Physical activity and physical function in older adults: the 45 and up study

Lisa C. Yorston, Gregory S. Kolt, Richard R. Rosenkranz

Published Version Information

Citation: Yorston, L. C., Kolt, G. S., & Rosenkranz, R. R. (2012). Physical activity and physical function in older adults: The 45 and up study. Journal of the American Geriatrics Society, 60(4), 719-725.

Digital Object Identifier (DOI): doi:10.1111/j.1532-5415.2012.03906.x

Publisher's Link: http://onlinelibrary.wiley.com/doi/10.1111/j.1532-5415.2012.03906.x/abstract

Article type : Brief Reports

Physical Activity and Physical Function in Older Adults: The 45 and Up Study

Lisa C. Yorston, BAppSc(Hons), Gregory S. Kolt, PhD, Richard R. Rosenkranz, PhD

School of Science and Health, University of Western Sydney, Australia

Corresponding author: Gregory S. Kolt, University of Western Sydney, School of Science and Health, Locked Bag 1797, Penrith NSW 2751, Australia. E-mail: g.kolt@uws.edu.au

Running Head: Physical activity and physical function

ABSTRACT

Objectives: To determine the strength of the relationship between physical activity and physical function in older adults.

Design: Cross-sectional.

Setting: The 45 and Up Study baseline questionnaire, New South Wales, Australia.

Participants: Ninety-one thousand three hundred seventy-five Australian men and women aged 65 and older from the 45 and Up Study.

Measurements: Physical activity engagement (Active Australia Survey), physical function (Medical Outcomes Study Physical Functioning), psychological distress (Kessler-10), and self-reported age, smoking history, education, height, and weight were all measured.

Results: Higher levels of physical activity were associated with better physical function in older adults (correlation coefficient = 0.166, p <.001). Participants engaging in higher levels of physical activity had progressively lower likelihoods of functional limitation (middle tertile: odds ratio (OR)=0.39, 95% confidence interval (CI) = 0.38–0.41; highest tertile: OR = 0.28, 95% CI = 0.27–0.29). This relationship remained significant, but weakened slightly, when adjusted for age, sex, body mass index, smoking history, psychological distress, and

educational attainment (middle tertile: adjusted OR (AOR) = 0.48, 95% CI = 0.46–0.50; highest tertile: AOR = 0.36, 95% CI = 0.34–0.37).

Conclusion: There is a significant, positive relationship between physical activity and physical function in older adults, with older adults who are more physically active being less likely to experience functional limitation than their more-sedentary counterparts. Level of engagement in physical activity is an important predictor of physical function in older adults.

Key words: older adults, psychological distress, sedentary lifestyle, activities of daily living, aging

By 2050, the World Health Organization[i] estimates that 2 billion people worldwide will be aged 60 and older, an increase from 650 million people in 2000. Such rapid aging of the population has led to a rise in the incidence of chronic disease and disability that limits older adults' ability to perform the daily functional tasks (e.g., dressing, shopping) required for independent living.[2] This trend has placed significant economic and physical strain on health services throughout the world.[3] In Australia, adults aged 65 and older now use three to four times more health services than their younger counterparts,[4] a level that has become unsustainable.[5]

One well-established approach to countering functional limitation in older adults is regular engagement in physical activity (PA).[6–8] The relative risk of older adults losing functional independence may be decreased up to 30% through engagement in 150 to 180 minutes per week of moderate to vigorous PA (MVPA) (e.g., brisk walking).[7] This risk may decrease up to a further 30% with more-vigorous PA.[7] As such, older adults are now encouraged to engage in a minimum of 150 minutes of moderate-intensity PA (75 minutes of vigorous-intensity aerobic activity or an equivalent combination of each) per week.[9]

Regular MVPA in older adults is associated with significantly fewer of a range of conditions, including cardiovascular disease; cancers of the colon, breast, lung, and prostate; type 2 diabetes mellitus; and musculoskeletal disorders such as arthritis and osteoporosis.[9] PA also provides health benefits fundamental to functional independence in older adults, such as maintenance of healthy bones, muscles, and joints;[9] increasing stamina and muscle strength;[9] and enhancing mental well-being through reducing stress and anxiety and increasing self-esteem.[9]

Despite the well-understood benefits of PA, older adults are becoming less active as they age,[10,11] exacerbating their physical and functional decline.[9] The goal of the current study was to determine the relationship between PA and physical function in Australian older adults, and the odds of having a functional limitation, based on level of PA engagement (also adjusting for age, sex, body mass index (BMI), presence and level of psychological distress, educational attainment, and smoking history).

The current literature does not adequately address these questions. Recent studies have focused on specific types of PA (e.g., walking, stretching), rather than general or incidental PA, as a rehabilitative technique for specific health conditions.[12,13] Other studies have examined the health benefits of structured exercise programs for older adults.[14] Although much of the literature has established the link between physical inactivity and a decline in physical function, these studies have not been specific to older adults or not inclusive of the population aged 65 and older in Australia. With one-third of the Australian population expected to be aged 65 and older by 2051,[15] identification of the strength of the relationship between PA and functional limitations in Australian older adults may better inform health and aged care policies and practices. This study aimed to use current Australian data to determine the strength of such a relationship in older adults, in the context of specific lifestyle variables.

METHODS

This cross-sectional study analyzed self-report data from 91,375 older adults (aged ≥65) living in New South Wales, Australia. Data were drawn from the baseline dataset of the 45 and Up Study, a longitudinal cohort study, which is currently tracking the health of more than 10% of all adults aged 45 and older in New South Wales (the most populous state in Australia).[16] The University of New South Wales Human Research Ethics Committee granted ethics approval.

Participants

Participants in the 45 and Up Study were randomly sampled from the Medicare Australia (national health insurance) database. All adults aged 45 and older who were current residents of New South Wales were eligible for inclusion. Oversampling of individuals resident in rural areas and individuals aged 80 and older allowed for observation of health patterns particular to these groups, which are of interest to contemporary health researchers. Participants were included if they completed a self-administered postal questionnaire and provided signed consent for participation and follow-up. Recruitment was conducted from August 2006 to December 2008, with an 18% response rate.[16] The current study extracted and analyzed data specific to older adults (aged ≥65) from the baseline dataset. Figure 1 shows the number of participants in the overall 45 and Up Study and those in the current study.

Measurement

The 45 and Up Study incorporates a number of validated health-related instruments in its baseline questionnaire. The Active Australia survey elicited information regarding participants' frequency, intensity, duration, and type of PA engagement.[17] Participants indicated the number of times they engaged in different types of PA (walking continuously, vigorous gardening, or heavy work, moderate PA, and vigorous PA) and the hours and minutes spent doing each in the 7 days before questionnaire completion.[17]

Because current PA guidelines recommend 150 minutes of PA per week, [9] participants were classified as sedentary (0 minutes), not meeting guidelines (1–149 minutes), or meeting guidelines (≥150 minutes).[9] The Active Australia Survey exhibits good face and criterion validity[17] and has been demonstrated to have acceptable test–retest reliability as a self-reported measure of PA.[18]

Physical function was measured using the Medical Outcomes Study Physical Functioning (MOS-PF) scale, which indicates how participants' health limits them in their daily functional activities.[19] Based on their score, participants were classified as having severe functional limitation (≤20), significant functional limitation (21–40), moderate functional limitation (41–60), slight functional limitation (61–80), or no functional limitation (≥81).[20] The MOS-PF is a valid and reliable measure of physical functioning.[20]

The Kessler-10 (K-10) measures psychological distress (based on levels of depression and anxiety reported by participants) and exhibits good reliability for this purpose.[21] The K-10 is a 10-item questionnaire that uses a 5-point Likert scale for each question. Participants were categorized as likely to be well (score 10–19), likely to have a mild mental disorder (20–24), likely to have a moderate mental disorder (25–29), or likely to have a severe mental disorder (30–50).[21]

Other variables included were self-reported age, sex, educational attainment (no school certificate or other qualifications, school or intermediate certificate, higher school or leaving certificate, trade or apprenticeship, certificate or diploma, or university degree or higher), and smoking history (prior or current regular smoker, never regular smoker). BMI was calculated from self-reported weight and height, with participants categorized as underweight (BMI <18.5 kg/m^2), normal weight (BMI 18.5–24.9 kg/m^2), overweight (BMI 25.0–29.9 kg/m^2), or obese (BMI ≥30.0 kg/m^2), in line with World Health Organization classifications.[22]

Data quality

An external organization received baseline questionnaire data and entered them into the study database. To control for measurement errors in self-report of PA, data were excluded if reported PA engagement was more than 5 standard deviations above the mean (>2,826 minutes/week) or if the participant responded to less than 50% of any multicomponent question. Only participants with data available for all variables were included in the regression models (n = 62,290). Data on the physical function scale were inverted, reflected, and log-transformed to account for its negative skew.

Statistical analysis

Bivariate Pearson product moment correlations (PA and physical function) and partial correlations (PA and physical function, controlling for each covariate in turn), followed by multivariate logistic regression models, were used to identify the relationship between PA engagement and physical function in the sample. Raw and adjusted odds of a functional limitation occurring, given one's age, sex, BMI, psychological distress, smoking history, and educational attainment, were then calculated. Significance level was set at $p < .001$ for all analyses to reduce the risk of a Type 1 error occurring, as is common in large datasets such as this one.[23]

RESULTS

Physical activity and physical function in older adults

Physical activity

More than 73% of participants reported sufficient engagement in PA (≥150 minutes/week), although PA levels varied considerably with age. In both sexes, a sedentary lifestyle (0 minutes of MVPA) became more common with advancing age, by up to 9% in men and 16% in women (comparing youngest to oldest age groups) (Table 1).

Physical function

Of the total sample of older adults, almost 53% reported that they experienced no limitation in daily functional activities, and just over 15% reported a significant or severe limitation. The proportion of adults reporting a functional limitation increased substantially with advancing age, by 40% in men and 45% in women (comparing youngest to oldest age groups).

Relationship between physical activity and physical function

A statistically significant, positive relationship was found between PA and physical function in this sample of older adults (correlation coefficient = 0.166, $p < .001$). Older adults engaging in higher levels of PA had progressively lower likelihoods of having a functional limitation than in the lowest tertile of PA engagement. The relationship between PA and functional limitation remained significant, albeit slightly weaker, when all other variables were accounted for (age, sex, educational attainment, smoking history, BMI, and psychological distress). The variance in functional limitation attributable to PA engagement was also significant (Nagelkerke $R^2 = 0.086$, $p < .001$)

Older adults most at risk of reduced physical activity and physical function.

Advancing age and the presence of any level of psychological distress influenced the relationship between PA and functional limitation the most in older adults.

Age

Adults aged 85 and older were the most likely to report insufficient (30.4%) or no (16.8%) PA, in conjunction with some level of functional limitation (79.7%). Participants in this age group were also nearly 7 times as likely to develop a functional limitation as those aged 65 to 74. When accounting for age, sex, BMI, psychological distress, smoking history, and educational attainment, these odds increased further, making adults aged 85 and older almost 8 times as likely to experience a functional limitation as those aged 65 to 74 (Table 2).

Psychological distress

Psychological distress scores indicated that 8.4% of all older adult participants were experiencing some level of psychological distress, and older adults who experienced a moderate level of psychological distress were the most likely to experience a functional limitation—almost 7 times as likely as those likely to be well (Table 2).

Educational attainment, BMI, sex, and smoking history

Controlling for educational attainment, BMI, sex, and smoking history had little or no influence on the relationship between PA and functional limitation, although the odds of having a functional limitation were significant for each covariate (Table 2).

Almost 60% of respondents were classified as overweight or obese, and 1.8% were underweight. BMI notably decreased along with advancing age (Table 1). Older adults classified as obese or underweight had the highest odds of functional limitation, being more than 2 times as likely to experience a functional limitation as those who were normal weight (Table 2).

Older adults with no formal school certificate were also the most likely to report functional limitation. The odds of a functional limitation systematically decreased with each progressively higher level of education (Table 2).

Women were 1.5 times as likely to experience functional limitation as men in all age groups, and older adults with a history of regular smoking were at a slightly higher risk of functional limitations than nonsmokers (Table 2).

DISCUSSION

The relationship between PA and physical function was investigated in a large sample of older adults in New South Wales, Australia. There was a significant positive relationship between PA engagement and physical function in this sample, with older adults who engaged in higher levels (middle and highest tertiles) of PA having better physical function than those who were less active. This relationship also remained significant when controlling for a range

of personal and lifestyle factors, suggesting that engagement in PA is an important predictor of physical function in older adults.

These results align well with views expressed by the Centers for Disease Control and Prevention; older adults can obtain significant health benefits with regular, moderate PA, although additional health benefits can be achieved through greater amounts of PA.[9] Findings from a recent systematic review also noted that a moderate level of regular PA was beneficial for improving daily functioning in older adults and reducing the likelihood of functional limitation.[7] Findings of a significant, positive relationship between PA and physical function have also been found in other recent studies.[9,12–14]

The current study indicated that psychological distress and advancing age primarily influenced the relationship between PA and physical function. Psychological distress has previously been linked to less PA[24] and greater functional limitation[25] across a range of age groups. This study appears to be one of only two in Australia to quantify the link between all three variables in older adults. In particular, it highlights how older adults who experience any level of psychological distress are more than 4 times as likely to experience functional limitation as those who are likely to be well. An earlier study,[26] focusing only on high levels of psychological distress, found a similar relationship, with participants (aged ≥45) on average 6 times as likely to experience a functional limitation as those likely to be well. A separate study also indicated that approximately 30% of reductions in physical activity and increases in psychological distress over time are due to functional limitations and chronic health problems.[24]

Similarly, advancing age has previously been linked to decline in PA and physical function. One recent Australian study analyzed this relationship across each older age group using convenience sampling,[27] but the present study demonstrates the significance of the relationship in a more-representative sample of the population.

Almost 10% of older adults in the current sample were aged 85 and older, and 10% of the sample reported experiencing some level of psychological distress. With the population aged 85 and older rapidly growing, the information gained from this study may be beneficial to health professionals and government bodies alike when considering areas for future health funding aimed at reducing functional limitation in older adults, in particular, targeting funding toward early intervention strategies for older adults and increasing community services catering to older adults, (community transport, community physical activity, social programs) and toward the education of the health workforce.

A particular strength of this study was its use of data from the large cohort from the 45 and Up Study. Data from approximately 10% of older adults in New South Wales (the most-populous state in Australia) were analyzed. Although the low response rate (18%) means that the cohort is not necessarily directly representative of the general population,[28] empirical data from the 45 and Up Study indicate that cross-sectional analyses of relationships between variables within the cohort, the method of analysis used here, yields results that do not differ significantly from those obtained from a more-representative sample.[29] The cross-sectional design of the study was ideal for its primary aim of identifying the relationship between variables, although this design may partially limit the findings, in that cause-and-effect relationships could not be determined. The questionnaire currently only being available in English also limited the study. This format may have been inaccessible to participants with insufficient knowledge of English to complete the questionnaire. Additionally, the 45 and Up Study questionnaire was based on self-report of participants, which is open to biased reporting, although the integration of valid and reliable population-level measures into the questionnaire (the Active Australia Survey, BMI, MOS-PF) and controlling for outliers during statistical analysis reduced the effect of this bias. The authors accept that other variables, such as disease and disability, may also affect PA engagement and physical

function of participants, as well as the relationship between the two, but it was not possible to compile an accurate variable of individual conditions based on the data available. The authors attempted to address this through the inclusion of the psychological distress and age variables, which may serve as proxies for these, because persons with chronic disease and disability are often older and have higher rates of psychological distress.[30]

In conclusion, this study found that there is a significant association between PA and physical function in older adults. PA and physical function both declined with increasing age and psychological distress in the older adult population in this study.

ACKNOWLEDGMENTS

The Sax Institute manages the 45 and Up Study in collaboration with major partner Cancer Council New South Wales and partners the National Heart Foundation of Australia (NSW Division); NSW Health; beyondblue: the national depression initiative; Ageing, Disability and Home Care, Department of Human Services NSW; and UnitingCare Ageing.

Aspects of this work were presented at the American College of Sports Medicine 58th Annual Meeting, Denver, Colorado, June 2011.

Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Author Contributions: Lisa C. Yorston and Gregory S. Kolt conceived of the study. Richard R. Rosenkranz and Lisa C. Yorston conducted data analysis. Lisa C. Yorston led the research process. Gregory S. Kolt and Richard R. Rosenkranz contributed to preparation of manuscript.

Sponsor's Role: None.

REFERENCES

1.World Health Organization. Ageing and life course [on-line]. Available at: http://www.who.int/fch/depts/alc/en Accessed August 26, 2011.

2.Dunlop DD, Manheim LM, Sohn MW et al. Incidence of functional limitation in older adults: The impact of gender, race, and chronic conditions. Arch Phys Med Rehab 2002;83:964–971.

3.World Health Organization. Physical activity and older adults [on-line]. Available at: http://www.who.int/dietphysicalactivity/factsheet_olderadults/en Accessed August 26, 2011.

4.Productivity Commission. Economic Implications of an Ageing Australia, Research report. Canberra, Australia. 2005.

5.Banks G. Health costs and policy in an ageing Australia 2008 [on-line]. Available at: http://www.pc.gov.au/speeches/?a=81758 Accessed August 26, 2011.

6.Daly RM, Ahlborg HG, Ringsberg K et al. Associations between changes in habitual physical activity and changes in bone density, muscle strength, and functional performance in elderly men and women. J Am Geriatr Soc. 2008;56:2252–2260.

7.Paterson DH, Warburton DE. Physical activity and functional limitations in older adults: A systematic review related to Canada's physical activity guidelines. Int J Behav Nutr Phys Act 2010;7:39.

8.Simonsick EM, Guralnik JM, Volpato S et al. Just get out the door! The importance of walking outside the home for maintaining mobility: Findings from the Women's Health and Aging Study. J Am Geriatr Soc 2005;53:198–203.

9.Centers for Disease Control and Prevention. Physical activity for everyone: The benefits of physical activity [on-line]. Available at: http://www.cdc.gov/physicalactivity/everyone/health/ Accessed August 26, 2011.

10.Brownson RC, Boehmer TK, Luke DA. Declining rates of physical activity in the United States: What are the contributors? Annu Rev Public Health 2005;26:421–443.

11.Chau J, Smith B, Chey et al. Trends in population levels of sufficient physical activity in NSW, 1998 to 2005, Report No: CPAH06–001c. NSW Centre for Physical Activity and Health, 2007.

12.Angevaren M, Aufdemkampe G, Verhaar H et al. Physical activity and enhanced fitness to improve cognitive function in older people without known cognitive impairment. Cochrane Database Syst Rev 2008;(3):CD005381.

13.Luctkar-Flude MF, Groll DL, Tranmer J et al. Fatigue and physical activity in older adults with cancer: A systematic review of the literature. Cancer Nurs 2007;30:E35–E45.

14.Chin A Paw MJ, van Uffelen JG, Riphagen I et al. The functional effects of physical exercise training in frail older people: A systematic review. Sports Med 2008;38:781–793.

15.Population by Age and Sex, Australian States and Territories, Report No: 3201.0. Australian Bureau of Statistics, 2009

16.45 and Up Study Collaborators. Cohort profile: The 45 and Up Study. Int J Epidemiol 2008;37:941–947.

17.Australian Institute of Health and Welfare. The active Australia survey: A guide and manual for implementation, analysis and reporting 2003 [on-line]. Available at: http://www.aihw.gov.au/publications/index.cfm/title/8559 Accessed August 26, 2011.

18.Brown WJ, Trost SG, Bauman A et al. Test-retest reliability of four physical activity measures used in population surveys. J Sci Med Sport 2004;7:205–215.

19.RAND Health. Medical outcomes study: 36-item short form survey [on-line]. Available at: http://www.rand.org/health/surveys_tools/mos/mos_core_36item.html Accessed August 26, 2011.

20.Haley SM, McHorney CA, Ware JE. Evaluation of the MOS SF-36 physical functioning scale (PF-10): I. Unidimensionality and reproducibility of the Rasch item scale. J Clin Epidemiol 1994;47:671–684.

21.Kessler RC, Andrews G, Colpe LJ et al. Short screening scales to monitor population prevalences and trends in non-specific psychological stress. Psychol Med 2002;32:959–976.

22.World Health Organization. Nutrition: Body mass index [on-line]. Available at: http://www.euro.who.int/en/what-we-do/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi Accessed August 26, 2011.

23.Portney LG, Watkins MP. Foundations of Clinical Research: Applications to Practice. Englewood Cliffs, NJ: Prentice Hall, 2009.

24.Cairney J, Faulkner G, Veldhuizen S et al. Changes over time in physical activity and psychological distress among older adults. Can J Psychiatry 2009;54:160–169.

25.Iwasa H, Yoshida Y, Kumagai S et al. Depression status as a reliable predictor of functional decline among Japanese community-dwelling older adults: A 12-year population-based prospective cohort study. Int J Geriatr Psych 2009;24:1192–1200.

26.Banks E, Byles JE, Gibson RE et al. Is psychological distress in people living with cancer related to the fact of diagnosis, current treatment or level of disability? Findings from a large Australian study. Med J Aust 2010;193:S62–S67.

27.Fone S, Lundgren-Lindquist B. Health status and functional capacity in a group of successfully ageing 65–85 year olds. Disabil Rehabil 2003;25:1044–1055.

28.45 and Up Study Collaborators. Cohort profile: The 45 and Up Study. Int J Epidemiol 2008;37:941–947.

29.Mealing NM, Banks E, Jorm LR et al. Investigation of relative risk estimates from studies of the same population with contrasting response rates and design. BMC Med Res Methodol 2010;10:26.

30.Centers for Disease Control and Prevention. Public health and aging: Trends in aging: United States and worldwide. Morb Mort Weekly Rep 2003;52:101–106.

Table 1. Physical Activity Levels, Functional Limitation Scores, Body Mass Index (BMI), Psychological Distress Scores, Smoking History, and Education for the Total Sample, Men, and Women

Variable	Total Sample	Men, %			Total Men	Women, %			Total Women
	N (%)	65–74	75–84	≥85	n (%)	65–74	75–84	≥85	n (%)
Physical activity minutes									
Sedentary	5,950 (6.5)	4.2	6.8	13.2	2,776 (5.8)	4.1	9.6	20.5	3,174 (7.3)
Not meeting guidelines	18,173 (19.9)	16.4	22.6	30.0	9,420 (19.6)	16.4	24.0	30.8	8,753 (20.2)
Meeting guidelines	67,252 (73.6)	79.4	70.6	56.8	35,774 (74.6)	9.4	66.4	48.7	31,478 (72.5)
Functional limitation									
Severe	6,371 (8.1)	3.7	7.8	18.4	2,573 (6.1)	4.9	14.3	33.8	3,798 (10.3)
Significant	6,126 (7.7)	4.2	8.2	13.6	2,650 (6.3)	6.2	13.1	18.6	3,476 (9.4)
Moderate	8,600 (10.9)	7.0	11.7	16.7	3,948 (9.3)	9.8	16.6	18.0	4,652 (12.6)
Slight	16,142 (20.4)	16.6	23.5	23.0	8,273 (19.6)	21.1	23.2	16.2	7,869 (21.3)
No limit	41,870 (52.9)	68.4	48.8	28.3	24,796 (58.7)	58.0	32.8	13.4	17,074 (46.4)
BMI									
Underweight	1,477 (1.8)	0.6	1.3	3.2	449 (1.0)	1.7	3.2	6.8	1,028 (2.6)
Normal	32,198 (38.4)	28.9	41.4	56.2	15,762 (35.4)	38.1	45.5	54.4	16,436 (41.9)
Overweight	34,274 (40.9)	48.9	44.1	34.3	20,569 (46.2)	36.3	34.2	28.2	13,705 (34.9)
Obese	15,844 (18.9)	21.6	13.2	6.3	7,780 (17.4)	23.8	17.1	10.5	8,064 (20.6)
Psychological distress									
Well	69,027 (91.6)	92.6	92.1	89.7	37,650 (92.3)	91.9	89.9	84.7	31,377 (90.7)
Mild	3,638 (4.8)	4.3	4.5	6.3	1,811 (4.4)	4.8	5.6	8.3	1,827 (5.3)
Moderate	1,417 (1.9)	1.6	1.8	2.3	695 (1.7)	1.8	2.3	3.9	722 (2.1)
Severe	1,300 (1.4)	1.5	1.7	1.7	650 (1.6)	1.6	2.2	3.1	650 (1.9)
Smoking history									
Smoker	39,357 (43.1)	55.7	55.8	52.2	26,596 (55.5)	32.5	25.9	21.5	12,761 (29.4)
Nonsmoker	51,987 (56.9)	44.3	44.2	47.8	21,349 (44.5)	67.5	74.1	78.5	30,638 (70.6)
Education									
No cert	14,984 (16.8)	13.8	15.5	16.2	6,831 (14.6)	16.7	22.1	25.8	8,153 (19.2)
School cert	23,557 (26.4)	17.8	18.2	21.0	8,510 (18.2)	35.2	35.9	36.4	15,047 (35.5)

HSC	8,484 (9.5)	8.2	9.6	10.9	4,167 (8.9)	9.4	11.1	12.2	4,317 (10.2)
Trade	12,050 (13.5)	21.4	21.0	17.4	9,843 (21.0)	4.9	5.6	5.8	2,207 (5.2)
Cert/diploma	15,773 (17.7)	18.3	17.5	16.6	9,389 (17.9)	19.3	15.2	12.5	7,384 (17.4)
Degree +	14,385 (16.1)	20.5	18.2	17.9	9,110 (19.4)	14.5	10.0	7.3	5,275 (12.5)

Table 2. Multivariable Logistic Regression Analysis: The Likelihood of Functional Limitation According to Variable (Physical Activity, Psychological Distress, Age, Sex, Body Mass Index, Educational Attainment, and Smoking History)

Variable	Functional Limitation, n (%)		Odds Ratio of Having a Functional Limitation (95% Confidence Interval)	
	None	Some	Raw	Adjusted[a]
Physical activity tertile				
Lowest[b]	9,127 (35.0)	17,061 (65.0)	1.00	1.00
Middle	15,010 (58.0)	10,865 (42.0)	0.39 (0.38–0.41)	0.48 (0.46–0.50)
Highest	17,688 (65.5)	9,313 (34.5)	0.28 (0.27–0.29)	0.36 (0.34–0.37)
Psychological distress				
Well[b]	36,351 (58.0)	26,302 (42.0)	1.00	1.00
Mild disorder	800 (24.3)	2,486 (75.7)	4.28 (3.94–4.66)	3.92 (3.57–4.30)
Moderate disorder	217 (17.1)	1,049 (82.9)	6.76 (5.78–7.89)	5.64 (4.78–6.65)
Severe disorder	238 (20.6)	916 (79.4)	5.15 (4.43–6.00)	4.19 (3.55–4.94)
Age				
65–74[b]	29,282 (63.5)	16,855 (36.5)	1.00	1.00
75–84	11,432 (41.9)	15,837 (58.1)	2.38 (2.30–2.46)	2.79 (2.68–2.90)
≥85	1,156 (20.3)	4,547 (79.7)	6.95 (6.41–7.53)	7.76 (7.11–8.46)
Sex				
Male [b]	24,763 (58.7)	17,444 (41.3)	1.00	1.00
Female	17,074 (46.3)	19,795 (53.7)	1.64 (1.59–1.69)	1.95 (1.88–2.03)
BMI				
Normal[b]	16,701 (59.8)	11,241 (40.2)	1.00	1.00
Underweight	495 (41.1)	709 (58.9)	2.05 (1.80–2.34)	1.35 (1.16–1.57)
Overweight	16,772 (56.0)	13,181 (44.0)	1.19 (1.14–1.23)	1.47 (1.41–1.53)
Obese	5,008 (36.2)	8,824 (63.8)	2.66 (2.54–2.78)	3.25 (3.09–3.42)
Education				
No certificate[b]	5,101 (41.6)	7,173 (58.4)	1.00	1.00
School or intermediate	9,905 (49.4)	10,162 (50.6)	0.71 (0.67–0.74)	0.83 (0.78–0.88)
HSC	3,875 (52.8)	9,469 (47.2)	0.63 (0.59–0.68)	0.77 (0.71–0.83)
Trade	5,563 (53.5)	4,837 (46.5)	0.60 (0.56–0.64)	0.90 (0.84–0.96)
Certificate or diploma	8,213 (57.7)	6,023 (42.3)	0.51 (0.48–0.54)	0.72 (0.68–0.77)
Degree +	8,503 (64.5)	4,673 (35.5)	0.38 (0.36–0.41)	0.58 (0.54–0.61)
Smoking history				
Nonsmoker[b]	24,234 (54.4)	20,327 (45.6)	1.00	1.00
Smoker	17,616 (51.0)	16,899 (49.0)	1.16 (1.12–1.20)	1.36 (1.31–1.42)

[a]Adjusted for physical activity, psychological distress, age, sex, education, smoking history, body mass index (BMI)).

[b]Reference category.

Figure 1. Participants in The 45 and Up Study and in the present sample of adults aged 65 and older