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The effect of social deprivation on fragility fracture of the distal radius

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ABSTRACT

Introduction: Social deprivation is associated with many adult fractures including distal radius fractures but the mechanisms for this are unclear. The aim of this study was to identify if social deprivation was associated with falls risk, mechanism of injury or osteoporosis in patients with a fragility fracture of the distal radius.

Method: Details of all patients aged 50 years and over presenting with a radiographically confirmed fracture of the distal radius over a one year period, were prospectively recorded. Patients were sent a questionnaire pack including questions regarding place and mechanism of injury, comorbidity assessment, falls risk assessment tool and FRAX assessment of bone health and fracture risk.

Results: 333 out of 521 eligible patients completed the questionnaire (279 female; 54 male, response rate = 64%). There was no difference between characteristics of responders and non-responders ($p = 0.58$). DRF rate was higher in socially deprived quintiles ($p = 0.040$). Less falls occurred in the home in socially deprived patients (Q1/2: 35%: Q3–5: 48%, $p = 0.037$) with more falls outdoors (Q1/2: 39%: Q3–5: 24%, $p = 0.001$). There was no difference in height from which falls took place with most occurring from standing height (Q1/2: 81%: Q3–5: 86%, $p = 0.336$). Linear regression analysis found no relationship between social deprivation rank and FRAX scores (major fracture risk: $p = 0.274$, hip fracture risk: $p = 0.283$) but demonstrated a significant relationship between social deprivation and increased number of falls risk factors ($p = 0.002$). Mean number of falls risk factors was higher in the two most socially deprived quintiles (Q1/2: 3.62: Q3–5: 2.79, $p = 0.028$).

Conclusion: We have identified increased falls risk as an important reason for DRF in socially deprived patients. Knowing which patients are at highest risk allows interventions to be efficiently targeted. We would recommend resources should be targeted towards patients from socially deprived areas and focused on specific falls prevention strategies.

Introduction

Distal radius fracture (DRF) is an important cause of morbidity particularly among the elderly. 6% of women in the western world will have suffered a distal radius fracture by the time they are 80 [1]. Poor socioeconomic status is associated with higher prevalence of many diseases such as asthma and heart disease [2,3]. Social deprivation has been shown to be associated with many adult fractures including distal radius fractures [4–7].

Understanding inequalities in healthcare and which groups are at increased risk of injury can allow preventative mechanisms and prophylactic interventions to be initiated. This is especially important for DRF patients who have an increased chance of hip fracture within the first year after injury [8]. Falls prevention, bone quality assessment and appropriate use of bone protective medication can reduce further fracture by 50% [9].

Several studies report increased fracture rate with social deprivation but the reasons for increased fracture risk have not been established. Risk factors for osteoporosis such as smoking, alcohol, poor nutrition, raised body mass index and low uptake of hormone replacement therapy treatment are likely to be found in areas of reduced socioeconomic status [10–12]. However, the association between social deprivation and osteoporotic fracture is unclear [4]. The aim of this study was to identify if social deprivation was associated with falls risk, mechanism of injury or osteoporosis in patients with a fragility fracture of the distal radius.

Method

Details of all patients presenting to our unit with a radiographically confirmed fracture of the distal radius between 1st April, 2015 and 31st March, 2016, were prospectively recorded. We only

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included patients aged 50 years and over as we wished to investigate the effect of social deprivation on patients with a fragility fracture. Bone mineral density has been shown to remain stable until 50 years of age and then decline [13]. Patients from outside the region or of no fixed abode were excluded. Death checks were carried out and any patients who died were removed from the study.

The Index of Multiple Deprivation 2010 (IMD 2010) is a measure of multiple deprivation at the small area level. Small spatial areas called Lower Super Output Areas (LSOAs) are used to measure and compare social deprivation in England [14]. There are 32,482 LSOAs in England with a mean population of 1500.

IMD 2010 is made up of seven domain indices. A score is given to each of these domains and combined to give an overall IMD score. A higher score reflects greater social deprivation. LSOAs are then ranked on this score from 1 to 32,482 with rank 1 being the most deprived area and highest IMD score. These rankings are split into 5 equal quintiles with quintile 1 being the most deprived.

Our unit is the only hospital to treat distal radius fractures in the region. Postcodes were used to link each patient to their respective LSOA with its assigned IMD 2010 rank and quintile. Accurate post code data was recorded for all patients so IMD rank and quintile was available for every patient in the study group. Proportion of wrist fracture patients from each quintile were compared to total proportion of people in each quintile for the whole region.

All included patients were sent a questionnaire pack with a stamped addressed envelope for return. Non-responders were sent 2 further reminders which included the questionnaires. The questionnaire pack included questions regarding place and mechanism of injury, comorbidity assessment, falls risk assessment tool and FRAX assessment of bone health and fracture risk.

Frax®

FRAX® is a freely available online tool which calculates the 10-year probability of hip fracture or a major osteoporotic fracture [15]. A major osteoporotic fracture is defined as a clinical spine, hip, forearm or humerus fracture. It has been shown to be robust, effective and is approved by National Institute for Health and Care Excellence (NICE).

Age, gender and height and weight measurements are required for each patient. The following risk factors are assessed with a simple yes or no response:

- Previous fracture
- Parental hip fracture
- Current smoker
- Glucocorticoid use (for more than 3 months)
- Rheumatoid arthritis
- Secondary osteoporosis
- Alcohol (3 or more units per day)

The tool calculates two percentage scores, one for 10-year risk of a hip fracture and one for the 10-year risk of other major osteoporotic fracture. Both FRAX scores were calculated for all patients in the study.

Falls risk assessment

NICE recommend a falls risk assessment for people who have had falls or are at risk of a fall but acknowledge there is a lack of evidence about which assessment tool is most useful [16]. Most assessment scales were developed for the elderly in hospital settings or nursing homes [17]. Rubenstein et al developed and validated a falls risk self-assessment questionnaire following qualitative analysis [18]. It was designed to be used in a falls risk self-assessment brochure and is widely used in falls prevention initiatives in the US [19,20]. It was chosen for this study as it is appropriate for community dwelling individuals and is a quick and simple checklist suitable for a postal survey. Respondents circle yes or no regarding twelve statements about falls risk factors. Two of the statements ("I have fallen in the past year", "I have been advised to use a cane or walker to get around safely") score 2 points while all others score 1 point. A total of 4 points or more suggests the respondent is at risk of falling.

Analysis

Comparison of responders with non-responders was performed to ensure the results were applicable to the underlying population.

The results from the most deprived quintiles (1 and 2) were compared with the least deprived quintiles (3–5) using the Chi squared test. Linear regression analysis was performed to investigate the association between FRAX scores and falls risk scores with IMD rank including age and gender as co-variables. Individual logistic regression models were then created for each individual FRAX and falls risk factor yes or no response also incorporating gender and age.

Results

553 patients aged 50 years and over sustained a DRF during the one year study period. 20 patients were from outside the region or of no fixed abode and 12 patients died during the study period. These 32 patients were therefore excluded from the study leaving 521 patients. Questionnaire packs were sent to all 521 eligible patients and completed by 333 (279 female; 54 male, response rate = 64%).

Comparison between characteristics of responders and non-responders was performed. There was no difference in the proportions seen in the most and least socially deprived quintiles overall ($p = 0.58$) and when examined by gender separately (men $p = 0.95$, women $p = 0.55$). This suggests that the survey responders are representative of the total DRF population. DRF rate was higher in the deprived quintiles with more fractures seen than would be expected based on the size of the population at risk ($p = 0.040$) (Table 1).

Data regarding mechanism of fall, co-morbidities, falls risk and osteoporosis risk factors was available for 96% of participants. Responders were also asked their height and weight. This was completed by 72% of patients. Multiple imputation was performed using gender, age, deprivation rank, number of comorbidities, falls risk factors and other osteoporosis risk factors to generate missing values. These values were then used to calculate FRAX scores for all patients.

Table 1
Population characteristics and observed and expected number of DRF in quintiles 1–2 compared with quintiles 3–5.

Quintile	Population	% of population	Fractures expected	Fractures observed	Rate (100,000/pts/year)
Q1–2 (most deprived)	86,951	25	84	108	124.2
Q3–5 (least deprived)	259,682	75	249	225	86.6

Mechanism of fall

A significantly lower proportion of falls occurred in the home in more socially deprived patients (Q1–2: 35%: Q3–5: 48%, p = 0.037) and more falls happened outdoors in the road or street in socially deprived patients (Q1–2: 39%: Q3–5: 24%, p = 0.001). There was no difference in the height at which falls took place with most being from standing height (Q1–2: 81%: Q3–5: 86%, p = 0.336).

Osteoporosis risk

There was no difference in FRAX scores for major 10-year fracture risk and 10-year hip fracture risk between the two most socially deprived quintiles and the three least socially deprived quintiles (Table 2). Linear regression analysis was carried out to investigate the relationship between IMD rank and FRAX scores but no association was found (major fracture risk: p = 0.274, hip fracture risk: p = 0.283). FRAX score does incorporate gender and age but due to the likely large effect of these variables further separate linear regression models were constructed for each gender which included age as a separate independent variable. This again demonstrated no association between IMD rank and FRAX scores. Increasing age was significantly associated with higher FRAX scores for both genders.

Regression modelling of individual osteoporosis risk factors revealed that smoking was the only risk factor with a significant relationship with social deprivation (Table 3). A lower rate of smoking and higher rate of rheumatoid arthritis was seen with increasing age. Men were more likely to smoke and less likely to have rheumatoid arthritis.

Falls risk assessment

Mean number of falls risk factors was significantly higher in those in the two most socially deprived quintiles compared to the three least socially deprived (Q1–2: 3.62: Q3–5: 2.79, p = 0.028). Linear regression analysis also demonstrated a significant relationship between lower IMD rank and increased number of falls risk factors (p = 0.002). Increasing age was also a significant factor (p < 0.001).

A significantly higher proportion of people with a total falls risk score of four or greater (indicating at risk of falling) was seen in those from the two most socially deprived quintiles (Q1–2: 39%: Q3–5: 28%, p = 0.041). Mean IMD rank was lower in those with a score of four or greater indicating more social deprivation (score ≥4: mean IMD rank 16874, score <4: mean IMD rank 19094, p = 0.042).

Separate regression analysis of the individual risk factors was performed (Table 4). Increasing age was associated with eight risk factors and social deprivation with five risk factors. Gender was not an influence.

Table 2
Mean values for fracture risk and number of falls risk factors for patients in the two most deprived quintiles (Q1–2) compared to those in the three least deprived quintiles (Q3–5).

	FRAX 10 yr major fracture	FRAX 10 yr hip fracture	Falls risk factors
Q1-2 (most deprived)	15.75	6.50	3.62
Q3–5 (least deprived)	17.43	7.75	2.79
P value	0.227	0.257	**0.028**

Statistically significant p values in bold (p<0.05).

Table 3
P values from individual logistic regression models investigating the relationship between each osteoporosis risk factor and deprivation (as measured by IMD rank), age and gender.

Osteoporosis risk	Deprivation	Age	Gender (male)
Parental hip fracture	0.762	0.189	0.116
Smoker	**0.019**	**0.020**[a]	**0.017**
Steroids	0.812	0.183	0.100
Secondary osteoporosis	0.771	0.083	0.189
Alcohol	0.307	0.150	0.184
Rheumatoid Arthritis	0.150	**0.005**	**0.047**[b]

Statistically significant p values in bold (p<0.05).
[a] Less likely to be a smoker with increasing age.
[b] Less likely to be male.

Table 4
P values from individual logistic regression models investigating the relationship between each falls risk factors and deprivation (as measured by IMD rank), age and gender.

Falls risk	Deprivation	Age	Gender
fallen in the past year	0.138	0.149	0.718
advised to use a cane or walker	0.643	<**0.001**	0.238
feel unsteady	0.373	<**0.001**	0.952
hold onto furniture	0.101	<**0.001**	0.725
worried about falling	**0.002**	<**0.001**	0.082
push with hands from a chair	0.193	<**0.001**	0.916
trouble stepping onto curb	**0.024**	<**0.001**	0.436
rush to the toilet	**0.003**	<**0.001**	0.766
lost feeling in feet	0.63	**0.003**	0.381
medicine makes me light-headed or tired	**0.002**	0.064	0.57
medicine for mood/sleep	0.17	0.841	0.242
feel sad or depressed	**0.004**	0.118	0.379

Statistically significant p values in bold (p<0.05).

Discussion

Social deprivation is known to be an important influence on fracture incidence but how it leads to increased fracture rate is not understood. We set out to investigate if social deprivation was associated with falls risk, mechanism of injury or osteoporosis in patients with a fragility fracture of the distal radius. We have established that falls risk is higher in older, socially deprived patients with a DRF and more falls occur outdoors. Bone fragility, assessed using the FRAX tool, did not appear to be significant.

Falls risk was significantly associated with increasing social deprivation. The World Health Organisation has previously identified a lack of research regarding the relationship between falls risk and socio-economic factors. Every year 30% of people over 65 will fall and the rates increase with increasing age [21]. 5% of falls result in a fracture [22]. The National Service Framework for Older People and recent NICE guidelines set out guidance for prevention of falls [16,23]. Multifactorial interventions reduce incidence of falls [24–26] but the effectiveness of interventions in different socio-economic groups has not been conclusively demonstrated [27]. This analysis has identified risks related to medication, depression, falls outdoors and concerns about falling in socially deprived patients. Polypharmacy, drug side effect problems and depression are potentially modifiable through primary care.

The commonly used multifactorial falls prevention methods are largely targeted at frail, elderly people who fall indoors. DRF patients are generally younger, fitter and more mobile than those who sustain other fragility fractures, such as hip fractures, with more injuries occurring outdoors. This is particularly true of the socially deprived DRF patients who had a significantly higher proportion of injuries outdoors. Prevention of outdoor falls in this

group has had little attention and there are no established guidelines [28–30].

Our findings suggest osteoporosis is not associated with social deprivation in DRF patients. The link between social deprivation and osteoporosis is unclear with studies reporting varied associations. Most studies investigate the relationship between social deprivation and fractures and draw conclusions from this rather than directly looking for an association between social deprivation and measures of osteoporosis or bone health. Pearson et al demonstrated a significantly higher bone mineral density of the heel in women in Nottingham from less socially deprived areas although uptake from those in socially deprived areas was poor [31]. In a study of over 60,000 patients in Wales, Jones et al found that the risk of osteoporotic fractures in older patients was not related to socioeconomic status [4].

Brennan et al performed a systematic review to address the question of whether socioeconomic status is an influence on osteoporotic fracture [32]. They found only 11 suitable studies and concluded that more research is required to identify if a relationship exists and establish any underlying mechanisms. In our study smoking was the only osteoporosis risk factor which was seen more frequently in socially deprived patients. This has been well described previously with smoking rates being shown to be four times higher amongst the most disadvantaged [33].

Limitations of this study include the response rate of 64% despite multiple efforts to increase response rate. This is a common finding with this type of data collection and the comparisons with the population studied show that the data is representative of the overall population. The majority of patients are women but this is representative of the largest group of people to suffer DRF and therefore the most important to target for prevention. These findings apply to DRF patients and may not be applicable for other important injuries such as hip fractures. However DRF is well known to be a risk fracture for a subsequent fracture of the hip so reducing DRF incidence will also reduce hip fracture incidence [34]. We did not perform a power calculation which would have been complex for this study, however basic rules of regression analysis suggest our sample size was easily adequate [35]. Further research should be targeted towards preventing falls in people from socially deprived areas. Specialist falls prevention strategies for these patients should be designed, tested and implemented.

With the increasing size and age of the population the number of patients who sustain a DRF and require treatment will continue to increase. Poverty is rising which will cause higher levels of social deprivation and an increase in DRF rate. Fracture prevention strategies are required to combat this rise. Health care professionals should be aware that increased falls risk is an important reason for DRF in socially deprived patients. Knowing which patients are at highest risk allows interventions to be efficiently designed and targeted. Resources should be directed towards patients from socially deprived areas and focused on specific falls prevention strategies.

Conflict of interests

We declare that we have no competing interests.

The lead author affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

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