Occupational mobility in nineteenth century rural England: the interpretation of entheseal changes.

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Occupational mobility in nineteenth century rural England: the interpretation of entheseal changes.

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Identified skeletal collections have been widely used to test methods for recording entheseal changes. These studies have all used the occupation provided with the death certificate or equivalent as the occupation during life. However, the variety of tasks undertaken within occupations, the range of occupational tasks and how these changed over the life course is rarely discussed. The aim of this paper is to highlight the value of using historical data to improve the interpretation of skeletal data.

Materials and Methods: Identified adult skeletons (n=18), from the churchyard of St. Michael and St. Lawrence, Fewston, North Yorkshire, England were recorded for entheseal changes (EC) and degenerative joint changes (DJC). The individuals were born and died between 1791 – 1921 (only one individual was buried after the churchyard's closure in 1896). All individuals have at least one census record which includes their occupation. Published sections of a diary coinciding with the cemetery's use and written by the son of two of the identified individuals were used to record the frequency and range of activities.

Results: 54.5% of males and 29% of females changed their occupations and those who changed occupation were found to be older than those who did not. The latter were found to have a lower frequency of DJC and EC, but this is likely due to the difference in age profile between the two groups. However, the detailed pattern of EC did not match that of DJC for the three occupation categories used. The diary demonstrated that a stonemason undertook a wide variety of occupational tasks as well as enjoying hobbies.

Discussion: The results demonstrate that occupations in nineteenth century rural England were not stable and demonstrated a wide variety of everyday and infrequent activities. This demonstrates that using occupation listed at death does not provide sufficiently detailed information for testing methods of recording EC or for interpreting the relationship between occupation and health.

Keywords
Fewston, North Yorkshire; historical evidence; musculoskeletal stress markers (MSM); degenerative joint changes (DJC); degenerative joint disease (DJD); diary; census; farming

Introduction

The study of activity-related stress through entheseal changes (EC) has become more critical and scientific (Jurmain *et al*., 2012), exemplified by the testing of recording methods on identified skeletal collections (Villotte, 2006; Villotte, *et al.,* 2010; Cardoso, 2008; Alves Cardoso and Henderson, 2010; Mariotti *et al*., 2004; Henderson *et al*., 2012; Milella *et al.,* 2012). All these studies have utilised the occupation listed at death to categorise individuals in these collections by occupation. Concerns regarding the systematic classification of final occupations have been raised elsewhere (Alves Cardoso and Henderson, 2012; Lopreno Perréard *et al.,* 2012). Occupational mobility, an area normally discussed in terms of economic history (Miles, 1993), has been highlighted as a potential confounding factor when interpreting degenerative changes in identified skeletal collections (Alves Cardoso and Henderson, 2010). It is crucial when interpreting human skeletal remains to adopt a biographical perspective; the skeleton does not represent a snapshot of an individual at death, but incorporates a variety of experiences pertaining to different life course stages (Gowland and Thompson, in press; Robb, 1998; 2002). It is therefore important to investigate the occurrence of occupational mobility in identified skeletal collections and its implications for the understanding and interpretation of EC and other degenerative changes.

In order to do so, systematic records on occupation accompanying identified collections are necessary. Identified skeletal collections in Britain commonly span the 17th to early 19th centuries (Cox, 1996; Brickley, *et al*., 2001; Cowie *et al*., 2008; Miles, *et al*., 2008; Scheuer and Bowman, 1995). While some of the individuals within these collections have detailed biographies, *e.g.* Samuel Richardson (Eaves and Kimpel, 1971), these are the higher ranking individuals. Occupational data were not collected systematically until the civil registration of births and deaths in 1837 (Whitehead, 2000) followed by the 1841 census of households, organised by the General Register Office (Higgs, 1989). These censuses continued every subsequent decade in March or April (Higgs, 1989), and were not solely undertaken for social and economic purposes, but also to study mortality (Higgs, 1991; 1995; Holdsworth, 1998). Householders were asked to include only occupations which were apprenticeships or waged, thereby excluding much female paid (particularly part time or seasonal) work (Higgs, 1987; 1995; Hill, 1993). Enumerators, who helped householders complete the census forms, played a part in standardising occupations, particularly those of females. In some cases social convention led to the occupation of married women being listed as 'housekeeper' (Higgs, 1989). In contrast, female members of farming families were listed as 'farmer's wife' or 'farmer's daughter', and, while this did not apply to other family-run businesses in the 1841 census, some enumerators applied this terminology to all females, e.g. 'stonemason's wife' (*ibid.*). In censuses taken between 1851 and 1871 this became more standard and most females were listed in the format of "wife of *husband's occupation";* particularly those thought to share their husband's role and therefore the same risks for disease and death (Higgs, 1987; Hill, 1993). In spite of their limitations, when accompanied by an identified skeletal collection from the same period, these census records allow the effect of occupational mobility on EC and other degenerative changes to be tested.

While the census records capture occupational data for populations, their resolution for daily life is poor, they do not record seasonal changes in occupation (being deliberately timed to

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avoid workers being absent from home during harvest season), and their resolution for female occupations and activities (e.g. unpaid employment working in the home) is poorer still. This is where biographical records become useful, particularly diaries. Autobiographical data contained within diaries has proven a particularly rich source of information for illuminating the lives of the working class in the 19th century (*e.g.* Humphries 2010). While diaries cannot be used to study occupation and activity for populations, they can provide detailed information about individuals and patterns of daily life. However, in most autobiographical works of this period it is the economic activities of the male 'breadwinner' that is paramount (Humphries 2006). Evidence from diaries of this period indicates that females/ 'mothers' may engage in a multitude of seasonal/cyclical occupations throughout the year, or assist with their husbands occupation, in addition to their domestic roles (*ibid*,). These are the primary limitations of using diaries, but the purpose for which they were written should be considered and it should be borne in mind that not all daily tasks and activities will be listed.

The aims and objectives of this paper are to: highlight occupational mobility during the late nineteenth century in rural England; examine the difference between occupation on probate records and occupation during life; study the effect of occupational mobility on EC and degenerative joint changes (DJC); compare EC and DJC in farmers, skilled workers and females. The hypotheses tested were:

1) Farmers, skilled workers and females would have different patterns of EC and DJC distribution, with farmers having higher frequencies of EC and DJC in the lower limb than either skilled workers or females, due to frequent walking around their land tending livestock and crops.
2) Occupational mobility leads to higher rates of EC and DJC due to inexperience in the tasks required and change in workload during the adjustment period.

Materials and Methods

The rural village of Fewston is located approximately nine miles to the west of Harrogate and nine miles north of Otley in the north of England (Fig. 1). Its Church of St. Michael and St. Lawrence was the parish church for a large rural area, including the communities of Fewston, Norwood, Great and Little Timble, and Blubberhouses (Anon., 2012). The graveyard closed in 1896, although exemptions allowed two individuals to be buried there in the early twentieth century. Development of the Washburn Valley Heritage Centre led to excavation of a section of the graveyard in 2009-2010 by John Buglass Archaeological Services (Buglass, 2010). The 144 skeletons recovered had been buried in an area probably extensively altered during rebuilding the body of the church in 1697 (Buglass pers. comm.; Milsted, 2010). Therefore most burials date to the post-medieval period, and coffin plates recovered date to 1862-1921. Nineteen individuals were confidently identified through coffin plates or monuments, including eighteen adults and one infant.

Only adults (aged >18 years) were included in this study: seven females and eleven males (Table 1). Biological sex (determined during osteological analysis, Caffell and Holst, 2010) corresponded with gender derived from coffin plates. Occupation was collected from the probate and from the census records. A Portuguese model for categorisation of male activities based on socio-economic status (Roque, 1988), which was previously applied for the study of

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the effect of occupation on degenerative processes (Cardoso, 2008; Alves Cardoso and Henderson, 2010; Alves Cardoso and Henderson, 2012), was used to categorise occupations into: female, farmer, skilled worker and unskilled worker. This was based on the occupation listed for the longest duration in the census. Unskilled workers were defined as those for whom apprenticeships would not be required, *e.g.* farm labourer, but not farmers. Skilled workers included tailors and stonemasons. Farmers were categorised separately because of the varied tasks required to run a farm. Female occupations were not subdivided because of the lack of information about them. It is, however, recognised that the classification system itself is a source of bias (for a discussion of this see Alves Cardoso and Henderson, 2012). To study occupational mobility all changes in occupation, including retirement, were collected from the census records.

Data from a diary kept intermittently by John Dickinson (son of John and Mary Dickinson, SLF09 351 and 310 respectively) between 1878 and his death in 1912, summarised by Harker (1988), were used to study the range of activities undertaken. Only the data for the years 1878-1879, 1881, 1884, 1889, 1891-1893 and 1897 were included (missing years correspond to either lapses in diary keeping or lost volumes), as this covers the period of cemetery use. The year 1897, although one year after the closure of the churchyard, was included as Dickinson writes that little had changed in his pattern of life in the intervening period (Harker 1988: 84). Unfortunately, Dickinson did not always record his physical activities, and the published diary only included a selection of the daily entries. All activities were entered into a spreadsheet to study the range of activities undertaken by the author per day, including playing cards and walking. When other people are mentioned, their activities were also recorded on a separate spreadsheet. The frequency of each activity by year was calculated as the mention of an activity divided by the number of diary entries published for that year (Harker, 1988).

Entheseal changes were recorded blind, *i.e.* no skeletal or documentary data were seen prior to recording. Fibrocartilaginous entheses (see Preface to this volume) were recorded using a visual method (Villotte, 2006) which was then recoded into presence and absence (Table 2; Fig. 2). Scores of 'A' were considered 'absence' of changes, while 'B' and 'C' were pooled as 'presence'. This method has been found to differentiate between heavy manual workers and those engaged in non-manual or light manual tasks, while controlling for age (Villotte *et al.*, 2010).

Previous studies have demonstrated that individuals with bone forming diseases, *e.g.* diffuse idiopathic skeletal hyperostosis and the seronegative spondyloarthropathies, have higher frequencies of EC than those without (Henderson, 2008). Bone forming diseases were diagnosed based on the presence of unilateral or bilateral sacroiliac ankylosis along with spinal ligament ossification on two or more vertebrae (*ibid.*).

Degenerative joint changes (DJC) were recorded independently from EC. DJC were classified as marginal osteophytes, central osteophytes, joint contour change and porosity (Figure 3) (Rogers and Waldron, 1995; Ortner, 2003; Waldron, 2009). This research did not attempt to relate these changes to any pathological process and therefore the term 'degenerative joint disease', which ascribes a pathological aetiology to the changes, was eschewed in favour of a term which does not inherently imply an underlying aetiology: degenerative joint changes (DJC). Eburnation was also not recorded, as this is associated with osteoarthritis. The method used here was one in which each change is considered as a potential, non-specific, stressor on the joint. When recording the DJC a simple presence or

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absence of change was recorded, even if multiple degenerative features were present. Preservation was an issue, but was mitigated by the separate recording of each joint facet. This meant that during analysis even partially preserved joints could be included in the total. If one of the elements of a partially preserved joint displayed degenerative change then the joint as a whole was recorded as present with DJC (Craps 2011).

The frequencies presented here are true prevalence rates (TPR), *i.e.* number of elements affected divided by elements available (Waldron, 1994). Due to the limited sample size, and to enable comparisons of EC and DJC by joint, EC frequencies were pooled by joint (Table 2) by adding up all the EC present and dividing by the observable number of entheses. This method demonstrates trends in the data, but pools several entheses from each individual.

Results

Long-bone ends were frequently damaged or incomplete. Coupled with poor surface preservation, this decreased the sample size for entheses and DJC. No evidence for bone forming diseases was found, but six individuals lacked vertebrae and sacro-iliac joints. However, due to the small sample size it was decided to include all individuals rather than excluding those for which no diagnostic criteria were available.

Occupations

The age-at-death of the sample ranged from 23 to 84 years (Table 1), but was not known for one male. At least one census provided data on occupation for each individual (Table 1). For seven males the occupation was also listed in the index to probates. Females were the youngest (median 54, n=7), compared to skilled workers (median 62, n=3) and farmers (median age 71.5, n=6). The one unskilled worker was 26, had been apprenticed to a grocer but was working as a farm labourer which, given the rural location, is more likely to have been the dominant activity. However, as there is only one unskilled worker, no further analyses were performed.

Figure 4 presents the TPR for EC and DJC in the lower limb. Farmers have the highest TPR for both EC and DJC in the lower limb. However, what is most interesting is that DJC and EC provide a different picture for symmetry of changes for the males with a left side bias for EC in the hip and ankle, whereas there is a right side bias for DJC. Table 2 presents the EC TPR by enthesis and it is notable that farmers have EC in all entheses of the hip excepting the *gluteus minimus.* This muscle is only affected in the right hip of females.

In the upper limb, there are also notable differences between the occupation groups and the results from DJC and the pooled EC TPR. The skilled workers demonstrate higher TPR for DJC of the elbow and for the pooled EC of the elbow and shoulder. Farmers have a higher TPR for both DJC and EC in the left hand and wrist but have higher TPR in the right side for all other joints and EC. Females have higher TPR in the right side for hand, wrist and elbow DJC and pooled EC, but a higher TPR for the pooled EC for the left shoulder compared to the right, and no DJC at this joint in either side. Most notably there is a high DJC TPR in the shoulder but low TPR for the pooled entheses (Figs. 4 and 5). TPRs of EC (Table 2) demonstrate a high frequency in farmers in the right *supraspinatus* and *subscapularis*, but no other entheses, while only the *subscapularis* was affected in the females and skilled workers. The left side was less well preserved and only the *subscapalaris* was affected in the females

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and farmers. For the entheses of the elbow, there is a different pattern of TPR for all occupations and this can be seen particularly in *triceps brachii,* which has a high TPR for all occupations in the right side, is high in the left side for females and skilled workers, while no cases of EC are seen in farmers. For entheses of the hand and wrist, preservation was poor.

Due to limited data available from the published diary (Harker, 1988) activity frequencies can only be used to indicate the range of tasks undertaken (Table 3). However, the data available demonstrate that, although the diarist's father (John Dickinson, SLF09 351) described himself as a stonemason in the census, the likely range of tasks undertaken was greater (Harker, 1988). For example, John Dickinson (the diarist) took over the task of registering births and deaths from his father. This job contributed to a lot of the diarist's walking prior to his purchase of a horse and cart (Table 3). The diarist also mentions that his father's favourite pursuit was shooting and he '...never tired of ranging the woods and fields for game' (Harker, 1988, 2nd of October 1899).

Unfortunately, in the selections made by Harker for the period 1878-1897, few tasks undertaken by women can be identified. John Dickinson does describe collecting water for his mother (SLF09 310) on an icy day and her helping him hang cuts of pork, as well as her laying out two dead villagers. That she did the cooking is implied when he complains in her absence at there being no hot meal ready when he arrives home. However, the fact that she worked hard is indicated: ‘My mother has rather more work than I think good, but she is used to work and I don’t think she is hurt with it yet’ (Harker 1988, 1st September 1881); and he refers to her death in 1886 ‘after a life of hard work’ (Harker 1988, 8th of March 1909). The diarist's wife is rarely mentioned, and although he refers to her housekeeping, there are only individual entries listing the following tasks: laundry, mangling, cleaning, attending the sick, baking tarts and making a hearthrug with help from a friend. There is no evidence of how these tasks would have been performed or how frequently

Occupational mobility

The census records have missing data for six individuals (four females and two males), which may affect the interpretation of occupational mobility. Data for John Dickinson and John Renton Newsome are missing from the 1841 and 1851 censuses. The former first appears in 1861 as a stonemason, and then in 1871 as a master stonemason, whereas the latter is listed as a farmer. From the existing data it was impossible to determine whether three of the four affected females (Grace Hutton, Eliza Wigglesworth and Sarah Darnbrook) had changed occupation. Based on the available census records: 2/7 (28.6%) of females and 6/11 (54.5%) of males changed occupation (Table 1).

Only one of the skilled workers had changed occupation (Table 1): Richard Gill who had become a farmer for at least the final three years of his life had been a tailor for at least three decades of his life. Of the farmers, four had changed occupation. Three (David Lister, Joseph Darnbrook and John R Newsome) had retired from farming, while John R Newsome and Gill Wigglesworth had started life as servants. The most noticeable trend is that those who were occupationally mobile were older (male n=6, median =77; female n=2, median=72) than those who were not (male n=4, median=52; female n=5, median=49).

The males and females who were occupationally mobile are always more affected by DJC than those who did not change occupations (Fig. 3). On the right side, the frequencies for the

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shoulder and the elbow are exactly the same in both groups. There was a large difference between the TPR of DJC of the wrist/hand between the groups, where the non-occupationally mobile have a higher prevalence than the occupationally mobile. Both previously described patterns are repeated on the left side, but interestingly the left elbow is more affected by DJC in the occupational change-group than in the non-occupationally mobile group. The pooled EC results mirror the DJC results perfectly, including the switch in the left elbow in the males.

For the females, the only comparisons of EC frequency between occupationally mobile and non-mobile groups could be made for left and right *brachialis* insertions and the left *biceps brachii* insertion (Table 4). For all of these insertions, which relate predominantly to elbow use, the occupationally mobile have the higher frequency and there is no difference between sides. The only individual in the occupationally non-mobile category with EC changes is the 54 year old female, Sarah Gill, who worked as a servant for her entire life.

In the males, the trend is less uniform (Table 4). For those entheses that can be compared, the occupationally mobile have higher frequencies for the right *subscapularis* insertion, left and right *biceps brachii* insertions, right common flexor origin, and left *semimembranosus* origin. Frequencies are identical for some entheses, while the reverse trend, with occupationally mobile individuals having a lower frequency of EC, is found for the right *triceps surae* insertion, and left *biceps brachii* and *triceps brachii* insertions.

Discussion

The identified individuals from the churchyard of St. Michael and St. Lawrence, Fewston, North Yorkshire, England, although poorly preserved, are an important skeletal collection due to the historical records associated with them. These allow numerous bioarchaeological hypotheses to be tested. The aim of this paper was to highlight preliminary data concerning the variety of tasks undertaken during this period and evidence for occupational mobility, and to study the effect of occupation and occupational change on EC and DJC

The method used to record EC has been developed only recently and, consequently, few publications exist with which to compare the results on occupation directly. Palaeopathological studies that have examined degenerative changes in joints usually look for the presence of osteoarthritis (i.e. an amalgamation of degenerative changes), whereas the primary purpose of clinical studies is to diagnose osteoarthritis so different criteria (e.g. inflammationand joint space narrowing) are used to define the disease. The purpose of this study was to examine the separate changes occurring on the joint surface regardless of underlying pathology. This has not been attempted before and thus no comparative studies are available from the palaeopathological and clinical literature.Both EC and DJC are known to occur in higher frequencies in older individuals, a factor which has to be considered when interpreting the results of this study. The other important limitation to consider is the poor preservation of the skeletal remains leading to very small sample sizes. Therefore, although the hypotheses appear to be supported, this can only be considered a preliminary study and a full study should be undertaken on a larger sample.

This study is limited by gaps in the census records, but, most significantly, by the lack of information on female occupations, which according to Hill (1993) has led to the underestimation of female employment. Indeed, a direct female perspective or 'voice' is

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rarely encountered in historical evidence from this period in England (Humphries 2006). This led to all females being clustered into one occupational category ('female'), rather than being subdivided. The documentary data on female activities at this site includes census records for two domestic servants and one dressmaker. It is not clear how a domestic servant's duties would differ from those of the ordinary housewife, or who in the area would be able to afford their services. However, what is clear from the published diary (Harker, 1988) is that wives did fetch and carry water, clean the house, do laundry, mangle and bake. These tasks are all heavy repetitive tasks, many requiring the use of both hands. Lateral and medial epicondylitis, in the clinical setting, is seen particularly in the construction industry, meat cutting and packing, and other work involving repetitive and forceful movements (Karjalainen, 1999). It is these motions which are most likely to have led to the high bilateral frequency of hand and wrist EC as well as to the high frequency of EC in the elbow (for which almost all entheses, apart from the *brachialis,* have high prevalences). However, the bilateral symmetry of the EC data is not reflected in the DJC results, which have a lower prevalence in the left hand and wrist compared to the right. The prevalence for elbow DJC is also low, compared to the EC data. This may be explained by current clinical trends in osteoarthritis patterns. Females tend to have a high prevalence in the wrist and hand (Jones and Doherty, 1995; O'Reilly and Doherty, 2003), but a low prevalence in the elbow (Gramstad and Galatz, 2006; Debono *et al.*, 2004; Stanley, 1994). This may relate to joint shape or to the effect of sex hormones (Huffman and Kraus, 2012). It is clear that different factors are affecting the frequency of EC and DJC.

It is also interesting that the pattern of shoulder DJC and EC differ. This was unexpected, as radiologic studies have demonstrated a correlation between the two (Kerr *et al.,* 1985). Clinical studies focus on the effect of the ageing process on both shoulder osteoarthritis (Millet *et al.*, 2008; Resnick and Niwayama, 1995) and rotator cuff tears (Jiang et al,. 2002; Levitz and Iannotti, 1995). The risks are increased for individuals repeatedly performing tasks at shoulder-level, especially if this involves static loading (Andersson, 1995). The only enthesis affected by EC is the *subscapularis* which is involved (with the rest of the rotator cuff) in stabilising the shoulder, while it also medially rotates the humerus. The available historical data does not indicate that this type of loading was occurring in females and may explain the disparity between DJC and EC results. Clinical studies state that the *supraspinatus* is the most frequently affected of the rotator cuff entheses (Levitz and Iannotti, 1995). However, other palaeopathological studies have found that the *subscapularis* is more frequently affected (Peterson, 1998; Chapman, 1997; Henderson, 2009). Therefore clinical findings concerning enthesis degeneration may relate to the reporting of symptoms or soft tissue changes, rather than the prevalence of enthesis degeneration. Importantly, this highlights the value of comparing EC and DJC when studying degenerative changes, particularly when studying the effect of activity on their occurrence.

Most of the male population were farmers, but it is unclear from the historical data whether they were predominantly arable or livestock based. The evidence from the diary (Harker, 1988) suggests a mix of arable and livestock farming, and highlights that the ground was stony. It was hypothesised that farmers would have the highest rates of EC and DJC in the hip, knee and ankle due to the amount of walking over hilly (Fig. 1), rough and uneven terrain. This was supported by both EC and DJC. However, while the DJC prevalences for the hip and knee are relatively bilaterally symmetrical, the EC prevalences for the hip and ankle are higher on the left side for all entheses recorded. The reason for this cannot be fully explained, but may relate to differences in age between those with observable entheses on the left (range 66 to 78 years, n=3) compared to the right (range 38 to 84, n=4) side. However, other factors, for example the use of walking sticks, may also be involved. Osteoarthritis of the hip is common in farmers (Bremner *et al.*, 1968; Croft *et al.*, 1992; Ali-Gombe *et al.* 1996), particularly in those who have been farming for over a decade (Thelin, 1990; Croft *et al.* 1992), which at least six of the seven farmers had done (Table 1). However, the reason for this is currently unknown, and while genetics are known to play a role in DJC and osteoarthritis prevalence (Manek and Spector, 2003), it cannot be the sole explanation for these findings.

The skilled workers are a small sample comprising two tailors and one stonemason. However, we do know something about the life of the stonemason (Harker, 1988). He acted as the local registrar and his favourite pursuit was shooting game, both activities that required a lot of walking. His son's life is well documented and he helped with the harvest, butchered and salted pigs, engaged in trade, and kept some livestock. This indicates that, in this rural community, there was an overlap between occupation and farming tasks and that the latter are underestimated in the census records (Higgs, 1995). This is further supported by the change in occupation of one of the tailors, Richard Gill, who went from being a tailor to being a farmer (Table 1). Due to the limited sample size for this occupation category, no trends can be highlighted. However, the good preservation of the elbow highlights that the tailors have more EC and DJC on the right than the left side for all entheses and joints.

The effect of occupational mobility on both EC and DJC is likely to be age-related, as the highest prevalences are generally in the older, occupationally mobile category. The increased age in this category is an effect of including retirement in this category. However, while this study is small, it does highlight the fact that, even in rural communities, people changed occupation. For females, mobility occurred following marriage when they moved from an occupation to being a wife. Whether these women continued taking on paid employment is not known and is obscured as females were categorised by their husband's occupation in the census (Higgs, 1987). For males the transition was primarily from a skilled job into farming, or from farming to retirement. However, the diary also highlights that this distinction is overly simplistic and that overlapping occupations existed. It is possible that some of the EC and DJC may be caused by a change in their regular tasks. This can only be tested in a larger sample. The most important aspect of this research is that it highlights problems of categorising individuals who have changed occupation. Other studies have demonstrated that occupational categorisation affects EC prevalence (Alves Cardoso and Henderson, 2012). Therefore, understanding the prevalence of occupational mobility through time is vital for the interpretation of EC in relation to occupation.

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Conclusions

It is clear from this study, based on census records and the contemporaneous diary, that occupation on the probate index is not fully reflective of the occupation of many individuals. This has implications for all studies which have used identified collections to test and develop methods for recording EC and DJC (Mariotti *et al.*, 2004; Villotte, 2006; Cardoso, 2089; Alves Cardoso and Henderson, 2010; Henderson *et al.,* 2012; Milella, *et al.,* 2012). In addition, males and females may have experienced different occupational trajectories over their life course and this should be considered when interpreting sex-related differences in EC and DJC frequencies. While females may be largely invisible in the historical record, the skeletal remains can help to provide valuable supplementary data concerning their lives.

Further research is required utilising the full extent of the historical records. Gaps in the census records need to be filled and additional data on occupation could be gleaned from marriage and birth certificates. Studying the original volumes of John Dickinson's diary may contribute further information on the range of tasks carried out by his parents, himself and his contemporaries. Improved understanding of the historical data could illuminate everyday life in this community, including work-related injury, and be used to help interpret EC and DJC.

Additional research is required to study the effect of genetics in this population on EC and DJC, as well as to contextualise this data through comparison with other identified collections. Most importantly occupational mobility must be studied in a larger sample to examine how common this was in the past and test its effect on EC and DJC. Due to limited sample size, this study compared the prevalence of EC and DJC only between those who were occupationally mobile and those who were not and there is a clear age bias between these groups. However, future studies should classify individuals based on their first, longest and final occupation, to study the effect of early occupation, the duration of occupation, and the impact of changing occupation. It is clear that the skeleton does not provide a snapshot of an individual at death, instead the total life course is important and this has to be considered when performing any skeletal analysis.

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Tables:

Table 1. Summary Skeletal and Historical Data.

No.	Confidence of identification	Method of identification	Name	Sex	Age	Date of death	Occupation: 1841	Occupation: 1851	Occupation: 1861	Occupation: 1871	Occupation: 1881	Occupation: 1891	Occupation at probate	Occupation - standardised	Occupational mobility
238	100%	Coffin plate + burial register	Elizabeth Demaine	female	49	Apr, 1888	(none given)	farmer's daughter	farmer's daughter	farmer's wife	farmer's wife			female	0
300	90%	Monument	Mary Darnbrook	female	78	7th Sept, 1870	farmer’s wife	farmer's wife 150 acres	retired farmer's wife					female	1
310	100%	Coffin plate	Mary Dickinson	female	66	6th Mar, 1888	female servant	(none given)	dressmaker	stone mason wife	(none given)			female	1
319	90%	Monument	Sarah Darnbrook	female	23	26th May, 1854	(none given)	farmer's daughter						female	0
325	100%	Coffin plate	Grace Hutton	female	73	3rd Apr, 1921		farmer's daughter	scholar	(none given)	Tailor & draper's wife	(none given)		female	0
363	100%	Coffin plate	Sarah Gill	female	54	13th Nov, 1889	(none given)	house servant	house servant	general servant (domestic)	general servant (domestic)			female	0
378	100%	Coffin plate	Eliza Wigglesworth	female	34	27th Feb, 1895			(none given)	scholar	farmer's daughter	(none given)		female	0
119	100%	Coffin plate	Matthew Marjerrison	male	38	25th Feb, 1890			scholar	farmer's son	farmer of 53 acres			farmer	0
130	100%	Coffin plate	George Lister	male	66	19 Jul, 1882	(none given)	farmer	farmer of 31 acres	farmer of 56 acres employing 2 men	farmer of 171 acres		farmer	farmer	0

138B	90%	Partly legible monument	James Dibb	male	79	17th Mar, 1890	jobber	farmer	farmer of 48 acres	farmer of 48 acres	farmer of 48 acres		farmer	farmer	0
339	100%	Coffin plate	Richard Gill	male	41	11th Feb, 1884		scholar	tailor	tailor	Tailor & draper		tailor and draper	skilled worker	0
351	100%	Monument	John Dickinson	male	63	18th Aug, 1875	(none given)	(none given)	stone mason	stone mason master			stonemason	skilled worker	0
226	100%	Coffin plate	David Lister	male	84	16th Apr, 1888	farmer	retired from trade	landed proprietor	retired farmer	land owner			farmer	1
307	90%	Monument	Joseph Darnbrook	male	78	7th Mar, 1869	farmer	Farmer 44 acres	retired farmer				yeoman	farmer	1
360	100%	Coffin plate	Gill Wigglesworth	male	67	24th Apr, 1886	male servant	farm servant	farmer	farmer of 50 acres	farmer of 34 acres		farmer	farmer	1
366	100%	Coffin plate	John Renton Newsome	male	76	3rd Feb, 1892	either butter factor or male servant	(none given)	farmer of 23 acres	farmer of 24 acres	farmer of 20 acres	retired farmer		farmer	1
408	100%	Coffin plate	Richard Gill	male	78	18th May, 1883	tailor	tailor employing 3 assistants	tailor and farmer 11 acres	tailor employing 2 sons and farmer of 11 acres	Farmer 46 acres		gentleman	skilled worker	1
342	100%	Coffin plate	Bentley Darnbrook	male	26	1st Nov, 1862	(none given)	grocer (apprentice)	farm labourer					unskilled worker	1

Side	Primary joint	Muscle	Female		Farmers		Skilled workers	
			n	freq	n	freq	n	freq
Right	Shoulder	Supraspinatus	2	0.00	2	0.50	1	0.00
		Infraspinatus	2	0.00	1	0.00	0	
		Teres Minor	1	0.00	1	0.00	0	
		Subscapularis	3	0.33	2	1.00	2	0.50
	Elbow	Anconeus	2	1.00	5	0.00	0	
		Biceps b.	3	0.67	5	0.60	2	0.50
		Brachialis	5	0.40	5	1.00	1	1.00
		Triceps b.	3	0.67	3	1.00	3	1.00
	Hand/wrist	Common extensor	1	1.00	3	0.67	0	
		Common flexor	2	0.50	5	0.20	0	
	Hip	Semimembranosus	3	0.33	2	0.50	2	0.50
		Gluteus min.	2	0.50	3	0.00	2	0.00
		Gluteus med.	0		2	0.50	1	0.00
		Iliopsoas	1	0.00	3	0.67	0	
	Ankle	Triceps surae	2	0.50	3	0.67	1	1.00
Left	Shoulder	Supraspinatus	0		1	0.00	0	
		Infraspinatus	0		1	0.00	0	
		Teres Minor	1	0.00	1	0.00	0	
		Subscapularis	2	0.50	1	1.00	0	
	Elbow	Anconeus	1	0.00	3	0.00	1	0.00
		Biceps b.	5	0.40	5	1.00	1	0.00
		Brachialis	5	0.40	5	0.80	2	0.00
		Triceps b.	1	1.00	3	0.00	3	0.67
	Hand/wrist	Common extensor	2	0.50	3	0.67	1	0.00
		Common flexor	1	1.00	2	0.50	1	0.00
	Hip	Semimembranosus	1	1.00	3	1.00	1	0.00
		Gluteus min.	1	0.00	2	1.00	1	1.00
		Gluteus med.	0		2	1.00	0	
		Iliopsoas	2	0.00	4	1.00	0	
	Ankle	Triceps surae	2	0.50	4	1.00	1	1.00

Table 3. Frequency of tasks mentioned by John Dickinson based on the number of days included in Harker's selection. NB 1889 has had the 10 days of honeymoon removed.

	Clerical work	Mason	Gardening	Handling livestock	Hay making etc.	Digging out stone from a field	Fetched water for mother	Butchery (hanging pigs, salting pigs)	Jobbing about	Joinery	Shovelling gravel	Trade	Walked	Drove	Rode	Swam
1878	8/45	16/45	1/45	0	0	0	0	0	0	1/45	0	2/45	8/45	0	2/45	0
1879	2/37	2/37	1/37	3/37	3/37	1/37	0	1/37	2/37	0	0	3/37	3/37	0	2/37	0
1881	7/59	2/59	0	10/59	1/59	0	1/59	2/59	2/59	0	0	5/59	7/59	0	0	1/59
1884	4/21	01/03/21	0	2/21	0	0	0	0	1/21	1/21	0	2/21	5/21	0	0	0
1889	3/38	1/38	0	0	1/38	0	0	1/38	1/38	1/38	0	2/38	4/38	0	0	0
1891	11/46	4/46	0	1/46	2/46	0	0	3/46	0	0	0	2/46	0	7/46	3/46	0
1892	3/26	1/26	0	4/26	4/26	0	0	2/26	0	0	1/26	3/26	1/26	3/26	0	0
1893	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1897	4/47	0	1/47	2/47	2/47	0	0	0	1/47	0	0	3/47	1/47	2/47	0	0

			n	freq	n	freq	n	freq	n	freq
Right	Shoulder	Supraspinatus	1	0.00	1	0.00	1	1.00	2	0.00
		Infraspinatus	1	0.00	1	0.00	0		1	0.00
		Teres Minor	1	0.00	0		0		1	0.00
		Subscapularis	1	1.00	2	0.00	2	1.00	2	0.50
	Elbow	Anconeus	2	1.00	0		2	0.00	3	0.00
		Biceps b.	2	1.00	1	0.00	4	0.75	3	0.33
		Brachialis	2	0.50	3	0.33	4	1.00	2	1.00
		Triceps b.	2	1.00	1	0.00	2	1.00	4	1.00
	Hand/wrist	Common extensor	1	1.00	0		1	1.00	2	0.50
		Common flexor	2	0.50	0		3	0.33	2	0.00
	Hip	Semimembranosus	2	0.50	1	0.00	2	0.50	2	0.50
		Gluteus min.	0		2	0.50	2	0.00	3	0.00
		Gluteus med.	0		0		1	1.00	2	0.00
		Iliopsoas	0		1	0.00	2	1.00	1	0.00
	Ankle	Triceps surae	1	1.00	1	0.00	2	0.50	2	1.00
Left	Shoulder	Supraspinatus	0		0		0		1	0.00
		Infraspinatus	0		0		0		1	0.00
		Teres Minor	0		1	0.00	0		1	0.00
		Subscapularis	0		2	0.50	0		1	1.00
	Elbow	Anconeus	1	0.00	0		1	0.00	3	0.00
		Biceps b.	2	1.00	3	0.00	3	1.00	3	0.67
		Brachialis	2	0.50	3	0.33	4	0.50	3	0.67
		Triceps b.	1	1.00	0		3	0.00	3	0.67
	Hand/wrist	Common extensor	1	1.00	1	0.00	1	1.00	3	0.33
		Common flexor	1	1.00	0		1	0.00	2	0.50
	Hip	Semimembranosus	1	1.00	0		2	1.00	2	0.50
		Gluteus min.	1	0.00	0		1	1.00	2	1.00
		Gluteus med.	0		0		0		2	1.00
		Iliopsoas	1	0.00	1	0.00	2	1.00	2	1.00
	Ankle	Triceps surae	1	1.00	1	0.00	3	1.00	2	1.00

towns. Note the reservoirs near Fewston and proximity to the Yorkshire Dales, both indicating hilly terrain.

Figure 2: EC of the *triceps brachii* insertion. A. Example of EC, notably the formation of an exostosis, in SLF09 226. B. Normal enthesis SLF09 351

Figure 3: Examples of DJC such as marginal osteophytes, porosity and joint contour changes on: A. The acetabulum and head of the femur (SLF09 226). B. the elbow joint: distal humerus, proximal ulna and proximal radius (SLF09 130).

Figure 4. True prevalence of DJC by occupation compared to pooled EC frequency by joint. Sample size for DJC in figure A. Sample size for pooled EC in Table 2.

Figure 5. True prevalence of DJC by occupation mobility category compared to pooled EC frequency by joint. Sample size for DJC in figure A. Sample size for pooled EC in Table 4.

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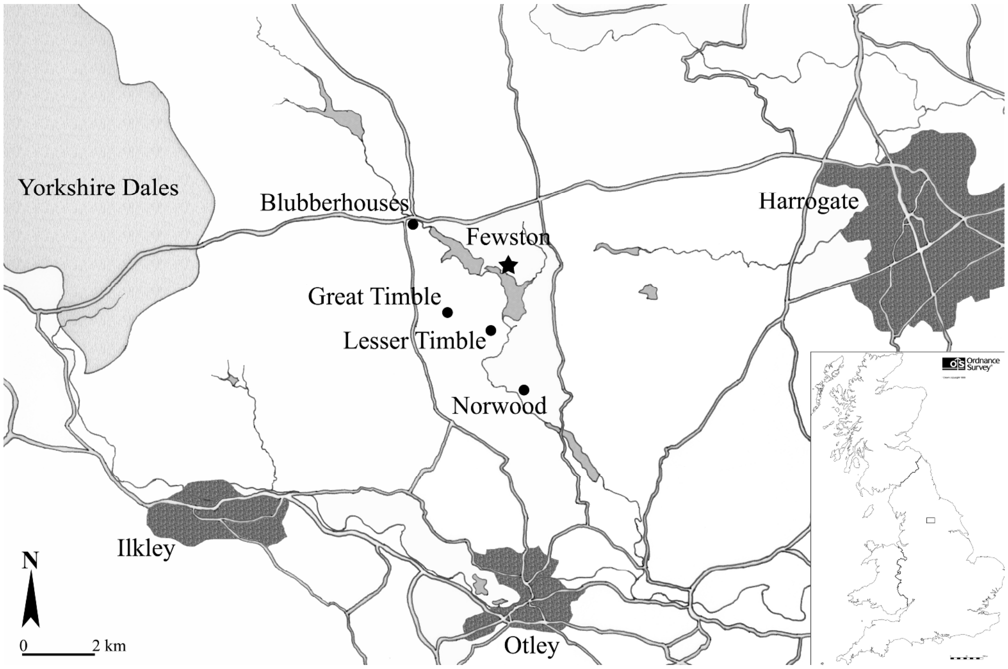

Map of site location (star), surrounding parish villages (closed circles) and nearby larger towns. Note the reservoirs near Fewston and proximity to the Yorkshire Dales, both indicating hilly terrain.
165x109mm (600 x 600 DPI)

Review

EC of the triceps brachii insertion. A. Example of EC, notably the formation of an exostosis, in SLF09 226.
B. Normal enthesis SLF09 351
282x239mm (300 x 300 DPI)

iew

Examples of DJC such as marginal osteophytes, porosity and joint contour changes on: A. The acetabulum and head of the femur (SLF09 226). B. the elbow joint: distal humerus, proximal ulna and proximal radius (SLF09 130).
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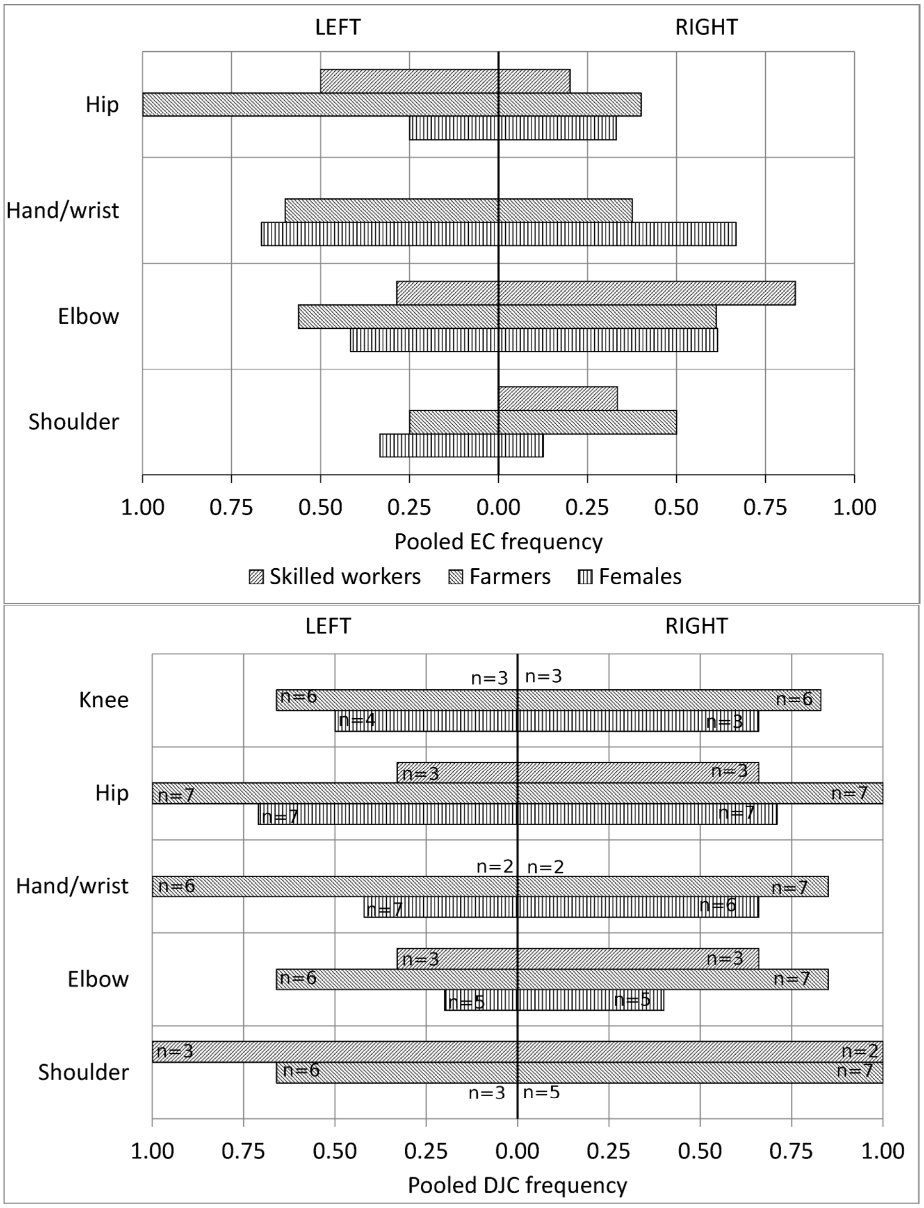

True prevalence of DJC by occupation compared to pooled EC frequency by joint. Sample size for DJC in figure A. Sample size for pooled EC in Table 2.
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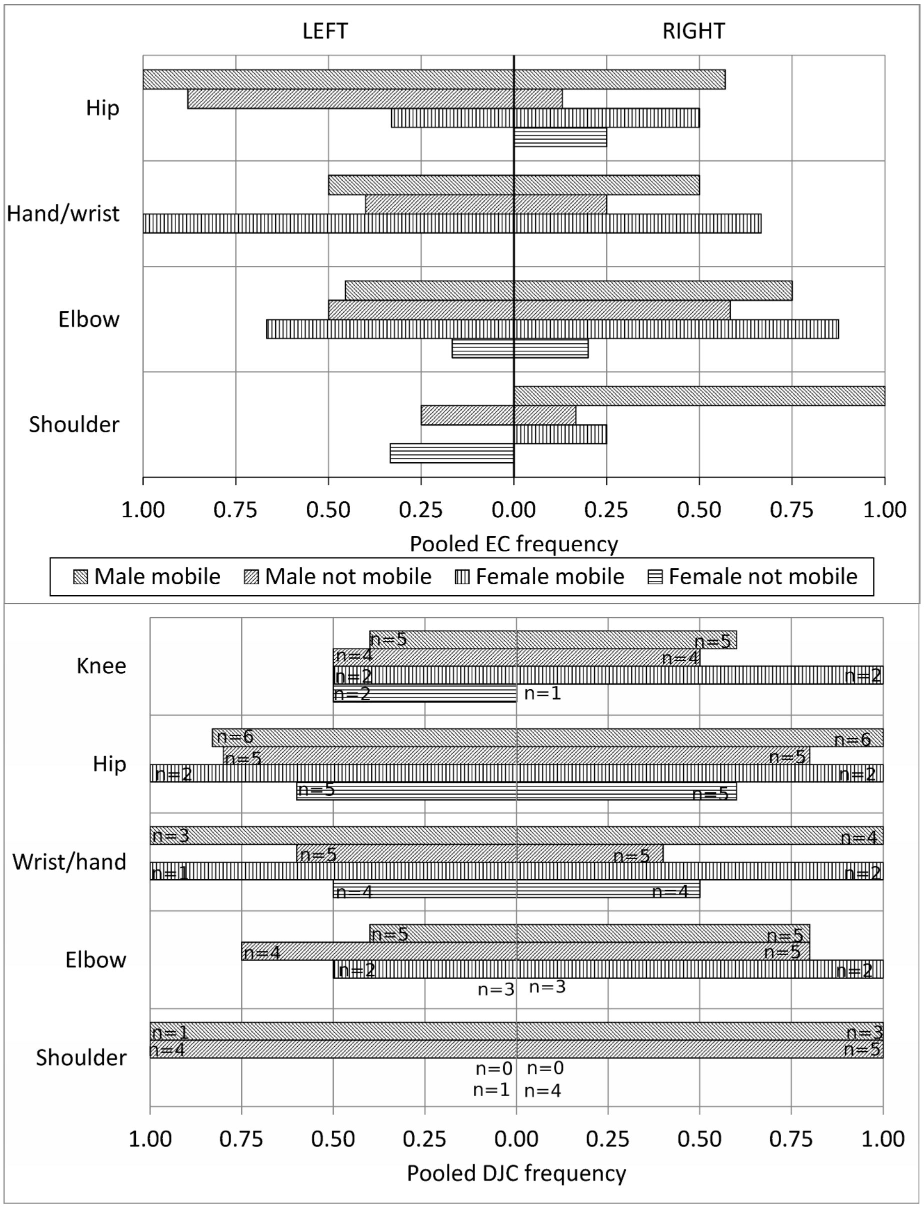

True prevalence of DJC by occupation mobility category compared to pooled EC frequency by joint. Sample size for DJC in figure A. Sample size for pooled EC in Table 4.
338x441mm (300 x 300 DPI)