Original Article

Lifetime adherence to physical activity recommendations and fall occurrence in community-dwelling older adults: a retrospective cohort study

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ABSTRACT

Wright RL, Robinson PD, Peters DM. Lifetime adherence to physical activity recommendations and fall occurrence in community-dwelling older adults: a retrospective cohort study. *J. Hum. Sport Exerc.* Vol. 7, No. 1, pp. 310-320, 2012. Falling is a major health concern for community-dwelling older adults. Regular physical activity has been proposed to prevent falls. The aim of this study was to assess whether the achievement of the 2004 UK Department of Health physical activity recommendations over a lifetime had a protective effect against falling in older people. 313 community-dwelling older adults completed a questionnaire about lifetime physical activity and fall occurrence. There were significantly fewer falls in those who had led an active lifestyle compared to those who had not (χ2Yates=4.568, p=0.033), with a lower relative risk of fall occurrence for the active respondents (RR=0.671) compared to the inactive (RR=1.210). Of those who were sufficiently active in their early adulthood, the decade where there was the biggest decrease in remaining active enough was in the 60s. It is concluded that an active lifestyle may have decreased the likelihood of having a fall in older age. **Key words**: EXERCISE, FALLS, LIFESTYLE, ELDERLY, GUIDELINES.

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INTRODUCTION

Falls and fall-related injuries are among the most serious and common medical problems experienced by the older population. Over 60% of community-dwelling people aged 50 and over reported at least one fall in a 4-year period (Painter et al., 2009), with women appearing more likely than men to fall (De Rekeneire et al., 2003). In non-fatal falls, almost half are unable to get up without help (Tinetti et al., 1993), and nearly one-third of falls in community dwelling older adults produce pain lasting for 2 or more days (Berg et al., 1997). The total annual cost of falls in the USA is $23.3 billion (Davis et al., 2010) whilst in the UK population the cost is £981 million (Scuffham et al., 2003). With an increasingly ageing population, these statistics signify major concern for health professionals and governments.

In the United Kingdom, the recommendations for physical activity for protection against chronic conditions such as cardiovascular disease, type II diabetes, cancer and obesity state that a minimum of 30 minutes of at least moderate intensity physical activity on at least 5 days of the week should be undertaken to achieve substantive health benefits (Department of Health, 2004). This is consistent with recommendations from other health organizations (Department of Health and Ageing, 1999; Swiss Federal Office of Sports et al., 2000; World Health Organization et al., 2003). Regular physical activity has also been proposed as one method of preventing falls and therefore fall-related injuries in older adults (Kannus, 1999), and higher levels of physical activity are associated with a decreased risk of recurrent falling (Peeters et al., 2010). Furthermore, physical activity interventions have been investigated with the aim of reducing the risk factors associated with falling (Lord et al., 1995; Lan et al., 1998; Li et al., 2004). It has also been estimated that if the whole population adopted the physical activity recommendations, health care costs for hip fractures alone could be reduced by 50% (Nicholl et al., 1994). However, most studies have investigated the effects of physical activity on risk factors for falls rather than falls themselves, and no study has as yet evaluated the impact of lifetime adherence to generic physical activity recommendations on fall occurrence.

Older adults are reported to be generally less physically active than young adults, with a tendency when active to participate in lower intensity activities (Chodzko-Zajko et al., 2009). However, the majority of data is cross-sectional or longitudinal over a few years rather than decades. Therefore, it is unclear whether there are gradual decreases in physical activity levels over the years, or whether there are key periods where physical activity patterns experience changes. Knowledge of patterns of physical activity across adulthood could be useful in targeting groups most likely to benefit from interventions to increase or sustain activity in older age.

The assessment of lifetime physical activity is key to the identification of etiologically relevant prior age periods for disease risk as well as the optimum duration, intensity, and frequency of regular lifetime activity (Chasan-Taber et al., 2002). The estimation of historical physical activity is also important in evaluating the efficacy of current guidelines in health promotion. Any study investigating lifetime physical activity in current older adults, out of necessity, involves information gathered retrospectively in the form of self-reports (Dawson et al., 2003). Unless a study group is assessed longitudinally from youth to old age, recall is the only option available to many researchers.

Few physical activity questionnaires have been investigated in exclusively elderly populations with many used in epidemiological studies developed predominantly using younger, male populations (Slattery, 1996). Of the questionnaires that are available to evaluate long-term physical activity, some have not included occupational (Kriska et al., 1988) or household activities (Kriska et al., 1990) and none have been designed

specifically to assess the adherence to current recommendations for physical activity (Friedenreich et al., 1998; Orsini et al., 2007).

Therefore, the primary aim of this study was to investigate whether there was a lower occurrence of falling in community-dwelling older adults who had been sufficiently active according to physical activity guidelines throughout their adult years. The secondary aim was to identify patterns of attainment of physical activity guidelines across the adult life course in this population.

MATERIAL AND METHODS

Instrument

A questionnaire was designed to assess lifetime physical activity in each decade of life against the achievement of minimum current physical activity guidelines for health benefit (at least 30 minutes of at least moderate intensity physical activity on five or more days of the week). Ethical approval was granted through institutional procedures undertaken at departmental level and required voluntary participation with written fully informed consent.

The physical activity questions asked how many days per week that at least 30 minutes of moderate or higher intensity physical activity was accumulated in leisure time and in occupational time (including housework) with examples given for reference (Whitehead et al., 1995; American College of Sports Medicine, 2000). It was then possible to create 'active' versus 'not active' categories from the responses based on attainment of 5 days or more or less than 5 days, respectively. Light-intensity activities were not included as these are not included in the public health guidance. Responses were divided into decades from the 20s onwards, and respondents were asked to complete each decade including their current one.

Test-retest reliability was investigated in 28 participants (4 males, 24 females, age 69 ± 8 years) with the re-test questionnaire conducted 2 months after the first questionnaire. Test-retest reliability was determined using the Kappa statistic as an absolute measure of agreement with acceptable levels of agreement taken from Landis and Koch (Landis & Koch, 1977) and the percentage level of agreement for each test-retest item. The physical activity responses were analysed in their answered format (i.e. 0-7 days per week) and also by recoding into either the 'active' or 'not active' categories (Department of Health, 2004).

For the number of days active per week, the Kappa statistic showed fair repeatability for each decade, except the 50s which showed slight repeatability (Table 1). No Kappa statistic was computable for the 70s and 80s due to empty categories impacting upon the essentially cross-tabulation based analysis. There was a high percentage of agreement for the activity questions when the respondents re-classified their activity to an accuracy of ± 1 day of the response given from their first questionnaire. When recoded into 'active' and 'not active' the Kappa statistic showed better absolute repeatability ranging from 0.3 to 1.0. Similarly, percentage of agreement (exact agreement of active and not active status) was also improved ranging from 68 to 100%. When identified as either achieving 'active' status over their lifetime (achieving recommendation in every decade) or 'not active' status over their lifetime (not achieving the recommendation in one or more decades) observed Kappa was 0.5 (moderate) with 75.0% classification agreement. Based on these test-retest statistics, the physical activity questions were considered reliable for categorising 'active' or 'not active' enough for each decade across the life-course.

Table 1. *Test-retest statistics for the physical activity questions (n=28)*

Decade	Kappa	%Agreement	Kappa active/not active	% Agreement active/not active
20s	0.27	75	0.73	89
30s	0.29	79	0.79	93
40s	0.35	75	0.48	75
50s	0.21	54	0.29	68
60s	0.29	68	0.39	72
70s	--	70	0.78	90
80s	--	67	1.0	100

The fall-related questions concerned falls history and adapted a monthly falls recall questionnaire (Lord et al., 2001) to include all falls occurring in older age. A fall was defined as a loss of balance resulting in the body, or part of the body, coming to rest on the ground (Nowalk et al., 2001; Jensen et al., 2002).

Participants

A sample of 313 community-dwelling older adults (78 men, 235 women; details in Table 2) who attended community-based older adult social group meetings participated voluntarily in this study. Respondents were all resident in the community (as opposed to sheltered or nursing accommodation) and aged 60 or over.

Table 2. *Datails of the respondents.*

	Males (n=78)	**Females** (n=235)
Age (y)	71.4±7.5	70.5±7.4
Height (m)	1.74±0.09	1.63±0.07
Body weight (kg)	76.2±10.8	66.4±11.4
University educated	30.8% (24)	26.8% (62)
Smoker	48.7% (38)	38.3% (90)
Uses a walking aid	5.1% (4)	10.3% (24)

Data analysis

The relationships between activity levels (active/not active) and fall status (faller/non-faller) were investigated using Chi-squared analysis. Yates' value for continuity was used for 2x2 Chi-square analyses. The level of significance was set at p=0.05. The odds ratio and relative risk were also calculated. The percentage of respondents active enough in each decade subsequent to having been identified as active enough in the previous decade(s) was reported.

RESULTS

Thirty percent (n=94) of the respondents had no history of falling, with the other 70% (n=219) reporting at least one fall.

Achievement of at least 30 minutes of at least moderate intensity physical activity on at least 5 days of the week during each decade of life for fallers and non-fallers can be seen in Figure 1, and demonstrates that the percentage complying with the physical activity guidelines reduces with increasing age category. Different trends in this decline can be observed, with a steady decrease in the percentage of those active enough occurring from the 30s onwards in the faller group, whereas in the non-faller group the percentage of those active enough remains relatively constant until the 50s after which a decline is also observed. However, these observed trends did not reach a statistically significant difference between groups on an individual decade basis. The only increase in physical activity attainment was for the non-fallers in the 80s, which may be due to the low participant numbers in this category (n = 5). Thirty percent of the participants (male n=24/78, female n= 70/235) achieved the recommendations in every decade of their life and were therefore classified as the 'active' group in subsequent analyses. There were significantly fewer falls in the active group than the non-active group (χ2Yates = 4.568, p = 0.033). The odds ratio for having a fall was 1.802. The relative risk (RR) for the non-active group was 1.210 whilst for the active group the relative risk was 0.671.

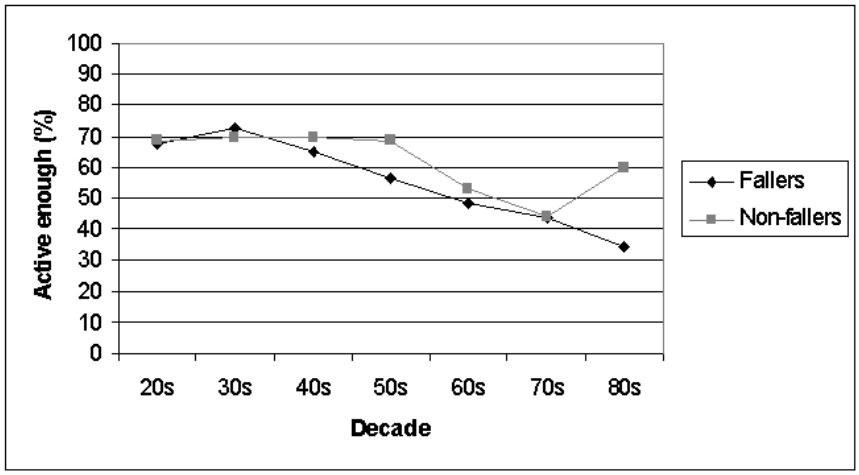

Figure 1. *Percentage of fallers and non-fallers who achieved enough physical activity in each decade.*

Two hundred and eight respondents reported themselves to be active enough when they were in their 20s. The number of people who remained sufficiently active steadily declines to 192 in their 30s, 170 in their 40s, 150 in their 50s and finally 109 in their 60s. Of those who had been active enough in their 20s, only 52.4% were still active enough in their 60s (active enough in each decade from their 20s to 60s inclusive; see Figure 2). In contrast, of those not active enough in their 20s, 30 respondents (28.6%) were then active enough in their 30s. This was the only decade where there was a large increase from the previous decade. In their 40s, only 9 people became active after being inactive in their 20s and 30s (13%), and in the 50s this number was only 4 (6%).

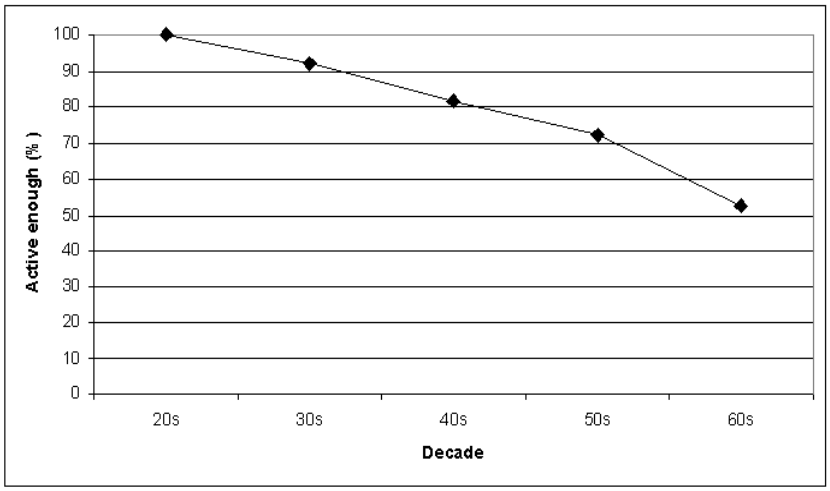

Figure 2. *Percentage of participants who were active enough in their 20s who remain active in each subsequent decade.*

DISCUSSION

The current study provides new information about lifetime physical activity and falls in community-dwelling older adults. Those older adults who had achieved an active status based on recommended activity for health benefits (Department of Health, 2004) were less likely to have experienced a fall than those who had led a less physically active lifestyle. The study also shows that although the numbers of people remaining active decreases with increasing age, the biggest population decrease occurs when people are in their 60s.

There was a 33% reduced risk of experiencing a fall in those individuals who had been active throughout their life. As 70% of the cohort in this study had experienced at least one fall in older age, which is consistent with the 60% of community-dwelling older adults who had experience a fall in a 4-year period in another study (Painter et al., 2009), this reduced risk of falling due to leading a physically active lifestyle is an important finding. This is particularly relevant as falls account for 0.85-1.5% of total health care expenditure in the USA, the EU, Australia and the UK (Heinrich et al., 2010). Based on falls requiring hospital attendance in a 12 month period (Scuffham et al., 2003), this 33% reduced risk is equivalent to reducing Accident & Emergency department attendance in the over 60s from 534.9 per 10,000 population to 358.4 per 10,000 population purely from the population attaining and maintaining an active lifestyle. If the incidence of falls can be reduced through physical activity, the number of hip fractures will also be reduced as 90% of hip fractures occur as a result of a fall (Grisso et al., 1991). Therefore, this study supports promotion of habitual physical activity to reduce the risk of falling in older age, alongside the other known health benefits of an active lifestyle such as decreased cancer risk (Friedenreich & Cust, 2008), decreased risk of coronary heart disease (Batty, 2002) increased bone quality and strength (Daly & Bass, 2006), and increased bone mineral density (Kolbe-Alexander et al., 2004).

There was a decrease in the number of people achieving the physical activity recommendations with increasing age. The 60s appeared to be the decade where the largest decline occurred in those people who had been physically active enough dropped their activity level to below the recommendations. This could coincide with retirement in the 60s changing the lifestyle of many people, who may previously have been active through their occupation. Confirmation of this theory is beyond the scope of this study, which did not differentiate between leisure time and occupational physical activity. Future research could focus on which people stay active enough when they reach retirement, and investigate the factors that would encourage the maintenance of sufficient physical activity into older age.

The numbers of people who increased their activity in later years was much smaller. Apart from becoming active enough in their 30s after not being sufficiently active in their 20s, the number of people who later became active enough was in single figures per decade. This suggests that although it is possible for people to increase their activity levels later in life, it is uncommon that people actually do and rather that these inactive and ill-health-related lifestyle behaviours are determined in relatively early adulthood and persist from then on. Previous research has found that higher levels of current physical activity are associated with a lower risk of subsequently developing recurrent falling patterns (Peeters et al., 2010). However, if older adults are unlikely to increase their physical activity levels, it is likely that these active older adults in the study by Peeters et al. (2010) were physically active over a long time period. Therefore, the establishment of sufficient habitual physical activity that may benefit an older person is important early in life as despite the potential benefits of an active lifestyle, it is difficult to persuade inactive older adults to become more physically active and to sustain the level of activity (Resnick & Spellbring, 2000) particularly if these inactive habits have been developed and entrenched over the life course.

This study was concerned with the examination of falls and achievement of the recommended quantity of physical activity over the life course and did not investigate lower intensity or lower frequency activity levels. Previous research has also suggested the benefits of lower levels of lifetime physical activity in the prevention of falls. Elderly women who reported regular activity in sports before the age of 40 had fewer falls than those who were less active (Bischoff et al., 2001). However, regular activity was only defined as "at least once weekly", which is below the current physical activity guidelines, and no occupational or household activity was accounted for. Despite these limitations, the findings give strong indications that even lower levels of physical activity are still beneficial in reducing fall risk in later life. Therefore, care has to be employed when recommending physical activity that some activity is not misinterpreted as being of limited or no value if the level does not reach specific targets (Blair et al., 2004). The consensus is that some physical activity is better than none, and any amount of physical activity will impart some health benefits (Chodzko-Zajko et al., 2009). Recent adjustments have been made to the physical activity recommendations in the UK (Department of Health, 2011) stating a weekly target of at least 150 mins (the equivalent of 5 days x 30 mins) moderate intensity activity or at least 75 mins of vigorous intensity activity. This clarification on intensity ensures that the benefits of vigorous as well as moderate intensity activity are explicit, and a weekly total target may be easier to work around busy lifestyles.

The test-retest regarding the number of days per week in each decade upon which the recommendations were achieved identified that this information cannot be recalled reliably. Kriska et al. (1988) used the Kappa statistic and accepted values of 0.39-0.47 as a fair agreement for their test-retest on questions relating to how often respondents participated in physical activity and these values are consistent with those presented here. However, when the data was reclassified into active enough/ not active enough categories this data showed substantial agreement for some decades. Repeatability of individual decade items using percentage agreement also showed the repeatability of the active enough/ not active enough

categories to be high, only dropping below 70% for the participants recalling their physical activity levels in their 50s and 60s. This may be a factor caused by career changes or retirement that occurred during these decades. Based on the combined information from these Kappa figures and the percentages of correct reclassification, the measure of physical activity recall in relation to attainment of the recommended physical activity guidelines for health was considered acceptable for studies of this nature.

The ability to accurately recall physical activity levels in the distant past will always present a limitation to studies of this nature. However, unless a study is able to be longitudinal over several decades, recall questionnaires are a necessary method to evaluate the etiological effects of physical activity on the development of subsequent chronic disease or conditions. Therefore, limitations need to be accepted and questionnaires designed to limit recall error as much as possible. In addition, questionnaires are the only feasible method of assessing habitual physical activity in larger populations (Shephard, 2003). There has never been, and never will be, a randomized, double-blind, placebo-controlled trial demonstrating that physical activity in youth, adulthood or old age reduces fall risk in older persons (Karlsson, 2004). It is not possible to conduct such a study blinded, as the participants will always know if they are randomized to physical activity or not. Even if the study was conducted un-blinded, it would be ethically unacceptable to randomize individuals to a no-physical activity group. Therefore, despite the limitations of a retrospective questionnaire approach, this method is the only feasible way to assess lifetime physical activity levels in a current group of older adults.

CONCLUSION

- Leading an active lifestyle throughout adulthood was associated with a decreased risk of experiencing a fall in a cohort of community-dwelling older adults.
- The number of respondents achieving sufficient activity for health benefits decreased with increasing age, with the largest decreases occurring when people reached their 60s.
- Strategies are needed to successfully promote the maintenance of health enhancing physical activity levels to establish more favourable profiles throughout adulthood, and especially post-retirement and into old age to reduce the risk of falling.

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