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HUMAN REMAINS FROM A SECONDARY CEMETERY IN THE PYRAMID COMPLEX OF KING DJEDKARE: A PRELIMINARY OVERVIEW

ABSTRACT: The aim of this paper is to present the preliminary results of the recent osteological analysis of the human remains discovered to the north of the funerary temple of King Djedkare at south Saqqara. The excavation began in spring 2018 as a part of Djedkare Project of the exploration and documentation of the pyramid complex of king Djedkare, directed by Mohamed Megahed. This paper will investigate some of the burials discovered in the so-called T.g area which is situated between the funerary temple of the king and the south side of the pyramid of the queen. The burials date back from the late Second Intermediate Period probably to the 1st millennium BCE based on the preliminary analysis of the pottery. The burials were discovered in three levels, the earlier burials in the bottom levels of the debris were in extended north-south or east-west position. Also, the upper-level burials were in extended east-west positions. The Middle level contains burials in ceramic coffins Besides the variety of burial customs and the correlation between age, sex, and grave good, The good preservation of bones surface allowed to record the pathological diseases. Many evidences recorded for activity-related skeletal changes, including degenerative disease in the spines and other joints in the older adult groups. Moreover, trauma (including fractures) was noted in any individuals, affecting the shoulders, femurs, hands and pelvis. It is likely that childhood stress observed in several individuals in the form of iron deficiency anaemia and dental developmental disorders. In some cases, evidence for spondylolysis, which might have been unilateral or bilateral, was observed. More unusual pathological conditions observed included infectious defects in the skull of a young adult female and a possible case of blunt force trauma. Several dental diseases were observed in Djedkare secondary cemetery individuals, including tooth attrition, abscesses, ante-mortem tooth loss and calculus, which related to age changes. This preliminary overview study will contribute to add new non-elite cemetery results and aim to make it accessible for researchers additionally, investigate the biological profile as sex, age, stature. Moreover, sheds light on the distribution of pathologies inside the assemblage.

KEY WORDS: Saqqara – King Djedkare – Human remains – Paleopathology – Pyramid complex

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1. INTRODUCTION

Despite the limited general attention that was paid to the non-elite secondary cemeteries in Egyptology, material from several sites was published during 1990s and 2000s. Most of them dates to Late Period onward. They include e.g. the Wall of the Crow cemetery at Giza plateau (Kaiser 2018: 70), and several groups of finds from Saqqara and Abusir, including the Teti cemetery at Saqqara (Bentley 1999), the mastaba of Akhethetep (Janot *et al.* 2001), the Anubeion (Giddy 1992), the cemetery around the tombs of Nyankhnefertem and Merefnebef (Myśliwiec 2008), and the mastaba of Ptahshepses (Strouhal, Bareš 1993). In addition, the non-elite cemetery at Deir el-Ballas can be counted as well (Jensen 2019: 70). Djedkare secondary cemetery is one of the non-elite cemeteries which located approximately 24 km south of Giza, at south Saqqara, which known as El-Shawaf El-Qibly, where the pyramid complex of King Djedkare is situated. The Egyptian archaeological mission headed by *Mohamed Megahed* started to explore Djedkare's pyramid complex in 2009. Previously, it was excavated between 1945–1946 by *Abdel Salam Hussein* (Verner 2000: 410, Megahed 2011: 617–619), and 1952 by *Ahmed Fakhry*. After minor works in the 1980's a number of human skeletal remains were found inside and outside the pyramid of Djedkare (Batrawi 1947: 98). In 2018 and 2019 the excavation concentrated on a previously unexcavated part of the monument, the so-called *T.g* area (Megahed *et al.* 2019: 19–34) to the north of the funerary temple of Djedkare and to the south of the queen's pyramid (*Figure 1*).

This area was used as a secondary burial site after the Old Kingdom for many generations.

According to the Egyptian mission team, T.g Area is divided into three levels (Megahed *et al.* 2019: 19–

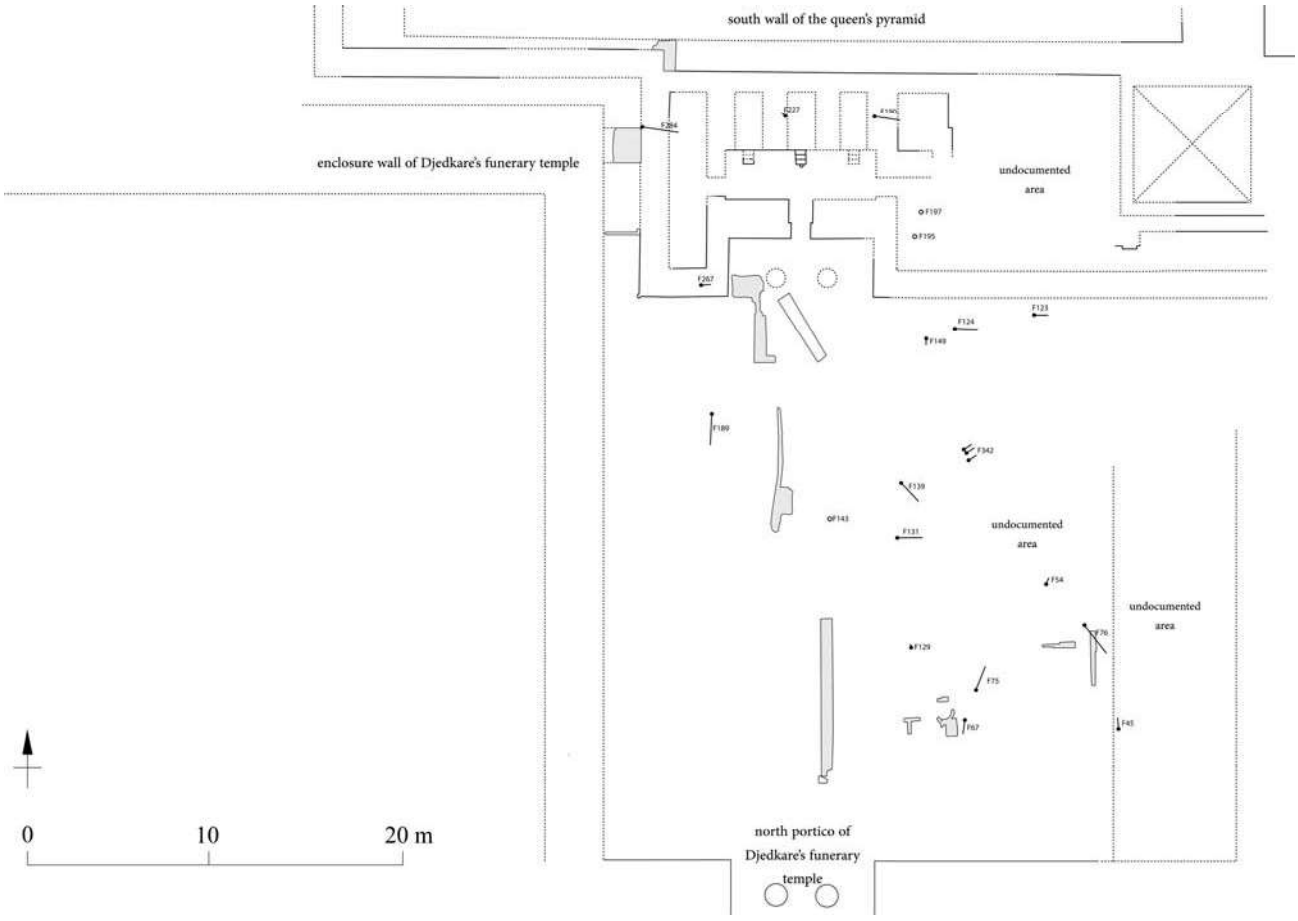

FIGURE 1: Plan of area T.g at Djedkare's pyramid complex with selected objects associated with burials (after Maragioglio, Rinaldi 1977; drawing Mohamed Megahed).

34): the upper level, the middle level, and the bottom level. Each level contains different types of debris and artifacts that provide valuable information about the history and development of the area.

Upper Level: The upper level is characterized by the presence of clean yellow wind-blown sand. The previously explored parts of this area were apparent due to the presence of clean yellow wind-blown sand.

Middle Level: The middle level is composed of yellow sand with some limestone chips. This level also includes several burials in ceramic coffins and small, simple structures made of irregular stones. The middle level has an elevation of around 47 meters above sea level (Megahed *et al.* 2019: 19).

Bottom Level: The bottom layer of the T.g Area is divided into two sectors: the west sector and the east sector. The west sector is covered with a thick layer (around 1–1.2 meters) of very fine dark grey dust. This layer, known as trash layer 1, resulted from waste accumulation during the late Old Kingdom and First Intermediate Period. It contains a large number of pottery fragments, small fragments of animal bones, clay cretulae with seal impressions, fragments of small offering tables and libation basins, gaming pieces, beads, and other small-sized finds (Megahed *et al.* 2019: 20–21).

The east sector of the bottom level consists of brown sand with a large number of pebbles and mud brick destruction, particularly in the southeast corner. It contains a significant quantity of pottery fragments, including complete vessels, mostly small cups, dating to the late Second Intermediate Period and early New Kingdom. The debris in the east sector also includes numerous burials placed near and over each other, with various orientations and associated equipment (Megahed *et al.* 2019: 21–23; see also Vymazalová, Hashesh 2019: 75–101)

2. METHODS AND THE EXAMINED SAMPLE

The material presented in this paper constitutes one part of the finds from the T.g area that has been studied up until 2022; another part has not yet been studied in detailes. The first preliminary analysis of a smaller sample of these burials focused on burials associated with grave goods (Vymazalová, Hashesh 2019) while the following study included a smaller part of the discovered 62 excavation numbers including 92 individuals (Hashesh, Gabr 2020). The current paper extends the studied material; of the 120 excavation numbers documented in the *T.g* area, it presents the results of the study of 185 individuals. These contained 139 primary individuals, and additional 46 secondary skeletons (*Figure 1, Table 1).*

The excavation number *DJ-F219-2018* contains comingled remains discovered in the T.g area, NW sector, between level 2 to level 6. A minimum number of individuals analysis was applied to the sample revealing the results of a minimum 15 individuals, seven were young adults and eight were juveniles (*Table 1).*

The cemetery population encompassed all age categories. Notably, children under the age of twelve (infants, young children, and older children) comprised the largest portion of the sample (91 out of 185 individuals), with 34 infants and 57 children. Adolescents (aged 12–20 years) constituted 13 individuals.

TABLE 1: Age, sex, and pathology in the secondary cemetery of king Djedkare.

Skeleton N	Excavation N	Area	Sex	Age	Primary/ Secondary
1	DJ-F45-2018	T.g, E sector, S part, level 3	Unknown	Young child	Primary
2	DJ-F54-2018	T.g, E2 sector, S part, level 2	Unknown	Young child	Primary
3	DJ-F67-2018	T.g, E2 sector, S part, level 3	Unknown	Older child	Primary
4	DJ-F75-2018	T.g, E2 sector, S part, level 4	Female	Middle adult	Primary
5	DJ-F76-2018	T.g, E2 sector, S part, level 4	Unknown	Older child	Primary
6	DJ-F123-2018	T.g, central sector, N part	Unknown	Infant	Primary
7	DJ-F124-2018	T.g, central sector	Female?	Adolescent	Primary
8	DJ-F124-2018	T.g, central sector	Female?	Adolescent	Secondary
9	DJ-F129-2018	T.g, central sector	Unknown	Older child	Primary
10	DJ-F127-2018	T.g, central sector	Unknown	Infant	Primary

TABLE 1: Age, sex, and pathology in the secondary cemetery of king Djedkare. Continued.

Skeleton N	Excavation N	Area	Sex	Age	Primary/ Secondary
11	DJ-F128-2018	T.g, central sector	Unknown	Infant	Primary
12	DJ-F131-2018	T.g, central sector	Female	Middle adult	Primary
13	DJ-F131-2018	T.g, central sector	Female	Adult	Secondary
14	DJ-F139-2018	T.g, central sector	Female	Young adult	Primary
15	DJ-F139-2018	T.g, central sector	Unknown	Adult	Secondary
16	DJ-F139-2018	T.g, central sector	Unknown	Older child	Primary
17	DJ-F139-2018	T.g, central sector	Female	Adolescent	Primary
18	DJ-F143-2018	T.g, central sector	Unknown	Infant	Primary
19	DJ-F139-2018	T.g, central sector	Unknown	Older child	Secondary
20	DJ-F139-2018	T.g, central sector	Unknown	Adolescent	Secondary
21	DJ-F149-2018	T.g, central sector, NW part, level 3	Female	Adolescent	Primary
22	DJ-F189-2018	T.g, W sector, E part, level of the trash layer	Unknown	Older child	Primary
23	DJ-F189-2018	T.g, W sector, E part, level of the trash layer	Unknown	Young child	Secondary
24	DJ-F190-2018	T.g , N sector, W end, level 2	Male	Adolescent	Primary
25	DJ-F195-2018	T.g N sector, W part, level 3	Unknown	Infant	Primary
26	DJ-F197-2018	T.g, N sector, W part, level 3 level	Unknown	Infant	Primary
27	DJ-F227-2018	T.g, NW sector, level 4 central part	Unknown	Young child	Primary
28	DJ-F263-2018	T.g, NW sector, level 6	Female	Young adult	Primary
29	DJ-F267-2018	T.g, NW sector, level 6	Unknown	Young child	Primary
30	DJ-F284-2018	T.g, NW sector, W part	Unknown	Infant	Primary
31	DJ-F286-2018	T.g, NW sector, W part	Female	Middle adult	Primary
32	DJ-F267-2018	T.g, NW sector, level 7	Unknown	Infant	Secondary
33	DJ-F342-2018	T.g, central sector	Unknown	Infant	Primary
34	DJ-F342-2018	T.g, central sector	Unknown	Infant	Primary
35	DJ-F342-2018	T.g, central sector	Unknown	Infant	Primary
36	DJ-F40-2018	T.g, central sector	Unkown	Adult	Primary
37	Dj-F46-2018	T.g, E sector, level 3	Unkown	Older child	Primary
38	Dj-F50-2018	T.g, E2 sector, N/central part, level 2	Male	Young adult	Primary
39	Dj-F50-2018	T.g, E2 sector, N/central part, level 2	Unkown	Older child	Secondary
40	Dj-F50-2018	T.g, E2 sector, N/central part, level 2	Female?	Adult	Secondary
41	Dj-F50-2018	T.g, E2 sector, N/central part, level 2	Male?	Adult	Secondary
42	Dj-F52-2018	T.g, E2 sector, central part, level 2	Female	Adult	Primary
43	Dj-F55-2018	T.g, E2 sector, S part, level 2	Female	Young adult	Primary
44	Dj-F56-2018	T.g, E2 sector, central part, level 2	Female	Young adult	Primary
45	Dj-F58-2018	T.g, E2 sector, S part, level 3	Unkown	Adolescent	Primary
46	Dj-F60-2018	T.g, E2 sector, S part, level 3	Female	Middle adult	Primary
47	Dj-F60-2018	T.g, E2 sector, S part, level 3	Female?	Adult	Secondary
48	Dj-F62-2018	T.g, E2 sector, S part, level 4	Male	Young adult	Primary
49	Dj-F69-2018	T.g, E2 sector, S part, level 3	Female	Middle adult	Primary
50	Dj-F69-2018	T.g, E2 sector, S part, level 3	Unkown	Adult	Secondary

51	Dj-F72-2018	T.g, E2 sector, N part, level 3	Unkown	Older child	Primary
52	Dj-F73-2018	T.g, E2 sector, N part, level 3	Unkown	Young child	Primary
53	Dj-F78-2018	T.g, E2 sector, S part, level 4	Unkown	Young adult	Primary
54	Dj-F78-2018	T.g, E2 sector, S part, level 4	Unkown	Older child	Primary
55	Dj-F80-2018	T.g, W sector, central part, level 1	Male	Adult	Primary
56	Dj-F81-2018	T.g, E2 sector, S part, level 4	Female	Young adult	Primary
57	Dj-F81-2018	T.g, E2 sector, S part, level 4	Female	Middle adult	Primary
58	Dj-F85-2018	T.g, E2 sector, S part, level 4	Male	Young adult	Primary
59	Dj-F85-2018	T.g, E2 sector, S part, level 4	Male	Young adult	Primary
60	Dj-F87-2018	T.g, E2 sector, S part, level 4	Female ?	Young adult	Primary
61	Dj-F88-2018	T.g, E2 sector, S part, level 4	Male	Middle adult	Primary
62	Dj-F89-2018	T.g, W sector, level 1	Male	Adult	Primary
63	Dj-F91-2018	T.g, W sector, central part, level 1	Female	Middle adult	Primary
64	Dj-F93-2018	T.g, W sector, central part, level 1	Unkown	Older child	Primary
65	Dj-F94-2018	T.g, W sector level 1	Unkown	Older child	Primary
66	Dj-F94-2018	T.g, W sector level 1	Unkown	Adult	Secondary
67	Dj-F266-2018	T.g, NW sector, level 6	Unkown	Infant	Primary
68	Dj-F92-2018	T.g, E2 sector, central part, level 4	Unkown	Older child	Primary
69	Dj-F95-2018	T.g, W sector level 1	Male	Young adult	Primary
70	Dj-F101-2018	T.g, W sector level 1	Unkown	Young child	Primary
71	Dj-F102-2018	T.g, W sector, level 2, central-E group	Male	Young adult	Primary
72	Dj-F118-2018	T.g, central sector, level 2	Female?	Adult	Primary
73	Dj-F119-2018	T.g, central sector, level 2	Female	Adult	Primary
74	Dj-F119-2018	T.g, central sector, level 2	Unkown	Infant	Primary
75	Dj-F121-2018	T.g, central sector, N part	Female?	Middle adult	Primary
76	Dj-F121-2018	T.g, central sector, N part	Female?	Adolescent	Primary
77	Dj-F125-2018	T.g, central sector	Male	Adolescent	Primary
78	Dj-F121-2018	T.g, central sector, N part	Unkown	Older child	Primary
79	Dj-F126-2018	T.g, central sector	Female	Young adult	Primary
80	Dj-F126-2018	T.g, central sector	Unkown	Young child	Secondary
81	Dj-F130-2018	T.g, central sector, S part, level 3	Male	Young adult	Primary
82	Dj-F130-2018	T.g, central sector, S part, level 3	Female	Adolescent	Primary
83	Dj-F132-2018	T.g, central sector, S part, level 3	Unkown	Young child	Primary
84	Dj-F136-2018	T.g, central sector, level 3	Unkown	Infant	Primary
85	Dj-F133-2018	T.g, central sector, S part, level 3	Unkown	Infant	Primary
86	Dj-F133-2018	T.g, central sector, S part, level 3	Unkown	Young child	Secondary
87	Dj-F134-2018	T.g, central sector, S part, level 3	Unkown	Adult	Primary
88	Dj-F134-2018	T.g, central sector, S part, level 3	Female	Adolescent	Primary
89	Dj-F140-2018	T.g, central sector, level 3	Female	Adult	Primary
90	Dj-F68-2018	T.g, E2 sector, S part, level 3	Male	Young adult	Primary
91	Dj-F68-2018	T.g, E2 sector, S part, level 3	Male?	Adult	Secondary
92	Dj-F68-2018	T.g, E2 sector, S part, level 3	Female	Adolescent	Primary
93	Dj-F98-2018	T.g, E2 sector, central part, level 4	Unkown	Infant	Primary

TABLE 1: Age, sex, and pathology in the secondary cemetery of king Djedkare. Continued.

Skeleton N	Excavation N	Area	Sex	Age	Primary/ Secondary
94	Dj-F141-2018	T.g, central sector, level 3	Male	Young adult	Primary
95	Dj-F144-2018	T.g, central sector, N part	Female	Young adult	Primary
96	Dj-F144-2018	T.g, central sector, N part	Unkown	Older child	Primary
97	Dj-F145-2018	T.g, central sector, N part	Male	Young adult	Primary
98	Dj-F145-2018	T.g, central sector, N part	Female	Young adult	Primary
99	Dj-F145-2018	T.g, central sector, N part	Male	Young adult	Secondary
100	Dj-F145-2018	T.g, central sector, N part	Female	Young adult	Secondary
101	Dj-F147-2018	T.g, central sector, level 3, W part	Unkown	Young child	Primary
102	Dj-F151-2018	T.g, Central sector, W part, level 3	Unkown	Older child	Primary
103	Dj-F151-2018	T.g, Central sector, W part, level 3	Male	Old adult	Secondary
104	Dj-F158-2018	T.g, E2 sector, S part, level 4	Unkown	Adult	Secondary
105	Dj-F157-2018	T.g, E2 sector, S part, level 4	Unkown	Adolescent	Primary
106	Dj-F159-2018	T.g, E2 sector, S part, level 4	Unkown	Young child	Primary
107	Dj-F160-2018	T.g, E2 sector, S part, level 4	Male	Young adult	Primary
108	Dj-F160-2018	T.g, E2 sector, S part, level 4	Male	Adolescent	Primary
109	Dj-F161-2018	T.g, E2 sector, S part, level 4	Unkown	Young child	Primary
110	Dj-F166-2018	T.g, E2/central sector, central part, level 4	Male	Middle adult	Primary
111	Dj-F171-2018	T.g, central sector/E2 sector	Unkown	Young child	Primary
112	Dj-F173-2018	T.g, N sector, S part	Male	Middle adult	Primary
113	Dj-F173-2018	T.g, N sector, S part	Unkown	Infant	Secondary
114	Dj-F172-2018	T.g, central sector/E2 sector, central part	Female?	Middle adult	Primary
115	Dj-F175-2018	T.g, N sector, S part, level 3	Female	Adult	Primary
116	Dj-F178-2018	T.g, central sector, level 4	Unkown	Infant	Primary
117	Dj-F183-2018	T.g, N sector, level 2	Unkown	Young child	Primary
118	Dj-F182-2018	T.g, N sector, level 3	Female	Middle adult	Primary
119	Dj-F182-2018	T.g, N sector, level 3	Unkown	Adult	Secondary
120	Dj-F186-2018	T.g, N sector, level 3	Unkown	Older child	Primary
121	Dj-F186-2018	T.g, N sector, level 3	Unkown	Young child	Secondary
122	Dj-F285-2018	T.g, NW sector, W part	Unkown	Infant	Secondary
123	Dj-F193-2018	T.g, N sector, W part, level 3	Unkown	Older child	Primary
124	Dj-F194-2018	T.g N sector, W part	Unkown	Young child	Primary
125	Dj-F194-2018	T.g N sector, W part	Unkown	Infant	Primary
126	Dj-F203-2018	T.g, central sector, N part	Female	Young adult	Primary
127	Dj-F204-2018	T.g, central sector, N part, floor level	Male	Young adult	Primary
128	Dj-F204-2018	T.g, central sector, N part, floor level	Unkown	Young child	Primary
129	Dj-F205-2018	T.g, central sector, NW part	Male	Young adult	Primary
130	Dj-F205-2018	T.g, central sector, NW part	Unkown	Young child	Primary
131	Dj-F205-2018	T.g, central sector, NW part	Male	Young adult	Secondary
132	Dj-F206-2018	T.g, central sector, NW part	Male	Adult	Primary
133	Dj-F206-2018	T.g, central sector, NW part	Unkown	Infant	Secondary

134	Dj-F206-2018	T.g, central sector, NW part	Unkown	Adult	Secondary
135	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Infant	Secondary
136	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Infant	Secondary
137	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Young child	Secondary
138	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Older child	Secondary
139	Dj-F219-2018	T.g, central sector, level 3	Unkown	Young child	Secondary
140	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Older child	Secondary
141	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Older child	Secondary
142	Dj-F219-2018	T.g, NW sector, level 2	Unkown	Young child	Secondary
144	Dj-F219-2018	T.g, NW sector, level 2	Male	Young adult	Secondary
145	Dj-F219-2018	T.g, NW sector, level 2	Male?	Young adult	Secondary
147	Dj-F219-2018	T.g, NW sector, level 2	Male	Young adult	Secondary
148	Dj-F219-2018	T.g, NW sector, level 2	Male	Young adult	Secondary
149	Dj-F219-2018	T.g, NW sector, level 2	Female ?	Young adult	Secondary
150	Dj-F219-2018	T.g, NW sector, level 2	Female	Young adult	Secondary
151	Dj-F219-2018	T.g, NW sector, level 2	Female	Young adult	Secondary
225	Dj-F222-2018	T.g, NW sector, level 3	Unkown	Young child	Primary
226	Dj-F228-2018	T.g, NW sector, level 4	Male	Adult	Primary
227	Dj-F228-2018	T.g, NW sector, level 4	Unkown	Infant	Secondary
228	Dj-F229-2018	T.g, NW sector, level 5, S part	Male	Old adult	Primary
229	Dj-F231-2018	T.g, NW sector, level 5	Unkown	Young child	Secondary
230	Dj-F232-2018	T.g, NW sector, level 5, S part	Female	Young adult	Primary
244	Dj-F273-2018	T.g., NW sector, level 6	Unkown	Infant	Primary
245	Dj-F243-2018	T.g., NW sector, N part.	Unkown	Young child	Primary
246	Dj-F243-2018	T.g., NW sector, N part.	Unkown	Infant	Primary
247	Dj-F242-2018	T.g., NW sector, N part.	Unkown	Infant	Primary
248	Dj-F296-2018	PQ area, SW corner sector, level 2	Unkown	Young child	Primary
249	Dj-F298-2018	PQ area, SW corner sector, level 2	Unkown	Infant	Primary
250	Dj-F368-2020	T.g, burial of a child with beads	Unkown	Young child	Primary
251	Dj-F357-2019 A	between the SE corner of king's pyramid and the south	Unkown	Young child	Primary
252	Dj-F367-2020A	T.g	Unkown	Young child	Primary
253	Dj-F367-2020A	T.g	Unkown	Infant	Primary
254	Dj-F370-2020	T.g	Unkown	Young child	Primary
255	Dj-F238-2018	NE corner of limestone structure F237, Area T.g,	Female	Young adult	Primary
256	Dj-F234-2018	T.g, NW sector, Level 4, from debris in the structure F234	Unkown	Young child	Primary
257	Dj-F235-2018	T.g, NW sector, Level 5, S part	Female	Young adult	Primary
258	Dj-F240-2018	T.g, NW sector, Level 5	Unkown	Young child	Primary
259	Dj-F240-2018	T.g, NW sector, Level 5, W part	Unkown	Infant	Primary
260	Dj-F241-2018	Part of a burial, T.g., NW sector, Level 5	Unkown	Older child	Primary
261	Dj-F244-2018	Part of a burial, T.g., NW sector, Level 6	Unkown	Adult	Primary
262	Dj-F247-2018	T.g, NW sector, Level 6	Male	Young adult	Secondary
263	Dj-F247-2018	T.g, NW sector, Level 6	Unkown	Young child	Primary
264	Dj-F247-2018	T.g, NW sector, Level 6	Unkown	Adult	Secondary

TABLE 1: Age, sex, and pathology in the secondary cemetery of king Djedkare. Continued.

Skeleton N	Excavation N	Area	Sex	Age	Primary/ Secondary
265	Dj-F250-2018	T.g, NW, level 6, S end.	Male	Young adult	Primary
266	Dj-F255-2018	NW sector, E Part	Unkown	Infant	Primary
267	Dj-F258-2018	NW sector, level 6, N part.	Unkown	Young child	Primary
268	Dj-F259-2018	T.g, NW sector, level 6, N Part.	Unkown	Older child	Primary
269	Dj-F261-2018A	T.g, NW sector, level 6	Male	Young adult	Primary
270	Dj-F262-2018	T.g, NW sector, Level 6	Unkown	Older child	Primary
271	Dj-F265-2018	T.g, NW sector, level 6	Female	Middle adult	Primary
272	Dj-F268-2018A	T.g,NW sector, Level 6	Male	Young adult	Primary
273	Dj-F276-2018	T.g, NW sector, level 6 NW part	Unkown	Infant	Primary

A preliminary investigation of the age distribution revealed a high childhood mortality rate, particularly between 3–12 years of age, compared to other age groups.

The osteological analysis was by visual examination, recording was based on the standards presented in (Bass 1995, Buikstra, Ubelaker 1994). Sex and age assessment were based on both pelvic and cranial dimorphic traits (Brookes, Suchey 1990, Lovejoy *et al.* 1985). For children, age assessment was carried out using epiphyseal fusion status and long bone measurements (Scheuer, Black 2004) and dental development (AlQahtani *et al.* 2010). The stature is calculated using both tibia and femur combined whenever possible, tibia or femur alone, or both humerus and radius length when the leg bones are not available based on Raxter *et al.* (2008) formulae for Egyptians remains.

All age categories were represented in the cemetery. Children under the age of twelve (i.e Infant, young child, older child) make up 91 individuals of 185 of the sample as 34 infants, 57 children. Adolescents (individuals between 12–20 years of age) make up 13 individuals of the material. Based on the preliminary investigation of age distribution in the cemetery, the childhood mortality between 3–12 years was high compared with the others, which suggests that the riskiest stage in the individual's age period was childhood especially the period of lactation and weaning. In addition, the workload of children in non-elite communities whenever they were able to help with daily activities might be also one of the reasons for high mortality. Hence, this result is consistent with several studies (e.g. Barker, Osmond 1986, Goodman 1996, Humphrey, King 2000, Cameron,

TABLE 2: Age and sex distribution in the secondary cemetery of king Djedkare.

	Male (M)	Probable male (M?)	Female (F)	Probable female(F?)	Unknown (Ambiguous)	Total
Infant	-	-	-	-	-	34
Young child	-	-	-	-	-	33
Older child	-	-	-	-	-	24
adolescent	3		5	3	2	13
Young adult	22	1	13	2	1	39
Middle adult	3	-	10	2	-	15
Old adult	2	-	-	-	-	2
Adult	4	2	5	3	11	25
Total	36	3	33	10	14	185

FIGURE 2: Multiple amulets discovered with some children and women burials (Photo H. Vymazalová).

Demerath 2002, Armelagos *et al.* 2009, Shidner 2018, Kaiser 2018).

Among the adults, the largest age group is the young adults between the ages of twenty to thirty-five, which comprise 39 individuals of the sample, after which the numbers decline with advancing age, with only 15 of the individuals estimated to have been middle adults between thirty-five to forty-nine, then the lowest age group in the material is the old adult group (above the age of 50) at time of death only two individuals. Individuals that could not be aged more narrowly than "Adult" comprise 25 individuals (*Table 2*).

Among adults, young adults (aged 20–35) formed the largest group (39 individuals). The number of individuals declined with advancing age, with only 14 estimated to be middle adults (aged 35–49) and a mere two individuals exceeding 50 years (old adults). Twenty-five Individuals could not be aged more narrowly than "Adult" (*Table 2*).

Unlike elaborate elite burials, the Djedkare secondary cemetery lacked evidence of complex mummification practices up till now. The bodies were simply wrapped in linen, with no record of embalming or intentional dehydration. Natural mummification was observed in just two exceptional cases *[excav nos. DJ-F263-2018; DJ-F286-2018]* – individuals buried within intact pottery coffins, which likely facilitated the process (Megahed *et al.* 2019).

Grave goods were primarily limited to burials of subadults and a few adult females (Binford 1972, Vymazalová, Hashesh 2019). Amulets depicting deities like Ra, Isis, Taweret, Horus, Bes, and Heqet were the most common inclusions, believed to offer protection, aid resurrection, or invoke divine assistance during the afterlife journey (Andrews 1994, Robins 1993; *Figure 2*).

3. An analysis of skeletal remains from the Djedkare secondary cemetery revealed a range of dental pathologies within the population (*Table* 3). These conditions included dental calculus, caries (cavities), abscesses, and congenital malformations like crowding and transmigration.

TABLE 3: Number of occurrences of pathological lesions. DJD – degenerative joint disease, Arth. – arthritis, Ost. – osteophytes, SN – Schmorl's nodes, Attr. – attrition, PD – periodontal disease, EH – enamel hypoplasia, Fr. – fractures, CO – cribra orbitalia, SBO – spina bifida occulta, OSTEo – Osteoporosis, Others – syndactyly, Asymmetrical and hypoplastic, non S – Infec – non specific infection, S – Infec.

Skeleton No.	Joint Diseases				Diseases of the Dentition						Trauma	Hematological Disorders			Congenital Anomalies			Infection diseases	
	DJD	Arthr	Ost	SN	Attri	CAR	PD	EH	Cal	Absc	FRC	CO	PH	Osteo	Sbo	Sacr	Others	Non-S Infec	S – Infec
1	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
3	–	–	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–
4	+	_	+	–	–	–	–	+	–	–	+	–	–	–	–	–	–	–	–
5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–
7	–	–	–	–	–	–	_	+	–	–	+	–	–	–	–	–	–	–	–
8	–	–	–	–	–	+		+	–	–		–	–	–	–	–	–	–	–
12	+	+	+	+	+	–	–	–	–	–	+	–	–	–	–	–	–	–	–
14	+	+	–	+	–	+	+	–	–	–	+	–	–	–	–	–	–	–	–
16					–	–	–	–	–	–	–	+	–	–	+	–	–	–	–
17	–	–	–	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–
21	–	–	–	–	–	–	+	+	–	–	–	+	–	–	–	–	–	–	–
24	–	–	–	–	+	–	+	+	–	–	–	–	–	–	+	–	–	–	–
25	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
27	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
30	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
31	+	–	+	+	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–

Skeleton No.	Joint Diseases				Diseases of the Dentition						Trauma	Hematological Disorders			Congenital Anomalies			Infection diseases	
36	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
38	–	–	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–
42	–	–	+	–	+	+	+	–	–	–	–	–	–	–	–	–	–	–	–
43	–	–	+	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–
46	–	–	+	–	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–
47	–	–	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–
48	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–
49	–	+	+	–	+	–	–	+	–	–	–	–	–	–	–	–	–	–	–
52	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
53	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
56	–	–	+	+	–	+	–	–	–	–	–	–	–	–	+	–	–	–	–
57	–	+	+	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
58	–	–	–	–	+	+	–	+	–	–	–	–	–	–	+	–	–	–	–
59	+	+	+	+	+	–	–	+	–	–	+	–	–	–	–	–	–	–	–
60	–	–	+	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
61	–	–	–	–	–	–	–	+	–	–	+	–	–	–	–	–	–	–	–
68	–	–	–	–	–	–	–	+	–	–	–	+	–	–	–	–	–	–	–
69	+	–	+	+	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
71	+	–	+	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–
72	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
76	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	–	–	–
77	–	–	–	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–
79	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	–	–
81													–	–	–	+		–	–
87	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–
88	–	–	–	–	–	+	–	–	–	–	+	–	–	–	–	–	–	–	–
90	–	–	+	–	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–
94	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
95	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
97	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–
99	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–
102	–	–	–	–	–	–	+	+	+	–	–	–	–	–	–	–	–	–	–
103	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
105	–	–	–	–	–	–	–	+	+	–	–	+	–	–	–	–	–	–	–
107	+	+	+	–	–	–	–	–	+	–	–	+	–	–	–	–	–	–	–
110	+	+	+	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
111	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
112	+	+	+	+	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
114	+	–	–	–	–	+	+	–	–	+	+	–	–	–	–	–	–	–	–
115	+	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TABLE 3: Number of occurrences of pathological lesions. Contidued.

Skeleton No.	Joint Diseases				Diseases of the Dentition						Trauma	Hematological Disorders			Congenital Anomalies			Infection diseases	
117	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
118	+	+	+	-	-	-	+	-	+	+	+	-	-	-	-	-	+	-	-
123	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-
124	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
126	-	-	+	-	-	-	+	-	+	-	-	-	-	-	-	+	-	-	-
127	+	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
128	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-
129	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-		-
131	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
132	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
135	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
138	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
144	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
145	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
148	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
149	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
150	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
228	+	+	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-
244	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
245	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+
246	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
252	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
255	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
257	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
258	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
261	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
263	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
264	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
265	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
267	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-
268	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
269	+	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
270	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
271	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
272	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-

3.1. Dental diseases

A total of 31 individuals (17 females, 9 males, 1 subadult, and 4 individuals of unknown sex) exhibited dental pathologies. Dental calculus (tartar buildup) was observed in 27 individuals, ranging from mild to moderate severity. The presence of caries in 11 individuals suggests that a portion of the population may have consumed a diet containing moderate to high levels of sugars. Abscesses, indicative of severe dental infections, were identified in only 9 individuals *[excav nos. DJ-F81-2018; DJ-F85-2018; DJ-F121-2018; DJ-F172-2018; DJ-F286-2018; DJ-F55-2018; DJ-F60-2018; DJ-F69-2018; Dj-F183-2018; Dj-F182-2018].* These findings suggest that while some practiced good oral hygiene, others likely suffered from poor habits that contributed to various dental diseases.

Ten individuals displayed evidence of congenital dental malformations, such as crowding and transmigration *[excav nos. DJ-F205-2018; DJ-F232-2018].* Crowding can arise from various factors including abnormal jaw growth, tooth loss before adulthood, or small jaw size. Alternatively, it could be linked to oral habits like thumb-sucking or tongue-thrusting. Transmigration, a rarer phenomenon, is associated with genetic factors or developmental abnormalities. Dental trauma or pathological conditions like tumors or cysts can also contribute (Camilleri, Scerri 2003, Marks, Schroeder 1996, Nag *et al.* 2014). Some studies suggest potential links between crowding and transmigration with factors such as retention of primary teeth, spacing between permanent teeth, or supernumerary teeth (Bjork 1963, Proffit *et al.* 2008). An additional ten individuals exhibited antemortem (before death) damage on tooth crowns *[excav nos. DJ-F81-2018; DJ-F85-2018]* (*Figures 3a–d*).

This damage could potentially serve as an indicator of daily activities and tool use. For example, teeth may have been employed as tools for tasks such as basket weaving, mat making, crafting fishing nets, or yarn production (King *et al.* 2005, Merbs 1983, Hashesh, Gabr *in press*; *Figure 4*).

3.2. Congenital disorder

Analysis of the skeletal assemblage revealed evidence of congenital diseases in 16 individuals (7 females, 6 males, and 3 juveniles) (Hashesh, Gabr 2020). These conditions included complete and incomplete sacralization, partial syndactyly (fused fingers or toes), and spina bifida occulta (incomplete closure of the spinal canal in the vertebrae). Affected individuals were identified through excavation nos. *[Dj-F81-2018, Dj-F203-2018, Dj-F182-2018, Dj-F232-2018, Dj-F60-2018, Dj-F121-2018, Dj-F190-2018, Dj-F85-2018, Dj-F102-2018, DjF145-2018, Dj-F76-2018, Dj-F139-2018, Dj-F193-2018, DJ-F62-2018; DJ-F130-2018, and Dj-F126-2018].* A unique case involved fused vertebrae (C3 and C4) and an unfused atlas (first cervical vertebra) in the posterior synchondrosis *[excav no. DJ-F232-2018]* (*Figure 5*).

The etiology of congenital diseases can be attributed to two main factors: environmental and genetic. Environmental factors encompass prenatal infections, exposure to toxins during pregnancy, and poor maternal health. Genetic factors involve mutations or alterations in genes that may occur spontaneously or be inherited from parents carrying a genetic or chromosomal abnormality, while the causes of some congenital disorders remain unknown (Barnes 1994).

4. HEALTH STATE BASED ON STRESS MARKERS

Fourteen non-specific stress markers were evaluated to assess the general health status of the population. These markers included cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia, degenerative joint disease, skeletal trauma, and signs of general infections.

4.1 Cribra orbitalia and porotic hyperostosia

Cribra orbitalia is characterized by pitting and porosity on the orbital roof, resulting from bone marrow hypertrophy (Waldron 2009). Porotic hyperostosis presents with similar pitting and porosity on the parietal or occipital bones (Ortner 2003). A combined occurrence of both lesions was observed in 31 individuals (5 females, 4 males, and 22 subadults). These cases were generally mild and primarily affected children and females *[e.g. excav nos. DJ-F92-2018, DJ-F121-2018, DJ-F157-2018, DJ-F160-2018, DJ-F178-2018, DJ-F183-2018, DJ-F194-2018, DJ-F205-2018, DJ-F219-2018, DJ-F222-2018, Dj-F258-2018,Dj-F259-2018,].* Only one young child (excavation no. DJ-F73-2018) exhibited a severe lesion, potentially linked to nutritional deficiencies, genetic hemolytic anemias, vitamin B12 or folate deficiencies, or chronic bacterial diarrheal infections (Aufderheide, Rodriguez-Martin 1998) *(Figure 6).*

4.2 Linear enamel hypoplasia

Linear enamel hypoplasia, a disruption in tooth enamel formation, was assessed as a non-specific indicator of metabolic stress during childhood. It can arise from dietary deficiencies or parasitic activity that hinders nutrient absorption. Within the sample,

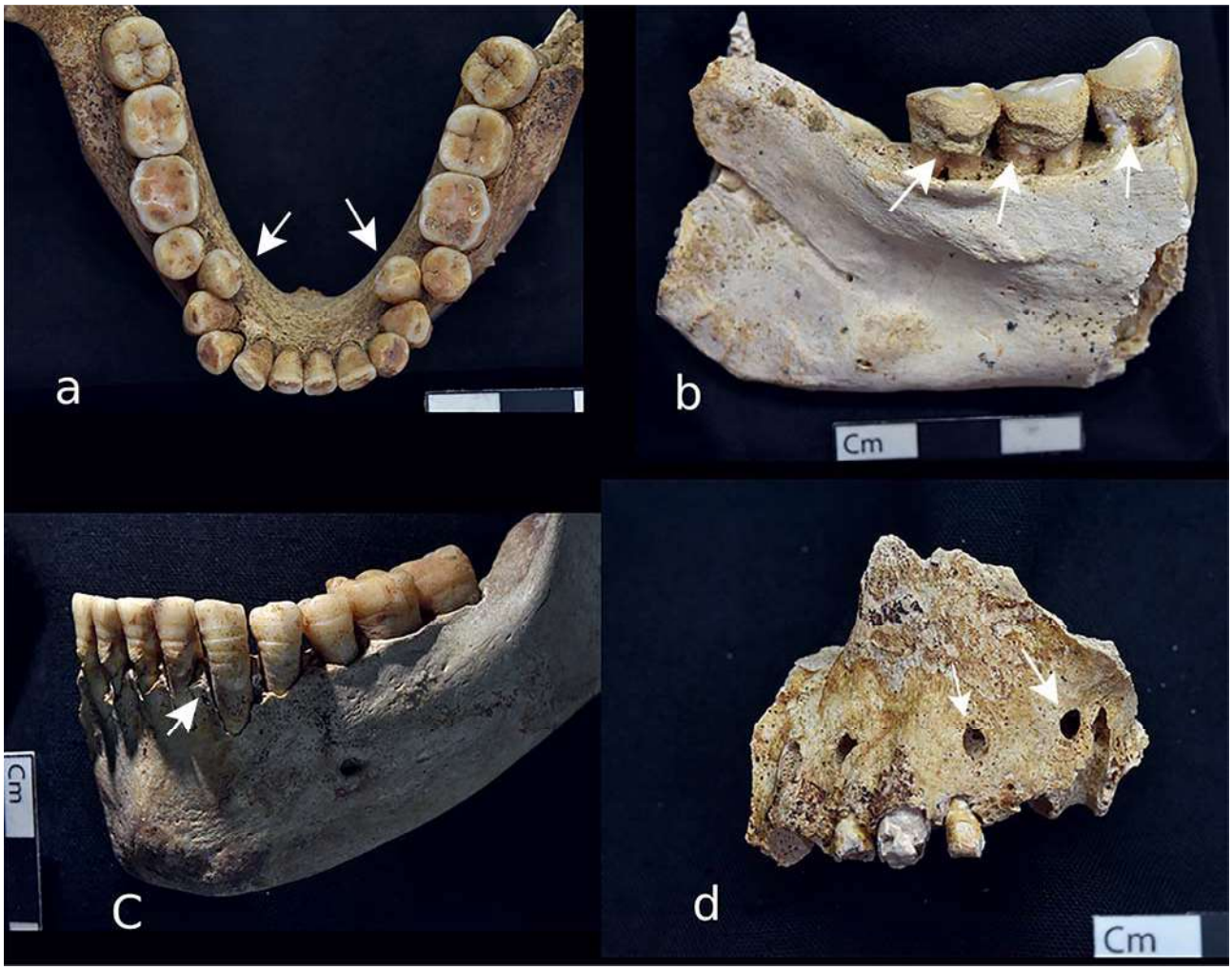

FIGURE 3: Various dental pathologies observed in the skeletal assemblage from the Djedkare Secondary Cemetery: a, Occlusal view of the mandible (Skeleton 230, Dj-F232-2018) showing dental crowding likely due to delayed shedding of both canine teeth. b, Lingual view of the left mandible (Skeleton 112, Dj-F173-2018) exhibiting a large amount of calculus (tartar buildup). c, Mandible (Skeleton 105, Dj-F157-2018) with extensive linear enamel hypoplasia, a developmental defect of the tooth enamel. d, Buccal view of the right maxilla (Skeleton 114, Dj-F172-2018) displaying multiple abscesses. (Photo by A. Gabr)

21 individuals displayed enamel hypoplasia (8 females, 6 males, 6 subadults, and 1 unknown sex) *[excav nos. DJ-F88-2018; DJ-F95-2018, DJ-F151-2018, DJ-F157-2018].*

Interestingly, the observed co-occurrence of cribra orbitalia, porotic hyperostosis, and enamel hypoplasia lesions might suggest a population with a generally balanced and adequate diet. However, a subset of subadults (9 children) exhibited a higher degree of growth stress. This is evidenced by a significant discrepancy between age estimations using long bone measurements and dental development, potentially indicating past episodes of malnutrition (Hashesh, Gabr 2020, Shidner 2018; *Figure 3c*).

4.3 Osteoarthritis and degenerative joint disease

Degenerative joint disease (DJD), encompassing both bone formation and destruction, was observed in the skeletal assemblage. A connection between workload, mechanical stress, and DJD lesions has been documented in various studies (Ortner 2003). Additionally, some research suggests associations between specific activities and affected joints; for example, hip osteoarthritis in farmers, hand

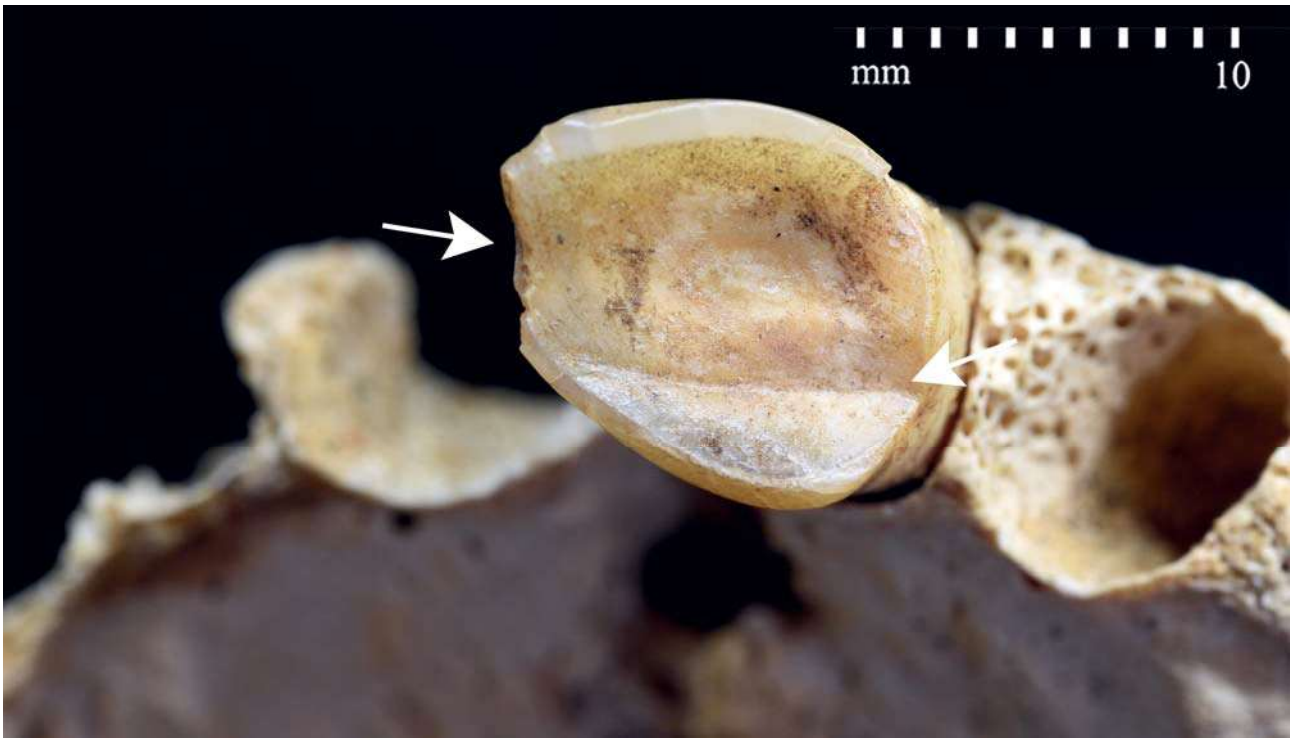

FIGURE 4: Antemortem chipping on the occlusal surface of the upper left medial incisor, [excav. no. DJ-F81-2018].

FIGURE 5: A congenital anomaly [excav no. Dj-F145-2018] exhibits a partial spine bifida occult, posterior view (Photo A. Gabr).

osteoarthritis in mill workers, and spinal/knee osteoarthritis in miners and construction workers (Waldron 2007). A total of 22 adults (11 females,10 males, 1 unknown sex) exhibited DJD. The affected areas included the shoulder, hand, hip, and knee joints *[e.g. excav nos. DJ-F75-2018, DJ-F81-2018, Dj-F75-2018, Dj-F131-2018, Dj-F139-2018, Dj-F284-2018, Dj-F144-2018, Dj-F175-2018, Dj-F182-2018,Dj-F235-2018, Dj-F265-2018, Dj-F172-2018, Dj-F85-2018, Dj-F95-2018, Dj-F102-2018, Dj-F160-2018, Dj-F166-2018, Dj-F173-2018, Dj-F204-2018, Dj-F229-2018, Dj-F261-2018A, Dj-F268-2018A, Dj-F244-2018, Dj-F247-2018].* These findings raise the possibility of work-related stress associated with activities that involve moving or carrying heavy objects, such as construction work, transporting water, washing clothes, or activities like bread and beer brewing. Notably, no cases of functional impotence were identified within the sample population.

Spinal osteophytes, bony outgrowths, were observed to develop in the third decade of life, increasing in prevalence by the sixth decade within the cervical and lumbar vertebrae. This likely reflects general lifestyle differences (Ortner 2003). In total, 27 individuals (15 females, 11 males, and 1 young adult of unknown sex)

FIGURE 6: Cribra Orbitalia on the bony roof of the eye orbits, individual Dj-F259-2018, Anterior view (Photo A. Gabr).

suffered from osteoarthritis *[excav nos. Dj-F75-2018, Dj-F131-2018, Dj-F139-2018, Dj-F284-2018, Dj-F52-2018, Dj-F55-2018, Dj-F60-2018, Dj-F69-2018, Dj-F81-2018, Dj-F81-2018, Dj-F175-2018, Dj-F182-2018, Dj-F203-2018, Dj-F87-2018, Dj-F60-2018, Dj-F118-2018, Dj-F50-2018, Dj-F85-2018, Dj-F95-2018, Dj-F102-2018, Dj-F68-2018, Dj-F151-2018, Dj-F160-2018, Dj-F166-2018, Dj-F173-2018, Dj-F204-2018, Dj-F229-2018, Dj-F342-2018, Dj-F78-2018].* Additionally, 13 cases of Schmorl's nodes(6 female,6 males,1 adult unknown sex), intervertebral disc herniations, were identified *[e.g., excav nos. Dj-F131-2018, Dj-F139-2018, Dj-F284-2018, Dj-F81-2018, Dj-F81-2018, Dj-F87-2018, Dj-F50-2018, Dj-F85-2018, Dj-F95-2018, Dj-F151-2018, Dj-F173-2018, Dj-F229-2018, Dj-F342-2018].* Schmorl's nodes typically occur in the lumbar and lower thoracic vertebrae and can arise from

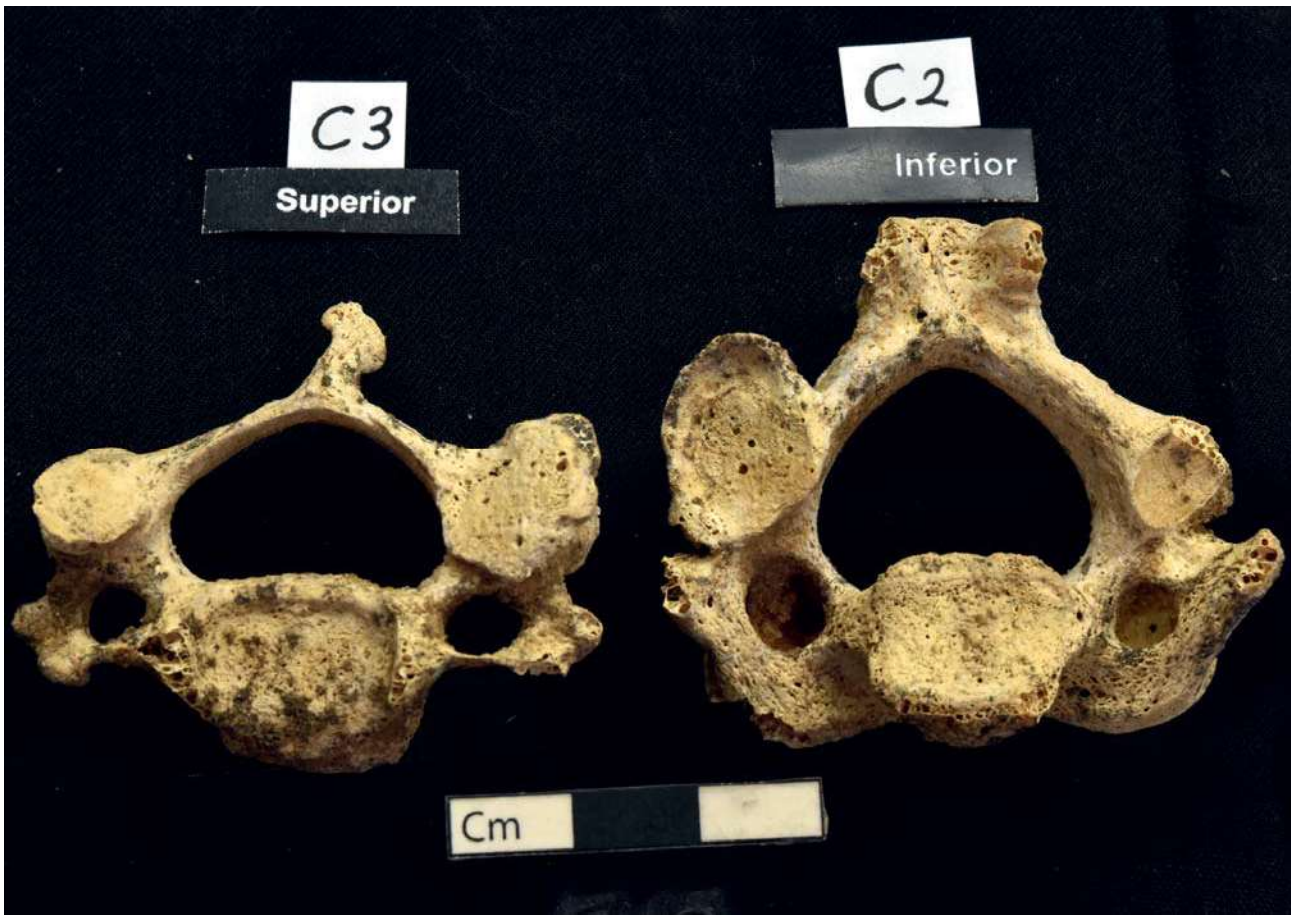

FIGURE 7: Second and third Cervicale vertebrae represented arthritis changes, [excav no. Dj-F182-2018], superior and inferior view. (Photo A. Gabr).

various factors including spinal stress due to heavy workloads, activities of elite athletes, trauma, acute spinal injuries, or even idiopathic (unknown cause) conditions (Roberts, Manchester 1995, Swärd 1992; *Figure 7*).

4.4 Trauma

Analysis of skeletal trauma offers insights beyond the general health status of an ancient population. It can also shed light on societal attitudes towards the sick and injured, as well as potential levels of violence (Dupras *et al*. 2010, Jurmain 1999). Trauma patterns with variations between sexes can further our understanding of differing lifestyles (Judd 2004).

The Edwin Smith Papyrus, an ancient medical document (Breasted 1930, Wilkins 1965, Lawrence, Christopher 2008, Allen 2005), describes treatments for head wounds, highlighting the seriousness associated with skull injuries. Three healed cases of skull trauma were identified in the assemblage *[excav nos. DJ-F134-2018, DJ-F173-2018, DJ-F205-2018].* One instance involved an endocranial infection in a young adult female *[excav nos. DJ-F134-2019]*, potentially linked to blunt force trauma. Another individual exhibited perimortem (occurring near the time of death) trauma affecting both the skull and a cervical vertebra. The cervical vertebra displayed markings consistent with six perimortem cut marks: one on the front of the vertebral body, three on the right transverse process and superior articular facet, and two on the left transverse process *[excav no. DJ-F219-2018].*

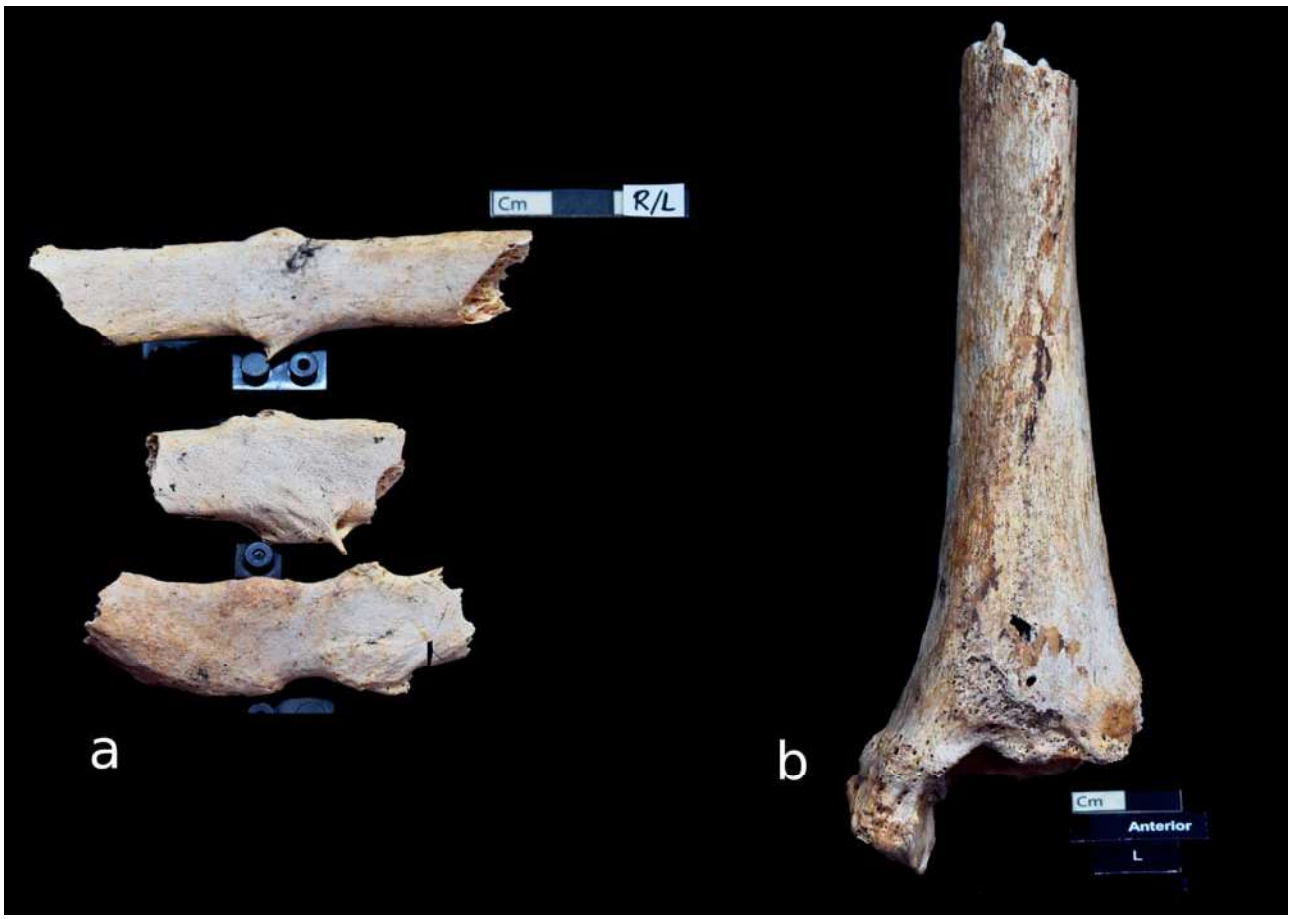

FIGURE 8: Healed Fractures in the Djedkare Secondary Cemetery Population: a, Three rib shaft fragments (unsided) exhibiting well-healed simple fractures [excav no. Dj-F166-2018]. b, Anterior view of the distal tibia showing a well-healed simple fracture [excav no. Dj-F172-2018]. (Photos A. Gabr).

FIGURE 9: Bilateral spondylolysis at the 4th lumbar vertebra, [excav. no. DJ-F126-2018], posterior view. (Photo A. Gabr).

FIGURE 10: Thoracic "T7–T12"and lumbar "L1–L5" vertebrae represented Tuberculosis lesions, Individual 245, [excav no. Dj-F243-2018], Anterior view. (Photo A. Gabr).

Furthermore, healed fractures were observed in the extremities, pelvis, and vertebrae of 23 individuals (8 females, 12 males, and 3 subadults) *[excav nos. DJ-F141-2018, DJ-F173-2018, DJ-F228-2018, DJ-F229-2018, DJ-F232-2018]* (*Figure 8*).

Notably, one individual *[excav nos. DJ-F126-2018]* presented a severe fracture on the neural arches of the 4th and 5th lumbar vertebrae, known as bilateral spondylolysis (*Figure 9*). Additionally, fractures were documented in various bones including the clavicle, scaphoid, tibia, fibula, calcaneus *[excav nos. DJ-F172-2018, DJ-F182-2018, DJ-F206-2018, DJ-F166-2018],* ribs [*excav nos.* DJ-F232-2018], and maxillary central incisors *[excav nos. DJ-F160-2018].* Interestingly, some fractures displayed evidence of attempted treatment to aid healing [*excav nos.* DJ-F88-2018; DJ-F134-2018], whereas others did not *[excav nos. DJ-F126-2018; DJ-F85-2018; DJ-F131-2018; DJ-F139-2018; DJ-F286-2018].*

4.5 Infectious diseases

Infectious diseases posed a significant threat to life expectancy in past populations, contributing to a high mortality rate (Larsen 1997, Ortner 2003). This trend is evident in the Djedkare skeletal remains, where evidence of infectious disease was observed in 33 individuals (4 females, 7 males, and 20 subadult, 2 adult unkown sex). *[excav nos. Dj-F235-2018, Dj-F265-2018, Dj-F182-2018, Dj-F172-2018, Dj-F206-2018, Dj-F247-2018, Dj-F261-2018A, Dj-F268-2018A, Dj-F141-2018, Dj-F145-2018, Dj-F204-2018, Dj-F204-2018, Dj-F243-2018, Dj-F242-2018, Dj-F357-2019 A, Dj-F367-2020A, Dj-F370-2020, Dj-F234-2018, Dj-F240-2018, Dj-F240-2018, Dj-F244-2018, Dj-F247-2018, Dj-F255-2018, Dj-F258-2018, Dj-F262-2018, Dj-F276-2018, Dj-F98-2018, Dj-F157-2018, Dj-F161-2018, Dj-F171-2018, Dj-F183-2018, Dj-F186-2018, Dj-F194-2018].* The common manifestation was bone inflammation, including ostitis, periostitis, and osteomyelitis (*Table 3*). Tuberculosis, identified in three individuals (1 young child, 2 infant) *[excav nos. Dj-F273-2018, Dj-F243-2018]* was another significant infectious disease (*Figure 10*). Additionally, three individuals exhibited signs of nonspecific infection *[excav nos. Dj-F68-2018 skeleton 90, Dj-F204-2018 skeleton 128, Dj-F258-2018].*

4.6 Adult stature

Stature estimation is influenced by both genetic and environmental factors. Chronic infections, for instance, can impede linear growth (Lovejoy *et al.* 1990). Long bone measurements were used to estimate stature for 44 individuals, including 20 females and 24 males, from the Djedkare secondary cemetery. Female stature ranged from 149.6 cm to 160.1 cm, and male stature ranged from 163.0 cm to 172.5 cm, based on the estimation methods of Raxter *et al.* (2008) (see also Hashesh, Gabr 2020: 114–115). These stature ranges suggest a population with generally good health. The stature estimates are consistent across individuals discovered within the Khuwy tomb substructure's secondary burials, as well as those within the debris layers and vicinity of the superstructure (Hashesh, Gabr *in press*). Stature estimates for this broader sample, including 8 females and 12 males with at least one complete long bone, revealed a female stature range of 146.93 cm to 170.43 cm. This aligns with the observations from the Djedkare secondary cemetery proper (Hashesh, Gabr 2020), which is considered an extension of the former. Notably, both the Djedkare cemetery females and the broader sample exhibit greater stature than females from Giza, whose stature ranged from 133 cm to 154 cm (Raxter *et al.* 2008). Similarly, the Djedkare males (150.0 cm to 177.95 cm) were taller than their Giza counterparts (145 cm to 174 cm) (Raxter *et al.* 2008). The robustness of the individuals, observed in both males and females, may be indicative of participation in strenuous daily activities.

5. CONCLUSION

This study presents a preliminary analysis of a secondary cemetery associated with the pyramid complex of King Djedkare at South Saqqara, Egypt. The skeletal assemblage comprises 185 individuals (139 primary and 46 secondary), dating back to the Late Second Intermediate Period to possibly the 1st millennium BCE. This non-elite population exhibits a near-equal mortality rate between males and females, with the highest mortality concentrated among subadults (youngest: 1–6 months old) and the oldest individuals exceeding 50 years of age.

The spatial distribution reveals a potential dedicated and sacred space for child burials near the queen's pyramid. Osteological analyses provided insights into health and activity patterns. Well-preserved skeletal elements facilitated the documentation of pathological conditions. Degenerative joint disease (including Schmorl's nodes, n=37) was observed in older adults.

Additionally, long bone fractures (n=21) in various locations (shoulders, femurs, hands, pelvis) suggest falls from heights, further supporting the interpretation of a peaceful community.

Childhood stress markers (n=20) such as Cribra Orbitalia, Porotic Hyperostosis, and Enamel Hypoplasia, alongside prevalent age-related dental diseases (tooth wear, abscesses, and tooth loss, n=31), were identified. The overall health profile suggests sufficient nutrition and an environment conducive to population growth. The low prevalence of infectious diseases (n=17) implies good personal hygiene practices (excluding oral hygiene) and minimal parasitic burdens. Notably, the limited presence of Cribra Orbitalia and Porotic Hyperostosis in some women might be linked to physiological stress associated with reproduction (menstruation, pregnancy, childbirth, lactation).

The most prevalent health concerns were related to the spine and joints (potentially biomechanical stress), affecting both sexes. This suggests activities like construction or manufacturing (mats, leather, rope) as primary occupations. Additionally, spondylolysis, a lower back condition, was documented. Trauma patterns, dominated by accidental falls, further support the peaceful community interpretation. Fractures were observed across genders and age groups, suggesting shared workloads. In conclusion, this analysis demonstrates the value of osteological studies of non-elite cemeteries for understanding past populations. Future research should integrate data from other disciplines for a holistic interpretation. This study contributes valuable data for comparative analyses of regional non-elite populations. The burial quality and practices suggest a social status distinct from both the elite and the most impoverished documented at Saqqara. However, acknowledging limitations inherent to osteological analyses, such as incomplete/biased samples and taphonomic factors, is crucial.

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