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Original scientific paper

Variation of Musculoskeletal Stress Markers in the Medieval Population from Cedynia (Poland) – Proposal of Standardized Scoring Method Application

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A B S T R A C T

The objective of this paper is: (a) to present a rating scale for the evaluation of the musculoskeletal stress markers; (b) to analyze the medieval population from Cedynia in terms of the degree of expression and frequency of the musculoskeletal stress markers. The presented rating scale was developed based on the variability of the morphology of muscle attachment sites, observed in the skeletal material from Cedynia (102 males and 99 females). The scale encompasses 10 musculoskeletal stress markers located on the scapula, humerus, radius, femur and tibia. The system reflects three degrees (1, 2, 3) of complexity of the muscle attachment sites morphology. The analysis of asymmetry and sexual dimorphism of the musculoskeletal stress markers was made based on the χ^2 *(Pearson) statistics or* χ^2 *statistics for 2×2 tables. Moderate degree (2) of muscle attachment site complexity is the most frequent degree of musculoskeletal stress markers development in the population from Cedynia. Low (1) and high (3) complexity of muscle attachment site are the most seldom observed categories. No statistically significant differences between the frequencies of the musculoskeletal stress markers on the bones of the right and left side of the skeleton were noted in females. Also in males the differences found were not statistically significant. Only in the case of deltoid tuberosity (H2)* $p=0.052$ *oscillating around the threshold value may suggest existence of a statistically significant difference in the degree of expression of this stress marker on the bone of the right and left side of the skeleton. On the bones of the right side of the skeleton dimorphic differences were observed in the glenoid tuberosity (S2), bicipital groove (H1), pronator teres origin (R2), tibial tuberosity (T1), soleal crest (T2) and linea aspera (F2). On the bones of the left side of the skeleton dimorphic differences were noted for the bicipital groove (H1), pronator teres origin (R2) and glenoid tuberosity (S2).*

***Key words**: musculoskeletal stress markers, rating scale, medieval population*

Introduction

Musculoskeletal stress markers are bone changes manifested as increased complexity of the surface of muscle attachment sites. Occurrence of these changes is a response to constantly repeated, moderately strenuous (or strenuous) physical activity (the so-called »daily activity«)[1]. These markers belonging to skeletal markers of occupational stress[2,3].

Studies on musculoskeletal stress markers focus mainly on the problem of evaluation of the pattern (type) and level (intensity) of the physical activity of an individual or a population[1,4–14]. Some of the researchers confirm correlations between MSMs and physical activity[1,8,10,11,15]. Some of them are skeptical and point out to multifactorial etiology of musculoskeletal stress markers[5,16,17]. These researchers stress that the attachment site surface complexity depends not only on physical activity but also on a number of other factors, including those of genetic[7,17] and hormonal[17] nature, as well as body size[10,18–20].

The recent years have witnessed a rise of interest of researchers in analyzing relationships between the morphology of muscle attachment sites and the shape, size and robusticity of the skeleton. This may be exemplified by the study by Berget and Churchill[21], Bridges[22], Stirland[14], Weiss[18–20]. Some aspects of correlation between body size and musculoskeletal stress markers can be also found in the works by Borgognini Tarli, Repetto[23], Churchill and Smith[24].

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Assessment of musculoskeletal stress markers – review of the methods

Methodology of research on the musculoskeletal stress markers has posed a problem for many years. Researchers use different sets of MSM and different scoring system in their studies.

Hawkey and Merbs[25] distinguish three types of musculoskeletal stress markers: robusticity, stress lesion, and ossification exostosis. As noted by Dutour[26], Galera, Garralda[27], Mariotti et al.[16], Benjamin et al.[28], Villotte et al.[15] changes of stress lesion or ossification type are morphological variations of pathological changes in tendon attachments, the so-called enthesopathies. They are a response to micro- or macro-injuries accompanying a strenuous physical activity[9,16] as well as a number of diseases of the locomotor system[5,16,29].

The researches[9,25] developed a 6-point scoring system for the assessment of the degree of expression of MSM. The research methods proposed by Hawkey and Merbs[25] was used in studies conducted by Chapman[6], Steen and Lane[1], Weiss[18–20], Molnar[11], Eshed et al.[8], Peterson[12].

Analyzing the musculoskeletal stress markers on the humerus, Stirland[14] used her own 5-point rating scale, assuming MSM variability from no changes at all on the attachment site surface to strongly developed ridges and sulci.

Al-Oumaoui et al.[4] carried out analyses based on the rating system in which presence or absence of changes within the attachment site was noted.

Robb[13] uses a 5-point rating system to evaluate MSM, assuming the variability ranging from no visible changes within the MSM to strongly developed attachment site with possible destructive changes of the bone tissue (enthesopathies and other). The methodological proposal by Robb[13] was used also in the study by Churchill and Morris[7].

The differences in the research attitude apply not only to the rating systems but also to the choice of the range of attachment sites to be analyzed.

Chapman[6] analyzed twenty-four attachment sites located on the clavicle, scapula, humerus, ulna and radius. Steen and Lane[1] examined fourteen entheses on the scull, twenty on the upper limb bones (clavicle, scapula, humerus, ulna, radius) and thirty on the lower limb bones (innominate, femur, tibia). Weiss[18] analyzed seven humeral, ulnar and radial musculoskeletal stress markers. Molnar[11] investigated the variability of thirty MSM on the clavicle, scapula, humerus, ulna, and radius and on the digital bones. Eshed et al.[8], Peterson[12] analyzed the variability of the muscle attachment sites on the scapula, clavicle, humerus, ulna and radius. Stirland[14] investigated only muscle attachment sites located on the humerus.

Al-Oumaoui et al.[4] examined fourteen muscle attachment sites located on the humerus, radius, ulna, femur, patella, tibia and calcaneus. Robb[13] proposed to evaluate eighteen entheses located on the scapula, humerus, radius, ulna, innominate, femur, tibia and calcaneus.

As evident from the above review there is no agreement among researchers as to the methods of assessment of musculoskeletal stress markers, both regarding the choice of the MSM and the developed rating scales.

Inconsistent existing methodology for the study of musculoskeletal stress markers and lack of access to complete photographic documentation, illustrating specific degrees of their expression necessitated developing an own rating system by the authors.

The purpose of the present work is: (a) to present a system for the rating of musculoskeletal stress markers development; (b) to assess the population from Cedynia in terms of the frequency and degree of intensity of MSM; (c) to assess asymmetry and sexual dimorphism in the development of musculoskeletal stress markers.

Material and Methods

The bone material used in the study came from the medieval burial ground in Cedynia (50 km south of the city of Szczecin, Poland). The cemetery was situated approximately 200 m north east of an early mediaeval castle. It is dated to the period from the end of the 10th century till the first half of the 14th century. The burial ground was used in three stages by the population of the fortified site and extramural settlement[30].

The population of Cedynia was socially diverse, making a living from trade, craftsmanship, fishing and farming[30]. However, neither the contents of the graves nor the mentions in the historical sources make it possible to precisely determine individuals' occupations.

Analyses of 201 skeletons, including 99 female and 102 male skeletons were carried out. The study covered individuals classified as adultus and maturus age groups. Incomplete development of bone structures in younger individuals and high frequency of involutional and degenerative changes in the senilis group could distort the results[4,16].

Recommended method were applied to estimate the sex age and of the individuals[31,32]. Characteristics of the cranium and pelvis was assessed to the sex estimation. The age was estimated through the analysis of the degree of cranial suture obliteration, the changes on the surface of pubic symphysis and the degree of dental crown attrition[33]. The population of Cedynia was a subject of numerous studies both in the field of anthropology[33–35] and archeology[30,36] studies.

Development of a rating system for the musculoskeletal stress markers

When selecting musculoskeletal stress markers to develop the rating system the following factors were taken into account: (a) repetitive occurrence of MSM in studies by various authors; (b) degree of bone material preservation. Having the above in mind the authors decided that the optimum set of MSM for the analysis of the population from Cedynia is the set proposed by Robb[13]. According to this researcher it is the best balanced group of muscle attachment sites as they participate in the so-called »daily activity« and play the essential role in the movements of the arm, elbow, palm, hip, knee and foot[13].

A preliminary analysis of the bone material from Cedynia helped to verify the musculoskeletal stress markers proposed by Robb[13]. Out of a set of eighteen traits proposed by this author ten muscle attachment sites were chosen for further analysis. This particular choice was made based on the following criteria:

(a) usefulness of specific MSM in the pursuing of the defined research objectives; disregarding the flexor digitorum superficialis origin (coronoid tuberosity) and common flexors' and extensors' origins (medial epicondyle, lateral epicondyle) as these muscles are mainly involved in manual activity;

(b) degree of bone material preservation; attachment sites located on poorly preserved bones (calcaneus) or bone fragments prone to frequent damage (ulnar tuberosity, ischial tuberosity) were excluded from the study;

(c) repetitive appearance of the selected MSM in studies by other authors.

The preliminary analysis of the bone material from Cedynia in terms of the variability of individual musculoskeletal stress markers proved that the optimum rating system for the studied population would be a three-point system. A two-point scale fails to exhaust the variability of the changes observed within the attachment sites, while excessively subtle differences between categories in four- or five-point scales tend to increase the evaluation error. Expanding of the scale results also in decreasing the frequency in individual categories, making it impossible (especially when sample size is small) to perform a number of statistical analyses.

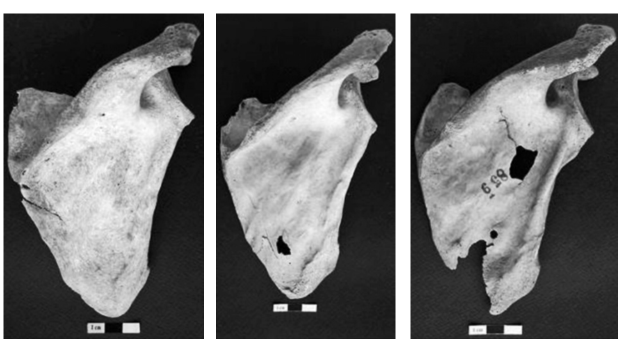

Fig. 1. Lateral margin – Teres minor origin (S1). a) Category 1. b) Category 2. c) Category 3.

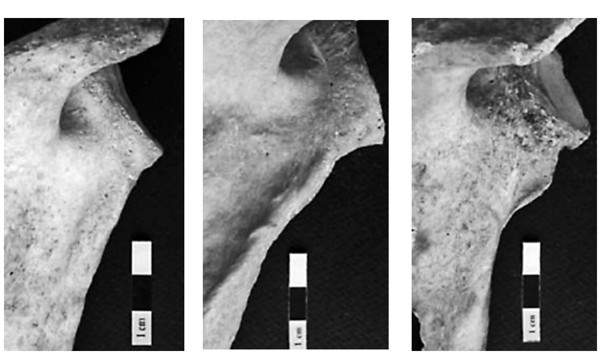

Fig. 2. Glenoid tubercule – Triceps origin (S2.) a) Category 1. b) Category 2. c) Category 3.

Fig. 3. Bicipital groove – Pectoralis major insertion (H)1. a) Category 1. b) Category 2. c) Category 3).

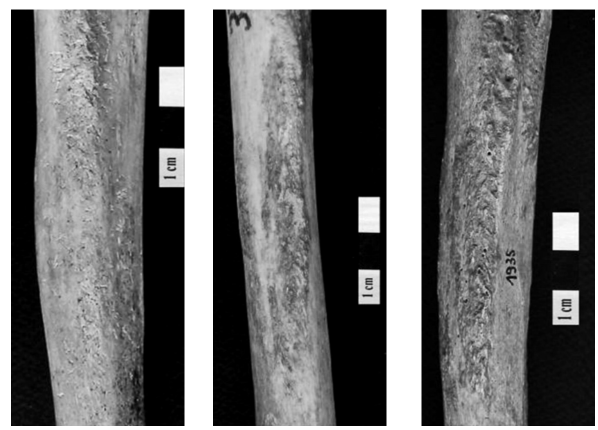

Fig. 4 A. Deltoid tuberosity – Deltoid insertion (H2). a) Category 1. b) Category 2. c) Category 3.

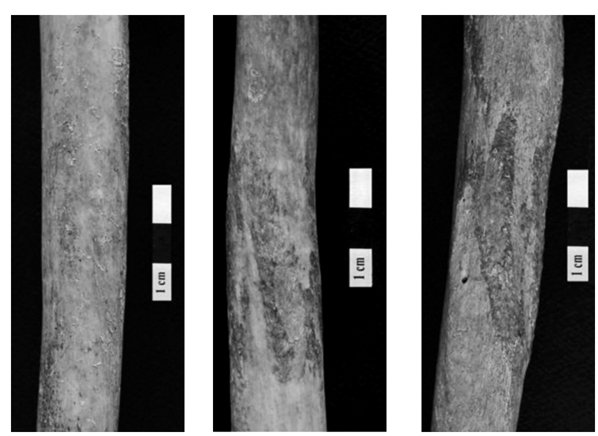

Fig. 4 B. Deltoid tuberosity – Deltoid insertion (H2). a) Category 1. b) Category 2. c) Category 3.

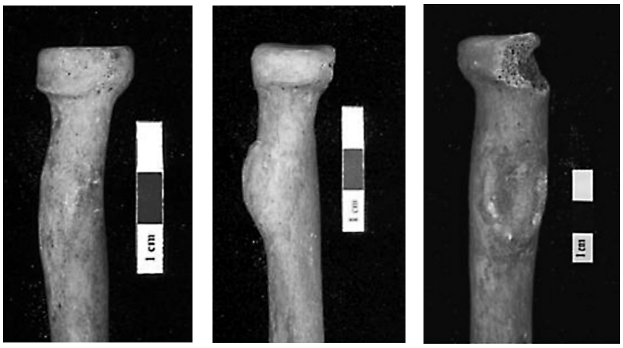

Fig. 5. Bicipital tuberosity – Biceps insertion (R1). a) Category 1. b) Category 2. c) Category 3.

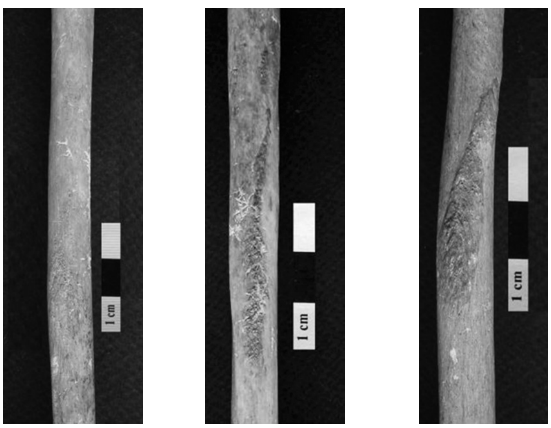

Fig. 6. Midshaft of radius – Pronator teres origin (R2). a) Category 1. b) Category 2. c) Category 3.

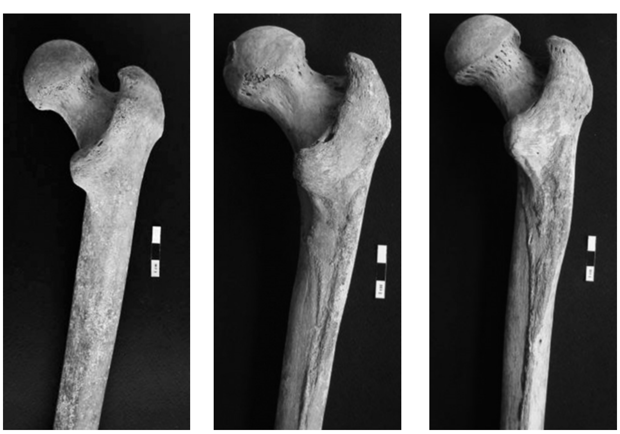

Fig. 7. Gluteal tuberosity – Gluteus maximus insertion (F1). a) Category 1. b) Category 2. c) Category 3.

Individual degrees (categories) of the complexity of muscle attachment sites were marked with digital symbols (1, 2, 3), however no equal sign can be put between these categories for different MSM.

Since including changes such as stress lesions or ossifications in the systems for the rating of musculoskeletal stress markers is disputable, only changes of robusticity type were included when developing the present system.

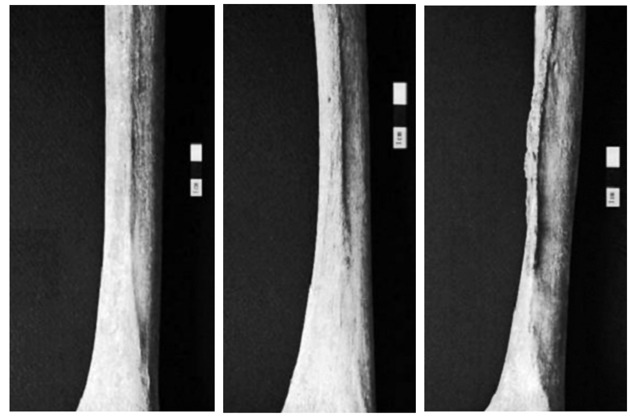

Fig. 8. Linea aspera (F2). a) Category 1. b) Category 2. c) Category 3.

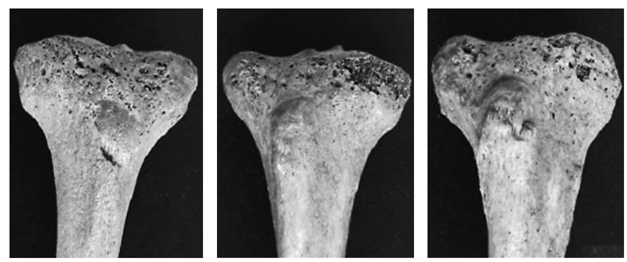

Fig. 9. Tibial tuberosity – Patellar ligament (T1). a) Category 1. b) Category 2. c) Category 3.

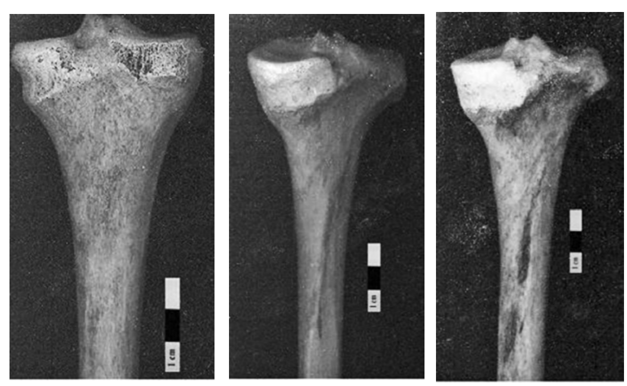

Fig. 10. Soleal crest – Soleus insertion (T2). a) Category 1. b) Category 2. c) Category 3.

Degrees of formation of the musculoskeletal stress markers are shown in Figures 1–10.

The rating system developed by the authors was used for the assessment of the musculoskeletal stress markers in the medieval population from Cedynia.

Statistical methodology

Musculoskeletal stress markers were analyzed in terms of their frequency in the population.

The analysis of the asymmetry of musculoskeletal stress markers was carried out based on the Pearson chi-square statistics. For some traits (females: S1, S2, R2, F2, R1) observed and expected frequencies were in

TABLE 1
FREQUENCIES OF CATEGORIES OF MUSCULOKELETAL STRESS MARKERS

Trait	Category	Females				Males			
		L		R		L		R	
		N	[%]	N	[%]	N	[%]	N	[%]
S1	1	32	54.24	30	46.87	29	45.31	22	34.92
	2	25	42.37	32	50.00	27	42.19	34	53.97
	3	2	3.39	2	3.12	8	12.50	7	11.11
S2	1	24	39.34	24	37.50	13	20.00	9	15.52
	2	33	54.10	36	56.25	46	70.77	41	70.69
	3	4	6.56	4	6.25	6	9.23	8	13.79
H1	1	33	55.93	33	55.93	24	33.33	24	32.88
	2	21	35.59	21	35.59	42	58.33	38	52.05
	3	5	8.47	5	8.47	6	8.33	11	15.07
H2	1	27	48.21	21	37.50	27	39.70	14	20.59
	2	17	30.36	23	41.07	28	41.18	36	52.94
	3	12	21.43	12	21.43	13	19.12	18	26.47
R1	1	7	10.29	8	11.59	2	2.90	3	3.95
	2	53	77.94	49	71.01	56	81.16	57	75.00
	3	8	11.76	12	17.39	11	15.94	16	21.05
R2	1	18	36.00	18	33.96	7	13.72	10	18.87
	2	24	48.00	33	62.26	33	64.70	28	52.83
	3	8	16.00	2	3.77	11	21.57	15	28.30
F1	1	8	11.76	9	13.04	8	10.39	8	10.26
	2	40	58.82	34	49.27	41	53.25	39	50.00
	3	20	29.41	26	37.68	28	36.36	31	39.74
F2	1	14	18.67	15	19.48	10	12.19	9	11.39
	2	59	78.67	59	76.62	62	75.61	56	70.89
	3	2	2.67	3	3.90	10	12.19	14	17.72
T1	1	14	18.18	11	12.50	10	12.82	9	9.89
	2	51	66.23	65	73.86	51	65.38	52	57.14
	3	12	15.58	12	13.64	17	21.79	30	32.97
T2	1	18	23.08	26	29.54	21	25.92	15	16.30
	2	45	57.69	42	47.73	40	49.38	42	45.65
	3	15	19.23	20	22.73	20	24.69	35	38.04

S1 – lateral margin, S2 – glenoid tubercule, H1 – bicipital groove, H2 – deltoid tuberosity, R1 – bicipital tuberosity, R2 – pronator teres origin, F1 – gluteal tuberosity, F2 – linea aspera, T1 – tibial tuberosity, T2 – soleal crest, N – sample size, L – left side, R – right side, % – frequency

some fields of contingency table lower than five, which made the obtained result inaccurate. The frequency analysis of these variables was then made based on χ^2 statistics for 2×2 tables, after prior combining of the categories with frequencies lower than five with categories with higher frequencies. In female group category 3 of variables S1, S2, R2, U2 was included into category 2 (category 3 was combined with category 2 for the bones of the right and left side of the body). In male group category 1 of variable R1 was included into category 2. The procedure referred to the bones of the right and left side of the skeleton.

Differences in the frequency of musculoskeletal stress markers between females and males were analyzed based on Pearson χ^2 statistics. For the markers, whose observed and expected frequencies in one of the categories were lower than five in the contingency tables, χ^2 statistics for 2×2 tables were used. In such case categories with frequencies lower than five were incorporated into categories with higher frequency. For the left side of the skeleton category 1 of trait R1 and category 3 of traits S1, S2 and F2 were combined with category 2. For the right side of the skeleton category 1 of traits R1 and R2 and category 3 of traits S1, S2 and F2 (*linea aspera*) was combined with category 2 of these variables. When combining the categories a principle was adopted whereby the least frequent category was joined to more frequent one, remembering to apply this rule for both sex groups.

Significance of the differences was determined at the probability level of 0.05. Computations and diagrams were made using Statistica 6.0 software.

Results

Frequencies of individual categories of musculoskeletal stress markers in female and male group are shown in Table 1.

Moderate degree of expression of the development of muscle attachment sites (category 2) was the most frequent category in the population from Cedynia, with the exception of attachment site S1 (lateral margin) on the bones of the left side of both female and male skeleton; H1 (bicipital groove) left and right humerus in females; H2 (deltoid tuberosity) left humerus in females. Category 1 (the faintest degree of the attachment site development) was observed most frequently.

Lateral asymmetry

Frequencies of individual categories of musculoskeletal stress markers for males and females are shown in Table 2.

Graphic representation of the frequencies of the studied traits on the bones of the right (R) and left (L) side of the skeleton in the female group is shown in Figure 11.

The results of Pearson χ^2-test and χ^2-test for 2×2 tables (females) compiled in Table 2 demonstrate the absence of significant differences between frequencies of musculoskeletal stress markers on the bones of the right and left side of the skeleton.

Distribution of the frequency of musculoskeletal stress markers on the bones of the right (R) and left (L) side of the male skeleton are shown in Figure 12.

Table 3 contains the compilation of the χ^2-tests for the frequency of the musculoskeletal stress markers of the right and left side of the skeleton in the male group. Like

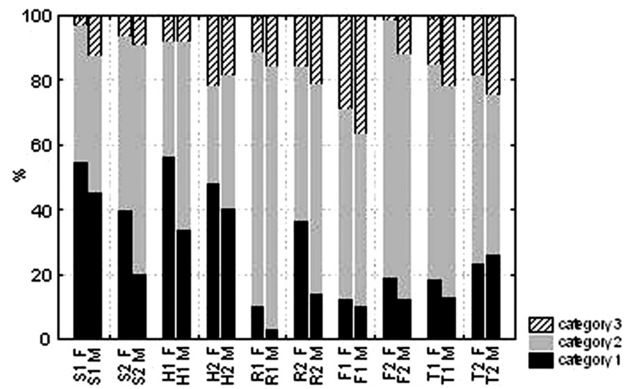

Fig. 11. Frequency of musculoskeletal stress markers on the bones of the right (R) and left (L) side of the skeleton (females). For explanation of the MSM symbols see Table 1.

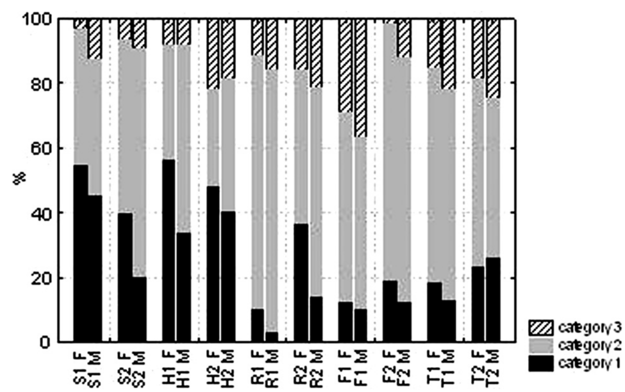

Fig. 12. Frequency of musculoskeletal stress markers on the bones of the right (R) and left (L) side of the skeleton (males). For explanation of the MSM symbols see Table 1.

TABLE 2
DIFFERENCIES BETWEEN THE FREQUENCIES OF MUSCULOKELETAL STRESS MARKERS ON THE BONES OF THE RIGHT AND LEFT SIDE OF THE SKELETON (FEMALES)

Trait	Pearson χ^2			χ^2 for 2×2 tables		
	χ^2	df	p	χ^2	df	p
S1	0.72	2	0.70	0.41	1	0.52
S2	0.06	2	0.97	0.04	1	0.83
H1	0.00	2	1.00			
H2	1.65	2	0.44			
R1	1.21	2	0.55			
R2	4.94	2	0.09	0.00	1	0.94
F1	1.32	2	0.52			
F2	0.02	2	0.90	0.02	1	0.90
T1	1.32	2	0.52			
T2	1.68	2	0.43			

* Statistical significance of the results at the 0.05 level, S1 – lateral margin, S2 – glenoid tubercule, H1 – bicipital groove, H2 – deltoid tuberosity, R1 – bicipital tuberosity, R2 – pronator teres origin, F1 – gluteal tuberosity, F2 – linea aspera, T1 – tibial tuberosity, T2 – soleal crest

TABLE 3
DIFFERENCIES BETWEEN THE FREQUENCIES OF MUSCULOKELETAL STRESS MARKERS ON THE BONES OF THE RIGHT AND LEFT SIDE OF THE SKELETON (MALES)

Trait	Pearson χ^2			χ^2 for 2×2 tables		
	χ^2	df	p	χ^2	df	p
S1	1.82	2	0.40			
S2	0.91	2	0.64			
H1	1.66	2	0.44			
H2	5.93	2	0.05			
R1	0.70	2	0.67	0.62	1	0.43
R2	1.52	2	0.47			
F1	0.20	2	0.91			
F2	0.97	2	0.62			
T1	2.67	2	0.26			
T2	4.46	2	0.12			

* Statistical significance of the results at the 0.05 level, S1 – lateral margin, S2 – glenoid tubercule, H1 – bicipital groove, H2 – deltoid tuberosity, R1 – bicipital tuberosity, R2 – pronator teres origin, F1 – gluteal tuberosity, F2 – linea aspera, T1 – tibial tuberosity, T2 – soleal crest

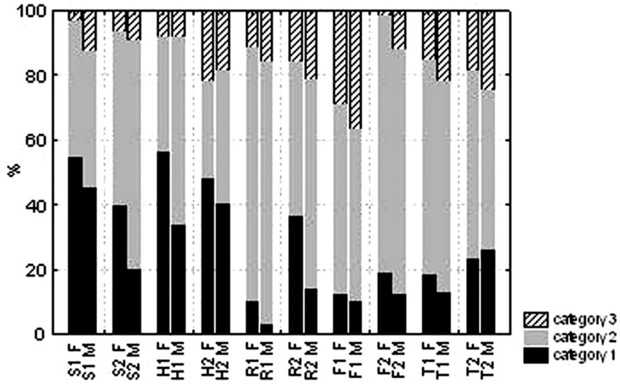

Fig. 13. Sex differences in musculoskeletal stress markers – right side of the skeleton. F – females, M – males (for explanation of the MSM symbols see Table 1).

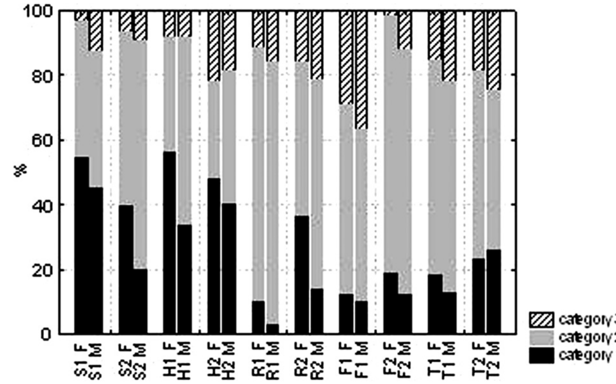

Fig. 14. Sex differences in musculoskeletal stress markers – left side of the skeleton. F – females, M – males (for explanation of the MSM symbols see Table 1).

in the female group distributions of the frequencies of the studied traits fail to show statistically significant differences. Only in the case of deltoid tuberosity (H2) value p ($p=0.052$) oscillating around the threshold may suggest a statistically significant difference in the degree of expression of this musculoskeletal stress marker on the right and left humerus.

Sexual dimorphism

Distribution of the size and frequency of the categories of the analyzed musculoskeletal stress markers is shown in Table 1. Graphic representation of the data from Table 1 is shown in Figures 13 and 14.

Table 4 contains aggregate results of the analysis of the significance of differences in the frequencies of MSM between females and males, separately for the left and right side of the skeleton.

The χ^2-test results for the bones of the left side of the skeleton demonstrate there are dimorphic differences in the degree of expression of the attachment site of the greater pectoral muscle (bicipital groove – H1) and the round pronator muscle (pronator teres origin – R2). Sexual dimorphism was also noted for the attachment site of the minor teres muscle (glenoid tuberosity – S2).

On the bones of the right side of the skeleton dimorphic differences were observed for the glenoid tuberosity (S2), bicipital groove (H1), pronator teres origin (R2), tibial tuberosity (T1), soleal crest (T2) and linea aspera (F2).

Discussion and Conclusions

Frequencies of musculoskeletal stress markers noted in the population from Cedynia demonstrate the correctness of the rating scale proposed for the assessment of

TABLE 4
DIFFERENCIES IN THE FREQUENCIES OF MUSCULOKELETAL STRESS MARKERS BETWEEN MALES AND FEMALES ON THE BONES OF THE LEFT AND RIGHT SIDE OF THE SKELETON

Trait	Left						Right					
	Pearson χ^2			χ^2 for 2×2 tables			Pearson χ^2			χ^2 for 2×2 tables		
	χ^2	df	p	χ^2	df	p	χ^2	df	p	χ^2	df	p
S1	3.63	2	0.16	0.98	1	0.32	4.06	2	0.13	1.88	1	0.17
S2	5.69	2	0.06	5.93	1	0.01*	8.20	2	0.02*	7.45	1	0.01*
H1	7.29	2	0.03*				7.16	2	0.03*			
H2	1.58	2	0.45				4.34	2	0.11			
R1	3.33	2	0.19	0.50	1	0.48	3.12	2	0.21	0.31	1	0.58
R2	6.72	2	0.03*				12.64	2	0.00*	3.11	1	0.08
F1	0.79	2	0.67				0.29	2	0.86			
F2	5.77	2	0.06	1.27	1	0.26	8.67	2	0.01*	1.96	1	0.16
T1	1.52	2	0.47				9.31	2	0.01*			
T2	1.18	2	0.55				6.66	2	0.03*			

Statistical significance of the results at the 0.05 level, S1 – lateral margin, S2 – glenoid tubercule, H1 – bicipital groove, H2 – deltoid tuberosity, R1 – bicipital tuberosity, R2 – pronator teres origin, F1 – gluteal tuberosity, F2 – linea aspera, T1 – tibial tuberosity, T2 – soleal crest these stress markers. The system exhausts the MSM variability in the studied population. It also correctly differentiates the analyzed muscle attachment sites in terms of the degree of their expression, as reflected in the distribution of frequency of individual MSM categories.

In the population from Cedynia no statistically significant differences were found with regard to the frequency of the MSM on the bones of the right and left side of the skeleton.

The absence of a statistically significant asymmetry in the degree of expression of all studied musculoskeletal stress markers was noted also by al-Oumaoui et al.[4], when studying agricultural populations). No side dominance in the MSM size was found by Steen and Lane[1] in Alaskan Eskimo populations.

Most researchers however find differences in the size of muscle attachment sites at the right and left hand site of the skeleton. Studying a hunting-gathering population, Molnar[11], found a low but statistically significant asymmetry for a few from among a few dozens of MSMs. Asymmetry of two from twenty four studied MSMs in a farming population was demonstrated by Liverse et al.[10]. Differences in the muscle attachment site sizes on the bones of the left and right hand side of the skeleton were also recorded for instance by Peterson[12], Eshed et al.[8] Mariotti et al.[16], Villotte et al.[15]. However, at this point we need to stress that the scarcity of well documented standardized observation methods limits the comparison between different studies.

On the bones of the right side of the skeleton dimorphic differences are displayed by: glenoid tuberosity (S2), bicipital groove (H1), pronator teres origin (R2), tibial tuberosity (T1), soleal crest (T2) and linea aspera (F2). For the bones of the left side of the skeleton dimorphic differences were noted for: bicipital groove (H1), pronator teres origin (R2) and glenoid tuberosity (S2).

In most skeletal sample males have higher muscle markers[1,8,11,16,20]. Higher musculoskeletal stress markers scores in females than in males have been noted by Chapman[6], al-Oumaoui et al.[4].

At this point however it is necessary to mention studies calling into question the existence of differences in the degree of MSMs expression in both sex groups. Weiss[20], Liverse et al.[10] indicate that it is possible that sex differences in musculoskeletal stress markers are often due to differences in body size.

We believe that the rating scale we propose may prove to be a useful research tool for the further studies of the frequency, bilateral asymmetry and sexual dimorphism of the musculoskeletal stress markers.

The presented rating scale seems to be a good instrument for the evaluation of musculoskeletal stress markers on bone materials. However, to verify and corroborate its correctness further testing on various skeletal populations is necessary.

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MARKERI MUSKULOSKELETALNOG STRESA U SREDNJOVJEKOVNOJ POPULACIJI IZ CEDYNIJE, POLJSKA

S A Ž E T A K

Namjera ovog rada bila je: a) prikazati skalu ocjenjivanja za evaluaciju markera muskuloskeletalnog stresa; b) analizirati srednjovjekovnu populaciju iz Cedynie kako bi se utvrdio stupanj ekspresije i frekvenciju markera muskuloskeletalnog stresa. Izložena skala ocjenjivanja razvijena je na temelju varijabilnosti morfologije mjesta vezivnog tkiva na osteološkom materijalu iz Cedynije (102 muškarca i 99 žene). U skalu je uključeno 10 markera muskuloskeletalnog stresa lociranih na skapuli, humerusu, radijusu, femuru i tibiji. Sistem prikazuje tri stupnja (1, 2, 3) složenosti morfologije mjesta vezivnog tkiva. Analiza asimetrije i spolni dimorfizam markera muskuloskeletalnog stresa bazirana je na χ^2 statistici (Pearson) ili χ^2 statistici za 2x2 tablice. Blagi stupanj (2) složenosti mjesta vezivnog tkiva je najčešći stupanj markera muskuloskeletalnog stresa u populaciji Cedynije. Niski (1) i visoki (3) stupanj složenosti morfologije mjesta vezivnog tkiva su najrjeđe uočeni u ovoj populaciji. Nema statistički značajne razlike između frekvencije markera muskuloskeletalnog stresa na kostima desne i lijeve strane kostura među ženama. Također nema statistički značajne razlike među muškarcima. Samo slučaj deltoidne simfize (H2) p=0,052, koja oscilira oko granične vrijednosti, može sugerirati prisutnost statistički značajne razlike u stupnju ekspresije markera muskuloskeletalnog stresa na kostima desne i leijeve strane kostura. Na kostima desne strane kostura uočene su dimorfne razlike na glenoidnoj simfizi (S2), bicipitalnom režnju (H1), pronator teres origin (R2), tibijalna simfiza (T1), solealna krijesta (T2) i linija aspera (F2). Na kostima lijeve strane kostura uočene su dimorfne razlike na bicipitalnom režnju (H1), pronator teres origin (R2) i glenoidnoj simfizi (S2).