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Physical Activity and Depressive Symptoms in Advanced Age: LiLACS NZ

Mace C[1,2,*], Kerse N[2], Maddison R[3], Kepa M[2], Dyall L[3], Merritt-McDonald M[2], Jatrana S[4,5,6], Wham C[7] and Pillai A[4]

[1]*Central Washington University, Physical Activity, School and Public Health, USA*

[2]*Department of General Practice and Primary Health Care, University of Auckland, Auckland, New Zealand*

[3]*National Institute for Health Innovation, University of Auckland, Auckland, New Zealand*

[4]*The School of Population Health, University of Auckland, Auckland, New Zealand*

[5]*Department of Public Health, University of Otago, Wellington, New Zealand*

[6]*Alfred Deakin Research Institute, Deakin University, Waterfront Campus, Geelong, Victoria-3220, Australia*

[7]*New Zealand Institute of Food, Nutrition & Human Health, Massey University, Auckland*

***Corresponding author:** Casey Mace, Professor, Central Washington University, Physical Education, School and Public Health, USA, Tel: 1-484-365-7385; E-mail: macec@cwu.edu

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Abstract

Background: Increased physical activity is associated with positive physical and mental health outcomes. The aim of this study was to assess the relationship between physical activity and depressive symptoms in advanced age people by gender and ethnicity in New Zealand.

Methods: We used cross sectional data from Life and Living in Advanced Age: A Cohort Study in New Zealand Te Puawaitanga o Nga Tapuwae Kia Ora Tonu (LiLACS NZ) (n=665, aged 83.66 ± 2.0) with a comprehensive set of demographic, physical and mental health indicators. Physical activity was assessed using the Physical Activity Scale for the Elderly (PASE), while the Geriatric Depression Scale (GDS) was used to measure depressive symptoms. Both bivariate and multivariable general linear regression models were used to examine the influence of demographic and health indicators in the relationship between physical activity and depressive symptoms. Analyses were conducted by gender and ethnicity.

Results: Higher levels of physical activity were associated with fewer depressive symptoms in non-Maori men (Beta=-0.001, $p<0.01$) and women (Beta=-0.006, $p<0.01$); however no significant associations were observed between these variables for Maori men or women.

Conclusion: Physical activity appears to be related to depressive symptoms in some people in advanced age; however differences exist by ethnicity and sex. Factors related to depression in older Maori men and women and in non-Maori women need further investigation.

Keywords: Physical activity; Depression; Aging

Introduction

Depression is one of the most common mental health issues affecting wellbeing and quality of life of older adults (adults aged 60 and over) [1-3]. According to the National Institute of Mental Health approximately 1-13% of adults will experience a major depressive episode during older age, depending on their health and socio-economic status. The number of older adults experiencing minor or moderate depression is higher than those experiencing a major depressive episode. However, minor or moderate depression is a risk factor for experiencing a major depressive episode (NIMH, 2007); thus given the ageing population, mental health issues in older adults represent a serious public health concern.

Physical activity is a modifiable lifestyle factor, and regular physical activity participation has been associated with lower depressive and anxiety symptoms, reduced stress, and improved mood, [4-6]. When examining this relationship in older adults one of the main challenges cited is the lack of homogeneity in populations of older adults. This is because of high rates of variability in the health status and life circumstance of older people and how quickly their health or circumstances can change. [7-9]. For example an older adult who active may experience a fall, a major health event such as a cardiac condition, or may move home following the loss of a spouse, which may result in reduced physical activity levels [10,11]. Variability also exists in the nature of the physical activity undertaken (e.g., light vs. moderate intensity, household vs. leisure-time, in groups vs. alone, etc.) particularly related to different settings and culture.

Regardless of health status or circumstances, it is generally accepted that physical activity declines with age once individuals reach adulthood, with advanced age or the oldest old age groups being the least active [12]. The terms advanced age or oldest old refers to those who are in the oldest age group, octogenarians and over. There is a dearth of research regarding the physical activity levels and behaviors among those of advanced age; however considerable research evidence exists for the younger old. For instance, researchers have found that the level and types of physical activities that older people do differ by gender [13]. And while there is information that physical activity is

related to the incidence and prevalence of depression in older age [8] there is a lack of evidence about these relationships in the oldest old.

Along with gender differences, it is clear that ethnic health disparities are prevalent in New Zealand between the indigenous Maori and non- Maori citizens. Disparity in health outcomes, for New Zealand's indigenous Maori persists into advanced age [14,15]. Prevalence of depression is high in middle aged Maori [16]. Variation in the way depression is experienced and expressed is also culturally mediated [17]. It is widely acknowledged that a Maori worldview conceptualises wellbeing from a holistic perspective [18-20]. The Maori worldview acknowledges multiple presentations of wellbeing – spiritual, physical, emotional and psychological. As such the measures of depression, such as the geriatric depression scale are based on Western conceptualization and measure emotional and cognitive symptoms of depression [21]. While culture specific tools are not available, we use available measures to explore the relationship between activity and depression, acknowledging that the measure may not completely assess all aspects of mental wellbeing for Maori. Socio-cultural conditions also have a significant impact on Maori mental health. Limited education, unemployment, poverty, urbanization, alienation from cultural resources such as customary land bases, language and whanau (family) are associated with poorer mental health for Maori [18,22,23]. Evidence has also shown that cultural aspects of daily living, such as knowing the native language Te Reo Maori me nga tikanga and participation in cultural activities are important factors in maintaining and enhancing Maori mental health [19,24-25].

Although there is some information about younger Maori there is no research that describes the relationship between physical activity and mental health in Maori of advanced age. Life and Living in Advanced Age: a Cohort Study in New Zealand, Te Puawaitanga o Nga Tapuwae Kia Ora Tonu (LiLACS NZ) enrolled Maori and non-Maori in advanced age in New Zealand in 2010. This study examines the relationship between physical activity and depression by ethnicity. In addition, given that previous research evidence has demonstrated that physical activity differs between men and women [13] this study also examine this relationship by gender within each ethnic group.

Methods

Study design

The study was a cross sectional sample taken from the inception cohorts of LiLACS NZ. [26]. The study was approved by the Northern X Regional Ethics Committee of New Zealand in December 2009 (NTX/09/09/088).

Sampling

Older Maori (NZ indigenous) people aged 80-90 years in 2010 and non-Maori adults aged 85 years in 2010, were recruited from the Bay of Plenty and Rotorua regions of the North Island in New Zealand. The region is home to just over a quarter million of New Zealand's population (277,900) and contains the highest concentration of older adults (14.8%) in the country outside of Auckland [27]. Participants were recruited using multiple overlapping strategies: from the electoral roll, through primary care providers, local iwi (tribal) groups, Hauora (Maori healthcare providers), community outreach, and an exhaustive sample was attempted. Potential participants (n=1636) were identified and 937 were enrolled in the study (57%). Participants were invited to take part in a full or partial interview for data collection. The partial interview was designed for individuals who were too unwell to cope with participation in the study, but this did not include physical activity so participation in the full baseline interview was required for inclusion in this analysis. All participants completed face-to-face interviews by trained interviewers using standardized techniques. The interview was available in English and Te Reo Maori, the indigenous language of Maori people, Individuals who indicated a cognitive impairment as defined as scoring a 72 or lower on the Modified Mini Mental State Exam (3MSE) were able to participate with assistance of a proxy.

Measures

Physical activity measure

The Physical Activity Scale for the Elderly (PASE) is a self-reported physical activity measure developed for adults over the age of 65 years [21] and was used in the present study because of its specific development and wide application in the study of older people. The PASE collects information on household, occupation, and leisure activities, which include light intensity activities, walking, and gardening and focuses on a seven-day recall period. While, there are no specific cut points to categorize activity levels, our data were separated into tertiles to categorize physical activity levels as high, medium, or low within each group for descriptive purposes; however the continuous outcome score was used in regression analysis. A higher score on the PASE indicates a higher level of activity. The PASE is one of the most widely used self-report instruments for assessing physical activity in older adults and it has demonstrated moderate to good reliability and validity in various populations of older people [28].

Depression

The Geriatric Depression Scale (GDS-15) was used to screen for the presence of depressive symptoms in older adults. This GDS is a widely used measure, which can be applied quickly and easily to a general population of older adults, and has been used in several cross-cultural studies of depression and depressive symptoms in older adults [29-31]. The GDS does not diagnose clinical depression; it is simply a screening tool indicating the presence of depressive symptoms, which can be used to target those in need of more in-depth assessment. Scores on the GDS range from 0-15 with categories of depressive symptoms ranging from none (0-4), mild/moderate (5-10), and severe (10>) depressive symptoms [21] were observed. This scale has been widely used and has demonstrated moderate to high validity and internal consistency in older adult populations [32].

Covariates

Potential confounders; health and socioeconomic factors were identified through a review of literature pertaining to depression in older people and included: living arrangements, marital status, education, disability, financial situation [33], self-reported health, pain [34], visual impairment [35], having a traumatic experience [36], cognitive impairment [37], and alcohol use [38]. These variables were chosen because they are associated with depression in older people and are likely to confound the relationship between activity and depression.

Age was controlled for Maori samples as the age range spanned between ages 80-90 while the non-Maori were all 85 during the

baseline year. Living arrangements were categorized as either living alone or with others. Marital status included never married/separated/divorced or currently partnered/married or widowed/widower. Education included primary/no school or secondary school with no qualifications or secondary school with qualifications or trade qualification or tertiary qualifications. Self-perceived economic resources included categories of comfortable or just enough to get along or can't make ends meet as a response to the question "thinking of your money situation would you say that you are…". Self-reported health was a measure for health related quality of life and ranged from poor, fair, good, very good to excellent. Pain was assessed using an item of the SF-12 measure and was based on the experience of pain interfering in daily activities, and ranged from never to almost always [39]. Disability was a dichotomous measure of whether or a not a person self-reported experiencing a long term disability. Visual disability was a dichotomous measure as to whether the person had visual impairment interfering with daily life. Alcohol use referred to the number of times per week or month a person had a drink containing alcohol, the measure ranged from never to four times per week. Additional variables were available for descriptive information but were not included in the models as they were repetitive of some of the constructs of the GDS measure. Instrumental support referred to whether a person had someone who could help them with practical daily tasks such as getting groceries, etc. when they need it. Emotional support referred to the person having someone to give them emotional support when they needed it [40]. Cognition was assessed by the Modified Mini Mental State Exam (3MSE) [37,41] and a score of 72 or below indicated the presence of some type of cognitive impairment

Cardiovascular disease included any cardiovascular condition such as heart attack, angina, stroke, transient ischemic attack, high blood pressure, atrial fibrillations, congestive heart failure, peripheral vascular disease, rheumatic fever, or other self-identified circulatory problem, and was indicated by a yes or no response. Diagnoses were validated by a GP record review and hospital record review.

Data and analysis

Data were analyzed using PAWS SPSS Version 18 statistical software. An outlier was removed from the Maori Men sample (n=1) to allow for normal distributions in all samples, which allows for congruent methods across samples. Missing data were not imputed.

To determine the relationship between the exposure variable (physical activity) and the outcome in question (depressive symptoms as reflected in the GDS score), general linear modeling techniques were used [42]. General linear models were built systematically by testing variables identified in the literature review for their bivariate significance to the outcome of depression. Variables that were significant at the bivariate level were combined in a general linear model to determine their main effects on depression. The adjusted estimated marginal means for the dependent variables were reported in the tables to demonstrate the relationship between levels of exposure to physical activity and the relationship with the outcome of depression. The models were analyzed for the goodness of fit through an R^2 analysis to determine how well the variables predicted the outcomes. Tests for interaction confirmed that variables of physical activity and depression were statistically significantly interacting by gender and ethnicity, which justified the need to analyze samples separately.

Results

Overall, 664 people in advanced age (aged 83.66 ± 2.0) were included in the analysis. Complete details of the samples are published elsewhere [43,44]. Data were categorized by gender and ethnicity into four groups; Maori women (n=149, aged 82.46 ± 2.62), Maori men (n=105, aged 81.93 ± 2.55), non-Maori women (n=218, aged 84.56 ± .53), and non-Maori men (n=192, aged 84.55 ± .52). Results for each are reported within each ethnic group by gender.

Physical activity patterns

Mean PASE scores differed by gender and ethnicity. Men and women had significantly different levels of physical activity for both Maori and non-Maori ($p<0.05$). Maori men had the highest level of physical activity followed by non-Maori men. Maori women had higher levels of physical activity than non-Maori women (Figure 1).

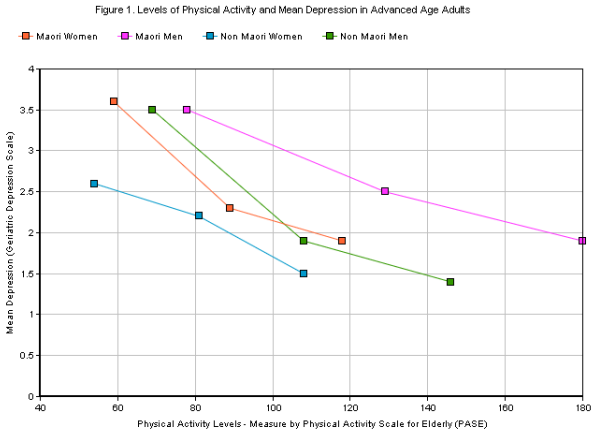

Figure 1: Levels of physical activity and mean depression in advanced age adults.

Variables with significance to depressive symptoms

Table 1 presents the covariates that were significantly associated with depression for each sample group.

Variable	Maori Women		Maori Men		Non Maori Women		Non Maori Men	
	B	p value	B	p value	B	p value	B	p value
Physical Activity	-0.009	<0.001**	-0.001	0.016*	-0.01	<0.001**	-0.002	<0.001**
Age	0.08	0.34	-0.1	0.32				

Living Arrangement	0.027	0.617	-0.019	0.857	0.502	0.092	-0.115	0.068
Marital Status	0.184	0.549	0.052	0.379	0.012	0.949	0.091	0.025*
Education	-0.384	0.010*	-0.026	0.493	-0.213	0.037	-0.015	0.47
Financial Situation	-1.25	0.003*	-0.376	0.399	-0.032	0.561	-0.682	0.063
Self-reported Health	0.784	<0.001**	0.168	0.001**	0.802	<0.001**	0.123	<0.001**
Pain	0.688	<0.001**	0.03	0.528	0.397	<0.001**	0.072	0.002*
Disability	1.518	<0.001**	0.104	0.253	1.555	<0.001**	0.187	0.002*
Cognitive Impairment	2.882	<0.001**	1.89	<0.001**	3.481	<0.001**	2.151	0.010*
Visual Impairment	0.143	0.092	-0.062	0.534	0.716	0.013**	0.146	0.035*
Traumatic Experience	0.187	0.163	0.285	0.014*	0.575	0.052*	0.239	0.005*
Alcohol Use	-0.539	0.003*	0.036	0.286	-0.016	0.295	-0.054	0.004*
*Significant at 0.05 level **Significant at 0.001 level								

Table 1: Bivariate general linear regressions assessing relationship of variables to depression in for inclusion in models.

Results for Maori

Seven variables were statistically significant when analyzed separately to determine their relationship to depression in Maori women. Physical activity (B=-0.009, p<0.001), education (B=-0.38, p=0.010), financial situation (B=-1.25, p=0.003), disability (B=1.52, p<0.001), experience of pain (B=0.69), p<0.001), alcohol use (B=-0.54, p=0.003), cognitive impairment (B=2.88, p<0.001), and self-reported health (B=0.78, p<0.001), were all significant factors that were combined in a general linear regression model (Table 2) to determine the main effects of each factor when combined with other significant factors.

Variable	n	%	Depression (M)	B	p value
Physical Activity				-0.01	0.315
High	41	33	3		
Medium	42	33	2.63		
Low	42	33	3.4		
Education				-0.178	0.222
Primary/No Schooling	36	29	3.6		
Secondary/No Qualification	48	38	3.11		
Qualification/Trade	25	20	3.04		
Tertiary Qualification	17	13	2.5		
Financial Situation				-1.005	0.014*
Just getting along	36	29	3.55		
Comfortable	89	71	2.46		
Self-reported Health				0.541	0.013*
Excellent	59	47	1.96		
Very Good	25	20	2.46		
Good	20	16	2.7		
Fair/poor	21	17	3.67		

Pain				-0.034	0.183
Not at All	71	49	2.4		
Slightly	27	19	3.01		
Moderately	25	17	2.9		
Quite a Bit/Extremely	21	15	3.11		
Disability				0.672	0.117
Yes	57	46	3.34		
No	68	54	2.68		
Cognitive Impairment				3.093	0.000**
Yes	9	6	3.31		
No	139	94	1.11		
Alcohol Use				-0.312	0.059
Never	78	55	3.72		
Monthly or Less	36	25	2.5		
Monthly-3/week	18	12	3.1		
Four or more/week	11	8	2.72		
Notes. R^2=0.390, Adjusted R^2=0.351 *Significant at 0.05 level **Significant at 0.001 level.					

Table 2: Multiple linear regression models assessing relationship of physical activity to depression in Maori women.

In this model physical activity was not associated with depression in older Maori women; however three variables remained statistically significant; A higher self-reported level of health was associated with lower levels of depression (B=0.54 p=0.013). Those who reported that they were 'just getting along' financially were more likely to indicate higher levels of depression than those were 'comfortable' financially (B=-1.01, p=0.014). Also those with cognitive impairment had higher levels of depression (B=3.09, p<0.001). Results from (Table 2) also indicate that the set of socioeconomic and health factors included in the multivariate model accounted for 35% (R^2=0.35) of the variance in predicting depression among older Maori women.

For Maori men, four factors were significantly associated with depression: physical activity (Beta=-0.001, p=0.016), cognitive impairment (B=1.89, p=0.000), having had a psychological trauma (Beta=0.29, p=0.014), and self-reported health status (Beta=0.17, p<0.001). These factors were combined in a general linear model (Table 3) and tested for main effects.

Variable	n	%	Estimated Marginal Means	B	p value
Physical Activity				-0.001	0.311
High	32	35	4.44		
Medium	32	35	4.9		
Low	28	30	5.25		
Self-reported Health				0.24	0.010*
Excellent/Very Good	38	41	2.13		
Good	32	35	2.77		
Fair/Poor	22	24	3.65		
Cognitive Impairment				1.171	0.074
Yes	10	10	4.21		

No	89	90	2.4		
Psychological stress				0.228	0.041*
Yes	17	18	5.32		
No	75	82	4.41		

Table 3: Multiple linear regression model assessing relationship of physical activity to depression in Maori men.

The following table (Table 3) presents the statistically significant factors that were included in the overall depression model for Maori men.

In the model, poor self-reported health (Beta=0.24, p=0.010) and experiencing psychological trauma (Beta=0.23, p=0.041), but not physical activity, were significantly associated with depressive symptoms in older adult Maori men, The model fit was adjusted R^2=0.174.

Results for non-Maori

Physical activity was statistically significant (B=-.01, p<0.001) when assessed for its relationship to an outcome of depression in non-Maori women in advanced age, therefore it was combined with other statistically significant factors: disability (B=1.56, p<0.001), self-reported health (B=0.80, p<0.001), pain (B=0.40, p<0.001), visual impairment (B=0.72, p=0.01), and cognitive impairment (B=3.481, p=0.00) into a general linear model (Table 4) to determine if other factors influence this relationship.

Variable	N	%	Estimated Marginal Mean	B	p value
Physical Activity				-0.006	0.011*
High	70	36	1.99		
Medium	68	35	2.56		
Low	56	29	2.56		
Education				-0.167	0.066
Primary/No Schooling	29	15	2.62		
Secondary/No Quals	72	38	2.41		
Qualification	46	24	2.52		
Trade or Apprenticeship	23	11	2.34		
Tertiary Qualification	24	12	1.95		
Self-reported Health				0.38	0.008*
Excellent	14	7	1.38		
Very Good	70	36	1.7		
Good	71	37	1.96		
Fair/Poor	39	20	3.2		
Pain				0.032	0.757
Not at All	81	42	2.57		
Slightly	43	22	2.07		
Moderate	33	17	2.67		
Quite a Bit/Extremely	37	21	2.48		
Disability				0.852	0.001*
Yes	108	56	2.84		
No	86	44	1.9		

Visual Impairment				0.204	0.445
Yes	45	23	2.38		
No	149	77	2.34		
Cognitive Impairment				3.19	0.000**
Yes	6	3	5.55		
No	204	97	2.05		
Notes. R^2=0.291, Adjusted R^2=0.270 *Significant at 0.05 level **Significant at 0.001 level.					

Table 4: Multiple general linear regression model assessing relationship of physical activity to depression in non-Maori women.

After combining all of the factors in the general linear model, four variables remained statistically significantly related to depression in older adult non-Maori women ($p<0.05$); physical activity (Beta -0.006, p=0.011), disability (Beta=0.85, p=0.001), and self-reported health status (Beta=0.38, p=0.008). Physical activity had a slightly inverse relationship with depressive symptoms and a significantly negative relationship with the presence of disability. Higher self-reported health was significantly associated with lower mean depression. Those with cognitive impairment had much higher mean depression (B=3.19, $p \leq 0.001$). The socioeconomic and health factors in the model (Table 4) accounted for about 27% of variance in depression for non-Maori women. The overall model fit was adjusted R^2=0.270.

Nine factors were statistically significant when assessed though bivariate linear regression depression outcomes for non-Maori men; physical activity (B=-0.002, $p<0.001$), marital status (B=0.09, p=0.025), self-report health (B=0.12, $p<0.001$), pain (B=0.07, p=0.002), disability (B=0.19, p=0.002), visual impairment (B=0.14, p=0.035), psychological stress (B=0.24, p=0.005), cognitive impairment (B=2.15, p=0.10) and alcohol use (B=-0.05, p=0.004). These factors were combined in a generalized linear model (Table 5) to determine the main effects of each variable.

Physical activity (Beta=-0.001, p=0.009) and the experience of a psychological stress (Beta=0.24, p=0.004) were both statistically significant ($p<0.05$), while alcohol use was very closely related but not significantly related (p=0.56) to the outcome of depression in older non-Maori men. The overall model fit was adjusted R^2=0.171 meaning that the socioeconomic and health factors in the multiple regression (Table 5) accounted for 17% of the variance of depression in non-Maori men.

Variable	**N**	**%**	**Estimated Marginal Mean**	**B**	**p value**
Physical Activity Level				-0.001	0.009*
High	60	34	3.88		
Medium	61	34	3.93		
Low	58	32	4.64		
Marital Status				0.022	0.564
Unwed/Separated/Divorced	16	9	3.35		
Married or Partnered	116	65	3.33		
Widowed	47	26	3.82		
Self-reported Health				0.025	0.455
Excellent	15	9	3.98		
Very Good	57	33	3.14		
Good	72	41	3.47		
Fair/Poor	31	17	4.5		
Pain				0.037	0.131
Not at all	103	59	3.71		
Slightly	30	17	3.95		

Moderately	20	11	3.86		
Quite a bit/Extremely	26	13	5.47		
Cognitive Impairment				0.263	0.701
Yes	11	6	3.91		
No	179	94	2.21		
Disability				0.065	0.29
Yes	97	54	3.88		
No	82	46	4.42		
Visual Impairment				0.004	0.946
Yes	41	24	4.3		
No	135	76	3.71		
Psychological Stress				0.239	0.004*
Yes	24	14	4.6		
No	152	86	3.71		
Alcohol Use				-0.032	0.056
Never	31	17	4.4		
2-4/Month or less	33	18	4.2		
Two to Three times per Week	28	16	4.07		
Four or more times per week	87	49	3.82		
Notes. R^2=0.208, Adjusted R^2=0.171 *Significant at 0.05 level **Significant at 0.001 level.					

Table 5: Multiple linear regression assessing relationship of physical activity to depression in non-Maori men.

Discussion

Main findings

This study sought to investigate relationships between physical activity and depression among older adults with a particular focus on gender and ethnicity. The key findings were, higher levels of physical activity were related to lower levels of depression for non-Maori men and women. Physical activity was associated to depression in bivariate models for Maori men and women but not in the models when other factors were included. The multivariate models explained a higher variance in predicting depression among women than for men. For example, all the predictors accounted for 17% of the variance in predicting the association for depression for Maori and non- Maori men as compared with 35% of the variance for Maori women and 28% for non- Maori women.

Some interesting patters were found when sex and ethnicity were examined. For example, cognitive impairment only remained significant in the models for women. Cognitive impairment has been shown to be related to depression in older people [45]. Men and women are known to have different determinants of depression so this further supports analyzing each gender separately. Future research on gender differences in the association between physical activity and depression among older adults should focus on improving understanding of the underlying factors, which differ by gender and explain more variance in outcome, such as social support and contact.

Strengths and weaknesses

The cross-sectional design of the study allowed for multiple exposures related to the outcome in question to be examined. It also allowed for the prevalence of several conditions important to the health of older New Zealanders to be determined. This generated a wealth of descriptive information that could be instrumental in population planning and research development. However, there are some inherent weaknesses associated with using a cross-sectional design. The main weakness is the lack of ability to determine causation. Also though the analysis gave information on the prevalence it did not capture the incidence of any of the variables because this study only focused on the baseline data. Another issue with cross-sectional design is that it cannot capture short-term disease or bouts of illness, which may be more prevalent in older populations. However, some conditions such as disability, visual impairment, or cognitive decline are unlikely to improve.

Splitting the entire data set into four smaller groups had advantages and disadvantages. The smaller sample sizes meant that there was more room for type II error, missing an association that was there because of small numbers (particularly in the Maori sample), variability in the

sample, however because the samples were more homogenous the results of each analysis could be more directly applied to each population and these results could be more easily comparable in future studies. Also separating the data allowed the results to highlight issues such as lack of emotional support and living alone in men, which was related to higher depression in non-Maori men but not women. This evidence is supported in other research on older men and women [46].

While the samples were split into more homogenous populations, the instruments used to measure the entire population were the same. The geriatric depression scale has been used in studies that have included Maori populations is limited in its ability to capture the Maori determinants of mental health. However, the use of these measures in this study could provide guidance for future studies aiming to investigate this topic further.

Comparative studies

The relationship between physical activity and depression has been examined in previous research on older adults and is strongly suggested in observational studies. For instance, a cross sectional study in Finland (n=1224) focusing on physical activity and psychological wellbeing on older adults aged 65-84 found at the relationship between physical activity and depression was only statistically significant for men but not for women in the oldest age group (over 75) while the younger old age groups had significant results for both sexes [47]. However, it was noted that degree or change of relationship of physical activity interventions to the targeted outcomes were less for the oldest old than younger old age groups when analyzed by age groups. The findings of these studies support the decision to analyse the sample separately by gender. The current study adds that the main variables related to depression differ for men and women with physical activity taking a leading role for men.

There is evidence that men and women in older age participate in different types and intensities of physical activity [43]. An exercise intervention study found that strenuous exercise had a significant effect on reducing depression in Swedish older men but not women (n=860) aged 60-89 but that light activity one had a significant effect on depression for women [48]. Studies analyzing the effects of different domains and activity may also explain this relationship. For instance men and women spend a different amount of time in various [43,49,50] housework and leisure activities.

The decision to analyze Maori separately to non-Maori was based upon the lack of evidence or literature surrounding the important determinants to mental wellbeing for older Maori adults. The decision to do this revealed quite interestingly that Maori might have a quite different set of factors that determine mental health than that of non-Maori.

The lack of definitive evidence on the determinants of mental health for older Maori coupled with the Westernized mental health constructs being applied to Maori could be reasons that these measures and models did not describe a significant relationship of physical activity or other factors to depression in this study. Or perhaps physical activity is simply not related to depression in older Maori. Either way this study has prompted the need for further inquiry into older Maori mental health.

Implications

This paper shows that physical activity is an important factor associated with depressive symptoms in some people in advanced age. The differences in outcomes based on ethnicity warrant a pause for reflection about the current diagnosis and classification of depression. The confounding factors used for the Maori population may have not been appropriate for depression given the lack of significance of many of the examined confounding factors used in this study. Whether the measures failed to accurately reflect these constructs or they were simply inappropriate constructs to apply is for debate. Given the evidence that Maori mental health is not uniformly understood in a clinical way, other approaches that aim to determine causation and diagnosis of depression in older Maori should be explored.

Conclusions

Understanding each unique population of people of advanced age will allow for depression interventions to be developed based on evidence. Physical activity has many positive benefits; however, physical activity may be more important for certain aspects of health and wellbeing for certain populations. Predictors of mental health for Maori in older age should be examined further.

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References

1. Salguero A, Martínez-García R, Molinera O, Marquez S (2010) Physical activity, quality of life and symptoms of depression in community-dwelling and institutionalized older adults. Archives of Gerontology and Geriatrics 53: 152-7.
2. Moraes H, Deslandes A, FerreiraIII C, PompeuIV FAMS, Ribeiro P, et al. (2007) Physical exercise in the treatment of depression in the elderly: a systematic review. Revista de Psiquiatria do Rio Grande do Sul 29: 70-79.
3. Frazer CH, Christensen, Griffiths K (2005) Effectiveness of treatments for depression in older people. Med J Aust. 182: 627-32.
4. Chodzko-Zajko WJ, Proctor DN, fiatarone Singh MA, Christopher TM, Claudio RN, et al. (2009) Exercise and physical activity for older adults. Medicine & Science in Sports & Exercise 41: 1510.
5. Brenes DGA, Williamson JD, Messier SP, Rejeski WJ, Pahor M, et al. (2007) Treatment of minor depression in older adults: a pilot study comparing sertraline and exercise. Aging and Mental Health 11: 61-68.
6. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, et al. (2007) Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Medicine and science in sports and exercise 39: 1423.
7. Davis MA, Neuhaus JM, Moritz DJ, Segal MR (1992) Living arrangements and survival among middle-aged and older adults in the NHANES I epidemiologic follow-up study. American Journal of Public Health 82: 401-406.
8. Strawbridge WJ, Deleger S, Roberts RE, Kaplan GA (2002) Physical activity reduces the risk of subsequent depression for older adults. American journal of epidemiology 156: 328-334.

9. McAuley E, Konopack JF, Motl RW, Morris KS, Doerksen SE, et al. (2006) Physical activity and quality of life in older adults: influence of health status and self-efficacy. Annals of Behavioral Medicine 31: 99-103.
10. Brawley LR, Rejeski WJ, King AC (2003) Promoting physical activity for older adults: The challenges for changing behavior. American journal of preventive medicine 25: 172-183.
11. Chad KE, Reeder BA, Harrison EL, Ashworth NL, Sheppard SM, et al. (2005) Profile of physical activity levels in community-dwelling older adults. Medicine and science in sports and exercise 37: 1774.
12. Harris TJ, Owen CG, Victor CR, Adams R, Cook DG (2009) What factors are associated with physical activity in older people, assessed objectively by accelerometry? British journal of sports medicine 43: 442-450.
13. Shephard RJ (2002) Gender, physical activity, and aging CRC Press.
14. Jatrana S, Blakeley T (2013) Socio-economic inequalities in mortality persist into old age in New Zealand: study of all 65 years plus, 2001-2004. Ageing Soc.
15. Jatrana S, Blakely T (2008) Ethnic inequalities in mortality among the elderly in New Zealand. Aust N Z J Public Health 32: 437-443.
16. Bushnell J, McLeod D, Dowell A, Salmond C, Ramage S, et al. (2005) Do patients want to disclose psychological problems to GPs? Fam Pract 22: 631-637.
17. Bennett PA (2009) Bridging two worlds in the interview process --the psychiatric assessment and Maori in primary care. J Prim Health Care 1: 63-65.
18. Durie M, Mauri ora (2001) The Dynamics of Maori Health Oxford University Press, Auckland.
19. McNeill H (2007) Te hau ora o naga kaumatau o Tuhoe: a study of Tuhoe kaumatau mental wellness AUT University.
20. Taitimu M, Nga whakÄwhitinga (2007) standing at the crossroads. MÄori ways of understanding extra-ordinary experiences and schizophrenia. University of Auckland: Auckland, New Zealand.
21. Washburn RA, Smith KW, Jette AM, Janney CA (1993) The Physical Activity Scale for the Elderly (PASE): development and evaluation. J Clin Epidemiol 46: 153-162.
22. Kingi TK (2005) Cultural interventions and the treatment of MÄori mental health consumers Massey University: Wellington, New Zealand.
23. Hirini P, Collings S (2005) Whakamomori: He whakaaro, he krero noa - A collection of contemporary views on MÄori and suicide (Report 3), M.o. Health, Editor. Wellington, New Zealand.
24. Durie M (1997) Maori cultural identity and its implications for mental health services. International Journal of Mental Health 23-35.
25. Edwards WJW (2010) Taupaenui: Maori positive ageing. Massey University Palmerston North, New Zealand.
26. Hayman KJ, Kerse N, Dyall L, Kepa M, Teh R, et al. (2012) Life and living in advanced age: a cohort study in New Zealand--e PuÄwaitanga o Nga Tapuwae Kia Ora Tonu, LiLACS NZ: study protocol. BMC Geriatr 12: 33.
27. Pink B (2004) National Population Projections: 2004 (base) - 205, M.o. Health, Editor., Statistics New Zealand: Wellington, New Zealand 1-18.
28. Dinger MK, Oman RF, Taylor EL, Vesely SK, Able J (2004) Stability and convergent validity of the Physical Activity Scale for the Elderly (PASE). J Sports Med Phys Fitness 44: 186-192.
29. Mui AC, Burnette D, Chen (2002) Cross-cultural assessment of geriatric depression: A review of the CES-D and GDS. Multicultural measurement in older populations 147-177.
30. de Craen AJ, Heeren TJ, Gussekloo J (2003) Accuracy of the 15-item geriatric depression scale (GDS-15) in a community sample of the oldest old. Int J Geriatr Psychiatry 18: 63-66.
31. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, et al. (1982) Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 17: 37-49.
32. Wancata J, Alexandrowicz R, Marquart B, Weiss M, Friedrich F (2006) The criterion validity of the Geriatric Depression Scale: a systematic review. Acta Psychiatr Scand 114: 398-410.
33. Statistics New Zealand Census (2006) "Definitions and Questionnaires" M.o. Health, Editor. Wellington, New Zealand.
34. Ware J Jr, Kosinski M, Keller SD (1996) A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care 34: 220-233.
35. Hayman KJ, Kerse NM, La Grow SJ, Wouldes T, Robertson MC, et al. (2007) Depression in older people: visual impairment and subjective ratings of health. Optom Vis Sci 84: 1024-1030.
36. Krause N, Shaw BA, Cairney J (2004) A descriptive epidemiology of lifetime trauma and the physical health status of older adults. Psychol Aging 19: 637-648.
37. Teng EL, Chui HC (1987) The Modified Mini-Mental State (3MS) examination. Journal of Clinical Psychiatry; Journal of Clinical Psychiatry.
38. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M (1993) Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II. Addiction 88: 791-804.
39. Gandek B (1998) Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. Journal of clinical epidemiology 51.
40. Timmerman I, Emanuels E, Zuurveen, Emmelkamp P (2000) The Social Support Inventory (SSI): A brief scale to assess perceived adequacy of social support. Clinical Psychology & Psychotherapy 7: 401-410.
41. Tombaugh T (1996) Mini-Mental State Examination (MMSE) and the Modified MMSE (3MS): A psychometric comparison and normative data. Psychological Assessment. 8: 48.
42. Liang KY, Zeger E (1986) Longitudinal data analysis using generalized linear models. Biometrika 73: 13-22.
43. Mace CJ, Kerse N, Maddison R, Olds T, Jatrana S, et al. (2015) Descriptive Epidemiology of Physical Activity Levels and Patterns in New Zealanders in Advanced Age; LiLACs NZ. J Aging Phys Act .
44. Teh R, Kerse N, Kepa M, Doughty RN, Moyes S, et al. (2014) Self-rated health, health-related behaviours and medical conditions of Maori and non-Maori in advanced age: LiLACS NZ. N Z Med J 127: 13-29.
45. Logsdon RG, Gibbons LE, McCurry SM, Teri L (2002) Assessing quality of life in older adults with cognitive impairment. Psychosom Med 64: 510-519.
46. Dean A (1992) The influence of living alone on depression in elderly persons. Journal of Aging and Health 4: 3-18.
47. Ruuskanen JM, Ruoppila I (1995) Physical activity and psychological well-being among people aged 65 to 84 years. Age Ageing 24: 292-296.
48. Lindwall M, Rennemark M, Halling A, Berglund J, Hassmén P (2007) Depression and exercise in elderly men and women: findings from the Swedish national study on aging and care. J Aging Phys Act 15: 41-55.
49. Teychenne M, Ball K, Salmon J (2008) Physical activity and likelihood of depression in adults: a review. Prev Med 46: 397-411.
50. Lawlor DA, Taylor M, Bedford C, Ebrahim S (2002) Is housework good for health? Levels of physical activity and factors associated with activity in elderly women. Results from the British Women's Heart and Health Study. J Epidemiol Community Health 56: 473-478.