WEIGHT REFERENCES FOR BURNED HUMAN SKELETAL REMAINS FROM PORTUGUESE SAMPLES[1]

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Abstract

Weight is often one of the few recoverable data when analyzing human cremains but references are still rare, especially for European populations. Mean weights for skeletal remains were thus documented for Portuguese modern cremations of both recently deceased individuals and dry skeletons and the effect of age, sex and the intensity of combustion was investigated using both multivariate and univariate statistics.

The cremains from fresh cadavers were significantly heavier than the ones from dry skeletons regardless of sex and age cohort ($p < .001$ to $p = .003$). As expected, males were heavier than females and age had a powerful effect in female skeletal weight. The effect of the intensity of combustion in cremains weight was unclear.

These weight references may, in some cases, help estimating the minimum number of individuals, the completeness of the skeletal assemblage and the sex of an unknown individual.

Keywords: forensic science; forensic anthropology; cremation; heat-induced changes; skeletal weights; burned bones.

The bioanthropological analysis of burned skeletal remains raises important analytical problems because of their highly fragmentary nature. Anatomical identification of every bone and tooth fragment is hardly possible and reconstruction of each element is thus even less feasible. As a result, the assessment of the degree of completeness of the burned skeleton or of eventual commingling based on the amount of each bone is problematic. In contrast, weight is a parameter that does not change as a result of fragmentation and is therefore more useful when examining burned bones (1). In addition, skeletal weights have also been used to aid in the estimation of the minimum number of individuals and in the sex determination although such procedures are only reliable in a few cases (2-4). Nonetheless, bioanthropologists have often relied on skeletal weights in order to complement other data resulting from more conventional osteological approaches or whenever these are prevented by the poor preservation of the remains (2,5-9). However, the burned skeleton is often incomplete so investigations merely based on weight may lead to inaccuracies, particularly when dealing with archaeological contexts. In addition, even if the whole remains are present, reliable inferences are only possible if trustworthy weight references are available. Such references are almost non-existent for contemporary European populations with the exception of the research carried out on a small sample by McKinley (10).

Weight references from samples of unburned skeletons such as those from Lowrance and Latimer (11) or Silva et al (12) cannot be extrapolated to burned skeletons due to heat-induced skeletal weight reduction. The loss of bone weight occurs mainly during the dehydration and decomposition stages of heat-induced transformation. Its key features are the loss of the water and organic components of bone (13,14). Weight loss ranging from 17% - in archaeological bone (15) – to 60% – in fresh bone – has been recorded experimentally (13,16-

18). This previous research indicated that major heat-induced weight reduction usually occurs at somewhat low intensity burnings (< 450º C). In addition, slight heat-induced shrinkage accompanies the loss of weight although this particular alteration is more pronounced at higher temperatures (19).

The literature includes only a few studies regarding the documentation of skeletal weights from burned remains (Table 1). The first studies seem to have been carried out in Europe by Malinowski and Porawski (20) on a Polish sample, by Herrmann (21) on a German sample and by McKinley (10) on a small British sample. The first two investigations took place more than 30 years ago. The size of the sample is unknown for the Polish sample and the German one was different from all others in one aspect – it presented no significant sexual dimorphism. European populations thus lack references in contrast to the United States (1,22-24) and Thailand (25) where recent studies have been carried out.

[Insert Table 1 here]

The present investigation aimed to document the weight of burned skeletons for a European sample and to investigate some factors that are potentially associated with heat-induced weight loss. To fulfill this objective, the weight of skeletal remains resulting from contemporary cremations of Portuguese individuals has been recorded. Such assessment can allow for inferences regarding the post-mortem handling of the remains regardless of this being carried out in forensic contexts – possibly involving foul play – or in archaeological contexts concerning the funerary practice.

Material and Methods

The investigation took place in a civil modern crematorium with permission being granted by the municipal authorities of Porto (Portugal) after its legal department approved our request. Cremations were carried out using a Diamond Mark III gas-fuelled cremator built by J. G. Shelton (U.K.). Those were monitored by the technicians at all times in order to adjust the combustion protocol according to the specificities of each cadaver.

The analysis started in 2008 and was carried out on two different samples of individuals – mainly from Porto – until the beginning of 2011 (Table 2). The first one was composed of 116 adult individuals – designated as cadavers – which were usually cremated within 48 hours after death. The cadavers were always burned on wooden coffins and wearing garments. The second sample included 88 skeletons of adult individuals that had been previously inhumed for at least five years before exhumation and subsequent cremation. In the latter case, cremation was then adopted as a secondary practice on dry bones. For that purpose, the complete skeleton was placed inside a wooden box. The mean inhumation period was of 16.3 years (sd = 15.8).

[Insert Table 2 here]

The sample of cadavers included 51 females with a mean age of 74.5 years-old (sd = 15.1; min.: 41; max.: 97) and 65 males with a mean age of 68.6 years-old (sd = 14.8; min.: 34; max.: 93). The sample of skeletons was composed of 49 females and 39 males. The age-at-death was known for only 25 females and the mean was of 72.6 years-old (sd = 14.5; min.: 46; max.: 99). As for male skeletons, the age-at-death was known for only 21 individuals and the mean age was of 67.3 years-old (sd = 17.9; min.: 23; max.: 92). Age-at-death was not known for a considerable part of the skeletons because this had not been recorded by the cemeterial records. For some individuals, this information was however successfully obtained at the Civil Records Department (Instituto dos Registos e Notariado). The skeletons without known age-at-death were nonetheless included in the sample in order to enlarge it.

After the wooden containers were consumed by fire, the time spent on the burning of the soft tissues of the cadavers took about 60 minutes but the duration of this process was quite variable and usually ranged from 30 to 120 minutes. This variation was related to several factors such as the kind of wood of the container for the human remains and the combustion protocol or the idiosyncrasies of each individual. In addition, the thickness and distribution of insulative skin, body mass and muscles have been reported to influence the length of the cremation (23, 26,27). Whereas the overall duration of the cremations of cadavers varied between 60 and 180 minutes, this was shorter in the case of the skeletons and ranged between 15 and 105 minutes, certainly due to the absence of soft tissues. For some cases, the last cremation of the day was scheduled for delivery only in the next day, so after a brief period of active burning, the cremator was switched off and the remains were left in the chamber overnight thus taking advantage of the heat that had been previously accumulated. This was sufficient to lead to the calcination of the skeletal remains. Therefore, these cases were not included in the report of the previously mentioned length of combustion. The maximum temperature of combustion was also recorded for each cremation in 25º C increments. For the cadavers, this varied between 750º C and 1050º C while the same ranged between 450º C and 950º C for the skeletons.

After each cremation was completed, the bones were left in the cremator to cool down until their retrieval. Additional cooling down took place outside the cremator as well. All non-human residues – such as charcoal, metal and plastic – were removed from the cremains. The remains were then sieved by using a 2 mm mesh following the procedure adopted by

McKinley (10). This was done in order to separate the residues of unknown origin – mainly composed of charcoals from the coffin and of clay residues from the degraded coating of the cremator – from larger and obvious human bone fragments. In addition, McKinley (10) proposed that this procedure makes the > 2 mm fraction more comparable to archaeological cremations. However, this process led to small human bone fragments being put aside as well. In order to avoid the discard of any human remains, the < 2 mm fraction was re-united with the > 2 mm fraction after weighing and then the grinding of the complete remains was carried out. The weight of both fractions was recorded to the tenth of a gram.

Multiple regression analysis was used to investigate the functional relationships between some factors – sex, age, duration and maximum temperature of combustion – and skeletal weight. Age and maximum temperature were investigated as ratio scaled variables while sex was used as a dichotomous variable (male; not male) and duration of combustion was divided into three separate groups on the sample of cadavers (60-100 minutes; 101-200 minutes; overnight cremations) and the sample of skeletons (15-25 minutes; 26-120 minutes; overnight cremations). Additional tests were used to investigate both the significant differences between groups – Pearson Chi Square, t-test, Mann-Whitney and the one-way ANOVA – and the significant correlations between variables – Pearson bivariate statistics. The statistical exploration of the data was done by using the SPSS software, version 17.0 (SPSS Inc., Chicago, IL).

Results

A statistically significant difference was found between the mean skeletal weights of cadavers and skeletons regardless of sex or age (Table 3). Cadavers systematically presented heavier cremains than skeletons regarding the skeletal weight excluding the 2 mm fraction. As a result, both samples were investigated separately.

[Insert Table 3 here]

The results for the skeletal weights of cadavers are presented in table 4. Males were heavier than females. In order to investigate the effect of the recorded variables in skeletal weight, multiple regression analysis was used. The model was statistically significant [F (4, 116) = 33.86; p < .001] and explained for 53.3% of the variation observed in skeletal weight. In contrast to age (p = .004), sex (p < .001) and to duration of combustion (p = .026), the maximum temperature of combustion had no significant effect in the variation of skeletal weight (p = .145). Further investigation of the significant variables demonstrated that mean weights were significantly different between females and males (t = -10.401; df = 114; p < .001; d = 1.98). Weight variation according to age for both sexes was investigated through linear regression. In the case of females, the relationship was significant at the 0.5 level [F (1, 49) = 6.87; p = .012] but only explained for 10.5% of the variation. No such significance was found for males [F (1, 63) = 3.58; p = .063]. Therefore, this means that the significant effect of age on weight was restricted to the female sample. In order to provide with more useful data, descriptive statistics are presented in table 4 according to an age break point at 70 years-old. This was chosen in order to allow for two well represented groups. Because the sample was very aged, a lower break point would have resulted in a very small sized younger group. As for duration of combustion, the one-way ANOVA did not find any significant difference at the .05 level although the female outcome came pretty close to it (Table 5). Games Howell *post hoc* tests did not detect any difference between the 3 levels of the duration of combustion on the female sample. Therefore the significant effect that had been detected with the multiple regression analysis was stronger when interacting with the remaining variables included in the regression model. These associations were not further investigated due to the small size of the sample.

[Insert Table 4 here]

[Insert Table 5 here]

The inclusion of the < 2 mm fraction in the skeletal weights led us to obtain the results given in Table 4. The inferential statistics carried out for these data provided for the same outcomes that were obtained by using the skeletal weights without the < 2 mm fraction. Males weighed significantly more than females (t = -9.038; df = 114; p < .001; d = 1.69) and the latter presented an almost significant difference between the two age cohorts (U = 163.0; p = .012; r = -.35). In contrast, the same significance was not found for the male sample (U = 384.0; p = .060).

The skeletal weights obtained for the sample of skeletons are presented in Table 6. The multiple regression obtained somewhat different results than the one previously obtained for the cadavers. Although the regression model was also statistically significant at the .01 level [F (3; 85) = 11.23; p < .001], it only explained for 26.8% of the variation in skeletal weight. In contrast to the duration (p = .521) and the maximum temperature of combustion (p = .686), sex had a significant effect in the skeletal weight (p < .001) - in fact, a t-test demonstrated later that females were significantly lighter than males (t = -6.192; df = 86; p < .001; d = 1.33). The regression model did not include age because this variable was unknown for a large amount of individuals. Nonetheless, a correlation test was carried out. The Pearson bivariate statistic detected a statistically significant negative correlation for females at the .05

level [r (24) = -.440; p = .032]. Therefore, skeletal weight decreased along with the increase of age. In contrast, no significant correlation was found for males[r (21) = -.255; p = .265].

Reproducing what had already been observed for the sample of cadavers, the skeletal weight including the < 2 mm fraction was significantly lower for females than for males (t = -5.05; df = 86; p < .001; d = 1.09).

[Insert Table 6 here]

Discussion and Conclusions

One interesting finding of this research was the significant difference between the skeletal weights from cadavers and the skeletal weights from skeletons. That difference was present regardless of sex and age cohort. Theoretically, regional differences do not explain it because both samples were drawn from the same population but chronological differences may be the cause for this because skeletons were inhumed for 16 years on average thus having most of them being buried during the 1990s. This means that physical changes may have taken place in the meanwhile which led to more recent Portuguese individuals to be heavier than their counterparts living at that time. Also, the comparison between cadavers and skeletons may have been inevitably biased because they are intrinsically different. Soft tissues offer some protection to the bones of cadavers against heat (27), so if the intensity of combustion has indeed a real significant effect on skeletal weight, this suggests that the fleshed cadavers are less susceptible to heat at least during the earlier stages of the combustion. Therefore, the weight differences could also have been the result of the contrasting pre-cremation conditions rather than being merely related to the combustion itself. However, we do not know if such pre-cremation conditions could actually lead to those differences. Given this result, eventual comparisons with our references for skeletal weight should be aware of the pre-cremation condition of the human remains – cadavers or skeletons – because these are significantly different.

The results also demonstrated that females were significantly lighter than males in both samples of cremated cadavers and skeletons, which is in accordance with expectations and other work (10,22-24,28). Age was also identified as having a significant influence in the variation of female skeletal weight. Younger women (≤70 years-old) were heavier than older ones (>70 years-old). This was possibly the result of osteoporosis which is age-related and more severe in post-menopausal women (29). A similar directional effect was found for the male sample but no statistical significance was present, at least at the .05 level, thus demonstrating that age-related loss of bone weight was not as substantial as was for females. This contrasted with the results obtained by other researchers that reported a similar effect for both females and males (10, 20,22, 25,28). The age composition of the sample of cadavers may have led to the dissimilar outcomes regarding the male sample. The Portuguese sample was quite aged and younger individuals were not sufficiently represented. In fact, only 12 individuals – seven of which were males – were less than 50 years-old and that led us to separate the age cohorts at 70 years-old in order to have large enough groups to allow for statistical analysis. In doing so, we ended up comparing old individuals against even older individuals rather than comparing young adults against old adults. This probably prevented the detection of a significant correlation of age on the skeletal weight of males, although one could also argue that other research also relied on quite aged samples. Therefore, our results should not be so contrasting. On the other hand, the age-related weight loss detected in females is in agreement to the known increasing bone loss that occurs during menopause as was argued by Bass and Jantz (22) in order to explain their own results.

Our investigation did not find a clear and direct association between the intensity of combustion and skeletal weight. Although the duration of combustion apparently had some effect on the cadavers when interacting with other variables – sex and age – no significant effect was found when investigated on its own. This indicated that the weight of cremains was not as affected by the length of the cremation as was by the other variables. As for the maximum temperature, no correlation was found. Once more, this was probably the result of the kind of sample that was chosen for this research. We recorded temperatures above 800º C for 98% of the cremations and this may have concealed any significant effect because we were not able to examine cremations from a larger spectrum of temperatures. The comparison with cremains burned at lower temperatures could have lead to different results, although some experimental burnings demonstrated that most weight loss takes place below 400º C (16-18). Nonetheless, a negative correlation between both variables has also been found on the same studies and our lacking of low-temperature cremations may have prevented us from obtaining the same result.

The comparison of our results with other European samples is problematic. Apparently, Malinowski and Porawski (20) documented cremains weight by adding the mean weight of all bone categories although they used different amounts of elements (e.g.: n♀ mandible = 35; n♀ scapula = 26). Taking this into consideration, our weighting procedure may not be entirely comparable to theirs. Their cremains weights were clearly lighter than our cadaver sample but are somewhat close to our skeleton sample with exclusion of the 2 mm fraction. In contrast, Herrmann (21) used large samples for his research (n = 393). The weighting procedure was not completely described but no sieving of the remains was reported. Nonetheless, our results are considerably different than the ones obtained by Herrmann because the German sample showed very little sexual dimorphism regarding skeletal weight which is also in contrast to all other reports. It is then possible that the compositions of the German and Portuguese samples are intrinsically different and therefore unsuitable for comparison. As for other reference data, The British sample along with Sonek's San Diego sample (7,22), the Florida sample (23) and the Thai sample were lighter than the Portuguese cadavers sample regardless of sex. The skeletons sample presented cremains weights more similar to those though. In contrast, the Tennessee (22) and the Chico (24) samples were heavier. The Portuguese sample presented a larger sexual dimorphism than the Thai and the British samples while the American samples were the most sexually dimorphic according to skeletal weight. In sum, a large variation can be found among all researches including the present one.

Beside age and sex, regional differences have also been pointed out as an explaining factor of that variation (22,24,28). The significance of the two first variables was demonstrated by our investigation. However, all investigations presented very aged samples so the variation of the results – for both females and males – is apparently not mainly related to differences in sample composition regarding the age of the individuals. This variation may eventually be partly due to physical differences between the populations under study. Stature and body mass index (BMI) have been debated as influential factors (22-25,28). The relation of both these variables with cremains weight is illustrated in Figure 1 for the Portuguese cadavers (30) as well as for the American (23,31), the British (32) and the Thai populations (25). These values refer to males older than 50 years-old and females older than 60 years-old because all samples were composed of older individuals. The exception was the Portuguese cadavers, for which mean BMI and stature values were taken from the overall working population (30). This was done because no anthropometric data of elders are available for the period of 2008-2011. No data for the Portuguese population living in the 1990s is available either so the cremains weight of skeletons was not included in Figure 1.

The values refer to the time at which each study took place (e.g.: mean BMI and mean stature reported for 2003 are given for the Tennessee population). In the case of the American samples, the values refer to each specific state because of inter-state variation. Those mean values refer to the population and not to the samples under study so there is no way of being sure that they are indeed applicable to the latter. Therefore, these are only approximate estimations and not the actual mean BMI and mean statures of the males over 50 and females over 60 years-old. The exceptions are the samples examined by Warren and Maples (23) and by Chirachariyavej (25) who have reported the stature and weight of the individuals composing their samples thus allowing for the direct calculation of the BMI.

Assuming that all values in Figure 1 are approximately correct, then the correlation between BMI, stature and cremains weight was not direct. Although the larger BMI and stature means of the Tennessee and Chico samples corresponded indeed to higher cremains weight, the association between these variables was not so clear in the other cases. As mentioned before, the Florida and Thai samples were the only ones for which direct BMI and stature means were available. Although correlation was as expected for males, the reverse scenario was observed on the female sample. The Florida sample presented larger BMI and stature than the Thai sample but resulted in lower weight cremations.

These observations suggest that sex, age and regional differences do not completely explain the observed variation in weight of skeletal remains. In fact, May (28) reported that age, sex and body mass only explain for 67% of the variation. Therefore, other factors must also be in play. The intensity of combustion may explain some of this variation. Although some association between duration of combustion and the variation in cremains weight was detected, maximum temperature apparently took no part in it. This may have happened because only high-temperature cremations were examined in this research. In addition, contrasting weighting procedures, different cremation procedures and the use of dissimilar wood containers may also be having a significant effect in the weight of burned skeletal remains. Actually, the latter factor has been previously suggested by Chiracharyavej et al (25). In sum, we cannot be absolutely certain that all weight references mentioned previously are entirely comparable.

Weight analyses are often the only workable data when dealing with burned skeletal remains due to the severe fragmentation usually present in this kind of material. In such cases, it may allow for some inferences regarding the completeness of skeletal remains, the identification of bone assemblages with more than one individual or even the sex determination of an individual. All these three parameters are closely related to each other when working with skeletal weights. This is so because the reliable interpretation of each one depends on the correct estimation of one or both the other parameters. If any of these can be obtained through an analysis other than the one based on skeletal weights, then the remaining parameters can be investigated by using the latter.

In the case of the completeness of the remains, any inference seems to be feasible only when done on the well-defined cremains from a single individual of known-sex. A very small weight points towards the scattering or deficient retrieval of the remains from the location where the burning took place. On the other hand, large weights are evocative of quite complete cremains. As for the identification of bone assemblages with more than one individual, this is carried out more accurately if the remains are from at least one known-sex individual because of sexual dimorphism in skeletal weight. Unusually heavy cremains are suggestive of the presence of more than one individual. However, the reverse scenario is not indicative of the presence of only one individual because commingling may still have occurred. Finally, any inference regarding sex determination should be based on the rather complete cremains from a single individual and be aware of the age-related differences as well as of the secular changes in skeletal weights. Heavier cremains are suggestive of the presence of a male. Again, the reverse scenario is not indicative of the presence of a female, especially if cremains are incomplete.

There are several conditions that must be met to obtain consistent information based on skeletal weights. Therefore, such an approach may often be impracticable to adopt. In addition, supplementary research is needed in order to better understand the considerable variation that has been recorded until now. Therefore, the analysis of skeletal weights should preferably be used to complement or to give support to other evidences obtained from the osteological examination. Despite the abovementioned limitations, the present research provides with weight references for the remains of both cadavers and skeletons from European individuals which are essential to carry out with analyses based on this kind of parameter.

FIG. 1 – Mean body mass index (BMI), mean stature and mean skeletal weight for cremated skeletons for the Portuguese, American, British and Thai samples.

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Table 1: Current weight references for burned human skeletal remains.

Author	Cremation Parameters		Females			Males		
	Temperature	Duration	gm	n	Age	gm	n	Age
Malinowski & Porawski (20)	± 1000º C	-	1540	-	45-65	2004	-	45-65
Herrmann (21)	-	-	1700	226	76.2	1842	167	72.8
McKinley (10) - no 2 mm fraction	-	-	1272	6	81.6	1862	9	77.3
McKinley (10) - with 2 mm fraction	-	-	1616	6	81.6	2284	9	77.3
Sonek (In Bass and Jantz [22])	-	-	1875	63	75.7	2801	76	64.1
Warren & Maples (23)	> 830º C	73-207'	1840	40	74.1	2893	51	66.3
Bass & Jantz (22)	871-982º C	120-180'	2350	155	70.7	3379	151	62.8
Chirachariyavej et al (25)	850-1200º C	60-90'	2120	55	73.3	2680	55	63.5
Van Deest et al (24)	871-927º C	120'	2238	363	76.1	3233	365	71.4

Table 2: Composition of the samples of cadavers and skeletons.

	Cadavers			Skeletons		
Age Cohort	Females	Males	Total	Females	Males	Total
20-29	0	0	0	0	1	1
30-39	0	3	3	0	1	1
40-49	5	4	9	2	1	3
50-59	4	10	14	1	4	5
60-69	8	15	23	1	3	4
70-79	8	14	22	8	6	14
80-89	22	17	39	10	2	12
90-99	4	2	6	2	3	5
Adults of unknown age	0	0	0	25	18	43
Total	51	65	116	49	39	88

Table 3: Descriptive and inferential statistics for the weights (gm) of the female and male samples according to the pre- cremation condition and to age cohort (< 2 mm fraction not included).

Age Cohorts	♀ ≤70		♀ >70		♂ ≤70		♂ >70	
Condition	Cadavers	Skeletons	Cadavers	Skeletons	Cadavers	Skeletons	Cadavers	Skeletons
n	17	5	34	20	34	11	31	10
Median	1894.8	1697.4	1585.1	1219.6	2466.5	1944.7	2353.2	1728.8
Range	1439.6	525.5	1353.5	1142.7	2318.6	1372.6	1774.8	1280.2
Mann-Whitney	-		132.0		57.0		57.0	
Sig.	-		.000		.001		.003	
Effect Size	-		r = .51		r = .51		r = .47	

Table 4: Descriptive statistics for the skeletal weights (gm) of cadavers according to sex and age cohorts.

		♀ ≤70	♀ >70	♀ Pooled	♂ ≤70	♂ >70	♂ Pooled
n		17	34	51	34	31	65
Mean	No < 2 mm fraction	1845.2	1556.0	1652.4	2520.5	2354.9	2441.5
	With < 2 mm fraction	2451.1	2114.5	2226.7	3146.1	2916.4	3036.5
Standard Deviation	No < 2 mm fraction	344.2	322.9	354.5	449.4	422.7	441.4
	With < 2 mm fraction	464.5	437.5	470.1	479.1	470.8	485.8
Median	No < 2 mm fraction	1894.8	1585.1	1658.0	2466.5	2353.2	2420.7
	With < 2 mm fraction	2507.5	2092.7	2207.7	3107.8	2940.4	2999.2
Range	No < 2 mm fraction	1439.6	1353.5	1496.3	2318.6	1774.8	2318.6
	With < 2 mm fraction	1950.7	1739.1	1956.5	2535.2	1965.5	2669.3
Minimum	No < 2 mm fraction	980.0	923.3	923.3	1486.7	1512.0	1486.7
	With < 2 mm fraction	1286.7	1280.9	1280.9	2036.0	1901.9	1901.9
Maximum	No < 2 mm fraction	2419.6	2276.8	2419.6	3805.3	3286.8	3805.3
	With < 2 mm fraction	3237.4	3020.0	3237.4	4571.2	3867.4	4571.2

Table 5: One-way ANOVA results for the skeletal weight (gm) of cadavers according to the duration of combustion.

	Duration of Combustion	n	Mean	Standard Deviation	95% Confidence Interval	F	df	Sig
Female	60-100’	17	1498.1	388.8	1298.2; 1698.9	3.096	2; 48	.054
	101-200’	19	1678.8	312.1	1528.4; 1829.2			
	Overnight	15	1793.8	315.6	1619.1; 1968.6			
Male	60-100’	23	2382.5	513.9	2160.3; 2604.7	.312	2; 62	.733
	101-200’	18	2471.1	442.8	2250.9; 2691.2			
	Overnight	24	2475.9	373.2	2318.3; 2633.5			

Table 6: Descriptive statistics for the skeletal weights (gm) of the sample of skeletons according to sex

	Without < 2 mm fraction		With < 2 mm fraction	
	Female	Males	Female	Males
n	49	39	49	39
Mean	1440.6	1967.4	1803.6	2313.5
Standard Deviation	395.5	397.6	497.1	435.6
Minimum	688.3	1245.1	856.9	1389.0
Maximum	2263.2	2644.1	2882.5	3160.4