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LARISSA PADOVAN

DIMORFISMO SEXUAL PELO ESTUDO DA VÉRTEBRA ATLAS EM BRASILEIROS

SEXUAL DIMORPHISM THROUGH THE STUDY OF THE ATLAS VERTEBRA IN THE BRAZILIAN POPULATION

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Trabalho de Conclusão de Curso apresentado à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para obtenção do título de Cirurgiã Dentista.

Udergraduate final work presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Dental Surgeon.

Orientador: Prof. Dr. Luiz Francesquini Júnior

ESTE EXEMPLAR CORRESPONDE A VERSÃO FINAL DO TRABALHO DE CONCLUSÃO DE CURSO APRESENTADO PELA ALUNA LARISSA PADOVAN E ORIENTADA PELO PROF. DR. LUÍZ FRANCESQUINI JÚNIOR.

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RESUMO

A identificação humana se estabelece por métodos primários e secundários, sendo que os primários são DNA, dente e datiloscopia e os secundários são antropometria e reconstrução facial. O trabalho em questão trata-se de um estudo por método secundário, que tem por objetivo estabelecer o dimorfismo sexual pela vertebra atlas em ossadas brasileiras. Foi realizado um estudo observacional e transversal utilizando 191 vértebras: 81 (42,4%) do sexo feminino e 110 (57,6%) do sexo masculino. Foram feitas medidas lineares dos diâmetros anteroposterior da vértebra, anteroposterior do canal raquidiano, transverso do canal raquidiano e transverso máximo. Verificou-se que as medidas estudadas são dimórficas sendo possível estabelecer um novo modelo de regressão logística (LOGITO Padovan): Sexo = - 23.7 + (0.18 × Antero posterior da vértebra) – (0.08 × transverso do canal raquidiano) + (0.25 × transverso máximo) sendo que valores maiores que 0,5 (cutoff) seriam considerados masculino e menores como feminino. O presente modelo matemático de regressão logística obteve 82,2% de acurácia, ou seja, apresentando grau de diferenciação sexual e, mostrando-se, portanto, mais eficaz na predição do sexo do que o mero acerto ao acaso. A partir deste resultado será possível criar um software para determinar o sexo em ossadas para brasileiras.

Palavras-Chave: Antropometria. Atlas cervical. Caracteres sexuais.

ABSTRACT

Human identification is established by primary and secondary methods, the primary ones being DNA, tooth, and dyoscopy, and the secondary ones are anthropometry and facial reconstruction. The work in question is a study by secondary method that aims to establish the sexual dimorphism by the vertebra atlas in Brazilian bones. An observational and transversal study was carried out using 191 vertebrae: 81 (42.4%) were female and 110 (57.6%) were male. Linear measurements were made of the anteroposterior diameters of the vertebra, anteroposterior of the spinal canal, transverse of the spinal canal and transverse maxillary. It was verified that the measured measures are dimorphic and it is possible to establish a new model of logistic regression (LOGITO Padovan): Sex = - 23.7 + (0.18 × Antero posterior of the vertebra) - (0.08 × transverse of the spinal canal) + (0.25 × transverse maximum) and values greater than 0.5 (cutoff) would be considered masculine and minor as female. The present mathematical model of logistic regression obtained 82.2% of accuracy, that is, presenting a degree of sexual differentiation and, therefore, being more effective in the prediction of sex than the mere chance adjustment. From this result it will be possible to create a software to determine the sex in bones for Brazilians.

Key words: Anthropometry. Cervical atlas. Sexual characters.

SUMÁRIO

1 INTRODUÇÃO

Quando se defronta com um esqueleto, há a necessidade de se estabelecer o nome do indivíduo quando em vida, pois este, tem direitos assegurados para si e para os seus descentes (direito sucessório). Para tal, faz-se necessário utilizar o processo de identificação humana, visando obter a identificação positiva (Scandoleiro, [2015]).

Tal prática vinha sendo realizada pela Medicina Legal dentro do Institutos Médico-Legais, porém com o florescer da Odontologia Legal, e com o aumento do campo de atuação destes, passou a ser atribuição também do Cirurgião-Dentista.

A Odontologia Legal de Oscar Amoedo emergiu como arte até se tornar especialidade odontológica, por meio da identificação positiva de carbonizados no Bazar da Caridade. Registros históricos sobre a evolução desta especialidade retratam sua transformação do empirismo à consolidação científica (Silva, 2017b).

A Odontologia Legal brasileira, surgida inicialmente por meio da aplicação de uma técnica para a identificação humana foi criada, desenvolvida e aplicada por Henrique Tanner de Abreu em 1922, por meio da obra “Medicina Legal aplicada à arte dentária”; na sequência foi estudada por Luiz Lustosa da Silva em 1924 (Silva, 2017a).

Foi na década de 30 que essa ciência integrou legalmente a formação dos Cirurgiões-dentistas, e dela fez parte até os dias atuais. A partir desta data, ela se disseminou de maneira mais abrangente uma vez que está entre as disciplinarias obrigatórias requeridas em território nacional. Consideravelmente distinta das demais áreas da Odontologia, esta veio a ser reconhecida como especialidade aproximadamente 40 anos depois do seu surgimento nos cursos de graduação.

A Odontologia Legal brasileira, teve seu auge com a criação em 1990 do primeiro curso de pós-graduação em Odontologia Legal e Deontologia na Faculdade de Odontologia de Piracicaba-UNICAMP.

Por meio deste e dos demais que se surgiram, a Odontologia Legal brasileira desempenha um papel fundamental e é aceita mundialmente como uma ferramenta confiável para diversas modalidades periciais, como identificação humana, antropometria física forense, importância do dano corporal do aparelho estomatognático, pós-traumático, dentre outros.

Desta forma, o conhecimento Odonto Legal, passou a ser desenvolvido no Brasil, findando a fase transitória (conteúdo internacional com conteúdo nacional), ingressando para a fase de conhecimento específico (validação de tabelas, modelos e demais metodologias (conjunto de técnicas, métodos e sistemas) direcionados para a população brasileira).

Sabe-se que o brasileiro atual é fruto de uma gigantesca miscigenação, tornando-o único entre os povos atuais.

Desta forma, o presente valida o método de estimativa do sexo por meio de medidas obtidas da vértebra atlas na população brasileira atual.

2 ARTIGO: SEXUAL DIMORPHISM THROUGH THE STUDY OF THE ATLAS VERTEBRA IN THE BRAZILIAN POPULATION

Artigo foi submetido ao periódico International Jounal of Legal Medicine (Anexo 2)

Authors: Padovan, L[1].; Silva, G.D.N[2].; Picapedra-Palomeque, A.M.[3]; Ulbricht, V[4].; Schmidt, C.M.[5]; Groppo, F.C.[6]; Daruge Jr. E.[7]; Francesquini Jr.L.[8]

1. Dentistry student at the Piracicaba Dental School-Fop/Unicamp.

2. Dentistry student at the Piracicaba Dental School-Fop/Unicamp.

3. Doctoral student of Public Health at Faculty of Dental Sciences (UFRGS) and Professor at the Universidad de la República - Uruguay (UDELAR).

4. Master's student of Legal Dentistry and Deontology at Piracicaba Dental School-Fop/Unicamp

5. Professor of Forensic Medicine and Bioethics at the Methodist University of Piracicaba.

6. Full professor of Pharmacology MS-6 and head of the Department of Physiological Sciences.

7. Associate Professor II of Legal Dentistry and Deontology. Senior Lecturer MS 5.2.

8. Associate Professor I of Legal Dentistry and Deontology. Senior Lecturer MS 5.1.

Correspondence to: Larissa Padovan

Avenida Attilio Gobbo, 3177- Santa Clara

Zip Code: 13210-473

Jundiaí, SP, Brazil

Phone: +55 11 975823583

E-mail: gobbo.padovan@gmail.com

Abstract: To establish sexual dimorphism through measurements of the Atlas vertebra from 191 skeletons in the forensic physical anthropology laboratory Prof. Eduardo Daruge. A study through files and quantitative measurements of the skeletons. Linear measurements were made of the anteroposterior diameter of the vertebra, anteroposterior of the rachidian canal, transverse of the rachidian canal and maximum transverse. This study has fulfilled the requirements of resolution 466/12 through the approval of the Research Ethics Committee (CEP) 138/2014 and Certificate of Presentation for Ethical Consideration (CAAE) 38522714.6.0000.5418. It was found that the measurements are dimorphic and it was possible to establish a logit model with the data obtained. There is a moderate to good correlation between measurements of the anteroposterior diameter of the vertebra and anteroposterior diameter of the rachidian canal and also with the maximum transverse, but not with the transverse of the rachidian canal, therefore, these relations were not influenced by the gender. The same occurs in the relation between the measurements anteroposterior of the rachidian canal and transverse of the rachidian canal. However, the relation between the measurement of the anteroposterior diameter of the rachidian canal and the maximum transverse was lower in males than in females, indicating a possible influence of gender in this relation. Here is the logit: Gender = - 23.7 + (0.18 × Anteroposterior of the vertebra) – (0.08 × transverse of the rachidian canal) + (0.25 × maximum transverse) revealed that the model compound by the measurements of diameters anteroposterior of the vertebra, transverse of the rachidian canal and maximum transverse results in 86.4% sensitivity, 76.5% specificity and 82.2% accuracy. We concluded that it is possible to determine the gender by linear measurements of the Atlas vertebra.

Keywords: Anthropometry, Gender Determination Through The First Cervical Vertebra, Sexual Dimorphism, Mathematical Models.

INTRODUCTION:

Gender determination by linear measurements of bone structures is already a reality in Brazil; however, due to the great extension of Brazil and its ancestral diversity, there is the need to develop a useful mathematical model for Brazil as a whole.

The Southeast region, headquarters of the osteological collection (Forensic Anthropology laboratory Prof. Dr. Eduardo Daruge), is the region with the greatest flow of individuals. In this region, there is a great miscegenation among leucodermas, melanodermas and xanthodermas. There is no prevalence of any phenotypic traits, but rather a miscellanea of these. Such context can generate a situation which a melanoderma woman may or may not be bigger than a xanthoderma man, which may complicate the gender determination by simple qualitative examination.

Such matter becomes more complicated since the possibility of existence of undifferentiated individuals (10 to 20%) which male and female characteristics are mixed[1] must be associated.

Such problem is analyzed by the forensic physic anthropometry as it allows the study of living or entire corpses, and/or in different states of conservation (putrefied, semi-skeletal, completely skeletal or even just some bone parts).

As we know, human skeletons develop in such a way that they present differential characteristics such as prominences, rugosity, crests, apophysis, lengths and others, which characterize the sexual dimorphism (occurrence of male and female individuals of a species with markedly different physical characteristics). Such characteristics are, in general, more prominent and visible in men than in women[2].

It also stands out the fact that variations of osseous sexual dimorphism characteristics suffer influences over the years, mainly due to genetic factors, such as hormones; secondly, due to environmental factors, such as nutritional diet, diseases, work habits etc[3].

Once the gender has been determined, it is necessary to check age, ancestry and stature. Obedience to this precept can prevent occurrence of errors in anthropological identification.

Gender determination is the main anthropometric study and is highly important in disaster situations of big proportions. It allows separation of male from female bones, which decreases search quantity, in addition to speed up the whole process of identification[4].

Gender determination makes the process faster and facilitates the search for the remaining characteristics that make each individual unique within their species.

Such characteristics are recognized as primary methods and allow identity establishment. In case of finding partial or total skeletal corpses, it is up to the expert to identify the individual by the teeth and DNA.

It turns out that such processes depend on prior material (updated medical register and genetic material for comparison). If the bones have already been analyzed anthropologically, gender, age, skin color and stature will be available.

The International Criminal Police Organization (Interpol)[5] is an international organization that helps with police cooperation in different countries and in 2014, classified the identity establishing methods into primary and secondary (anthropometry is classified as a secondary method, because it does not allow to establish the identity of bones separately).

It is a known fact that to consider a method as a primary one that allows to establish someone's identity, it must cover five fundamental principles: uniqueness (characteristics that make a individual unique), immutability (attributes do not change over the individual's life), persistence: (characteristics that resist to time action), practicability (process of obtaining and registering data must be easy and viable) and finally , the classificability (use and search of data must be viable and fast).

One of the human identification techniques and consequent gender determination of high precision is the DNA examination. Accomplished through genetic analysis, which most popular method is based on the amplification by Polymerase Chain Reaction (PCR) and observation of sequence or size between the amelogenin chromosomal genes X and Y. The ancestry determined by genetic analysis may not match the expected phenotype or morphological aspect. This is especially true in populations that have reached a high degree of miscegenation, such as the Brazilian [6,7 e 8]. However, it must be noted that some factors such as immersion in chemical products (acids or bases), or even sea water and natural degradation of the necrotic tissues can make the gene study not viable in 73.68% [9].

Such situation puts the anthropometry as a necessary method that must be used with others for human identification, since there will be situations in which the gene study will be unsuccessful.

Even knowing the pelvis bones and the skull bones right after them are those with the most accurate qualitative and quantitative characteristics (metric ones) for gender determination of a particular skeleton and despite the most found bones at a crime scene being the skull, the femur and the jaw [10]. There is the possibility to determine gender through the Atlas vertebra which is part of the axial skeleton.

The first Atlas vertebra, which is also the first cervical vertebra, is considered an irregular bone, formed by a spongy bone tissue surrounded by a thin layer of compact bone tissue. It it articulated with the occipital bone, in the occipitoatloid joint, allowing the head movements. This name was given to it because as the Titan of Greek mythology, it supports the head's globe. Its main particularity is not having a body like the other vertebrae. This happens due to the fact that, during its embryonic development, its body is fused with the second vertebra's body. It has annular shape and two arches: an anterior one, which corresponds to about one-fifth of its diameter and a posterior one, which corresponds to approximately two-fifths of its diameter. It has two lateral masses and does not have a spiny process. In the center of its ventral face, it presents the anterior tubercle, and, in its dorsal face, a smooth, oval or circular face, with the odontoid process or the tooth articulated with the axis or second cervical vertebra; the posterior arch ends at the posterior tubercle, rudimentary form of the spiny process [11].

In carbonization interactions, serious traumatic accidents (plane crash), crime scene alterations, there is a huge possibility to find this vertebra rather than the skull, the femur or the pelvis, which makes our study very important.

MATERIALS AND METHODS:

This research was designed and follows the determinations of the resolution 466/12 through the approval of the Research Ethics Committee (CEP) 138/2014 and Certificate of Presentation for Ethical Consideration (CAAE) 38522714.6.0000.5418 and aims to evaluate linear measurements of the atlas vertebra (anteroposterior distance of the atlas, anteroposterior diameter of the rachidian canal, transverse diameter of the rachidian canal, maximum transverse diameter of the atlas) regarding dimorphism. In addition, to discuss for sure the importance of Forensic Anthropometry in the process of identity establishment.

191 vertebrae were considered for the calculation, being 81 (42.4%) female and 110 (57.6%) male. All the bones belonged to individuals whose families were no longer alive, or

did not request the corpse remains during a period of 3 to 5 years, for socioeconomic personal reasons. Such skeletons were legally donated to the Piracicaba Dental School and are part of the osteological collection of the laboratory of forensic physical anthropology Prof. Eduardo Daruge. All measurements were taken with a Stainless-harned® 150 mm digital caliper, Mauá, São Paulo, Brazil.

The inter and intra examiner test was carried out to verify the researcher's calibration. To do it so, 25 skeletons properly identified by gender, ancestry and age, three times each and at different times, to obtain and compare the error margin percentage.
According to Szklo and Nieto (2000), it was found after descriptive analysis of the data that there was an excellent concordance (ICC $\geq$ 0.75) both in the evaluator inter analysis and evaluator intra analysis, for the four studied measurements (transverse diameter of the Atlas vertebra, anteroposterior diameter of the Atlas vertebra, transverse diameter of the rachidian canal, and anteroposterior diameter of the rachidian canal), according to Figures 1, 2, 3 and 4. Once calibrated with standard of excellence, the remaining measurements in the Atlas vertebra were finalized on 191 skeletons.

We carried out data analysis of the measurements by using the Shapiro–Wilk and Levene's tests to assess, respectively, distribution and equality of variances (homoscedasticity) of the variables under study. The unpaired t-test and the Pearson test were performed as well and a logistic regression was obtained (Hachward Stepwire-wald, Homer & Lemeshow and Nagelkerke).

Measurements of the anteroposterior diameter of the vertebra (A), anteroposterior of the rachidian canal (B), transverse of the rachidian canal (C) and maximum transverse (D) are represented on the figure below.

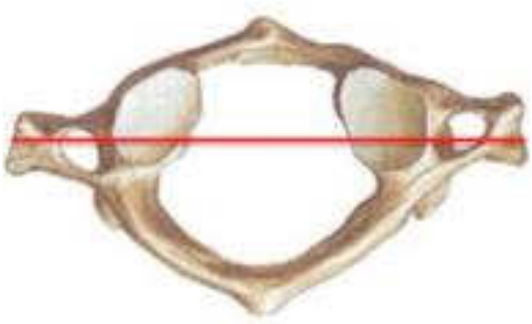

Fig. 1 Transverse diameter of the Atlas vertebra (D)

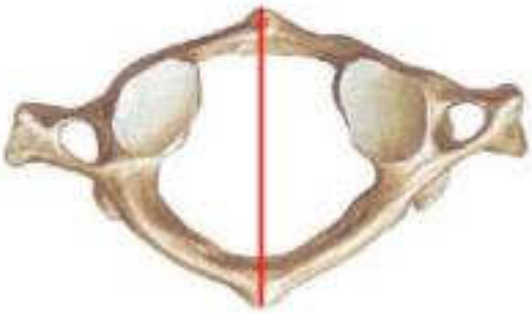

Fig. 2 Anteroposterior diameter of the Atlas vertebra (A)

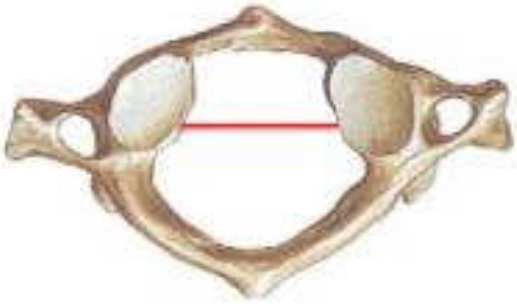

Fig. 3 Transverse diameter of the rachidian canal (C)

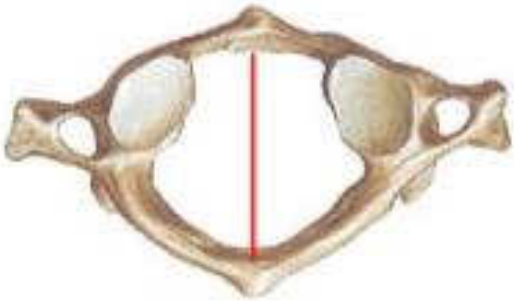

Fig. 4 Anteroposterior diameter of the rachidian canal (C)

RESULTS:

The Shapiro-Wilk test showed that the measurements (p=0.29), B (p=0.74), C (p=0.10) e D (p=0.07) showed normal distribution. In addition, the Levene's test showed homoscedasticity (p>0.05) for all measurements.

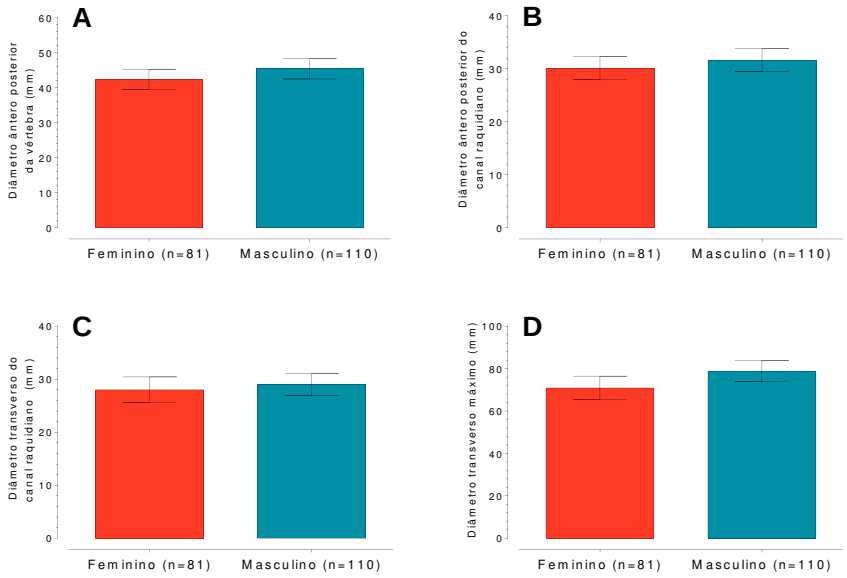

Fig 5 Mean (± standard deviation) of the measurements of the anteroposterior of the vertebra (A), anteroposterior of the rachidian canal (B), transverse of the rachidian canal (C) and maximum transverse (D) diameters.

Means obtained for females were lower (unpaired t test) than those obtained for males considering the measurements A (p<0.0001), B (p<0.0001), C (p=0.0033) e D (p<0.0001). Thus, these measurements are influenced by the genders.

Table 1 shows the correlation (Pearson test) for measurements of diameters with and without gender influence.

Table 1. Table 1 shows the correlation (Pearson test -rP) for measurements of the diameters with and without gender influence.

		Diameters		
	Diameters	**Anteroposterior of the vertebra**	**Anteroposterior of the rachidian canal**	**Transverse of the rachidian canal**
Total	Anteroposterior of the rachidian canal	0.52 (p<0.0001)		
	Transverse of the rachidian canal	0.19 (p = 0.0077)	0.61 (p<0.0001)	
	Maximum transverse	0.55 (p<0.0001)	0.44 (p<0.0001)	0.42 (p<0.0001)
Female	Anteroposterior of the rachidian canal	0.42 (p<0.0001)		
	Transverse of the rachidian canal	0.08 (p=0.4988)	0.68 (p<0.0001)	
	Maximum transverse	0.32 (p=0.0035)	0.38 (p=0.0006)	0.4 (p=0.0002)
Male	Anteroposterior of the rachidian canal	0.43 (p<0.0001)		
	Transverse of the rachidian canal	0.13 (p=0.1622)	0.51 (p<0.0001)	
	Maximum transverse	0.44 (p<0.0001)	0.27 (p=0.0052)	0.36 (p<0.0001)

Table 1 reveals that there is a moderate to good correlation between measurements of the anteroposterior diameter of the vertebra and anteroposterior diameter of the rachidian canal and also with the maximum transverse, but not with the transverse of the rachidian canal, in such a way that these relations were not influenced by the gender. The same occurs in the relation between the measurements anteroposterior of the rachidian canal and transverse of the rachidian canal. However, the relation between the measurement of the anteroposterior diameter of the rachidian canal and the maximum transverse was lower in males than in general and in females, indicating a possible influence of gender in this relation. Therefore,

the logistic regression (Stepwise-Wald) was performed considering males as "1" and females as "0" for the calculation.

Considering the probability of accuracy at random, the data revealed a 57.6% chance of predicting the gender. Regression revealed that the model formed by the diameter measurements of the anteroposterior of the vertebra, transverse of the rachidian canal and maximum transverse was better (Chi-square=89.5 $p<0.0001$) to predict the gender than by chance. The measurement of the anteroposterior diameter of the rachidian canal was not important to the model ($p=0.23$). The Nagelkerke R^2 showed that the variables are responsible for 50.3% of the variation found in gender. In addition, the Hosner-Lemeshow test showed that the model was adequate ($p=0.29$). This model is presented below on Table 2.

Table 2. Logistic regression analysis

	Coefficient	**Standard error**	**Wald**	**p-Value**	**Coefficient Standardized (ODDS Ratio)**
Anteroposterior of the vertebra	0.18	0.07	5.9	0.0152	1.19
Anteroposterior of the rachidian canal	-0.08	0.09	0.67	0.41	0.93
Maximum transverse	0.25	0.05	26.7	<0.0001	
Constant	-23.7	4.0	36.0	<0.0001	4.9×10^{-11}

Therefore, the logit would be:

Gender = - 23.7 + (0.18 × Anteroposterior vertebra) – (0.08 × transverse of the rachidian canal) + (0.25 × maximum transverse)

Values higher than 0.5 (cutoff) would be considered as “male” and lower as “female.” Table 3 shows the prediction considering this relation.

Table 3. Frequency distribution of correct percentages of gender prediction.

		Prediction by formula		
		Female	**Male**	**Correct percentage**
Real gender	**Female**	62	19	76.5
	Male	15	95	86.4
			Correct general percentage	82.2

This table shows that the method results in 86.4% sensitivity, 76.5% specificity, and 82.2% accuracy, therefore, being more effective in the gender prediction than the mere random accuracy.

DISCUSSION

The results obtained indicate that male vertebrae are bigger than female ones.

Such situation is according to international researchers who verified that all variables showed that, on average, measurements of the first cervical vertebra in men are higher than in women and there is an 80-87% percentage of correct gender attribution in the study samples (Medina et al. 2011).

In the present study, 82.2% correct general percentage was obtained, which confirmed to be possible determine gender by the Atlas.

Another researcher verified trust levels between 75 and 85% in the metric study on the first cervical vertebra (Marino et al. 1995). In another study, 82% confidence was obtained in the image analysis study on the first cervical vertebra (Del Río et al. 2000).

In a master's thesis, a logistic regression function was obtained which accuracy percentages of women and men classification were respectively 88.7% and 89.4% (Pinto 2012).

Gender determination through the Atlas first cervical vertebra is not commonly used, unlike what happens to several other osseous structures of the body. The small number of this type of study is specially due to the low number of adequate human skeletons, that is, well documented and preferably with known personal data. In addition, Atlas is a very fragile structure, therefore, hard to find in good conditions for research conduction.

However, it is understood that results identified through research on the first cervical vertebra after literature review, present a large degree of gender differentiation. Furthermore, the measurements found in the present study and consequently the bone under study are sexually dimorphic, with acceptable classification standards and hence, useful for forensic anthropology.

From this result and the mathematical model, it will be possible to create specific softwares to determine gender in Brazilian skeletons.

After the efficient statistical analysis, we concluded that all the linear measurements carried out in the first Atlas vertebra and the first cervical vertebra are dimorphic. It was also possible to build a mathematical logistic regression model (logit): Gender = - 23.7 + (0.18 × Anteroposterior vertebra) – (0.08 × transverse of the rachidian canal) + (0.25 × maximum transverse) with 82.2% accuracy.

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3 CONCLUSÃO

Após a análise estatística das medidas realizadas foi possível observar que todas as medidas realizadas são dimórficas. Também foi possível validar e criar um novo modelo de regressão logística para se estimar o sexo, a saber LOGITO Padovan 2017 [Sexo=- 23.7 + (0.18 × Antero posterior da vértebra) – (0.08 × transverso do canal raquidiano) + (0.25 × transverso máximo)]. A aplicação deste na mesma amostra obteve índice de acerto de 82,2%. Acredita-se que o mesmo será de grande valia no processo de identificação a ser realizado pelos antropologistas/odontolegistas, dentro dos IMLs.

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Anexo 1 - Certificado do Comitê de Ética em Pesquisa da FOP/UNICAMP

COMITÊ DE ÉTICA EM PESQUISA
FACULDADE DE ODONTOLOGIA DE PIRACICABA
UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa "Validação de modelos já existentes e desenvolvimento de softwares por meio da análise de mensurações do crânio e antropometria óssea", protocolo CEP/FOP nº 138/2014, CAAE nº 38522714.6.0000.5418, dos pesquisadores Luiz Francesquini Júnior, Marilia Souza de Carvalho, Eduardo Daruge Júnior, Lucas Del Vigna Pinheiro Peixoto, Lucas Procopio Meneghetti, Paulo Roberto Neves, João Cesar Barbieri Bedran de Castro, Yuli Andrea López Quintero, Maria Júlia Assis Vicentin, Graciele Dib Nunes Silva, Ana Flavia de Carvalho Cardozo, Viviane Ulbricht, Vanessa Germano, Larissa Stasievski, Nivia Cristina Duran Gallassi, Carlos Sassi, Cristhiane Martins Schmidt, Ana Paula Desuo, Brenda Galvão Bruder, Bruna Caroline Pincinato, Maria Cláudia, Bruna da Costa Guedes de Araujo e Larissa Padovan, satisfaz as exigências do Conselho Nacional de Saúde – Ministério da Saúde para as pesquisas em seres humanos e foi aprovado por este comitê em 30 de janeiro de 2017.

The Ethics Committee in Research of the Piracicaba Dental School, University of Campinas, certify that the project "Validating existing models and software development by analyzing measurements of the skull and bone Anthropometry", register number CEP/FOP 138/2014, CAAE nº 38522714.6.0000.5418, of Luiz Francesquini Júnior, Marilia Souza de Carvalho, Eduardo Daruge Júnior, Lucas Del Vigna Pinheiro Peixoto, Lucas Procopio Meneghetti, Paulo Roberto Neves, João Cesar Barbieri Bedran de Castro, Yuli Andrea López Quintero, Maria Júlia Assis Vicentin, Graciele Dib Nunes Silva, Ana Flavia de Carvalho Cardozo, Viviane Ulbricht, Vanessa Germano, Larissa Stasievski, Nivia Cristina Duran Gallassi, Carlos Sassi, Cristhiane Martins Schmidt, Ana Paula Desuo, Brenda Galvão Bruder, Bruna Caroline Pincinato, Maria Cláudia, Bruna da Costa Guedes de Araujo and Larissa Padovan comply with the recommendations of the National Health Council – Ministry of Health of Brazil for research in human subjects and therefore was approved by this committee on Jan 30, 2017.

Profa. Fernanda Miori Pascon
Vice Coordenador
CEP/FOP/UNICAMP

Prof. Jacks Jorge Junior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo aparece como fornecido pelos pesquisadores, sem qualquer edição.
Notice: The title of the project appears as provided by the authors, without editing.

Anexo 2 - Carta de submissão do trabalho

UNICAMP

Luiz Francesquini Júnior <francesq@unicamp.br>

IJLM: Your manuscript entitled Sexual dimorphism through the study of the Atlas vertebra in the Brazilian population.
1 mensagem

Andreas Schmeling <em@editorialmanager.com> 14 de junho de 2017 14:00
Responder a: Andreas Schmeling <andreas.schmeling@ukmuenster.de>
Para: LUIZ FRANCESQUINI JÚNIOR <francesq@unicamp.br>

Ref.: Ms. No. IJLM-D-17-00131
Sexual dimorphism through the study of the Atlas vertebra in the Brazilian population.
International Journal of Legal Medicine

Dear DR FRANCESQUINI JÚNIOR,

Reviewers' comments on your work have now been received. You will see that they are advising against publication of your work. Therefore I must reject it.

The reviewers' comments can be found at the end of this email or can be accessed by following the provided link.

This is your login information:
Your username is: francesquini
Your password is: available at this link http://ijlm.edmgr.com/Default.aspx?pg=accountFinder.aspx&firstname=LUIZ&lastname=FRANCESQUINI+J%c3%9aNIOR&email_address=francesq@unicamp.br

Thank you for giving us the opportunity to consider your work.

Yours sincerely,

Prof. Andreas Schmeling
Associate Editor
International Journal of Legal Medicine

Reviewers' comments:

Reviewer #1: Sexual dimorphism through the study of the Atlas vertebra in the Brazilian population.

International Journal of Legal Medicine

The aim of this paper is to explore sexual dimorphism in the atlas vertebrae relevant to a Brazilian population. The paper itself doesn't really present a novel exploration of the topic and its overall study design has some glaring omissions. Add to this the generally poor written English, and continued misuse of the term gender, it fails to meet the high standard required of IJLM. Methodologically, the DFA's do not appear to be cross-validated and the sex-bias of >10% is ignored. The precision study is also not appropriate -

the ICC is a sub-standard way of quantifying measurement error and TEM, R would be more appropriate. I believe that this population specific data would be better suited for publication in a journal that deals specifically with that type of data.

Reviewer #2: The manuscript under review is an original study to assess sexual dimorphism in a Brazilian population, through measurement of the atlas vertebra in 191 skeletons of known sex. The authors study 4 measurements and use these for logistic regression calculation to propose sex estimation formulae.

Estimation of sex is a central theme in forensic anthropology and, e.g. due to population specificity, it is important to continuously update and improve sex estimation techniques. Studies that propose novel sex estimation techniques or make important contributions to currently used sex estimation techniques therefore deserve full consideration for publication in the IJLM.

However, i feel there are important issues with this manuscript that prompt me to advise rejection of this paper. These issues are amongst others related to the used language, the introduction/relevancy, the methodology, the presentation of the results of this study. I will present my main objections in detail below.

Used language:
Throughout the manuscript, the used language is of insufficient quality for a scientific paper. On more than one occasion, I had problems following the train of thoughts of the authors which severely hampered the peer reviewing process. Also, the authors use anthropological nomenclature incorrectly (e.g. gender). I suggest that the authors offer the manuscript for thorough proofreading by a native english speaker.

Introduction/relevancy:
The authors fail to put forward why this study adds to the already existing literature on sex estimation. The first part of the introduction contains information that is readily available in forensic anthropological textbooks. The authors rightfully argue that DNA-analysis is sometimes impossible in skeletonized remains. However, the citation used by the authors is on archaeological material and therefore fails to prove the point. In my opinion, the true reason to do anthropological sex estimation is the costs and time needed for DNA-analysis and not so much the successrate. In addition, the authors fail to prove why the atlas should be studied. That the atlas is more often recovered than the skull or pelvis, or other proven sexual dimorphic bones such as the proximal humerus or femur is not backed by scientific evidence and seems unlikely to me. In the discussion, the authors admit themselves that the atlas is a fragile structure, while the proposed measurements require an intact vertebra. Also in the discussion, it becomes apparent that similar research has been done before, which limits the added value of the study.

Methods and Material
The information on the used skeletal material is way too succinct. e.g. How old were the individuals? Is there anything known of their geographic ancestry or health status? How was the sex of these individuals determined?
Very importantly, the eventual sex estimation formulae are not tested in a separate testing population, nor in a bootstrap-configuration. The reported accuracies will be therefore overestimate the actual estimations and are of no use to show the sexual dimorphism of the measurements.
Also, the methods section contains results, which should be placed in the results-section.

Results
The results of the inter- and intraobserver variation should show the standard error of the measurements. Without this data, it becomes impossible to interpret the data on the means and standard deviation of the four selected measurements.
The data in figure 1 is best presented in a table. It is apparent that there is a large overlap between the 95% confidence intervals of the measurements, which illustrates actually the lack of clear sexual dimorphism of the measurements.
Table 1 gives information on the interdependability of the measurements but does not add any information on the sexual dimorphism of the measurements, nor does the paragraph that discusses this table. the data in table 2 does not make sense to me, how can it be that both p-values under and above 0.05 are reported? And why is no Odds-ratio for maximum transverse given? As said in the methods and materials, the precentages given in Table 3 are not useful as the actual accuracy of the formulae, since the

method was not tested in a separate population or in a bootstrap configuration. Also, the found accuracy is not that impressive if compared to sexual dimorphism of other (more often recovered) skeletal parts.

—

Anexo 3 - Certificado de verificação de originalidade e prevenção de plágio

DIMORFISMO SEXUAL PELO ESTUDO DA VÉRTEBRA

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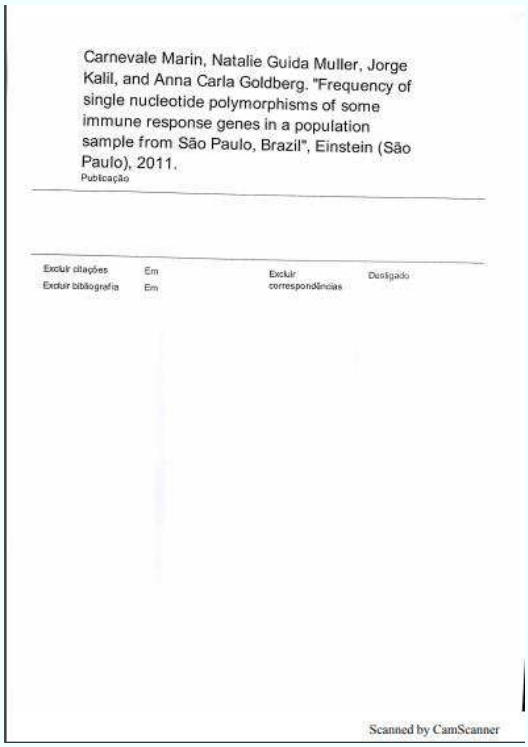

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