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Palaeopathology of human remains of the 1st century BC–3rd century AD from Armenia (Beniamin, Shirakavan I)

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ABSTRACT: The aim of this article was to document the pathology of the individuals from the archeological sites of Beniamin and Shirakavan I, Armenia, dated on the 1st century BC - 3rd century AD. The findings revealed that two groups differed in mean age at death of adults. At Beniamin it was 24 years, 40.8 years for males and 30.9 years for females, whereas at Shirakavanit it was 29.3 years, 29.6 years for males and 35.8 years for females. The greatest mortality appeared to have occurred when the children reached the age of one year (Beniamin). The population had high number of young-adult females with a cause of death associated with child-bearing . Very few females survived to old age. Traumatic conditions (63.64%) and enamel hypoplasias (57.2%) have a high frequency in the skeletal material from Shirakavan. The volume of selection of Shirakavan does not allow itself to so big discussion as it was possible with the Beniamin site. Fewer hypoplasias in Beniamin group indicate that food resources were more abundant and more easily exploited. The small frequency of a periodontal disorder indicates that dental hygiene was good during the Antiquity period. We here report a case of possible pituitary dwarfism and a case of decapitation.

KEY WORDS: demography,cranial modifications, dental diseases, cribra orbitalia,decapitation, scalping, trauma, pituitary dwarfism

Introduction

The Armenian highland was in early history a crossroad linking the worlds of East and West (Martirosyan 1964). The Armenian highland was an area of frequent military conflicts, and its history was largely determined by external forces (Eremyan 1968). The Classical/Late Antiquity period saw the interaction of various ethno-cultural groups – Iranic nomads (Scythians, Sarmatians, Sauro-

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matians, Saka) and locals are interacted. Their presence in this region perhaps goes back to the 8 th century BC (Piotrovsky 1959; Eremyan 1968). It is generally accepted that in the 7th century BC the Scythians mounted their incursions into the Ancient Near East through the Caucasus. A statistical analysis of measurements of crania from the 1st century BC – 3rd century AD cemetery at Armenia indicates considerable morphological heterogeneity (Khudaverdyan 2012b). The results indicate that two subgroups can be separated, both of them dolichocranic. The male skulls of the first group have been diagnosed as classical European sample. The second is the same European type, but the horizontal profile of the face (group II) is a little weakened. The female skulls sample has the same analogical image as the males. It is necessary to state that carriers of this complex remind one of the Scythians from the territory of the Dnestr region, Steppes of the Black Sea Coast, Ukraine, the Sarmatians from the Volga region and the Saka from the territory of Turkmenistan (Khudaverdyan 2012). The analysis of the main odontological traits in sites indicates that their frequencies fit within the range characteristic for the European dental complex and the biologically admixed groups (Khudaverdyan 2014). This scenario is consistent with other archaeological and historical studies of the area which show the long-standing presence of Scythians in the Caucasus (Piotrovsky 1959; Eremyan, 1968).

The purpose of the present paper was to review health status of people living in the Late Antiquity period on the Shirak Plateau (western Armenia) in order to reconstruct their biological state and living conditions on the past.

Materials and Methods

Between 1989 and 2006 the Institute of Archaeology and Ethnography, National Academy of Science, Republic of Armenia and the Shirak Museum conducted a joint excavation at Beniamin. The Beniamin collection, one of the few large collections in the Armenia (Figure 1). Data from excavations suggest that a small farming community occupied the site from at least 1st century BC – 3rd century AD. A total of 350 burials were recovered from Beniamin during field seasons from 1989 to 2006. Grave associations were generally uncommon, and when present, usually consisted of small personal items like tupu pins, goods including metalwork, pottery, etc. Individuals were placed in extended positions. The sample consisted of 165 individuals: 63 from females, 44 from males, 57 from subadults. One adult individual was of undetermined sex (very fragmented skull, absent pelvic bones). The anthropological material presented in this work was collected with the assistance of the author. Although I have published preliminary reports of our work (Khudaverdyan 2010a), but the full report of the skeletal remains from Beniamin site has not been published.

In 1980, the Institute of Archaeology and Ethnography, National Academy of Science, Republic of Armenia conducted an excavation at Shirakavan. The Shirakavan sample is remarkable due to the archaeological presence of two time periods of ancient Armenian history (Late Iron Age /Shirakavan/ and Antiquity period /1st century BC – 3rd century AD, Shirakavan I/). The site includes a settlement area as well as a large cemetery referred to as Shirakavan I. Skeletons were discovered in 30 graves during initial ex-

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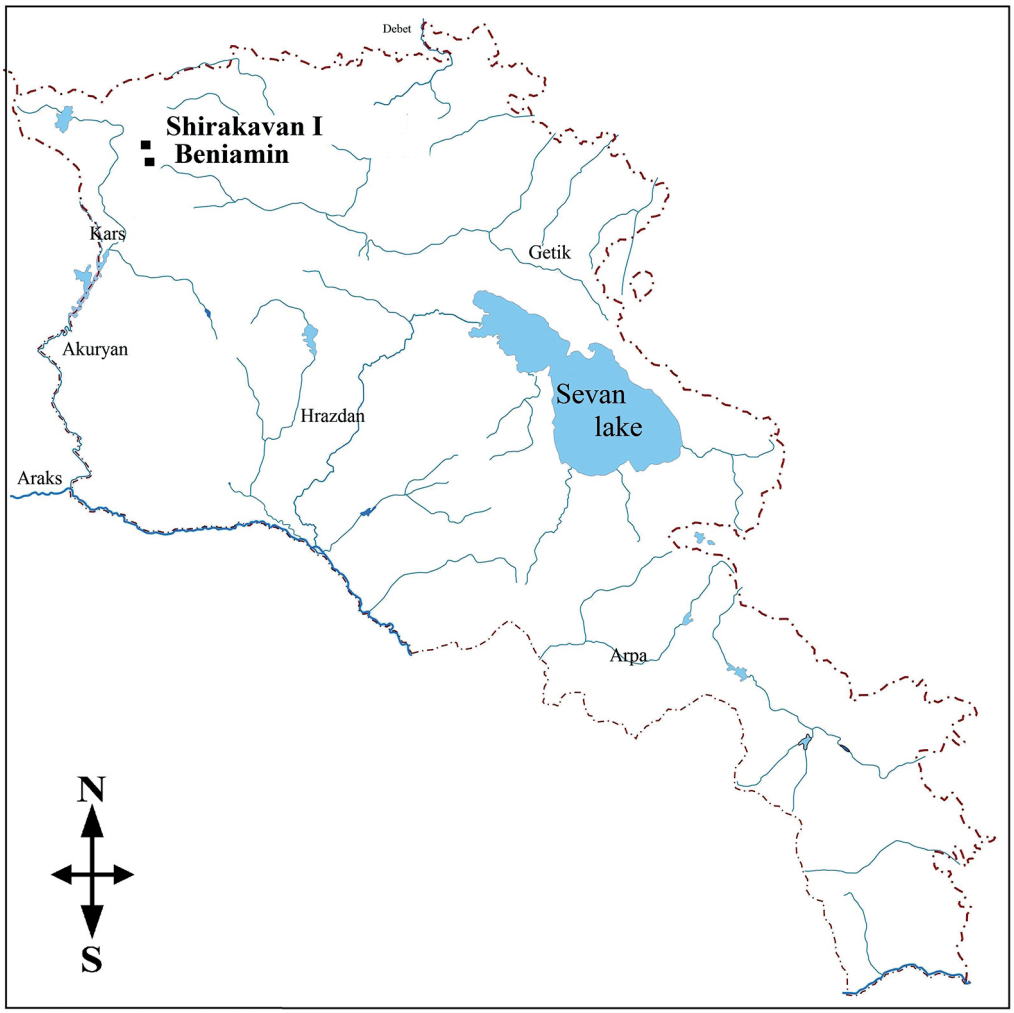

Fig. 1. Map of Armenia showing the location of the sites discussed in the paper

cavations at the site. In most cases, the upper extremities were placed along the bodies. Most of the skeletons, however, were lost after excavations. Therefore, human remains from only 11 burials (3 – females, 7 – males, 1 – juvenile) remained available for examination. A juvenile (8–9 yrs.) skull showed evidence of trepanation (Khudaverdyan 2011). Integrity of the skulls was satisfactory. Within the graves, a variety of burial accompaniments were recovered, including jewellery (e.g., rings, pendants), tools (e.g., knives), household goods (e.g., dishes, needles).

The present author participated in both research projects and took charge of the pathological examination of the skeletal remains from both sites.

The age-at-death and sex of adults were assessed through the use of multiple indicators: morphological features

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of the pelvis and cranium were used for the determination of sex (Phenice 1969; Buikstra and Ubelaker 1994); a combination of pubic symphysis (Gilbert and McKern 1973; Katz and Suchey 1986; Meindl et al. 1985), auricular surface changes (Lovejoy et al. 1985), degree of epiphyseal union (Buikstra and Ubelaker 1994), and cranial suture closure (Meindl et al. 1985) were used for adult age estimation. For subadults, dental development and eruption, long bone length, and the appearance of ossification centres and epiphyseal fusion were used (Moorrees et al. 1963a, 1963b; Ubelaker 1989; Buikstra and Ubelaker 1994).Long bone length was measured according to Alekseev (1966).

The life table approach was used based on two assumptions: 1. stationary populations and 2. stable populations with a 1% growth rate.

Human skeletal remains were analyzed for patterns pertaining to health. Health, as impacted by malnutrition, disease, is assessed through pathological analyses of skeletal and dental conditions. Traumatic conditions, especially fractures, can tell a lot about the life style of an individual and how they may have died. Analysis of traumatic injuries provides a basis for assessing the role of warfare. All fractures were examined macroscopically, followings recommendations provided by Roberts (2000).

Skeletons from the samples were subjected to a careful macroscopic investigation for pathological lesions. Cribra orbitalia, a descriptive term for porotic hyperostosis lesions of the orbit, were identified as pitting of the compact bone varying in size from capillary like impressions to coalescing outgrowths (Stuart-Macadam 1991). The orbital roof was examined macroscopically for evidence of pathological change. Each orbital roof is recorded as a single unit with cribra orbitalia noted as present, absent or unobservable. Lesions are recorded following the grading system defined by Stuart-Macadam (1991) (types 1–5).

Caries was recorded at individual tooth level noting the position and severity of the largest carious lesion visible. Carious lesions were recorded based on the system devised by Buikstra and Ubelaker (1994). Destruction of enamel and irregular margins were the main criteria for identifying lesions. Lesions were recorded on all observable permanent teeth. Care was exercised to avoid confusing carious lesions with pulp exposure due to severe wear.

Calculus was noted where mineralized plaque can be seen adhering to the tooth surface (Hillson 1996). Calculus was recorded on an individual tooth level stating the location and severity of the formation. The location was recorded as supra- or sub-gingival based on the location of the deposit (on the crown or the root) and on the characteristics of the calculus (Hillson 1996). The severity was recorded as slight, medium or considerable deposition following Brothwell (1981). Diagnosis of hypoplastic defects refers to Hillson (1996) for description of linear and pit-shaped interruption in the enamel formation. Enamel hypoplasia is recorded on individual tooth level. Periodontal disease is recorded on an individual tooth level.

Due to the small sample size from Shirakavan, no statistical testing of inter-sex or inter-site differences was applied.

A statistical computer software SPSS 14.0 for Windows was used for statistical calculations and testing statistical significance at the level of $p<0.05$.

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Results

Paleodemography. The Late Antique sample from Beniamin consisted of 165 individuals: 57 subadults, 62 females and 44 males. One adult individual was of undetermined sex. The distribution of age-at-death is represented in survivorship and mortality profiles. At Beniamin, the greatest mortality appears to have occurred when the children reached the age of one year.Mortality starts to reduce in an earlier age group (5–19 as opposed to 20–29). A high portion of the individuals from this population survived into mature adulthood and older.

Life table (Table 1) revealed that the highest percentage of deaths for the entire population occurred during the young and middle-aged intervals.

Very few individuals survived to old age. The mean age at death for the entire sample was 24 years, while for Beniamin males it is 40.8 years, and for females, 30.9 years. In the Beniamin population until the age of 40 years, female mortality is higher than male mortality. Life expectancy (ex) sharply diminishes after young adulthood. Very similar trends were found when male and female segments of the adult population were compared separately.

The Late Antique sample from Shirakavan consisted of 11 individuals: 3 – females, 7 – males, 1 – juvenile. The average age-at-death of adults from Shirakavan is 29.3 years, while for males it is 29.6 years, and for females, 35.8 years. These mortality rates should be viewed cautiously.

Description of cases with pathological conditions

Traumatic damages of bones

Beniamin site. Evidence of traumatic events in Beniamin group were few, but remarkable. A total of 10.4% (n=165) of the individuals excavated from the Beniamin presented with well-healed, healing fractures. Fourteen of these were male and three female. A total of 18 fractured bones were observed. These included 17 fractured crania, as well as one humerus. Single fractures were noted in 11 individuals, while six people had two fractures. Many were simple depressions (11 cases) in the external table of the

Table 1. Life-table for the Beniamin skeletons

Age classes	Dx	dx	lx	qx	Lx	Tx	Ex
0–4	50.00	30.30	100.0	0.303	424	2405	24.05
5–9	5.00	3.03	69.70	0.043	341	1980	28.41
10–14	2.00	1.21	66.67	0.018	330	1639	24.59
15–19	3.00	1.82	65.45	0.028	323	1309	20.00
20–24	21.00	12.73	63.64	0.200	286	986	15.50
25–29	24.00	14.55	50.91	0.286	218	700	13.75
30–34	14.00	8.48	36.36	0.233	161	482	13.25
35–39	6.00	3.64	27.88	0.130	130	321	11.52
40–44	13.00	7.88	24.24	0.325	102	191	7.87
45–49	11.00	6.67	16.36	0.407	65	89	5.46
50+	16.00	9.70	9.70	1.000	24	24	2.50
	165.0				2405		

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Fig. 2. Bone fracture: Baniamin, burial 1/52, male 35–39 years (concavity fracture on the right)

cranial vault, although some were indicative of more severe injuries, including deep cuts with heavy sharp-edged weapons such as swords and axes. There are 3 cases of traumas inflicted as a probable result of battle injuries in adult male individuals.In all cases, healed fractures showed considerable evidence of bone remodeling.

In the Shirakavan group, five of the eleven individuals (63.64%) analyzed displayed evidence of antemortem trauma. Three of these were male and two female. These included 2 healed fractures of the nasal bone, three depressed fractures of the parietal bone. These lesions were all of relatively similar size and shape, with preference in location towards the left side of the skull. They are suggestive of blunt force trauma. A decapitation was the proximate cause of death in one case.

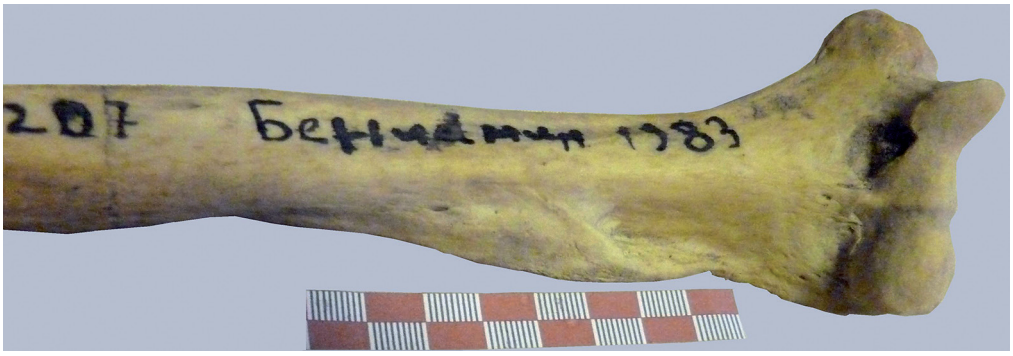

Fig. 3. Fracture on right humerus: Beniamin, burial207/1, male 35–39 years

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Fig. 4. Fracture of nasal bones: Shirakavan, burial 15, male 40–44 years

The most dramatic cranial trauma is a massive, distinctively oval shape (27×17.5mm) perimortem fracture to the right parietal and perforated fracture (6.2×5mm) to the frontal bone of a male aged between 36 and 40 years (burial 1/52). Figures 2a and 2b illustrate the location of cranial fractures in males. In both fractures bone remodeling confirmed that the wound was not fatal.

Of the 48 humeri included for analysis (24 left and 24 right), one showed fracture (Beniamin, burial 2007/1, male 35–39 years, Figure 3). The fracture is located in the distal third of the diaphysis. The two fractured ends of the bone overlapped. Also, the humerus presents an expanded callus, even though alignment is good.

Nasal bone trauma was observed in one individual (burial 15, male, 40–44 years old; Figure 4). The nose was considerably deformed and the displacement of bone fragments was apparent.

A Beniamin site also yielded evidence of historic scalping (burial 239). The

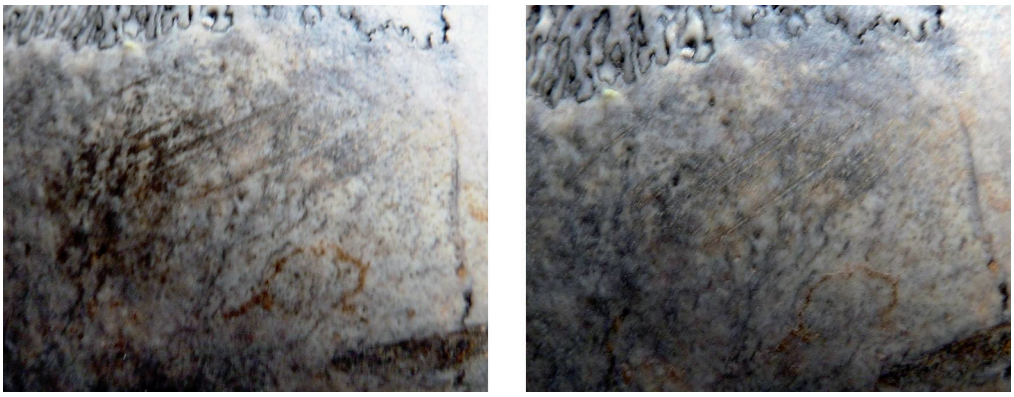

Fig. 5. Right parietal bone with traces of scalping: Beniamin, burial 239/1, female 40-44 years

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scalping victim was a female, approximately 30–34 years in age. This individual displayed cut marks consistent with scalping. These include a horizontal cut above the left parietal bone, two horizontal cuts above the right temporal (Figure 5).

Decapitation

The female from Shirakavan group (burial 4) was assessed to be approximately 45 to 49 years old at death. Postcranial skeleton has not been found. In 2014, we have documented the existence of the cutmarks during a detailed examination of the skull: physical evidence on the base of the skull, including the edge of the foramen magnum, the mastoid process (Figure 6). Such kind of injuries have only one definition (beheading of the person who was in vertical situation) (Manchester 1983).

Pituitary Dwarfism

Examination of the burials from the Antique cemetery site in Beniamin showed a skeleton (221) of small proportions (Figure 7). Pelvic morphology suggests that the remains are of a woman, aged 40–45 years. The skull was missing. The bones are all gracile, slender, and shorter than normal but in proportion with each other. The major diagnostic criteria applied are listed in Table 2.

Comparison with a dataset of the population from Beniamin with a dwarf-female from burial 221 shows that she was significantly shorter than the mean of the female population of that period. The femoral length is about 357 millimeters or 75 percent of the

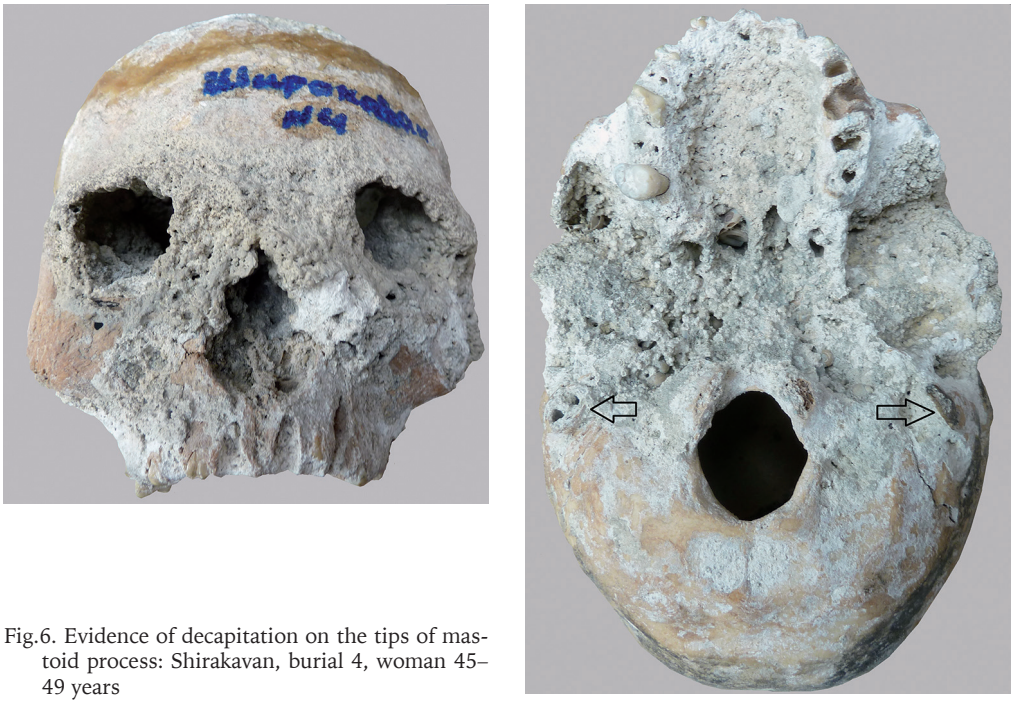

Fig.6. Evidence of decapitation on the tips of mastoid process: Shirakavan, burial 4, woman 45–49 years

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expected length. Dwarf-female is a fairly symmetrical individual in terms of maximum lengths of long bones. The greatest difference in length is in the maximum length of the tibia, where the left tibia is 8 mm longer than the right. Otherwise, differences in lengths range from 2 to 4 mm. In all cases the left element has a greater maximum length than the right. The left scapula measured 5 mm higher than the right one. Less significant differences in measurements include humeral maximum length (the left side is 3 mm longer than the right), maximum length of the radius (the left side is 3 mm longer than the right). The smallest differences in measurement values are in the femora.

Table 2. Osteological characteristics

Element	Measurement	Pituitary Dwarfism		Beniamin (female site)
Scapula	Height	175? /right/	180 /left/	–
	Width	89 /right/	90 /left/	–
	Scapular index	50.86	50	–
	Length	262 /right/	265 /left/	297.8 (17)
	Head vertical diameter	28 /right/	28.2 /left/	–
Humerus	Shaft maximum diameter	18.5/right/	18.8 /left/	20.3 (17)
	Shaft minimum diameter	13 /right/	13 /left/	15.4 (17)
	Epicondylar width	39 /right/	39 /left/	47.1 (20)
Radius	Length	197 /right/	200 /left/	226.9 (17)
	Physiological length	183.8 /right/	184.5 /left/	214,2 (20)
	Transverse diameter	12 /right/	12.5 /left/	14.1 (17)
	Antero-posterior diameter	8 /right/	10 /left/	10.2 (17)
	Shaft minimum diameter	30 /right/	32 /left/	36.9 (20)
Ulna	Antero-posterior diameter	12.5 /right/	–	11,31 (20)
	Transverse diameter	9 /right/	–	14.95 (20)
	Maximum length	212 /right/	–	246.07 (16)
	Physiological length	189 /right/	–	243.8 (15)
Sacrum	Length	89		–
	Breadth	104		–
Femur	Maximum length	356 /right/	358 /left/	415.8 (10)
	Mid shaft circumference	65 /right/	68 /left/	77.1 (18)
	Med-lat mid-shaft diameter	21 /right/	22 /left/	25.7 (17)
	Ant-post mid-shaft diameter	20.3 /right/	21 /left/	23.7 (17)
Tibia	Total length	289 /right/	296 /left/	338.7 (17)
	Maximum length	292 /right/	300 /right/	346 (16)
	Med-lat diameter at foramen	16 /right/	17.5 /left/	21.5 (20)
	Ant-post diameter at foramen	24 /right/	25 /left/	30.1 (20)
	Shaft minimum diameter	63.5 /right/	65 /left/	67.9 (20)
Fibula	Length	279 /right/	283 /left/	329.47 (13)
	Maximum height	149.8 /right/	155.5 /left/	196.1 (10)
Hip joint	Iliac width	102 /right/	102.5 /left/	149.1 (11)
	Ilium height	125 /right/	125 /left/	–

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Fig. 7. Pituitary dwarf: Beniamin, burial 221, female 40–45 years. Comparative anterior views a) right normal and abnormal femur, b) right normal and abnormal humerus

The left femur is 2 mm longer than the right (maximum length).

The femur/tibia maximum length ratio illustrates the disproportionately short length of the femur (85.76 /left/), that she was significantly smaller, than the mean of the female population of this period. The mean index value for all other individuals from Beniamin was 121. This ratio further illustrates the disproportionately short lengths of the femora. The ratio of humerus maximum length to radius maximum length was calculated to see, whether there was a distinction in the proportions of the upper arm to lower arm. This index value was 77.56 /right/ and 77.83 /left/. This ratio shows that the arm bones for dwarf-female are fairly close proportionately to the individuals of normal stature.

The humero-femoral index are significantly higher (78.45) than the mean index value for all non-dwarfed individuals (73.5). The humero-femoral index of dwarf-female shows that, at least in terms of the humerus and the femur, the individual shows normal proportions. This shows that female is not proportional, and therefore a less 'classic' case

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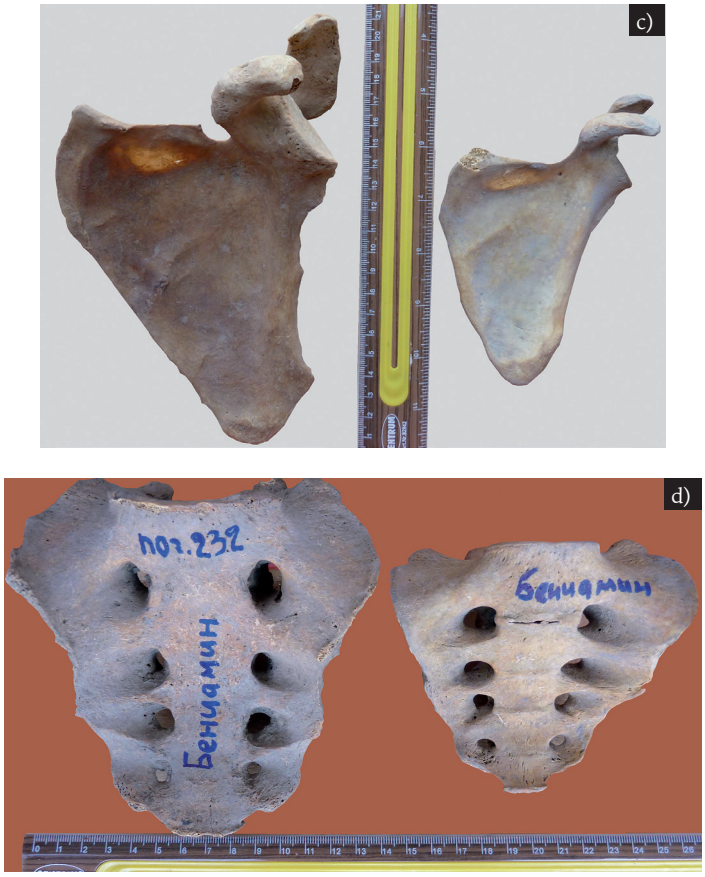

Fig. 7. cont. c) right normal and abnormal sacrum, d) right normal and abnormal scapula

of pituitary dwarfism, or is perhaps not a pituitary dwarf at all.

Estimation of the general state of health on stress markers

Hematopoietic diseases. The frequency of cribra orbitalia in the population from Beniamin is 35.9% (n=117). The frequency of cribra orbitalia in adults is 28.95% (22/76), without statistical significance between males (29.78%) and females (27.59%) (chi-square=0.001; p=0.97). In the Beniamin site 20 juveniles were affected by cribra orbitalia. It was found that the studied population of Shirakavan showed a high frequency of cribra orbitalia (45.5%). This pathology is present in healed and active condition, and its intensity varies between mild and severe.

Dental diseases. Among the 97 individuals evaluated for carious lesions. A total of 5 lesions were observed. Carious lesions affected a very low proportion (5.2%) of all teeth studied (Table 3). Predictably, the majority of the teeth affected were molars with most lesions affecting the occlusal and interproximal surfaces. The frequency of carious

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Table 3. The distribution of dental pathology in the different sites

Sample	Caries	Dental abcesses	Dental calculus	Peridontal disease	Enamel hypoplasias
Beniamin	5.2 (5/97)	66.7 (4/6)	69 (69/100)	16.7 (1/6)	7.4 (7/95)
Shirakavan	–	14.3(1/7)	28.6 (2/7)	14.3 (1/7)	57.2 (4/7)

lesions in both sexes is higher in the maxilla.

Abscesses were observed in 66.7% of the individuals from Beniamin, while the Shirakavan site averaged about 14.3%. In both sexes abscesses are more frequent in the maxilla than the mandible, but these differences are not statistically significant. As in all analysed dental pathologies, the frequency of abscesses in both sexes is higher in the 40+ years age group.

In the Beniamin group, 69% of individuals had calculus deposits on their dentition. The most severely affected teeth were the molars and premolars. A similar prevalence was observed in both sexes (68.58% among men and 69.24% among women, chi-square=0.001; p=0.99). Calculus in the Shirakavan group was relatively rare. Only 28.6% of the individuals in the group had observable calculus deposits.

As shown in Table 3, the incidence of periodontal disease was 16.7% in the Beniamin group. Out of 7 observable dentitions in the Shirakavan sample, one (14.3%) displayed alveolar bone loss. Table 3 presents the frequency of hypoplastic defects. Enamel hypoplasias were present on the teeth of 7 of 95 observable individuals (7.4%) from Beniamin, with four of those experiencing multiple lesions. Individuals in the 40+ age group showed the greatest percentage of hypoplasias. As is generally the case with enamel hypoplasias, anterior teeth, canines, were affected most. This paucity of enamel hypoplasias can be interpreted as evidence for relatively stressor-free childhoods for the members of the Beniamin population. In adults, males exhibit a higher frequency of enamel hypoplasias compared to females (8.3% vs. 5.8%; chi-square=2.472; p<0.05). Incidences of enamel hypoplasias in the Shirakavan group were frequent (57.2%). Four individuals (n=7) in the group bore evidence of multiple enamel hypoplasias.

Discussion

The palaeopathological examination of skeletal remains from the classical/late antiquity period has increased the knowledge on diseases occurring in Shirak Plateau (Armenia). Some diseases can be related to the conditions of life and health, and the comparison between the results for the two necropolises, the Beniamin and Shirakavan I.

At Beniamin the greatest mortality appears to have occurred when the children reached the age of one year. In that group, the most frequently occurring deaths at the end of the first year of life could be accounted for by some form of infection. It is difficult to find out the true reasons for the differences in the spread of infant deaths in the population, especially as they occurred over a number of centuries. Chance may be an important factor, especially in the excavation process, but illness and malnutrition cannot be ignored as possible causes. The probability of dying is slightly reduced, most noticeably at age 13. The highest percentage of deaths for the

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entire population occurred during young and old-aged intervals.

In group, there are more females than males represented in the young adult age category. Also, typical risks of death, such as infectious disease, which were common in the population (Khudaverdyan 2010a), are going to affect certain age groups more than others, so they are also not age-independent.

Based on the above results, we can argue that adult female Late Antiquity period mortality in the younger adult age cohorts is higher than adult male Late Antiquity period mortality. Very few female survived to old age.

Population studies of trauma frequency are essential for addressing questions about human adaptation to physical and social environments. Both groups of Shirak Plateau displayed a variety of healed fractures, some of which may have been accidental and others which might indicate aggressive behaviours. The assessment of healed trauma observed in this study, can give a more accurate view into the lives of the peoples, since these lesions were not the reason for death. Blunt trauma to the skull and evidence of cut marks by a sharp object are all indicative of interpersonal violence (Lovell 1997; Ortner 2003). Mechanical breaks of a bone are received at the moment of death of the individual from Shirakavan site. Such kind of injuries have only one definition (beheading at the person who is in vertical situation) (Manchester 1983). Where the cut marks have a polished appearance, the bone must have contained the same amount of collagen that it did in life (Wenham 1989) and, therefore, decapitation – if not the cause of death – was carried out immediately after it had occurred. Decapitation could occur under the following circumstances: (1) as a form of corporal punishment in which an individual is executed by severing the head from the body through the use of an edged weapon; (2) as a trophy of armed confrontation; (3) as a form of veneration or relic collection; (4) as a result of bloodletting in which the head is removed in order to collect the body's blood supply etc. Holding by hair the victim, the head of the individual cut a sword. Humeral fracture, on the other hand, are usually related to accidents such as falls.

In modern publications dwarfism is uncommon. The representation of dwarf individuals in iconography has been common since ancient times (Kozma 2006). In different cultures dwarfs have been objects of curiosity and/or veneration (Haworth and Chudley 2001; Waldron 2009). Here it is reported about a case of possible pituitary dwarfism encountered in a routine analysis of specimens from the Late Antiquity period. Pituitary dwarfism corresponds to a "loss of pituitary function during childhood" and it is characterized by proportioned body segments "as well as normally proportioned extremity lengths in relation to the trunk" (Aufderheide and Rodríguez-Martín 1998: 328). Causes of pituitary dysfunction in childhood may have a neoplasm origin (Aufderheide and Rodríguez-Martín 1998; Ortner 2003) or, but far less common, a congenital deformity or traumatic or enzyme deficiencies, among others etiologies (Aufderheide and Rodríguez-Martín 1998).

Diet is an important aspect of past people's lives as it can have a wide ranging effect on the health and well-being of populations. The small frequency of periodontal disorder indicates that dental hygiene was good during the Antiquity period. Enamel hypoplasias occurred in

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a much higher frequency in the Shirakavan site. Fewer hypoplasias in Beniamin group indicate that food resources were more abundant and more easily exploited. Overall, the caries rate appears to fit a more mixed economy group than into an agricultural economy. The average caries rate of a population engaging in a mixed economy is around 5 percent while individuals from an agricultural economy usually have caries rates greater than 10 percent (Mickleburgh 2007). Dental calculus occurred frequently in the materials (Black Fortress I, Vardbakh) from Shirak Plateau (Khudaverdyan 2010b). Dental calculus was less of a problem for the Shirakavan group (28.6%) than for the Beniamin site (69%). The presence of calculus can result in protection against caries as the tooth surface is covered with hard concretions making it less susceptible to infection (Hillson 1996). Plaque buildup can occur in diets with heavy carbohydrate consumption (Hillson 1996), although protein may increase oral alkalinity, thereby promoting calculus mineralization. Compared to the Beniamin group, the Shirakavan sample had a significantly higher rate of dental abscesses. At Black Fortress I, nine adult individuals showed evidence of dental abscesses, which was higher than in the Vardbakh population where only one individual was affected (Khudaverdyan 2010b).

Overall, what can be inferred about the health and adaptive success of the Beniamin population and the Shirakavan? Most reports concerning this question have concluded that pathologies were few, food was abundant, and life was healthy. However, appearances can be deceiving. Paleopathological analysis reveals generally low rates of life-threatening stressors. However, a lack of skeletal lesions does not necessarily mean good health. In fact, finding large numbers of young and middle adults in a population (like Beniamin) would seem to support a conclusion of poor health and adaptation for the population, since that segment of the population should not be dying. Yet, there is little evidence, osteologically, that would point out or explain the high mortality of young adults. However, contagious infectious disease could have been present during the Late Antiquity period on the Shirak Plateau. The archeological synthesis tells of a rise in population, and the development of a long-distance trade network. This network could conceivably act as a pathway for disease. It is only a suggestion that contagious infectious disease may have been one of many factors that affected the health and adaptation of the Late Antiquity. The last factor that could explain the nature of the Beniamin sample is the difficulty of surviving in a harsh environment. Death could have been caused by a myriad of factors such as infection, trauma, or malnutrition. The Antiquity period show a relative high frequency of porotic hyperostosis. This would indicate that were marked by severe iron anemia caused by dietary deficiency or parasites. Violence would suggest negative interactions between the indigenous and intrusive populations that may have had effects on social structure. None of these factors can be pointed to as a specific reason for the low life expectancy at Beniamin, but the cumulative effect could result an overall high mortality for the population at large. The sample size of Shirakavan does not lend itself to as great a discussion as is possible with Beniamin site.

Conclusion

The purpose of this report was to examine the state of health and adaptation of

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the Shirak Plateau sites by combining paleopathological analysis, a review of published anthrological reports, and the archeological record. The Beniamin site represents the largest Antiquity cemetery in the region. Most other sites contain few individuals (Black Fortress I, Vardbakh, Shirakavan, Garni). According to the paleopathological record of this specific population, instances of infectious diseases, traumas, nutritional deficiency diseases, degenerative joint disease, and neoplastic conditions were relatively low infrequency. Certain dental pathologies, like abscesses, dental calculus were of a relative high frequency, but that can be attributed to poor dental hygiene. However, some evidence from the Beniamin group suggests otherwise. The sample is dominated by young (20–35) and middle -aged adults (35–50). The reasons for the low life expectancy in group are complex. However, it can probably be attributed to the harsh environment faced by populations living on the Shirak Plateau. Incidental occurrences of infectious diseases, traumas, and other deadly disorders combined to produce a low life expectancy. There is no reason, judging from the skeletal remains, to conclude that anything but an endemic disease pattern predominated during the Late Antiquity period.

This analysis of the individuals from the Shirak Plateau is by no means complete, but it provides a data set to be used for future studies and more importantly it contributes to a better understanding of the lives of Late Antiquity period.

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Conflict of interest

The authors declare that there is no conflict of interest.

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