

BMJ Open Depression following fracture in women: a study of age-matched cohorts

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To cite: Williams LJ, Berk M, Henry MJ, *et al.* Depression following fracture in women: a study of age-matched cohorts. *BMJ Open* 2014;**4**: e004226. doi:10.1136/bmjopen-2013-004226

► Prepublication history for this paper is available online. To view these files please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2013-004226>).

Received 13 October 2013
Revised 17 December 2013
Accepted 10 January 2014

ABSTRACT

Objectives: High levels of disability, functional impairment and mortality are independently associated with fracture and depression, however the relationship between fracture and depression is uncertain. The aim of this study was to investigate whether fracture is associated with subsequent depressive symptoms in a population-based sample of women.

Design: A study of age-matched fracture versus non-fracture cohorts of women.

Setting: Barwon Statistical Division, southeastern Australia.

Participants: Two samples of women aged ≥ 35 years were drawn from the Geelong Osteoporosis Study (GOS). The fracture cohort included women with incident fracture identified from radiology reports and the non-fracture cohort were randomly selected from the electoral roll during 1994–1996.

Outcome measure: Symptoms of depression for women with and without fracture during the 12-month period 2000–2001 were identified by self-report questionnaire based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) criteria.

Results: A total of 296 women with fracture (12 hip, 48 vertebral, 91 wrist/forearm, 17 upper arm, 7 pelvis, 11 rib, 62 lower leg and 48 other fractures) and 590 women without fracture were included. Associations between fracture and depression differed between younger (≤ 65 years) and older (> 65 years) women. Age and weight-adjusted odds ratio for depression following fracture among younger women was 0.62 (0.35 to 1.11, $p=0.12$) and 3.33 (1.24 to 8.98, $p=0.02$) for older women. Further adjustment for lifestyle factors did not affect the results.

Conclusions: This study demonstrated that differences in mood status exist between older and younger women following fracture and that fracture is associated with increased depression in older women. Assessment of mood status in both the short and long term following fracture in the elderly seems justified, with early detection and treatment likely to result in improved outcomes.

Strengths and limitations of this study

- To our knowledge, there are no published studies investigating postfracture depression among the younger, fracture sites other than the hip, or studies with longer follow-up periods; these are all strengths of the current study.
- The time lag between fracture and depression measurement, an inability to provide pre-event psychiatric status and the use of a self-report instrument to determine depression are limitations.
- As with all observational studies, our results could be biased by unrecognised confounders and may not be generalisable to other populations of women, men, or those with other medical conditions.

concerns, particularly in women, and are associated with high levels of disability, functional impairment and early mortality. Depression is common and often persistent following a medical event, adversely affecting outcomes and prognosis by hindering adherence to treatment regimes and diminishing quality of life.¹ It is estimated that up to 20% of adults are affected by depression,^{2,3} with over \$A644 million per annum spent on health system costs in Australia alone.⁴

As a function of an ageing population, fracture rates and the associated burden are projected to rise substantially.^{5,6} It has been estimated that the lifetime risk of fracture lies within the range of 40–50% in women and 13–22% in men.⁷ In 2000, the estimated number of fragility fractures worldwide was 9.0 million, of which 1.6 million were hip, 1.7 million forearm and 1.4 million clinical vertebral fractures, with 61% occurring in women.⁸

Decline in quality of life is typical following a fracture, regardless of the site of fracture, and impose substantial medical and social costs.⁹ Furthermore, poorer psychological health has also been observed, with the associated decline in physical functioning, physical disability and a loss of independence



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BACKGROUND

Independently, depression and fracture are both increasingly prevalent public health

associated with fracture.^{10–12} A review investigating outcomes following hip fracture concluded that postinjury depressive symptoms are common and a strong predictor of poor recovery in the elderly.¹¹

It is likely that a bidirectional relationship between depression and fracture exists. Recently, depression has been shown to precede fracture, possibly influenced by medication use and biological and lifestyle factors dysregulated in depression.¹³ Moreover, depression has been shown to be a common response to chronic medical conditions that can, in turn, impact on symptom burden and treatment adherence and increase the risk of complications.¹⁴ Given the high prevalence of depression and fracture in women, as well as the previously reported associations showing depression to precede fracture, the aim of this study was to investigate whether fracture is associated with subsequent depressive symptoms in a study of age-matched fracture versus non-fracture cohorts. Understanding such an association is important in providing integrated and effective treatment.

METHODS

Participants

This study included women participating in the Geelong Osteoporosis Study (GOS), who were recruited from the Barwon Statistical Division (BSD) situated in south-eastern Australia to investigate the epidemiology of osteoporosis and fracture.¹⁵

Fracture cohort

Women identified from radiological reports as having sustained an incident fracture between February 1994 and February 1996 (n=1397), living in the BSD at the time of recruitment and aged 35 years and older were invited to participate in the fracture cohort of the GOS.¹⁶ The process of fracture ascertainment from radiological reports has previously been validated.¹⁷ A total of 1082 women were eligible for participation, with 77.4% accepting initial involvement (n=832). Those who participated in the 6-year follow-up (n=439) were sent a depression questionnaire, with a total of 296 returned (67%) and thus included in this study (median age 63 years, range 35–87 years).

Non-fracture cohort

Between 1994 and 1997 an age-stratified, random sample of women residing in the BSD was recruited from the Commonwealth electoral rolls. The initial group totalled 1494 women (median age 54 years, range 20–94 years), with a participation rate of 77.1%.¹⁸ Those eligible to participate in the 6-year follow-up (n=1275) were sent a depression questionnaire, with a total of 758 returned (60%). For this current study, 590 women aged 35 years and older (median age 59.3 years, range 35–91 years) were included.

MEASUREMENTS

Outcome variable

Symptoms of depression during the 12-month period, 2000–2001, were identified using a self-report questionnaire based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria.¹⁹ An episode of major depression was defined as a depressed mood state and a loss of interest and pleasure in usual activity lasting for at least a 2-week period. In addition, the presence of at least four symptoms including weight change, sleep disturbance, psychomotor changes, fatigue, feelings of worthlessness, poor concentration and suicidal ideation had to be evident, accompanied by diminished physical performance determined to be causing distress or impairment in at least one domain of work, social or personal functioning. The Cronbach's α coefficient for determining internal reliability of the questionnaire was 0.895.²⁰

Exposure variables

Body weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively. Information on lifestyle and other health factors was obtained via self-report questionnaire. Women were classed as physically active if they participated in light to vigorous activity on a regular basis. Tobacco smoking was recognised if practised currently, and alcohol use recognised if average consumption exceeded two standard drinks per day.

Statistical analyses

Statistical analyses were completed using Minitab (V.15; Minitab, State College, Pennsylvania, USA). Associations between fracture and depression differed for younger and older women; thus, all analyses were stratified by age (≤ 65 years and > 65 years). Differences in characteristics between those with fracture and those without fracture according to age group were compared using Student t tests for continuous parametric data, Mann-Whitney for continuous non-parametric and χ^2 analyses for categorical data. Logistic regression was used to determine the association between fracture and the likelihood of depressive symptoms among the younger (≤ 65 years) and older (> 65) women. Age, anthropometry, physical activity, smoking and alcohol use were tested in the models as potential confounders and/or effect modifiers. Values of $p < 0.05$ were considered as significant.

RESULTS

A total of 296 women with fracture (12 hip, 48 vertebral, 91 wrist/forearm, 17 upper arm, 7 pelvis, 11 rib, 62 lower leg and 48 other fractures) and 590 women without fracture were included in the analyses. Characteristics of the women with fracture versus those without fracture according to age are shown in table 1.

Table 1 Characteristics of the fracture versus non-fracture cohorts according to age (≤ 65 years and >65 years)

	Women with fracture n=170	Women without fracture n=382	p Values
≤ 65 years			
Age (year)	54.0 (45.0–60.2)	50.6 (43.2–58.5)	0.019
Weight (kg)	69.1 (61.4–78.4)	67.6 (60.1–79.0)	0.386
Height (cm)	162.2 \pm 6.5	161.9 \pm 5.9	0.619
Depression (12 months)	17 (10.0%)	60 (15.7%)	0.074
Physical activity (active)	117 (79.6%)	275 (75.6%)	0.328
Alcohol consumption (current)	77 (52.4%)	198 (54.4%)	0.679
Smoking (current)	20 (26.7%)	40 (11.0%)	<0.001
>65 years	n=126	n=208	
Age (year)	72.2 (69.2–76.4)	74.1 (70.3–81.0)	0.002
Weight (kg)	64.7 (57.0–70.6)	63.7 (56.0–71.9)	0.736
Height (cm)	157.21 \pm 6.3	156.7 \pm 6.4	0.502
Depression (12 months)	12 (9.5%)	7 (3.4%)	0.019
Physical activity (active)	48 (45.7%)	78 (50.0%)	0.497
Alcohol consumption (current)	40 (38.1%)	69 (44.2%)	0.324
Smoking (current)	3 (5.3%)	3 (1.9%)	0.192

Values are given as median (IQR), mean (\pm SD) or n (%)

Younger women (≤ 65 years)

Among the younger women (n=552), there were no differences in weight, height, depression, physical activity or alcohol consumption between those with and those without fracture, however women with fracture were older and more likely to smoke (table 1).

The association between fracture and depression among younger women was not significant. The unadjusted odds of having depression following fracture was 0.60 (95% CI 0.34 to 1.06, p=0.08) compared with those without fracture. Adjustment for age and weight did not affect the relationship (OR=0.62, 95% CI 0.35 to 1.11, p=0.12), nor did further adjustment for height, physical activity, smoking and alcohol consumption.

Older women (>65 years)

Among the older women (n=334), no differences in weight, height, physical activity, alcohol or smoking status were evident between those with or without fracture; however, women with fracture were younger and more likely to have depression (table 1).

The odds of having depression following fracture was three times greater (OR 3.02, 95% CI 1.16 to 7.89, p=0.02) for women with fracture compared with those without. Adjusting for age and weight did not affect the relationship (OR=3.33, 95% CI 1.24 to 8.98, p=0.02), which was also sustained after further adjustment for height, physical activity, smoking and alcohol consumption.

DISCUSSION

The findings from this study indicate an association between fracture and depression, although only among older women. Those aged >65 years were up to three times more likely to have depression post-fracture, while this relationship was not evident for younger women

(≤ 65 years). These associations were independent of age, anthropometry and lifestyle factors.

Our findings suggesting the risk of depression postfracture is increased among older women are consistent with findings from previous studies. Recently, several publications have explored health outcomes following hip fracture surgery and found depression to be common and to impact negatively on recovery up to 2 years postfracture.^{21–23} A systematic review that investigated the prevalence of psychiatric illness in hip fracture patients found that the prevalence of depression following fracture ranged from 9% to 47%²⁴; those rates being somewhat higher than community rates. Similarly, the prevalence of depressive symptoms in postmenopausal women with osteoporosis was reported to be greater for women who also had prevalent vertebral fractures compared with those without.²⁵ Both depressive symptoms following fracture and preinjury mood state have been shown to be predictive of recovery in the elderly, while a failure to regain preinjury functional and ability levels increases the possibility of persistent depressive symptomatology.^{10–26} In a prospective cohort study of 240 older participants, those who experienced high levels of depressive symptoms prior to a medical event (hip fracture, stroke and heart attack), had a poorer likelihood of recovery in activities of daily living.²⁷ Finally, a recent study using cultural models approach to understand how older women viewed osteoporosis reported that experiencing a fracture coincided with the acknowledgement of ‘getting older’.²⁸ Thus, we may expect a fracture to increase the likelihood of depression for some older women. It is plausible that stigma may be associated with a fracture in older age,²⁸ and thus impact negatively on an older woman’s self-identity. Taken in context, although a lower prevalence of depression overall has been reported among older women,³ the occurrence of a fracture may enhance the susceptibility to depression for a variety of reasons.

Our findings suggest no relationship between fracture and later depression among younger women. It is plausible that the causal pathway to fracture may differ across age groups, resulting in differing effects on psychological and physical outcomes. For instance, an internal locus of control (the belief one can control one's own life), high self-esteem, hope, acceptance, optimism and a sense of mastery have all been associated with resilience or the ability to maintain or regain mental health following adversity.²⁹ Furthermore, differences in premorbid emotional and cognitive state may have existed between the younger and older women prior to fracture. This is an important factor, as high positive affect and motivation has been observed as increasing the chances of returning to premorbid levels of functioning after a major health event.²⁷ Finally, compared with older women, younger women may have more access to social networks on which they can draw on for support, be less likely to remain homebound postfracture, and be able to fulfil ongoing work and social commitments during recovery.^{30–32}

Some methodological issues should be considered when interpreting the study findings. The time lag between fracture and depression measurement and an inability to provide pre-event psychiatric status is a limitation and it has to be taken into consideration that depression is a long-term, recurrent disorder in most individuals.³³ Thus, it is likely that depression preceded fracture in at least some of the women. The use of a self-report instrument, rather than a clinical diagnostic interview must also be acknowledged, also sensitivity and specificity of this scale was not determined. Response bias may also have influenced the findings, with higher rates of psychopathology and other comorbid conditions possibly present in the population declining participation. Last, as with all observational studies, our results could be biased by unrecognised confounders and may not be generalisable to other populations of women, men or those with other medical conditions. To our knowledge, there are no published studies investigating postfracture depression among the younger, fracture sites other than the hip, or studies with longer follow-up periods; these are all strengths of the current study.

CONCLUSION

In conclusion, this study demonstrated that differences in mood status exist between older and younger women following fracture and that fracture is associated with increased depression in older women. Assessment of mood status in both the short term and long term following fracture in the elderly seems justified, with early detection and treatment of elevated levels of depression likely to result in improved outcomes. Further research investigating a causal link between fracture and depression is warranted and is currently underway.

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Contributors LJW took part in the conception and design of the study, data cleaning, statistical analysis, interpretation of the data and took primary responsibility for writing the manuscript. MB and SLB took part in the interpretation of data and critically revised the manuscript. MJH and ALS took part in the conception and design of the study, statistical analysis, interpretation of the data and critically revised the manuscript. FNJ took part in the conception and design of the study, acquisition of the data and critically revised the manuscript. JAP took part in the conception and design of the study, interpretation of the analysis and critically revised the manuscript. All authors read and approved the final version of the manuscript.

Funding This work was supported by the National Health and Medical Research Council (NHMRC) of Australia. LJW is supported by a NHMRC Career Development Fellowship, MB is supported by a NHMRC Senior Principal Research Fellowship and SLB is supported by a NHMRC Early Career Fellowship.

Competing interests LJW has received grant/research support from Eli Lilly, Pfizer, The University of Melbourne, Deakin University and the NHMRC. MB has received grant/research support from the NIH, Simons Foundation, CRC for Mental Health, Stanley Medical Research Institute, MBF, NHMRC, Beyond Blue, Geelong Medical Research Foundation, Bristol-Myers Squibb, Eli Lilly, GlaxoSmithKline, Organon, Novartis, Mayne Pharma, Servier and AstraZeneca. He has been a paid consultant for AstraZeneca, Bristol-Myers Squibb, Eli Lilly, GlaxoSmithKline, Janssen Cilag, Lundbeck and Pfizer and a paid speaker for AstraZeneca, Bristol-Myers Squibb, Eli Lilly, GlaxoSmithKline, Janssen Cilag, Lundbeck, Organon, Pfizer, Sanofi-Synthelabo, Solvay and Wyeth. SLB has received grant/research support from the University of Melbourne, and the NHMRC. FNJ has received grant/research support from the Brain and Behaviour Research Institute, NHMRC, Australian Rotary Health, Geelong Medical Research Foundation and the University of Melbourne, and has been a paid speaker for Sanofi-Synthelabo, Janssen Cilag, Servier, Pfizer, Network Nutrition, Health Ed and Eli Lilly. JAP has received speaker fees from Amgen, Eli Lilly and Sanofi-Aventis and funding from the Geelong Region Medical Research Foundation, Barwon Health, Perpetual Trustees, the Dairy Research and Development Corporation, the University of Melbourne, the Ronald Geoffrey Arnott Foundation, ANZ Charitable Trust, the American Society for Bone and Mineral Research, Amgen (Europe) GmbH and the NHMRC.

Patient consent Obtained.

Ethics approval Human Research Ethics Committee at Barwon Health.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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BMJ Open

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BMJ Open 2014 4:

doi: [10.1136/bmjopen-2013-004226](https://doi.org/10.1136/bmjopen-2013-004226)

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