A Possible Case of Scurvy in Byzantine Skeletal Remains from Khirbet el-Bediyah Archaeological Site, Jordan

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ABSTRACT

Scurvy, a disease resulting from vitamin C (ascorbic acid) deficiency, leaves distinct skeletal markers that are well-documented in bioarchaeological studies, providing valuable insights into the characteristics of this metabolic disorder. This research investigates the osteological indicators and manifestations of scurvy in a young individual from the Byzantine period at the Khirbet el-Bediyah archaeological site in Jordan. While scurvy has been identified globally in archaeological contexts, few cases have been reported in Jordan, making this study particularly valuable for understanding the broader health and nutritional patterns of the region during the Byzantine era. The skeletal analysis revealed several diagnostic features of scurvy, including subperiosteal new bone formation (SPNB) on the long bones, porosity on the cranial bones, and cortical abnormalities on the mandible. The study applies established diagnostic criteria for scurvy, offering a comprehensive assessment of the lesions. The results highlight the significance of scurvy as a health condition in Byzantine Jordan and contribute to the growing body of knowledge on nutritional deficiencies, health disparities, and their socio-cultural implications in ancient Mediterranean societies.

ARTICLE INFO

Article history
Received 7 October 2024
Received in revised form 4 January 2025
Accepted 2 February 2025
Available Online 24 February 2025

KEYWORDS

Scurvy- Byzantine period- evidence Khirbet el-Bediyah - Jordan

INTRODUCTION

The study of ancient human remains provides valuable insights into the health and dietary practices of past societies. Among these health issues is scurvy, a disease caused by a lack of vitamin C (ascorbic acid), which can lead to a variety of skeletal manifestations that are well-documented in bioarchaeological literature (Brown &Ortner2011; Armelagos et al. 2014; Mays 2014; Pitreet al. 2016; Snoddy et al. 2018). Human bodies are unable to synthesize ascorbic acid, the active form of vitamin C, they must obtain it through their diet (Armelagos et al. 2014). Otherwise, skeletal manifestations of scurvy will be active and manifest in diverse forms. The typical lesions include new bone formation along the diaphysis and metaphysis on the long bones, craniofacial porotic hyperostosis and cribra orbitalia, as well as rib changes and

dental abnormalities (Ortner & Ericksen 1997; Maat 2004; Brickley & Ives 2008). Vitamin C plays a crucial role in the synthesis and maintenance of collagen, a structural protein found in connective tissues throughout the body (Monroig-Rivera et al. 2022), and its deficiency can lead to the weakening and breakdown of tissues containing collagen, including bones, cartilage, and blood vessels (Ortner & Putchar 2003), and may impair the body's ability to repair and regenerate The impact of scurvy on past populations can be significant, as the disease can lead to debilitating physical symptoms, increased susceptibility to other illnesses, and even death (Aufderheide & Rodríguez-Martin1998; Hirschmann & Raugi 1999;Geber & Murphy 2012). The diagnosis of scurvy in archaeological contexts, however, can be challenging due to the similarity of lesions to those associated with other nutritional deficiencies and pathological conditions (Ortner & Ericksen 1997; Klaus 2014). Scurvy shares many skeletal manifestations with other deficiency diseases, such as the new bone formation along the diaphysis and metaphysis of long bones, which can also be observed in cases of rickets and anemia (Ortner & Putschar 2003; Armelagos et al. 2014; Snoddy et al. 2018; Brickley & Ives 2020). Additionally, craniofacial changes like porotic hyperostosis and cribraorbitalia are not exclusive to scurvy, as they can result from variety of nutritional and infectious conditions (Stuart-Macadam 1989; Walker et al. 2009). This overlap in skeletal pathology can complicate the differential diagnosis of scurvy in archaeological samples, necessitating a careful and comprehensive analysis of the skeletal remains.

Scurvy has been well-documented in the archaeological record, with evidence of the disease found in numerous historic and prehistoric sites across the globe (McMillan &Inglis 1944; Ortner et al. 1999; Ortner et al. 2001; Mays 2007; Brown & Ortner 2011; Armelagos et al. 2014; Mays 2014). Excavations at the site of Tell Hisban in Middle Jordan specifically identified one case of scurvy. The uncovered skeletal remains exhibited characteristic lesions associated with scurvy, dating to the 16th century AD (Edwards 2019)

Paleopathologists examine the markers displayed by different skeletal remains in order to reach the correct diagnoses, but over the last decade, they started to employ multidisciplinary techniques, especially when the osteological evidence is extremely similar (Vargova et al. 2021). They have discussed several cases of shared lesions with scurvy such as leprosy (Rubini & Zaio 2009), tuberculosis (Müller et al. 2016; Larentis et al. 2023), and syphilis (Salesse et al. 2019). Furthermore, they reported several shared lesions of other diseases with scurvy such as thalassemia (Orzincolo et al. 1990), anemia (Zuckerman et al. 1014), osteoporosis (Brzezińska et al. 2020), and vitamin D deficiency (Brickley & Morgan, 2023). Recently, increasing attention has been given to the differential diagnosis of scurvy, allowing for more accurate identification in affected skeletal remains (Lovász et al. 2013; Bourbou 2014; Mays 2014; Woo et al. 2017; Brickley & Morgan, 2023).

Vitamin C has several functions including wound healing and bone remodeling. In addition, it is essential for hydroxylation of collagens, mucus membranes, bones, and teeth. In addition, synthesis of aldosterone and corticosteroids requires vitamin C (Aguirre et al. 2024). Accordingly, scurvy may impact daily physical activities, wound healing, and its insufficiency may cause death (Simonit et al. 2023).

Ortner & Ericksen's (1997) study is one of the seminal studies on the osteological lesions of scurvy. The study described the typical lesions that are associated with the disease, such as new bone growth along the diaphysis and metaphysis of long bones and changes in the face and head, like porotic hyperostosis and cribra orbitalia. Building on this foundation, subsequent studies have further refined the diagnostic criteria for identifying scurvy in the archaeological record (Brickley & Ives 2005).

 DOI: 10.21608/shedet.2025.326543.1273

Accurately diagnosing scurvy in skeletal remains can be challenging due to the overlap in disease markers with other nutritional deficiencies and disease processes. To address this, researchers have employed a multifaceted approach, incorporating macroscopic, microscopic, and even molecular techniques to strengthen the diagnostic process (Klaus 2017). For instance, researchers have identified potential vitamin C deficiency by analyzing trace element concentrations in bone and dental tissues (Klepinger 1984; Eerkens et al. 2011). Integrating these various diagnostic techniques is critical for accurately identifying and understanding the prevalence of scurvy in past populations. Recent studies have reported evidence of scurvy in a variety of archaeological contexts, including medieval burials in Serbia (Brown & Ortner 2011) and historic cemetery sites in England (Brickley & Ives 2005).

The oldest scurvy description was documented in 1550 BC in an Eber's papyrus from Egypt (Pimentel 2003). Bioarchaeologists discovered the oldest probable identified scurvy case in the pre-dynastic site of Nag el-Quarmila in Aswan, Egypt, ca. 3800-3600 BC (Pitre et al. 2016).

While scurvy has been extensively documented in various archaeological contexts globally, there remains a significant gap in understanding the prevalence, causes, and socio-cultural implications of scurvy among ancient populations, especially in Jordan, where few cases have been documented. The few cases identified at the Jordanian archaeological sites provide a starting point, but they raise important questions about the broader dietary patterns and health conditions of individuals during the Byzantine period in the region. Specifically, what are the osteological indicators of scurvy in Byzantine skeletal remains from Jordan, and how do these findings contribute to our understanding of nutritional deficiencies, health disparities, and cultural practices in the context of the broader Mediterranean world during this time. Accordingly, this research aims to address these questions by examining the skeletal remains of an individual from the Khirbet el-Bediyah archaeological site, thereby establishing a cornerstone in the understanding of health and nutrition in Byzantine Jordan.

Khirbet el-Bediyah Archaeological Site

Khirbet el-Bediyah is located about 9 km south of the city of Ajloun in Northern Jordan. Excavations revealed significant archaeological finds and features, including two Byzantine churches and urban structures. The churches contain panels framing Greek inscriptions dating their construction to the years AD 640 and AD 662 (Al-Muheisen 2006; Nassar & Al-Muheisen 2013). During the Byzantine period, the site was agriculturally productive and densely occupied, revealing hundreds of cisterns, wine, and olive presses, and three cemeteries with chamber and single shaft tombs surrounding the main occupational area (Al-Muheisen & Al-Shorman 2004). Tomb typologies and grave goods clearly indicate tomb reuse and social stratification (Al-Muheisen 1996; Waterhouse 1998). The skeleton of this study was recovered from a single vertical shaft grave in the southern cemetery (Tomb 5, grave 1) and reported by Al-Muheisen & Al-Shorman (2004) to house individuals of lower social class (Fig. 1). The site witnessed political stability that initially reflected positively on the economy, as evidenced by the continuity of Byzantine currency (Al-Muheisen et al. 2010). The skeletal lesions were evaluated according to the diagnostic criteria for scurvy established by Ortner et al. (1999, 2001), as shown in Table (1) below, which strongly substantiates a diagnosis of scurvy.

Table 1: Macroscopic osseous lesions after Ortner et al. (1999, 2001).

Lesion location	Lesion type	Paleopathological references	Diagnostic strength
Ectocranial parietal and/or squamous temporal	Abnormal cortical porosity, SPNB	Ortner and Ericksen 1997; Ortner et al. 1999; Ortner et al. 2001	Diagnostic ×

Lesion location	**Lesion type**	**Paleopathological references**	**Diagnostic strength**
Endocranialcalvarium	Islands of abnormal cortical porosity and/or SPNB	Brown and Ortner 2011; Snoddy et al. 2017	Suggestive *Not seen*
Sphenoid: Greater wing	Abnormal cortical porosity, bilateral SPNB	Ortner and Eriksen 1997; Ortner et al. 1999; Ortner et al. 2001	Diagnostic ✓
Sphenoid: Foramen rotundum	SPNB	Geber and Murphy 2012	Diagnostic ✓
Sphenoid: Lesser wing	Abnormal cortical porosity	Brickley and Ives 2006	Suggestive *Not seen*
Sphenoid: Pterygoid fossae/plates	Abnormal cortical porosity, SPNB	Crist and Sorg 2014; Klaus 2017	Diagnostic ✓
Frontal: Orbital roof	Abnormal cortical porosity, SPNB	Ortner and Ericksen 1997; Ortner et al. 2001; Brickley and Ives 2006; Klaus2014	Diagnostic ✓
Zygomatic: Lateral aspect	Abnormal cortical porosity; SPNB	Ortner et al. 1999; Ortner et al. 2001; Snoddy et al. 2018	Suggestive ×
Zygomatic: Internal (posterior) aspect	Abnormal cortical porosity	Ortner et al. 2001	Suggestive *Not seen*
Maxillae: Anterior surface/infraorbital foramina	Abnormal cortical porosity, SPNB	Ortner et al. 2001	Diagnostic ✓
Maxillae: Posterior surface	Abnormal cortical porosity, SPNB	Ortner and Eriksen 1997; Ortner et al. 1999; Ortner et al. 2001	Diagnostic ✓
Maxillae: Palatal surface	Abnormal porosity	Ortner and Eriksen 1997; Ortner et al. 1999; Ortner et al. 2001	Diagnostic *Broken*
Mandible: Medial surface/coronoid process	Abnormal cortical porosity, SPNB	Ortner and Eriksen 1997; Ortner et al. 1999; Ortner et al. 2001	Diagnostic ✓
Mandible: Mylohyoid line	Bilateral SPNB	Snoody et al. 2018	Suggestive ✓
Occipital: Inferior surface of pars basilaris	Abnormal cortical porosity, SPNB	Moore and Koon 2017; cf. González et al. 2018	Suggestive ✓
Scapula: Supraspinous fossa	Abnormal cortical porosity	Ortner et al. 2001	Diagnostic *Missing*
Scapula: Infraspinous fossa	Abnormal cortical porosity, SPNB	Ortner et al. 2001	Diagnostic
Ilium: Visceral surface	Abnormal porosity, SPNB, VIs	Brown and Ortner 2011	Suggestive *Missing*
Femur: Linea aspera and surrounding area	SPNB	Buckley et al. 2014	Suggestive ✓

 DOI: 10.21608/shedet.2025.326543.1273

Lesion location	Lesion type	Paleopathological references	Diagnostic strength
Appendicular skeleton: Diaphyses/ metaphyses	SPNB (diffuse)	Merweet al. 2010; Brown and Ortner 2011; Geber and Murphy 2012; Klaus 2014; Buckley et al. 2014; Snoddy et al. 2018	Diagnostic ✓
Ribs: Costochrondral junction	Swelling/flaring	Buckley et al. 2014; Schattmann et al. 2016	Suggestive *Missing*
Ribs: Antero-lateral shaft	SPNB	Buckley et al. 2014;Snoddy et al. 2018	Suggestive *Missing*
Appendicular skeleton	Ossified hematomas: Bilateral	Maat 2004;Merwe et al. 2010	Suggestive ×
Appendicular skeleton	Metaphyseal cupping/flaring	Schattmann et al. 2016	Suggestive ×

Materials and methods

The study comprises a Byzantine skeleton from Tomb 5 at Khirbetel-Bediyah. Age and sex estimation were estimated based on morphological features of the skull and *os coxa* after Buikstra & Ubelaker (1994).

The pathological lesions were examined visually. We used ancient DNA screening to rule out differential diagnoses, i.e. *Mycobacterium tuberculosis* and *Mycobacterium leprae* infections or other-pathogen related explanations for the observed lesions. A sample of the left maxillary first molar was sampled and prepared for pathogen screening at Globe Institute, University of Copenhagen.

Prior to sampling, the tooth (left maxillary M^1) was cleaned with a 50% bleach solution to remove surface contamination. Subsequently, one of the tooth roots was cut off using a handheld Dremel drill fitted with a diamond-coated cutting disc. The root was homogenized, and 112 mg of sample material was transferred into a 5 mL Lo-Bind Eppendorf tube.

DNA was extracted using a standard silica-in-solution protocol developed for human teeth and bone material (Damgaard et al. 2015). The prepared sample was incubated with 1 mL of digestion buffer (0.45 M EDTA, 0.25 mg/mL Proteinase K) for 10 minutes at 37 °C, after which the supernatant was discarded, and 4 mL of fresh digestion buffer was added for overnight incubation at 37 °C. After the digestion, the sample was purified with 50 µl silica pellets (SiO_2) and 40 mL binding buffer (5 M Gu-HCl, 100 mMNaOAc, 20 mMNaCl, 30% isopropanol). Subsequently, the sample was washed twice with ice-cold 80% ethanol and eluted in 30 µl elution buffer EB. An extraction blank containing only molecular grade H_2O was processed alongside the sample to control any potential contamination. The DNA extract was then built into a single-stranded library following the Santa Cruz Reaction (SCR) protocol (Kapp 2021). Prior to the library build, the DNA extract concentration was estimated on Qubit Fluorometric Quantification to determine the input-specific single-strand binding protein (SSB) and adapter dilution tier. 20µl DNA extract was combined with 2µl SSB solution, incubated on a thermocycler for 3 minutes at 95°C, and then moved to a cooling block for 2 minutes. 26µl SCR Mastermix (50% PEG 8000, SCR Buffer, 1M DTT, 100mM ATP, 10000 U/mL T4 PNK, and 2.000.000 U/mL T4 DNA Ligase) along with 2µl P5 and P7 splinted adapter were added to the reaction and incubated at 37°C for 45 minutes.

The library reaction was cleaned up using 1.5X ratio MagBio beads (MagBio Genomics Inc.), washed twice with ice-cold 80% ethanol, and eluted in 60µl elution buffer EBT (EB, 0.05%

Tween-20). A library blank was included to monitor for any potential contamination. The DNA library was indexed and amplified using a 10µl library template, 1x Q5U Master Mix, and 200nM UDI P5 and P7 indexing primers. The PCR cycling conditions were set to denaturation: 98°C for 30 seconds, denaturation: 98°C for 10 seconds, annealing: 65°C for 30 seconds, extension: 72°C for 60 seconds, and the final extension at 72°C for 5 minutes. The optimal number of PCR cycles was determined by real-time PCR (Mx3005 PTM QPCR System). Following amplification, the indexed library was purified, quantified on a fragment analyzer (Agilent), and submitted for sequencing to the GeoGenetics Sequencing Core, Copenhagen, Denmark. The library was sequenced on a 50 bp read length, paired end (PE), Illumina NovaSeq SP flow cell.

Results

Based on long bone measurements and teeth eruption, the individual was a young child between 5.2 to 6.2 years old at death. Skeletal sex estimation based on skull and os coxa morphology was unreliable; however, DNA analysis confirmed the individual was female. (Table 3). Visual examination of the skeleton revealed the presence of several lesions typical of scurvy. The frontal bone exhibits mild porosities (Fig. 2). Moreover, the bilateral greater wings of the sphenoid bone display extensive porosities, a main diagnostic feature of scurvy, although they may also manifest in a few other conditions (Fig. 3) (Ortner & Erickson1997). According to Moore and Koon (2017), one of the most distinctive and extremely important diagnostic manifestations of scurvy is the presence of porosities around the basilar suture (Fig. 4). Among the 25 diagnostic lesions of scurvy in skeletal remains is subperiosteal new bone formation (SPNB) on long bones (Ortner et al. 1999, 2001). Fig. 5 illustrates that SPNB **is** present in two-thirds of the proximal diaphyseal part of the left humerus, located anteriorly. Furthermore, both the left and right femurs express SPNB. The mandible exhibits abnormal cortical porosity, SPNB on the medial surface, mylohyoid line, and coronoid process, which are diagnostic features of scurvy (Fig. 6) (Eggington et al., 2024).

The sequencing results are listed in Table (2). We generated 7,113,203million read pairs for the sample, which resulted in 6,079,087collapsed reads after trimming and QC. The average fragment length of the processed reads was 51 bp.

Table 2: Eager results (Fellows Yates et al. 2021).

Raw reeds	Processed reeds	Mapped	Unique	Endo.	5’ C to T
7,113,203	6,079,087	137,011	102,196	1.7%	9.6%

Human reads

Out of the 6,079,087 reads, 137,011 (2.3%) could be mapped to the human reference genome (hg19). This was reduced to 102,196reads after removing PCR duplicates, representing a human endogenous content of 1.7%. MapDamage results revealed elevated C to T substitution rates of around 10% at the 5’ ends of DNA fragments, indicating that the sample ancient. The results of the sexing analysis revealed that the individual was female (Table 3).

Table 3: Sexing results after Skoglund et al. (2013).

X+Y reads	Y reads	Ry	SE	95% CI	Sex
3,987	40	0.01	0.0016	0.0069- 0.0131	XX

 DOI: 10.21608/shedet.2025.326543.1273

Pathogen screening

The pathogen screening with pathopipe did not reveal any significant hits to any relevant human pathogens. A simple, naïve mapping approach to the *Mycobacterium leprae* (ASM19585v1) and the *Mycobacterium tuberculosis* reference (ASM19595v2) did yield 1,047and 1,513 aligned reads, respectively. However, as shown in Fig.7, the DNA fragments are a poor match for both the *Mycobacterium leprae* and *Mycobacterium tuberculosis* reference genomes suggesting that neither pathogen is present in the

Sample. Instead, the hits to the reference are likely to derive from closely related nontuberculous mycobacteria (NTM) that occur naturally in the burial environment (Borówka et al. 2019).

Discussion

The results of this study confirmed the presence of scurvy in the Early Byzantine period in Khirbet el-Bediyah. The various lesions in the cranium greater wings of the sphenoid, mandible, and long bones of the young child suggest a death while scurvy was active.

While non-specific infections and acquired anemia, conditions to which individuals with scurvy exhibit increased susceptibility (Weinstein et al. 2001; Schattmann et al. 2016; Snoddy et al. 2018), were considered in the differential diagnoses of the observed abnormal new bone formation and porosities, the absence of coincident scorbutic lesions in the parietal and occipital bones suggests that scorbutic hemorrhaging in these locations is improbable. Specifically, cribra orbitalia and porotic hyperostosis were not observed in conjunction with lesions characteristic of vitamin C deficiency.

The disease process and other environmental factors can influence childhood growth rates, leading to inaccurate age estimations based on the length of long bones (Perry & Edwards 2021). The best approach to diagnosing a single case of scurvy is to use a biological approach that looks at the underlying pathophysiological causes of each lesion separately while taking the community as a whole into account (Perry & Edwards 2021). The limited number of skeletal remains from Khirbet el-Bediyah makes it difficult to draw socio-biological conclusions about the community and its interactions with the broader social, political, and environmental factors of the time.

From a narrower perspective of the disease, few studies have documented the occurrence of scurvy in skeletal remains from Jordan. Schultz & Schmidt-Schultz (2019) identified significant cases of scurvy from the Pre-Pottery Neolithic period at Basta, while Ortner et al. (2007) reported cases from Early Bronze Age IA burials at Bab edh-Dhra. More recently, Perry & Edwards (2020, 2021) uncovered scurvy in subadult skeletons from the Late Ottoman-Era at Tell Hisban, a disease prevalent during that time according to ethnohistoric accounts (Abu-Rabia, 2015). These studies that spanned a period of more than 8000 years stressed on the lesser access of vitamin C sources despite the continued development of subsistence economy.

The skeleton presented in this study represents the first documented case of scurvy from Byzantine Jordan. This period also saw other metabolic disorders that, along with other factors, contributed to the collapse of Byzantine society in the region (Al-Shorman 2022). However, the occurrence of scurvy throughout Jordan's archaeological history can largely be attributed to environmental factors, including limited access to a diet rich in vitamin C (Farmer 2004). Prolonged exposure to stressors from social environments, such as discrimination, poverty, or marginalization, also played a significant role in causing physiological changes that led to diseases like scurvy (Krieger 2012). Evidence from several Byzantine-period archaeological sites in Jordan supports this (Al-Shorman 2022).

Interestingly, the site of Khirbet el-Bediyah, where this scurvy case was found, was known for its economic prosperity (Al-Muheisen and Al-Shorman, 2004), a pattern also observed in agriculturally productive areas in Europe (Racanska et al. 2022). This apparent paradox—scurvy occurring in a prosperous context—can be explored through the lens of social identity theory (Tajfel and Turner 1979), which posits that social categories such as gender, class, and potentially ethnicity influence an individual's access to resources. While the site was prosperous overall, access to vitamin C-rich foods, such as, may have been unevenly distributed. For example, if this individual was female, it aligns with broader trends of women in past societies having less access to food resources and social power compared to men (Walker 1986). Further research, including analysis of stable isotopes and paleodietary data, could provide more specific insights into dietary differences between social groups at Khirbet el-Bediyah and other Byzantine sites, helping to understand the factors contributing to nutritional deficiencies like scurvy.

CONCLUSION:

This study provides a robust diagnosis of scurvy in a young child female based on the macroscopic evidence. The observed osteological lesions align with established paleopathological indicators of scurvy, corroborated by ancient DNA analysis to rule out differential diagnoses. As the first documented case of scurvy from the Byzantine period in Jordan, this finding contributes significantly to our understanding of nutritional deficiencies and their skeletal impact on subadult populations in archaeological contexts.

ACKNOWLEDGEMENT:

First of all, we are very grateful to Professor Zaidoun Al-Muheisen, a Professor emeritus, at the Department of Archaeology in Yarmouk University, for access to his skeletal collection. We would like to thank Mr. Yosuf Al-Zoubi, who took several photos for the skeleton. In addition, it is a pleasure to be thankful to the anonymous reviewers.

 DOI: 10.21608/shedet.2025.326543.1273

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FIGURES:

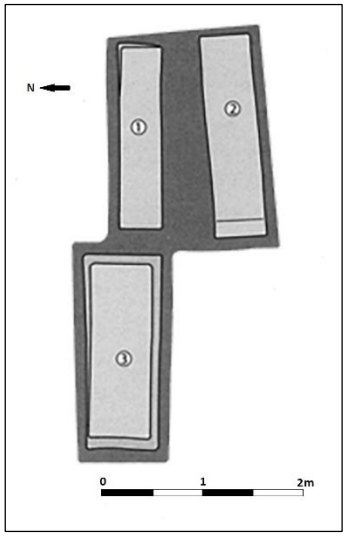

Figure (1): Tomb 5 at the Southern Cemetery of el-Bediyeh.

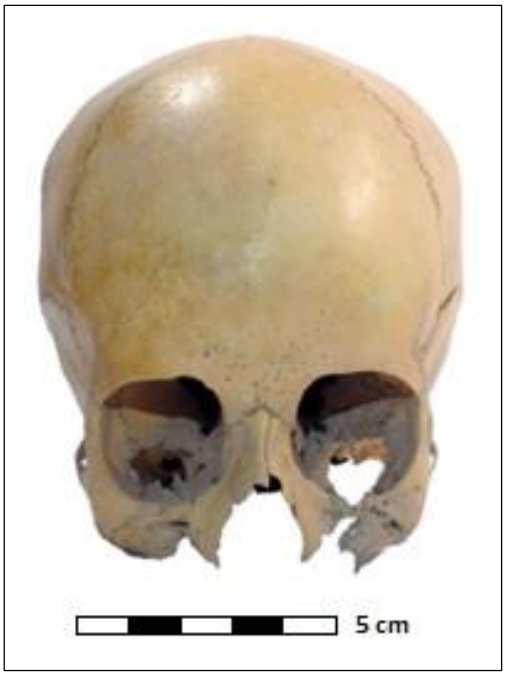

Figure. (2): Mild Porositiesin the Middle of Frontal Bone (Photographed by Al-Zoubi).

 DOI: 10.21608/shedet.2025.326543.1273

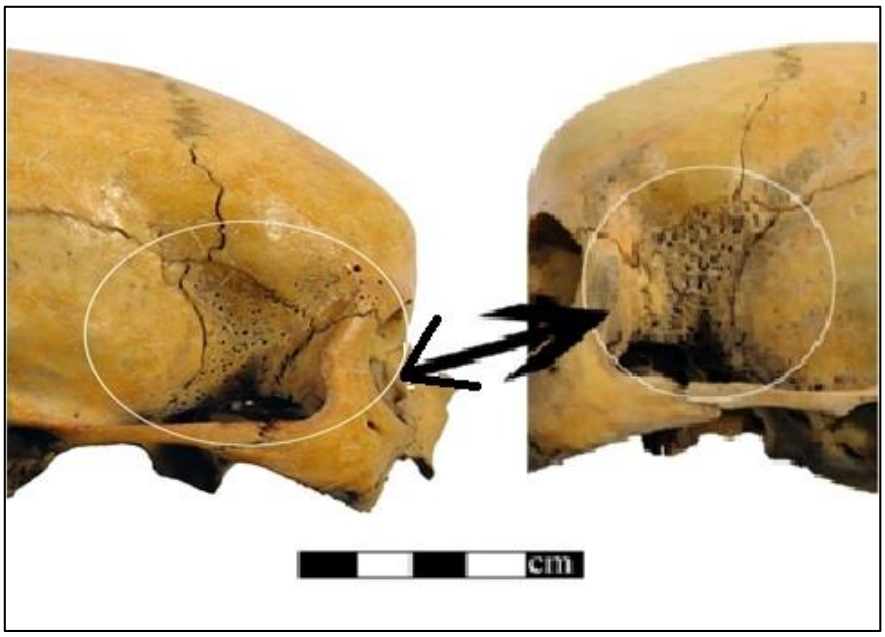

Figure (3): Porosities on the Greater Wings of Sphenoid Bone (Photographed by Al-Zoubi).

Figure (4): Porosity around a Basilar Suture (Photographed by Al- Zoubi).

Figure (5): Subperiosteal New Bone Formation (SPNB) on the Proximal Diaphyseal Part of Left Humerus, Right Femur, and Left Femur (Photographed by Al- Zoubi).

Figure (6): New Bone Formation, Porosities and Perforation of the Right Mandible (Photographed by Al-Zoubi).

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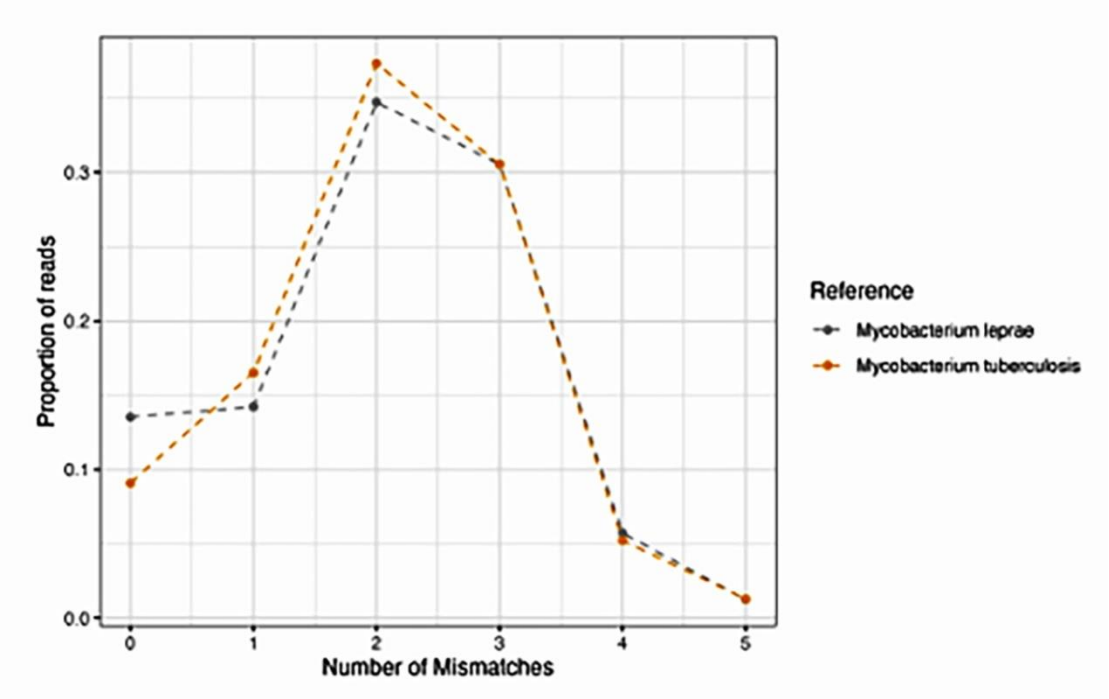

Figure (7): Edit Distance Plot for Reads Aligning to the *Mycobacterium leprae* (ASM19585v1) and *Mycobacterium tuberculosis* (ASM19595v2) Reference Genomes, respectively.

حاله محتمله لمرض نقص فيتامين C في هيكل عظمي لطفله مكتشف في البديّه: موقع أثري بيزنطي في الاردن

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الملخص

يؤدي مرض نقص فيتامين C (Scurvy) الى ظهور علامات مميزه على الهيكل العظمي، والتي بدورها تزودنا برؤى حول خصائص هذا المرض الايضي حسب دراسات علم الاثار الحيوي. يتناول هذا البحث مرض نقص فيتامينC بناءا على ألعلامات الظاهرة على بقايا هيكل عظمي لطفله من موقع البديّة الاثري الواقع في الاردن ويعود الى الفترة البيزنطية. ومما يميز هذا الدراسة، رغم تشخيص حالات عديدة في هياكل عظمية من مواقع اثرية متعددة في العالم ،الا أن عدد الابحاث التي تناولت مرض نقص فيتامين C في الاردن قليلة، ولذلك تعتبر هذه الدراسة ذات قيمة عالية حيث تساعدنا على الفهم الواسع للصحة والمرض في هذا الموقع الاثري خلال الفترة البيزنطية.بناءا على تحليل بقايا الهيكل العظمي، تم تحديد ألاعراض الدالة على مرض نقص فيتامينC وهي تشكل عظم جديد على السطح الخارجي للعظام الطويلة والنخرفي عظام الجمجمة وتشوهات في عظام القشرة للفك السفلي. هذه العلامات تتشابه مع تلك التي تظهر نتيجة لمرضي السل والجذام مما يوجب القيام بتحاليل اضافية لتشخيص المرض بشكل مؤكد وتحييد الامراض الاخرى. وبناءا على ذلك، فقد تم تحليل الحمض النووي القديم في عينات اخذت من الاسنان حيث أشارت النتائج الى عدم وجود البكتيريا المسببة لمرضي السل والجذام وعليه تم التاكد أن المرض هو نقص فيتامين.C

تلقي الدراسة الضوء على أهمية مرض نقص فيتامين C في الاردن خلال الفترة البيزنطية وتساهم في اثراء المعرفة حول مشاكل التغذية والفوارق الصحية واثارها الاجتماعية والاقتصادية في مجتمعات حوض البحرالابيض المتوسط القديمة.

بيانات المقال

تاريخ المقال
تم الاستلام في ٧ أكتوبر ٢٠٢٤
تم استلام النسخة المنقحة في ٤ يناير ٢٠٢٥
تم قبول البحث في ٢ فبراير ٢٠٢٥
متاح على الإنترنت في ٢٤ فبراير ٢٠٢٥

الكلمات الدالة

مرض نقص فيتامين C ; الفترة البيزنطية ؛ المؤشرات العظمية ؛ خربة البديّه; الاردن

 DOI: 10.21608/shedet.2025.326543.1273