

## **You Are What You Ate: Using Bioarchaeology to Promote Healthy Eating**

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## **Abstract**

The *You Are What You Ate* project is a collaboration between historians, archaeologists, museum officers, medieval re-enactors and food scientists. We aim to encourage public debate and personal reflection on modern eating habits through exploration of the dietary choices of the medieval and early modern period. This paper will discuss our osteology workshops, aimed at adults or at school children.

We use archaeological examples of diet-related conditions, including dental disease, scurvy, rickets and gout, plus those associated with obesity such as osteoarthritis and DISH, to help the public visualise how dietary choices can affect the body. This information is delivered via an introductory talk and carefully monitored bone handling sessions – and, for the children, includes the analysis of a plastic skeleton modified to display pathological conditions.

Evaluation data shows that the majority of adults and all children feel they have learnt something new during the sessions, and that this has led them to think about healthy eating. The inclusion of examples of dental pathology has promoted dental hygiene to school children, although it was not one of our primary aims. It is difficult to assess if these short-term experiences translate to long-term knowledge gain or to changes in behaviour.

**Keywords:** public engagement; osteology; workshops; diet; medieval; healthy eating

## **1 About You Are What You Ate**

The *You Are What You Ate* project (hereafter YAWYA; <http://www.leeds.ac.uk/yawya/>) is a collaboration between historians, archaeologists, osteologists, museum officers, food scientists and medieval re-enactors. We are supported by the Wellcome Trust through a Society Award (2009 themed call on eating). Our project aims to promote debate and personal reflection on healthy eating by exploring dietary choices of the past, specifically the medieval (here defined as the 13<sup>th</sup> to 15<sup>th</sup> centuries) and early modern (16<sup>th</sup> and 17<sup>th</sup> centuries) periods. Our project is based in West Yorkshire and, due to the collaboration with the museums and museum education service of Wakefield Council, we targeted the Wakefield district specifically. We focussed on the medieval period because of the expertise of team members combined with local interest in the Battle of Wakefield (AD 1460), Sandal Castle and the curation of a large number of medieval skeletons at the University of Bradford, including many local to the district. The inclusion of the early modern period allows us to discuss changes in diet that a more global economy introduced and allowed us to use Clarke Hall, Wakefield (built AD 1680) as a venue for cooking workshops. We have deliberately designed a range of activities and events to reach as wide a demographic as possible. While some events will reach a wide audience, others are designed and run to cater to specific groups (adults, children, those already interested in archaeology, history, or food and eating), some of which are considered 'hard to reach' including 13-19 year olds, young people not in education, employment or training (NEETS), young people at risk of exclusion, Black and Minority Ethnic (BME) young people and young people with learning difficulties. The three-year project (running 2010-2013) includes a wide range of public engagement activities: stalls at food festivals and local markets, museum exhibitions, school assemblies and activities, food workshops for children and adults, youth workshops, osteology workshops for both adults and children, evening talks and 'historic food days' – public research conferences.

A key theme for YAWYA was how diet affects the body. Working with food scientists, we wanted to stress that no food was inherently bad, but that getting the right balance can improve our health – thus we focussed on metabolic diseases and the effects of both obesity and undernourishment on the skeleton in particular. We believe that showing how bodies are affected in a visually stimulating environment has the potential to make a bigger impact on people than merely stating something is ‘good for you’ or ‘bad for you’. Anecdotally, the first two authors (JB and ARO) were aware that students (and staff!) tend to modify their behaviour slightly following certain palaeopathology labs; the desire to clean teeth following anything on dental disease, or an increased awareness of poor posture after examining spinal joint disease, for example. Specific issues were addressed in our first two exhibitions: ‘Sugar and Spice and All Things Nice’ (Wakefield Museum, March to September 2011) included a section on the relationship between sugar consumption and the prevalence of caries in the past (Moore and Corbett 1978), whereas ‘The Dark Side of Eating’ (Pontefract Museum, March to September 2012) discussed a wide range of diet-related pathologies including obesity (and the increased risk of osteoarthritis, especially of the knee), gout, scurvy and rickets (Roberts and Manchester 1995). We drew on these themes for the osteology workshops, which were timed to coincide with the exhibitions. This paper will discuss the osteology workshops in more detail, highlighting our aims, session structure/content and the results of our evaluation.

## **2 About the workshops**

In our initial plan, we aimed to deliver two osteology workshops to adults, and two to Key Stage 2<sup>1</sup> school children per year; after the success of the first year we expanded the provision of children’s osteology workshops to four per year. To date we have delivered four

adult workshops and six children's workshops, engaging with 94 adults and 141 children plus 22 teachers/accompanying adults. All of the workshops were planned to include two activities – a short talk followed by a hands-on workshop – each modified to meet the needs of the audience and/or the exhibition theme. It is well known that people are naturally predisposed to different learning styles (Hein, 1998). By combining auditory, visual and kinaesthetic components in each workshop we hoped to make the sessions memorable to as many people as possible. For the adults, the hands-on workshop offered the opportunity to examine real archaeological material; this was preceded by a brief introduction about the ethics of excavating and researching human remains and appropriate behaviour. For the children, a series of carefully selected archaeological specimens were shown to small groups of children by demonstrators, who facilitated discussion about the pathology present and the possible dietary causes. This was followed by an activity known as 'skeleton in a box' where, working in small groups, the children laid out and analysed a modified plastic skeleton (see section 2.2.1).

## **2.1 The aims of the adult workshops**

We anticipated that the adult osteology workshops might attract repeat participants; therefore we decided to address slightly different themes each year. In the first year we focussed on dental disease as this linked well with the exhibition 'Sugar and Spice and All Things Nice'. The first two workshops were identical, and lasted 2.5 hours. One was on a Wednesday and one on a Saturday; in later years we decided to run all of these events on Saturdays as fewer people were able to attend the Wednesday session and thus attendance was lower. The aims for the first two adult workshops were:

1. To engage the lay public in human osteology
2. To show the effects of diet on teeth and jaws

3. To compare patterns of medieval oral health with modern oral health, and to see what lessons can be learned
4. To raise awareness of the ethical treatment of working with human remains

In the second year, we expanded the osteology workshops to also include skeletal pathologies, taking the lead from our exhibition theme 'The Dark Side of Eating'. Thus our second and third aims were modified to include skeletal diseases, increasing the pathologies to encompass scurvy, rickets, cribra orbitalia, osteoarthritis, diffuse idiopathic skeletal hyperostosis (DISH) and gout (Roberts and Manchester, 1995). The first workshop was run as part of the British Festival of Science (in Bradford) in September 2011 and was limited to two hours; the second was timed to occur shortly after 'The Dark Side of Eating' opened in Pontefract, and reverted to the 2.5 hour format.

For the first half of each workshop ARO delivered a lecture which illustrated the different pathologies and highlighted their aetiologies and especially links to diet. Where possible, observations were made about the presence of these diseases in modern populations and, for some (e.g. dental caries), comments were made about differences in treatment. After a short break participants were taken to the osteology lab, where they were each given a lab coat. We briefed them on the ethical treatment of human remains, encouraging them to learn from the remains laid out in the lab but to handle them with care, if at all. A team of five demonstrators, including JB and ARO, circulated around the lab discussing the specimens and the observable pathologies. In each case we tried to explain the aetiologies and the links to diet, but stressed that these were complex. Invariably these informal discussions developed to include personal observations regarding participants' own health, or those of their friends and family, and topical subjects including the fact that rickets is being diagnosed more often

in recent years in British populations (Pearce and Cheetham, 2010), discussed as a topical news item on the YAWYA web site (McCleery and Buckberry, 2010). At the end of the session, all participants and team members were asked to complete an evaluation form.

## **2.2 Children's workshops**

The osteology workshops for children were designed to suit a range of different learning styles – visual, kinaesthetic, auditory and problem-solving, allowing all children to learn in the way that suits them (Smith 1998). The workshops included repetitive elements, delivered in different ways (talk, show-and tell, discussion, hands-on activity). The activity encouraged teamwork and discussion, which has been shown to be particularly beneficial for girls (Askew and Ross, 1988; Fennema, 1996), whereas boys have been shown to need physical interaction in order to learn and therefore they often respond well to hand-on activities (Russell, 1994). At the end of the session each group reported back to the class, promoting and developing public speaking and presentation skills. Regular discussions with the large team of demonstrators, and teachers and classroom assistants accompanying each group allowed pupils to express their own views throughout the hands-on activity.

The children's workshops were advertised through Wakefield Council's iPoint school service and via the museum's school contact list, and were made available to Key Stage 2 children, but were specifically targeted to Year 6 (the final year before secondary school, ages 10 to 11 years). Each session was for one class of approximately 30 children, with accompanying teachers and adults. In line with the adult workshops, during the first year we focussed on dental disease. We expanded the workshop to include other conditions in the second year of delivery. The aims of the children's workshops were:

1. To engage school children in human osteology

2. To show the effects of diet on teeth and jaws
3. To show that similar dental diseases are seen in both archaeological and modern populations – the main difference is in the level of medical care available.
4. To promote the *You Are What You Ate* project to teachers

In the second year, the second and third aims were modified to reflect that the focus was now on the entire skeleton, not just the dentition.

The school groups were bussed from Wakefield to Bradford. On arrival, the children and teachers were taken to our osteology teaching lab where they were given lab coats to wear – as well as protecting clothing, this reinforced the health and safety messages (don't eat, wash your hands), but also added to the sense of occasion. We started by delivering a short talk on how and why we analyse skeletons, focussing on the diet-related pathologies and their causes. It was a challenge to pitch these to the right audience, but by using humorous images and asking lots of questions, and keeping this as short as possible, most of the children appeared to be engaged throughout the talk. All of the demonstrating team were present during the talk, as it allowed us to ensure we were consistent in the messages that we were conveying.

After the talk, each demonstrator selected one archaeological specimen with a different pathology. We circulated around the room, talking to the children (and adults!) in small groups about what we could see, what the pathology looked like, what disease this was, and which type of food might have caused the condition, and what type of person (rich, poor) might be affected. We asked the children questions (linking back to the talk to reinforce the content) and encouraged as much discussion as possible. If children wanted to touch the remains we allowed this, but only within the constraints of this highly controlled

environment. Once all of the children had seen each example, we started the main activity ‘skeleton in a box’, modified from school sessions which have been run by John McIlwaine in Bradford for the last ten years. In the YAWYA activity, we used modified plastic skeletons, altered to show evidence of the diseases discussed in the first half of the session.

### **2.2.1 Modifying plastic skeletons**

Ten commercially available, low price full size plastic replica skeletons (described as a ‘full disarticulated budget skeleton with skull’) were purchased. In the two weeks prior to the first course they were modified to show clear evidence of a range of diet-related dental pathologies, including dental caries, dental granulomas and abscesses, dental calculus and ante-mortem tooth loss (Ogden, 2007). Prior to the workshops in the second year, these skeletons were further modified to show clear evidence of diet-related skeletal pathologies including rickets, cribra orbitalia, scurvy, DISH and gout (Roberts and Manchester, 1995). As in the real world, some skeletons had multiple pathologies. Three principal methods were used, which are discussed below.

#### **Building-up**

The surfaces to be built-up were cleaned, dried and slightly roughened with file strokes to ensure a good bond. An ivory-coloured fast setting epoxy putty (Milliput©) was then mixed according to the manufacturers guidelines. Like most chemicals in domestic use this product may cause irritation to sensitive skins, and when kneading the two components together it is advisable to use disposable gloves. The putty is sticky and adhesive when first mixed and can then be placed where needed. After 30 minutes it becomes rubbery and less tacky. After about one hour it can be cut into shape with a knife. During this period it can be shaped by modelling tools, and its surface smoothed with moistened tools or wet gloved fingers. The

material becomes hard after four hours at 20-25°C. It can then be filed, sawn or even painted to improve realism.

By this means we were able to simulate calculus deposition on the teeth, and the bone deposition in the orbits and beneath the muscles of mastication, seen in scurvy, and the flowing spinal osteophytes characteristic of DISH (Fig. 1).

### **Drilling**

In a well-ventilated room (or even under extraction or a fume cupboard, if available) and wearing a face mask, a 12V hand-held drill (Proxxon Micromot ©) and 1-2mm diameter dental rose-head and tapered cross-cut burrs was used to drill shallow pores in the roofs of the orbits in a pattern suggestive of cribra orbitalia. Para-articular scooped out lesions, characteristic of gout, were drilled into the distal end of first metatarsals. Carious cavities were drilled into teeth, producing a range of sizes of occlusal and interproximal lesions. Where carious lesions were extensive, pulpal exposures and alveolar granuloma/cysts and abscesses in the alveolus were also fabricated. By this means teeth could also be removed and the alveolus 'resorbed' to simulate periodontal disease, anterior tooth loss due to scurvy and the long-term effect of posterior tooth loss (Fig. 2).

### **Bending**

In a well-ventilated room, extremely cautious softening of the mid-shafts of long bones with a 1500W hot-air gun (for DIY paint-stripping), enabled the gentle bending of the shafts. The ends of the bones were then held firm in the new position whilst the 'bone' was cooled in cold water. By this means we were able to simulate the results of rickets in childhood on the long-bones of upper and lower limbs (Fig. 3).

### **2.2.2 The skeleton in a box activity**

The children were organised into groups of 3 or 4 (with the help of the class teacher – in some cases the teachers deliberately moved the children about into specific groups). Each group was presented with a box containing a skeleton for analysis and each child had a specially designed recording form and YAWYA pencil. We asked the children to start by laying out their skeleton in anatomical order, using four hanging skeletons as a reference with the help of the demonstrator team and the accompanying teachers/adults, and colouring in which bones were present. Next, they assessed the sex of the skeleton, using a small number of standard traits of the pelvis and skull (Buikstra and Ubelaker, 1994) and the age of the skeleton by observing the pattern of dental wear (Brothwell, 1972) and the morphology of the pubic symphysis (Brooks and Suchey, 1990). The images used for this section of the recording form were those used by professional osteologists (to keep this as authentic as possible) and were simplified to reduce the amount of specialist information. After the first year, the images were simplified further to ensure the children were not confused by having too much information available, based on staff observations and experiences in the first two sessions. Although we encouraged the children to use these methods as accurately as possible, if the group decided the skeleton was female (the replica skeletons were all males), we agreed with their assessments. Once age and sex had been established, the children were asked provide a name for the skeleton. This was added to the activity as we felt it would encourage the children to think about the skeleton as a person. The final part of the activity was to describe and diagnose the pathology present, with space to draw the pathology if the child wished to do so. Questions were then asked about what might have caused the pathologies – focussing on diet, but also incorporating lack of dental hygiene, as most of the jaws observed (both real and plastic) had evidence of calculus in particular. At the end of the

session each group presented their findings to the rest of the class, and then packed their skeletons away.

After the session was completed, all participants (children, accompanying adults and – a little later on – the project team) completed evaluation forms. We then made sure everyone returned their lab coats, washed their hands, and were given a YAWYA freebie as they left: project stickers and either a project water bottle or set of coloured pencils.

### **3 Measuring success – evaluation of events**

Evaluation forms were designed with the help of cultural officers at Wakefield Museums and the project administrator, Fiona Blair. They were designed to contain both open and closed questions and therefore produce both quantitative and qualitative data. Questions were written to enable the analysis of Generic Learning Outcomes (GLOs) and Generic Social Outcomes (GSOs), devised by the Museums, Libraries and Archives Council (MLA), and used as a standard museum evaluation tool. This methodology recognises that learning is not just about knowledge transfer, but can also include inspiration, change or progression in attitude or behaviour, and new skills (Foster, 2008; Museums, Libraries and Archives Council, 2008). We have adapted this approach to investigate if we met our aims, and will undertake formal GLO and GSO evaluation of the data at the end of the project.

Four different audiences evaluated the workshops: adult participants; children; teachers (and other accompanying adults); and project team members. Questions explored the running of the event, if participants had been to another YAWYA event, enjoyment, the learning experience and about the ethics of studying human remains (adults only). For the school

children, the final section prompted them to discuss ‘what I will remember most – write or draw it’, next to a large speech bubble.

All responses were collated onto excel spreadsheets, allowing us to collate qualitative comments and analyse quantitative data. All comments were typed up as written on the evaluation forms and any spelling mistakes were transcribed directly. Occasionally it was difficult to read handwritten comments. Comments selected for inclusion here were thought to reflect the main issues raised by the participants; occasionally comments which were contrary to general opinion were selected to demonstrate that differences of opinion were evident on the evaluation forms. It is hoped that these represent a sample of typical comments, while not being limited to just those who had either a positive or negative experience. Comments were also used to help develop the sessions further: team members were asked to reflect on how well sessions were run, how we had achieved our aims, and how we could improve similar sessions in the future. Comments by adult participants and teachers allowed us to develop ideas and to deal with small snags we had not identified ourselves. Thus each session evolved from the last, and evaluation forms were modified to avoid ambiguity or changed focus in subject matter. Chi-squared tests were undertaken to compare agree/strongly agree and disagree/strongly disagree, or yes/no responses using SPSS version 20.0. For the schools workshops, comparisons were made between boys and girls for yes/no responses to see if the sex of the participant had any effect on their experience. It is commonly reported that boys and girls have different levels of achievement at different developmental stages (Younger et al., 2005), and we wanted to ascertain whether they had engaged with the workshop in a similar way. Chi-squared tests comparing yes/no responses for boys and girls were undertaken on 2x2 tables, and where appropriate Fisher’s exact tests

were used. The evaluation forms were all copied and are archived at the University of Leeds, with a second copy at the University of Bradford.

#### **4 Results – informal observations and formal evaluation**

Overall, the participants indicated both formally (via evaluation forms) and informally (by chatting to the team, or to each other) that they had had a positive, enjoyable and educational experience. After each event, the osteology team noted things that could be done differently, and incorporated these into our event plans for the next workshop. It was gratifying to note that after each event, the team evaluation became more positive, especially in terms of the event organisation. Actively reflecting on how things had gone helped improve the events.

##### **4.1 Workshops for adults**

All of the quantitative data is strongly skewed towards the positive responses. Tables 1 and 2 collate the responses to a series of questions by adult participants based on yes/no type questions and those on an ordinal scale respectively. Almost all found the workshops had been well planned and that they would recommend the event to others. Only 2 participants felt they had not learnt anything new, and all who responded found the workshop to be ‘interesting’ or ‘very interesting’.

The majority of participants (n=86, 91.5%) felt it was alright to study and handle archaeological human bone; the remaining individuals either responded ‘don’t know’ or left the question blank. One participant circled both ‘yes’ and ‘no’, and qualified this with the statement:

“Handling remains in a situation similar to today or as part of research is okay but not if you are not in an academic/scientific situation”.

This positive response is unsurprising, as individuals opposed to the study of human bone are unlikely to have signed up to take part in this event.

Each of the quantitative questions was coupled with an open, qualitative question (such as ‘why do you say this?’). The responses to these questions were assessed by JB and VS. 61 participants answered ‘Would you recommend this event to others? Why do you say this?’, although sadly we could not read one response. All of the comments were positive, many highlighting that they had found the event interesting, that the lecture was both interesting and fun, and that all of the team were knowledgeable; indeed access to academics who enthused about their subject seemed to be a real draw. Several participants observed how important it was to be aware of health-related issues, and that it made them aware of modern-day issues. Others noted that they enjoyed the hands-on aspects of the workshop, and it was better seeing the bones than just photographs. Comments included:

“It's generally really interesting and fun. It's applicable to everybody”,

“Interesting, informative, close up view of specimens”,

“Very accessible & introduced the subject on a friendly basis”,

“Very interesting presentation - reminding us of how DIET really impacts on health”  
(participant’s emphasis),

“Because it makes you understand why we do the things we do today to prevent these diseases”,

“Sheer quantity of freely given expert analysis. Very fluent, eminently understandable”.

Many of these themes were picked up again in answers to the questions ‘What did you particularly like about this workshop?’ and ‘Would you describe your participation in the workshop as a positive experience? Why do you say this?’.

When we asked what people had learnt the answers were wide and varied, from great amounts of specific details to simple statements such as “A lot!”. Each statement was read by JB and a tally was kept of how many times comments reflected certain key themes: health/disease/lesions (n=31), care/treatment/loving conditions (n=7), comparisons of the past and the present (n=3), references to diet (n=10), anatomical knowledge (n=17), scientific approaches/techniques of analysis (n=5) and personal reflection (n=3). One comment could easily encompass several of these broad themes. Anecdotally, it was obvious from talking to the participants that most of them had learnt something about most of these areas, but of course they would only write a fraction of that down on the forms.

The majority of people made a comment about seeing what different pathologies looked like, understanding disease processes more or made a comment about a specific pathology, an expected outcome given the focus of our workshop, and indicating we had successfully raised their awareness of human osteology (Fig 4.). Some comments included personal reflection, suggesting that the workshop had encouraged personal reflection on individual but also family health:

“The effects of vitamin D on rickets and how it has affected my family history”,

“Names of tooth and gum problems. Thankful that I have dentures!”.

Interestingly, most of the demonstrating team had had lengthy discussions with participants about family and friends with certain diseases; in particular the fact that gout is in part hereditary seemed to resonate with those who knew people with gout running through their families. General observations on the level of health were common, but those that directly compared past and present health were rare:

“How terrible dental health was in the past and also how living now brings it's (sic) own problems”.

It was interesting to see that many people learnt some basic anatomical knowledge, and clearly appreciated being able to see and handle real bones:

“DISH and what a normal spine looks like! Never seen a whole skeleton laid out before”,

“Effects of vitamin deficiency etc. on bones. What human bones really look and feel like”,

“I know a bit but seeing the actual material really made a difference”.

Finally, several comments noted that participants had learnt about *how* we analyse skeletons and identify the diseases; becoming aware of the scientific process itself was an important learning outcome:

“How evidence can be found”,

“Effect of evolution of diet on disintegration of teeth and methods of archaeological investigation”.

It was clear that the theme of the workshop influenced the types of comments made – those from the first two workshops, linked to ‘Sugar and Spice and All Things Nice’, tended to specifically mention teeth, whereas those in the following year, when we took a much broader approach, tended to be far less specific.

#### **4.1.1 Evaluation of aims – adult workshops**

Before the workshops we set specific aims; each will be discussed here. By attending the workshops, each participant had become aware of human osteology, which was our first aim.

Evaluation indicated that they had really enjoyed the hands-on aspect of the workshop. The interaction with multiple demonstrators really enhanced that experience:

“Hands-on! Real bones. Really old bones. Amazing” (participant’s emphasis),

“Examining skeletons and meeting friendly people”,

“The opportunity to handle the teeth, with knowledgeable demonstrators who could provide extra information”.

Our second aim was to show the effects of diet on teeth and jaws/on the skeleton and dentition. 97.9% of participants indicated that they learnt something new at the event, and the subsequent comments indicated this was often connected to the specific appearance of skeletal/dental lesions:

“The mechanism of the diseases. How disease leaves a trace on your bones...”,

“How different diets can affect different aspects of the skeleton”.

Our third aim was to compare patterns of medieval (oral) health with modern (oral) health, and to see what lessons can be learned. Some participants commented on the contrast between modern and medieval health:

“That people's health was worse than I thought it was and how easy we have it today”.

We did not specifically set out to change people’s behaviour (and this would be very difficult to evaluate), but some comments suggested that seeing this evidence encouraged participants to reflect on their own habits:

“To improve my diet and brush my teeth more often”,

“I'm reflecting on my diet as a result!”.

Others recognised the need to pass this information on to a wider audience:

“...we need to focus on telling people how much a poor/unbalanced diet impacts on their health”.

Our final aim was to raise awareness of the ethical treatment of working with human remains. Team members commented on their evaluation forms that the briefing section at the start of each hands-on session really emphasised this point. Participants often had informal discussions about this with team members, discussing their own opinions, and recognising the importance of skeletal data (although this is, of course, a self-selecting audience). Answers to the question ‘Do you think that it is okay for people to study and handle human bones from archaeological sites? Why do you say this?’ were generally in support of analysis (91.5% of responses answered ‘yes’); this reflects the general trend for public support on the analysis of human remains revealed in a recent ICM opinion poll commissioned by English Heritage (Payne, 2010). Comments on YAWYA evaluation forms revealed that participants felt this was OK, provided they were treated appropriately:

“It is the only way we can learn. Human remains hold no special significance to me but we must respect the sensibilities of others”,

“As long as it is done carefully and respectfully it is fine”,

“We'll only learn for the future by looking at the past as long as treated with respect it's fine”,

“With respect”.

One participant clearly found it difficult to reconcile the educational and research value against the disturbance of graves:

“I agree that you should examine them to learn but I also find it disrespectful to dig out peoples (sic) resting places. So I'm not sure!”.

## **4.2 Workshops for schools**

This section combines quantitative data, qualitative data and starts with general observations by team members. It was clear from the outset that most of the children thoroughly enjoyed the workshops; most were clearly engaged with the event from the moment they donned a lab coat. During the talk they were generally attentive, and keen to answer questions, although this did vary between schools. Most groups who visited in the second year of the project had prior knowledge of scurvy, which they had encountered during the Key Stage 2 topic ‘Tudor explorers’, so when we asked them ‘what kind of people get scurvy?’ the answer was usually ‘sailors’ or ‘explorers’. One unexpected, but technically correct, answer was ‘pirates’! The team became aware that we were reinforcing the key messages delivered during the talk while we were discussing the archaeological bones in small groups, and prompted the children to remember key facts during this part of the session.

‘Skeleton in a box’ was clearly a very successful activity, and the children seemed to enjoy it immensely. When asked ‘what did you enjoy most, write or draw it’, many children described putting the skeleton back together, or drew a skeleton laid out on the table. Some groups became very engrossed in the puzzle-like challenge of getting all of the bones in anatomical order, going to great lengths to sort out the ribs and to articulate the loose hand and foot bones (each skeleton had one articulated and one disarticulated hand and foot), grasping the need to arrange this as a mirror image very quickly. During the first few workshops one team member observed that this seemed to be more common in groups of boys than groups of girls or mixed-sex groups, however in later sessions this task was completed by both boys and girls. Some groups became so engrossed in re-articulating the hands and feet that we had to encourage them to move on to the other aspects of the activity.

Many children were very good at assessing the age and sex of their skeleton, debating within the group what age/sex they thought the skeleton was, and supporting their observations with information and pictures provided on the worksheets (Fig. 5). They all seemed to really enjoy thinking of a name for their skeleton, but some were a little bit perplexed that they had to make this up, and not work it out from some data provided by us – perhaps revealing how immersed the children were in the scientific scenario. This was the one aspect of the activity that seems to spark the greatest debate within the groups, and caused the most hilarity for team members. As a compromise, many of the skeletons had multiple middle names.

The children spotted most of the pathologies very quickly. Interestingly, the more subtle changes – those of the dentition, orbits and feet, were not equally easy to find. The scooped out lesions of gout were most commonly overlooked (until prompted to look at the feet), whereas equally small lesions in the cranium were generally observed early on, perhaps due to the focus of attention of the skull and dentition while assessing age and sex. Rickets was over-diagnosed by all groups; due to the inexpensive nature of the skeletons, quite a few had curved fibulae. This suggests the children had understood the diagnostic features of rickets and were noticing the mild curvature of the fibulae as well as the severe changes we had produced in the tibiae and femora. Generally speaking, the children were very observant, and remembered what the pathologies were. Some found it more difficult to associate the skeletal lesions with diet compared with dental lesions. Perhaps the general awareness that eating sweets caused holes in your teeth and the importance of dental hygiene contributed to this pattern.

The pupil presentations given at the end of the lab were often of an incredibly high standard, with many groups justifying their age and sex assessments and their diagnoses with

observations. Where there was disagreement over the sex of the skeleton due to disparity between the skull and the pelvis, some groups chose the sex as assessed from the pelvis, because they had learnt that this was more accurate. This is important, as it reveals an understanding of the analytical process.

Evaluation data showed that every child indicated that they had learnt something new, and 130 children (92.2%) indicated that they had learnt something about diseases and eating (Table 3). Comments indicated that they had learnt how to lay out and analyse a skeleton:

“I can tell if the skull is a boy/girl by the eyebrows”,

“how to bild a scealton”.

Others clearly identified specific diseases in their answers, often using specialised language:

“Your legs bend if you don't get enough sunlight, the disease is called rickets”,

“About granulomas”,

“I didn't know you could get serious desises just by not eating the right amount of iron or vitamin C/D”,

“scurvy makes you bleed inside”.

In some cases, the general message was clearly understood, even if the detail was a little inaccurate:

“That if you don't eat your greens then you will get holes in your brain”!

All bar one child (who did not respond to the question) had enjoyed the workshop and 138 (97.9%) thought the activity was exciting. Many of the teachers indicated they thought the activity was positive and one teacher commented (verbally) that it was good to see an activity that was equally enjoyed by boys and girls. Indeed, chi-squared tests revealed no significant

differences at the 95% confidence level in the responses of girls and boys for any of the quantitative questions (Table 4). When asked what surprised them about the workshop, some children noted that:

“It wasn't like a normal school lesson”,

“I didn't think we would've done things that were as fun as they were”,

“In normal lessons we don't join bones together!”,

“Because we never get to do owt like that in class” and

“That we get to wear lab coats”.

This indicates that the session as a whole was a very different experience (and perhaps more fun) compared to school. Most of the children wanted to find out more and were interested in learning about the past (129, 91.5% for both questions).

Of the 86 children asked if medieval diets were healthier than modern diets, 22 (25.6%) thought they were and 63 (73.3%) thought modern diets were healthier (Table 3). The reasons given for this were varied, but the lack of sugar in the past was a common theme. Some children noted that medieval peasants had less access to food:

“Because they were poor and they didn't have as much sugar”,

“because most of them were poor”,

Others attributed this to a lack of fruit and vegetables in the past:

“Because they didnt grow enough vegatables”,

“We had more fruit”.

Some answers appeared to be based on the findings of the ‘skeleton in a box’ activity:

“Because nearly every skeleton had a disease”,

or based on personal reflection:

“because my teeth are cleaner that theres”.

128 children (90.8%) felt they gained some ideas about how to eat more healthily and 138 (97.9%) felt they had gained some ideas about looking after their teeth. These themes were backed up with comments:

“You need to brush your teeth or you'll get plaque”,

“I learnt you need to have vitamin C and iron”,

“Don't have too much fizzy pop”,

“Eating no fruit and veg is really bad”,

“That in our time people have better toothbrushes”.

Many children drew a tooth brush in the ‘what I will remember most’ section at the end of the questionnaire, particularly in the first year when we focussed on oral health.

#### **4.2.1 Evaluation of aims – workshops for schools**

We believe we successfully engaged school children in human osteology; many of the children wrote about analysing their skeletons and working out the age and sex. Several drew pictures of the skeleton being laid out in the lab for ‘What I will remember most’. We showed the effects of diet on teeth and jaws through the PowerPoint, archaeological skeletons and via the ‘skeleton in a box’ activity. Drawings in ‘What I will remember most’ included images of calculus, DISH, rickets and gout. There was less awareness (evidenced in the evaluation data) that similar diseases are seen in both archaeological and modern populations, but the answers to ‘Do you think medieval people have healthier diets than us? Why?’ suggested they were aware that different access to food – and especially sugar – has a huge impact on health. The children were also struck by the lack of dental hygiene in the past. Finally, we promoted the YAWYA project to teachers, encouraging them to book multiple YAWYA events by handing out merchandise at the end of the session. One school group clearly did some follow up work

after the workshop, and sent us a series of beautiful thank you letters. Certainly one child thought the workshop would be memorable:

“Everything was amazing. I will remember this in the future”.

We had some unexpected outcomes. We raised the awareness of science (and the lab coats were a huge hit):

“It was like science”,

“We wore lab coats, we saw the facts”,

“how Toby looks in a white suit” (Fig. 6).

One teacher observed that it was valuable to bring the children to a university for the workshop, as it could help raise their aspirations. At the start of the YAWYA project we did not anticipate these wider social outcomes.

## **5 Conclusions**

This paper presents interim data: two further workshops for adults and four further schools workshops are planned for 2013. In addition, the YAWYA project has been recently awarded an extension, and four further schools workshops will run in 2014. Once these workshops have been completed, we will have more evaluation data, which will allow us to assess if the overwhelmingly positive responses reported here continue. We continue to modify the workshops in response to participants’ and demonstrators’ comments – for 2013 we intend to modify the section on the recording form ‘what was the person called?’ to ‘What do you think the person might have been called? (Think about names that might have been common in the past)’, – this change in language is hoped to convey that this aspect of the schools workshops is about imagination and reflection, rather than the scientific analysis of the skeleton.

The osteology workshops run as part of YAWYA are an extremely rewarding experience. We achieved all of our aims, and had some positive outcomes that we did not expect. We cannot assess long term reflection/knowledge gain, due to the scope of project, but the indications are that the workshops were memorable, and both adults and children gained knowledge about the impact diet can have on health. Overall the workshops seemed to have been a huge success:

“...it was very fun and it was fun learning and I would want to come again”.

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<sup>1</sup> Key Stage 2 (or KS2) refers to the four years of school for children aged 7 to 11 years. This applies to England and Wales, but not Scotland or Northern Ireland.

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## Figures

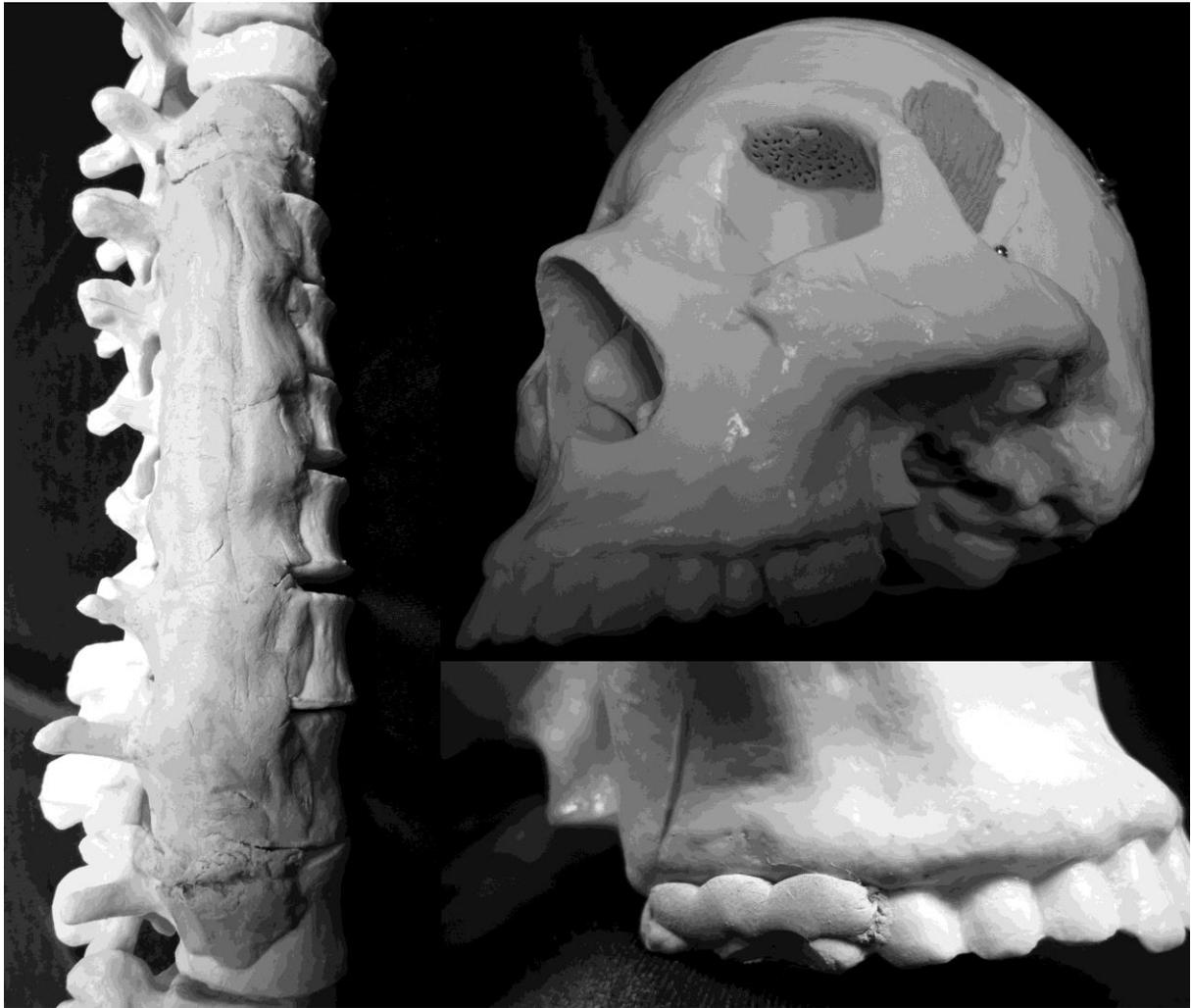


Figure 1: Examples of 'build-up' pathology on the modified skeletons. Left: DISH; top right: scurvy; bottom right: calculus.



Figure 2: Examples of 'drilling' pathology on the modified skeletons: Top: cribra orbitalia; middle: caries and apical granuloma; bottom: gout.



Figure 3: Rickets created by bending replica femur and tibia.



Figure 4: Adults comparing a pathological cranium with a non-pathological cranium at a YAWYA osteology workshop.



Figure 5: Children analysing their 'skeleton in a box' with the help of demonstrator Alice.



Figure 6: Illustrative feedback from a YAWYA osteology workshop for schools of Toby wearing a white suit.

## Tables

**Table 1: Responses to yes/no questions by adult participants (n=94)**

Question	Yes	No	Yes and No	Don't know	Blank
Would you recommend this event to others?	92			1	1
Did you think that the event was well planned?	92		1		1
Have you learnt anything new from this event?	92	2			
Would you describe your participation in the workshop as a positive experience?	92	1			1
Do you think that it is okay for people to study and handle human bones from archaeological sites?	86		1	4	3

**Table 2: Responses to questions on an ordinal scale by adult participants (n=94)**

How interesting did you think the workshop was?	<b>Very interesting</b>	<b>Interesting</b>	<b>Okay</b>	<b>Not interesting</b>	<b>Boring</b>	<b>Don't know</b>
	84	10				
In your opinion, was the overall standard of the workshop:	<b>Excellent</b>	<b>Good</b>	<b>Satisfactory</b>	<b>Poor</b>	<b>Blank</b>	
	76	17			1	

**Table 3: Responses to yes/no questions by participants at schools workshops (n=141)**

	Yes	No	Don't know	Blank	Chi <sup>2</sup> p-value
I had fun today	140			1	-
I learnt some new things	141				-
I learnt some things that surprised me about diseases and eating	130	8		3	0.120
This was an exciting activity	138	1		2	-
I want to find out more	129	11		1	0.684
Do you think medieval people had healthier diets than us?*	22	63		1	0.153 <sup>^</sup>
I am interested in learning about the past	129	8		4	0.665
Today has given me some ideas about how to eat more healthily	128	11		2	0.170
Today has given me some ideas about looking after my teeth	138	2		1	1.000

\*55 children from two schools were not asked this question, therefore n=86

Chi<sup>2</sup> tests were performed using SPSS 20.0 to compare responses of boys and girls. All tests bar <sup>^</sup> were Fisher's exact tests, due to low cell counts.