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The factors associated with self-reported physical activity in older adults living in the community

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Abstract

Background: despite the vast literature in the area, few studies examined the large range of factors associated with physical activity (PA) in the older adult collectively, information that could help develop a supportive culture for healthy ageing.
Objective: to identify the socio-demographic, social connectedness, physical environment and physical and mental health-related factors associated with PA.
Setting and participants: adults aged 65 and over living in the community ($n = 3499$).
Methods: this study used a cross-sectional design. Self-report, interview and physical assessment were the data collection methods used. The International Physical Activity Questionnaire (short form) measured PA in metabolic equivalents.
Results: 31.8% of older people did not meet the recommended guidelines. The regression model was significant, explaining 31.3% of the variance in PA ($F = 34.32$, $P < 0.001$). In order of strength of relationship, the β coefficients, the variables time

spent sitting, gender, quality of life, grip test, disability, age, depression, BMI, anxiety, employment, member of a non-church club, type of house and cognitive ability were significant factors associated with PA.
Conclusion: from a range of 40 original variables, this study identified the variables most strongly related to PA were not physical health or physical environment. They included modifiable variables, such as time spent sitting and mental health, which can be actively targeted in policy and practice. They also included non-modifiable variables such as gender and age that can be addressed through increased awareness and targeted health promotion.

Keywords: *physical activity, determinants, older adults, community dwelling*

Background

Guidelines recommend the equivalent of at least 30 min a day of moderate intensity activity 5 days a week for older adults [1]. Making recommendations is not enough; we need to understand the factors associated with physical activity (PA) in the older adult to optimise participation.

Utilising both objective and direct measurements research to date has identified many factors associated with PA in older adults [1–3]. These include many socio-demographic characteristics. Higher PA has been associated with younger age [1, 3–12], males [1, 2, 4, 6, 11–15], married [7, 12, 13] and higher education [2, 3, 7, 8, 12–14, 16]. Higher PA is also associated with higher income or socio-economic status [7, 8, 12, 13], certain modes of transport [4] and not been employed [2, 4, 12].

Social connectedness also has been shown to influence PA. Low PA has been associated with poor social networks [5, 17, 18], lack of company [6, 9, 18, 19], living alone [6, 16], loneliness [12, 15] and location of residence [1, 4, 7]. Research has also shown that indicators of poor environment and neighbourhood safety are associated with low activity levels [4, 6, 9, 12, 16].

In addition there are health factors that have been identified with lower PA levels. Lower PA levels is associated with higher BMI [3, 7, 11, 14, 15], smoking [2, 3, 7], higher alcohol use [5], diabetes [4, 15], injury/disability/medical condition/functional limitations [2, 4, 5, 8, 9, 12, 13, 18, 19], and higher number of medications [12].

The main psychosocial and appraisal barriers that directly and indirectly affect participation in PA include depression, general health and self-rated health [2, 4, 12, 14, 15, 18], vision [5] and fear of falling or injury [12, 19].

Despite the vast array of research there is a need for studies that contain representative samples of community-based older adults, utilise a reliable tool, analyse collectively a wide range of variables, in order to validate the cited associations with PA in older adults [1, 12]. Analysis of this nature will provide a hierarchy of the importance of the factors known to influence PA. These factors can then be used to inform and prioritise changes in policy and practice so as to optimise healthy ageing.

Aim and objectives

The aim of this study was to determine the socio-demographic, social connectedness, physical environment and physical and mental health-related factors associated with self-reported PA in community living older adults in the early 21st century.

Methods

Sample and recruitment

The cross-sectional study was based within a large prospective cohort study—The Irish LongituDinal Study on Ageing (TILDA) [http://www.tcd.ie/tilda/ (27 March 2015, date last accessed)]. The sample was selected using a random stratified sample of the population aged 50 and over living at home between 2009 and 2011 [http://tilda.tcd.ie/assets/pdf/DesignReport2010.pdf (27 March 2015, date last accessed)]. The response rate was 62.0% [20].

Data collection

The majority of data collection took place in the participants' home either through interview by a trained interviewer and by self-completion questionnaire. Assessment of physical measurements such as BMI and grip strength was by trained research nurses when the participants visited a health assessment centre or in their own home.

The study used the IPAQ short-form questionnaire to determine PA. This recorded minutes per week vigorous activity, moderate activity, walking and sitting. These were converted to total energy expenditure per week in METs (Metabolic equivalents) for the regression models and subsequently categorised for comparison with other studies utilising IPAQ scoring guidelines [21; https://sites.google.com/site/theipaq/scoring-protocol (27 March 2015, date last accessed)].

The 40 potential factors were grouped into five main categories: socio-demographic, physical health, mental health, social connectedness and physical environment. The socio-demographic factors were: gender, age, marital status, education, medical insurance status, household composition, employment, socio-economic status, household income and transport. The health-related variables were: smoking, alcohol (CAGE alcohol scale [22]), time spent sitting (IPAQ), number of chronic conditions, fall history, pain, disability (activities of daily living), self-rated vision, self-rated hearing, number of medications, BMI, waist–hip ratio, grip strength and childhood illness. The social variables included social connectedness score [23], participation in non-church club,

attends church and loneliness (UCLA scale [24]). The mental health parameters were cognitive ability (Mini Mental state exam, MMSE), anxiety (HADS anxiety scale [25], depression (CES-D scale [26]), worry, memory and quality of life. The built environment variables examined were: location of home, physical state of buildings in area, vandalism in area, type of housing and litter in area.

Analysis

Analysis used SPSS version 20. PA in MET's was log-transformed, as it had a marked left skewness. Bivariate analyses utilised *t* tests, Pearson's correlation or ANOVA as appropriate. Hierarchical multiple regression analysis was used to identify the variables associated with PA. To achieve the most parsimonious final model, we deleted factors from the analysis for two reasons. Firstly, if the collinearity between factors was high ($r > 0.7$) the factor with the weaker relationship to PA was removed. Secondly, factors were removed from the final model if their correlation to PA was of low significance ($P > 0.7$). The significance level was set at <0.05. The significant level within the bivariate analysis was corrected using Bonferroni adjustment for 40 variables and was therefore set at 0.001.

Results

The study recruited 3,499 people aged 65 and over of which 3,475 completed the IPAQ questionnaire which made up the sample available the analysis.

Sample descriptives

The sample had an average age of 72.6 ± 5.2 years and a BMI of 28.5 ± 4.5 kg/m^2. A greater proportion were: female (53%), in the 65–69 age group (34%), widowed (34%), lived alone (32%), were rarely lonely (79%), not disabled (82%), retired (69%), had no chronic conditions (57%) and were not often troubled with pain (64%) (Tables 1 and 2 and Appendix S1 available as Supplementary data in *Age and Ageing* online).

Physical activity

The analysis categorised 32, 34 and 34% as having low, medium or high PA, respectively. The proportions within the PA categories differed significantly across the age groups [χ^2 (6, n = 3475) = 151, $P < 0.001$]. The proportion of individuals in the high PA category declined with age and the proportion of individuals in the low activity category increased with age (Figure 1). This resulted in the number of participants not achieving recommended exercise levels ranging from 28% in the youngest age group (65–69 years) to 55% in the oldest age group (>80 years) (Figure 1).

Bivariate analysis

Of the 40 factors examined, 31 were significantly associated with PA (METs per week). The variables not reaching statistical significance were: total household income, waist–hip ratio, alcohol, smoking, childhood illness, attends church, living location, vandalism and litter (Table 1 and Appendix S1 available as Supplementary data in *Age and Ageing* online).

Multivariate analysis

There was no violation of the assumptions of normality, linearity or homoscedasticity. The nine variables non-significant in the bivariate analyses were removed from the final multivariate model. The first exploratory model revealed that there was too close a relationship between social connectedness/non-church attendance; worry/anxiety; and social class/employment; chronic health problems/long-term illness, so social connectedness, worry, social class and chronic health problems were removed from the model. Finally, review of the model indicated a low significant relationship between PA and marital status, insurance status, household composition and transport used, so these variables were removed from the model.

The final model with 23 variables was significant and explained 31.3% of the variance in PA (F (23, 1,752) = 34.32, $P < 0.001$). In this model, 13 variables remained significant (Table 2). In the order of strength of relationship (β coefficient): more time spent sitting, being female, having a lower quality of life, a lower grip test, more disabilities of daily living, being older, having a higher depression score, having a higher BMI, having a higher anxiety score, not employed, not a member of a non-church club, not living in a detached house/farm, and having a lower cognitive ability score were significantly associated with lower PA (Table 2).

Discussion

A total of 68.1% older adults met the national and international guidelines for recommended PA. This falls within the majority of previous self-report and objective studies results, which range from 2.4 to 83% [1, 4]. The percentage of older adults meeting the recommended levels of activity is on the high side of normal. Self-reporting of PA is often cited as leading to increased estimates. This could be due to giving the desirable answer or difficulty in recalling low levels of PA. In addition, the conversion of recorded activity from minutes to METs may cause an overestimation of activity as the METs values are most likely based on calculations from a younger population [27]. However, studies that have examined both methods have shown inconsistent results [1] and the correlation between results from both methods have been shown to be moderate [27].

The strength of this study is the multivariate analysis of a large number of factors from across a wide range of categories seldom examined together previously [17].

In support of some previous studies but in contrast to many studies, using both self-report and objective measures, education [7, 8, 12–14, 16], indicators of socio-economic status including income [7, 8, 13] and transport [4] were not significant in this study. However, in support of most previous research being female [1, 2, 4, 6, 8, 11–13, 19], and older [1–4, 6, 9, 11, 12, 17],

Table 1. Demographic profile and bivariate analysis of the factors that are associated with physical activity of participants (IPAQ MET minutes per week) in the final multivariate model (*t* test unless otherwise stated) (see Appendix S1 available as Supplementary data in *Age and Ageing* online for complete profile)

	Number/percentage/mean	IPAQ METs mean	*t*	*P*-value
Socio-economic variables				
Gender ($n = 3475$)				
Male	1646 (47)	3023 ± 3409	12.70	<0.001*
Female	1829 (53)	1847 ± 2472		
Age group ($n = 3475$)[b]				
65–69	1191 (34)	3046 ± 3370	77.48	<0.001*
70–74	957 (27)	2541 ± 2895		
75–79	709 (20)	2024 ± 2759		
80+	618 (18)	1429 ± 2168		
Employment status ($n = 3475$)[b]				
Employed	704 (20)	1978 ± 3470	7.80	<0.001*
Retired and other	2771 (79)	2512 ± 2873		
Social connectedness				
Membership of non-church club ($n = 3475$)[b]				
Yes	1694 (49)	2736 ± 3140	−9.84	<0.001*
No	1781 (51)	2088 ± 2848		
Built environment variables				
Type of housing ($n = 2669$)[b]				
Detached	1344 (50)	2473 ± 3133	4.45	0.001*
Semi-detached	639 (24)	2167 ± 2567		
Terrace	496 (19)	1856 ± 2489		
Apartment	49 (2)	1747 ± 1938		
Farm	1419 (5)	3305 ± 3959		
Physical health				
Disability (3475)[b]				
Not disabled	2865 (82)	984 ± 1741	107.38	<0.001*
IADL disability only	175 (5)	2115 ± 3072		
ADL disability only	222 (6)	598 ± 1465		
IADL and ADL disability	213 (6)	2648 ± 3082		
Time spent sitting (Hours) ($n = 3444$)	310 ± 151		−0.364	<0.001*
Grip strength (kg) ($n = 2331$)[a]	23.5 ± 8.9		0.303	<0.001*
BMI (kg/m^2) ($n = 3475$)[a]	28.5 ± 4.5		−0.112	<0.001*
Experienced fall in past year ($n = 3474$)				
Yes	759 (22)	2181 ± 2998	−3.60	0.001*
No	2715	2467 ± 3013		
Mental health				
Anxiety HADS-A scale ($n = 2750$)[a]	4.7 ± 3.5		−0.075	<0.001*
Mini Mental State examination ($n = 2363$)[a]	27.6 ± 2.6		0.193	<0.001*
Quality of life ($n = 2329$)[a]	44.5 ± 7.4		0.290	<0.001*
Depression CES-D ($n = 3403$)[a]	5.6 ± 6.5		−0.220	<0.001*
Worry ($n = 2517$)	14.6 ± 7.3		−0.125	<0.001

*Significant at ≤0.001.
[a]Correlation tests used.
[b]Analysis of variance used.

and being employed were associated with lower PA [2, 12]. The strength of the relationship between these factors and PA was ranked as follows: gender 2nd, age 4th and employment 10th (Table 2). The association between being employed and lower PA is worrying, as current policy and processes are aiming to increase the number of years spent working, which will delay the increased PA we observe at first retirement. Although these variables are non-modifiable, awareness that gender and age are strong influences on PA, should be used to specifically target health promotion in females and the older old, including promoting PA for as long as possible.

In contrast to most previous studies the majority of social connectedness and physical environment variables when examined in a multivariate manner were not significant [4–6, 9, 13, 15–17]. However, been a member of a non-church organisation and house type were significant and were ranked 11th and 12th, respectively, in their strength of relationship with PA. Those who lived in detached houses or farms were more physically active. Whether this is an indicator of wealth or location of house is hard to see, but whichever, it does imply that we need to be aware that those living in housing such as apartments are less likely to be physically active and would therefore need more encouragement. Caution must be used is the applicability of this results. This study did use questions previously used to reflect the physical environment; however, they only indicate a limited perspective of

Table 2. Final multiple regression model of the factors associated with physical activity in the older adult ($n = 596$)

	β	t	95.0% Confidence		% of variance explained by each variable	P-value
			Lower	High		
Gender	−0.127	−4.247	−0.228	−0.084	0.7%	<0.001*
Age in categories	−0.081	−3.541	−0.070	−0.020	0.4%	<0.001*
Education	0.013	0.592	−0.024	0.044		0.554
Employment status	−0.062	−2.775	−0.120	−0.021	0.3%	0.006*
Loneliness (UCLA loneliness scale)	0.041	1.624	−0.007	0.079		0.105
Membership of non-church club	0.063	2.958	0.026	0.127	0.3%	0.003*
Physical state of buildings in area	−0.024	−1.161	−0.060	0.015		0.246
Type of house	0.054	2.698	0.004	0.028	0.3%	0.007*
Disability	−0.095	−4.102	−0.101	−0.036	0.7%	<0.001*
Time spent sitting (hours per day)	−0.250	−11.567	−0.001	−0.001	5.3%	<0.001*
Grip test (dominant hand)	0.111	3.706	0.004	0.011	0.5%	<0.001*
Often troubled with pain	0.013	0.580	−0.039	0.072		0.562
BMI	−0.069	−3.322	−0.015	−0.004	0.4%	0.001*
Long-term illness	−0.017	−0.713	−0.046	0.021		0.476
Self-rated vision	−0.025	−1.083	−0.044	0.013		0.279
Self-rated hearing	−0.023	−1.051	−0.038	0.011		0.293
Number of regular medications	−0.037	−1.634	−0.047	0.004		0.103
Fallen in the last year	−0.011	−0.517	−0.075	0.044		0.605
Anxiety (HADS-A)	0.068	2.846	0.004	0.020	0.3%	0.004*
Quality-of-life scale (CASP-19)	0.127	5.049	0.006	0.015	1%	<0.001*
Depression (CES-D scale)	−0.073	−2.553	−0.012	−0.002	0.3%	0.011*
Mini Mental State examination	0.052	2.309	0.002	0.023	0.2%	0.021*
Self-rated memory	−0.016	−0.707	−0.039	0.018		0.479

BMI, body mass index.
*Significant at < 0.05.

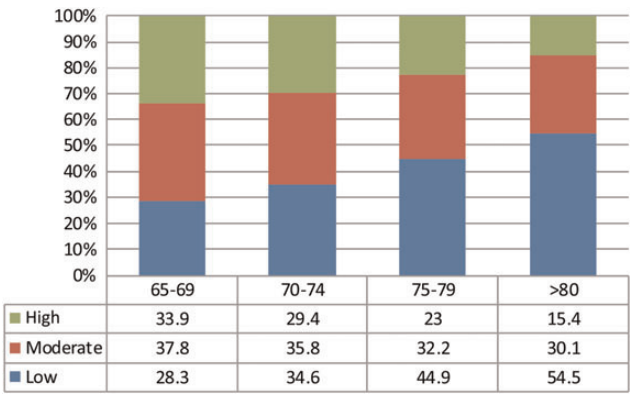

Figure 1. Percentage of participants in the different categories of physical activity across the age groups.

this parameter compared with other studies. While the physical environment does not arise as a main factor in this study, a poor or unsafe environment may contribute to anxiety, which was a significant variable. Creating a good environment that relieves the anxiety of the individuals may help improve PA. The observation that being a member of a non-church organisation was significant is an easy point to import into practice and health promotion.

Despite findings from most previous studies, most physical health predictors were not significant in the mix of variables examined in this multivariate study [2–5, 12, 13, 15, 17, 28]. In support of previous findings this study found that time spent sitting, grip strength, disability [2, 5, 12] and BMI [2, 3, 11, 12, 14, 15] were significantly associated with PA, ranking 1st, 4th, 5th and 8th, respectively, in their strength of association with PA. This seems to indicate it is neither the illness itself, nor the presence of most symptoms, even pain, but rather only when the illness gets so severe that it becomes a functional limitation that it significantly interferes with PA. Most of the factors significant here are modifiable and are therefore open to intervention at an individual and health promotion level. In this regard we should therefore promote activity despite disease for as long as possible. Time spent sitting had the strongest influence on PA, longer sitting times being associated with low PA. While this may be somewhat expected, those who sit a lot may include those who are very inactive and those who only do short bouts of activity even though this might be vigorous. This is an interesting finding and needs further investigation to explore the relationship between PA, sitting and subsequent health.

In support of previous studies, this study found that of the variables that remained significant, four were mental health variables. These were quality of life, depression, anxiety and cognitive ability [4, 9, 12, 29], ranking 2nd, 7th, 9th and 13th with regard their β coefficients, respectively. The relationship between PA and these factors may be bidirectional, i.e. PA influencing depression and depression influencing PA [29]. Although the relationship between mental health and PA is well established, it has not been explored in many of the large population-based studies [9, 12]. This finding indicates that policy and practice need to both be aware that those with mental health issues tend to have lower PA and facilitate intervention to increase PA within this group. This may not only improve the physical health but also improve the mental

health issues themselves. It is interesting to observe that while many of the physical health variables did not remain significant the mental health variables did.

It seems that the type of analysis used in this study, the variety and number of variables from many different domains were probable contributing factors in the difference in significance of the variables in this study compared with previous research revealing a hierarchy of variables that could be targeted to improve PA in the older adult.

Conclusion

This study has identified that when examined in a multivariate manner, with many factors, the main factors that influence PA were not physical health or physical environment. But are how many hours we sit a day, gender, functional ability, mental health and employment status. The more important influence of mental health compared with physical health was identified and has not previously been well established or attended to in practice or health promotion. This does not negate the influence of previously identified factors shown to influence PA, but it does indicate that these factors may have a mediating rather than a core influence on PA. Overall this information is useful to practitioners so that they can be aware of the most important factors that influence PA participation and so target PA intervention for these subgroups. In addition, the identification of specific modifiable factors may alert practice to the need to attend and modify these factors in order to optimise any PA health promotion strategies.

Limitations

The profile of the participants was a good match to the Irish population with a small underrepresentation of those with lower levels of education [20]. The use of self-report PA, particularly with relation to the levels of PA, may give rise to overestimations of PA for the reasons previously cited in the discussion. While this study did use a large range of factors, it did not survey the interest of the participants in PA, a dominant influence on participation in PA [9, 12, 17].

Key points

- Many factors previously seen to influence PA did not emerge as significant in this study.
- The most important influences of PA were not disease or physical environment.
- Sitting, gender functional ability and mental health were the most important factors associated with PA.
- The significance of factors such as age and gender reinforce the need to target subgroups to optimise their PA.
- Modifiable factors such as time spent sitting and mental health need to be addressed in interventions and health promotion.

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Conflicts of interest

None declared.

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Association between hand-grip strength and depressive symptoms: Locomotive Syndrome and Health Outcomes in Aizu Cohort Study (LOHAS)

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Abstract

Background: no study has examined the longitudinal association between hand-grip strength and mental health, such as depressive symptoms.
Objective: we investigated the relationship between baseline hand-grip strength and the risk of depressive symptoms.
Design: a prospective cohort study.

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