Are extremity musculoskeletal injuries in children related to obesity and social status? A prospective observational study in a district general hospital

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Abstract

Background Obesity is one of the several independent risk factors for the risk of fractures. Major epidemiological studies also suggested the social status of the patients to be a confounding factor. We aimed to look at the influence of obesity on fractures and to determine if the social status of the patients is a confounding factor.

Methods This is an observational study of 560 children with musculoskeletal injuries who presented over a period of 8 months and the data were collected prospectively. Obesity status and social deprivation index were estimated.

Results The prevalence of overweight and obese children was 29.9%. Twenty-four percent of the boys and 31% of the girls were obese ($P = 0.2$). In the group of most deprived areas, the prevalence of obesity increased to 40% in those needing admission for intervention.

Conclusions Although there is a slight increase in obesity, there is no suggestion of increased rate of fractures in deprived areas. Upper limb injuries were more predominant, with distal radius fracture being the most common injury. Boys sustain fractures twice as often as girls. There is a tendency to increasing obesity with increasing age.

Keywords Obesity · Children · Fractures · Social deprivation

Introduction

Fractures account for 10–25% of childhood injuries and before a child attains an age of 15 years, almost two-thirds of all boys and nearly half of all girls will have had a fracture, with a peak incidence of 14 years for boys and 11 years for girls [4, 15]. A major epidemiology study of fractures using the General Practice Research Database reconfirms these findings [4]. In otherwise healthy children, low peak bone mass has been related to skeletal fragility, but several independent risk factors such as birth weight, dietary calcium, ethnicity and low socioeconomic factors have been implied [2, 12, 16, 20]. Reduced physical activity and increased television viewing and computers have been a concern [17]. There are contrasting studies showing that high bone mass and more physical activity did not decrease the incidence of fractures, especially among children near puberty [2, 16].

Obesity has always been associated with decreased mobility in children and the risk of falling during daily activities is reported to be higher in overweight and obese children owing to difficulties with balance [9]. Obese children were shown to have 1.7 times greater risk of fractures compared to non-obese children [5]. There has been a dramatic overall increase in the body weight of children in the United Kingdom in recent years. The Department of Health (DOH) reported an increase in prevalence of obesity from 9.9% in 1999 to 17% in 2005 [26]. The recent Health Survey for England (HSE) trends show that around 3 in 10 boys and girls aged 2–15 years were classified as overweight or obese (31 and 29%, respectively) [30]. Children over the 91st percentile were considered to be overweight and over the 98th percentile as obese. Those falling below the 0.4th percentile were considered to be underweight. The prevalence of obesity in

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adolescents is much higher than among children aged 4–5 years. In addition, there is an increased risk of surgical treatment in obese children [13]. Children living in deprived areas were found to have higher fracture rates [24].

On the basis of this background, we looked into the fracture epidemiology of children attending the outpatient fracture clinic. We aimed to look at the influence of obesity on fractures and whether the social status of the patients is a confounding factor.

Materials and methods

This is an observational study looking at the attendance of children with musculoskeletal injuries and data collected prospectively over a period of 8 months from October 2007 to May 2008. The diagnosis after orthopaedic consultation at final follow-up in the clinic was documented. The injuries were classified as soft tissue injuries or fractures and were grouped according to anatomical region. They were further classified according to the extremity involved as upper or lower limb injuries. Injuries not fitting into any of the extremity regions such as back pain and soft tissue injuries of the spine were defined as miscellaneous injuries. Fractures of the clavicle were classified as upper extremity injuries.

All children had their heights and weights measured using a standardised method described by the DOH in the National Child Measurement Programme (NCMP) [26]. The child's body mass index (BMI) was calculated and the percentiles were determined according to Cole's method, which adjusts the BMI distribution to different ages [3]. The estimated weight of the supportive plaster of Paris was deducted before the calculation of the BMI. The average weight of the plaster cast has been established by taking the average of six and was deducted from the weight of the child before the BMI was calculated. For those children who needed admission for surgical intervention of their fracture or observation, their heights were not accurately documented. Therefore, the age was mapped against the corrected weight using the World Health Organization (WHO) recommended growth charts to determine the percentile.

The social class of the child was determined by using the underprivileged area index based on the Neighbourhood Renewal Fund (NRF) areas [27]. These are the areas judged to be most deprived based on multiple indices of deprivation. The post codes of all of the children were collected to provide the area index.

Statistical analysis was performed using SPSS version 14.0 and Microsoft Excel 2003. The Pearson Chi-square test was used to compare groups. A *P*-value of less than 0.05 was considered to be a significant difference.

Results

A total of 560 children were identified with musculoskeletal injuries during the study period. The results have been divided into those who were treated on an outpatient basis and those who needed admission from casualty. This is because the method of obesity and overweight estimation was different in both groups.

There were 405 children who presented to the outpatient trauma clinics, of whom 252 were boys and 153 were girls. The mean age was 10.5 years with a median age of 12 years (range 2–15 years). In the inpatient group (*n* = 155), the mean age was 9.2 years with a median of 9 years (range 2–15 years).

Results from the outpatient group

The incidence of fractures is higher in boys at 64.9% (200/308) compared to girls at 35.1%. This is statistically significant (*P* = 0.04). The prevalence of overweight and obese children was 13.1 and 13.8%, respectively. Twenty-four percent of the boys and 31% of the girls were obese (*P* = 0.2). In the group of children from the most deprived areas, the prevalence of obese children increased to 17.3%, but the prevalence of overweight children decreased to 11.5%.

The incidence of fractures in obese and overweight children was 74.3% as opposed to 76.7% (*n* = 405) in normal weight children. There is no statistically significant difference (*P* = 0.6).

The incidence of overweight and obese children in the deprived areas was 28.8% (45/156) and it was 25.7% (64/249) in non-deprived areas. Although the percentage of children with obesity and children with fractures from deprived areas was comparatively higher, this difference was not statistically significant (*P* = 0.5 and 0.2, respectively).

Results from the inpatient group

There were a total of 155 children admitted to hospital for either observation or further management. Despite reviewing the notes, it was not possible to estimate the height and, therefore, obesity was estimated using the WHO weight for age charts. There was, again, a male predominance 66.5% (103). Children above the 91st percentile accounted for 34% (53/155); 26% (27/53) of boys and 31% (16/53) of girls were in this category. There were a total of 55 children from the deprived areas in this group, of which 40% (22/55) were overweight compared to 30% (31/53) from the non-deprived areas.

Upper limb injuries were significantly more common (*P* < 0.001) in both groups of children compared to lower

limb injuries, with an overall incidence of 72.8% in comparison to 24.3% lower limb injuries and 2.9% other injuries. There is no significant difference between the obese and normal weight groups ($P = 0.9$).

The most common fracture in both obese and normal weight groups was the distal radius fracture. This is followed by fractures of finger phalanges, metacarpal and diaphyseal fractures of the radius and ulna. Metatarsal and phalangeal fractures of the toes were the most common injuries of the lower extremity, followed by distal tibial and fibular fractures. Boys sustain fractures twice as often as girls.

The most common reason to admit children for orthopaedic intervention were fractures of the distal end and diaphyseal fractures of the radius and ulna. This is followed by long bone fractures of the lower extremity.

Discussion

The incidence of fractures in children in the United Kingdom is 20.2/1,000/year and is almost twice the incidence in adults (11.1/1,000/year) [21]. Our results are in general accordance with numerous other epidemiologic studies showing a strong male predominance and distal radius injury being the most common occurrence, which, along with the metacarpal and phalanges fractures, account for 50% of all fractures [4, 21]. Radial cross-section diameter and bone mineral density was found to be lower in girls, leading to a higher incidence of these fractures. However, in our study, we had a similar distribution between genders for these fractures [7, 23].

There is evidence that genetic factor, poor nutrition and lack of weight-bearing physical activity may influence fracture risks in the general paediatric population [10]. There is a progressive increase in the number of fractures with age in the paediatric population [12, 19]. In our series, we noticed that 60% of the children in the outpatient and 50% of the inpatient study group were between 11 and 15 years old. There is pronounced disparity in the evidence on an association between puberty and fractures. The rapid increase in weight and fat with dissociation between skeletal expansion and mineralisation was implied. There are others who proposed that increased physical activity in this age group with behavioural changes is a significant reason [1, 2, 18]. Whiting and Goulding et al. in their studies showed that overweight and obesity in childhood and adolescence reduces bone mineral density and are associated with an increase in the incidence of childhood fractures [8, 25]. In our study, we noticed that the incidence of overweight and obesity in this region is similar to the national statistics (29.9 vs. 30.3%), but the difference is not statistically significant. There is also an increase of

overweight and obesity as age progresses from 7% below the age of 5 years to 30% between the ages of 11 and 15 years.

Overall, in 2008, a higher proportion of boys (32%) than girls (24%) were classified as meeting the government's recommendations for physical activity, which is a minimum of 60 min of at least moderate intensity activity each day [29]. This, on the contrary, does not reflect on the obesity statistics, where 31% of boys and 29% of girls were overweight or obese [30]. Our study group had more overweight girls than boys in both the outpatient and admitted groups. However, we do not have any documented evidence of physical activity patterns.

Fractures, sprains and ligament injuries not related to sports showed an association with the degree of deprivation [11]. Population-based studies from Scotland found that children living in deprived areas have higher fracture rates than those from affluent areas [19, 24]. In contrast, a similar study from South Wales did not show any correlation [14]. Rewers et al., in their study of childhood femoral fractures, demonstrated that the risk is generally higher among children who live in the areas with lower socioeconomic indicators [22]. In our series, in the outpatient group, there was a slight increase in the incidence of obesity ($P = 0.5$) in children from deprived areas (28%) compared to non-deprived areas (25%), but there is no suggestion that the fracture rate is higher in children from deprived areas, being 72% in comparison to 78% ($P = 0.2$) in non-deprived areas. For those children requiring an intervention, there was a dramatic rise in the percentage of children from deprived areas (40%). This correlates with the latest HSE results which were reflecting the pattern of the mean BMI according to income groups; those children from the highest income quintile were the least likely to be obese [30].

The data were prospectively recorded, allowing an accurate assessment of the study population, but this study group is too small to be able to arrive at any definite conclusions. There is a tendency to show that both obesity and fractures are increasing with age. Although there is no increased fracture rate in obese children in this study group, childhood obesity can result in a number of disorders, including hyperinsulinaemia, poor glucose tolerance, sleep apnoea, social exclusion and depression, the greatest health problems are likely to be seen in the next generation, as the current childhood obesity epidemic passes through into adulthood [28]. Children from deprived areas and those reaching puberty are at increased risk of obesity and should probably be targeted. Biomechanical analysis suggested that environmental modifications are unlikely to lower the risk of arm fractures in obese children and that fracture risk can be reduced only by attaining a healthy body weight [5]. Alternative modes of physical activity

such as swimming and bicycle riding are recommended to alleviate lower extremity loading in obese children [6]. There are several government programmes formulated to increase the awareness of recommended guidelines for physical activity and the self-perception of weight.

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