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Anthropometric Study of Human Hip Bones of Southern Brazilians by Rabbi Method

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Abstract. Forensic anthropology is a branch of forensic sciences that deals with research and aims to determine the identity of an individual by means of the origin of remains, general patterns of identification and individualizing characteristics. Currently, as Brazil has a significant percentage of homicides, serious accidents and natural disasters, it is necessary to use more precise anthropometric techniques to search for victim identification. Therefore, this study proposes to measure human hip bones using bone anthropometry technique, more specifically pelvimetry in order to determine standard measures for this bone for people of the south region of Minas Gerais. The measures obtained were as follows: VDA data was 49.74 ± 3.49 for right hip bone (RHB) and 51.06 for left hip bone (LHB). GSND data was 33.18 ± 3.08 for RHB and 32.96 ± 3.35 for LHB. Regarding CGSN measure, the values were 81.23 ± 6.74 for RHB and 82.87 ± 6.77 for LHB. DASIS results were 114.1 ± 6.62 for RHB and 112.4 ± 5.90 for LHB. OFD measures were 45.95 ± 4.21 for RHB and 47 ± 3.98 for LHB while OFL data were 31.34 ± 3.56 for RHB 30.42 ± 2.82 for LHB. From the results above, one could conclude that there were significant differences in the measure of the hip bone when compared with data

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published for other ethnic groups. It is suggested that such differences may be related to the multiple genetic miscegenation that occurred in this region of Brazil during 500 years or more after colonization.

Keywords: Pelvis; Hip bone; Forensic anthropology; Pelvimetry; Ethnic group.

1. Introduction

In a report published in 2015 by the United Nations Office for Disaster Risk Reduction (UNDRR) and the Center for Research on the Epidemiology of Disasters (CRED), Brazil is the only country in the American continent that figures on the list of the 10 countries with the largest number of people affected by disasters from 1995 to 2015[1]. Natural mass disasters with great casualty have always existed but nowadays they seem to become more frequent, perhaps due to human action. Only in 2018, natural disasters killed 4,996 people worldwide[2]. In January, 2019, Brazil underwent one of its greatest environmental disasters in history, at Brumadinho's mining tailings dam, in Minas Gerais. This dam fell down and its rupture resulted in 255 deaths and several missing so far[3].

The forensic identification of victims of mass disasters is essential for reasons not only humanitarian, but also due to the need of civil and / or criminal investigation, and is essentially based on anatomy and pathology[4-6]. In cases such as those mentioned above, the identification of remains is of paramount importance and it is up to the criminal expert specialized in physical and / or forensic anthropology to unveil the findings[7-9].

For Souza and Soares (2019), forensic anthropology has been acclaimed worldwide by the numberless advantages offered by its methods, such as performing easiness and simple equipment required for its use. In Brazil, there is a lack of data from forensic anthropology; unfortunately, when such analyses are performed, it becomes necessary to use comparative data generated in American, European or Asian populations that have little miscegenation or a miscegenation degree different from the Brazilian one, which may produce incorrect data and almost always prevent or make identification difficult.

According to Kimmerle, Ross and Slice (2008), one of the four pillars of the anthropological protocol is the estimation of sex, which consists of a metric analysis and visual evaluation of the characteristics of the skeleton, mainly of the skull and

pelvis. Hence, the more measures and data observed in a report, the more reliable the result will be[11].

When the victims' corpses or human remains are no longer identifiable by their external features or fingerprints, forensic anthropologists begin the identification work. They must participate in the recovery of remains, establish them as being human or animal, and work in the identification of victims of homicides, suicides, wars and mass disasters[12,13].

Thus, bone anthropometric analysis allows essential conclusions about the victim's identity, in a quick, reliable and accurate way, besides using an inexpensive and affordable instrument[14,15]. However, the methodology must be validated for different populations, due to ethnic differences, which are directly related to the individual's phenotype[15].

According to Barreto Filho (2002) and Iscan (2005), anthropometric studies should be directed to specific populations. Mainly due to the different ethnic elements found in each region of the world, the identification methods in forensic anthropology should be regionalized[16,17]. And according to Meindl et al. (1985), previous studies should be carried out in determined populations[18].

Therefore, it is of utmost importance to expand knowledge about anatomical variations in Brazilian population. Only after this is achieved, it will be possible to test the existing methods to assess the biological profile and eventually develop new approaches or, at least, adapt existing methods to Brazilian reality.

By using the Rabbi method, this study aimed to measure specific parameters of human hip bones, found in the south region of Minas Gerais, in order to contribute to the elaboration of an osteometric table for them and, in addition, to compare these measures with data from other ethnic groups already published in the scientific literature.

2. Material and methods

For this study, a sample of 60 right and left human hip bones was obtained from two universities in the south region of Minas Gerais that had an expressive number of these bones in their anatomical collection, namely the Federal University of Alfenas (UNIFAL-MG) and José do Rosário Vellano University (UNIFENAS). The project was submitted and approved by the Research Ethics Committee of UNIFAL-MG.

Bone measurements were made by a single evaluator who performed two (2) repetitions and from these an average was taken; these repetitions had an interval of fifteen (15) days between one measurement and another.

The analysis was based on the Rabbi Method (2000)[19] and the measures taken from the hip bones were compared with standard measures available in the scientific literature. The parameters were obtained by a digital caliper and, when necessary, a millimeter ruler, and they were as follows (Figures 1 and 2):

- Vertical diameter of the acetabulum (VDA).
- Chord of the greater sciatic notch (CGSN).
- Greater sciatic notch depth (GSND).
- Distance from the anterior superior iliac spine to the pubic tubercle (DASIS).

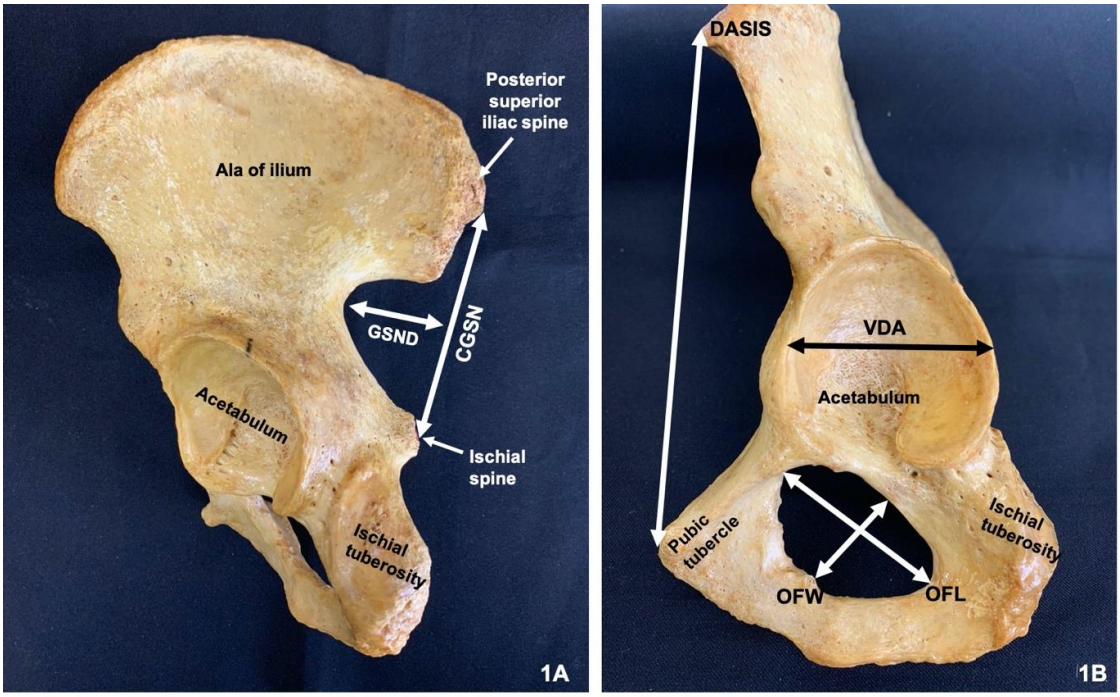

Figure 1. Left hip bone showing some relevant anatomical structure as well as the measurement acronyms. 1A. External face. 1B. Lateral view.

The GraphPad Prisma 7 program (San Diego, CA, USA) was used to analyze the data. Statistical analysis was performed by taking the maximum and minimum values and the averages of each measure[20].

3. Results

For clear visualization of the obtained data, the values of each measure were depicted in Table 1 and Figure 2. In Table 1, it is possible to observe all maximum, minimum

and average value in millimeters (mm), standard deviation and standard error of mean of each measured parameter of both right and left hip bones, which gives reliability to the data. None of the data obtained in this study showed significant differences between the right and left sides. The findings are also represented in Figure 3, which shows the maximum and minimum values in millimeters (mm) on the vertical axis, and all parameters measured on the horizontal axis.

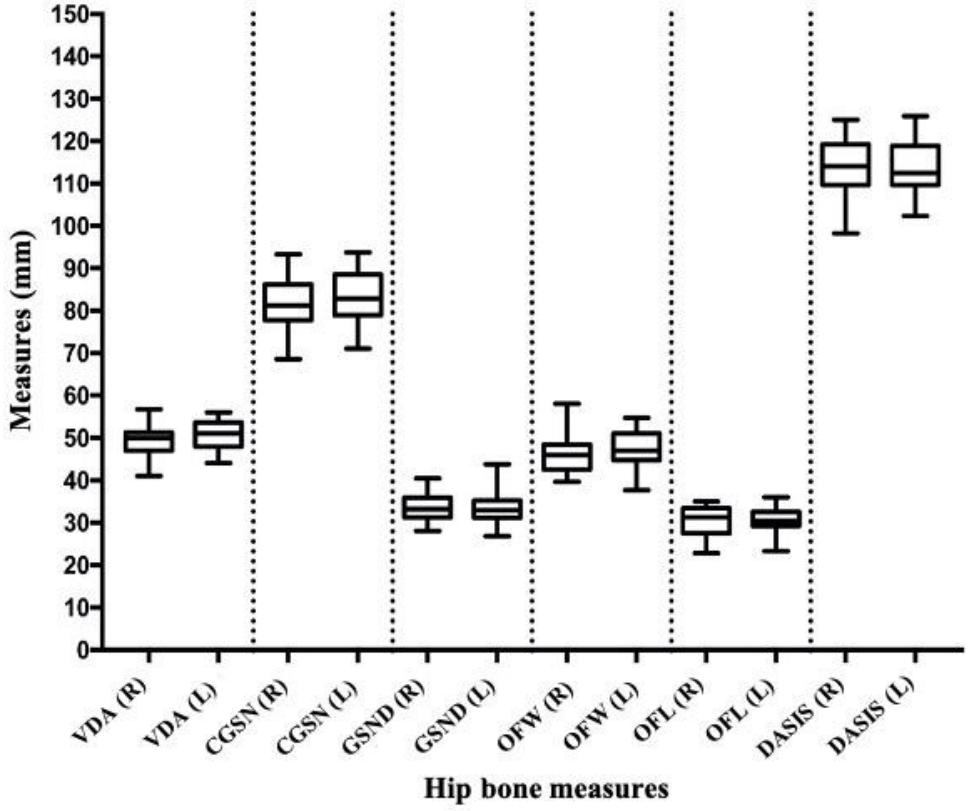

Figure 2. Minimum, maximum and average values of the different parameters measured on the right and left hip bones of southern Brazilians.

4. Discussion

Patriquin et al. (2002)[21] studied 400 hip bones of South Africans, measuring the obturator foramen length (OFL), obturator foramen width (OFW), chord of the greater sciatic notch (CGSN), greater sciatic notch depth (GSND) and vertical diameter of the acetabulum (VDA). The data obtained were: OFW - 52.86 mm; OFL - 33.47 mm; CGSN - 39.99 mm; GSND - 24.61 mm; and VDA - 55.19 mm. Comparing the data obtained by these authors and the present work, it is possible to observe a great difference for the values of CGSN (82.05 mm), GSND (33.07 mm), OFW (46.47 mm) and VDA (50.49 mm) from the present study while the value obtained for OFL (30.88 mm) is closer.

Table 1. Data referring to the maximum and minimum values (mm), mean, standard deviation and standard error of the mean of each measured parameter of the hip bones obtained from both the right and left sides.

	VDA (R)	VDA (L)	CGSN (R)	CGSN (L)	GSND (R)	GSND (L)	OLF (R)	OLF (L)	OFW (R)	OFW (L)	DASIS (R)	DASIS (L)
Max. value (mm)	56.73	56.06	93.32	93.76	40.4	43.8	58.05	54.76	35.03	36	125.1	125.9
Min. value (mm)	41.01	44.09	68.6	71.07	28.09	26.82	39.67	37.67	22.78	23.3	98.27	102.4
Mean and SD	49.93 ± 3.49	51.06 ± 3.46	81.23 ± 6.74	82.87 ± 6.77	33.18 ± 3.08	32.96 ± 3.35	45.95 ± 4.21	47.00 ± 3.98	31.34 ± 3.56	30.42 ± 2.82	114.10 ± 6.62	112.40 ± 5.90
SE of mean	0.61	0.65	1.25	1.35	0.54	0.63	0.74	0.75	0.63	0.53	1.29	1.15

Legend: R = right hip bone; L = left hip bone; VDA = vertical diameter of the acetabulum; CGSN = chord of the greater sciatic notch; GSND = greater sciatic notch depth; OFL = obturator foramen length; OFW = obturator foramen width; DASIS = distance from the anterior superior iliac spine to the pubic tubercle; SD = standard deviation; SE = standard error.

In 2005, Patriquin et al[22] measured the chord of the greater sciatic notch (CGSN), greater sciatic notch depth (GSND) and vertical diameter of the acetabulum (VDA) of 400 hip bones of human skeletons from South Africa regardless being whites and blacks, men and women. The findings were: CGSN - 45.93 mm; GSND - 25.83 mm; and VDA - 53.29 mm. In this case, it is possible to observe a significant difference in the results obtained by them and the data obtained in the present study, in which the hip bones had mean values of CGSN - 82.05 mm; GSND - 33.07 mm; and VDA - 50.49 mm.

Steyn and Iscan (2008)[23] analyzed 192 hip bones of Greek individuals and found the following average values: CGSN - 47.16 mm; GSND - 29.63 mm; and VDA - 51.87 mm. The data shows a very significant difference from hip bones found in the south of Minas Gerais, mainly in the values of CGSN (82.05mm); and GSND (33.07mm), but VDA was similar (50.49mm).

Another study, carried out by Gómez-Valdés et al. (2011)[24], presented data referring to VDA measure on 146 skeleton hip bones of Mexican population. The average value found was 51.67mm, very close to that found in the present study (50.49mm). However, this does not make it possible to affirm a likelihood between Brazilians and Mexicans, since it would be necessary to use more parameters for comparison.

Franklin et al. (2014)[25] analyzed 400 hip bones of Western Australians and the mean CGSN was 76.95 mm, being 84 mm for female samples and 69.9 mm for male ones. There is, therefore, a sexual dimorphism which is discussed in the work in question. When comparing the values found by the authors with the results obtained in the present work, it is remarkable that the mean CGSN of the southern Brazilians (82.05 mm) is close to that obtained from female hip bones of Western Australians.

Rosenberg K. (2002)[26] measured the hip bones of a regional population in China and obtained the following means: CGSN - 45 mm; GSND - 32 mm; and VDA - 47.2 mm. The mean GSND value (33.07mm) found for hip bones from the south of Minas Gerais is very close to that of the Chinese regional population, while the mean CGSN (82.05mm) and VDA (50.49mm) for southern Brazilians presented a significant difference.

Figure 3 shows an overview of the mean values found in all articles cited above as well as the mean values obtained in the present study for comparison purposes.

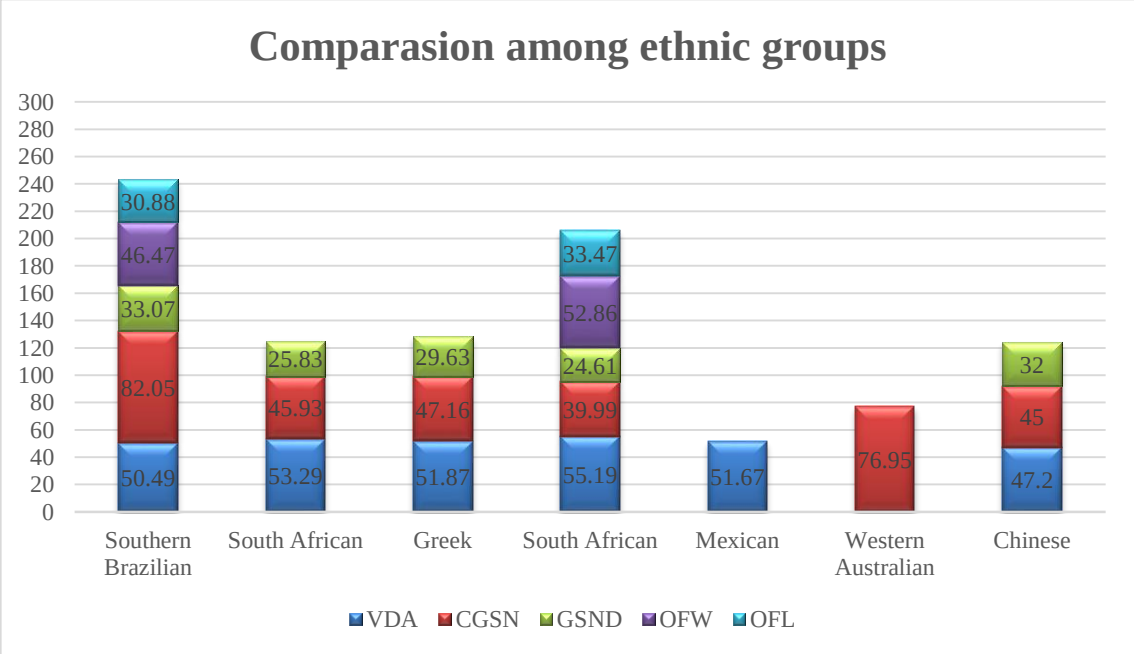

Figure 3. Comparison of the mean values of different parameters measured and the results obtained in the different ethnic groups.

5. Conclusion

Taking into account the results obtained in this study, it is possible to conclude that the values found by the Rabbi Method for identification of hip bones in southern Brazilians differ from the values already established for other specific ethnic groups. From this

analysis, it is suggested that such differences may be directly linked to the extensive inherent miscegenation of Brazilians in addition to the continuous process of evolution that is also a factor of anatomical variability.

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