this study, components of physical functioning were assessed by measurements that are commonly used in the field of physiotherapy. Different tests in this study including TUG, SPPB and HGS were used to evaluate muscle strength and balance. These components of physical functioning can be assessed and treated by physiotherapy, which often may improve an individual's physical condition and restore function.[61–64] Physiotherapy practice appears to be an effective route for promoting a physically active lifestyle.[65] Although physiotherapists might experience barriers to promoting PA,[66] they can adapt PA in accordance with the older adults' abilities taking into consideration both physical and mental status.[62]

Limitation and strength

The first limitation of this study is that the cross-sectional design of this study does not allow a true causal relationship to be established. Though PA may affect physical functioning, it is also possible that reduced function may lead to lower levels of PA. We consider this as a limitation in this study, and this association requires further investigation to determine the direction of this relationship.

Second, a possible limitation of this study, that a small number of participants were included within the age category of ≥ 85 years, that can be attributed due to the extent of life expectancy in Palestine which equals 72.0 for males and 75.0 for females.[33] This also corresponded with limited number of the elderly ≥ 85 years whom had met the inclusion criteria of this study. Another potential limitation was that the PA-SCAQ determined an overall description of PA level based on the walking minutes without quantifying various types of PA. However, this limitation was minimized because the PA-SCAQ was developed in accordance with the WHO global recommendations on PA.[8] Further investigations are needed in future studies so as to help the development of more specific PA measures that are culturally appropriate, and to be used to differentiate intensities and domains of PA among the older adults in Palestine.

A key strength of this study is that the applied physical functioning tests were convenient to be administered in home settings, and the tests were appropriate for evaluating the physical performance of the participants.

Conclusion

There were strong associations between higher levels of PA and levels of physical functioning. Older adults who participated in MIA-PA for ≥ 150 min/week have recorded higher levels of physical functioning than older adults who were classified as low physically active (participated in < 150 min/week). Moderate to high level of PA may contribute to

maintain physical functioning among community-dwelling older adults.

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Disclosure statement

The authors report no conflicts of interest.

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