The Archaeology of Disease Documented in Skeletons

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People shaped the past and
Created the sites archaeologists excavate
Study of their remains enables us to understand how they interacted with their
environments, and to
Help people today appreciate how we have evolved and adapted to change over
the epidemiological transitions
The last 10,000 years of health changes has set the stage for what we are today
1. Emergence, communities, and complexity
2. Resilience, persistence, transformation, and collapse
3. Movement, mobility, and migration
4. Cognition, behavior, and identity
5. Human-environment interactions

‘They show an increasing concern with relevance to the modern world’ (p. 879)

Bioarchaeology in particular can contribute to all these themes
Bioarchaeology is about contextualising data......

...and is question driven
A bit of history of UK bioarchaeology

In the 1980s
Fewer people
Male dominated!
Not generally contextualised

From the 1990s
Many MSc courses (currently 12)
More PhDs & academic posts
1990: changes in commercial archaeology
Recognition of bioarchaeology’s value
1998: BABAO founded
Guidance documents
Standards for recording
Better infrastructure and funding
It documents normal and abnormal variation in human skeletons.

Abnormal variation = palaeopathology
Why study palaeopathology?

- Direct evidence for disease
- Shows the history of disease without impact of modern therapy
- Provides a ‘long view’ of disease origin, evolution and history
- Explores the impact of the interaction of people with their environments
Methods of analysis

But only a small number of diseases affect the skeleton.
Bone formation

Bone destruction

Distribution pattern

Pseudopathology

Differential diagnosis
Isotope (chemical) analysis of teeth and bones

Ancient DNA analysis

Leprosy

Richards (Orkney Islands 14th C AD)

Diet

Bentley (Pacific Islands)

Mobility

Donoghue 2008

Richards (Orkney Islands 14th C AD)

Bentley (Pacific Islands)

Diet

Mobility
1953: structure of DNA

1993 UK’s Ancient Biomolecules Initiative

1985: 1st report: Egyptian mummy
1989: 1st bones (forensic)
1993: 1st pathogen aDNA (archaeological)

Bos et al 2011
*Nature*

Warinner et al 2014
*Nature Genetics*

Modern and ancient genomes now being sequenced
34,778 skeletons from 211 archaeological sites

Health declines through time

21 studies of health from the Old and New Worlds

Health declines through time
**Period**
- Neolithic
- Bronze Age
- Iron Age
- Roman
- Early medieval
- Late medieval
- Post-medieval

**% of total teeth/tooth positions**

- 4,000 BC
- 1850 AD

**Height (cm)**

- Male
- Female

**Period**
- Mesolithic
- Neolithic
- Bronze Age
- Iron Age
- Roman
- Early medieval
- Late medieval
- Post-medieval

**Height (cm)**
- 8,000 BC
- 1850 AD

**TODAY**
- Males 1.76m
- Females 1.62m

**Notes:**
- Stature data from different periods.
- Dental caries analysis from 4,000 BC to 1850 AD.
- Height trends from 8,000 BC to 1850 AD.
History of health in the Americas (12,000 skeletons)

Health declines through time
Reconstructing Health and Disease in Europe: The Early Middle Ages through the Industrial Period.

Global History of Health Project

17,250 skeletons
Measures of ‘health’
Over time
Context and climate
Latitude/ longitude/ elevation

Standard data recording
online database

(http://global.sbs.ohio-state.edu)
Tuberculosis

Mycobacterium tuberculosis - human
Mycobacterium bovis – animal

A bacterial infection
**Mycobacterium tuberculosis**

- Human

**Mycobacterium bovis**

- Bovine (animal)

Mycobacterium tuberculosis complex organisms

A bacterial infection

Steinbock 1976

Roberts & Buikstra 2003

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**Figure 4.3** Pott's disease of the spine, Norris Farms site. Photo by George Milner; skeletal remains curated at the Illinois State Museum, Springfield.

P Davies

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Figure 69. Skeletal distribution of tuberculosis. Indicate the most frequent sites and diagonal lines identify the least frequent sites.
One third of the world’s population affected

1993 WHO “Global Emergency”

Treated with multiple antibiotics; resistance common
Pre-1400 AD England
Pre-1400 AD Scotland

Post-1400 AD England
Post-1400 AD France

People were probably moving around a lot!

Müller et al 2014 *Proceedings Royal Society B* 281:20133236
Late Medieval TB bacterial strains

SCG 5 strain at Auldhame

SCG 3 strain at Leicester (100–200 years earlier)

Auldhame strain may have been introduced into Scotland from Scandinavia

AND there is

Skeletal evidence of TB in Scandinavia prior to date of Auldhame

This actually tells us something about the evolution of TB
Leprosy

A bacterial infection

- Evidence in skeletons from 3 continents (Africa, Asia, Europe)
- Particularly common in Europe
- Especially Denmark, Hungary, Sweden, and the UK
- Most date to the late medieval period

- Majority buried in non-leprosy hospital cemeteries; often in “normal” parish cemeteries

Roberts forthcoming *The past and present of leprosy*. University Press of Florida
Evidence in skeletons from 3 continents (Africa, Asia, Europe)

- Particularly common in Europe where most countries had evidence
- Especially Denmark, Hungary, Sweden, and the UK
- Most burials from the late medieval period of Europe
- Majority of the skeletons with leprosy buried in non-leprosy hospital cemeteries; often in “normal” parish cemeteries.
- Some burials were “special” compared to the rest.
270 respondents

**Majority knew:**
- It’s an infection
- Is most frequent in Asia
- Nerves most affected
- Is curable

**Mixed responses about:**
- The pathological organism causing it
- How it is contracted
- Predisposing factors
- Whether fingers and toes ‘fall off’;
- What happened to diagnosed people in the past

**Comparison of knowledge between developed and developing countries:** similar
Syphilis

245 burials
Monks
Lay people

‘Hull Magistrates Court’
Augustinian Friary Church
(1316-1539)
Strontium

Geology, soils, food

87Sr/86Sr biosphere map
(http://www.bgs.ac.uk/nigl/SBA_Methodology.htm)

Oxygen

Drinking water

Mitchell & Millard 2009
Eastern Europe, Scandinavia; east of Baltic Sea; Wales/Scotland

Migration and health in people buried at the Anglo-Saxon cemetery, Bamburgh Castle, Northumberland

91 burials

7th-9th century AD
Expectations

1. There were locally, non-locally, and non-English born and raised people buried here
2. The health of the migrant and the local groups differ
• Over half were non-locally born people
• Scandinavia, southern Mediterranean, North Africa
• There were differences in health between the groups
Were locals more or less healthy than non-locals?
Air quality and health

The quality of air that we breathe can affect our health.
Respiratory disease

Roberts 2007 American J Physical Anthropology 133:792-807

Sites

Rural
Urban
Urban London

URBAN > RURAL FARMERS > HUNTER-GATHERERS
Christchurch, Spitalfields, London – 18th/19th century AD

Walker & Henderson 2010
Post-Medieval Archaeology
Disease of a worker?

Coach Lane, North Shields, Tyne and Wear, NE England (1711-1857 AD)

12-14 year old
Possible diagnoses

“Phossy jaw” – working in the matchmaking industry
TB – population density, exposure to contaminated meat and milk, D deficiency
‘Respiratory disease” – population density, poor air quality
(work/housing/environment)
Smallpox – population density
Actinomycosis - fungal disease
Scurvy (C deficiency) – poor diet
Rickets (D deficiency) – reduced access to UV light (work, housing, clothing)
Infectious joint disease – poor living conditions

Short long bones for age, dental enamel defects: stress during growth

Phossy jaw:
Industrial disease associated with white phosphorus
Side effect of bisphosphonate treatment (cancer/osteoporosis)

Signs and symptoms:
Painful, could lead to blood infection, meningitis & death
Facial swelling, odorous oral discharge

Identity:
Affected the person’s identity
Attracted stigma.

This person likely experienced poor living conditions, crowding, compromised air quality, malnourishment, and working long hours, possibly in the matchmaking industry.
Big questions, big projects, funding
Advanced cutting edge methods (biomolecules)
Multi-method/cross-disciplinary

……is bright for bioarchaeology
Ethics and human remains

We must appreciate:

• Ethical issues to studying human remains
• Differ through time and across the world
• How do we know what the dead think?
• Do the dead have rights?
• Can we disturb them for science?
• Human remains are different to other excavated archaeological evidence
Human remains are curated in museums and universities, and are used for research and teaching.

- Provide a professional dedicated environment
- Be respectful of the remains it curates
- Long term curation benefits science

A privilege and not a right
A non-renewable resource
Palaeopathological research: Impact beyond academia

Research with direct relevance to commerce, industry, the public and voluntary sectors
Summary

**Palaeopathology:**

- Is a multidisciplinary, multi-method questions driven discipline
- Inherently considers the impact of the environment on human health

**Future:**

- More DNA and isotope analyses
- Big picture/datasets
- Ambitious questions
- Contributions to understanding health today/planning for the future health of society
- Ethical issues are important