

https://dspace.org/

A study of the sacrum and some aspects of presacral vertebrae in San (Bushmen) and Southern African and American Negroes

2015-02-20
http://hdl.handle.net/10539/17039

Downloaded from a DSpace repository. https://dspace.org/

(present series) is 99,2 cm which is only 0,8 cm less than that for Washburn's sample (100,0 cm), whilst the range is extended from 93 - 108 in Washburn's sample to 91,3 - 112,9 cm in the present series.

The distribution of the ischium-pubis index in the present San sample is shown graphically in Figure 9. Washburn (1949) places the dividing line between male and female at 91,9% and Figure 9 shows that two skeletons approach the separation line. One has an index of 91,0% - the highest limit of the male range. The sciatic notch width in this pelvis is 40 mm which suggests that it is more likely to be a male pelvis (values of 40 mm and less are used to support the diagnosis of male - see discussion on sciatic notch width). Thus, on the evidence of the ischium-pubis index and sciatic notch width, this skeleton is classified as male. The remaining borderline skeleton has an ischium-pubis index of 91,7% but happens to be of a known San female. The sciatic notch width is 49 mm. This value falls within the female range and outside the male range (Table 5) and this confirms that the skeleton belongs in the female category.

2. The Sciatic Notch Width

The values of sciatic notch width are analysed according to sex as determined by the ischium-pubis index and the results given in Tables 5 and 6 and Figure 10.

TABLE 5

Values for Sciatic Notch Width in the present San (Bushman) Series.

	Male	No.	Mean	Range	SD	CV
Sciatic Notch width	Male	31	37,9	30-45	4,5	14,0
	Female	21	43,8	30-53	5,8	13,3

TABLE 6

Distribution of Sciatic Notch Width in the present San (Bushman) Series

	Sciatic Notch Width		
	30-40 mm	41-53 mm	Range
Males	24 (77,4%)	7 (22,6%)	30-45
Females	6 (28,6%)	15 (71,4%)	30-53

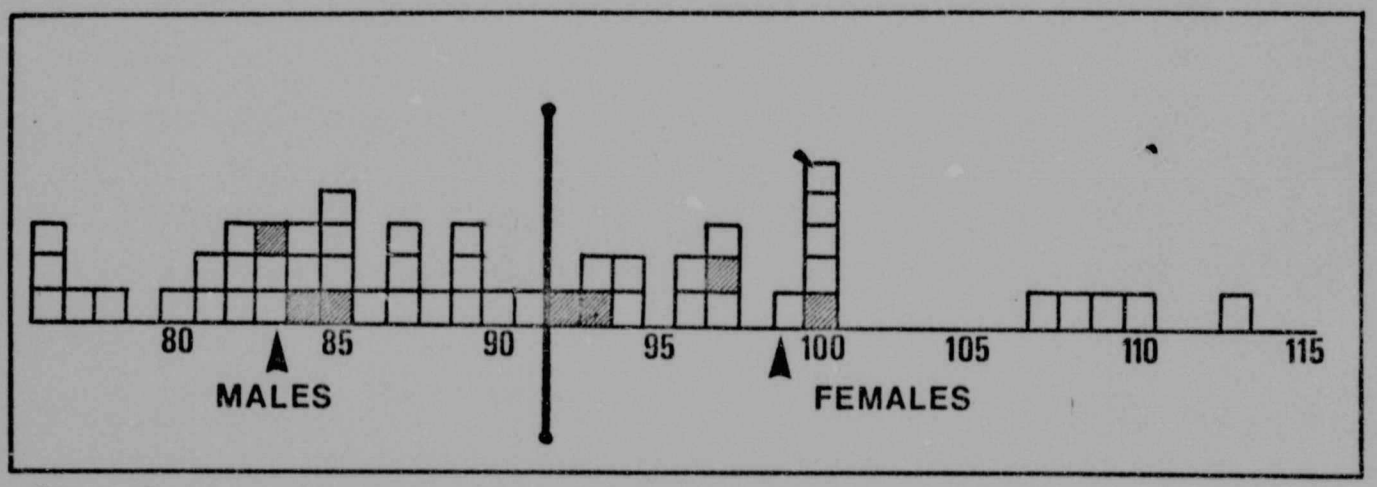

Figure 9 Distribution of Ischium-pubis Index in Present San Series

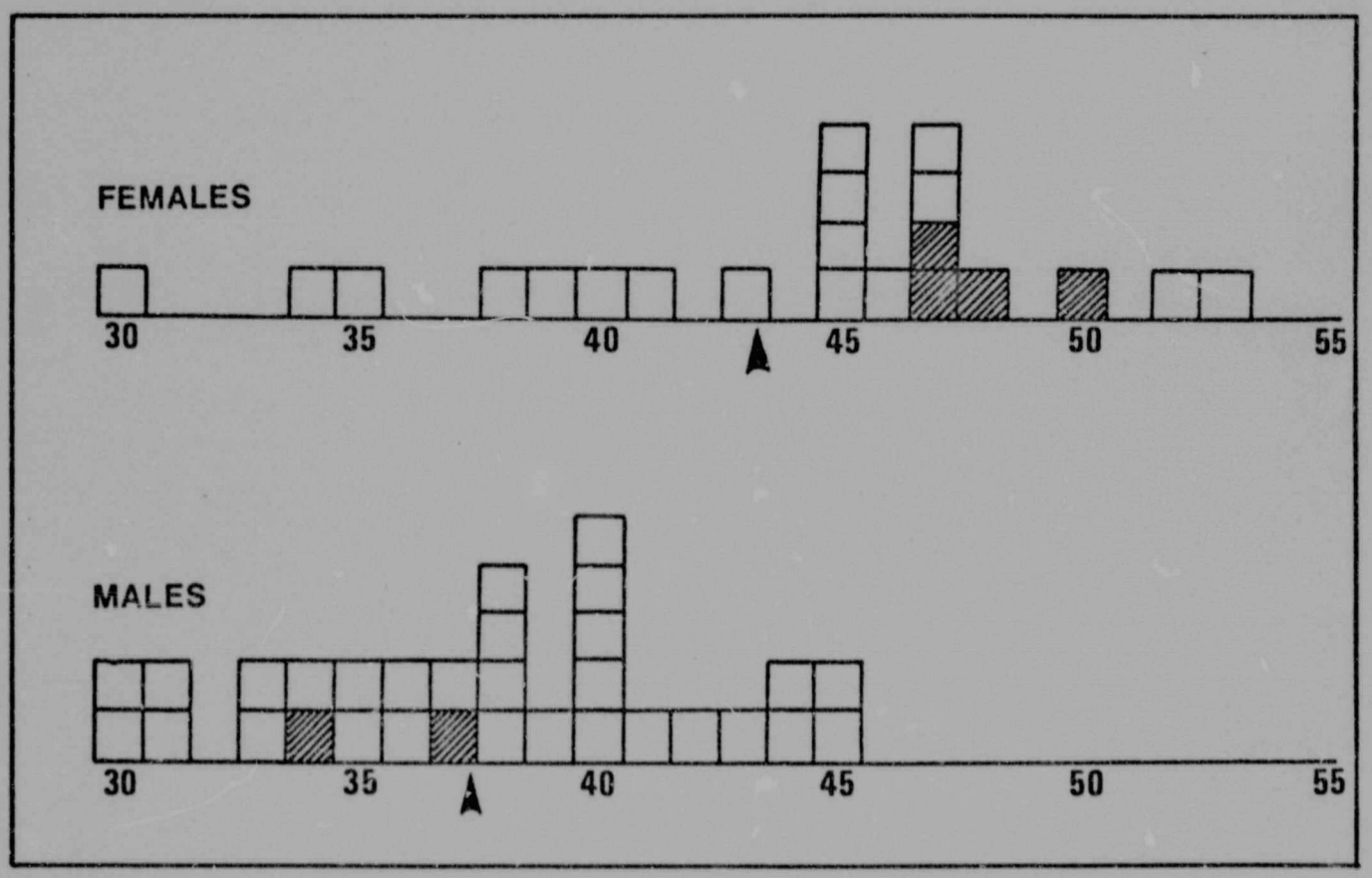

Figure 10 Distribution of Sciatic Notch Width in Present San Series

Key to figures 9 and 10:

Represents individual of known sex.

Indicates the mean

Table 5 shows that the mean sciatic notch width is 37,9 in males and 43,8 mm in females. The range for males extends from 30-45 and that for females from 30-53 mm showing that there is a large overlap in respect of the sexes. However, if the distribution of sciatic notch width is analysed, Table 6 and Figure 10 show that over 75% (24) of males have sciatic notch widths lying between 30 and 40 mm, whereas only 28,6% of females (6) fall within this range. Only seven males (22,6%) have values over 40 - the highest reaching 45, whereas fifteen females (71,4%) have values greater than 40; of these, twelve have sciatic notch widths of 45 mm and over. No male bone has a sciatic notch width greater than 45 mm. This difference in distribution between males and females is highly significant (P<,0001).

The values of the sciatic notch width in individuals of known sex (34 and 37 in males, and 47, 47,48 and 50 in females) support the findings in Table 6. However, the notch width is used only to assess the sex of some of the doubtful pelves. Values of 40 mm and less are used to support the diagnosis of male and of 45 mm and more to support the diagnosis of female.

available from the 63 San skeletons. These were from the 52 skeletons already sexed and comprise 16 male and 12 female spines.

C. STATISTICAL METHODS

In this study, the statistical methods used are divided into those employed in the analysis of (i) the metrical features of the sacra and (ii) the non-metrical features of the sacra and vertebral columns.

In general, the method has been to select samples of sacra or vertebral columns at random from suitable populations and to infer the characteristics of the sacra and vertebral columns from analysis of the observations. Comparisons are then made between the samples, and with data from other population groups where available.

Sample or Series

(i) The Southern African Bantu-speaking Negro: the age, sex and tribal division or chiefdom of this series are detailed in Chapter 2. The sub-groups of the S.A. Negro series are drawn from population groups of considerable size, that for the Natal Nguni being 4,848,000, Cape Nguni 3,780,000 and Sotho 3,372,000 according to van Warmelo (1974) in Chapter 3 of The Bantu-speaking peoples of Southern Africa.

(ii) The San Series: the San sample of 63 sacra and 28 vertebral columns belonging to the sacra, is small, but its inclusion is justifiable

[1] see addendum, p. 39.

as so few San skeletons are available or suitable for observations and fewer still have been placed on record. The San sample is drawn from a total Southern African San (Bushman) population estimated by Tobias (1957) to be over 55,000.

1. Metrical Features

The measurements have been taken on sacra only. The data for males and females are considered separately.

The following statistics have been computed from the data:

Mean $\bar{x} = \frac{\Sigma x}{n}$

Range = the difference between the uppermost and lowermost values

Variance $S^2 = \frac{\Sigma(x - \bar{x})^2}{n-1}$ where n = the number of observations and x = the measures

Standard deviation $S = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n-1}}$

Coefficient of Variation $C.V. = \frac{S}{\bar{x}} \times 100$

Standard error of the mean $S.E. = \frac{S}{\sqrt{n}}$

Tests of significance

The t test or Student's test is used to test the significance of the difference between the means for any measure in two samples. In this test, the difference of two means is divided by the standard error of the difference and the value of t is calculated by the following

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{S.E._1^2 + S.E._2^2}}$$

where $\bar{x}_1$ = the larger of the two means and $S.E._1$ its standard error and $\bar{x}_2$ = the smaller of the two means and $S.E._2$ its standard error.

The value of t varies with the size of the combined samples which, in almost all instances, in this study, consist of 30 or more. The significance value of t at the 1% confidence limit with 30 degrees of freedom

is 2,457 and thus a constant significance value of $\underline{t}$ = 2,500 has been employed throughout this study. When the combined samples are less than 30, correspondingly larger significance values of $\underline{t}$ are used. All the above statistical calculations and significance tests were carried out in the early part of the study before an electronic computer became available. A Facit hand-calculator was used.

Mahalanobis's D^2 or Generalised Distance Statistic

Whereas the Student or $\underline{t}$ test has been used to compare the means of single characters, it was suggested to me (Tobias, personal communication) that it would be worthwhile to do a generalised distance study to compare the overall dimensions of the sacra as a whole. After consultation (Hawkins, personal communication), the Generalised Distance Statistic (D^2) devised by Mahanalobis (1936) was used. This test depends on the calculation of co-variance matrices and is valuable since it allows for the inclusion of all characters by taking account of the correlations between them. Indices may therefore be omitted (Trevor 1947). The following nine metrical characters were used for the test:- anterior curved length, anterior straight length, height of maximum curvature, position of maximum curvature, greatest breadth, anterior straight breadth, transverse diameter of the body of S1, anteroposterior diameter of the body of S1 and the angle of the promontory. The complicated and extensive calculations involved were made on the Witwatersrand University IBM computer by Mr. P. Tuffin.

In view of the large total sample sizes, the chi-square approximation to the T^2 distribution is used to test the significance of the D^2 value (Hawkins personal communication; Anderson 1958). The following formula is applied:

$$\chi^2_9 = \frac{n_1 \; n_2 \; \times D^2}{n_1 + n_2}$$

where n_1 = the sample size of one population group

and n_2 = the sample size of another population group.

The result is looked up in a chi-square table using 9 degrees of freedom.

Variability

To test variability of the measures, a series of F tests have been performed on the standard deviations. The following formula is used (Hawkins, personal communication):

$$F = \left(\frac{s_1}{s_2}\right)^2$$

where s_1 = the larger of the two estimated standard deviations with $n_1 - 1$ degrees of freedom,

s_2 = the smaller of the estimated standard deviations. with $n_2 - 1$ degrees of freedom

and n_1 & n_2 = the sample sizes.

An F-table gives the significant values of the F ratio for the relevant degrees of freedom: the column headings are the degrees of freedom values for the numerator and the row labels are the degrees of freedom values for the denominator. In this analysis F is significant at 0,01.

2. Non-metrical Features

The chi-square test is used to test the significance of intergroup and sex differences of the non-metrical features. The value of chi-square was calculated according to the usual formula

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

The 1% level of significance ($P < 0,01$) is accepted as significant in this study. Yates's correction for continuity was applied to the chi-square test when any cell frequency was less than 5 (Guilford 1965).

General

In addition to the publications cited, Hill (1956) and Smith (1962) were consulted on statistical procedures.

Addendum

A critical examination is made of a further eight skeletons which lie near the dividing line of the ischium-pubis index. Of the males, one has an index of 90,0% but the sciatic notch width is 40 mm and this supports the diagnosis of male. The remaining three pelves have indices of 89,9%, 89,7% and 89,6%, and notch widths of 46, 30 and 31 respectively. The sciatic notch width supports the diagnosis of male in two pelves (30 and 31 mm) but is of no value in the remaining skeleton. Of the female skeletons, one has an index of 93,5% and is derived from a cadaver. Another has an index of 93,1% but the notch width is of no help (34 mm). The value of the corporo-basal index in the sacrum, however, strongly supports the diagnosis of female (see footnote, p. 262). The remaining two pelves (which lie furthest from the separation line) both have indices of 94,4%. One has a notch width of 45 mm and is almost certainly female, whilst the other has a notch width of 43 mm which is close to the lower limit set for females. The possibility cannot be excluded, however, that there may have been a misdiagnosis of sex in three male pelves (those with indices of 91,0%, 90.0% and 89,9%) and in one, possibly two, female pelves (93,1% and 94,4%). This possibility is considered in the analysis of results on the number of sacral vertebrae and on sex differences in the San sacrum. The sample of 28 San spines were all reliably sexed by the index and sciatic notch width.

$$F = \left(\frac{s_1}{s_2}\right)^2$$

where s_1 = the larger of the two estimated standard deviations with $n_1 - 1$ degrees of freedom,

s_2 = the smaller of the estimated standard deviations. with $n_2 - 1$ degrees of freedom

and n_1 & n_2 = the sample sizes.

An F-table gives the significant values of the F ratio for the relevant degrees of freedom: the column headings are the degrees of freedom values for the numerator and the row labels are the degrees of freedom values for the denominator. In this analysis F is significant at 0,01.

2. Non-metrical Features

The chi-square test is used to test the significance of intergroup and sex differences of the non-metrical features. The value of chi-square was calculated according to the usual formula

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

The 1% level of significance ($P < 0,01$) is accepted as significant in this study. Yates's correction for continuity was applied to the chi-square test when any cell frequency was less than 5 (Guilford 1965).

General

In addition to the publications cited, Hill (1956) and Smith (1962) were consulted on statistical procedures.

Addendum

A critical examination is made of a further eight skeletons which lie near the dividing line of the ischium-pubis index. Of the males, one has an index of 90,0% but the sciatic notch width is 40 mm and this supports the diagnosis of male. The remaining three pelves have indices of 89,9%, 89,7% and 89,6%, and notch widths of 46, 30 and 31 respectively. The sciatic notch width supports the diagnosis of male in two pelves (30 and 31 mm) but is of no value in the remaining skeleton. Of the female skeletons, one has an index of 93,5% and is derived from a cadaver. Another has an index of 93,1% but the notch width is of no help (34 mm). The value of the corporo-basal index in the sacrum, however, strongly supports the diagnosis of female (see footnote, p. 262). The remaining two pelves (which lie furthest from the separation line) both have indices of 94,4%. One has a notch width of 45 mm and is almost certainly female, whilst the other has a notch width of 43 mm which is close to the lower limit set for females. The possibility cannot be excluded, however, that there may have been a misdiagnosis of sex in three male pelves (those with indices of 91,0%, 90.0% and 89,9%) and in one, possibly two, female pelves (93,1% and 94,4%). This possibility is considered in the analysis of results on the number of sacral vertebrae and on sex differences in the San sacrum. The sample of 28 San spines were all reliably sexed by the index and sciatic notch width.

CHAPTER 4

THE NUMBER OF VERTEBRAE IN THE SACRUM

This chapter deals with the number of sacral vertebrae in the Natal Nguni, the Cape Nguni and the Sotho sub-groups of the S.A. Negro series, in the combined S.A. Negro sample and in the San. These results are compared inter se and with the findings in the American Negro and with data for other population groups.

The chapter is presented under the following headings:

A. Number of Sacral Vertebrae in the South African Negro and the San
B. Number of Sacral Vertebrae in Other Human Populations
C. Discussion
D. Summary and Conclusions

A. NUMBER OF SACRAL VERTEBRAE IN THE SOUTH AFRICAN NEGRO AND THE SAN

The sacrum usually consists of five conjoined sacral vertebrae. This number may be increased to six, when the sacrum is known as a 6-piece sacrum, or reduced to four, a 4-piece sacrum. Furthermore, as mentioned in Chapter 3, this study recognises 4/5-piece sacra (those in which there are 4 anterior sacral foramina on one side, while the fourth foramen is incomplete on the other) and 5/6-piece sacra (those which have, similarly, 5 complete anterior sacral foramina on one side and an incomplete foramen on the other). The 4/5-piece and 5/6-piece sacra, however, closely resemble the 5-piece and 6-piece categories of sacra respectively due to the partial sacralisation of the last sacral element and, for this reason and to facilitate comparisons with other workers, the 4/5-piece and 5/6-piece sacra are included in the categories of 5-piece and 6-piece sacra respectively.

1. South African Negro

Table 7 gives the incidence of 4-, 5- and 6-piece sacra in the three S.A. Negro chiefdoms and in the S.A. Negro series as a whole.

Four-piece sacra occur infrequently, with a range from 1,2% in N. Nguni males to 5,9% in C. Nguni males. Seven 4-piece sacra (2,8%) are present in the total S.A. Negro male sample of 248 and three (one in each sub-sample) in the 157 female sacra (1,9%).

TABLE 7

Number of Sacral Vertebrae in the South African Negro and the San

Chiefdom or Ethnic Group		Number of Sacral Pieces					
		4		5		5/6+6	
		n	%	n	%	n	%
S.A. Negro Males							
N. Nguni	(85)	1	1,2	60	70,6	24	28,2
C. Nguni	(85)	5	5,9	45	52,9	35	41,2
Sotho	(78)	1	1,3	54	69,2	23	29,5
Total Males	(248)	7	2,8	159	64,1	82	33,1
S.A. Negro Females							
N. Nguni	(54)	1	1,9	40	74,1	13	24,0
C. Nguni	(37)	1	2,7	28	75,7	8	21,6
Sotho	(66)	1	1,5	49	74,2	16	24,3
Total Females	(157)	3	1,9	117	74,5	37	23,6
S.A. Negro Males & Females	(405)	10	2,5	276	68,1	119	29,4
San (Bushman)							
Males	(31)	0	-	27	87,1	4	12,9
Females[1]	(21)	1	4,7	16	77,1	4[1]	18,2
Males & Females[2]	(63)	1	1,6	53	84,1	9	14,3

[1]One San female sacra classified as a 5/6-piece sacrum may have been a 5-piece sacrum: if the latter, this would alter the figures and percentages to 1 (4,7%): 17 (81,0%): 3 (14,3%); for 4-, 5- and 6-piece sacra respectively in San females.

[2]This total of 63 includes 11 unsexed sacra.

Two 4/5-piece sacra (one belonging to a Sotho male, the other to a C. Nguni female) were found in the entire series of 405 sacra. These two sacra are included in the 5-piece category.

The incidence of 6-piece sacra in males varies from 28,2% in the N. Nguni and 29,5% in the Sotho to 41,2% in the Cape Nguni. The incidence of 6-piece sacra is lower in all female sub-groups: it varies from 21,6% in Cape Nguni to 24,0% in Natal Nguni and 24,3% in Sotho.

2. San

The incidence of 4-, 5- and 6-piece sacra in the San is given in Table 7. No 4-piece sacra are present in the male sample of 31 and only one is present in the female sample of 21, giving a possibly somewhat inflated incidence of 4,7% in female sacra. This frequency drops to 1,6% in the combined-sex sample (n=63). One 4/5-piece (unsexed) sacrum is present in the San, but, as in the S.A. Negro, this was included in the 5-piece category.

Six-piece sacra are present in four males (12,9%) and in four (possibly three) females (18,2% or 14,3%). The San material was mainly from excavations and one female sacrum was damaged at the lower end, but it might have been a 5/6-piece sacrum. It has therefore been included in the 6-piece category.

3. Intergroup Differences

There is a wide range of variation in the frequency of 6-piece sacra among the male sub-groups which constitute the S.A. Negro sample. The differences in frequency range from 1,3% between Sotho and Natal Nguni, to 11,7% between Cape Nguni and Sotho, and 13,0% between Cape Nguni and Natal Nguni. However, these inter-group frequency differences are not significant at the 1% confidence level (X^2 = 3,680). If the exceptionally high frequency in Cape Nguni (41,2%) is tested against that for Natal Nguni and Sotho combined (28,9%), the difference is not significant, even at the 2% level (X^2 = 3,970). The difference among the corresponding female sub-groups of the S.A. Negro sample are small and not significant.

Four-piece sacra occur seldom; there is only one 4-piece sacrum in each of the male and female sub-groups, save for the C. Nguni male sample which has 5 such sacra. The small differences among the sub-groups were not tested for significance.

In the absence, then, of any substantially significant findings

on variation in sacral number among the three chiefdoms in either male or female category, the three sub-groups have been combined to form total samples of male and of female S.A. Negro sacra. This procedure is in line with that followed in a craniological study by de Villiers (1968) on skull series drawn from four S.A. Negro chiefdoms, namely, N. Nguni, C. Nguni, Sotho and Shangana-Tonga. There, too, it was found that there were no major inter-group differences in either male or female category and the subsets were therefore combined to form a single S.A. Negro population.

Comparison of the pooled S.A. Negro samples with the San samples (Table 7) shows that in males, there is a marked difference in the frequency of 6-piece sacra between San (12,9%) and S.A. Negro (33,1%). This difference is not, however, significant at the 1% level when tested by the chi-square test with Yates's correction for small cells (χ^2 = 5,996). The difference, too, between the corresponding female groups is not significant (P< 0,50).

B. NUMBER OF SACRAL VERTEBRAE IN OTHER HUMAN POPULATIONS

1. Source of Data

(a) American Negro

Great difficulty was experienced in finding comparable data on the number of sacral pieces in American Negroes. Care was taken that work on any one collection was not recorded twice in the study. For example, both Bardeen (1904) and Schultz (1930)[1] studied the collection of American Negro sacra at the Johns Hopkins University. Bardeen's results are used because he gives the findings on the related presacral vertebrae. The sample of Bardeen is, however, small; hence the absence

---

[1] It should be placed on record that Schultz (1930) when citing Trotter's (1929) study, quotes a figure of seven 6-piece sacra out of a total of 97 Negro sacra. Examination of Trotter's data, however, shows that she examined 119 Negro spines and sacra, of which 22 had variation in the vertebral column formulae (she terms this 'unusual segment groupings'). This leaves 97 spines with usual vertebral column formula. Schultz apparently misinterpreted Trotter's table as showing 22 spines with variation in spinal formula out of 97 (22,6%), whereas in fact it is 22 out of 119 (or 18,5%). Thus, the frequency of 6-piece sacra in Trotter's study should be 11 out of 119(or 9,2%), instead of 7 out of 97 (or 7,2%). It is the percentages out of 119 that are cited in Table 8.

of any 6-piece sacra in his total female sample may be owing to this small sample being unrepresentative (Table 8).

Trotter and Lanier (1945), in a study of the hiatus canalis sacralis, examined the sacra of an exceptionally large series of American Negroes (696) and American Caucasoids (529) from the Terry and Todd collections. The frequencies for 6-piece sacra in American Negro males and females in their report (see Table 8) were substantially and significantly lower than those for S.A. Negro males and females (and the frequencies in their American Caucasoid groups, too, were significantly lower than the weighted frequencies for the general Caucasoid group compiled from various authors).

The American data were re-examined to see if an explanation could be found for these differences. Trotter and Lanier (1945) describe the 6-piece category as one in which the fifth lumbar vertebra is partially or completely sacralised and fused to the sacrum. This corresponds with my definition of a 6-piece sacrum which shows, in addition, transitional features in S1 (Figure 11, a). Trotter and Lanier give a sub-category of 5-piece sacra in which the first cocygeal piece or the entire coccyx is said to be ankylosed to the sacrum (abbreviated to 5S + Co 1). This category corresponds with my 5S + Co 1 category in which the first coccygeal vertebra is said to be synostosed to the sacrum (Figure 11, b). This synostosis (or ankylosis as Trotter and Lanier term it) is clearly distinguishable from a Co 1 showing sacralisation, as defined in the present study, when there is sufficient development of the transverse processes and caudal elements of the last sacral element to complete the fifth anterior sacral foramen and thus form a 6-piece sacrum. Throughout their article, Trotter and Lanier use the term ankylosis or fusion of Co 1, except for one place on p. 37 when the term "sacralisation of the first or more coccygeal vertebrae" is used synonymously with ankylosis. It is possible that in their category of 5S + Co 1, they included 6-piece sacra which showed no evidence of a fused sacralised L5 (on their definition) but with sacralisation of Co 1, whereas I have called such specimens 5/6-piece or 6-piece sacra. There are a number of such sacra in the present study (see Figure 11, c and d) which show no transitional features in S1 (or 'sacralisation' of L5, as defined by Trotter and Lanier). The apparent exclusion by Trotter and Lanier of these sacra from the 6-piece category might account for the low frequencies of 6-piece sacra reported by them.

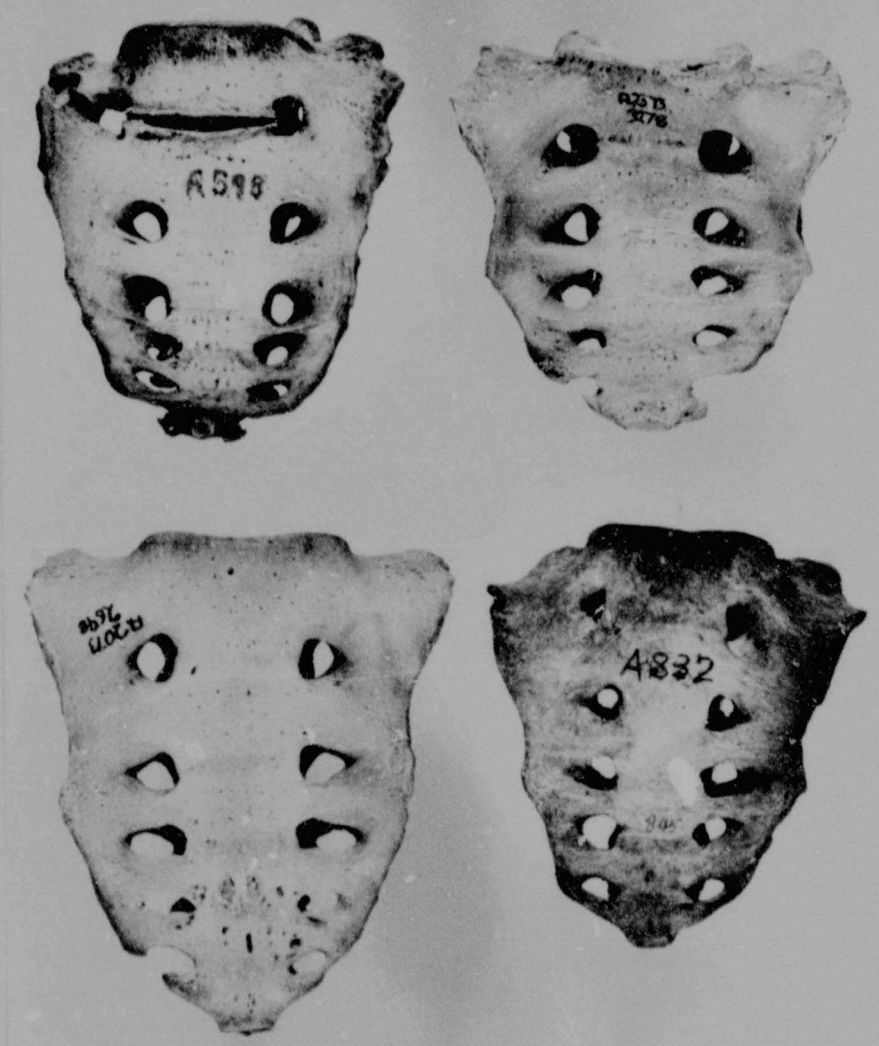

Figure 11 Five-piece and 6-piece Sacra

a. A 598 6-piece sacrum with transitional features in S1
b. A 2373 5-piece sacrum with synostosis of the coccyx
c. A 2073 5/6-piece sacrum with no transitional features in S1. The sixth piece shows evidence of transition or sacralisation.
d. A 832 6-piece sacrum with no transitional features in S1.

TABLE 8

Number of Sacral Vertebrae in the American Negro

Author	Source of Material	Male						Female					
		Total n.	4-piece n	%	5-piece n	%	6-piece n	%	Total n	4-piece n	%	5-piece n	%	6-piece n	%
Bardeen 1904	Johns Hopkins Univ.	34	2	5,9	27	79,4	5	14,7	20	1	5,0	19	95,0	0	0,0
Trotter 1929	Washington Univ.	92	0	0,0	81	88,0	11	12,0	27	0	0,0	27	100,0	0	0,0
Trotter & Lanier '45	Terry & Todd Collections	256	2	0,8	223	87,1	31	12,1	440	4	0,9	376	85,5	60	13,6
Present study	Terry & Todd Collections	250	3	1,2	174	69,6	73	29,2	250	3	1,2	196	78,4	51	20,4

n = number of sacra.

Trotter's (1929) series of American Negro vertebral columns included 27 females and none of these was recorded with a 6-piece sacrum. It is probable that her category of "usual vertebral column formula (C7, T12, L5, S5)" which was used for measurements (unusual segment groupings were not measured) included some 6-piece sacra which showed no transitional features in S1 and were thus classified as 5S + Co 1, as in the 1945 series. Thus her 1929 results on Negro sacra, as well as those of Trotter and Lanier (1945) on Negro sacra must be used with caution.

The difficulties in finding comparable and reliable data on the American Negro sacrum prompted a study of American Negro sacra. A sample of 500 sacra (250 male and 250 female) was studied from the Terry Collection and from the Hamann-Todd Collection. These sacra were classified in accordance with the methods of this study. It can be seen from Table 8 that the frequency of 6-piece sacra in males is some 17% to 18% higher in the present American Negro series than in the samples of Bardeen (1904), Trotter (1929) and Trotter and Lanier (1945). Likewise, in females, the frequency in the recent series is higher than in the early series. The methods of classification of the number of sacral pieces in the early series are almost certainly not comparable with those of the present study; clearly therefore, only the present series (1973) of American Negro sacra will be used for comparisons with the S.A. Negro and other population groups.

(b) Caucasoid and Other Series

The literature covering the past 60 to 70 years was surveyed for reports giving the incidence of 4-, 5- and 6-piece sacra in different population groups. Some studies give only combined-sex data, for example, Frets (1909, cited by Sitsen 1926), Paterson (1892) and Bianchi (1875, cited by Bardeen 1904). These three reports are on Caucasoid sacra. The large sample of Frets totalled 1,730 male + female sacra and the frequency of 6-piece sacra was 27,8%. Paterson (1892), too, found a relatively high frequency of 6-piece sacra in a sample of 265 individuals (23,4%), whilst Bianchi (1875) reported only 13 6-piece sacra out of 130 individuals (10%). These results on combined-sex samples must, however, be interpreted with caution in view of the differing sexual composition of the samples and differing degrees of sexual dimorphism in different populations. Thus, only the reports which give results for males and females separately are given in Table 9.

Care was taken that the definition of the 6-piece sacrum in the comparative studies corresponded with that in the present survey. Where possible, data were used only from published records which had been personally examined. Many studies, however, were carried out at the turn of the century, some even earlier, and it was difficult to obtain the original reports. The data of Frets (1909), cited by Sitsen (1926), for example, is reliable as Sitsen gives an unambiguous definition of the 6-piece sacrum based on the number of sacral foramina. The study of Steinbach (1889, cited by Bardeen 1904) is included in Table 9 as Bardeen detailed the total numerical spinal formula including the coccygeal vertebrae, as did Adolphi (1912) and Frey (1929). On the other hand, Le Double's (1912) series of 1,528 Caucasoid sacra is not included in the table, partly because some of his sources of data are quoted here from the original and partly because he does not define clearly a 6-piece sacrum. He cites Paterson (1892), for example, as finding a 35% frequency of 6-piece sacra (a figure quoted, too, by Schultz, 1930). Examination of Paterson's original data shows the incidence to be 23.4% on the present classification. Le Double (and Schultz) clearly included Paterson's category of a 5-piece sacrum plus a synostosed coccygeal vertebra, among the 6-piece sacra. Another worker on Caucasoid sacra whose results are not used on similar grounds is Radlauer (1908). Willis (1923) reported on the lumbo-sacral columns of 748 Caucasoid individuals but did not record the number of sacral pieces.

Reports on South African Negro sacra are available from Gillman (1929) who reported on 32 sacra, from Shore (1930) who examined 81 vertebral columns including sacra and from Heyns (1945) who reported on a large sample of 166 sacra. These results are not, however, included in Table 9 as the material used for all three studies was drawn from the same collection as for this study.

The small San sample of the present series is augmented by the sample of Duparc (1942) of 28 sacra. Duparc studied the collection of Bushman (San) skeletons at the Anthropological Laboratory at the University of Geneva.[1]

Separate-sex data were available for a sample of Japanese sacra from Hasebe (1913), for a sample of Eskimo vertebral columns (Stewart 1932) and for 111 Australian aborigine vertebral columns (Tulsi 1972).

---

[1] There is some overlap of the San samples as Duparc's series of 28 sacra was from the S.A. Museum. The present sample includes 17 sacra from that source.

2. Frequency of 4-, 5- and 6-piece Sacra in Various Population Groups

Table 9 gives the frequencies of 4-, 5- and 6-piece sacra in males and females of the population groups compared in this study.

Four-piece sacra occur infrequently and the percentage incidence in male samples of good size ranges from 0,0% to 1,1% in the Caucasoid samples, to 2,8% in the S.A. Negro sample (Table 9). Results are similar in females and the frequency ranges from 0,0% to 2,7% in good-sized samples. The interpopulation differences are thus small and were not tested for significance.

Six-piece sacra occur more commonly than 4-piece sacra in all populations in both males and females. In males, the frequency ranges from 6.3% to 33,1%. South African Negro male sacra have the highest frequency of 6-piece sacra in the table (33,1%) and this is closely followed by the frequency for American Negro male sacra (29,2%). The small difference between the two Negro groups is not significant ($P< 0,4$, see Table 10).

The small San (Bushman) male sample of Duparc (1942)gives a high frequency of 6-piece sacra (31,3%) and this is almost as high as that for the S.A. Negro sample. The present San male sample has a much lower frequency (12,9%) and, as stated, this is not significantly different from that in the S.A. Negro sample. There is thus an exceptionally low frequency of 6-piece sacra in the present San male sample as compared with the other African series including the San sample of Duparc (1942). This may be owing to this comparatively small sample being unrepresentative for, as will be shown in Section 3 of this Chapter, a low frequency of 6-piece sacra in male sacra as compared with female sacra is found only in the present San series.

In the Caucasoid samples drawn from various European populations the frequency of 6-piece sacra is virtually the same in the samples of Steinbach and Frey (22,9%, 22,8%) and somewhat higher (29,5%) in the larger sample of Adolphi (1912). The weighted frequency is 27,0% and this represents the incidence in 374 Caucasoid individuals. The frequency in Caucasoid male sacra is 6,1% less than that in S.A. Negro male sacra (33,1%) but this difference is not significant ($P< 0,20$).

The frequency of 6-piece sacra in Japanese male sacra is 18,8% and a similar value is found in Australian aborigines (19,0%), whilst the Eskimo sample has an exceptionally low frequency of 6,3%. All three samples have significantly lower frequencies than that for S.A. Negro male sacra ($P< ,005$ for Japanese and aborigine samples, and $P< ,0005$ for

TABLE 9

Number of Sacral Vertebrae in Males and Females of Various Population Groups

Series	Male sacra						Female Sacra						Reference
	Total	4-piece		5-piece		6-piece	Total	4-piece		5-piece		6-piece	
	n	no.	%	no.	%	no. %	n	no.	%	no.	%	no. %	
S.A. Negro	248	7	2,8	159	64,1	82 33,1	157	3	1,9	117	74,5	37 23,6	present study
American Negro	250	3	1,2	174	69,6	73 29,2	250	3	1,2	196	78,4	51 20,4	present study
San (Bushman)	31	0	-	27	87,1	4 12,9	21	1	4,7	16	77,1	4 18,2	present study
	16	0	-	11	68,7	5 31,3	12	0	-	10	83,3	2 16,7	Duparc 1942[1]
Caucasoid	234	2	0,8	163	69,7	69 29,5	58	0	-	45	77,6	13 22,4	Adolphi 1912
	48	0	-	37	77,1	11 22,9	35	0	-	28	80,0	7 20,0	Steinbach 1889
	92	1	1,1	70	76,1	21 22,8	58	1	1,7	49	84,5	8 13,8	Frey 1929
Total Caucasoid	374	3	0,8	270	72,2	101 27,0	151	1	0,7	122	80,8	28 18,5	
Japanese	122	1	0,8	98	80,4	23 18,8	59	0	-	51	86,5	8 13,5	Hasebe 1913
Eskimo	95	2	2,1	87	91,6	6 6,3	84	2	2,4	78	92,8	4 4,8	Stewart 1932
Australian aborigine	63	1	1,6	50	79,0	12 19,0	48	0	0,0	46	95,8	2 4,2	Tulsi 1972

n = number of Sacra.

[1] Some or all of Duparc's 16 San male and 12 San female sacra referred to in this Table are included in my 31 San male and 21 San female sacra.

Author De Beer Kaufman P M
Name of thesis A study of the sacrum and some aspects of presacral vertebrae in San (Bushmen) and Southern Africa and American Negroes 1975

PUBLISHER:
University of the Witwatersrand, Johannesburg
©2013

LEGAL NOTICES:

Copyright Notice: All materials on the University of the Witwatersrand, Johannesburg Library website are protected by South African copyright law and may not be distributed, transmitted, displayed, or otherwise published in any format, without the prior written permission of the copyright owner.

Disclaimer and Terms of Use: Provided that you maintain all copyright and other notices contained therein, you may download material (one machine readable copy and one print copy per page) for your personal and/or educational non-commercial use only.

The University of the Witwatersrand, Johannesburg, is not responsible for any errors or omissions and excludes any and all liability for any errors in or omissions from the information on the Library website.