

TECHNICAL NOTE

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Evaluation of the Suchey–Brooks Method for Aging Skeletons in the Balkans

ABSTRACT: This study has been carried out to examine whether the Suchey–Brooks (S&B) methods could be successfully applied in age assessment of populations from the Balkans. The known-age sample consists of 33 females and 52 males pairs of pubic bones collected from the autopsy cases. Age estimation by S&B method showed an accuracy of 89.74% in males and 72.0% in females. Statistical analysis showed a positive correlation between the actual age of the investigated individuals and age phases obtained by the S&B method, although the mean values of the sixth age category differed significantly compared with the original model. The most reliable indicators in both sexes were the relief of the symphyseal surface, lipping, symphyseal rim, and dorsal margin. The discriminating power of these indicators was the least reliable in distinguishing S&B phases 2 and 3. Based on these results, the appropriate recommendations for aging Serbian populations are made. There was a good agreement between two observers ($\kappa = 0.726$).

KEYWORDS: forensic science, age assessment, identification, pelvis

Pubic symphyseal aging is one of the most popular methods for age assessment of individuals (1). Since Todd (2) developed a method based on age-related changes in the morphology of the symphyseal surface, pubic aging schemes have undergone multiple revisions (3–9). The results of these revisions, as well as testing on other populations (5,6,10–12), showed that poor performance in aging skeletal material was related to interpopulation variation, applicability of aging standards derived from modern bones to archaeological remains, broad age-spans corresponding to each phase (except the youngest adults), and the characteristics of reference samples (i.e., reliability of age documentation, sample size, age range, sex distribution). Some authors also criticized the applicability of this method because of the low rate of survival of pubic symphysis in the osteoarchaeological material (13,14). Nevertheless, the Suchey–Brooks (S&B) revision of the symphyseal aging method (9), in which each phase was divided into stages, has been the method of choice for most forensic anthropologists in the past three decades, and a widely used method in recent forensic practice in the region of the former Yugoslavia. This paper reviews the results of independent tests of the S&B aging method applied to a modern Serbian sample and carried out by an experienced and an inexperienced anthropologist.

Material and Methods

The sample consisted of 85 pairs of pubic bones collected from autopsy cases from the Institute for Forensic Medicine, University of Belgrade, during the period 1999–2002. The bones were collected from 33 females and 52 males of various ages, ranging from 17 to 91 years.

Documentation of age at death was not accessible to the observer before analysis, while individuals' sex was known, because it was necessary for the application of the S&B age scheme. After the general visual age assessment of each individual (based on observations of the casts of typical six S&B age phases), the following features of the symphyseal surface were recorded: changing relief of the symphyseal surface (furrows and ridges, graininess, and symphyseal convexity or concavity), dorsal margin, ventral beveling, lower extremity, ossification nodule, upper extremity, ventral rampart, dorsal plateau, lipping of the margin, and symphyseal rim. The cases were categorized in to the corresponding S&B phase, and coincidence of observed traits with the S&B description of each phase was recorded. After comparing the actual age with the estimated age, the accuracy of overall assessment as well as the reliability of each observed age indicator were analyzed separately for males and females. We scored each morphological trait according to its degree of expression, ranging it from 1 to 4, depending on the variable in question. The Student *t*-test, Pearson linear correlation coefficient, and discriminant analysis were used for this analysis. In discriminant analysis, the class variable was six S&B age phases and the independent variables were changing relief of the symphyseal surface, dorsal margin, ventral beveling, lower extremity, ossification nodule, upper extremity, ventral rampart, dorsal plateau, lipping of the margin, and symphyseal rim.

Testing of the interobserver variability error was carried out on a separate occasion, a month later, with an inexperienced anthropologist, and analyzed by κ -statistics.

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Results

The application of the S&B method to our sample showed that 82.98% of males and 75.0% of females were correctly classified in to an appropriate age phase. The mean values of chronological (documented) age at death in each estimated S&B phase are given (separately for females and for males) in Table 1. Significant difference ($p < 0.01$) between the mean chronological age of the individuals and the mean values established by S&B was found in the oldest category (phase 6), in both males and females (females: $t = 2.99$, $df = 31$; males: $t = 3.01$, $df = 50$). The mean actual age of this category was significantly higher in our material, i.e., the S&B criteria tended to underage the specimens.

To assess a correlation between the actual age and the age estimated by the S&B method, the Pearson coefficient was used. It showed a significant degree of correlation ($r = 0.899$, $p < 0.01$), which means that the general distribution of individuals into S&B age categories corresponds to the actual age, but (as pointed out by the t -test) the mean values of certain categories will differ in our population.

Attempting to determine what morphological traits were the best age indicators in our sample, i.e., what features best distinguish adjacent age phases, we conducted the stepwise linear discriminant analysis. The results of discriminate analysis (Table 2) showed that the best discriminators of the phases were relief of symphyseal face, lipping, oval outline (definition of the symphyseal rim), and dorsal margin (order in which the variables entered the stepwise function). The relief of the symphyseal face shows ridges and furrows in S&B phases 1 and 2; it was roughly grained in phase 3, smooth or fine grained in phases 4 and 5, and pitted in phase 6. Lipping was present in phases 5 and 6. Oval outline was absent in phases 1, 2, and 3, incomplete in phases 4 and 6, and complete in phase 5. The dorsal margin was distinct in all phases, except phase 1.

The adequacy of a given model had been proven with a Wilks' λ of 0.144 and $p = 0.000$. Positions of the mean values (1, 2, . . . 6) of the canonical variables for the six phases are represented in Fig. 1. From the plot it is evident how separate the phases are, with the exception of the difference between phases 2 and 3 ($F = 1.356$, $p = 0.257$), where the discriminant power of age indicators was not good enough to discriminate these phases.

Analysis of the data obtained by an inexperienced anthropologist using κ statistics showed that both examiners exhibit a good agreement in categorization into S&B age phases ($\kappa = 0.726$); therefore, this item was not analyzed further (15).

Discussion

The rate of reliability of the S&B method applied on the Balkan sample indicates the need for establishing the population-specific

TABLE 2—Canonical discriminant function coefficients for four of the best symphyseal age indicators.

	Function			
	1	2	3	4
Relief of symphyseal face	1.022	−0.668	−1.080	−0.642
Dorsal margin	0.945	3.210	−2.037	2.994
Symphyseal rim	0.301	1.090	0.863	−0.659
Lipping	1.482	−0.831	1.789	1.749
(Constant)	−7.177	−5.546	2.238	−5.477
Percent of variance in age phases explained	82.0	9.5	4.7	3.8

standards. Generally, problems in applicability of aging methods to populations other than the reference sample and necessity of developing the population-specific models are pointed out by several anthropologists (11,16–18). The lower rate of accuracy in the female sample was expected because the authors themselves as well as some other investigators (19) noticed the large morphological variability of age indicators in females. The results of this study indicate the low discriminant power of the S&B method between categories 2 and 3, and poor agreement with actual age in category 6. The age distribution of our sample was relatively uniform; thus we do not expect that it influenced the results of the technique applied, as it was concluded in some other studies (1). The results suggesting the use of the S&B method only for age estimation of younger individuals have also been obtained in other studies (18–20).

The best age indicators distinguishing phases in our sample were relief of symphyseal face, lipping of the margins, definition of the symphyseal rim, and dorsal margin. Considering that S&B method is widely used in forensic identification of the war victims in former Yugoslavia, the above observations could be useful in routine forensic practice in this area. Based on the experience from this sample, several corrections of the original S&B description could be proposed in aging Serbian populations:

- In rugged male symphyses, ridges, and grooves over less than half of the surface and of a small density indicated phase III/2.
- If the male symphysis is finely granulated, then the absence of lipping and ventral rampart suggests IV/2 age category, while their presence indicates phase V/1.
- In eroded male symphyses, the presence of ossification nodules suggests VI/1 age category.
- Formation of the oval contour ends later in our sample than it was originally described; appearance of oval contour points to phase V, while complete formation indicates an age over 55.

TABLE 1—Descriptive statistics of the Suchey–Brooks (S&B) aging method applied to the Balkans sample.

		Female						Male			
		S&B Age Range		Chronological Age at Death (<i>n</i> = 33)				S&B Age Range		Chronological Age at Death (<i>n</i> = 52)	
S&B phase	<i>n</i>	Mean	SD	Mean	SD	<i>n</i>	Mean	SD	Mean	SD	
I	4	19.4	2.6	20.50	3.00	6	18.5	2.1	20.17	1.47	
II	3	25.0	4.9	23.00	2.65	3	23.4	3.6	22.67	1.15	
III	4	30.7	8.1	30.75	11.59	5	28.7	6.5	26.60	4.10	
IV	10	38.2	10.9	39.80	7.57	18	35.2	9.4	34.39	7.49	
V	7	48.1	14.6	47.71	5.53	9	45.6	10.4	52.11	10.08	
VI	5	60.0	12.4	74.80*	12.11	11	61.2	12.2	76.18*	12.66	

*Significant difference between S&B age range and chronological age at death.

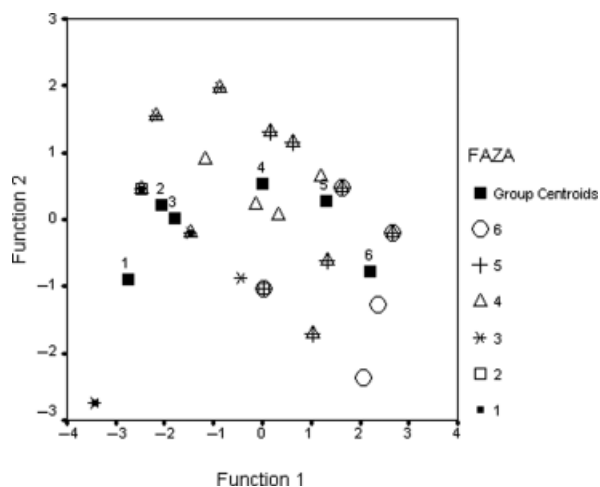


FIG. 1—Plot of the canonical variables with six age phases. *Each symbol (not applied to group centroids) corresponds to a group of less than five individuals.

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