SPRAWOZDANIA ARCHEOLOGICZNE VOL 75/2 (2023), PP. 187-223

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PL ISSN 0081-3834, e-ISSN: 2719-647X

DOI: https://doi.org/10.23858/SA/75.2023.2.3432

https://rcin.org.pl/dlibra/publication/277427

Jak cytować:

Matczak, M., Kozłowski, T., & Chudziak, W. (2023). A multidisciplinary assessment of disability in early medieval Culmen, Poland. Sprawozdania Archeologiczne, 75(2), 187–223. https://doi.org/10.23858/SA/75.2023.2.3432

SPRAWOZDANIA ARCHEOLOGICZNE 75/2, 2023
PL ISSN 0081-3834
DOI: 10.23858/SA75.2023.2.3432

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A MULTIDISCIPLINARY ASSESSMENT OF DISABILITY IN EARLY MEDIAEVAL CULMEN, POLAND

ABSTRACT

Matczak M. D., Kozłowski T. and Chudziak W. 2023. A multidisciplinary assessment of disability in early mediaeval Culmen, Poland. *Sprawozdania Archeologiczne* 75/2, 187-223.

This study bridges a gap between palaeopathology and the textual analysis, with the aim of investigating which diseases and pathological lesions could have been associated with disability in Early Mediaeval Culmen in Poland. We used palaeopathological methods to examine 661 skeletons, as well as reviewed Early Mediaeval hagiographies and chronicles. The textual analysis revealed three types of disability: mobility difficulties, an abnormal posture, and blindness, which were also identified in the osteological materials from Culmen. Eight skeletons display lesions corresponding to Pott's disease, poliomyelitis, leprosy, osteomyelitis, multiple myeloma, and amputation, which were identified as disabilities. The prevalence of disability depended on the age, with adults affected more frequently. This interdisciplinary study is the first to analyse people with disabilities on a population level, using textual sources and osteological materials from mediaeval Central Europe. The protocol for research on disability in archaeology presented by us may be applied to other archaeological contexts, also from sites outside Poland, from historical periods of time.

Keywords: disability studies, bioarchaeology, biohistory, palaeopathology, Middle Ages
Received: 18.03.2023; Revised: 26.06.2023; Accepted: 21.12.2023

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1. INTRODUCTION

All societies acknowledge the existence of physical and behavioural differences, but their attitude towards them varies across cultures (Hubert 2000a). In Western culture, three main models of disability were developed (Barnes and Mercer 2010; see also Byrnes and Muller 2017a). The first of them, the medical model, focuses on disability as a biological impairment and handicap, limiting the proper (*normal*) functioning of a person, and thus resulting in their inability to work, social exclusion and stigmatisation.

The second one, the social model, was developed in the 1960s, when people with disabilities started highlighting the lack of adjustment of the able-bodied society to the needs of those with different (*dis*-abled) bodies (Cross 1999). In 1976, the Union of the Physically Impaired Against Segregation defined impairment as the lack of 'part or all of a limb, or having a defective limb, organ or mechanism of the body', and disability as 'the disadvantage or restriction of activity caused by a contemporary social organisation which takes no or little account of people who have physical impairments and thus excludes them from participation in the mainstream of social activities' (Barnes and Mercer 2010, 30). This was an important step in changing society's attitudes towards people with disabilities.

The mixed (multifactorial) model is a response to medical and social models of disability (Beaudry 2020). It indicates that disability results from many factors (individual and environmental), and includes different dimensions of disability within one definition. A well-known example of the multifactorial model is the WHO's 'biopsychosocial model' (2002, 10), in which 'disability and functioning are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and contextual factors' (environmental and personal factors). We argue that it is impossible to ignore the biological factor of disability, especially in bioarchaeology, which focuses on the physical dimension of impairment. On the other hand, the archaeological context and the mentality of the epoch must be taken into account in the (re)construction of the disability experience. Therefore, the multifactorial model seems to be the most adequate approach in bioarchaeological studies.

Disability studies emerged as an academic response to the recognition of the rights of people with disabilities, and represent an interdisciplinary field merging sociology, history, and anthropology, including bioarchaeology and palaeopathology (Goffman 1986; Finlay 1999; Kudlick 2003; Barnes and Mercer 2010; Ginsburg and Rapp 2013). Bioarchaeological studies on disability developed with research conducted on Shanidar Neanderthals, a male called Romito 2 from the Italian Late Upper Palaeolithic, and a male from Early Archaic Florida, from the perspective of compassion and care (Solecki 1971; Trinkaus 1983; Frayer *et al.* 1987; Dickel and Doran 1989). Dettwyler (1991) criticised these studies and argued that health-challenged individuals survived not because of compassion and care, but because they could contribute to their societies. Since this seminal paper, the interest in disability has decreased, except for a few studies (*e.g.*, Finlay 1999; Hubert

2000b). The interest in disability rose again with the emergence of bioarchaeology of care (Tilley and Oxenham 2012; Tilley and Cameron 2014; Tilley 2015), which resulted in numerous new studies (*e.g.*, Byrnes and Muller 2017b; Tilley and Schrenk 2017; Micarelli *et al.* 2022; see also Matczak *et al.* 2019; Matczak *et al.* 2020).

Bioarchaeologists (*e.g.*, Cross 1999; Finlay 1999; Roberts 2000; Zakrzewski 2014) agree that the perception of disability depends on the cultural context and is related to social norms observed in a given society. Disability is defined on the basis of physical impairments that limit the daily life and functioning of an individual in a significant way, and as a sociobiological status that results from the society's attitude toward a person with disability (Cross 1999; Knüsel 1999; Roberts 2000; Zakrzewski 2014, 2015; Tilley 2015; Boutin 2016). In other cases, disability is inferred when an individual had a significant physical impairment that limited their ability to meet social requirements, and that made them dependant on the care of other people to survive (Tilley and Oxenham 2012; Tilley and Schrenk 2017). Other researchers identify disability when a person was marked as different in the mortuary context (*e.g.*, by being buried in an atypical grave; Palkovich 2012; Lovell 2016). Other scholars emphasise that it is difficult to conclude whether someone was disabled solely on the basis of pathological lesions and the mortuary context (Cormier and Buikstra 2017).

Thus far, the aforementioned ground-breaking studies presented cases of disabled individuals using methods of palaeopathology and mortuary archaeology. Health and diseases in a population were investigated in the socio-cultural context from the perspective of care (*e.g.*, Tremblay Critcher 2017), and the socioeconomic status (*e.g.*, Powell 1988; Robb *et al.* 2001; Peck 2013). Some attempts were made to quantify a physical impairment and investigate disability on a population level (Byrnes 2017; Stodder 2017; Young and Lemaire 2017), and to combine palaeopathology with archival research (Phillips 2017), as well as a review of textual sources from the mediaeval period (Dittmar *et al.* 2023). Archaeological research on disability is characterised by a broad temporal-geographical range, covering *e.g.*, Neolithic France and Vietnam, Bronze Age Bahrain, ancient Egypt and Italy, medieval Europe, and the Americas (Dettwyler 1991; Buquet-Marcon *et al.* 2007; Tilley 2015; Zakrzewski 2015; Boutin 2016; Lovell 2016; Cormier and Buikstra 2017; Micarelli *et al.* 2022).

Studies on disability in mediaeval Poland were also conducted and they addressed this problem on the individual (Matczak and Kozłowski 2017; Matczak *et al.* 2022), and on the population level (Matczak *et al.* 2021). The analysis of disability in textual sources is crucial for the assessment of disability in the archaeological records from the mediaeval period. To date, only an initial assessment of disability in Polish mediaeval sources had been conducted (Matczak *et al.* 2022).

The present study presents a more extensive review, using textual sources and osteological materials on disability on the population level. Our paper presents a study focused on a group of individuals with potential disabilities in Early Mediaeval Poland. This study

had the following objectives: (i) to investigate which afflictions could have been perceived as disabilities, using textual sources, together with palaeopathological, ethnomedical and modern clinical studies; (ii) to identify various types of disability, and (iii) to verify if there is a relation between sex and age and disabilities in terms of their prevalence. Therefore, this study not only contributes to the bioarchaeology of disability, but also to biohistory, understood as a field of research that focuses on the biological roots of human social behaviour to explain social processes. Biohistory is the study of the interrelationships between social groups, a health status, and a physical condition. Only when we understand all aspects of life, we can assemble the complete picture of the past, because biological aspects influenced social factors and vice versa. Therefore, biohistory combines the methods from various disciplines, especially history, archaeology, anthropology, and medicine, which, together with bioarchaeology, put it in the context of broadly understood biohumanities.

2. DAILY LIFE IN EARLY MEDIAEVAL POLAND

Disability, disease and various health conditions may impact the functioning of an individual, and their ability to perform various tasks and fulfil social obligations. Disability could be related to sex, age, and a social role. To better understand the impact of disability on the human life, a social role of a given individual in the mediaeval society must be considered. Polish mediaeval society was divided into three main parts: the first included craftsmen, peasants and warriors, the second one consisted of clergy, and the third was formed by nobility, with dukes or a king at the top. Men from the upper classes were knights and dukes. Royals handled political affairs and arranged marriages for their sisters and daughters, to maintain or establish good relations between noble families. For people from the upper classes, an alternative to marriage was to become a nun, a monk, or a priest (Miśkiewicz 2010).

People in cities, strongholds, and settlements surrounding them were responsible for ensuring the comfortable living of the upper classes. Some men in cities were merchants (Miśkiewicz 2010), while others were craftsmen, *e.g.*, saddlers, tinsmiths, blacksmiths, and potters. They tanned animal skins and wove cloth. Men felled trees and built houses and other buildings. Peasants constituted a significant part of the mediaeval society, and cultivated cereals (wheat, barley, rye, and oat), vegetables and fruit. They also got food by fishing, hunting, collecting honey, and breeding animals (*e.g.*, cattle, pigs, and sheep). They were obliged to deliver a part of their crops to landowners as the tithe. A special group among the men were warriors responsible for defending settlements and fighting in wars.

Women married early and their lifespan was short due to high mortality rates at childbirth (Kozłowski 2012). They were supposed to take care of the household (*e.g.*, cook

meals) and raise children. Women were responsible for cultivating vegetables, breeding animals, weaving fabrics, and making ceramics (Miśkiewicz 2010).

Children from the upper classes in cities received schooling, while those in villages learned occupational and domestic skills from their parents, and worked and helped them to earn a living from their earliest years (Penny-Mason and Gowland 2014). In their free time, children played games (Miśkiewicz 2010). The hair-cutting ritual at the age of seven was a time of the transition from childhood to youth for boys (Delimata 2004a). For girls, the transition from childhood to youth might have happened at the same age; however, we do not have any evidence for that. The transition to adulthood occurred at the age of 12-15 years (Delimata 2004b).

3. MATERIALS AND METHODS

3.1. Materials

Chronicles and hagiographies are some of the best sources for assessing disabilities and diseases in mediaeval times. Two chronicles were selected for the textual analysis. The first (Anonim tzw. Gall 2008), is from the 12th century and it was written by an anonymous and probably non-Polish author, traditionally referred to as 'Gallus' (a person from Gaul, or France). The second is from the 13th century, and was written by Master Vincentius called Kadłubek from Cracow (Mistrz Wincenty 2008). The hagiography of Saint Hedwig, a Duchess of Silesia, was written shortly after her death before the end of the 13th century. The original source was not preserved; however, its copy was included in *Vita beate Hedwigis* (*Legenda świętej Jadwigi* 1993) from the 14th century. These sources are dated to the same period as the archaeological and osteological materials used in this study.

Archaeological and osteological materials were excavated in 1957 and 1997-2011 in the village of Kałdus, situated on the east bank of the Vistula River, in northern Poland (Fig. 1). The Early Mediaeval (10th-13th century) settlement complex uncovered at the foot of Mount Saint Lawrence was named Culmen (or Chełmno in Polish). Culmen was initially located outside the borders of the Gniezno state (the first Polish state), but later was one of its main centres, to eventually become a castellany in the 12th century. It was strategically located on the border between the Polish state and the Prussian lands, and at the crossroads of two main routes linking Rus' with the Baltic Sea and Scandinavia (Chudziak 2003, 2006, 2010).

The settlement complex consisted of a stronghold with the remains of a stone basilica (Site 3) and a cemetery (Sites 1, 2, and 4) with up to 1,500 graves – one of the largest in Early Mediaeval Central Europe (*e.g.*, Chudziak 2006, 2010; Kozłowski 2012; Bojarski 2020). A significant number of burials contained grave goods, with temple rings, knives and rings being the most common. Other grave goods included beads, coins, chains, pendants,

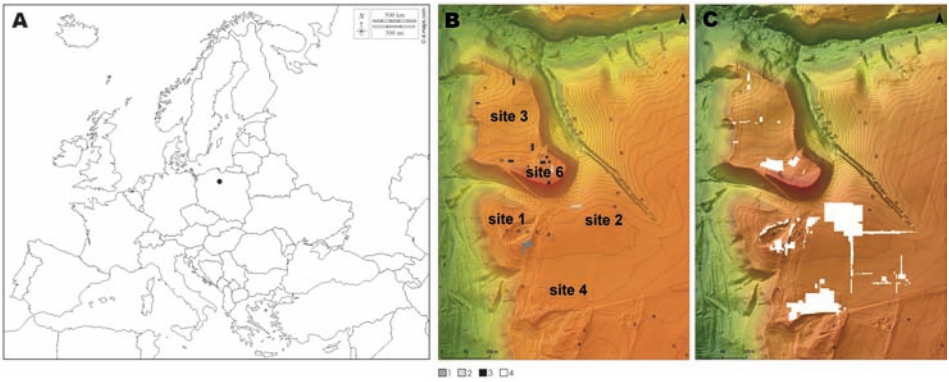

Fig. 1. A: The location of Kałdus in Poland (www.d-maps.com). B: The location of remains of the Early Mediaeval settlement complex of Culmen at archaeological sites in Kałdus, Poland. The site and height guidelines plan of the settlement complex, with trenches explored in 1958-1973. C: The site and height guidelines plan of the settlement complex, with trenches explored in 1996-2015 (by M. Skrzatek, M. Weinkauf, W. Ochotny; Chudziak, Noryśkiewicz 2016).
1 – excavations conducted in 1958 (E. Kaszewska, MAIEŁ); 2 – excavations conducted in 1958 (H. Wiklak, KA UŁ); 3 – excavations conducted in 1967-1973 (A. Kola, KA UMK); 4 – excavations conducted in 1996-2015 (W. Chudziak, IA Nicolaus Copernicus University)

rattles, a sword, whetstones, iron fire strikers and flintstones, ceramic whorls, and bowls (Chudziak 2006, 2010). The majority of individuals were buried in simple earth graves, but some were buried in graves containing structures such as coffins, frames, or chamber graves. Eight chamber graves, dating back to the end of the 10th century or the first half of the 11th century, were linked to the local elite (Chudziak *et al.* 2010a, b; Stawska *et al.* 2010; Bojarski *et al.* 2016). A chamber grave is a burial in an external 'non-portable wooden structure, shaped like a small building/chamber, erected over the deceased's body at a burial site' (Janowski 2011, 257; 2015, 25). The design of the chamber graves from Culmen and the goods found within (a bronze bowl, a plate with gilded fittings, glass beads) indicate that all or at least some of the individuals buried in them were of Scandinavian origin (Chudziak 2001, 2010, 2012; Bojarski 2021). The Scandinavian elite could have significantly influenced the development of the settlement in Culmen, as is evidenced by items with runic inscriptions (a game piece and a lead cross pendant). However, the latest stable isotope analysis of strontium showed that five out of nine individuals buried in the discussed chamber graves probably came from the Polish lands (Błaszczyk 2017), indicating that they could be Slavs.

In total, we selected 661 skeletons from 653 burials (some of them being multiple burials) for the analysis of disability and diseases in Culmen. The palaeopathological analysis indicated a number of pathological lesions, diseases and health conditions that were present in the population in Culmen (Kozłowski 2012). They included degenerative joint disease, injuries, specific infections (tuberculosis, leprosy), periosteal reactions, and

osteomyelitis, as well as metabolic diseases (anaemia, rickets, and scurvy). Furthermore, tumour-like lesions, paralysis, endocrine disorders, developmental defects, dental caries, and stress markers were also observed.

3.2. Methods

3.2.1. Disability and palaeopathology

In our study, we use the above-mentioned multifactorial definition of disability (WHO 2002). In this interdisciplinary analysis, we developed and used the following protocol for studying disability in historical periods of time. First, we reviewed the textual sources, to learn which physical conditions might be perceived as disabilities. Second, we identified pathological conditions that were observed in skeletons of the individuals from Culmen; and, on the basis of ethnomedical, modern clinical, and palaeopathological studies (*e.g.*, Ibingira 2003; Goodwin *et al.* 2013; Baliga *et al.* 2015), we assessed their impact on the daily life. At this stage, disability was perceived as physical conditions associated with diseases that were likely to negatively affect the individual's functioning, and significantly impacted their daily lives for a considerably long period of time (Matczak and Kozłowski 2017). Next, we analysed which pathological lesions found in the skeletons could be linked with disabilities described in the textual sources. This way, we identified those skeletons that belonged to people with disabilities. These analyses resulted in a synthesis of information on how disability was defined and which afflictions present in the textual and osteological materials were regarded as disabilities.

In our work aiming at determining which diseases were considered disabilities, we used historical source criticism (information evaluation) to evaluate the qualities of information (validity, reliability, and relevance) available in historical sources (Topolski 1976). The palaeopathological analysis of the skeletons was performed by Tomasz Kozłowski, mostly as part of the European Module of the Global History of Health Project using the *Data Collection Codebook* (Steckel *et al.* 2006) and associated software. The results of this analysis were also published (Kozłowski 2012).

3.2.2. Age and sex

Sex was determined by interpretation of skull and pelvis morphology (Acsádi and Nemeskéri 1970; White and Folkens 2005), while the age at death in adults was estimated by morphology of pubic symphyseal surfaces (Brooks and Suchey 1990) and pelvic auricular surfaces (Buikstra and Ubelaker 1994), the fusion of cranial sutures (Steckel *et al.* 2006), dental attrition (Lovejoy 1985), and assessment of the sternal rib end (Krogman and Ýţcan 1986; Bass 1987). The age of subadults was additionally estimated on the basis of ossification of long bones, pelvis and vertebrae (Buikstra and Ubelaker 1994). For children, the

age at death was estimated on the basis of the dental development stage of deciduous and permanent teeth and tooth buds (Ubelaker 1989), diaphyseal lengths, and the size of a pelvis and a scapula (Florkowski and Kozłowski 1994). The individuals were assigned to six age categories: young children (0-7), older children (8-15), adolescents (16-18), young adults (19-29), mature adults (30-49), and old adults (50+).

4. RESULTS

4.1. Perception of people with disabilities in mediaeval Poland

The *Vita beatae Hedwigis*, a hagiography of Saint Hedwig, the duchess of Silesia, provides numerous descriptions of people with various ailments. The source mentions 'thirteen particularly handicapped poor men'; however, it does not say which diseases were regarded as 'handicaps' (*Legenda świętej Jadwigi* 1993, 99). A man, 18 years old, with all his limbs stiff, was regarded as a 'cripple'. He could not feed himself unassisted and was completely bedridden. Siostromił, Racław and Więcymił were paralysed, and the last two were called 'cripples' (*Legenda świętej Jadwigi* 1993, 99-101). A woman bent almost in half, whose chest was touching her legs, was called an 'invalid' (*Legenda świętej Jadwigi* 1993, 101). A man called Wawrzyniec had an ulcerated wound in his chest that oozed pus and stank, and a swollen leg, and was unable to walk. His wife was so disgusted with his condition that she abandoned him. Some of the spouses of health-challenged people claimed that they were useless in the household and forced them to beg. For example, Racław, who suffered from cramps, was called 'a cripple' and was a beggar in Wroclaw (*Legenda świętej Jadwigi* 1993, 101). The cataract that caused blindness was perceived as 'an eye impairment' (*Legenda świętej Jadwigi* 1993, 66). Mutilations, such as cut-off body parts (*e.g.*, a hand) or a lost eye, inflicted during battles or resulting from a punishment, like cutting off the tongue or the nose of a slanderer or blinding of a criminal (Anonim tzw. Gall 2008; Mistrz Wincenty 2008), contributed to the number of people with impairments.

People of a high social status, who were mutilated in a battle, were perceived in a positive manner and could maintain their social roles and good living. On the other hand, some people of a lower social status, suffering from health conditions that prevented them from working, received care while others were forced to beg or were abandoned. This indicates that both physical and social factors played a role in perception of disability associated with the listed health conditions (WHO 2002; compared with Barnes and Mercer 2010). These conditions impaired the functioning of an individual and as a result, some people created social barriers for certain individuals with the above-mentioned afflictions. Taking the discussed sources into account, we assumed that disabilities in mediaeval Poland included paralysis and other health conditions causing problems with movement, or inabi-

lity to move, an abnormal posture of the body, and blindness. Disabilities involving a loss of a body part resulted from punishments, battles, and possibly also from accidents, although this third cause is not mentioned in textual sources (*Legenda świętej Jadwigi* 1993; Anonim tzw. Gall 2008; Mistrz Wincenty 2008). We divided disabilities into mobility difficulties (*e.g.*, paralysis, amputation), an abnormal body posture (*e.g.*, postural kyphosis), and blindness. We use them as the basis and as indicators for investigating which pathological lesions might have been perceived as disability in Culmen. On the basis of textual sources, it can be noticed that it was adults, of all age groups, who were perceived as disabled in mediaeval Poland.

4.2. Disability, disease and health conditions found in Culmen

4.2.1. Disability in Culmen

As mentioned above, the analysis determined numerous diseases and health conditions present in the population in Culmen. On the basis of medical, palaeopathological and ethnomedical studies, we assessed the impact of diseases and health conditions on the daily life of relevant individuals, to see if they were disabled. Our research shows that out of 661 skeletons from Culmen, eight skeletons display pathological lesions indicating disability, 313 skeletons have lesions indicating diseases and other health conditions that had an impact on the functioning of individuals, and 340 skeletons do not have such lesions (Fig. 2). Table 1 presents diseases and health conditions classified as disabilities. Osteomyelitis (N=3) was the most prevalent disability (Fig. 3). The remaining disabilities, associated

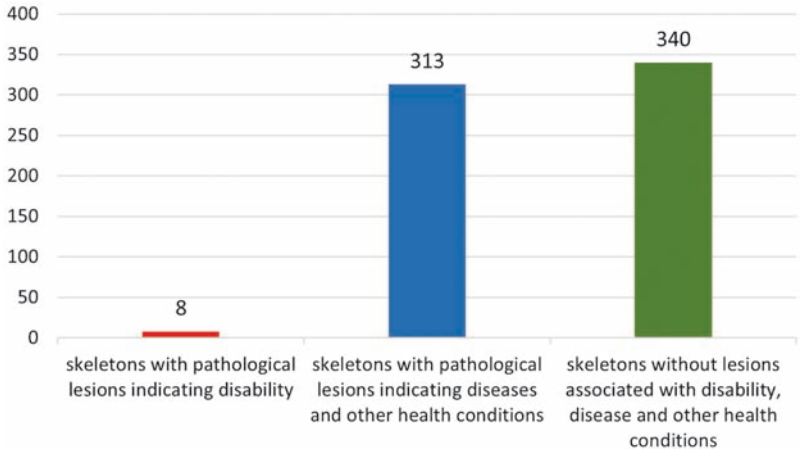

Fig. 2. The number of skeletons with pathological lesions indicating disability, pathological lesions associated with disease and other health conditions, and without lesions associated with disease, health conditions or disability, found in Culmen (by M. D. Matczak)

Table 1. Diseases and health conditions identified as disability and grave numbers in Culmen

Diseases and health conditions identified as disability	Grave numbers		
	Site 1	Site 2	Site 4
Spinal tuberculosis (Pott's disease)			42/00
Leprosy	101/98		
Lower limb paralysis (post poliomyelitis)		5/03	
Osteomyelitis	56/98	31/04	52/00
Neoplasm (multiple myeloma)	122/99		
Amputation			41/00

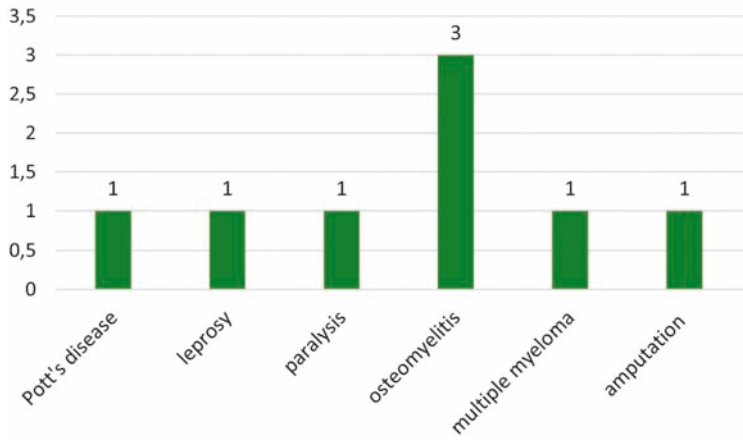

Fig. 3. The prevalence of afflictions associated with disability in Culmen (by M. D. Matczak)

with Pott's disease, leprosy, paralysis, multiple myeloma, and amputation, were identified only once. Below we present the description of those diseases and health conditions that had the greatest impact on the functioning of individuals, leading to their disability. Table 2 contains a detailed palaeopathological description of each individual with identified disability.

An individual from Grave 42/00, who was seven years old at the time of his/her death, displays signs of spinal tuberculosis known as Pott's disease (Fig. 4). Tuberculosis was confirmed by molecular analysis (Kozłowski 2012). The most common symptoms of Pott's disease include back pain (84%), followed by fever (40%) and pain elsewhere (28%), local tenderness, stiffness, and muscle spasms. Neurological complications, if untreated, may lead to paraplegia (Garg and Somvanshi 2011; Kamara *et al.* 2012; Rasouli *et al.* 2012). At the onset of Pott's disease, the child could experience weakness, fever, and coughing. Active disease in a child could cause malaise, loss of weight and appetite, night sweats, an

Fig. 4. A: Location of the lesions in the skeleton diagram of an individual with Pott's disease from Grave 42/00. B: Anterior view of the spine fragment. C: Right lateral view of the spine fragment. Note a block of four, probably lower mid and/or lower thoracic vertebrae (only arches preserved), suggesting formation of a hump. D: An X-ray image of thoracic vertebrae, the lateral projection: a significant arching of the block and the irregular arrangement of osseous tissue with destruction centres (round, small bone defects) and minor sclerotic changes visible (photos by T. Kozłowski; Kozłowski 2012)

evening rise in the temperature, generalised body aches, and fatigue (Garg and Somvanshi 2011). The intensity of pain in Pott's disease varies from a chronic mild and dull ache to severely disabling pain, and it is localised to the site of involvement and most common in the thoracic region. The thoracic region was involved in the case of the child from Culmen, so it is probable that she/he experienced pain in that area (Fig. 4). Spinal motions, coughing and weight-bearing could aggravate the pain. The incidence of neurological complications varies from 10% to 43% of the cases, and they are common in the thoracic and cervical regions. If the thoracic or lumbar spine is involved, the function of upper extremities is maintained, while the symptoms in the lower extremities progress, leading to paraplegia (Garg and Somvanshi 2011; Kamara *et al.* 2012; Rasouli *et al.* 2012), which has a devastating effect and the incidence rate ranging from 23% to 76% of the cases. In the past, when multi-drug therapy and surgical treatments were unavailable, severe cases could lead to permanent neurological disability (*e.g.*, paraplegia) and spinal deformity such as severe kyphosis, which affects the biomechanics of the spine and body and contributes to motor deficits, respiratory deficiencies, and degenerative spinal stenosis (Kamara *et al.* 2012; Rasouli *et al.* 2012). As the disease progressed in the thoracic part of the spine of the child from Culmen, it would have led to paraplegia of the lower limbs. The child would not have been able to fully help her/his parents in the household and/or play with other children. When the child was free of fever, she/he could perform easy daily tasks with the hands that required sitting, but she/he could not move unassisted. It is possible that the child did not work at all, and was just lying in bed at the advanced stage of the disease, when back pain, fatigue, weakness, paraplegia, and the respiratory deficiency (caused by the gibbous spine)

could be severe. The child's contribution to the household was minimal and she/he mostly required a lot of care. The child was probably provided with food, fed and his/her hygiene was maintained. Somebody had to carry the child during her/his paraplegia episodes. The child could probably not play and interact with other children unless she/he had siblings and could interact with them in a household.

An adult female from Grave 101/98 was infected with leprosy (Fig. 5a, b, c), which was identified using the macroscopic analysis of skeleton morphology (mostly the facial skull), and the molecular analysis at the Department of Molecular Biology, the Medical University of Łódź (Kozłowski 2012; Matczak and Kozłowski 2017). At the advanced stage, leprosy causes loss of sensation in hands, feet and other areas, and causes various eye problems, including blindness. This leads to a limited ability to work, as well as to social and psychological problems (Matczak and Kozłowski 2017). Nowadays, this condition is perceived as disability, and multi-drug therapy helps people to recover from it. In the past, when such therapy was not available, leprosy caused significant impairment. It is possible that the female from Culmen experienced such problems. As a result, she was probably unable to perform many or all of her daily tasks: cultivating vegetables, breeding animals, weaving fabrics, and producing ceramics. She could have had a problem with finding a husband and, if unmarried, would depend on her relatives for housing and support. Her need for assistance would increase as her condition worsened. She would require help in acquiring and preparing food and feeding herself, and would need a guide outside the known territory.

Atrophy of bones in lower limbs, associated with paralysis-induced changes (probably poliomyelitis), was identified in the skeleton of a female, 30-40 years old at death, from Grave 5/03 (Fig. 5d, e, f; Kozłowski 2012). Her shorter and more fragile left lower limb indicates that poliomyelitis was contracted in childhood (Waldron 2009). This acute viral infection is characterised by fever, hypersensitivity, irritation of the gastrointestinal tract, headaches and muscle aches, paralysis of single muscles or muscle groups, muscle weakness, or permanent paralysis (Aufderheide and Rodríguez-Martín 2006; Roberts and Manchester 2010; Baliga *et al.* 2015). This condition leads to complications such as instability and contracture of the joints, limb growth disorders, muscle balance disorders, and muscle cramps and distortions (Gaździk 2008). Poliomyelitis also causes a decrease in muscle tone, abolition of reflexes in the affected limb, muscle fasciculations, or atrophy of denervated muscles (Spodaryk 2002). Therefore, the person is unable to move without support and assistance, or without special equipment (*e.g.*, crutches). Nowadays, it leads to disability (Baliga *et al.* 2015) and in the past, it could also have a significant impact on someone's life. The female from Culmen probably experienced the above-mentioned symptoms of poliomyelitis. Her shorter limb prevented her from walking and restricted her mobility. If she contracted poliomyelitis in childhood (which is probable), she would have experienced difficulties in performing various tasks from an early age. She needed assistance of others to move due to possible paralysis. It could be difficult or even impos-

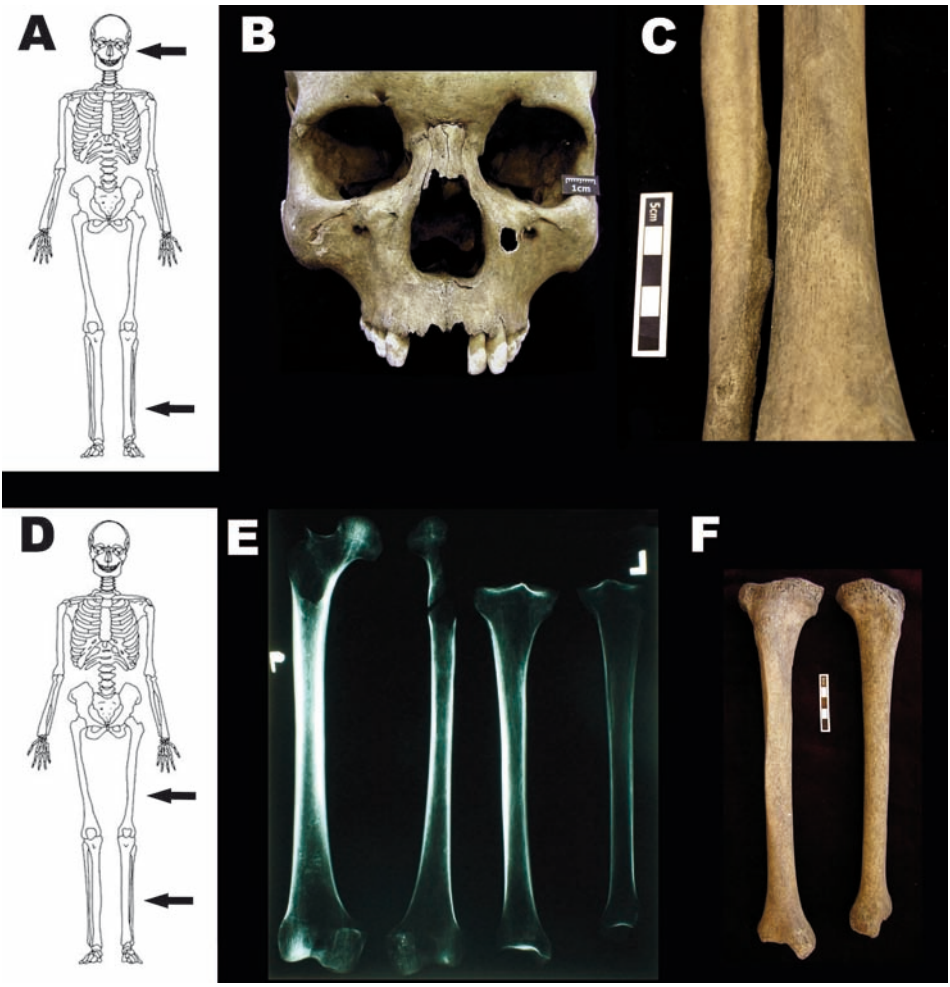

Fig. 5. A: Location of the lesions in the skeleton diagram of the individual with leprosy from Grave 101/98. B: Anterior view of the skull. Note clear cylindrical edges of the anterior nasal aperture, atrophy/destruction of the nasal spine, and atrophy of the frontal surface at the base of the nasal cavity, with the receding edge of the anterior nasal aperture, where all these characteristics are specific for *facies leprosa*. C: Signs of periostitis on the surface of right tibial and fibular shafts. D: Location of the lesions in the skeleton diagram of the individual with poliomyelitis (Heine-Medin disease) from Grave 5/03. E: An X-ray image of the right and left femora and tibiae, the anterior projection. The left femur and tibia display atrophic features: general osteoporosis of epiphyses and significant thinning of shaft walls, when compared to the right femur and tibia. Epiphyses of atrophic bones, of a reduced size, are covered with a very thin layer of the compact substance (almost invisible). Cross sections of the shafts are reduced. F: Anterior view of the right tibia and the left tibia with symptoms of atrophy. The left tibia is shorter, with barely developed shaft edges and surfaces, as well as attachments of muscles and ligaments. A pronounced lateral twist of the distal epiphysis suggests an external (lateral) foot position (photos by T. Kozłowski; Kozłowski 2012)

sible for her to perform duties such as collecting honey, plants, and fungi, or ploughing and working in the fields. She could sit and help with cooking, craftwork, and looking after small children. She lived until she was in her 30s-40s, so she required help and care for a considerably long time.

Three individuals present pathological lesions associated with osteomyelitis (Kozłowski 2012). Osteomyelitis is a nonspecific infectious disease of the bone and bone marrow caused by bacteria, viruses, fungi, and multicellular parasites (Roberts 2019). It is a debilitating condition that has three forms: acute, subacute, and chronic. It starts with an acute or subacute form that lasts for a couple of weeks, and when left untreated, develops into a chronic bone infection. Chronic osteomyelitis is associated with a vascular necrosis of the bone and the formation of sequestra (fragments of dead bone) (Lew and Waldvogel 2004). Symptoms of acute osteomyelitis include fever, chills, and swelling (Lazzarini *et al.* 2004). Subacute osteomyelitis is manifested as mild pain and slight functional impairment (Ibingira 2003). Symptoms of chronic osteomyelitis include pus discharge, swelling, deformity, chronic pain, muscle spasm, fever, limping when lower limbs are affected, restricted mobility, the inability to use the infected body part, and functional impairment (Lazzarini *et al.* 2004; Biruk and Wubshet 2007; Roberts and Manchester 2010; Mundada and Patil 2022). Osteomyelitis is also considered a disability. In the past, when no antibiotics, surgical treatment (*e.g.*, debridement, or amputation) and physiotherapy were available, it could easily develop into a chronic form that significantly impacted the life of an individual. If the infection spreads through the body, it can be fatal (Lew and Waldvogel 2004). In an adult female from Grave 56/98 on Site 1 (Fig. 6a, b, c), chronic osteomyelitis is manifested as shaft deformation and broadening, and a sequestrum with cloacae in the left femur (Kozłowski 2012). This could have caused severe pain in the left femur, and difficulty with using the left lower limb and walking. She could have done light daily peasant and craftwork tasks, *e.g.*, make pots, so she would still contribute to earning income and looking after the household. This person could cook, as well as take care of small children. However, her abilities in those areas were limited, and she needed assistance, *e.g.*, she had to be provided with food ingredients, etc. In the case of an adult male from Grave 52/00 at Site 4, osteomyelitis was chronic as indicated by a broad cloaca, and significant thickening and deformation of the tibial shaft (Fig. 6d, e, f, g; Table 2). It caused severe pain in the tibia and difficulty with using the affected lower limb and walking. Thus, it was impossible for him to perform certain tasks such as tree felling, building huts, or ploughing. Somebody had to help him to walk to places where he could work as a peasant or craftsman, and provide him with the necessary materials to perform his work. He could contribute to sustaining the family and household, although to a limited extent, due to his sickness and the care that he needed. Osteomyelitis was also identified in the form of osseous tissue layers on the tibia of a male, 50-60 years old at death, from Grave 31/04 on Site 2 in Culmen (Fig. 6h, i, j; Table 2; Kozłowski 2012). Osteomyelitis could have had a significant impact on the life of that male because it could have caused pain, deformity, and functional limitation of

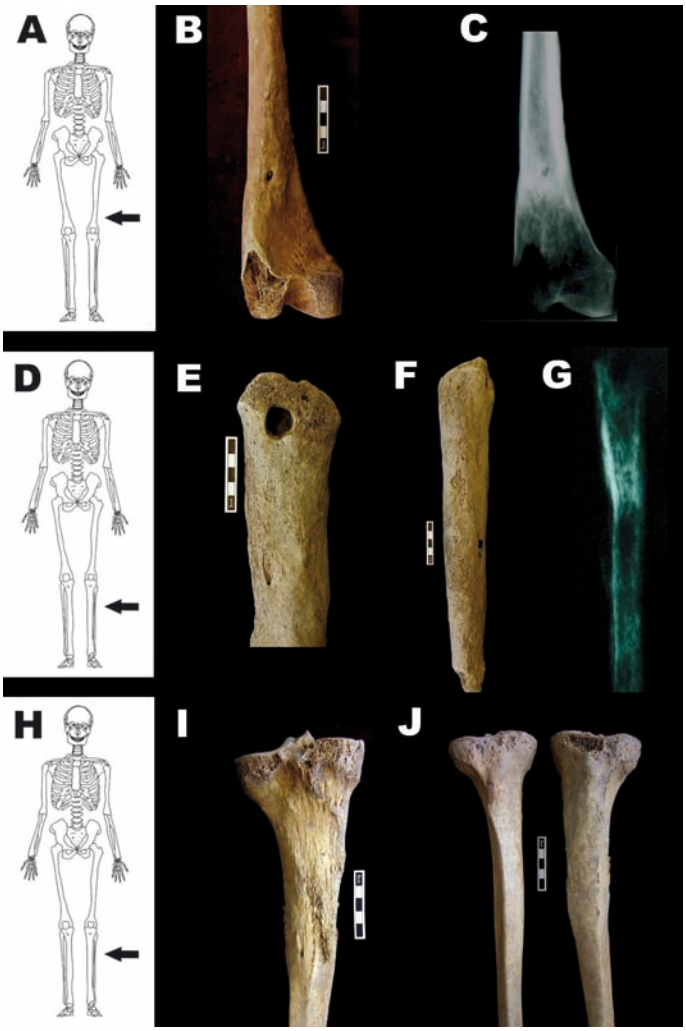

Fig. 6. A: Location of the lesions in the skeleton diagram of the individual with osteomyelitis from Grave 56/98. B: The left femoral shaft near the distal metaphysis is deformed and broadened. Note the cloaca with bone fragments (so-called sequestra) adhering. C: An X-ray image of the part of the left femur showing deformation of the bone contour, irregular sclerotization of internal structures, and a sequestrum. D: Location of the lesions in the skeleton diagram of the individual with osteomyelitis from Grave 52/00. E: The left tibia with a round, broad cloaca penetrating into the bone near the proximal epiphysis, and a significant widening of the nutrient foramen. F: A significant thickening and deformation of the left tibial shaft and epiphysis, as a result of the inflammation process. G: An anterior-posterior X-ray image of the tibia shows substantial bone damage caused by the disease process involving all its segments, together with irregular sclerotic areas and cavernous defects in the internal structure and the original cortical bone. H: Location of the lesions in the skeleton diagram of the individual with osteomyelitis from Grave 31/04. I: Posterior view of the left tibia. Note obliterated signs of massive *periostitis* and widening of the nutrient foramen. J: Anterior view of the tibiae. The left tibia displays deformation of the proximal part (widening) and signs of *osteitis*. The right tibia is free of pathological lesions (photos by T. Kozłowski; Kozłowski 2012)

Table 2. A catalogue of skeletons with pathological lesions associated with disability in Culmen (Chudziak *et al.* 2006, Kozłowski 2012, this study). DJD – degenerative joint disease

Item	Grave no.	Date	Sex and age	Pathology	Figures
1	56/98	the 12th c. – 1st half of the 13th c.	Female 35-45	In the left femur, osteomyelitis involved most of the diaphysis with cloacae. The shaft near the distal metaphysis is deformed and broadened. Small bone fragments (so-called sequestra) are well visible in the cloaca. Periosteal reactions are visible as markedly accentuated longitudinal striations. Other identified pathological lesions included: DJD manifested as slight marginal lipping observed in both shoulder joints, dental caries in eight teeth, an antemortem loss of five teeth, and two hypoplastic lines on a mandibular canine, an incisor, and a maxillary canine.	6 a-c
2	101/98	the 12th c. – 1st half of the 13th c.	Female 25-30	Leprosy manifests as a rounded and receding edge characterising the anterior nasal aperture, with the atrophy of the anterior nasal spine. A porous palate and chronic inflammation in the nasal cavity were also identified. Markedly accentuated longitudinal striations are visible in the shaft of the humerus and the metatarsal bones. Periosteal inflammation, manifested as slight, discrete patches of reactive bone, involves less than one quarter of the surface of the long bones in the lower limbs. The morphological deformation of the left tibia shaft is probably caused by a healed fracture. Signs of a massive periosteal reaction and remodelling are present. A massive deposit of osseous tissue is visible on the left tibia and fibula, leading to deformation of the shaft shape. Systemic osteoperiostitis is present in both tibias and fibulas. Schmorl's nodes on thoracic vertebrae and a congenital fusion of the C2 and C3 vertebrae were identified. *Cribra orbitalia* as a cluster of mostly fine foramina covering a small area (≤1 cm^2), and porotic hyperostosis visible as slight pitting or severe parietal porosity may suggest anaemia.	5 a-c
3	122/99	the 12th c. – 1st half of the 13th c.	Female 25-30	A neoplasm, probably multiple myeloma, was identified on the basis of circular lytic defects on the vertebrae, the pelvis and the long bones. Circular osteolytic lesions with irregular edges spread on the external (*clunis*) surface of the ala of ilium, and in the posterior part and on the epiphysis and proximal metaphysis of the humerus. Signs of periostitis were present, manifesting as numerous holes for tiny blood vessels, typically located on the shaft of the humerus. Osteolytic lesions can be found on the epiphysis and proximal metaphysis of the right humerus in the form of numerous, round defects in the external compact bone layer. Periostitis, active at the moment of death, involved the shaft in the area of the nutrient foramen of the right ulna. Vessel holes are broadened on the posterior surface of the vertebral bodies of the lumbar spine (from the side of the vertebral canal), and there are signs of osteolysis on the external plate of the bone. Osteolytic lesions are visible within the epiphysis and the area of the proximal metaphysis of the right femur, manifesting as numerous round defects in the plate layer, holes made by tiny blood vessels and periostitis. Other identified pathological lesions included: a healed fracture of the distal part of the right ulna, DJD – slight marginal lipping in the right elbow, an antemortem loss of six teeth, and one root abscess.	7 a-f

Item	Grave no.	Date	Sex and age	Pathology	Figures
4	5/03	2nd half of the 11th c. – 2nd half of the 12th c.	Female 30-40	The left lower limb is shorter and more fragile than the right one. The left tibia is shorter than the right one, with barely developed shaft edges and surfaces, as well as muscle and ligament attachments. A pronounced lateral twist of the right distal epiphysis suggests external (lateral) foot position – post-paralytic lesions that could be connected with poliomyelitis (Heine-Medin disease). In comparison to the right femur and tibia, a radiograph showed general osteoporosis in the epiphysis and significant thinning of the shaft walls in the left femur and tibia. A very thin layer of the compact substance (almost invisible) covers the epiphysis of the bones, which are reduced in size (atrophied). Cross-sections of the shafts are reduced. A radiograph showed atrophy of the left patella and talus, which were reduced in size and displayed signs of reduced bone density (osteoporosis). The left first proximal phalanx is reduced in size when compared to the right one. DJD, manifesting as slight marginal osteophytic lipping, is visible in both temporo-mandibular joints, the left shoulder, and the right wrist and hand. Osteophytic formations are present in the thoracic and lumbar vertebral bodies. The lateral surface of the proximal end and the shaft of the atrophic side of the tibia displays signs of periosteal reactions, which are partially healed and probably not directly associated with the atrophy. Periosteal reactions manifest as markedly accentuated longitudinal striations, with moderate involvement of the periosteum, but affecting less than one-half of the long bone surface, and as slight, discrete patches of reactive bone affecting less than one quarter of the long bone surface. Mandibular and maxillary canines and a mandibular incisor have one hypoplastic line, while a maxillary incisor has two hypoplastic lines. An antemortem loss of six teeth was also observed.	5 d-f
5	31/04	2nd half of the 11th c. – 2nd half of the 12th c.	Male 50-60	DJD manifests as slight marginal lipping in the temporo-mandibular joints, shoulders, elbows, hips, left knee, wrists and hands, and the left ankle and foot. Cervical and lumbar vertebrae are characterised by osteophytic formations. The thoracic vertebrae display extensive osteophytic formations. Signs of a massive lesion caused by healed *periostitis* on the posterior aspect, widening of the nutrient foramen, and deformation of the proximal part of the bone are visible in the left tibia, indicating osteomyelitis. Periosteal reactions are present in the form of markedly accentuated longitudinal striations, and slight, discrete patches of reactive bone affecting less than one quarter of the long bone surface. Layers of osseous tissue are visible on the pleural surface of the rib. A radiograph of the rib, at the vertical projection angle, towards the shaft surface, showed limited irregular areas of sclerotic lesions in the shaft. The identified pathological changes included: osteoma on the right parietal bone (8 mm), complete sacralization of L5, dental caries in seven teeth, and an antemortem loss of 10 teeth.	6 h-j

Item	Grave no.	Date	Sex and age	Pathology	Figures
6	41/00	40s of the 11th c. – 11th/12th c.	Male 40-50	DJD in the form of slight marginal lipping was identified in shoulders, elbows, the right knee, wrists and hands. Osteophytic formations are visible in the cervical vertebrae. An extensive osteophytic formation is visible in the thoracic and lumbar vertebrae. Distal parts of the left tibia and fibula were amputated, which resulted in their shortening by about 7 cm, when compared to the right tibia and fibula. Observed periosteal reactions are probably associated with amputation. Proliferation and remodelling (healing) processes in the tibia and fibula suggest that the male survived amputation and lived with this condition. Porotic hyperostosis, indicated by the presence of slight pitting or severe parietal porosity, possibly indicating anaemia, was identified. Furthermore, an antemortem fracture of the crown was observed in the upper right medial incisor.	8 a-d
7	42/00	2nd half of the 12th c. – 12th/13th c.	Unknown 7	Thoracic vertebrae form an arch, resembling a gibbus deformity. A radiograph shows a significant arching of the block and an irregular arrangement of osseous tissue with destruction centres (round, small defects). The thoracic vertebrae display lytic lesions, and are obliterated and fused. These pathological lesions correspond to Pott's disease (spinal tuberculosis). *Cribra orbitalia* are present as a cluster of mostly fine openings covering a small area, indicating possible anaemia.	4 a-c
8	52/00	10th/11th – 1st half of the 11th c.	Male 30-40	Osteomyelitis was identified on the basis of a round, broad cloaca penetrating into the bone near the proximal epiphysis and a significant widening of the nutrient foramen of the tibia. The shaft and the epiphysis are significantly thickened and deformed as a result of the inflammation process. An anterior-posterior radiograph of the tibia showed substantial bone damage caused by the disease process affecting all its segments. Furthermore, irregular sclerotic areas and cavernous defects in the internal structure and original cortical bone are also visible. One hypoplastic line on a mandibular canine and two or more hypoplastic lines on a maxillary canine were identified.	6 d-g

the infected limb. The assessment of disability in that male is difficult; however, it cannot be excluded that he had functional impairment in his advanced age.

A neoplasm, probably multiple myeloma, was identified in the skeleton of a female, 30-40 years old at death, from Grave 122/99 (Fig. 7, Table 2; Kozłowski 2012). Multiple myeloma causes bone pain, anaemia, kidney failure, infections and neurological problems, and in its advanced stages, results in severe pain and an inability to move, which nowadays leads to disability (Goodwin *et al.* 2013). The female from Culmen probably experienced pain, anaemia, kidney failure, infections and neurological problems. At the advanced stage, multiple myeloma causes weakness and severe pain (Goodwin *et al.* 2013). The female could not work and was lying down all the time. The family had to provide assistance to ensure that her domestic, basic, and economic needs were satisfied. For some months or years before her death, while multiple myeloma was progressing, she was probably fully

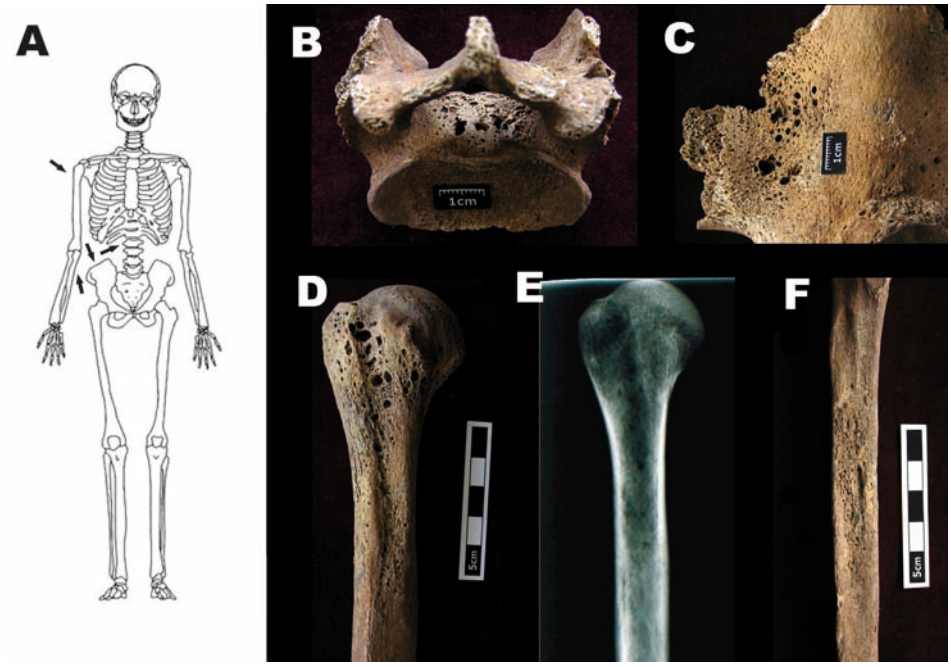

Fig. 7. A: Location of the lesions in the skeleton diagram of the individual with suspected multiple myeloma from Grave 122/99. B: Broadened vessel holes on the posterior surface of the second lumbar vertebral body (from the vertebral canal side) and osteolysis affecting its external surface. C: Circular osteolytic lesions with irregular edges spread to the external (*clunis*) surface of the posterior aspect of the right ala of the ilium. D: Osteolytic lesions are visible on the epiphysis and the proximal metaphysis of the right humerus as numerous round defects in the external compact bone layer. E: An X-ray image of the right humerus, the anterior projection. Note areas of significantly reduced density (osteoporosis) and numerous round cavities. The greater tubercle does not have a normal internal spongy structure and the contour of its shaft surface is blurred. F: Signs of active periostitis near the nutrient foramen of the right ulna (photos by T. Kozłowski; Kozłowski 2012)

Fig 8. A: Location of the lesions in the skeleton diagram of the individual with amputation of the left tibia and fibula from Grave 41/00. B: Anterior view of the right tibia and fibula and amputated distal parts of the left tibia and fibula. C: An X-ray image of the tibia and fibula, the anterior projection, showing signs of proliferation and remodelling processes. D: Anterior view of significant rebuilding and consolidation/fusion (bridging bone fusion) between tibial and fibular shafts (post-mortem damage to the bridging bone) (photos by T. Kozłowski; Kozłowski 2012)

disabled. Nowadays, multiple myeloma leads to death within 7-60 months of the diagnosis (Piotrowski 2003). It could probably be the reason of the death of the female from Culmen.

An amputation, which was identified in the skeleton of a male, 40-50 years old at death, from Grave 41/00, could have a long-term impact on that individual's life (Kozłowski 2012). As a result of amputation, the distal parts of the left tibia and fibula were shorter by about 7 cm than the corresponding bones in the right lower limb (Fig. 8). Proliferation and remodelling (healing) processes in the tibia and fibula (Fig. 8d) suggest that the male survived amputation and lived with this condition. In his advanced age, he could have had considerable problems with obtaining food and earning an income as a consequence of amputation and walking difficulties. He might have been unable to actively perform all his duties at work and in the household. It is possible that someone had to support him to satisfy his economic needs. Amputation of one lower extremity at or above the ankle is nowadays considered a disability in Poland and elsewhere, *e.g.*, in the USA (*Disability Evaluation Under Social Security*). Being a condition that restricts mobility, it could have also been perceived as such in the past. Therefore, the individual from Grave 41/00 might have been considered as a disabled member of the community.

4.2.2. Types of disability

On the basis of mediaeval texts, we have distinguished disability due to mobility difficulties, an abnormal posture, and blindness, and linked those types with the specific diseases and health conditions identified in osteological materials from Culmen. A bone neo-

plasm (probably multiple myeloma), osteomyelitis and Pott's disease could have caused severe pain, which could have affected the individual's ability to move. Additionally, paralysis (caused by poliomyelitis), amputation, and leprosy could also be associated with disability due to mobility difficulties. For this reason, those afflictions can be considered as a disability due to mobility difficulties (Table 3). Disability due to an abnormal posture could result from Pott's disease (spinal tuberculosis), limb paralysis (due to poliomyelitis), and amputation. Disability due to blindness could be associated with leprosy. In some cases, one affliction can be assigned to two categories of disability, *e.g.*, paralysis and amputation can be considered as a disability due to mobility difficulties, as well as due to an abnormal posture.

Of the discussed types of disability, disability due to mobility difficulties was the most frequent (N=8; Table 3). Only one individual with amputation (Grave 41/00) was disabled as a consequence of a specific human activity such as surgery, punishment or fighting, and the remaining ones (N=7) were disabled due to development of disease. Some individuals could be fully or partially disabled, depending on the severity and the number of afflictions a particular person suffered from. However, the qualitative analysis of disability is out of the scope of this article.

Table 3. The prevalence of disability types in Culmen

Diseases and health conditions identified as disability	Disability due to mobility difficulties		Disability due to an abnormal posture		Disability due to blindness	
	N	%	N	%	N	%
Spinal tuberculosis (Pott's disease)	1	12.5%	1	33.3%	0	–
Leprosy	1	12.5%	0	–	1	100%
Lower limb paralysis (post poliomyelitis)	1	12.5%	1	33.3%	0	–
Osteomyelitis	3	37.5%	0	–	0	–
Neoplasm (multiple myeloma)	1	12.5%	0	–	0	–
Amputation	1	12.5%	1	33.3%	0	–
Total	8	100%	3	100%	1	100%

4.2.3. Age and sex of people with disabilities

Table 4 presents the age and sex of the people with disabilities from Culmen. The values are too low to perform a statistical analysis; however, it is visible that the majority of people with disabilities were adults (N=7), with only one child found. The prevalence of disability is almost equal in males (N=3) and females (N=4).

Table 4. Distribution of age and sex per group of skeletons of individuals with disabilities in Culmen

Age	Sex						Total	
	Female		Male		Unknown			
	N	%	N	%	N	%	N	%
Young child (0-7)	0	–	0	–	1	100.0%	1	12.5%
Older child (8-15)	0	–	0	–	0	–	0	–
Adolescent (16-18)	0	–	0	–	0	–	0	–
Young adult (19-29)	2	50%	0	–	0	–	2	25%
Mature adult (30-49)	2	50%	2	66.7%	0	–	4	50%
Old adult (50+)	0	–	1	33.3%	0	–	1	12.5%
Total	4	100.0%	3	100.0%	1	100.0%	8	100.0%

4.2.4. Diseases and health conditions in Culmen

We treated the remaining afflictions from Culmen as diseases and health conditions that impacted the functioning of individuals. They included anaemia, scurvy, rickets, degenerative joint disease, thoracic disc herniation, periosteal reactions, tuberculosis (excluding Pott's disease), meningitis, hyperostosis frontalis interna (HFI), trauma (excluding amputation), osteochondritis dissecans, osteochondrosis, spondylolysis, spondylolisthesis, enthesopathy, hip dysplasia, developmental foot defect, deep dental caries, dental abscesses and tooth fracture.

139 individuals were identified as having anaemia, manifesting as *cribra orbitalia*, porotic hyperostosis, and other lesions (Kozłowski 2012) (Fig. 9). The most common symptoms of anaemia include pale skin, mucous membranes and conjunctiva, weakness, fatigue, tenderness, reduced exercise tolerance, headaches, sleep disorders, worsening of memory, apathy, depression, feeling cold, and constipation (Aufderheide and Rodríguez-Martín 2006; Kotschy 2009; Zahorska-Markiewicz and Małecka-Tendera 2009; Roberts and Machester 2010). Other symptoms involve arrhythmias, functional systolic murmur, cardiac hypertrophy, and congestive heart failure, which can be fatal if left untreated (Pegelow *et al.* 1977). Advanced forms of anaemia lead to the inability to work (Brittemham 2000). In the present and in the past, anaemia could cause fatigue and weakness when performing various duties. Headaches and sleeping disorders associated with anaemia could affect the individual's ability to rest sufficiently during the day or at night.

Skeletal signs of scurvy were identified in 24 individuals (Fig. 9). This condition is characterised by swelling of the gums, bleeding, blood spots on the skin, epidermal keratosis, impaired wound healing, periodontal diseases, weakness, pain in muscles and joints of the lower limbs, and irritability (Wojtecka-Łukasik 2009; Roberts and Manchester 2010). It is probable that 24 individuals from Culmen experienced such symptoms; however, it is hard to estimate how they affected their performance of daily tasks.

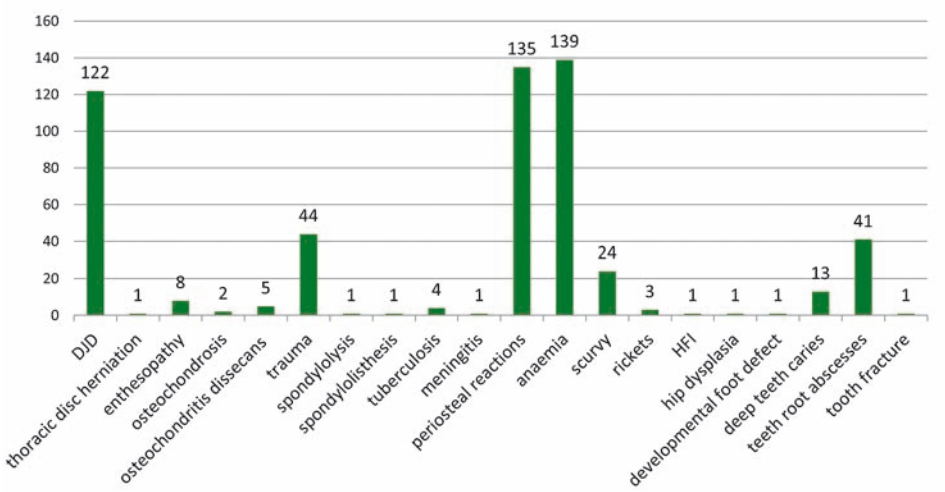

Fig. 9. Numbers of cases of diseases and health conditions identified in the skeletons in Early Mediaeval Culmen. DJD – degenerative joint disease, HFI – hyperostosis frontalis interna (by M. D. Matczak)

Rickets was identified in three skeletons (Fig. 9). It causes bone deformation, a delay in serration, thickening of the bones of the forearm and lower leg, malocclusion, tendency to develop caries, a high palate, scoliosis, bone pain in the limbs, pelvis and spine, and muscle weakness (Henning and Schmidt 1973; Sahay and Sahay 2012). It also leads to malaise, bone pain, and rapid fatigue with muscular weakness, which may manifest as a waddling gait (Spodaryk 2002; Kozłowski and Witas 2012). Bone deformities (mostly on the *femora*) caused by rickets in early life were identified in one adult individual. Rickets also affected two children in Culmen.

Periosteal reactions at different stages of development could cause pain, and are one of the components of the human body's reaction to pathogens (of septic origin), non-infectious diseases (of non-septic origin), and injuries (Brothwell and Sandison 1967; Steckel *et al.* 2006; Roberts and Manchester 2010; Weston 2012). In Culmen, 135 skeletons display signs of periosteal reactions (Fig. 9), which could be connected with scurvy, leprosy, tuberculosis, and tumours or traumas to the skull, ribs, vertebrae, long bones, and the 3rd metatarsal.

Four individuals from Culmen show pathological lesions that could be associated with tuberculosis (Fig. 9). Symptoms of tuberculosis could include chest pain, a draining sinus in the chest wall, and abscesses (Chang *et al.* 1999). The skeleton from Grave 347/02 (male, adult) has signs of possible active tuberculosis of the ankle, and in the skeleton from Grave 82/01 (female, older adult), the talocrural joint is destroyed by tuberculosis to a great extent. In an individual from Grave 82/01, tuberculosis was confirmed by a molecular analysis (Kozłowski 2012).

Signs of nonactive endocranial meningeal reactions (probably post meningitis) were observed in the skeleton of a female, 45 years old at death, from Grave 455/04, and on the inner surface of several infant calvarial bones. In the latter case, aetiology of lesions is not clear, and they could also indicate metabolic disorders, for example, scurvy or infection. Meningitis causes headache, photophobia, nausea, drowsiness, unconsciousness, coma, epilepsy, nuchal rigidity, irritability, an increase in the body temperature, and arthritis. Today, if left untreated, meningitis can be fatal, with a mortality rate of 70-100% (Longmore *et al.* 2004).

Hyperostosis frontalis interna (HFI; continuous overgrowth of the frontal bone) manifests as chronic headaches (Torrealba-Acosta and Mandel 2020). Therefore, HFI found in a female from Culmen, 45-55 years old at death, should be considered a disease in terms of human life and functioning.

Degenerative joint disease (DJD) was identified in 122 individuals in total (Fig. 9). In the joints of the limbs, slight marginal lipping (osteophytes <3 mm) and slight degenerative changes do not cause pain intense enough to be felt constantly. Severe marginal lipping (osteophytes of >3 mm) and severe degenerative changes may cause frequent episodes of moderate pain (Neogi *et al.* 2009; Matczak 2015). Advanced DJD, such as complete or near-complete (>80%) destruction of the articular surface in the knee joint, can cause chronic pain (*e.g.*, Neogi *et al.* 2009). Two individuals from Culmen had complete or near-complete (>80%) destruction of the articular surface in the right glenohumeral joint (Grave 82/98) and the right hip joint (Grave 367/03). Several different scales are used to evaluate osteoarthritis in the glenohumeral joint, *e.g.*, the Kellgren and Lawrence scale, but there are no studies on their association with disability. Results of research on the relationship between hip pain and the DJD grading system are ambiguous. Some studies show that there is no relationship between the degree of pain and the degree of osteoarthritis according to the Kellgren and Lawrence grading system (Kim *et al.* 2015; Hattori *et al.* 2021). On the other hand, other researchers have demonstrated a relationship between pain and the grading system (Assogba *et al.* 2020). Hip osteoarthritis leads to pain, stiffness, and limitations in activities (Rydevik *et al.* 2010). On the basis of osteological studies, it is very difficult to determine whether a person with advanced DJD in the glenohumeral or hip joint was disabled. Thus, advanced DJD in the glenohumeral and hip joints, identified in Culmen, cannot be considered as disability.

Osteophyte formation on at least one vertebral body is associated with the reduction of the disc size, and causes back pain (Fujiwara *et al.* 1999; Pye *et al.* 2004; Hart *et al.* 2015). Extensive osteophyte formation on the lumbar vertebral body can cause chronic pain (lasting for over 3 months to up to one year) (de Schepper *et al.* 2010; Matczak *et al.* 2022). DJD decreases the quality of life; however, it is difficult to observe a correlation between osteophytes and pain and disability, because some DJD changes in the spine might be asymptomatic, while even small changes may cause pain. Therefore, it is difficult to conclude if DJD in the spine and back pain could lead to disability, and for this reason we

consider DJD as a disease rather than disability. We are aware that Schmorl's nodes are not as good an indicator for pain assessment, because they cause pain in some individuals, whereas in others, they do not (Williams *et al.* 2007). However, clinical research shows that ≥1 Schmorl's nodes on lumbar vertebrae and ≥2 Schmorl's nodes on thoracic vertebrae can cause pain and stiffness in a relevant joint (Williams *et al.* 2007; Faccia and Williams 2008). Plomp (2017) discussed studies providing evidence that Schmorl's nodes cause pain. For this reason, we consider the presence of ≥1 Schmorl's nodes on lumbar vertebrae and ≥2 Schmorl's nodes on thoracic vertebrae as indicators of pain that has an impact on the quality of life of an individual. Considering the above, only joint fusions in the spine and limbs are easier to interpret as disability, because they lead to an inability to move the affected body parts. However, we did not identify any joint fusions in the osteological material from Culmen.

A hole in the anterior surface of the thoracic vertebral body, resulting from a forward shift (outside the vertebrae body outline) and herniation of the nucleus pulposus, was identified in a skeleton of a male, 50-60 years old at death, from Grave 444/04 (Kozłowski 2012).

Osteochondrosis (N=2), osteochondritis (N=5) and enthesopathy (N=8) can cause pain (Spodaryk 2002; Saseen *et al.* 2012). Sacralization is the fusion of the L5 vertebra with the sacrum, which is asymptomatic (Spodaryk 2002). Spondylolisthesis (N=1) and trauma cause pain, and at more severe stages, an inability to move (Roberts and Manchester 2010). Traumas were identified in 44 skeletons in total (Fig. 9) and included neurocranium trauma (N=20), facial trauma (N=1), trephination (N=4), long limb bones trauma (mostly, healed fractures, N=16), weapon trauma (N=2), and other cases of post-cranial trauma (N=9). They affected the life of individuals temporarily by causing pain and mobility difficulties in a relevant body part.

The presence of DJD in the left hip and the age of a male (adult) with a possible hip dysplasia from Grave 319/02 indicates that he could walk, but almost certainly with a waddling gait (Waldron 2009). A developmental defect of metatarsal bones (joints deformation and 'compression', N=1) could affect mobility (Kozłowski 2012; Jung *et al.* 2013).

Osteoma is a benign tumour that is located mainly in the bones of the skull and does not cause any symptoms (Spodaryk 2002; Mazurkiewicz 2008).

Deep caries (N=13) causes acute or chronic (in the case of pulp and nerve inflammation) pain in response to cold or heat (Winiarska-Majczyno 1983). Dental abscesses (N=41) could cause severe pain, difficulty in swallowing, fever, and facial swelling (Górski 1983; Roberts and Manchester 2010; Arslan *et al.* 2016). Antemortem crown fracture of the upper right medial incisor could cause temporal pain and sensitivity (Patnana and Kanchan 2023). The antemortem loss of permanent teeth in adults results in articulation disorders of speech sounds and chewing disorders (Włoch 1983). However, only a small number of individuals experience total loss of teeth. Some individuals experience the loss of one tooth or several teeth, which does not have a significant impact on the individual's functioning.

A thorough assessment of the impact of antemortem loss of teeth on the individual's life should be the subject of further investigation. The degree to which some pathological lesions such as, *e.g.*, enamel hypoplasia (Roberts and Manchester 2010) could affect the ability of an individual to 'function', and their association with other diseases is unclear. Figure 9 presents the number of cases of each disease, health condition, and pathological lesion that had an impact on the life of individuals from Culmen, but which are not considered disability.

5. DISCUSSION

5.1. Disability, age, and sex

Although disability is a modern concept that has developed in the Western culture (Barnes and Mercer 2010; Horstmanshoff 2012), textual sources show that there was a concept of 'otherness' associated with a physical impairment in mediaeval Poland. The textual analysis reveals that some people with disabilities were perceived in a positive way while others experienced social marginalisation, and did not receive the necessary care from their spouses and partners (*Legenda świętej Jadwigi* 1993; Anonim tzw. Gall 2008; Mistrz Wincenty 2008). However, such individuals could seek healing at holy places, *e.g.*, at tombs of saints, as well as seek help and protection from dukes and royals (*Legenda świętej Jadwigi* 1993). On the basis of textual sources, we have distinguished three types of disability, due to mobility difficulties, an abnormal posture, and blindness, which can be associated with disabilities observed in skeletons of the individuals from Culmen. The hagiography of Saint Hedwig describes three males who were paralysed and called 'cripple' (*Legenda świętej Jadwigi* 1993). In Culmen, we identified an individual from Grave 5/03 with paralysis, who could have been considered disabled. This supports the approach according to which interdisciplinary research, combining the textual analysis with osteological examinations, is crucial for identification of disabled people in archaeological records.

Textual sources indicate that in mediaeval Poland some adults were disabled. The analysis of osteological materials from Culmen confirms this observation. At Culmen, adults were more often disabled than children. This may be related to the fact that adults lived longer, so diseases could leave pathological lesions in their bones, whereas children died earlier. The occurrence of disability in males (N=3) and females (N=4) was almost equal. Research on individuals with disabilities from various periods and locations show that these problems affected males and females alike (*e.g.*, Dettwyler 1991; Pany and Tescher-Nicola 2007; Buquet-Marcon *et al.* 2007; Palkovich 2012; Tilley and Oxenham 2012; Boutin 2016; Lovell 2016; Roberts 2017; Schrenk and Martin 2017; Willett and Harrod 2017). However, we do not know the sex, age and prevalence of disability and pathological lesions in their respective populations.

5.2. Covenants and constraints

The fact that disability due to mobility difficulties was the one most frequently observed in the osteological materials from Culmen may result from the situation that we can only study the skeleton, which is a part of the locomotor system. Out of 661 skeletons, only eight displayed lesions connected to disabilities. This is due to the fact that disability is very often assessed on the basis of the most apparent symptoms, such as blindness or lameness (Ginsburg and Rapp 2013). Many diseases and disabilities do not leave traces on the bones, and thus, it is impossible to identify them (Roberts 2002). This mostly concerns diseases affecting soft tissues, acute infections, blindness, and lameness. We also have to bear in mind that infectious diseases could kill people at a young age without leaving any pathological lesions in their skeletons. While those who had stronger immune system and survived to a more advanced age could have other diseases, *e.g.*, DJD, that left lesions in their bones (Wood *et al.* 1992).

Even when we have bones with pathological lesions, we have to be careful with an assessment of disability and disease because diseases like advanced DJD might be asymptomatic (Roberts and Manchester 2010), whereas an individual may complain of severe pain despite the fact that they have no degenerative changes (Rogers and Waldron 1995; Bedson and Croft 2008; Waldron 2012). Early-mediaeval people performed many activities related to physical work; for example, they worked in the fields, or were craftsmen or warriors. Pain associated with DJD could be very nagging with hard physical work. On the other hand, these people could be more accustomed to pain and thus, they could accept it and live with it, contrary to people of the 21st century. For this reason, we should not rely solely on biological definitions of disability, and we need textual sources to guide us in defining what disability was at that time.

6. CONCLUSIONS

This interdisciplinary study is the first that analyses in such detail people with disabilities on a population level in the mediaeval period in Central Europe. It presents a detailed and in-depth analysis of 661 individuals in Culmen, including eight individuals with disabilities whose skeletal remains were discovered at a cemetery at the foot of Mount Saint Lawrence in Kałdus. The textual sources suggest three groups of disabilities, which we identified in osteological materials from Culmen. They include disability due to mobility difficulties, an abnormal posture, and blindness. The number of adults with disabilities was higher than that of children, because they lived longer than children. Thus, they were exposed to diseases for a longer time and this led to the development of more advanced diseases and health conditions, resulting in disability and leaving pathological lesions in their skeletons. This study contributes to the growing body of literature about disability in

archaeology and in the Slavic world, and reveals a hitherto overlooked aspect of the life of mediaeval populations. It should help to better understand the daily life of individuals in the Middle Ages. Only interdisciplinary research, combining palaeopathology with textual analysis, could provide more evidence on who was perceived as disabled at that period. While our study remains preliminary, its findings would definitely benefit from analyses of the social status of people in Culmen with disabilities, enabling better understanding of their position in this society. The protocol for studies on disability in archaeology presented by us can be applied to other archaeological contexts, also to sites outside Poland, from historical periods of time. The analysis of disability using more populations and textual sources from the mediaeval period and other parts of Europe can provide a bigger picture of who was perceived as a disabled member of a community in that period.

Acknowledgements

We would like to thank Marcin Weinkauf for providing the map of the archaeological sites and Jane Buikstra and anonymous reviewers whose comments contributed to the improvement of this article. The article was prepared under grant No. UMO-2014/13/N/HS3/04602 of the National Science Centre, realised in the former Department of Anthropology of the Faculty of Biology and Environmental Protection (currently the Faculty of Biological and Veterinary Sciences) of Nicolaus Copernicus University in Toruń, entitled 'The Ill and the Impaired in Early Medieval (10th-13th century) Poland. A case study of the sites from Kałdus (Kuyavian-Pomeranian voivodship)'.

References

Textual sources

Anonim tzw. Gall. 2008. *Kronika polska*. R. Grodecki (trans.), M. Plezia (ed.). Wrocław, Warszawa, Kraków: Zakład Narodowy in. Ossolińskich.

Legenda świętej Jadwigi. 1993. A. Jochelson and M. W. Gogolewska (trans.), J. Pater (ed.). Wrocław: Uniwersytet Wrocławski, Centrum Badań Śląskoznawczych i Bohemistycznych.

Mistrz Wincenty (tzw. Kadłubek). 2008. *Kronika polska*. B. Kürbis (trans., ed.). Wrocław, Warszawa, Kraków: Zakład Narodowy im. Ossolińskich.

Literature

Acsádi G. and Nemeskéri J. 1970. *History of Human Life Span and Mortality*. Budapest: Akadémiai Kiadó.

Arslan F., Karagöz E., Arslan B. Y. and Mert A. 2016. An unnoticed origin of fever: periapical tooth abscess. Three case reports and literature review. *Le Infezioni in Medicina* 1, 67-70.

Assogba T. F., Niama-Natta D. D., Kpadonou T. G., Lawson T., Mahaudens P. and Detrembleur C. 2020. Disability and functioning in primary and secondary hip osteoarthritis in Benin. *African Journal of Disability* 9(0), a675. https://doi.org/ 10.4102/ajod.v9i0.675

Aufderheide A. C. and Rodríguez-Martín C. 2006. *The Cambridge Encyclopedia of Human Paleopathology*. Cambridge: Cambridge University Press.

Baliga S., Mcmillan T., Sutherland A. and Sharan D. 2015. The Prevalence and Severity of Joint Problems and Disability in Patients with Poliomyelitis in Urban India. *The Open Orthopaedics Journal* 9, 204-209.

Barnes C. and Mercer G. 2010. *Exploring Disability. A Sociological Introduction*. Cambridge: Polity Press.

Bass M. W. 1987. *Human Osteology. A Laboratory and Field Manual*. Springfield: Missouri Archaeological Society.

Beaudry J. S. 2020. Theoretical Strategies to Define Disability. In D. T. Wasserman and A. Cureton (eds), *The Oxford Handbook of Philosophy and Disability*. Oxford: Oxford University Press. https://ssrn.com/abstract=3399016 (access 13.07.2022).

Bedson J. and Croft P. R. 2008. The discordance between clinical and radiographic knee osteoarthritis: A systematic search and summary of the literature. *BioMed Central Musculoskeletal Disorders* 9(116), 1-11.

Biruk W. L. and Wubshet K. 2007. Chronic osteomyelitis at Tikur Anbessa hospital, Addis Ababa University, Ethiopia. *East and Central African Journal of Surgery* 12, 33-41.

Błaszczyk D. 2017. *Między ziemią a niebem. Groby komorowe na obszarze państwa pierwszych Piastów*. Warszawa: Uniwersytet Warszawski.

Bojarski J. 2020. *Obrzędowość pogrzebowa w strefie chełmińsko-dobrzyńskiej we wczesnym średniowieczu* (= *Mons Sancti Laurentii* 9). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Bojarski J. 2021. Ethnic or Cultural Identity? Problem of Elite Burals in Early Medieval Cemeteries of the Chełmno-Dobrzyń Zone. In B. Dybaś and J. Bojarski (eds), *Gruppenidentitäten In Ostmitteleuropa. Auf der Suche nach Identität*. Göttingen: Brill/V&R unipress, 47-70.

Bojarski J., Chudziak W., Kozłowski T. and Reitsema L. 2016. Wczesnośredniowieczne groby komorowe z ziemi chełmińskiej. In D. Błaszczyk and D. Stępniewska (eds), *Pochówki w grobach komorowych na ziemiach polskich w okresie wczesnego średniowiecza*. Warszawa: Instytut Archeologii Uniwersytetu Warszawskiego, 102-121.

Boutin A. T. 2016. Exploring the social construction of disability: An application of the bioarchaeology of personhood model to a pathological skeleton from ancient Bahrain. *International Journal of Paleopathology* 12, 17-28.

Brittemham G. M. 2000. Disorders of Iron Metabolism: Iron Deficiency and Overload. In R. Hoffman, E. J. Benz Jr, S. J. Shattil, B. Furie, H. J. Cohen, L. E. Silberstein and P. McGlave (eds), *Hematology: Basic Principles and Practice*. Philadelphia: Churchill Livingstone, 397-428.

Brothwell D. and Sandison A. T. (eds) 1967. *Diseases in Antiquity. A Survey of the Diseases, Injuries and Surgery of Early Populations*. Springfield: Charles C. Thomas.

Brooks S. T. and Suchey J. M. 1990. Skeletal age determination based on the os pubis: a comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods. *Journal of Human Evolution* 5, 227-238.

Buikstra J. and Ubelaker D. H. 1994. *Standards for Data Collection from Human Skeletal Remains*. Fayetteville: Arkansas Archaeological Survey Research, University of Arkansas.

Buquet-Marcon C., Philippe C. and Anaick S. 2007. The oldest amputation on a Neolithic human skeleton in France. *Nature Precedings*, https://www.nature.com/articles/npre.2007.1278.1 (access 7.01.2023).

Byrnes J. F. 2017. Injuries, Impairment, and Intersecting Identities: The Poor in Buffalo, NY 1851–1913. In J. Byrnes and J. Muller (eds), *Bioarchaeology of Impairment and Disability. Theoretical, Ethnohistorical, and Methodological Perspectives*. New York: Springer, 201-222.

Byrnes J. F. and Muller J. 2017a. Mind the Gap: Bridging Disability Studies and Bioarchaeology — An Introduction. In J. Byrnes and J. Muller (eds), *Bioarchaeology of Impairment and Disability. Theoretical, Ethnohistorical, and Methodological Perspectives*. New York: Springer, 1-15.

Byrnes J. F. and Muller J. (eds) 2017b. *Bioarchaeology of Impairment and Disability. Theoretical, Ethnohistorical, and Methodological Perspectives*. New York: Springer.

Chang J. H., Kim S. K. and Lee W. Y. 1999. Diagnostic issues in tuberculosis of the ribs with a review of 12 surgically proven cases. *Respirology* 4, 249–53.

Chudziak W. 2001. Wczesnośredniowieczne groby komorowe z Kałdusa pod Chełmnem na Pomorzu Wschodnim. *Slavia Antiqua* 42, 63-96.

Chudziak W. 2003. *Wczesnośredniowieczna przestrzeń sakralna in Culmen na Pomorzu Nadwiślańskim* (= *Mons Sancti Laurentii* 1). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Chudziak W. (ed.) 2006. *Wczesnośredniowieczne cmentarzysko szkieletowe w Kałdusie (stanowisko 1)* (= *Mons Sancti Laurentii* 3). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Chudziak W. (ed.) 2010. *Wczesnośredniowieczne cmentarzysko szkieletowe w Kałdusie (stanowisko 4)* (= *Mons Sancti Laurentii* 5). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Chudziak W. 2012. Raz jeszcze w kwestii grobów komorowych z Kałdusa na Pomorzu Nadwiślańskim. In W. Dzieduszycki and J. Wrzesiński (eds), *Obcy* (= *Funeralia Lednickie* 14). Poznań: SNAP, 313-320.

Chudziak W. and Noryśkiewicz A. M. (eds) 2016. *Wczesnośredniowieczny zespół osadniczy w Kałdusie. Studia archeologiczno-paleobotaniczne* (= *Mons Sancti Laurentii* 8). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Chudziak W., Bojarski J. and Stawska V. 2010a. Chronologia cmentarzyska. In W. Chudziak (ed.), *Wczesnośredniowieczne cmentarzysko szkieletowe w Kałdusie (stanowisko 4)* (= *Mons Sancti Laurentii* 5). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 105-120.

Chudziak W., Bojarski J. and Stawska V. 2010b. Podsumowanie. In W. Chudziak (ed.), *Wczesnośredniowieczne cmentarzysko szkieletowe w Kałdusie (stanowisko 4)* (= *Mons Sancti Laurentii* 5). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 121-126.

Chudziak W., Stawska V., Weinkauf J. and Kozłowski T. 2006. Katalog. Część II. Badania Instytutu Archeologii i Etnologii UMK w Toruniu w latach 1997-1999. In W. Chudziak (ed.), *Wczesnośredniowieczne cmentarzysko szkieletowe w Kałdusie (stanowisko 1)* (= *Mons Sancti Laurentii* 3). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 345-388.

Cormier A. A. and Buikstra J. 2017. Impairment, Disability, and Identity in the Middle Woodland Period: Life at the Juncture of Achondroplasia, Pregnancy, and Infection. In J. Byrnes and J. Muller (eds), *Bioarchaeology of Impairment and Disability. Theoretical, Ethnohistorical, and Methodological Perspectives*. New York: Springer, 225-248.

Cross M. 1999. Accessing the Inaccessible: Disability and Archaeology. *Archaeological Review from Cambridge* 15/2, 7–30.

Delimata M. 2004a. *Dziecko w Polsce średniowiecznej*. Poznań: Wydawnictwo Poznańskie.

Delimata M. 2004b. Rytuał pogrzebowy dzieci w Polsce średniowiecznej i wczesnonowożytnej. In W. Dzieduszycki and J. Wrzesiński (eds), *Dusza maluczka, a strata ogromna* (= *Funeralia Lednickie* 6). Poznań: SNAP, 99-102.

Dettwyler K. A. 1991. Can Paleopathology Provide Evidence for „Compassion"? *American Journal of Physical Anthropology* 84, 375-384.

Dickel D. N. and Doran G. H. 1989. Severe neural tube defect syndrome from the Early Archaic of Florida. *American Journal of Physical Anthropology* 80, 325-334.

Disability Evaluation Under Social Security https://www.ssa.gov/disability/professionals/bluebook/1.00-Musculoskeletal-Adult.htm (access 7.01.2023).

Dittmar J. M., Mulder B., Tran A., Mitchell P. D., Jones P. D., Inskip S. A., Cessford C. and Robb J. E. 2023. Caring for the injured: Exploring the immediate and long-term consequences of injury in medieval Cambridge, England. *International Journal of Paleopathology* 40, 7-19.

de Schepper E. I. T., Damen J., van Meurs J. B., Ginai A. Z., Popham M., Hofman A., Koes B. W. and Bierma-Zeinstra S. M. 2010. The Association Between Lumbar Disc Degeneration and Low Back Pain. The Influence of Age, Gender, and Individual Radiographic Features. *Spine* 35/5, 531-536.

Faccia K. J. and Williams R. C. 2008. Schmorl's nodes: clinical significance and implications for the bioarchaeological record. *International Journal of Osteoarchaeology* 18: 28-44.

Finlay N. (ed.) 1999. *Disability and Archaeology* (= *Archaeological Review from Cambridge* 15/2). Cambridge: Cambridge University Press.

Florkowski A. and Kozłowski T. 1994. Ocena wieku szkieletowego dzieci na podstawie wielkości kości. *Przegląd Antropologiczny* 57/1-2, 71-86.

Frayer D. W., Horton W. A., Macchiarelli R. and Mussi M. 1987. Dwarfism in an adolescent from the Italian late Upper Palaeolithic. *Nature* 330, 60-62.

Fujiwara A., Tamai K., Yamato M., An H. A., Yoshida H., Saotome K. and Kurihashi A. 1999. The relationship between facet joint osteoarthritis and disc degeneration of the lumbar spine: an MRI study. *European Spine Journal* 8, 396-401.

Garg R. K. and Somvanshi D. S. 2011. Spinal tuberculosis: A review. *Journal of Spinal Cord Medicine* 34/5, 440-454.

Gaździk T. Sz. 2008. Porażenia i niedowłady wiotkie. In T., Sz. Gaździk (ed.), *Ortopedia i traumatologia* 2. Warszawa: Wydawnictwo Lekarskie PZWL, 468-469.

Ginsburg F. and Rapp R. 2013. Disability Worlds. *Annual Review of Anthropology* 42, 53-68.

Goffman E. 1986. *Stigma: Notes on Management of Spoiled Identity*. New York: Simon and Schuster.

Goodwin J. A., Coleman E. A., Sullivan E., Easley R., McNatt P. K., Chowdhury N. and Stewart C. B. 2013. Personal Financial Effects of Multiple Myeloma and its Treatment. *Cancer Nursing* 36/4, 301-308.

Górski M. 1983. Zębopochodne zapalenie kości szczęk i tkanek okołoszczękowych. In Z. Jańczuk (ed.), *Zarys stomatologii. Podręcznik dla studentów medycyny*. Warszawa: Państwowy Zakład Wydawnictw Lekarskich, 224-236.

Hart O. R., Uden R. M., McMullan J. E., Ritchie M. S., Williams T. D. and Smith B. H. 2015. A Study of National Health Service Management of Chronic Osteoarthritis and Low Back Pain. *Primary Health Care Research & Development* 16/2, 157-166.

Hattori T., Shimo K., Niwa Y., Tokiwa Y. and Matsubara T. 2021. Association of Chronic Pain with Radiologic Severity and Central Sensitization in Hip Osteoarthritis Patients. *Journal of Pain Research* 14, 1153-1160.

Henning N. and Schmidt E. 1973. Witaminy i choroby z niedoboru witamin. In L. Heilmeyer (ed.), *Patofizjologia szczegółowa*. Warszawa: Państwowy Zakład Wydawnictw Lekarskich, 530-569.

Horstmanshoff M. 2012. Disability and Rehabilitation in the Graeco-Roman World. In R. Breitwieser (ed.), *Behinderungen und Beeinträchtigungen/ Disability and Impairment in Antiquity* (= *BAR International Series* 2359. *Studies in Early Medicine* 2). Oxford: British Archaeological Reports, 1-9.

Hubert J. 2000a. Introduction: the complexity of boundedness and exclusion. In J. Hubert (ed.), *Madness, Disability and Social Exclusion. The Archaeology and Anthropology of "difference"*. London: Routledge, 1-8.

Hubert J. (ed.) 2000b. *Madness, Disability and Social Exclusion. The Archaeology and Anthropology of "difference"*. London: Routledge.

Ibingira C. B. R. 2003. Chronic osteomyelitis in a Ugandan rural setting. *East African Medical Journal* 80/5, 242-246.

Janowski A. 2011. Early medieval chamber graves on the south coast of the Baltic Sea. In F. Biermann, T. Kersting and A. Klammt (eds), *Der Wandel um 1000*. Halle: Beier&Beran, 257-267.

Janowski A. 2015. *Groby komorowe w Europie Środkowo - Wschodniej. Problemy wybrane*. Szczecin: Instytut Archeologii i Etnologii PAN, Ośrodek Archeologii Średniowiecza Krajów Nadbałtyckich.

Jung J-Y., Kim J-H., Choi J-K., Won Y. and Kim J-J. 2013. Association Analysis of Flat Foot and High-Arch Foot using Data Mining. *Proceedings of the 12th International Conference on Applied Computer and Applied Computational Science*. Kuala Lumpur, Malaysia, 138-142.

Kamara E., Mehta S., Brust J. C. M. and Jain A. K. 2012. Effect of delayed diagnosis on severity of Pott's disease. *International Orthopaedics (SICOT)* 36, 245-254.

Kim C., Nevitt M. C., Niu J., Clancy M. M., Lane N. E., Link T. M., Vlad S., Tolstykh I., Jungmann P. M., Felson D. T. and Guermazi A. 2015. Association of hip pain with radiographic evidence of hip osteoarthritis: diagnostic test study. *British Medical Journal* 351:h5983.

Knüsel Ch. J. 1999. Ortopaedic Disability: Some Hard Evidence. *Archaeological Review from Cambridge* 15/2, 31-53.

Kotschy M. 2009. Choroby krwi i układu krwiotwórczego. In S. Maśliński and J. Ryżewski (eds), *Patofizjologia. Podręcznik dla studentów medycyny* 1. Warszawa: Wydawnictwo Lekarskie PZWL, 438-479.

Kozłowski T. 2012. *Stan biologiczny i warunki życia ludności in Culmen na Pomorzu Nadwiślańskim (X-XIII wiek): studium antropologiczne* (= *Mons Sancti Laurentii* 7). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Kozłowski T. and Witas H. 2012. Metabolic and Endocrine Diseases. In A. L. Grauer (ed.), *A Companion to Paleopathology*. Wiley-Blackwell: Chichester, West Sussex, Malden, 401-419.

Krogman M. W. and Ýţcan Y. M. 1986. *The Human Skeleton in Forensic Medicine*. Springfield: C. C. Thomas.

Kudlick C. J. 2003. Disability History: Why We Need Another „Other". *American Historical Review* 108/3, 763-793.

Lazzarini L., Mader J. T. and Calhoun J. H. 2004. Osteomyelitis in long bones. *The Journal of Bone and Joint Surgery* 86/10, 2305-2318.

Lew D. P. and Waldvogel F. A. 2004. Osteomyelitis. *Lancet* 364(9431), 369-379.

Longmore M., Wilkinson I. B. and Rajagopalan S. R. 2004. *Oxford Handbook of Clinical Medicine*. Oxford: Oxford University Press.

Lovejoy C. O. 1985. Dental wear in the Libben population: Its functional pattern and role in the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68, 47-56.

Lovell N. C. 2016. Tiptoeing through the rest of his life: A functional adaptation to a leg shortened by femoral neck fracture. *International Journal of Paleopathology* 13, 91-95.

Matczak M. D. 2015. *The Ill and the Disabled in Early Medieval Culmen. The Archaeological and Anthropological Perspective*. PhD diss. Poznań: Adam Mickiewicz University (in Polish).

Matczak M. D. and Kozłowski T. 2017. Dealing with difference: using the osteobiographies of a woman with leprosy and a woman with gigantism from medieval Poland to identify practices of care. In L. Tilley and A. Schrenk (eds), *New Developments in the Bioarchaeology of Care: Further Case Studies and Extended Theory*. New York: Springer, 125-151.

Matczak M. D., Buikstra J. E., Pearson J. and Wyrwa A. M. 2019. Bioarcheologia niepełnosprawności: przegląd obecnych badań i perspektywy na przyszłość. *Museion Poloniae Maioris* 6, 35-57.

Matczak M. D., Buikstra J. E., Pearson J. and Wyrwa A. M. 2020. Bioarcheologia niepełnosprawności. *Teksty Drugie* 2, 158-174.

Matczak M. D., Kozłowski T. and Chudziak W. 2021. A Multidisciplinary Study of Anti-Vampire Burials from Early Medieval Culmen, Poland: Were the Diseased and Disabled Regarded as Vampires? *Archaeologia Historica Polona* 29, 219-252.

Matczak M. D., Buikstra J. E., Wyrwa A. M. and Pearson J. 2022. The Problem of Assessing Intervertebral Disc Disease as Impairment and Disability in Bioarchaeology. The Case of a Male Individual from the Late Medieval and Early Modern Period in Łekno, Poland. *Forum Kritische Archäologie* 11, 167-194.

Mazurkiewicz T. 2008. Nowotwory narządu ruchu. In T. Sz. Gaździk (ed.), *Ortopedia i traumatologia*. Vol. 2. Warszawa: Wydawnictwo Lekarskie PZWL, 532-573.

Micarelli I., Tilley L. and Tafuri M. A. (eds) in press. Disability and care in Western Europe during Medieval times: a bioarchaeological perspective. *International Journal of Paleopathology*.

Miśkiewicz M. 2010. *Życie codzienne mieszkańców ziem polskich we wczesnym średniowieczu*. Warszawa: UKSW, Państwowe Muzeum Archeologiczne w Warszawie, Wydawnictwo TRIO.

Mundada P. H. and Patil D. S. 2022. Early Physiotherapy as an Adjunct to Surgical Approach in Case of Chronic Tibial Osteomyelitis Treated with Sequestrectomy and an Ilizarov Ring Fixator in a 14-Year-Old Schoolgirl: A Case Report. *Cureus* 14/9, e29663.

Neogi T., Felson D., Niu J., Nevitt M., Lewis C. E., Aliabadi P., Sack B., Torner J., Bradley L. and Zhang J. 2009. Association Between Radiographic Features of Knee Osteoarthritis and Pain: Results from Two Cohort Studies. *British Medical Journal* 339, b2844.

Palkovich A. M. 2012. Reading a Life: A fourteenth-century ancestral Puebloan woman. In A. L. W. Stodder and A. M. Palkovich (eds), *The Bioarchaeology of Individuals*. Gainesville: University Press of Florida, 242-254.

Pany D. and Tescher-Nicola M. 2007. Klippel-Feil syndrome in an Early Hungarian period juvenile skeleton from Austria. *International Journal of Osteoarchaeology* 17, 403-415.

Patnana A. K. and Kanchan T. 22 May 2023. Tooth Fracture. In *StatPearls. Treasure Island (FL)*. StatPearls Publishing, https://www.ncbi.nlm.nih.gov/books/NBK551650/ (access 20.12.2023).

Peck J. J. 2013. Status, health, and lifestyle in Middle Iron Age Britain: A bioarcheological study of elites and non-elites from East Yorkshire, Northern England. *International Journal of Paleopathology* 3, 83-94.

Pegelow Ch., Powars D. and Wingert W. 1977. Severe Iron Deficiency Anemia. *The Western Journal of Medicine* 126/3, 190-195.

Penny-Mason B. J. and Gowland R. L. 2014. The Children of the Reformation: Childhood Palaeoepidemiology in Britain, ad 1000-1700. *Medieval Archaeology* 58, 162-194.

Phillips S. 2017. A Long Waiting for Death: Dependency and the Care of the Disabled in a Nineteenth Century Asylum. In L. Powell, W. Southwell-Wright and R. Gowland (eds), *Care in the Past: Archaeological and Interdisciplinary Perspectives*. Oxford: Oxbow, 125-140.

Piotrowski J. 2003. Nowotwory układu krwiotwórczego. In A. Kułakowski and A. Skowrońska-Gardas (eds), *Onkologia. Podręcznik dla studentów medycyny*. Warszawa: Wydawnictwo Lekarskie PZWL, 205-223.

Plomp K. A. 2017. The Bioarchaeology of Back Pain. In J. Byrnes and J. Muller (eds), *Bioarchaeology of Impairment and Disability*. New York: Springer, 141-157.

Powell M. L. 1988. *Status and Health in Prehistory: A Case Study of the Moundville Chiefdom*. Washington: Smithsonian Institution Press.

Pye R., Reid D. M., Smith R., Adams J., Nelson K., Silman A. J. and O'Neill T. W. 2004. Radiographic features of lumbar disc degeneration and self-reported back pain. *The Journal of Rheumatology* 31/4, 753-758.

Rasouli M. R., Mirkoohi M., Vaccaro A. R., Yarandi K. K. and Rahimi-Movaghar V. 2012. Spinal Tuberculosis: Diagnosis and Management. *Asian Spine Journal* 6/4, 294-308.

Roberts C. A. 2000. Did they take sugar? The use of skeletal evidence in the study of disability in past populations. In J. Hubert (ed.), *Madness, Disability and Social Exclusion. The Archaeology and Anthropology of "difference"*. London: Routledge, 46-59.

Roberts C. 2002. Paleopathology and archaeology: the current state of play. In R. Arnott (ed.), *The Archaeology of Medicine. British Archaeological Report. Papers given at a session of the annual conference of the Theoretical Archaeology Group held at the University of Birmingham on 20 December 1998*. Oxford: Archeopress, 1-20.

Roberts C. 2017. Applying the 'Index of Care' to a Person Who Experienced Leprosy in Late Medieval Chichester, England. In L. Tilley and A. Schrenk (eds), *New Developments in the Bioarchaeology of Care: Further Case Studies and Extended Theory*. New York: Springer, 101-124.

Roberts C. A. 2019. Infectious Disease: Introduction, Periostosis, Periostitis, Osteomyelitis, and Septic Arthritis. In J. E. Buikstra (ed.), *Ortner's Identification of Pathological Conditions is Human Skeletal Remains*. London, San Diego, Cambridge, Oxford: Academic Press, Elsevier, 285-319.

Roberts C. A. and Manchester K. 2010. *The Archaeology of Disease*. Stroud: The History Press.

Rogers J. and Waldron T. 1995. *A Field Guide to Joint Disease in Archaeology*. Chichester, New York, Brisbane, Toronto, Singapore: John Wiley & Sons.

Robb J., Bigazzi R., Lazzarini L., Scarsini C. and Sonego F. 2001. Social status and biological status: a comparison of grave goods and skeletal indicators from Pontecagnano. *American Journal of Physical Anthropology* 115, 213-222.

Rydevik K., Fernandes L., Nordsletten L. and Risberg M. A. 2010. Functioning and disability in patients with hip osteoarthritis with mild to moderate pain. *The Journal of Orthopaedic & Sports Physical Therapy* 40/10, 616-624.

Sahay M. and Sahay R. 2012. Rickets–vitamin D deficiency and dependency. *Indian Journal of Endocrinology and Metabolism* 16/2, 164-176.

Saseen J. J., Agashivala N., Read Allen R., Ghushchyan V., Yadao A. M. and Nair K. V. 2012. Comparison of patient characteristics and gout-related health-care resource utilization and costs in patients with frequent versus infrequent gouty arthritis attacks. *Rheumatology* 51/11, 2004-2012.

Schrenk A. A. and Martin D. L. 2017. Applying the Index of Care to the Case Study of a Bronze Age Teenager Who Lived with Paralysis: Moving from Speculation to Strong Inference. In L. Tilley and A. Schrenk (eds), *New Developments in the Bioarchaeology of Care: Further Case Studies and Extended Theory*. New York: Springer, 47-64.

Solecki R. S. 1971. *Shanidar: The First Flower People*. New York: Alfred A. Knopf.

Spodaryk K. 2002. *Patologia narządu ruchu*. Warszawa: Wydawnictwo Lekarskie PZWL.

Stawska V., Bojarski J. and Chudziak W. 2010. Rodzaje grobów i konstrukcje wewnętrzne. In W. Chudziak (ed.), *Wczesnośredniowieczne cmentarzysko szkieletowe w Kałdusie (stanowisko 4)* (= *Mons Sancti Laurentii* 5). Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 55-65.

Steckel R. H., Larsen C. S., Sciulli P. W. and Walker P. L. 2006. Data Collection Codebook. In R. H. Steckel, C. S. Larsen, Ch. A. Roberts and J. Baten (eds), *The Backbone Europe. Health, Diet, Work and Violence over Two Millenia*. Cambridge: Cambridge University Press, 397-427.

Stodder A. L. W. 2017. Quantifying Impairment and Disability in Bioarchaeological Assemblages. In J. Byrnes and J. Muller (eds), *Bioarchaeology of Impairment and Disability. Theoretical, Ethnohistorical, and Methodological Perspectives*. New York: Springer, 183-200.

Tilley L. 2015. *Theory and Practice in the Bioarchaeology of Care*. New York: Springer.

Tilley L. and Oxenham M. F. 2012. Survival against the odds: Modelling the social implications of care provisions to seriously disabled individuals. *International Journal of Paleopathology* 1, 35-42.

Tilley L. and Cameron T. 2014. Introducing the Index of Care: A web-based application supporting archaeological research into health-related care. *International Journal of Paleopathology* 6, 5-9.

Tilley L. and Schrenk A. (eds) 2017. *New Developments in the Bioarchaeology of Care: Further Case Studies and Extended Theory*. New York: Springer.

Topolski J. 1976. *Methodology of History*. Warszawa, Dordrecht, Boston: PWN, D. Reidel Publishing Company.

Torrealba-Acosta G. and Mandel J. 2020. Hyperostosis frontalis interna diagnosed after a provoked seizure. *BMJ Case Report* 13/7, e236520.

Tremblay Critcher L. A. 2017. An Exploration of a Modified Bioarchaeology of Care Methodological Approach for Historic Institutionalized Populations. In L. Tilley and A. Schrenk (eds), *New Developments in the Bioarchaeology of Care: Further Case Studies and Extended Theory*. New York: Springer, 277-288.

Trinkaus E. 1983. *The Shanidar Neanderthals*. New York: Academic Press.

Ubelaker D. H. 1989. *Human Skeletal Remains: excavation, analysis, interpretation*. Washington, D.C.: Taraxacum Press.

Waldron T. 2009. *Paleopathology*. Cambridge: Cambridge University Press.

Waldron T. 2012. Joint Disease. In A. L. Grauer (ed.), *A Companion to Paleopathology*. Wiley-Blackwell: Chichester, West Sussex, Malden, 513-530.

Weston D. A. 2012. Nonspecific Infection in Paleopathology: Interpreting Periosteal Reactions. In A. L. Grauer (ed.), *A Companion to Paleopathology*. Cambridge: Cambridge University Press, 492-512.

White T. D. and Folkens P. A. 2005. *The Human Bone. Manual*. Amsterdam, Boston: Elsevier Academic.

Willett A. Y. and Harrod R. P. 2017. Cared for or Outcasts: A Case for Continuous Care in the Precontact U.S. Southwest. In L. Tilley and A. Schrenk (eds), *New Developments in the Bioarchaeology of Care: Further Case Studies and Extended Theory*. New York: Springer, 65-84.

Williams F. M. K., Manek N. J., Sambrook P. N., Spector T. D. and MacGregor A. J. 2007. Schmorl's Nodes: Common, Highly Heritable, and Related to Lumbar Disc Disease. *Arthritis & Rheumatism (Arthritis Care & Research)* 57/5, 855-860.

Winiarska-Majczyno M. 1983. Wady twarzowo-szczękowo-zgryzowe i ich leczenie. In Z. Jańczuk (ed.), *Zarys stomatologii. Podręcznik dla studentów medycyny*. Warszawa: Państwowy Zakład Wydawnictw Lekarskich, 34-71.

Włoch S. 1983. Utrata zębów a stan zdrowia. Zjawiska kompensacyjne w niewydolności narządu żucia. In Z. Jańczuk (ed.) *Zarys stomatologii. Podręcznik dla studentów medycyny*. Warszawa: Państwowy Zakład Wydawnictw Lekarskich, 308-311.

Wojtecka-Łukasik E. 2009. Patofizjologia tkanki łącznej. In S. Maśliński and J. Ryżewski (eds), *Patofizjologia. Podręcznik dla studentów medycyny* 2. Warszawa: Wydawnictwo Lekarskie PZWL, 840-877.

Wood J. W., Milner G. R., Harpending H. C. and Weiss K. M. 1992. The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples. *Current Anthropology* 33/4, 343-370.

World Health Organization (WHO). 2002. *Towards a Common Language for Functioning, Disability and Health*, https://cdn.who.int/media/docs/default-source/classification/icf/icfbeginnersguide.pdf (access 13.07.2022).

Young J. L. and Lemaire E. D. 2017. Using Population Health Constructs to Explore Impairment and Disability in Knee Osteoarthritis. In J. Byrnes and J. Muller (eds), *Bioarchaeology of Impairment and Disability. Theoretical, Ethnohistorical, and Methodological Perspectives*. New York: Springer, 159-182.

Zahorska-Markiewicz B. and Małecka-Tendera E. 2009. *Patofizjologia kliniczna. Podręcznik dla studentów*. Wrocław: Elsevier.

Zakrzewski S. 2014. Paleopathology, disability and bodily impairments. In R. Metcalfe, J. Cockitt and R. David (eds), *Paleopathology in Egypt and Nubia: A Century in Review* (= *Archaeopress Egyptology* 6). Oxford: Archaeopress, 57-68.

Zakrzewski S. 2015. Behind every mask there is a face, and behind that a story. Egyptian Bioarchaeology and Ancient Identities. In S. Ikram, J. Kaiser and R. Walker (eds), *Egyptian Bioarchaeology: Humans, Animals and the Environment*. Leiden: Sidestone Press, 157-167.