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ORIGINAL INVESTIGATION

Volunteering as a productive ageing activity: the association with fall-related hip fracture in later life

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Abstract This paper aims to contribute to the literature on the relationship between productive and healthy ageing as two key theoretical concepts in contemporary ageing. Specifically, volunteering as a productive activity in later life has been associated with social and health benefits for older people. Evidence from the literature has generally focused on global outcomes, such as mortality and self-rated health, or on measures of psychological well-being. This study explored whether volunteering is protective of an important adverse health outcome in later life, that of fall-related hip fracture, utilising data from a case control study of 387 participants. The results showed that volunteer activity in older age remained significantly protective of hip fracture risk [OR: 0.61 (0.38–0.99)], independent of social and physical activity, social support and health status, supporting the hypothesis of a relationship between the concepts of productive and healthy ageing. Whilst further studies are clearly needed to establish causality, these results suggest that health benefits of volunteering in later life might be more extensive than previous studies have shown.

Keywords Volunteering · Productive ageing · Healthy ageing · Hip fracture risk · Older age

Introduction

In the contemporary ageing environment, there is growing interest in how older people can age well. Recent theories of positive ageing are beginning to explore the importance of the concepts of productive and healthy ageing in later life (Herzog et al. 2002; Morrow-Howell et al. 2001; Peel et al. 2004). Productive ageing is used to focus on the positive contributions made by older adults as an integral part of the notion of successful ageing (Mendes de Leon 2005; Morrow-Howell et al. 2001), and to deflect attention away from the narrow, biomedical aspects of the ageing process (Hinterlong et al. 2001). Given the potential importance of the concepts of productive and healthy ageing to social and economic futures, there is a strong need for empirical tests of the relationship between productive activities and health in later life.

In recent years, there has been a number of studies exploring the relationship between volunteering, as a particular dimension of productive ageing, and health (Lum and Lightfoot 2005; Musick and Wilson 2003; Thoits and Hewitt 2001). Findings from these studies consistently demonstrate a strong relationship between volunteering and health outcomes, even after controlling for prior health and socioeconomic status (Burr et al. 2002; Hinterlong et al. 2007). These outcomes include lower rates of mortality (Glass et al. 1999; Oman et al. 1999; Shmotkin et al. 2003); higher self reported health (Lum and Lightfoot 2005; van Willigen 2000); and improved life satisfaction (Aquino et al. 1996; Thoits and Hewitt 2001; van Willigen 2000). A particular dimension of this literature relates to psychological health (Greenfield and Marks 2004; Musick and Wilson 2003). Studies show an association between volunteering in later life and declines in somatic and mood symptoms (Fonda and Herzog 2001); lower depressive symptoms (Lum and Lightfoot 2005; Thoits and Hewitt 2001); reduced anxiety and improved ability to deal with psychological distress (Rietschlin 1998).

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Generally, however, there have been far fewer studies exploring the impact of volunteering on physical health outcomes in later life. There are a few notable exceptions which have utilised measures from existing longitudinal studies such as activities of daily living (ADLs) (Hinterlong et al. 2007; Lum and Lightfoot 2005; Shmotkin et al. 2003). Results from these studies suggest that volunteers report slower declines in functioning than non-volunteers, but do not report fewer medical conditions. These findings suggest that there may indeed be a relationship between volunteering and physical health outcomes, but that it is probably quite complex. In addition, the generality of measures suggests the need for more specific measures of physical health outcome and for research that tests this relationship as an a priori aim.

The aim of the present study is to contribute towards this body of literature by exploring the relationship between volunteering and the risk of a special case adverse health outcome related to ageing, fall-related hip fracture injury. This is one of the most common causes of physical disability and mortality in older people (Kannus et al. 2005) and represents a marker of adverse health and frailty (Woods et al. 2005). While risk factors for hip fracture and restriction of activities *following* hip fracture have been well-documented (Braithwaite et al. 2003; Cooper 1997; Cummings and Melton 2002), there has been little previous research investigating the association between hip fracture risk and pre-fracture activities, particularly productive activities. One study reported decreased risk of hip fracture in women who had been gainfully employed during the previous two decades (Farahmand et al. 2000), while another found increased risk associated with infrequent church attendance (a proxy for activities outside the home) (Young et al. 2001). This preliminary research suggests that participation in activity has the potential to be associated with protection against the risk of hip fracture.

Evidence of a relationship between volunteering and this specific health outcome (fall-related hip fracture) would thus provide some strong evidence of the relationship between productive and healthy ageing and contribute to knowledge of the extent of potential protective effects of volunteering in later life. In addition, it would provide a rationale for promoting such healthy ageing activities as strategies for falls injury prevention.

Methods

Study design

This paper uses data from a case control study designed specifically to explore the relationship between the determinants of healthy ageing and hip fracture risk. Behavioural and psychosocial determinants associated with fall-related hip fracture risk have previously been reported (Peel et al. 2006, 2007). To further explore the role of productive activities, this paper specifically examined the hypothesis that participation in volunteer activity is protective of hip fracture risk, independent of social and physical activity, social support and health status.

The case control study was conducted in Brisbane, a metropolitan city on the eastern coast of Australia. For examining differences between cases and controls on levels of voluntary activity, a sample size of at least 350 (with ratio of two controls per case) was sufficient to detect an odds ratio of 2.0, with 80% power and an alpha risk of 5%, given that the volunteer participation rate of the Australian population aged 65–74 years is approximately 30% (Australian Bureau of Statistics 2000). Ethical approval for the study was obtained from Institutional Health Ethics Committees. After receiving information about the project and an invitation to participate, all subjects (or their proxy health carers) gave written consent to participate.

Participants

Eligible cases, identified by hospital staff, were given details of the project and asked for their consent to be contacted by the researcher. Eligibility criteria were that cases were aged 65 years or over and admitted to one of six hospitals for acute treatment of a fall-related hip fracture. Additional selection criteria were that participants were residing in the community (living independently or with low care support) at the time of the fall and had sufficient cognitive capacity (or had a proxy carer) to answer a questionnaire.

For each case, at least two controls were randomly selected from the electoral roll. Since voting in Australia is compulsory, the Electoral Roll is considered one of the most up-to-date databases of Australian citizens. Controls were matched to cases on sex, age (within 5 year age range) and postcode. Matching ensured that case and control groups had similar proportional distributions on age and sex, since it is known that hip fracture rates increase exponentially with age and are consistently higher in women than men in age groups over 65 years (Sanders et al. 1999). Matching was also on postcode, used as a proxy indicator of socio-economic status (SES) (Australian Bureau of Statistics 2004), since SES is also associated with risk of hip fracture (Farahmand et al. 2000). As with cases, controls were ineligible if residing in institutions and in receipt of high care nursing services.

On notification by hospital staff of an eligible case being admitted, the researcher arranged a suitable time for the interview, which generally took place in hospital about a week after surgery and prior to discharge. Those selected as

controls were contacted by the researcher with a letter inviting participation and a follow-up phone call within two weeks of receiving the letter. Controls who agreed to participate were given the option of being interviewed in their homes or any other place they nominated, at a time and date convenient to them.

Measures

A questionnaire designed to assess factors identified as determinants of healthy ageing (Peel et al. 2004), was administered to both cases and controls at face-to-face interviews. A proxy was sought when the score on a modified mini-mental test (Cumming and Klineberg 1994) administered at interview was below the cut-off of seven out of ten correct answers to questions assessing orientation to person, place and time. For cases, questions on health status, functioning and activities related to the time period prior to the injury event. For the purposes of this study, older age was defined as the period after turning 65 years of age.

Volunteer activity was defined as unpaid work undertaken on a voluntary basis. Examples included community service, civic and committee roles. The question on engaging in volunteer activity had a dichotomous response option ("yes" or "no") and related to undertaking the activity on a regular basis in older age, that is, after turning 65 years of age. The evidence indicates that the median hours of voluntary work is highest in older age groups, and that regular (weekly) voluntary work accounts for over 70% of all voluntary hours (Australian Bureau of Statistics 2000).

To address the study hypothesis, a number of variables were selected to include in multivariate models as alternative explanations for the relationship between volunteering and hip fracture risk, if one existed. From an understanding of the literature, potential confounders were chosen on the basis that they could plausibly be associated with the outcome (hip fracture) and, independently, with the factor of interest (volunteering). These covariates, as outlined in the study hypothesis, were social and physical activity, social support and health status.

One of the benefits from volunteer activity is said to be derived from social integration (Musick and Wilson 2003; van Willigen 2000), and active social engagement has been shown to be associated with better health outcomes (Bath and Deeg, 2005). Social engagement of particular relevance for this study was social activity, recorded as regular participation in older age in social groups (including church attendance).

Physical limitations may restrict being able to engage in volunteering (van Willigen 2000). In this study physical activity levels, classified as "sufficient" or "insufficient" to maintain health (Armstrong et al. 2000), were based on minutes per week spent walking, as well as doing moderate and/or vigorous activity in an average week in the six months prior to interview. Physical functioning was measured as limitations ("limited a lot"; "limited a little"; "not limited at all") in performance of six activities (moderate household activities, lifting/carrying, climbing stairs, bending/kneeling, walking outdoors, bathing/dressing). Independent functioning was measured as ability to do ("without help"; "with some help"; "not at all") seven instrumental activities of daily living (IADL) (Lawton 1988). The activities were using the telephone, getting to places out of walking distance, going shopping for groceries or clothes, preparing own meals, doing house or yard work, taking medications and handling money.

From the literature, other health measures associated with volunteering include self-rated health (Lum and Lightfoot 2005; van Willigen 2000) and psychological well-being (Greenfield and Marks 2004; Musick and Wilson 2003). In this study, self-rated general health was recorded in five categories (excellent, very good, good, fair, or poor). Psychological health was assessed using the abbreviated Kessler measure (Kessler et al. 2002). Medical conditions associated with falls risk in older age (Tinetti 2003) were recorded. These included having a diagnosis of heart problems, cancer, osteoporosis, diabetes, stroke, Parkinson's Disease, respiratory disease, depression or other major illness. Other risk factors included having a self-reported history of hip replacement, eyesight problems, hearing loss, incontinence, arthritis affecting lower limb joints, difficulty sleeping, dizziness/loss of balance, or needing walking aids.

One of the benefits that older people may accrue from volunteering is access to companionship and social support (Aquino et al. 1996). In this study, the measure of social support (size of friendship network and contact, availability of confidante, perception of loneliness and sources of help in times of need) was adapted from the Older Americans Resources and Services (OARS) Multidimensional Assessment Questionnaire (Fillenbaum et al. 2000). Given the association of volunteering with socio-demographic factors (Choi 2003; Warburton and Stirling 2007), demographic information included age, sex, education level, financial status, and country of birth.

Statistical analysis

Stata 9.0 (StataCorp College Station, TX, USA, 2005) was used for statistical analysis. Frequency distributions and summary statistics were initially used to describe the data. Where continuous data were not normally distributed, it was categorised, based on percentiles, to account for outliers and skewness. For testing the hypothesis that

volunteer activity is protective of adverse health outcome, the dependent variable, "outcome" was coded "1" for a case (that is, with incident hip fracture) or "0" for a control (that is, without incident hip fracture). Associations between outcome and study factors were initially tested in univariate analysis, using conditional logistic regression analysis for matched case control data. Odds ratios (ORs) with 95% confidence intervals (CIs) measured the effect of exposure variables on the outcome of hip fracture. A probability (P) value of less than 0.05 was the criterion of significance. Effect modification by age and sex was tested by examining two-way interactions between the independent variable (volunteering) and age and sex. Interaction terms were included in the model if significant at the level $P < 0.1$.

Following model building process guidelines (Hosmer and Lemeshow 2000), multivariate models were developed to examine independent effects of volunteer activity on outcome, adjusting for factors shown to be significant predictors of outcome in univariate analysis. Confounders and interaction terms were added to the model and those not significant were eliminated in stepwise progression, based on P values. The independent variable (volunteer activity) was adjusted when the potential confounder/s remained significant in the multivariate model and altered the Odds Ratios (ORs) of the factor of interest by more than 10%.

It is possible that the covariates chosen as confounders, particularly the health status variables, could be considered on the causal pathway. For example volunteering may lead to less decline in functional abilities (activities of daily living) which, in turn, may result in fewer fall-related hip fractures. If the measures chosen as confounders are on the causal pathway then, theoretically, they are not confounders and adjustment of the model for these factors is not necessary. However, a conservative approach to analysis was adopted by inclusion of the covariates as confounders.

Results

In total, 126 cases and 261 controls completed an interviewer-administered questionnaire. The overall participation rate of eligible subjects was 85% (93% for cases and 81% for controls). Chi-square tests showed there were no significant differences between participants and non-participants on sex or age group distribution. Proxies assisted with 25 (6.5%) of interviews, with no significant differences between cases and controls on proxy use, nor on demographic variables. The distribution of demographic characteristics in the study population is shown in Table 1.

Table 2 shows the association of factors with hip fracture risk in univariate analysis. Volunteer activity was significantly protective of hip fracture risk [OR: 0.53 (0.33–0.84)], as was belonging to social groups [OR: 0.50 (0.31–0.81)], having a high level of social support [OR: 0.52 (0.33–0.81)] and undertaking sufficient physical activity [OR: 0.48 (0.27–0.82)].

Other factors that were protective of hip fracture risk in univariate analysis included having fewer than three medical conditions [OR: 0.66 (0.44–0.99)], fewer than four sensori-motor impairments [OR: 0.62 (0.40–0.96)], experiencing symptoms of psychological distress infrequently [OR: 0.49 (0.32–0.76)], having no limitations in physical functioning [OR: 0.42 (0.24–0.74)], or being dependent in no more than one IADL [OR: 0.37 (0.21–0.63)].

Table 1 Demographic characteristics of the study population

Characteristic	Levels	Cases ($N = 126$)	Controls ($N = 261$)	P value
Age	Mean (years)	82.5	82.7	0.63
	Standard deviation	6.9	6.8	
Sex[a]	Males	23 (18.3%)	47 (18.0%)	0.95
	Females	103 (81.7%)	214 (82.0%)	
Education[b]	Primary	67 (54.0%)	135 (51.7%)	0.59
	Secondary/Tertiary	57 (46.0%)	126 (48.3%)	
Finances[b]	Less than adequate	9 (7.4%)	17 (6.5%)	0.94
	Adequate for needs	91 (75.2%)	176 (67.7%)	0.09
	More than adequate	21 (17.4%)	67 (25.8%)	(reference)
Country of Birth	Australia	95 (75.4%)	194 (74.3%)	(reference)
	Other English Speaking	21 (16.7%)	47 (18.0%)	0.72
	Non- English Speaking	10 (7.9%)	20 (7.7%)	0.94

[a] While cases and controls were matched on sex, the proportions shown in Table 1 are not equal because nine additional controls (one male and eight females) were interviewed

[b] There are missing data where variables do not sum to 126 cases or 261 controls

Table 2 Univariate analysis

Factor	Levels	Cases no. (%)	Controls no. (%)	OR (95% CIs)	*P* value
Volunteering[a]	No	65 (54.6%)	102 (39.7%)	0.53 (0.33–0.84)	0.007
	Yes	54 (45.4%)	155 (60.3%)		
Other Factors					
Belonging to social groups[a]	No	41 (33.9%)	48 (18.6%)	0.50 (0.31–0.81)	0.005
	Yes	80 (66.1%)	210 (81.4%)		
Level of social support[a, b]	≤Median	61 (50.0%)	88 (33.9%)	0.52 (0.33–0.81)	0.004
	>Median	61 (50.0%)	172 (66.1%)		
Physical activity level	Insufficient	100 (79.4%)	175 (67.1%)	0.48 (0.27–0.82)	0.008
	Sufficient	26 (20.6%)	86 (32.9%)		
Health Status					
Medical conditions[b]	≥3	68 (54.0%)	112 (42.9%)	0.66 (0.44–0.99)	0.044
	<3	58 (46.0%)	149 (57.1%)		
Sensori-motor impairments[a, b]	≥4	69 (55.2%)	117 (45.0%)	0.62 (0.40–0.96)	0.033
	<4	56 (44.8%)	143 (55.0%)		
Psychological distress symptoms[a]	Frequent	77 (61.6%)	114 (43.7%)	0.49 (0.32-0.76)	0.002
	Infrequent	48 (38.4%)	147 (56.3%)		
Physical function limitations[a, b]	≥1	104 (83.2%)	181 (69.4%)	0.42 (0.24–0.74)	0.003
	None	21 (16.8%)	80 (30.6%)		
IADL limitations[b]	>1	75 (59.5%)	111 (42.5%)	0.37 (0.21–0.63)	<0.001
	≤1	51 (40.5%)	150 (57.5%)		
Self-rated health	Ex/v.good	59 (46.8%)	126 (48.3%)	1 (reference)	
	Good	38 (30.2%)	79 (30.3%)	1.02 (0.63–1.66)	0.94
	Fair/poor	29 (23.0%)	56 (21.5%)	1.13 (0.66–1.95)	0.65

[a] There are missing data where variables do not sum to 126 cases or 261 controls

[b] Continuous variables were dichotomised based on distribution of the data, using medians as the cut-off points

As shown in Table 2, self-rated health did not differ significantly between cases and controls, with the proportions of cases and controls rating their health in each of the three categories (excellent/very good; good; fair/poor) being very similar. An explanation may be that older people perceive themselves as healthy, even in the face of real physical problems (Rowe and Kahn 1999) and that the older people get, the greater is the discrepancy between subjective evaluations of their health and objective medical status (Baltes and Smith 2003).

Establishing dichotomous categories for variables such as levels of social support, medical conditions, sensori-motor impairments and limitations in physical functioning was based on distribution of the data, using the median as the cut-off point.

In multivariate models, volunteer activity was included as the independent variable and other explanatory variables significant in univariate analysis (Table 2) were added to the model. Demographic variables used in matching (age and sex) as well as education, ethnicity and financial status were not included in the multivariate model because there were no significant differences between cases and controls on these variables (Table 1). Age and sex interaction terms were not significant and, therefore, not included in the model. Self rated health similarly was not added to the model as a confounder because it was not significant in univariate analysis (Table 2). There was, however, a significant relationship between volunteering and self-rated health. Those who volunteered in later life were twice as likely to rate their health as excellent/very good/good as those who had not done voluntary work in later life ($P < 0.01$) (data not shown).

In the final model (Table 3), volunteer activity in older age remained significantly protective of hip fracture risk. Of the other factors, having no limitations in physical functioning and independence in IADL remained significant. In this model, the adjusted odds ratio (AOR) for voluntary activity was 0.61 (0.38–0.99), showing the

Table 3 Multivariate model

Factor	AOR[a]	CIs	*P* value
Volunteer activity in older age	0.61	0.38–0.99	0.045
Having no limitations in physical functioning	0.52	0.28–0.97	0.041
Having no more than one limitation in IADL	0.50	0.28–0.90	0.022

There were 362 records in the model. The pseudo *R*-squared value of 8% indicated the percent predictability of the model

[a] Model adjusted for social and physical activity measures, social support and health status factors

strength of association, while still significant, was attenuated by the addition of health status variables.

Discussion

Study results provide evidence of the relationship between productive activities as measured by volunteering, and a specific health outcome—the risk of fall-related hip fracture. The association remained significant when health status measures and other types of activity (social and physical) were taken into account and was also independent of level of social support. While the predictive capability of the final model was low (pseudo *R*-square of 8%), the purpose of the study was to develop an indicative model of the relationship between volunteering and hip fracture risk, rather than develop a predictive model of all risk factors.

Potential explanations for a relationship between volunteering and health outcomes suggest that volunteering has a positive psychological effect on older people. Thus, for example, volunteering is said to provide a social role at a time when other role identities may be lost (Greenfield and Marks 2004; Thoits and Hewitt 2001) and that volunteering is related to a sense of mastery or control (Hinterlong et al. 2007; Luoh and Herzog 2002). The social dimension of volunteering is also potentially very important for older people, as involvement in volunteering can increase networks and social supports, and help counteract loneliness and social isolation (Onyx and Warburton 2003; Warburton 2006).

Studies exploring the effect of volunteering on physical health and functioning, whilst much less common in the literature, propose some additional explanations. Lum and Lightfoot (2005) suggest that volunteering improves social and psychological resources and enhances an individual's capacity to cope with physical health problems. It may be too that the effect of volunteering is mediated through better perceived health (Lum and Lightfoot 2005; van Willigen 2000) and higher rates of physical activity (Luoh and Herzog 2002); it protects against cognitive decline (Zunzunegui et al. 2003); or that helping others strengthens the immune system (Oman et al. 1999). While restriction of activity due to previous experience of falls injury has been found in the literature (Murphy et al. 2002), there was no relationship in this study between volunteering and having a history of falls or fall-related injuries (data not shown).

What is apparent is that there are a range of potential explanations for why volunteering protects health and wellbeing in later life. Many of the same causal pathways are also related to the specific health outcome explored in this study, and the explanation for the association between volunteering and hip fracture is assumed to be via the psychological and physical health benefits that volunteering confers.

This study thus contributes new knowledge towards the body of literature exploring the relationship between volunteering and health in later life. In particular, this study adds evidence to the emerging body of literature on the relationship between volunteering and physical functioning in older people. That volunteering is protective of hip fracture is important because of the association of this event with disability and mortality in older people (Kannus et al. 2005; Woods et al. 2005). These findings suggest an important area for health promotion and falls prevention activities.

Further research is needed to replicate the results of this study. The results are based on observational data and the case control study design has strengths and limitations. Focusing on a specific health outcome is a major strength of the study. Other strengths include the rigour of the methodology; in particular, the population-based case and control groups with a high response rate, low level of missing data, and with adequate control for confounding. However, the study has some limitations, including the collection of only limited data on volunteer participation, thus making it difficult to explore for differences between volunteers by types of activity or levels of participation. There are also limitations associated with case–control designs, including recall bias and reliance on self-reported retrospective data. Biases may have been introduced because of differences in interview settings between cases and controls (hospital vs. home) and the fact that confounders may not have been adequately accounted for or imperfectly measured. A further limitation of cross-sectional data is that causal relationships are difficult to establish and perceptions of events may well be influenced by outcome status. The results would need to be corroborated in prospective studies to draw causal inferences.

Generalisation of the results to the wider community of older people is also limited to some extent by gender bias in the study population. Eighty-two percent were female, reflecting not only the higher proportion of females to males in the 65 years and over age group in the Australian population (14% females; 11% males) (Australian Bureau of Statistics 2003) but also the higher age-standardised rate of fall-related injury in women (twice that of men) (Peel et al. 2002).

Conclusion

Results from this study contribute to the body of knowledge demonstrating the positive relationship between productive activities, such as volunteering, and healthy ageing. They thus provide some evidence of the relationship between

these two important theoretical concepts in the contemporary ageing context. There are also some clear policy considerations for ageing societies across the world. It may be that productive engagement through activities such as volunteering may indeed be a health promotion and disease prevention intervention for older people (Oman et al. 1999).

However, there are important provisos in relation to these findings. It needs to be remembered that the causation between health and volunteer work is most likely bi-directional (Luoh and Herzog 2002), since people with greater personal resources and better physical and mental health are more likely to seek community service (Thoits and Hewitt 2001). Studies such as the present one indicate that there are positive health advantages with pursuing volunteer activities; however, those promoting volunteering as a productive ageing activity need to recognise that there are many older adults who do not choose, or are unable, to volunteer (Martinson and Minkler 2006). Choice is essential, and indeed, the psychological benefits exist precisely because of the element of choice and sense of control in volunteering (Bailis et al. 2001; Warburton 2006). Those who do not wish to volunteer should not be devalued, whilst those who wish to do so should be enabled and encouraged (Martinson and Minkler 2006). In this context, policy-makers have a responsibility to draw on this growing body of evidence in demonstrating the importance of engagement in productive activities for positive individual health outcomes. Emergent policies built on this evidence should focus on providing opportunities and supportive structures for engaging in productive activities in later life.

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