The psychological impact of long bone fractures in KwaZulu-Natal, South Africa: A cross-sectional study

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Abstract

Background: Long bone fractures are known to cause a decline in quality of life due to loss of physical functioning. Loss of independence due to loss or decline of physical functioning can also cause poorer psychological health. There is limited data on depression among orthopaedic patients in South Africa.

Methods: The validated Patient Health Questionnaire-9 depression scale was used to establish patient reported outcomes. The Chi-square or Fishers exact test was used where appropriate to compare the various psychological variables and the impact from upper and lower extremity sites. The Kruskal Wallis test was used to test differences in the overall depression score between subgroups. Univariate and multivariate linear regression was used to assess the relationship between variables of interest and the overall depression score, while adjusting for age and gender.

Results: A total of 821 research participants completed the questionnaire. The overall depression score in patients with a fracture ranged from 0 to 23 with a mean of 8.26 and a standard deviation of 4.76. The majority of participants (37.64%) had depression scores ranging from 5 to 9 which is associated with mild depression.

Introduction

Long bone fractures, which are often an acute event, are known to cause a short-term decline in quality of life, due to the physical restriction caused by the fracture that often prevents an individual from performing certain activities. Loss of independence due to loss or decline of physical functioning can also cause poorer psychological health, which can impose medical and social costs.[1] Psychological distress after a fracture may be exacerbated by acute pain which is common after a fracture.[2] Depression is one of the precursors to a poorer quality of life.[3] Suicidal thoughts are common in people who are depressed. There is limited data on depression among orthopaedic patients in South Africa.[4] Understanding the association between long bone fractures and psychological health is important for providing appropriate treatment and resource allocation for mental health services. Previous studies on the psychological impact of long bone fractures have mostly included geriatric patients with osteoporotic fractures, in high and middle-income countries (HMIC's). South Africa is ranked as a 'middle income' country by the World Bank. There is a paucity of reliable orthopaedic data in lower and middle-income countries (LMIC's).[5,6] The impact of fractures has mostly included polytrauma patients with injury to more than one body system or studies with limited sample sizes, which may have inaccurately depicted the true impact of the long bone fracture. The aim of the study was to investigate the psychological impact of long bone fractures in adults receiving care at public service facilities in KwaZulu-Natal (KZN), a province in South Africa, using the validated Patient Health Questionnaire (PHQ-9) which has been validated and used in the South African context.

Materials and Methods

Study design and setting

A cross-sectional design was used to investigate the psychological impact of long bone fractures in adults. This was a multi-site study, involving patients receiving orthopaedic care at nine KZN public sector hospitals. The study was conducted from July 2017 to February 2018.

Measurement

The PHQ-9 is a validated scale used to measure depression severity. The PHQ-9 has a Cronbach Alpha of 0.86, which makes it a reliable instrument. Each item on the scale is rated on a four-point scale; 0 (not at all) to 3 (nearly every day) using nine items for a total score ranging from 0 to 27. A score of 0-4 indicates no depression, 5-9 indicates mild depression, 10-14 indicates moderate depression, 15-19 indicates moderately severe depression and 20-27 indicates severe depression. The PHQ-9 is included in Appendix A.

Inclusion and exclusion criteria

Only patients aged eighteen and older, with one long bone fracture, sustained in the preceding four to twelve weeks prior to questionnaire completion were eligible for inclusion. Cognitively impaired participants and those not able to read and/or write in English and/or isiZulu were excluded from the study since only English and isiZulu information sheets, consent forms and questionnaires were available. Only fractures of the humerus, radius, ulna, femur, tibia and fibula were included.

Study ethics

This publication is part of a PhD study at the University of KwaZulu-Natal (UKZN) and was reviewed and approved by the UKZN, School of Nursing and Public Health Medicine and the Biomedical Research Ethics Committee, reference number BE583/16. Administrative approval was obtained from the KZN Department of Health and the medical managers of the nine hospitals.

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Data collection

Data was collected by two independent health practitioners with experience in orthopaedic care and treatment, and who were fluent in English and isiZulu. A pilot study, which included twenty participants, was conducted to test the questionnaire and for the research assistants to familiarise themselves with data collection procedures. Participants from the pilot study were not included in the main study and the data from the pilot study was not included in the final analysis. Potential participants were recruited with the assistance of orthopaedic staff after reviewing patient's records and X-rays. Long bone fractures were classified as not displaced, moderately displaced and severely displaced after consulting with orthopaedic staff, reviewing of patient records and X-rays. The research assistant explained the aim and objectives of the study to the participants and those who wished to be included were given an information sheet to read, and thereafter a consent form to sign. Participants were assured that their anonymity would be persevered. Approximately thirty to forty-five minutes were spent by each participant on the questionnaire. The research assistant assisted participants who wanted to participate in this study, but who were unable to write due to the fracture. In those instances, the research assistant asked the patient the questions and recorded the responses.

Sampling technique

The sample size was calculated by a statistician using G-Power™. A sample size of 821, with a level of precision of 0.13 at a type 1 error rate of 5% was set. To obtain the sample, a two-stage sampling strategy was used since the study population and sample size were large. A list of all KZN health institutions was retrieved from the KZN Department of Health website. In the first stage of sampling, all health institutions that do not provide orthopaedic services were excluded. In the second stage of sampling, all clinics were excluded and only hospitals with inpatient and outpatient orthopaedic facilities were included. The hospitals are situated in various districts and there was a mix of urban and rural hospitals and inpatients and outpatients. The number of participants that were included per hospital depended on the orthopaedic statistics of each hospital. Data was collected until the sample size target was reached. The number of participants that were chosen from each hospital is detailed in Table 1.

Bias

To limit bias, the questionnaire was tested in the pilot study and the two research assistants were trained on the use of the

Table 1. Number of participants chosen from each hospital.

Hospital	Frequency	Percent
A	204	24.85
B	112	13.64
C	155	18.88
D	60	7.31
E	111	13.52
F	121	14.74
G	21	2.56
H	5	0.61
I	32	3.90
Total	821	100.00

Table 2. Demographics and injury characteristics.

Number	Percentages	
Age group		
18-35 years (young)	346	42.14
36-59 years (middle age)	319	38.86
60 and over (old)	156	19.00
Total	821	100
Gender		
Male	519	63.22
Female	302	36.78
Total	821	100
Ethnicity		
Black	718	87.45
White	19	2.31
Coloured	3	0.37
Indian	73	8.89
Other	8	0.97
Total	821	100
Region of fracture		
Upper extremity	251	30.57
Lower extremity	570	69.43
Fractured long bone		
Humerus	91	11.08
Radius	86	10.48
Ulna	74	9.01
Femur	310	37.76
Fibula	65	7.92
Tibia	195	23.75
Severity of fracture		
Open long bone fracture	57	7.06
Closed long bone fracture	750	92.94
Displacement of fracture		
Severely displaced	148	18.07
Moderately displaced	540	65.93
Not displaced	131	16.00
Time frame of fractures		
4-6 weeks	711	86.71
7-8 weeks	60	7.32
9-10 weeks	17	2.07
11-12 weeks	32	3.90
Mechanism of Injury		
Motor vehicle accident	190	23.17
Assault	78	9.51
Sports injury	17	2.07
Injury due to fall	470	57.32
Other	65	7.93
Participants who had surgery	161	19.73

tool. The research assistants were not employees of the KZN Department of Health so patients would not feel obliged to give positive responses only.

Data management, statistical methods and confounders

Before data capturing, the isiZulu questionnaires were translated back to English by one of the research assistants. The collected data was entered onto a custom database by a data capturer at the South African Medical Research Council. Ten percent of the questionnaires were double entered by a second data capturer to ensure quality control. Cronbach's alpha and individual item correlations were computed to measure the overall reliability of the PHQ-9 scale in our setting. Demographic characteristics were summarized as frequencies and percentages. The Kruskal-Wallis test or Wilcoxon rank sum test was used to compare psychological score between participants with upper and lower extremity long bone fractures. To assess the impact of key variables on psychological score, after adjusting for potential confounders such as age and gender, multivariate linear regression was used with p-values less than 0,05 considered statistically significant. All analysis was performed using Stata 15.

Results

The demographics of the participants and fracture characteristic are summarised in Table 2.

A total of eight hundred and twenty-one participants with long bone fractures were included in the final analysis. Most patients were younger than 60, with 346 (42.14%) and 319 (38.86%) aged 18-35 and 36-59, respectively. Approximately two thirds of the participants were male 519 (63.22%). Most participants had closed long bone fractures (92.94%). A higher proportion of participants sustained fractures to the lower extremity 570 (69.43%).

The long bone most fractured was the femur 310 (37.76%) and the least fractured bone was the fibula 65 (7.92%). The most common mechanism of injury was falls.

Table 3 compares the individual psychological variables of the PHQ-9 scale, between those who sustained upper and lower limb fractures. Significantly higher levels of loss of motivation were observed in those with lower limb fractures compared to those with upper limb fractures (p-value 0.001). Over a period of more than half the days and nearly every day, participants with lower extremity fractures felt depressed more often compared to those with upper extremity fractures (34.44% *versus* 31.87%). There was a significant association between having suicidal thoughts and location of fracture (p-value=0.01), where 10.76% of those with upper limb fractures reported frequently feeling suicidal, compared to 5.79% of those with lower limb fractures. There was a significant association between changes in movement and speech between the two groups (p-value =0.048).

Table 4 shows a comparison of depression scores between key groups of interest. The overall depression scores were higher in the lower extremity group however, there was no significant differences in overall depression scores between upper limb and lower limb fractures. There was also no significant differences in depression scores between those with open and closed long bone fractures, but those with open long bone fractures had higher depression scores than those with closed fractures. However, there was a significant difference in depression scores when varied by displacement of the long bone fracture and how long ago the fracture was sustained. Those who experienced no displacement had significantly lower depression scores compared to those severely displaced.

Table 5 demonstrates the depression scores for all participants when categorised into the five established depression score categories of the PHQ-9 scale. Overall, the majority of participants, 37.64%, had mild depression.

Multivariate analysis

After adjusting for potential confounders such as age and gender, there was no statistical significance in depression scores between participants with upper extremity and lower extremity fractures. However, there was a statistically significant difference between psychological scores of undisplaced and severely displaced fractures (p-value 0.001), with higher depression scores noted in those with severely displaced fractures. The depression scores among participants who had fractures that were eleven to twelve weeks old were significantly lower than those who had sustained a recent fracture (p-value 0.04).

Discussion

The aim of this study was to investigate the psychological impact of long bone fractures on adults in KZN.

A slightly higher proportion of participants with lower limb fractures reported feeling depressed for more than half the days of the preceding two weeks compared to those with upper limb fractures. Lower extremity fractures generally cause greater physical restriction in terms of restriction of movement than fractures of the upper extremity. Orthopedic trauma may often result in depressive symptoms due to lack of ease in performing daily activities and greater dependence on family, friends or healthcare workers.[7] Depression is a state of low mood and disinclination to activities or tasks that can affect an individual's general health. Depression may further compromise the patient's well- being and may affect recovery time after a fracture. A longer recovery time may impose added public health costs due to a longer stay in hospital and financial costs to the patient due to them being unable to work. It may also include feelings of sadness, anxiety, apathy, lethargy, hopefulness, worthlessness, guilt, irritability or restlessness.[8] Depressed people are likely to lose interest in activities that once were pleasurable, have trouble concentrating, remembering details or making decisions and may contemplate or attempt suicide. Twenty five percent of patients over the age of 65 sustaining long bone fractures may never regain their previous levels of mobility resulting in stress and anxiety.[9] In this study, nineteen percent were aged sixty and over and if twenty five percent never regain their previous level of function, this may indicate that they would require long term assistance from their social network or prolonged rehabilitation.

The number of people who develop depression or display severity of depressive symptoms after a fracture is often related to the extent of disability such as non-displaced, moderately displaced, and severely displaced fractures.[9] Greater psychological distress is suffered by participants with displaced fractures compared to participants with non-displaced fractures. Displaced fractures also result in more complications such as non-union and neurovascular complications, whereas non-displaced fractures generally heal well with good functional recovery. A study by Dibbern and colleagues[10] demonstrated that fracture severity also increases osteoarthritis risk, despite surgical management which is aimed at preventing posttraumatic osteoarthritis. Mendonca *et al.*[11] found that in patients with femoral fractures, those who had displaced fracture had slightly higher mental health scores compared to those with undisplaced fractures but the difference was not significant. The study was conducted on forty-five patients, with a mean age of 74.38. Our study did not demonstrate a significant difference in the mean depression scores among patients with open and closed fractures.

Table 3. PHQ-9 depression scale items.

Factor	Participant answers	Upper extremity fractures, n (%)	Lower long bone fractures, n (%)	Total extremity long bone	p
Little interest or pleasure in doing things (Motivation)	Not at all	75 (29.88)	101 (17.72)	176 (21.44)	0.001*
	Several days	116 (46.22)	301 (52.81)	417 (50.79)	
	More than half the days	52 (20.72)	139 (24.39)	191 (23.26)	
	Nearly everyday	8 (3.19)	29 (5.09)	37 (4.51)	
	Total	251 (100)	570 (100)	821 (100)	
Feeling depressed	Not at all	61 (24.30)	108 (18.98)	169 (20.61)	0.38
	Several days	110 (43.82)	265 (46.57)	375 (45.73)	
	More than half the days	69 (27.49)	171 (30.05)	240 (29.27)	
	Nearly everyday	11 (4.38)	25 (4.39)	36 (4.39)	
	Total	251 (100)	569 (100)	820 (100)	
Trouble falling asleep, staying asleep or sleeping too much	Not at all	79 (31.47)	164 (28.82)	243 (29.63)	0.76
	Several days	104 (41.43)	247 (43.41)	351 (42.80)	
	More than half the days	56 (22.31)	123 (21.62)	179 (21.83)	
	Nearly everyday	12 (4.78)	35 (6.15)	47 (5.73)	
	Total	251 (100)	569 (100)	820 (100)	
Feeling tired or having little energy	Not at all	80 (31.87)	162 (28.52)	242 (29.55)	0.56
	Several days	125 (49.80)	298 (52.46)	423 (51.65)	
	More than half the days	34 (13.55)	88 (15.49)	122 (14.90)	
	Nearly everyday	12 (4.78)	20 (3.52)	32 (3.91)	
	Total	251 (100)	568 (100)	819 (100)	
Poor appetite or overeating	Not at all	106 (42.40)	239 (42)	345 (42.12)	0.34
	Several days	93 (37.20)	234 (41.12)	327 (39.93)	
	More than half the days	39 (15.60)	81 (14.24)	120 (14.65)	
	Nearly everyday	12 (4.80)	15 (2.64)	27 (3.30)	
	Total	250 (100)	569 (100)	819 (100)	
Feeling bad about yourself or that you are a failure or that you have let yourself down	Not at all	116 (46.22)	223 (39.12)	339 (41.29)	0.06
	Several days	85 (33.86)	235 (41.23)	320 (38.98)	
	More than half the days	47 (18.73)	95 (16.67)	142 (17.30)	
	Nearly everyday	3 (1.20)	17 (2.98)	20 (2.44)	
	Total	251 (100)	570 (100)	821 (100)	
Trouble concentrating on things, such as reading the newspaper or watching television	Not at all	118 (47.01)	246 (43.16)	364 (44.34)	0.72
	Several days	90 (35.86)	227 (39.82)	317 (38.61)	
	More than half the days	39 (15.54)	87 (15.26)	126 (15.35)	
	Nearly everyday	4 (1.59)	10 (1.75)	14 (1.71)	
	Total	251 (100)	570 (100)	821 (100)	
Moving or speaking so slowly that other people could have noticed? Or the opposite -being so fidgety or restless that you have been moving around a lot more than usual	Not at all	119 (47.41)	248 (43.51)	367 (44.70)	0.048*
	Several days	88 (35.06)	197 (34.56)	285 (34.71)	
	More than half the days	44 (17.53)	109 (19.12)	153 (18.64)	
	Nearly everyday	0 (0)	16 (2.81)	16 (1.95)	
	Total	251 (100)	570 (100)	821 (100)	
Thoughts that you would be better off dead, or of hurting yourself in some way	Not at all	115 (45.82)	233 (40.88)	348 (42.39)	0.01*
	Several days	68 (27.09)	203 (35.61)	271 (33.01)	
	More than half the days	41 (16.33)	101 (17.72)	142 (17.30)	
	Nearly everyday	27 (10.76)	33 (5.79)	60 (7.31)	
	Total	251 (100)	570 (100)	821 (100)	

*p significant.

Table 4. A comparison of depression scores between key groups of interest.

Group	N	Mean	SD	Median (IQR)	p
Location of fracture					0.14
Upper extremity	251	7.92	5.03	7 (4-12)	
Lower extremity	570	8.41	4.63	8 (5-12)	
Displacement					0.0001*
Severely	148	8.90	4.63	8 (6-13)	
Moderately	540	8.50	4.64	8 (5-12)	
Not displaced	131	6.57	5.04	6 (2-11)	
Severity					0.87
Open	57	8.60	5.64	8 (4-12)	
Closed	750	8.22	4.70	8(5-12)	
Total			4.77		
Time frame					0.04*
4-6 weeks	711	8.37	4.78	8 (5-12)	
7-8 weeks	60	8.33	4.80	7.5 (5-13)	
9-10 weeks	17	6.59	4.26	6 (3-10)	
11-12 weeks	32	6.41	4.01	6 (4-8)	

*p significant.

The depression scores were significantly lower in participants with fractures that were sustained eleven to twelve weeks before data collection compared to those who sustained fractures four weeks before data collection. This is possibly because bone fracture healing is completed six to eight weeks after the injury. Unlike soft tissue healing which leads to scar formation, fracture healing results in the regeneration of anatomy of the bone and in some cases a complete return to function. Soon after a fracture, an inflammatory process begins which peaks in forty-eight hours and is completed after approximately one-week post fracture. Pain and swelling may cause restriction of movement.[12]

At eleven to twelve weeks post fracture the participant may have undergone a surgical procedure to correct the fracture and some form of rehabilitation to improve mobility and flexibility of the affected anatomical region. This period is usually sufficient for both upper and lower limb bones to heal. Collaborations between orthopaedic surgeons, physiotherapists, nurses and other health professionals may have assisted in the rehabilitation process. A study comparing anxiety and depression after injuries in Nigeria demonstrated that there was a significant difference in depression and anxiety levels between long bone fracture subjects at Time one (baseline), Time two (4-8 weeks) and Time three (10-12weeks).[13] The study was a prospective, repeated measure design and included 160 subjects. The findings from this study is consistent with our study. A study by Forsberg and colleagues[14] investigating patient experiences after suffering a lower limb fracture shows that soon after injury occurrence patients may feel helpless, frustrated and anxious until they regain autonomy. Once patients realise that they are likely to gain full function, they are more likely to become optimistic about the future, hence an improvement in mood. The findings from this study is consistent with our study since participants who sustained a fracture four to six weeks before data collection had higher depression scores compared to those who sustained a fracture eleven to twelve weeks before data collection.

Even minor levels of depressive symptoms are linked to loss of productivity and motivation.[15] To be motivated is to be moved to achieve a goal or perform a task, or to decide to accomplish a goal. For motivation to occur, biological and psychological factors push an individual to achieve a goal, while environmental prospects like incentives and goals pull an individual. However, even if an individual has many sources of motivation, a task may not be achieved. Sufficient energy is also necessary for motivation.[16] A larger percentage of participants who sustained fractures to the lower extremity felt little interest or pleasure in performing normal activities after the fracture. Medication may also cause a patient to feel tired or have little energy and as a result, they have little interest or pleasure in doing things since to be motivated assumes a supply of energy.[16] Without energy to power muscles and neurons of the brain, behaviour is compromised since psychological and physical energy are the two major categories of energy for motivation. We found that a larger percentage of participants with lower extremity long bone fractures felt tired or had little energy which is similar to other studies.[5,6] Hans Selye, the creator of the stress concept stated that the body possessed a certain amount of adaptation energy that could be used to overcome stress. A long bone fracture may cause stress to an individual. The body's ability to adapt to stress depends upon their available adaptation energy. When a person's adaptation energy runs out, their motivation may cease. Even with sufficient energy, knowledge and competence, motivation is still an important factor for accomplishing tasks.[17] A 2012 study by Aitken and colleagues[18] found that after injury restoring psychological stability was an important goal for patients since it consequently affects their return to work, gaining independence and fulfilling family duties.

Depression also influences the autonomic nervous system activity which may affect sleep. The World Health Organisation and the National Sleep Foundation recommend an average of eight hours of sleep per night for adults. Patients in pain exhibit several changes in sleep such as frequent sleep stage shifts, increased nocturnal awakenings and decreased slow wave or rapid eye movements in sleep.[19] Sleep disruption may contribute to psychiatric conditions such as anxiety.[20] In this study, participants with upper extremity fractures had a greater percentage of oversleeping or under sleeping. People experiencing changes in sleep patterns may also have a problem with concentration or being attentive. Patients with fractures of the upper extremity also showed a higher percentage of concentrating on things such as reading the newspaper or watching television. Sleep deprivation combined with stress may lead to decreased adaptive stress response. Exercise has been suggested as an arousal provoking activity, although it might be painful for patients with fractures to engage in exercise.[20]

Suicide remains a public health concern in many countries. Any medical condition combined with depressive symptoms is a risk factor for suicide.[21] When a patient is sent home, the support of their family and friends is important to prevent them from causing self-harm.[9] A study conducted in the Western Cape of South Africa found that social support may hinder suicidal tendencies in human immunodeficiency virus positive adolescents.[22] In this study upper extremity fractures had a greater percentage of thoughts of suicide or self-harm nearly every day in the preceding two weeks, even though lower extremity fractures had higher depression scores. The difference in thoughts of suicide or self-harm was significantly different between the two groups. There may be numerous factors which may explain this finding from your study, and that this may be investigated in future research.

Participants with fractures to the lower extremity experienced greater physical restriction. Lower limb fractures are linked to considerable morbidity since the lower limbs are used to weight bear. The Seligman's Attribution model proposes that the meaning given to negative events can determine the risk of depression.[23,24] If patients attributed the fracture to some fault of their own, they are more likely to become depressed. However, if patients saw the event as something beyond their control then they would have handled it well emotionally.[23,24] According to the George Brown model of self-esteem and depression negative experiences can give rise to low self-esteem which can act as a diathesis for depression. Self-esteem falls within the fourth tier of Maslow's Hierarchy of needs. If esteem needs are not met, then the patient will not be able to achieve their full poten-

Table 5. Overall depression scores.

Depression score category	Frequency	Percent
0-4 No depression	194	23.63
5-9 Mild depression	309	37.64
10-14 Moderate depression	242	29.48
15-19 Moderately severe depression	61	7.43
20 -27 Severe depression	15	1.83

tial, since self-actualisation is the fifth tier.[25] Sluys and colleagues[26] compared the health related quality of life in upper extremity and lower extremity injuries. They found that participants with lower extremity injuries had the highest impact on quality of life. Similarly, this study found that those with lower extremity fractures had a higher overall depression score.

Recommendations and public health considerations

The mental health vision of the KZN Department of Health is to promote well-being for all people in KZN through appropriate mental health programs. One of the missions of the Department of Health in KZN is to develop policy guidelines and support programs to promote mental well-being. It is therefore suggested that counselling should be offered especially to those with lower limb fractures and more complicated fractures.

Limitations

A few limitations should be considered when interpreting the results. Research participants with pre-existing depression were not identified prior to enrolment in the study as it would have been costly and time-consuming to enlist the services of a mental health practitioner. More than eighty percent of participants sustained the fracture four to six weeks before data collection which could have biased results. Due to the study design, the authors cannot infer causality, but can only comment on associations.

Conclusions

In this study, long bone fractures were associated with mild depression in 37.64 percent of participants. A slightly higher proportion of participants with lower limb fractures reported feeling depressed for more than half the days of the preceding two weeks compared to those with upper limb fractures (30.05% *versus* 27.49%). A slightly higher proportion of those with upper limb fractures had suicidal thoughts nearly every day in the preceding two weeks compared to those with lower limb fractures (10.76% *versus* 5.79%). Loss of motivation, changes in appetite and sleep patterns, lethargy, thoughts of guilt and trouble concentrating after sustaining the fracture were also evident in participants.

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