Dear Author

Here are the proofs of your article.

- You can submit your corrections **online** or by **fax**.
- For **online** submission please insert your corrections in the online correction form. Always indicate the line number to which the correction refers.
- Please return your proof together with the permission to publish confirmation.
- For **fax** submission, please ensure that your corrections are clearly legible. Use a fine black pen and write the correction in the margin, not too close to the edge of the page.
- Remember to note the journal title, article number, and your name when sending your response via e-mail, fax or regular mail.
- **Check** the metadata sheet to make sure that the header information, especially author names and the corresponding affiliations are correctly shown.
- **Check** the questions that may have arisen during copy editing and insert your answers/corrections.
- **Check** that the text is complete and that all figures, tables and their legends are included. Also check the accuracy of special characters, equations, and electronic supplementary material if applicable. If necessary refer to the *Edited manuscript*.
- The publication of inaccurate data such as dosages and units can have serious consequences. Please take particular care that all such details are correct.
- Please **do not** make changes that involve only matters of style. We have generally introduced forms that follow the journal's style.
  Substantial changes in content, e.g., new results, corrected values, title and authorship are not allowed without the approval of the responsible editor. In such a case, please contact the Editorial Office and return his/her consent together with the proof.
- If we do not receive your corrections **within 48 hours**, we will send you a reminder.

Please note

Your article will be published **Online First** approximately one week after receipt of your corrected proofs. This is the **official first publication** citable with the DOI. **Further changes are, therefore, not possible.**

After online publication, subscribers (personal/institutional) to this journal will have access to the complete article via the DOI using the URL:

`http://dx.doi.org/10.1007/s12520-020-01215-x`

If you would like to know when your article has been published online, take advantage of our free alert service. For registration and further information, go to: http://www.springerlink.com.

Due to the electronic nature of the procedure, the manuscript and the original figures will only be returned to you on special request. When you return your corrections, please inform us, if you would like to have these documents returned.

The **printed version** will follow in a forthcoming issue.

AUTHOR'S PROOF!

Metadata of the article that will be visualized in OnlineFirst

1	Article Title	**Missing prehistoric women? Sex ratio as an indicator for analyzing the population of Iberia from the 8th to the 3rd millennia B.C.**	
2	Article Sub- Title		
3	Article Copyright - Year	**Springer-Verlag GmbH Germany, part of Springer Nature 2020 (This will be the copyright line in the final PDF)**	
4	Journal Name	Archaeological and Anthropological Sciences	
5	Corresponding Author	Family Name	**Cintas-Peña**
6		Particle	
7		Given Name	**Marta**
8		Suffix	
9		Organization	Universidad de Sevilla
10		Division	Department of Prehistory and Archaeology
11		Address	C/ María de Padilla s/n, Sevilla 41004, Spain
12		e-mail	marcinpen@us.es
13	Author	Family Name	**Corral**
14		Particle	
15		Given Name	**Ana Mercedes Herrero**
16		Suffix	
17		Organization	Universidad Complutense de Madrid
18		Division	Department of Prehistory
19		Address	C/ Profesor Aranguren s/n, Madrid 28040, Spain
20		e-mail	
21	Schedule	Received	15 April 2020
22		Revised	
23		Accepted	2 October 2020
24	Abstract	In the last few decades, archaeology has undergone a profound transformation. The inclusion of techniques from a wide range of other sciences, as well as the specific contribution of physical anthropology, genetics, and paleodemography using the analyses of human remains, has enabled the reconstruction of some key aspects of past populations such as mobility, diet, physical activities, and health status. In addition, the emergence of gender archaeology has led to a great renewal in how societies in the past are conceptualized and approached. Although the gender approach completely relies on the accuracy of the method used for estimating the sex of individuals, the increasing number of publications on this issue rarely focuses on the criteria on which these results are based. The aim of this paper is, firstly, to present the anthropological data	

AUTHOR'S PROOF!

		available for the Iberian Mesolithic, the Neolithic, and the Copper Age (8th–3rd millennia B.C.) and the analysis of this from the perspective of the "sex ratio." This demographical indicator has allowed us to detect a higher proportion of male individuals than female ones in most of the sites analyzed. Secondly, the different causes of this systematic disproportion (cultural, methodological, and biological) are discussed, concluding that the methodological bias in favor of males presented in research over 40 years ago still exists.
25	Keywords separated by ' - '	Sex ratio - Paleodemography - Iberia - Mesolithic - Late prehistory
26	Foot note information	The online version of this article (https://doi.org/10.1007/s12520-020-01215-x) contains supplementary material, which is available to authorized users. Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Electronic supplementary material

ESM 1
(DOCX 46 kb)

AUTHOR'S PROOF!

JrnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

Archaeological and Anthropological Sciences _####################_
https://doi.org/10.1007/s12520-020-01215-x

ORIGINAL PAPER

Missing prehistoric women? Sex ratio as an indicator for analyzing the population of Iberia from the 8th to the 3rd millennia B.C.

Marta Cintas-Peña[1] · Ana Mercedes Herrero Corral[2]

Received: 15 April 2020 / Accepted: 2 October 2020
© Springer-Verlag GmbH Germany, part of Springer Nature 2020

Abstract

In the last few decades, archaeology has undergone a profound transformation. The inclusion of techniques from a wide range of other sciences, as well as the specific contribution of physical anthropology, genetics, and paleodemography using the analyses of human remains, has enabled the reconstruction of some key aspects of past populations such as mobility, diet, physical activities, and health status. In addition, the emergence of gender archaeology has led to a great renewal in how societies in the past are conceptualized and approached. Although the gender approach completely relies on the accuracy of the method used for estimating the sex of individuals, the increasing number of publications on this issue rarely focuses on the criteria on which these results are based. The aim of this paper is, firstly, to present the anthropological data available for the Iberian Mesolithic, the Neolithic, and the Copper Age (8th–3rd millennia B.C.) and the analysis of this from the perspective of the "sex ratio." This demographical indicator has allowed us to detect a higher proportion of male individuals than female ones in most of the sites analyzed. Secondly, the different causes of this systematic disproportion (cultural, methodological, and biological) are discussed, concluding that the methodological bias in favor of males presented in research over 40 years ago still exists.

Keywords Sex ratio · Paleodemography · Iberia · Mesolithic · Late prehistory

UNCORRECTED PROOF

Introduction

Since the emergence of new archaeology and its commitment to a more scientific archaeology (Binford 1962, 1971; Clarke 1968; Renfrew 1973; Schiffer 1987) in the 1960s, archaeology has undergone a profound transformation. The inclusion of techniques and methodologies from other sciences such as physics, chemistry, biology, and demography has left a strong multidisciplinary mark, leading to advances in the reconstruction of past societies that were inconceivable a few decades ago. Although it is difficult to highlight one area, the contribution of physical anthropology, genetics, and paleodemography to the advancement of our knowledge of prehistoric societies is unquestionable. The remains of human bone, previously seen as useless, are now at the center of research. With such material records, it is possible to examine key social issues such as mobility patterns, nutrition, activities, and diseases suffered by both men and women, young and old, in past societies.

In addition to this, the irruption of gender archaeology (Conkey and Spector 1984; Bertelsen et al. 1987; Arnold et al. 1988; Ehrenberg 1989; Gero and Conkey 1991; Sorensen 2000) has highlighted the relevance of incorporating gender as a basic category of social analysis, distinguishing between male and female individuals when approaching to past societies. Since gender analysis is strongly bound by the sex estimations of skeletons recovered in funerary contexts, the dependence of gender archaeology on physical anthropology is very strong. However, publications have mostly assumed sexual estimations, without considering the methodological criteria on which such estimations are based. Both the rapid shift towards a multidisciplinary approach and a

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s12520-020-01215-x) contains supplementary material, which is available to authorized users.

✉ Marta Cintas-Peña
marcinpen@us.es

[1] Department of Prehistory and Archaeology, Universidad de Sevilla, C/ María de Padilla s/n, 41004 Sevilla, Spain

[2] Department of Prehistory, Universidad Complutense de Madrid, C/ Profesor Aranguren s/n, 28040 Madrid, Spain

AUTHOR'S PROOF!
JnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

significant increase in gender archaeology publications over recent years have, to some extent, prevented reflection and in-depth assessment of the results obtained as well as the methods used.

This paper aims to contribute to this issue. Specifically, we present an analysis of the anthropological data available for the study of the "sex ratio" demographical index among Iberian Mesolithic, Neolithic, and Chalcolithic populations. This indicator allows us to quantify the sex ratios in a given society, offering a first insight on the demographic composition of a society, as well as on potential differences or inequalities between men and women.

Sex ratio as a demographic index

The ratio offers us a first demographic approach to a human contingent (Hobbs 2004: 129 et seq.). The formula used to obtain it is RS = 100 * men/women, and it can be expressed in hundreds (105) or units (1.05), showing the number of men (105) per 100 women in each case.

Sex ratio in modern populations is usually between 95 and 102, while values exceeding the 90–105 limit are considered extreme or unusual (Hobbs 2004: p. 130). At birth, this demographic index is higher for men, with global data between 104 and 107 (Hobbs 2004: p. 133). Later in the life cycle, the proportion of men to women changes slightly due to a higher male mortality rate. Additionally, the sex ratio may vary later on in life as a consequence of different factors: greater mobility of one sex, lower female life expectancy linked to risks of reproduction, the role of violence in the increase of male mortality, or certain cultural practices aimed at regulating reproduction, among others.

The aforementioned reasons make the sex ratio dependent on the stage of life being analyzed, offering fact-based information about the cultural practices and the social organization of human groups. The most obvious current example of which can be found in countries such as China, Pakistan, and India, whose sex ratio at birth is 117.8, 109.9, and 110.5, respectively (Gilmoto 2012: 20). We know that these values, which imply a high number of "missing women" (Sen 1990), are related to the practice of female selective abortion and infanticide (Coale and Banister 1994; Klasen and Wink 2003), and are a direct consequence of discrimination against women and the preference for male offspring. However, high sex ratios are not exclusive to contemporary complex societies and they have also been documented in numerous hunter-gatherer, agricultural-livestock and pastoralist groups, whose subsistence levels could be considered equivalent to those of the people that inhabited the European continent between the Upper Paleolithic and the Bronze Age.

As in the case of the populations of China, Pakistan, and India, "extreme" sex ratios at birth presented by the Ache (Paraguay) or the Agta (Philippines) have mostly been explained as a result of practices of female neglect or differential investment in sons and daughters (Hewlett 1991). Other researchers suggest that high sex ratios may be explained by adaptive reasons (Sieff et al. 1990; Page et al. 2019). Consequently, it would be a mistake to blindly compare the social dynamics of these groups with those of prehistoric communities or to assume that high sex ratios are synonymous with gender inequality in all cases. However, the data presented is useful for establishing a frame of reference, since it shows both diachronic and synchronic tendencies that can be useful when assessing data from prehistoric archeological records. Therefore, ethnography and demography are key tools for explaining and understanding data obtained through the anthropological study of archeological remains, which are often incomplete (Chamberlain 2006: p. 177).

Methodology and empirical records

The data analyzed in this paper has been compiled during the development of a doctoral research at the University of Seville (Cintas-Peña 2020). The database is comprised of a total MNI of 2410 from 62 sites in Iberia (Fig. 1), grouped chronologically into the Mesolithic, the Neolithic, and the Copper Age. This data covers a period between the 8th and the 3rd millennia cal B.C.

The data compiled has been produced and published by other researchers (for a complete list of references, see Supplementary Material). These works are mainly physical anthropological studies carried out in accordance with a standardized, scientific methodology, and they have been published and are available for consultation. After collecting the data, information was stored in a purpose-specific database. The selection of our sample has been made according to three criteria: first, the clear chronological adscription of the contexts; second, the existence of bio-archeological data obtained using explicitly defined criteria; third, the accessibility of data. The resulting set comprises 62 sites, with 20 for the Mesolithic (MNI 172), 21 for the Neolithic (MNI 515), and 21 for the Chalcolithic (MNI 1723).

The analysis has been carried out on five levels: (i) general, considering the overall values for each period; (ii) site-level, distinguishing the highest value among the four categories: female or likely female, male or likely male, undetermined adult, and non-adult of unknown sex (henceforth F/F?, M/M?, UND, and NAD); (iii) site-level, comparing the sex ratios; (iv) site-level, selecting only the presence/absence of men and women; (v) site-level, selecting only adult individuals with estimated sex.

UNCORRECTED PROOF

AUTHOR'S PROOF!

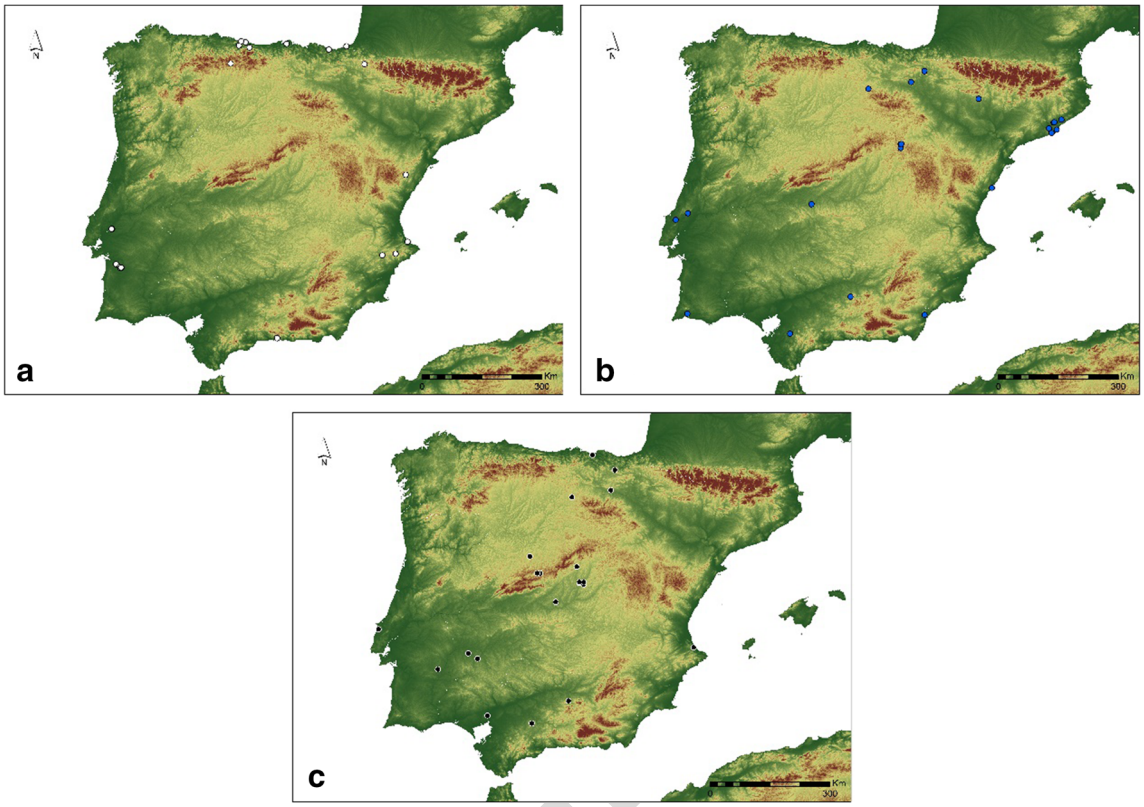

Fig. 1 Sites included in the analysis. **a** The Mesolithic. **b** The Neolithic. **c** The Chalcolithic. Author: Rodrigo Paulos Bravo

The geographical and temporal scale, as well as the large volume of individuals compiled, ensures both the representativeness of the sample and the validity of the conclusions reached.

Analysis

The Mesolithic

We have compiled data from 20 Mesolithic sites, storing information of MNI 172. Regarding the first level of analysis, this sample is comprised of 61 (35.47%) M/M?, 47 (27.33%) F/F?, 36 (20.93%) UND, and 28 (16.28%) NAD (Table 1). The sex ratio at the Iberian level is 129.8, which implies that if we were looking at a living population, there would be 130 men for every 100 women.

Secondly, if we examine the general distribution on a site-level, the pattern is slightly different. At ten sites, the highest percentage (Table 1; shaded cells) corresponds to M/M? individuals, while at four sites, F/F? is dominant. At three sites, UND is the most highly represented category, and lastly, in two other places, NAD is dominant.

Thirdly, regarding the sex ratio, there is not enough data (either because of the absence of men or the absence of women) to obtain the value at 12 sites. In the remaining eight places, there are four sites where the sex ratio reveals a predominance of males (Arapouco, El Collado, Los Canes, and, Moita do Sebastião), one in which the index indicates more women (Cabeço do Pez), and three sites where the value is balanced and comparable with a "natural" sex ratio. Therefore, sex ratio more frequently shows a majority of men to women, although in certain cases, the values are insufficient.

On the fourth level of analysis, that is, assessing only individuals with sexual identification (Fig. 2), at ten of the 20 sites, the highest value corresponds to men, compared with five sites where the highest value corresponds to women. The major differences are found at El Collado (4F, 9M) and Cabeço das Amoreiras (0F, 5M) where, as already indicated in previous works (Peyroteo Stjerna 2016: 446), men represent 83.3% of the whole MNI. In the remaining five places (Cabeço da Arruda, Cingle del Mas Nou, Cueva de Linatzeta, Vale de Romeiras, and Várzea da Mó), there is an equal number of men and women.

Finally, if we focus exclusively on adult individuals with estimated sex, the results are similar, as there are only four non-adult individuals with estimated sex. They correspond to the sites of Cabeço da Arruda (1 M?), El Collado (1 M?), and Los Canes (1 M) from El Truchiro/La Garma (1 F?). If we excluded them from the general data, the sample would comprise 46 F/F? and 58 M/M?, with 126.09 as the sex ratio on the Iberian level.

UNCORRECTED

AUTHOR'S PROOF!
JnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

t1.1 **Table 1** The Mesolithic sites.
t1.2 *F/F?*, female or likely female; *M/M?*, male or likely male; *UND*, undetermined adult; *NAD*, non-adult of unknown sex. Italicized values show the highest percentage

Site	F/F?		M/M?		UND		NAD		Total	Sex ratio
	N	%	*N*	%	*N*	%	*N*	%	*N*	
Aizpea	*1*	*100.00*	0	0.00	0	0.00	0	0.00	1	-
Arapouco	8	36.36	*10*	*45.45*	1	4.55	3	13.64	22	125.00
Braña-Arintero	0	0.00	*2*	*100.00*	0	0.00	0	0.00	2	-
Cabeço da Arruda	6	20.00	6	20.00	*13*	*46.67*	5	16.67	30	100.00
Cabeço das Amoreiras	0	0.00	*5*	*83.33*	0	0.00	1	16.67	6	-
Cabeço do Pez	*9*	*34.62*	6	23.08	7	26.92	4	15.38	26	66.67
Casa Corona	*1*	*50.00*	0	0.00	0	0	*1*	*50.00*	2	-
Cingle del Mas Nou	1	14.29	1	14.29	0	0	*5*	*71.43*	7	100.00
Colomba	0	0.00	*1*	*100.00*	0	0.00	0	0.00	1	-
Cueva de Linatzeta	0	0.00	0	0.00	0	0	*1*	*100.00*	1	-
Cueva de Nerja	*1*	*100.00*	0	0.00	0	0.00	0	0.00	1	-
El Collado	4	26.67	*9*	*60.00*	1	6.67	1	6.67	15	225.00
El Truchiro/La Garma	*1*	*100.00*	0	0.00	0	0.00	0	0.00	1	-
Jaizkibel 3/J3	0	0.00	*1*	*100.00*	0	0.00	0	0.00	1	-
Los Azules	0	0.00	*1*	*100.00*	0	0.00	0	0.00	1	-
Los Canes	1	25.00	*2*	*50.00*	1	25.00	0	0.00	4	200.00
Moita do Sebastião	10	34.48	*12*	*41.38*	4	13.79	3	10.34	29	120.00
Tito Bustillo	0	0.00	*1*	*100.00*	0	0.00	0	0.00	1	-
Vale de Romeiras	4	20.00	4	20.00	*8*	*40.00*	4	20.00	20	100.00
Várzea da Mó	0	0.00	0	0.00	*1*	*100.00*	0	0.00	1	-
Total	47	27.33	*61*	*35.47*	36	20.93	28	16.28	172	129.79

Therefore, male individuals form the majority on the Iberian level as well as on the site-level. The five levels of analysis reveal a predominance of men versus women. Different research carried out focusing on Europe showed that 26% of the Mesolithic population buried there were men, while 20% were women (Grünberg 2000: p. 257). However, both in Iberia and on the continent, data shows a high number of undetermined adults and non-adults, which demands caution.

The Neolithic

Regarding the Neolithic, we have compiled the data available for MNI of 515, distributed with great heterogeneity over 21 sites. The set comprises 119 M/M? (23.11%), 79 F/F? (15.34%), 174 UND (33.79%), and 143 NAD (27.77%) (Table 2), with a sex ratio of 151, incompatible with the reference values for a natural population. The high number of undetermined cases can be partially explained by the collective burial practices that began in the

UNCORRECTED PROOF

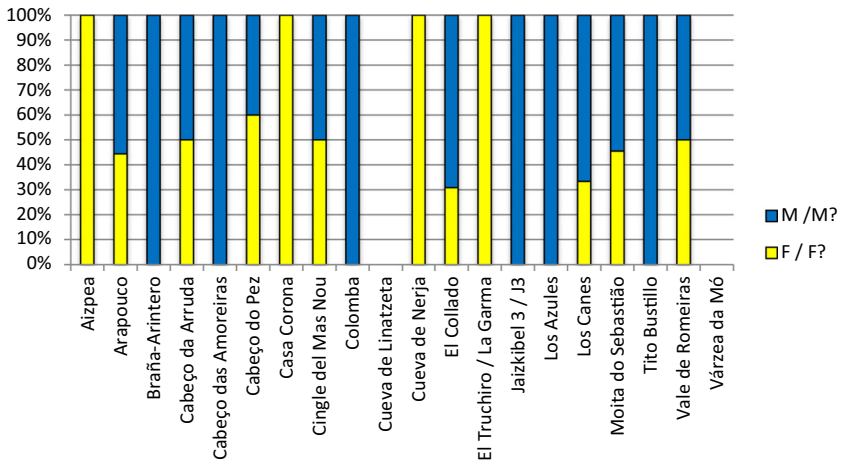

Fig. 2 Individuals with sex estimation for the Mesolithic sites. M/M? male or likely male. F/F? female or likely female

AUTHOR'S PROOF!

t2.1 **Table 2** The Neolithic sites.
t2.2 *F/F?*, female or likely female; *M/M?*, male or likely male; *UND*, undetermined adult; *NAD*, non-adult of unknown sex. Italicized values show the highest percentage
t2.3
t2.4
t2.5
t2.6
t2.7
t2.8
t2.9
t2.10
t2.11
t2.12
t2.13
t2.14
t2.15
t2.16
t2.17
t2.18
t2.19
t2.20
t2.21
t2.22
t2.23
t2.24
t2.25

Site	F/F?		M/M?		UND		NAD		Total	Sex ratio
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	
Alberite	*1*	*50.00*	*1*	*50.00*	0	0.00	0	0.00	2	100.0
Algar do Barrao	2	10.00	3	15.00	*11*	*55.00*	4	20.00	20	150.0
Algar do Bom Santo	3	20.00	*8*	*53.33*	3	20.00	1	6.67	15	266.7
Alto del Reinoso	6	14.29	13	30.95	8	19.05	*15*	*35.71*	42	216.7
Azután	0	0.00	1	11.11	3	33.33	*5*	*55.56*	9	-
Bòbila Madurell	13	9.29	12	8.57	*61*	*43.57*	54	38.57	140	92.3
Camí de Can Grau	11	28.95	*12*	*31.58*	5	13.16	10	26.32	38	109.1
Can Gambús	8	14.04	7	12.28	*42*	*73.68*	0	0.00	57	87.5
Castelo Belinho	0	0.00	3	18.75	*10*	*62.50*	3	18.75	16	-
Cerro Virtud	2	18.18	*5*	*45.45*	4	36.36	0	0.00	11	250.0
Costamar	0	0.00	*4*	*57.14*	0	0.00	3	42.86	7	-
Cova de les Agulles	0	0.00	0	0.00	4	40.00	*6*	*60.00*	10	-
Cueva de Chaves	0	0.00	*1*	*100.00*	0	0.00	0	0.00	1	-
La Caserna de Sant Pau del Camp	4	15.38	3	11.54	3	11.54	*16*	*61.54*	26	75.0
La Lámpara	*1*	*100.00*	0	0.00	0	0.00	0	0.00	1	-
La Sima	9	34.62	2	7.69	5	19.23	*10*	*38.46*	26	22.2
La Tarayuela	1	5.88	*11*	*64.71*	2	11.76	3	17.65	17	1100.0
Los Cascajos	4	11.11	*23*	*63.89*	6	16.67	3	8.33	36	575.0
Minas de Gavá	*7*	*30.43*	5	21.74	6	26.09	5	21.74	23	71.4
Paternanbidea	*5*	*38.46*	*5*	*38.46*	1	7.69	2	15.38	13	100.0
Polideportivo de Martos	2	40.00	0	0.00	0	0.00	*3*	*60.00*	5	-
Total	79	15.34	119	23.11	174	33.79	*143*	*27.77*	515	150.6

UNCORRECTED PROOF

Neolithic period. The reuse of spaces produces commingled deposits, complicating the individualization and the sexual estimation of the skeletons.

In relation to the second level of analysis, at seven of the 21 sites, the greatest amount of individuals observed (Table 2; shaded cells) corresponds to M/M? (Algar do Bom Santo, Camí de Can Grau, Cerro Virtud, Costamar, Cueva de Chaves, La Tarayuela, and Los Cascajos), in six cases to NAD (Alto del Reinoso, Azután, Cova de les Agulles, La Caserna de Sant Pau del Camp, La Sima, and Polideportivo Martos), at three sites to UND (Algar do Barrão, Bòbila Madurell, Can Gambús), and in only two places to F/F? (La Lámpara and Minas de Gavá). The remaining two places (Alberite and Paternanbidea) have the same number of F/F as M/M?

On the third level, and considering the sex ratio, at seven sites, the data is insufficient to obtain the value. At the remaining 14, we found a balanced sex ratio in two places (Alberite and Paternanbidea), an index favorable to men in seven (Algar do Barrão, Algar do Bom Santo, Alto del Reinoso, Camí de Can Grau, Cerro Virtud, La Tarayuela, and Los Cascajos), and a figure which indicates more women in five contexts (Bòbila Madurell, Can Gambús, La Caserna de Sant Pau del Camp, La Sima, and Minas de Gavá). Three places stand out because of their extreme values: La Tarayuela (SR = 1100, 11 M/M? versus 1 F/F?), Los Cascajos (SR = 575, 23 M/M? versus 4 F/F?), and La Sima SR = 22.22, 2 M/M? versus 9 F/F?). Assigning the number of undetermined to the minority group, whether male or female, would not balance the sex ratio at any of these three sites.

A detail worth mentioning is the data from Bòbila Madurell and Can Gambús, where according to the publication (Alliès 2016), the anthropological collection is comprised of 61 (MNI = 140) and 42 (MNI = 57) UND individuals, respectively. This data has been collected from the most recent anthropological study (Alliès 2016) that covers a greater number of subjects than the previous one (Roig Buxo et al. 2010). Alliès considers that the poor state of skeletal preservation does not allow a reliable sexual estimation to be carried out in most cases, which consequently prevents the establishment of a discussion in terms of sex ratio, which goes beyond simply saying that men and women are present in the archeological record (Alliès 2016: pp. 83, 154 and 227). The authors of the reports linked to the project called "Sepulturas Neolíticas"

AUTHOR'S PROOF!
JnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

hold a different opinion; they do carry out a sexual adscription for a higher number of individuals, and use this data as the basis for other works (Ruiz et al. 2010; Fontanals-Coll et al. 2015). The divergence in the number of M/M? and F/F? in each analysis is significant; we will return to this issue in the "Discussion" section.

On the fourth level of analysis, if we focus only on the individuals with sexual determination (Fig. 3), the number of M/M? exceeds the number of F/F? at 10 sites, while in seven places, the situation is the inverse, and in two, there is an equilibrium. We have no data for the remaining site.

Finally, if we consider only adult individuals with estimated sex, we should exclude three individuals from Los Cascajos (1 F, 1 M?, 1 M), one from Minas de Gavá (1 M), one from Camí de Can Grau (1 F), two from Paternanbidea (1 F, 1 F?), two from Alto del Reinoso (2 M), and one from Cerro Virtud (1 M?). Without them, the total amount of F/F? and M/M? is of 75 and 113, respectively, which gives a sex ratio of 150.67.

Consequently, the results are very similar to those of the Mesolithic. A high sex ratio indicating a greater male presence is observed both in general and in site-level terms.

The Copper Age

The 21 sites selected for the analysis presented here yield a MNI of 1723: 334 M/M? (19.38%), 287 F/F? (16.66%), 492 UND (28.55%), and 610 NAD (35.40%) (Table 3). The sex ratio gives us a value of 116.38, showing once again the incompatibility between the funerary population and a natural demographic curve. Notwithstanding, the high number of undetermined individuals (1102 if we add UND and NAD) requires prudence.

With respect to the category with the highest representation at each of the sites (Table 3; shaded values), we can see that in up to nine of the 21 places, most individuals correspond to the NAD group. These are the sites of Pico Ramos, Huerta Montero, San Juan Ante Portam Latinam, Perdigões, Soto de Henares, Camino de las Yeseras, El Perdido, El Tomillar, and Aldeagordillo. The second highest category is that of M/M?, which prevails in Fuente Celada, Cerro de la Cabeza, La Vital, and Cueva de Nardakoste IV, followed by UND in Paimogo I, La Pijotilla, and Valle de las Higueras. Finally, F/F? have a high representation only in Valencina, while in La Molina and La Magdalena, the number of men and women is the same, and in El Rebollosillo, those of UND and NAD have the highest representation.

The fact that UND and NAD are the majority at 13 of the 21 sites prevents us from seeing clear differences based on sex. As in the Neolithic period, during the Copper Age, the funerary practice of collective burial and re-utilization of spaces makes it very difficult to analyze the anthropological remains. High numbers of sexually undetermined individuals are undoubtedly linked to the characteristics of the context, in which it is not always possible to individualize the skeletons to obtain a clear sexual diagnosis.

Thirdly, regarding the sex ratio, at two of the sites, the data is insufficient to obtain the index; in 11 places, the number obtained is favorable to men, in six to women, and in the remaining two, the value is compatible with the natural sex ratio. It is more frequent to find a high sex ratio (prevalence of men) than a low one (prevalence of women).

Concerning the fourth level of analysis (Fig. 4), at 12 of the 21 sites, there are more men than women, while at seven sites, the category of women has higher values, and finally, in two places (Pico Ramos and La Molina), the number of males and females is the same. It suggests that it may have been more common for men to have access to inhumation funerary practices than women, although the high number of undetermined people should not be forgotten. The quantitative differences between men and women are especially marked in Huerta Montero (15 F/F? versus 29 M/M?), Fuente Celada (1 F/F? versus 2 M/M?), Camino de las Yeseras (16 F/F? versus 6 M/M?), Cueva de Nardakoste IV (2 F/F? versus 6 M/M?),

UNCORRECTED PROOF

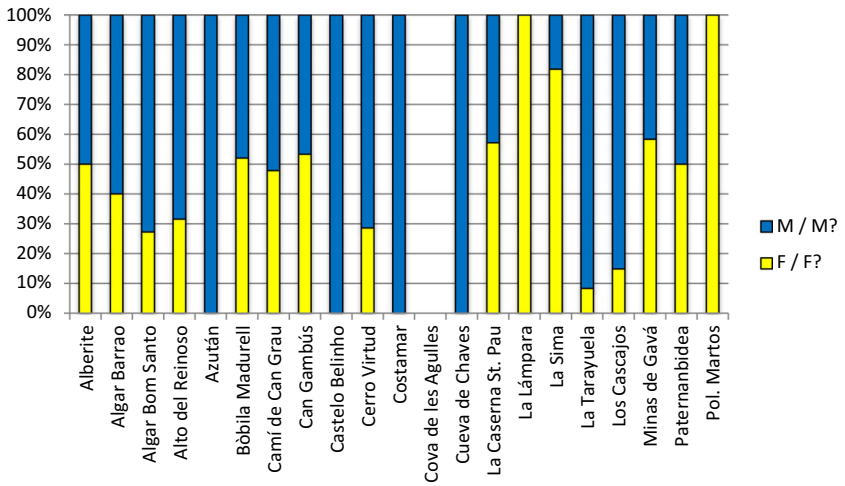

Fig. 3 Individuals with sex estimation for the Neolithic sites. M/M? male or likely male. F/F? female or likely female

AUTHOR'S PROOF!

t3.1 **Table 3** The Copper Age sites.
t3.2 *F/F?*, female or likely female;
M/M?, male or likely male; *UND*,
t3.3 undetermined adult; *NAD*, non-
adult of unknown sex. Italicized
t3.4 values show the highest
t3.5 percentage

Site	F/F?		M/M?		UND		NAD		Total	Sex ratio
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	
Pico Ramos	12	11.54	12	11.54	8	7.69	*72*	*69.23*	104	100.0
Huerta Montero	15	13.76	29	26.61	17	15.60	*48*	*44.04*	109	193.3
SJAPL	46	13.61	108	31.95	18	5.33	*166*	*49.11*	338	234.8
Perdigões	6	5.61	7	6.54	46	42.99	*48*	*44.86*	107	116.7
Valencina	*60*	*31.41*	43	22.51	53	27.75	35	18.32	191	71.7
Paimogo I	69	16.71	46	11.14	*175*	*42.37*	123	29.78	413	66.7
La Pijotilla	18	10.11	27	15.17	*110*	*61.80*	23	12.92	178	150.0
Fuente Celada	1	25.00	*2*	*50.00*	0	0.00	1	25.00	4	200.0
Valle de las Higueras	4	9.52	6	14.29	*17*	*40.48*	15	35.71	42	150.0
El Rebollosillo	1	4.76	2	9.52	*9*	*42.86*	*9*	*42.86*	21	200.0
Marroquíes (N1)	11	25.58	7	16.28	*13*	*30.23*	12	27.91	43	63.6
Soto de Henares	1	10.00	0	0.00	4	40.00	*5*	*50.00*	10	-
Camino de las Yeseras	16	30.19	6	11.32	12	22.64	*19*	*35.85*	53	37.5
Cerro de la Cabeza	1	11.11	*8*	*88.89*	0	0.00	0	0.00	9	800.0
La Vital	1	25.00	*2*	*50.00*	1	25.00	0	0.00	4	200.0
El Perdido	11	32.35	8	23.53	2	5.88	*13*	*38.24*	34	72.7
El Tomillar	2	10.53	5	26.32	1	5.26	*11*	*57.89*	19	250.0
Cueva Nard2akoste IV	2	14.29	*6*	*42.86*	1	7.14	5	35.71	14	300.0
Aldeagordillo	0	0.00	2	40.00	0	0.00	*3*	*60.00*	5	-
La Molina	*4*	*40.00*	*4*	*40.00*	1	10.00	1	10.00	10	100.0
La Magdalena	*6*	*40.00*	4	26.67	4	26.67	1	6.67	15	66.7
Total	287	16.66	334	19.38	492	28.55	*610*	*35.40*	1723	116.4

UNCORRECTED PROOF

Aldeagordillo (0 F/F? versus 2 M/M?), San Juan Ante Portam Latinam (46 F/F? versus 108 M/M?), Cerro de la Cabeza (1 F/F? versus 8 M/M?), and El Tomillar (2 F/F? versus 5 M/M?). At the last four sites, the predominance of males has previously been indicated by some authors (Fabián García 2006: p. 439; Etxeberría Gabilondo and Herrasti Erlogorri 2007: p. 273). At all of the sites, there are twice as many men as women, with the exception of Huerta Montero, which are closed to this figure, and of Camino de las Yeseras, where the number of women more than doubles that of male subjects. In spite of the above data, at Fuente Celada, El Rebollosillo, La Vital, and Aldeagordillo, the figures are too low to reach a conclusion. On the contrary, at Huerta Montero, San Juan Ante Portam Latinam, Camino de las Yeseras, Cerro de la Cabeza, and, to a lesser extent, El Tomillar and Cueva de Nardakoste IV, the data indicates a clear male majority.

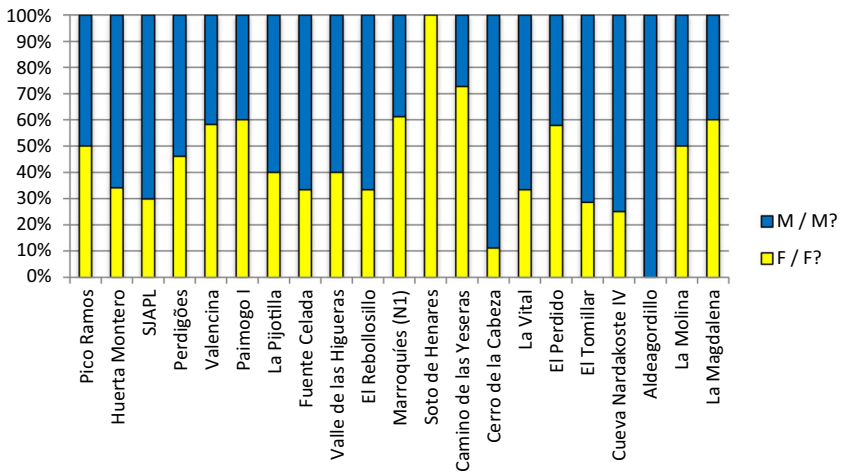

Fig. 4 Individuals with sex estimation for the Copper Age sites. M/M? male or likely male. F/F? female or likely female

AUTHOR'S PROOF!
JnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

As regards the fifth and last level of analysis, there are 55 individuals with estimated sex that did not reach adult age. Their remains come from the sites of Cerro de la Cabeza (2 M), Huerta Montero (4 F, 2 M), La Magdalena (1 F), El Perdido (2 F, 1 M), Perdigões (2 M), San Juan Ante Portam Latinam (12 F, 23 M), Valencina (1 F?, 3 M), and Camino de las Yeseras (2 F). If we exclude them, the initial amount of 287 F/F? and 334 M/M? is reduced to 265 F/F? and 301 M/M?, resulting in a sex ratio of 113.58.

Discussion

The data shown in this research exhibits a clear trend: there is a majority of male individuals over female ones. Of the 2410 individuals considered in this study, 413 are F/F?, 514 M/M?, 702 UND, and 781 NAD. On the five levels of analysis and in every period covered in this study, men outnumber women. In every period, the sex ratio favors men: 129.8 in the Mesolithic, 150.6 in the Neolithic, and 116.4 in the Copper Age. If we consider exclusively adult individuals with estimated sex, the sex ratio for each period varies very slightly: 126.1 in the Mesolithic, 150.7 in the Neolithic, and 113.6 in the Chalcolithic. Although there are some exceptions, and despite the high number of undetermined individuals, there is a clear pattern, even when considering the sites separately.

What are the reasons for this pattern? Where are the missing prehistoric women?

As we previously indicated, in modern populations, the sex ratio at birth stands typically between 104 and 107 (Hobbs 2004: p. 133; Chamberlain 2006: p. 18). Although values may vary both within different populations and in comparisons between them, due to issues such as race, birth order and socioeconomic context (Sieff et al. 1990: p. 25), sex ratios over 90–105 are considered to be extreme (Hobbs 2004: p. 130). Moreover, according to Hobbs (2004: p. 136), "a sex ratio deviating even further […], above 110 or below 85 must be accounted for in terms of some unusual feature of the area […]." This statement is equally valid for data from ethnography. Although there are remarkable differences between populations such as the Chinese and Yanomami, to give two examples, some demographic parameters are constant (Chamberlain 2006: p. 180); sex ratio, supported by an extensive body of literature, is one of them.

Ethnographic documentation indicates great sex ratio variability in societies with economies and ways of life similar to those in prehistory. Hewlett, in a publication from 1991, provides data from 15 different groups of hunter-gatherers, horticulturists, and shepherds with a preindustrial demography model (Table 4). For the first group, the sex ratio at birth ranges from 109 (Aka y Efe) to 122 (Agta), from 81 (Dusun) to 111 (Nvimba) for horticulturists, and between 110 (Datoga and Kipsigis), and 126 (Sebei) for shepherds. At 15 years old and during adulthood (> 15 years), the situation changes drastically in most populations with an average ranging between 86 (Dusun) and 141 (Cuiva), although most of the groups (ten out of 15) do not exceed 85–110, the limits proposed by Hobbs. In our study, the results obtained for the Mesolithic, the Neolithic, and the Copper Age do exceed those figures of 85 and 110. Additionally, at every site, the sex ratio is closer to the upper limit (110) than the lower one (85), indicating a vast majority of men versus women, which is not compatible with an adaptive explanation.

The discrepancy between the number of men and women found in the prehistoric osteological assemblages in Iberia, with a natural demographic structure, was already considered in other contexts (Fernández-Crespo and de-la-Rúa-Vaca 2015: p. 610). In addition, a recent regional research published by one of the authors of this study confirms this trend (Herrero -Corral 2019). In this case, human remains were recovered from the Copper Age sites of Humanejos, El Rebollosillo, La Salmedina, Juan Barbero, and El Juncal, located in the upper and middle Tagus basin. In total, 172 individuals were analyzed, providing data of 41 M/M? (18.50%), 28 F/F? (16.47%), 36 UND (26.69%), and 67 NAD (38.33%). The general sex ratio of this sample is 127.46, which indicates a substantial majority of men. At three sites, the value obtained was greater than 100, at one site, equal to 100, and it was lower than 100 only at one site.

From our point of view, there are three possible explanations for this fact: (i) a natural selection scenario in which one sex has more access to the inhumation ritual than the other, (ii) a methodological bias that causes a higher identification of masculine individuals, and (iii) men and women may have had differential preservation due to biological factors.

Cultural selection

The cultural hypothesis is not new. Several researchers have indicated the possibility of intentional selection of those individuals who had access to certain funerary contexts, for megalithic monuments during the Neolithic and Copper Age. Fernández-Crespo and de-la-Rúa (2016: p. 290) noted the predominance of male individuals in megalithic tombs (with sex ratios between 110 and 200), while there is a majority of women in caves and rock shelters (sex ratios between eight and 57) at six sites on the Cantabrian coast. Other megalithic sites in the interior of the Peninsula, such as La Peña de la Abuela, La Tarayuela, or the dolmen of Las Arnillas (Delibes de Castro 1995: p. 77; Rojo Guerra et al. 2005: pp. 61 y 62), would have been preferentially reserved for men at the expense of women and children. Regarding La Tarayuela, it is noted that "there is a predominance of men as a direct consequence of an intentional act from which most of the women of the group were excluded" (Velasco Vázquez 2005: p. 349).

UNCORRECTED PROOF

AUTHOR'S PROOF!

t4.1 **Table 4** Sex ratio data of hunter-gatherers, horticulturalists, and pastoralists groups. Source: Hewlett 1991: pp. 10–12

	Population	Birth	Juvenile (= 15)	Adult (> 15)	Mean
Hunter-Gatherers	Ache	116	154	133	134
	Agta	122	145	83	117
	Aka	109	115	75	100
	Cuiva	118	163	ND	141
	Efe	109	106	97	104
	Northern!Kung	120	81	85	95
Horticulturalists	Bari	96	94	ND	95
	Dusun	81	103	75	86
	Nyimba	111	113	118	114
	Semai	107	103	112	107
	Tikopia	82	136	104	107
	Yanomamo	107	134	109	117
Pastoralists	Datoga	110	116	71	99
	Kipsigis	110	103	75	96
	Sebei	126	101	102	110

La Tarayuela is one of the places where our analysis found the greatest differences between men and women and also at other Neolithic sites such as Costamar, Los Cascajos, and Algar do Bom Santo, and San Juan Ante Portam Latinam, Huerta Montero, and Cerro de las Cabezas for the Copper Age. Most of them are non-megalithic graves; they are caves, rock shelters, or simple pits, which indicates that sexual selection would not have a direct relation with megalithism.

An alternative explanation could be that sexual selection could have been related to specific geographic areas, such as the Cantabrian coast or the interior of Iberia, where there was predominantly male access to graves. The idea of a regional pattern is supported by the results obtained by Silva (2002: pp. 166–167) for a Neolithic and early Copper Age sample in Portugal, which shows a slight but systematic majority of women. This feminine predominance is also comparable with the results obtained from the "Chasséen" culture sample in France (Silva 2002: p. 171). Considering possible regional cultural practices, Silva suggests that the results could show that men were inhumed somewhere else, but at the same time, the author does not exclude a methodological problem (Silva 2003: pp. 58–59). A recent study carried out by Díaz-Zorita Bonilla (2017) at 15 Copper Age sites in Southwest Iberia (La Pijotilla and Valencina among them) shows similar rates for men and women. Specifically, in a sample of 225 sexed individuals, 114 were identified as women (49%) and 111 as men (51%), perfectly consistent with a natural demographic curve.

However, in this same area, other sites with sex ratios which are markedly favorable to men, such as Huerta Montero, have been detected, therefore rejecting the hypothetical sexual selection linked to a regional pattern. Moreover, the great geographical dispersion of the sites with high masculine indexes, such as El Collado (Valencia) and Arapouco (Alentejo) for the Mesolithic period, Algar do Bom Santo (Lisbon), and Los Cascajos (Navarra) for the Neolithic, and San Juan Ante Portam Latinam (Álava), Cerro de la Cabeza (Ávila), and Cueva de Nardakoste IV (Guipúzcoa), for the Copper Age, does not suggest a relation between an elevated frequency of men and a specific geographical area.

Finally, Bishop and Knüsel (2005: pp. 205–206) suggested that an elevated number of men versus women in graves are an indicator of a conflict or confrontation. This hypothesis would be valid for some sites such as San Juan Ante Portam Latinam, where several signs of violence were documented (Vegas Aramburu 2014) but would not explain other contexts.

Methodological bias

Although there are countless methods for sex assignation in archeological collections (Buikstra and Ubelaker 1994; Ferembach et al. 1980), most experts coincide in using the morphological traits of the skull and the pelvis (Mays and Cox 2000: p. 217). The characteristics of these bones can be qualitatively or quantitatively analyzed, but the efficiency of both methods depends directly on the number of observable traits, the observer, and the type of traits (cf. Krogman 1962: pp. 112–152; see Harrison 2019 for a detailed account). The greater the number of traits, the greater the precision. At the same time, the results are more accurate when using both of these bones, the skull and the coxal, than when using just one of these. If it is possible to use both bones, the coxal is the most reliable bone (≈ 96% accuracy) (White and Folkens 2005: p. 398) with the highest sexual dimorphism in adults and those pre-adults in whose skeletons the three elements of the hip bone had already fused (ilium, ischium, and pubis). Unlike the pelvis, the skull alone is not very reliable, between

UNCORRECTED PROOF

AUTHOR'S PROOF!
JnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

62 and 92% (White and Folkens 2005: p. 387), which leads to a higher probability of wrongly sexing an individual. Beyond morphological methods, the molecular analysis of the X and Y chromosomes is, to date, the most accurate technique for sexing individuals, at over 99%, when the sample is well preserved (Stone et al. 1996).

Regarding the morphological methods, which are by far the most common, there are several problems when trying to assign the male or female sex. Firstly, there are inherent difficulties when sexing adolescents or those individuals who were about to enter adulthood. During this stage, the three elements of the hip bone may be fussed; therefore, the same method based on the morphology of the pelvis used for adults can be applied. However, young growing bones can be wrongly identified as feminine. Something similar happens with the morphology of a young skull, which is easily mistaken for a feminine one (González Martín 2008: p. 63). This fact is taken into account by physical anthropologists, and as a common precaution, they tend to classify those individuals within the undetermined group, and only when the traits are clearly masculine are they classified as men. In our sample, sex ratio favor males whether we consider all individuals or exclusively adult individuals. On the other hand, the opposite situation should be taken into account, when young masculine individuals are wrongly sexed as women. A clear example was detected at the Copper Age site of Camino de las Yeseras (Madrid), one of the few places with a higher frequency of women than men. The molecular analysis of X and Y chromosomes (Olalde et al. 2019: supplementary data, table S1) has enabled researchers to sex a 12-year-old individual as masculine who was previously osteologically identified as a woman (Gómez Pérez et al. 2011: p. 104).

Methodological problems are also found in other stages of life besides the young individuals. A systematic, regular bias of 12% benefiting men was already demonstrated in a classic work (Weiss 1972) when assigning sex in adult skeletons. This bias was caused by the application of methods based on secondary sex characteristics in prehistoric populations in which the preservation of the pelvis is usually worse than the skull. Meindl et al. (1985) reached a similar conclusion with a blind test that demonstrated a tendency to wrongly classified masculine individuals (1985: p. 81). Consequently, the authors suggested that only adult individuals with well-preserved pelvises should be sexed (Meindl et al. 1985: p. 84). More than a decade later, Konigsberg and Hens (1998) also indicated the presence of a more frequent misclassification of males than females. In the publication of Alto del Reinoso, a Neolithic round barrow included in this study, the researchers mentioned explicitly that "it is worth noting that sex determination based solely on crania, without taking into account the pelvis results in an imbalance in the sexes" (Alt et al. 2016: p. 9). Additionally, the osteological methods applied for the pelvis are mostly based on the presence/absence (masculine/feminine) of certain traits, and it has been demonstrated that it is easier to detect a clear absence than an ambiguous or poorly defined presence (Rascón 2017: p. 181). Q12

The Neolithic sites of Bòbila Madurell and Can Gambús can give a clear example. As previously mentioned, two anthropological analyses were made by two different researchers (the results of both works can be found in Alliès 2016: Anexo 34–37). According to Alliès (2016), as shown in Table 2, the osteological collection of Bòbila Madurell was composed of 140 individuals, of which 61 adults were of undetermined sex and in Can Gambús 42 out of 57 were assigned to that group. However, in another study, previously carried out (Roig Buxo et al. 2010; Ruiz et al. 2010) and used by other researchers (Fontanals-Coll et al. 2015), a greater number of individuals were sexed. In particular, within the group of individuals classified by Alliès as undetermined (2016: p. 228), 12 women and 39 men were identified, which means twice as many men as women.

Something similar happened with the "reassessment of demographic estimates for Pecos Pueblo" (Ruff 1981), which examined a new study of the osteological collection of 101 individuals from Pecos Pueblo (México) 50 years after the first anthropological report (Hooton 1930). As a result, 38 of the 40 individuals classified by Hooton as feminine were confirmed by Ruff and the other two were identified as men, which is not a substantial difference. However, only 49 of the 61 individuals classified as men by Hooton were

UNCORRECTED PROOF

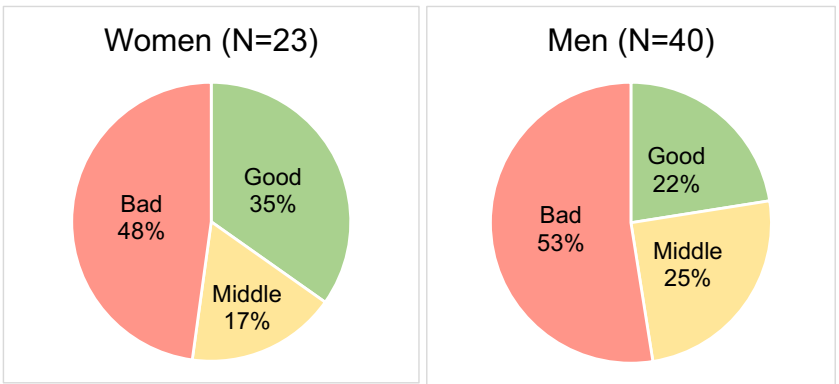

Fig. 5 Preservation of female (left) or male (right) remains

AUTHOR'S PROOF!

confirmed by Ruff, who identified the remaining 12 as women. In this sense, we went from 61 men and 40 women in the first approach (Hooton) to 51 men and 50 women (Ruff) showing a clear tendency to overestimate male individuals. As the methods used by both researchers were similar, Ruff suggests that the differences lie "in subjective judgment rather than in specific forensic techniques" (Ruff 1981: p. 150).

Considering that there is a period of 50 years between the two studies, it can be argued that those methodological biases have been corrected. However, the examples of Bòbila Madurell and Can Gambús and the data presented in this study suggest that this problem is by no means behind us as we continue to uncover biases in research methods. Questioning assumptions and results is still required (Milner et al. 2018: p. 608).

Biological factors

A third option to explain the bias in favor of men is differential preservation. This hypothesis suggests that female individuals would have been preserved in a worse condition than men in archeological contexts. Although studies based on bone differential preservation are not very common, in the research of several sites from different areas and distinct chronological periods (Stojanowski et al. 2002; Walker et al. 1988), no significant differences in the preservation between men and women have been detected.

To verify this hypothesis, we analyzed the preservation of the individuals buried in the III–II millenia B.C. site of Humanejos ($n = 146$) (Madrid), one of the sites included in the previously mentioned regional study (Herrero-Corral 2019). The collection is comprised of 23 F/F?, 40 M/M?, 31 UND, and 52 NAD (of unknown sex). To evaluate the state of preservation, we used a method (modified from Rascón et al. 2011), which takes into account both the number of anatomical units preserved and the quality of the bone. The skeletons can then be classified in three groups from 1, the best preservation condition, to 3, the worst preservation condition. The results (Fig. 5) show, as we would expect, that the better the preservation, the easier it is to sex the individual. On the other hand, no differential preservation was detected between men and women, in fact, a higher number of women were classified within group 1 (35% versus 22.5% for men), and in contrast, more men (52.5%) were labeled as group 3, the worst preserved.

Conclusions

Sex ratio is a crucial indicator to detect eventual differences or inequalities between men and women in a certain group. High sex ratios could be related, with some exceptions, to discrimination against women. The results presented in this study show a clear predomination of men in osteological contexts between the 8th and the 3rd millennia cal. B.C. in Iberia. In light of this unquestionable majority of masculine individuals in the archeological record, the question that must be answered is *where are the missing prehistoric women?*

Without completely excluding the differential funerary treatment received by some women, it is difficult to deny the existence of a methodological problem, which causes women to not be identified as such. The effectiveness of the sex ratio parameter relies directly on the reliability of the osteological methods used to identify sex. The assignation of the human remains to the categories of "man" and "woman" is crucial for any demographic, social, economic, political, or gender approach. It is therefore essential to consider the tendency towards sexual determination of a greater number of men than women before conducting any social analysis; otherwise, the conclusions reached will be questionable. In addition, a thorough review of anthropological methods would be advisable to solve this problem.

UNCORRECTED PROOF

References

Aliaga Almela R (2012) Sociedad y mundo funerario en el III y II milenio a.C. en la región del Jarama. Ph.D. Dissertation, Universidad Autónoma de Madrid. https://repositorio.uam.es/handle/10486/660395

Alliès F (2016) Les sépultures de la Bòbila Madurell-Can Gambús (Vallès occidental). Éclairages sur les pratiques funéraires du nord-est de la péninsule Ibérique à la fin du Ve et au début du IVe millénaire. Ph.D. Dissertation, Université Paris 1 Panthéon-Sorbonne and Universitat Autònoma de Barcelona. https://ddd.uab.cat/record/176063

Alt K W, Zesch S, Garrido Pena R, Knipper C, Szécsényi-Nagy A, Roth C, Tejedor Rodríguez C, Held P, García Martínez de Lagrán Í, Navitainuck D, Arcusa Magallón H, Rojo Guerra MÁ (2016) A community in life and death: the Late Neolithic megalithic tomb at Alto de Reinoso (Burgos, Spain). PLoS One 11(1):1–32

Arnold K, Gilchrist R, Graves P, Taylor S (1988) Women in archaeology. Archaeological Review from Cambridge7 (1): 2-8

Bertelsen R, Lillehammer A, Naess JR (eds.) (1987) Were They All Men? An Examination of Sex Roles in Prehistoric Society. Acts from a workshop held at Ulstein Kloster, Rogaland, November 2-4, 1979. Arkeologisk Museum i Satavanger, 1997, Stavanger

Binford LR (1962) Archaeology as anthropology. Am Antiq 28(2):217–225

Binford LR (1971) Mortuary practices: their study and their potential. Memoirs of the Society for American Archaeology 25:6–29

Bishop NA, Knüsel CJ (2005) A palaeodemographic investigation of warfare in prehistory. In: Parker Pearson M, Thorpe IJN (eds) Warfare. Violence and Slavery in Prehistory, BAR International Series, Oxford, pp 201–216

Brown JA (1981) The search for rank in prehistoric burials. In: Chapman R, Kinnes I, Randsborg K (eds) The archaeology of death. Cambridge University Press, Cambridge, pp 25–37

Bruzek J (2002) A method for visual determination of sex, using the human hip bone. Am J Phys Anthropol 117:157–168

AUTHOR'S PROOF!
JnlID 12520_ArtID 1215_Proof# 1 - 09/10/2020

Buikstra JE, Ubelaker DH (1994) Standards for data collection from human skeletal remains. Proceedings of a seminar at the Field Museum of natural history. Arkansas Archeological Survey Research Series, Falleteville

Chamberlain AT (2006) Demography in archaeology. Cambridge University Press, Cambridge

Cintas-Peña M (2020) La Desigualdad de Género en la Prehistoria de la Península Ibérica: Una Aproximación Multi-Variable. BAR International Series, Oxford

Clarke D (1968) Analytical archaeology. Methuen, New York

Coale AJ, Banister J (1994) Five decades of missing females in China. Demography 31(3):459–479

Conkey MW, Spector JD (1984) Archaeology and the study of gender. Adv Archaeol Method Theory 7:1–38

Delibes de Castro G (1995) Ritos funerarios, demografía y estructura social entre las comunidades neolíticas de la Submeseta Norte. In: Fernández Ibáñez C, Pérez Losada F, Fábregas Valcarce R (coord) Arqueoloxía Da Morte: Arqueoloxía da Morte na península Ibérica desde as orixes ata o medievo*:* Proceedings of the curso de verán da Universidade de Vigo. Concello de Xinzo de Limia, Vigo, pp 61–94

Díaz-Zorita Bonilla M (2017) The Copper Age in south-west Spain: a bioarchaeological approach to prehistoric social organisation. BAR International Series, Oxford

Ehrenberg M (1989) Women in prehistory. University of Oklahoma Press, Oklahoma City

Etxeberria Gabilondo F, Herrasti Erlogorri L (2007) Los restos humanos del enterramiento de SJAPL: caracterización de la muestra, tafonomía, paleodemografía y paleopatología. In Vegas Aramburu J (ed) San Juan Ante Portam Latinam: una inhumación colectiva prehistórica en el valle medio del Ebro: memoria de las excavaciones arqueológicas, 1985, 1990 y 1991. Diputación Foral de Álava, Vitoria, pp. 159–282

Fabián García JF (2006) El IV y III milenio a.C. en el Valle de Amblés (Ávila*)*. Junta de Castilla y León. Consejería de Cultura y Turismo, Salamanca

Ferembach D, Schwidetzky I, Stloukal M (1980) Recommendations for age and sex diagnoses of skeletons. J Hum Evol 9:517–549

Fernández-Crespo T, de-la-Rúa-Vaca C (2015) Demographic evidence of selective burial in megalithic graves of northern Spain. J Archaeol Sci 53:604–617

Fernández-Crespo T, de-la-Rúa Vaca C (2016) Demographic differences between funerary caves and megalithic graves of northern Spanish Late Neolithic/Early Chalcolithic. Am J Phys Anthropol 160:284–297

Fontanals-Coll M, Subirà i de Galdàcano ME, Díaz-Zorita Bonilla M, Duboscq S, Gibaja Bao JF (2015) Investigating palaeodietary and social differences between two differentiated sectors of a Neolithic community, La Bòbila Madurell-Can Gambús (north-east Iberian Peninsula). J Archaeol Sci 3:160–170

Gero JM, Conkey MW (eds) (1991) Engendering archaeology. Women in Prehistory. Blackwell, Oxford

Gilmoto ChZ (2012) Sex imbalances at birth. Current trends, consequences and policy implications. UNFPA Asia and Pacific Regional Office, Bangkok

Gómez Pérez JL, Blasco Bosqued C, Trancho Gayo G, Ríos Mendoza P, Grueso Domínguez I, Martínez-Ávila MS (2011) Los protagonistas. In Blasco Bosqued C, Liesau von Lettow-Vorbeck C, Ríos Mendoza P (eds) Yacimientos Calcolíticos con Campaniforme de la Región de Madrid. Universidad Autónoma de Madrid, Madrid, pp. 101–132

Gómez Vázquez E (2014) Diferenciación sexual y de edad en los contextos funerarios campaniformes: los recientes hallazgos en la Comunidad de Madrid. In: Proceedings IX jornadas de Patrimonio Arqueológico en la Comunidad de Madrid. Comunidad de Madrid, Madrid, pp 169–174

González Martín A (2008) Mitos y realidades en torno a la excavación, el tratamiento y el estudio de los restos arqueológicos no-adultos. In: Gusi F, Muriel S, Olaria C (coords) Nasciturus, infans, puerulus vobis mater terra: la muerte en la infancia. Diputació de Castelló, Servei d'Investigacions Arqueològiques i Prehistòriques, Castellón, pp 57-76

González Wagner C, Peña V, Ruiz Cabrero LA (1996) La mortalidad infantil en el mundo antiguo: causas biopatológicas y conductas culturalmente pautadas. Consideraciones a propósito del debate sobre la incidencia del infanticidio. In: Villalín Blanco JD, Gómez Bellard C, Gómez Bellard F (eds) Proceedings II Congreso Nacional de Paleopatología, Valencia, pp 63-68

Gusinde M (1982) Los indios de Tierra del Fuego. Centro Argentino de Etnología Americana, Buenos Aires

Harris M (2009) Vacas, cerdos, guerras y brujas. Alianza Editorial, Barcelona

Harris M, Ross EB (1999) Muerte, sexo y fecundidad. La regulación demográfica en las sociedades preindustriales y en desarrollo. Alianza Editorial, Barcelona

Harrison D (2019) Investigations in sex estimation. Academic Press, An Analysis of Methods Used for Assessment

Herrero-Corral AM (2019) Enterramientos infantiles de la Prehistoria reciente en el interior peninsular: un estudio bioantropológico y arqueológico. Ph.D. Dissertation, Universidad Complutense de Madrid

Hewlett BS (1991) Demography and childcare in preindustrial societies. J Anthropol Res 47(1):1–37

Hobbs F (2004) Age and sex composition. In: Siegel JS, Swanson DA (eds) The methods and materials of demography, 2nd edn. Elsevier Academic Press, California, pp 125–173

Hooton EA (1930) The Indians of Pecos Pueblo. A study of their skeletal remains. Papers of the Phillips Academy Southwestern Expedition n° 4. Yale University Press, New Haven

Irurita J, Alemán I (2016) Validation of the sex estimation method elaborated by Schutkowski in the Granada Osteological Collection of identified infant and young children: analysis of the controversy between the different ways of analyzing and interpreting the results. Int J Legal Med 130(6):1623–1632

Klasen S, Wink C (2003) "Missing women": revisiting the debate. Fem Econ 9(2–3): 263–299, 263

Konigsberg LW, Hens SM (1998) Use of ordinal categorical variables in skeletal assessment of sex from the cranium. Am J Phys Anthropol 107:97–112

Krogman WM (1962) The human skeleton in forensic medicine. Springfield, IL: Charles C. Thomas.Lloyd Warner W (1937) A black civilization. A Social Study of an Australian Tribe. Harper & Brothers Publishers, New York and London

Mays S, Cox M (2000) Sex determination in skeletal remains. In: Cox M, Mays S (eds) Human osteology in archeological and forensic science. Greenwich Medical Media Ltd, London, pp 117–130

Meindl RS, Lovejoy CO, Mensforth RP, Don Carlos L (1985) Accuracy and direction of error in the sexing of the skeleton: implications for paleodemography. Am J Phys Anthropol 68:79–85

Milner GR, Wood JW, Boldsen JL (2018) Paleodemography: problems, progress, and potential. In: Grauer AL (ed) Katzenberg A. Biological Anthropology of the Human Skeleton, Wiley-Blackwell, pp 593–633

Nicklisch N, Uerpmann A, Alt KW (2005) Estudio de los restos humanos neolíticos de la tumba de La Sima, Miño de Medinaceli. In: Rojo Guerra MA, Kunst M, Garrido Pena R, García Martínez de Lagrán Í, Morán Dauchez G (eds) Un desafío a la Eternidad: Tumbas monumentales del Valle de Ambrona (Soria, España). Consejería de Educación y Cultura de la Junta de Castilla y León, Valladolid, pp 323–339

Nielsen A, Galán J, Martínez R (2010) Estudio antropológico de la necrópolis "Huerta Montero" perteneciente a la tumba calcolítica

UNCORRECTED PROOF

AUTHOR'S PROOF!

excavada en Almendralejo (Badajoz). In: Gutiérrez Redomero E, Sánchez Andrés Á, Galera Olmo V (eds) Diversidad humana y antropología aplicada. Universidad de Alcalá, Madrid, pp. 539–548

Olalde I et al (2019) The genetic history of the Iberian Peninsula over the last 8000 years. Science 363:1230–1234

Palomo Díez S (2015) Caracterización genética de las poblaciones de las Edades del Cobre y del Bronce de la submeseta norte de la Península Ibérica. PhD. Dissertation, Universidad Complutense de Madrid. http://eprints.ucm.es/34256/

Pecero Espín JC (2016) Caracterización antropológica de los restos óseos humanos del *tholos* de Montelirio. In: Fernández Flores Á, García Sanjuán L, Díaz-Zorita Bonilla M (eds) Montelirio. Un gran monumento megalítico de la Edad del Cobre. Junta de Andalucía. Consejería de Cultura, Sevilla, pp. 409–442

Pérez Villa A (2014) Prácticas funerarias de la Edad del Bronce en la cuenca media-alta del Tajo. Ph.D. Dissertation, Universidad Nacional de Educación a Distancia

Peyroteo Stjerna R (2016) Death in the Mesolithic or the mortuary practices of the last hunter-gatherers of the South-Western Iberian Peninsula, 7th-6th Millennium BCE. Dissertation, Uppsala Universitet, Ph.D http://uu.diva-portal.org/smash/record.jsf?pid=diva2%3A892353&dswid=6457

Rascón J, Cambra-Moo O, Pimentel G, González A, Campo M (2011) Influencia del estado de preservación de los restos óseos en el diagnóstico paleopatológico. Proceedings X Congreso de Paleopatología Nacional, Madrid, In, pp 45–59

Rascón J (2017) Análisis de las diferencias sexuales en la morfología del esqueleto y de la distribución de caracteres de interés relacionados con el sexo. Ph.D. Dissertation, Universidad Autónoma de Madrid. https://repositorio.uam.es/handle/10486/680138

Renfrew C (1973) Before civilisation: the radiocarbon revolution and prehistoric Europe. Jonathan Cape, London

Roig Buxo J, Coll JM, Gibaja Bao JF, Chambon P, Villar V, Ruiz J, Terradas X, Subirà ME (2010) La necrópolis de Can Gambús-1 (Sabadell, Barcelona). Nuevos conocimientos sobre las prácticas funerarias durante el Neolítico medio en el Noreste de la Península Ibérica. Trab Prehist 67(1):59–84

Rojo Guerra MÁ, Garrido Pena R, Morán Dauchez G, García-Martínez de Lagrán I, Kunst M (2005) Del enterramiento colectivo a la tumba individual: el sepulcro de La Sima en Miño de Medinaceli, Soria, España BSAA Arqueología: Boletín del Seminario de Estudios de Arqueología:11–42

Ruiz J, Villar V, Subirà i de Galdàcano ME (2010) La población Neolítica de sepulcros de fosa de Can Gambús 1 (Sabadell). In: Gutiérrez Redomero E, Sánchez Andrés Á, Olmo Galera V (eds) Diversidad humana y antropología aplicada. Universidad de Alcalá, Madrid, pp 593–602

Ruff CB (1981) A reassessment of demographic estimates for Pecos Pueblo. Am J Phys Anthropol 54(1):147–151

Sen A (1990) More than 100 million women are missing. The New York Review of Books, December 2. https://www.nybooks.com/articles/1990/12/20/more-than-100-million-women-are-missing/

Schiffer MB (1987) Formation processes of the archaeological record. University of New Mexico Press, Alburquerque

Sieff DF, Betzig L, Cronk L, Fix AG, Flinn M, Sattenspiel L, Gibson K, Herring DA, Howell N, Johansson SR, Pavlík Z, Sheets JW, Smith EA, Voland E, Siegelkow E (1990) Explaining biased sex ratios in human populations: a critique of recent studies [and comments and reply]. Curr Anthropol 31(1):25–48

Silva AM (2002) Antropologia funeraria e paleobiologia das populaçoes portuguesas (litorais) do Neolitico final/Calcolitico. Dissertation, Universidade de Coimbra, Ph.D

Silva AM (2003) Portuguese populations of late Neolithic and chalcolithic periods exhumed from collective burials: an overview. Anthropologie 41(1–2):55–64

Stig Sorensen ML (2000) Gender Archaeology. Blackwell

Stone AC, Milner GR, Paabo S, Stoneking M (1996) Sex determination of ancient human skeletons using DNA. Am J Phys Anthropol 99:231–238

Stojanowski CM, Seidemann RM, Doran GH (2002) Differential skeletal preservation at Windover Pond: causes and consequences. Am J Phys Anthropol 119(1):15–26

Vegas Aramburu JI (2014) Testimonios de violencia a finales del Neolítico. El abrigo de San Juan ante Portam Latinam. In: Guerra Doce E, Fernández Manzano J (eds) La muerte en la prehistoria ibérica: casos de estudio. Universidad de Valladolid, Valladolid, pp 77–104

Walker PL, Johnson JR, Lambert PM (1988) Age and sex biases in the preservation of human remains. Am J Phys Anthropol 76(2):183–188

Weiss KM (1972) On systematic bias in skeletal sexing. Am J Phys Anthropol 37:239–2350

White TD, Folkens PA (2005) The human bone manual. Elsevier Academic Press, USA

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

UNCORRECTED PROOF

AUTHOR'S PROOF!

AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES.

Q1. Please check the captured title if presented correctly.
Q2. Please check if the affiliations are presented correctly.
Q3. The citation “Ehrenberg” has been changed to “Ehrenberg, 1989” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.
Q4. Ref. "Sorensen 2000" is cited in the body but its bibliographic information is missing. Kindly provide its bibliographic information in the list.
Q5. Ref. "Page et al. 2019" is cited in the body but its bibliographic information is missing. Kindly provide its bibliographic information in the list.
Q6. The shaded emphasis found in the tables were set to italics. Please check if this is correct.
Q7. Ref. "Grünberg 2000" is cited in the body but its bibliographic information is missing. Kindly provide its bibliographic information in the list.
Q8. The citation “Fernández Crespo y De-la-Rúa 2015” has been changed to “Fernández-Crespo and de-la-Rúa-Vaca, 2015” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.
Q9. Ref. "Herrero -Corral 2019" is cited in the body but its bibliographic information is missing. Kindly provide its bibliographic information in the list.
Q10. Ref. "Velasco Vázquez 2005" is cited in the body but its bibliographic information is missing. Kindly provide its bibliographic information in the list.
Q11. The citation “Krogman, 1986” has been changed to “Krogman, 1962” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.
Q12. The citation “Rascón 2011” has been changed to “Rascón, 2017” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.
Q13. The citation “Milner et al., 2019” has been changed to “Milner et al., 2018” to match the author name/date in the reference list. Please check if the change is fine in this occurrence and modify the subsequent occurrences, if necessary.
Q14. References [Aliaga Almela, 2012, Brown, 1981, Bruzek, 2002, Gómez Vázquez, 2014, González Wagner et al, 1996, Gusinde, 1982, Harris, 2009, Harris & Ross, 1999, Irurita & Alemán, 2016, Nicklisch et al, 2005, Nielsen et al, 2010, Palomo Díez, 2015, Pecero Espín, 2016, Pérez Villa, 2014, Stig Sorensen, 2000] were provided in the reference list; however, this was not mentioned or cited in the manuscript. As a rule, all references given in the list of references should be cited in the main body. Please provide its citation in the body text.

UNCORRECTED PROOF