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ORIGINAL PAPER

The Bell Beaker multiple burial pit of La Atalayuela (La Rioja, Spain): stable isotope insights into diet, identity and mortuary practices in Chalcolithic Iberia.

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Abstract

La Atalayuela is a Middle Chalcolithic (ca. 2900–2500 cal BC) multiple burial pit located in the mid-upper Ebro Valley (north-central Iberia) where a large number of individuals (more than 70) were inhumed. The site shows an apparently constrained period of funerary use, which includes the probable simultaneous burial of a large proportion of the deceased. This offers an outstanding opportunity to investigate the lifeways and identity of the members of what was presumably a single community living and interring their dead at the very beginnings of the Bell Beaker culture in the region. Here, we present stable carbon and nitrogen isotope values on bone collagen from 46 humans. While the overall results are consistent with diets focused on C_3 plants and terrestrial animal resources, as would be expected, the variability still demonstrates some interesting patterning. Thus, there is a significant differentiation in $\delta^{13}C$ values between burial context *base* (the earliest funerary use identified, interpreted as a 'house of the dead') and the following context *a2* (interpreted as a mass grave), supporting the existence of potentially distinct funerary uses. Remains from the *vestibule* (a structure to the south of the pit interpreted as entrance), whose carbon isotope values also differ from those of *a2*, have been tentatively associated with *base* and interpreted as a result of potential bone arrangements prior to the mass interment. Statistically significant age- and sex-related isotopic differences are also identified, which allow social insights, such as possible differential access by children and women to certain food sources, which may in turn reflect a possible sexual division of labour. The results are set in the context of other Late Prehistoric Iberian funerary and isotopic data.

Keywords Multiple pit grave · Diet · Funerary practices · Middle Chalcolithic · North-central Iberia

Introduction

For over a century, the presence in many regions of Europe of decorated Bell Beakers associated with weapons and personal ornaments, accompanying individual burials, has raised a series of questions regarding the origin, interpretation and possible significance of what is conventionally called 'the Beaker phenomenon' or 'the Beaker people'. There have been many proposals for its area of origin (the Iberian Peninsula, the Netherlands, Central Europe), and explanations of its spread over a whole continent (folk and/or élite migrations of people, objects and/or ideas). There is still no consensus (Gallay 2001: 52; Lemercier 2012). However, many recent studies support the Iberian Peninsula and Portugal in particular (Salanova 2000; Lemercier 2004) as serious candidates for the origin of the Beaker phenomenon as shown by the distribution of radiocarbon dates (Müller and van Willigen 2001) and by local sequences (Kunst 2001), and suggest that, rather than positing mass migration as the only process of Beaker expansion (Olalde et al. 2017), cultural transmission was also very significant (Parker Pearson et al. 2016).

Whatever the case, it seems clear that the possession of Bell Beaker items, often interpreted as prestige objects (Clarke 1976), would require social groups to form alliances and

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privileged relationships (Vander Linden 2007), involving the movement of people (e.g. warriors, chiefs, traders, craftspeople) and/or the exchange of goods (weapons, pottery, ornaments) and commodities (e.g. salt) (Guerra-Doce 2016). In this scenario, many authors suggest that Bell Beaker pottery may form part of rituals of hospitality, ceremonies and funeral banquets (symposia) amongst local and regional emerging elites and foreign people, where special foods and also alcohol were consumed (Sherratt 1987; Garrido-Pena 2007).

Food and drink are basic and continual human physiological needs, but they are also a condensed social fact embodying relations of production and exchange and linking the domestic and political economies, and a prime tool in the construction of social and economic identities and relationships (Hayden 1996; Dietler 2005). Despite the fact that food and drink served and consumed at feasts often differ from everyday products, their use as highly charged symbolic media of expression in an idealized representation of social order stresses the important role that foodstuffs played and indeed still play (Dietler 1996).

In this regard, the Middle Chalcolithic multiple pit grave of La Atalayuela (La Rioja, Spain) provides an ideal framework to investigate the diets, identities and social relationships of early Bell Beaker people. On the one hand, the large number of individuals inhumed (more than 70), including people of varying ages and both sexes, allows us to examine potential dietary differences among the population. On the other, the presumable existence of two periods of funerary use spanning the first half of the 3rd millennium cal BC, the earliest probably associated with the use of the site as a 'house of the dead' and attributed to the AOO (All Over Ornamented) Beaker, and the latest with a probably simultaneous multiple burial and geometric dotted Beaker ware, allows the investigation of possible diachronic trends in the subsistence strategies of this community.

The site

The multiple pit grave of La Atalayuela (Agoncillo, La Rioja) is located in the mid-upper Ebro Valley (north-central Iberia), at the top of a small Oligocene hill near the river, 425–435 m above sea level (Fig. 1). The site was fortuitously discovered after the Spanish Civil War (1936–1939) and may have been preserved intact until the late 1940s. This was followed by a series of uncontrolled digs and looting causing destruction of some areas of the grave, as well as the dismantling of almost the whole mound that originally covered the burial (Barandiarán 1973). Archaeological excavations undertaken in 1970 revealed the existence of a 5 m long by 2–3 m wide oval pit of shallow depth (40–45 cm), dug into a layer of fine clays (layer *b*) overlying a geological substratum of very compacted clays (layer *c*). Its walls were partially covered with flagstones and the clay floor was intentionally flattened. The structure and its contents (layer *a2*) would have been originally covered by a low mound (layer *a1*) (Fig. 2).

The pit held a large number of skeletons, many of them juxtaposed and superimposed, and interpreted as being simultaneously deposited (Barandiarán 1973; Barandiarán and Moreno 1976; Barandiarán1978). Associated with the burials were a limited number of grave goods, including a dozen barbed and tanged flint arrowheads, three double-pointed and square section copper awls, one V-shaped bone button, and one complete geometric dotted Beaker vessel, perhaps deposited as communal offering immediately before the closing of the grave (Andrés 1998: 122; Andrés and Barandiarán 2004: 98). The accumulation of skeletons, while usually consisting of three layers, was not uniform. The northwestern corner (strips 5 and 7), for example, held up to five or six superimposed bodies placed against its walls, as though there was insufficient space in this part of the tomb, yet it was preferred to other parts of the tomb (Andrés and Barandiarán 2004: 105) (Fig. 3), such as the eastern corner, where the density of bodies was much lower. In any case, and according to their depth and location, all the skeletons were distributed in three main sublayers reflecting the sequence of deposition of the bodies (Fig. 4): *upper a2* held the uppermost remains, which were also the most affected by looting; *intermediate a2* contained the best preserved skeletons; and *lower a2* included the deepest burials, some of which were damaged by moisture retained by the clayey floor. There is one radiocarbon date available for each of the sublayers, all obtained from skeletons in the northwestern corner of the pit: 4060 ± 60 BP (BM-2365) for *upper a2* (skeleton E2b), 4120 ± 70 BP (BM-2366) for *intermediate a2* (skeleton E42) and 4110 ± 60 BP (BM-2367) for *lower a2* (skeleton E17) (Harrison 1988; Andrés and Barandiarán 2004: 101). The calibration and Bayesian modeling of the dates supports the chronological consistency of the sequence but given the small number of dates does not provide much precision for delimiting the funerary use of the site, which is modeled as lying between *2900 and 2420 BC* (68.2%) (Fig. 5), nor for assessing the simultaneity of the deposit. The dates can be successfully combined in OxCal 4.2, to 2866–2497 cal BC (4095 ± 37 BP: χ^2, $T = 0.5$ (5% (6.0), $df = 2$)), and so are not inconsistent with a single event, though equally could reflect deposition over a few centuries. This also needs to be seen in the context of (1) the relatively high error terms of ± 60 years for the individual determinations and (2) the presence of a relatively flat region of the calibration curve with multiple peaks and troughs between 2850 and 2500 BC. Nevertheless, the nearly intact condition of the skeletons, which seem to have decomposed in a filled space often resulting in the retention of labile articulations (especially in the intermediate and upper sublayers), and their ordered position and superimposition have been argued to indicate a simultaneous deposit and the subsequent closing of the grave (Barandiarán 1978: 417; Andrés and Barandiarán

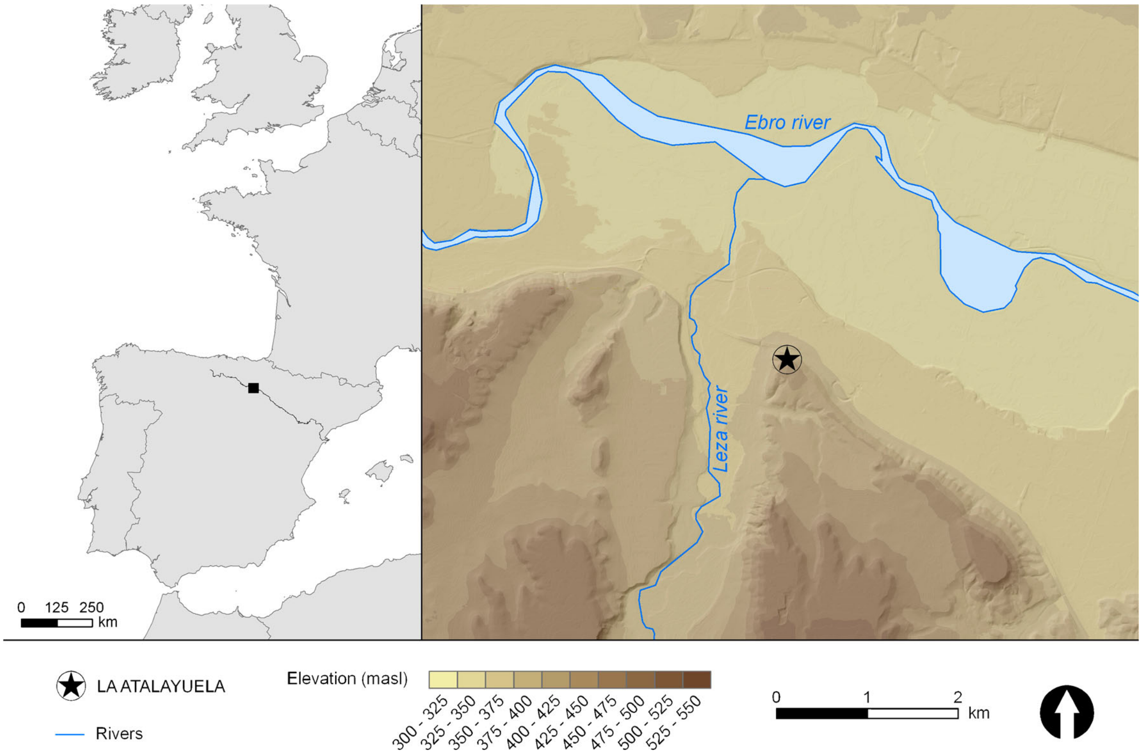

Fig. 1 Map showing the location of La Atalayuela in both Western Europe and its immediate region

2004: 97). Against this, the accompanying artefacts appear to refer to different time periods (especially the consecutive Beaker types).

However, this was not the only funerary evidence documented from the pit. A small circular posthole (40 cm diameter and 8–12 cm deep) was also identified in the centre of its floor, slightly shifted towards the northern corner. It contained a few disarticulated human bones and one sherd of an undecorated bowl (Barandiarán 1978: 388). This finding has been interpreted as evidence for the existence of a central post or pillar for a wooden house of the dead or funerary hut (perhaps used for decomposing and disarticulating the skeletons prior to their final deposition) that would have preceded the simultaneous burial (Andrés and Barandiarán 2004: 106). This earlier funerary use has also been associated with the few complete skeletons and partially connected or fragmentary skeletal remains (mainly represented by vertebral elements) of a dozen individuals found in the lowest depths of the aforementioned sublayer *lower a2*, particularly in the southern corner of the pit (henceforth referred to as *base*), and with the finding of chrono-typologically earlier materials (i.e. two calaite beads, one leaf-shaped arrowhead, one exotic pierced-lug bone needle—found on the bottom of the pit and stylistically suggesting a potential trans-Pyrenean origin—some sherds of an AOO Beaker vessel and other sherds with nipple-like bosses and small pierced holes below the rim) that may have had a votive function (Barandiarán and Moreno 1976; Andrés 1998: 97; Andrés and Barandiarán 2004). Unfortunately, there are no radiocarbon dates available to place this evidence more precisely within the site's overall chronology. The existence of such a funerary structure preceding the simultaneous deposit would explain the size of the pit, since if the grave had been erected just for

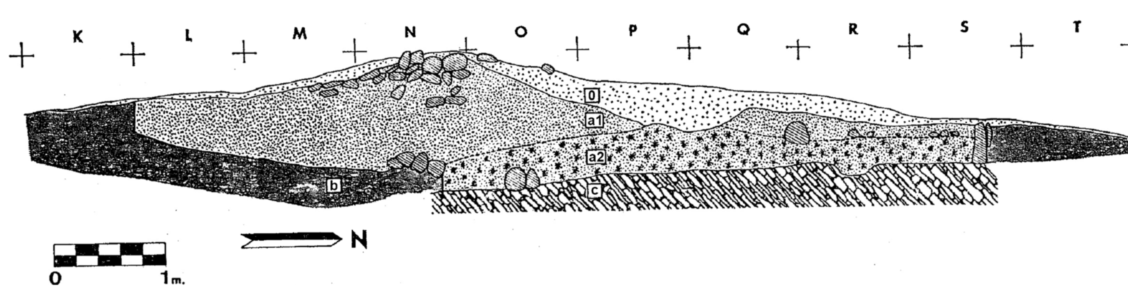

Fig. 2 La Atalayuela's stratigraphy showing the main layers of the pit grave (modified from Andrés (1973) after Barandiarán (1973))

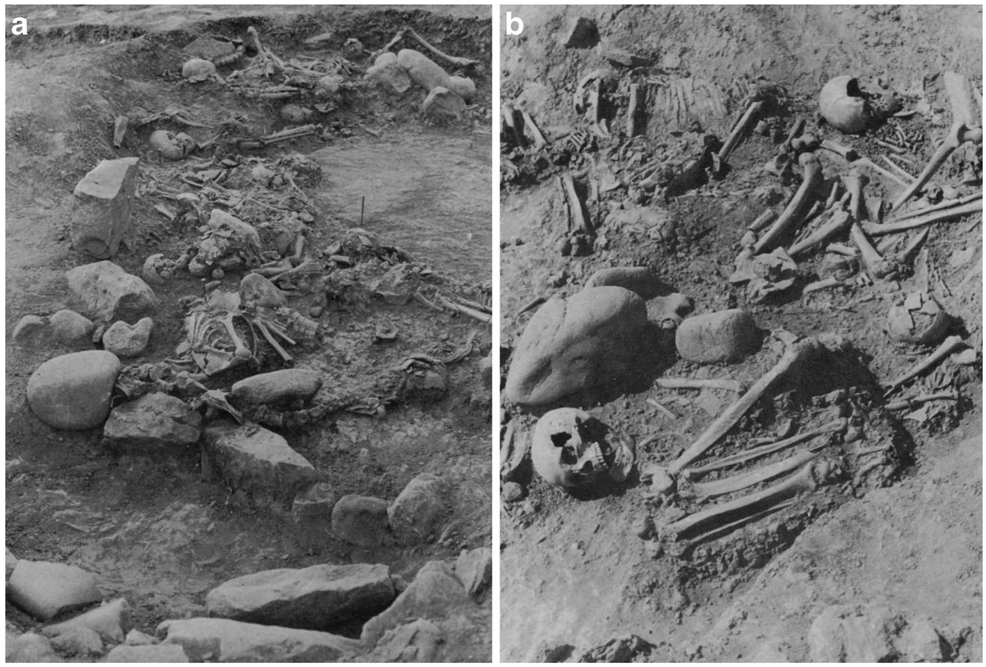

Fig. 3 Photos with examples of skeletal arrangement and superimposition at La Atalayuela. **a** View of the northwestern corner (lower *a2* layer). **b** Detailed view of flexed skeletons (intermediate *a2* layer) (Barandiarán 1978)

interring the dead of a potential catastrophe, its dimensions would have probably been more modest and suited to the size of the burial group.

In addition to the pit itself, an extension or entrance area was also documented at the southern end of the grave. This has been interpreted as either: (a) a vestibule where some mortuary rituals and feasts would have taken place (in view of the greater concentration of undecorated pottery and flint), while the site was used as a house of the dead; or (b) a place where some of the bones (all skulls and mandibles, e.g., E6, E7, E8 and E14; henceforth referred to as the *vestibule*) belonging to the potentially simultaneous deposit would have been moved when the wooden funerary hut was dismantled (Andrés and Barandiarán 2004: 100,105).

Finally, typologically more recent materials found in the upper levels of the pit, in its mound and in looted/mixed areas, notably incised Beaker vessels and bowls and one bone arrowhead, have been interpreted as possible offerings with the purpose of perpetuating the memory of the funerary site following its closure (Andrés 1998: 122).

The skeletal assemblage

The vast majority of the human remains found at La Atalayuela shows good preservation and anatomical connection, allowing the identification of a total of 56 bone assemblages during the excavation. At least 45 of these corresponded to complete or nearly complete skeletons. The individuals were carefully deposited, lying on their right side—except for three cases from *base* lying on the left side (E19, E25 and E52, all non-adults)—generally in flexed or hyperflexed (e.g. E5, E10, E15) positions with their heads oriented towards the southeast (facing east-northeast) (cf. Fig. 3b). Moreover, at least three male individuals (e.g. E1, E15 and E26) had their heads surrounded by flagstones, possibly with the intention of framing or protecting them (Barandiarán 1978: 390; Andrés and Barandiarán 2004: 91).

The anthropological data available until recently did not provide any relevant information on the demography of the burials, on the funerary practices performed during the earlier burial phase (the house of the dead) or on the possible causes (e.g. ritual, epidemic, violent) for the presumably simultaneous deposit. The only published study (Basabe 1978) mainly focuses on the morphometric analysis of some of the best preserved skeletal elements (namely 21 skulls, 9 mandibles, 5 humeri, 4 radii, 3 ulnae, 8 femora, 10 tibiae and 12 coxal bones). A minimum of 70 individuals, of whom at least 40% would be infants/children, is estimated for the site, and near-parity for male (55%) and female (45%) adults is mentioned. The study also suggests, in keeping with the interest in racial approaches of that time, the predominance of 'Mediterranean' cranial features together with some 'Alpine' characteristics (mesodolichocephaly and low cranial height, especially among men), proposing a possible genetic flux with neighbour Basque or French communities. Finally, an average height of 162 cm for males ($n = 8$) and of 157 cm for females ($n = 5$) is calculated through the length of the long bones, and the existence of some pathologies, including a case of tooth decay and oral abscess (E15), a large cranial osteoma (E33), three healed cranial traumas on a skull (E15) and a healed severe blunt force trauma on a mandible (E53), is mentioned. In this regard, it is also worth noting the unconfirmed case of a barbed and tanged arrowhead embedded in the back of a skull

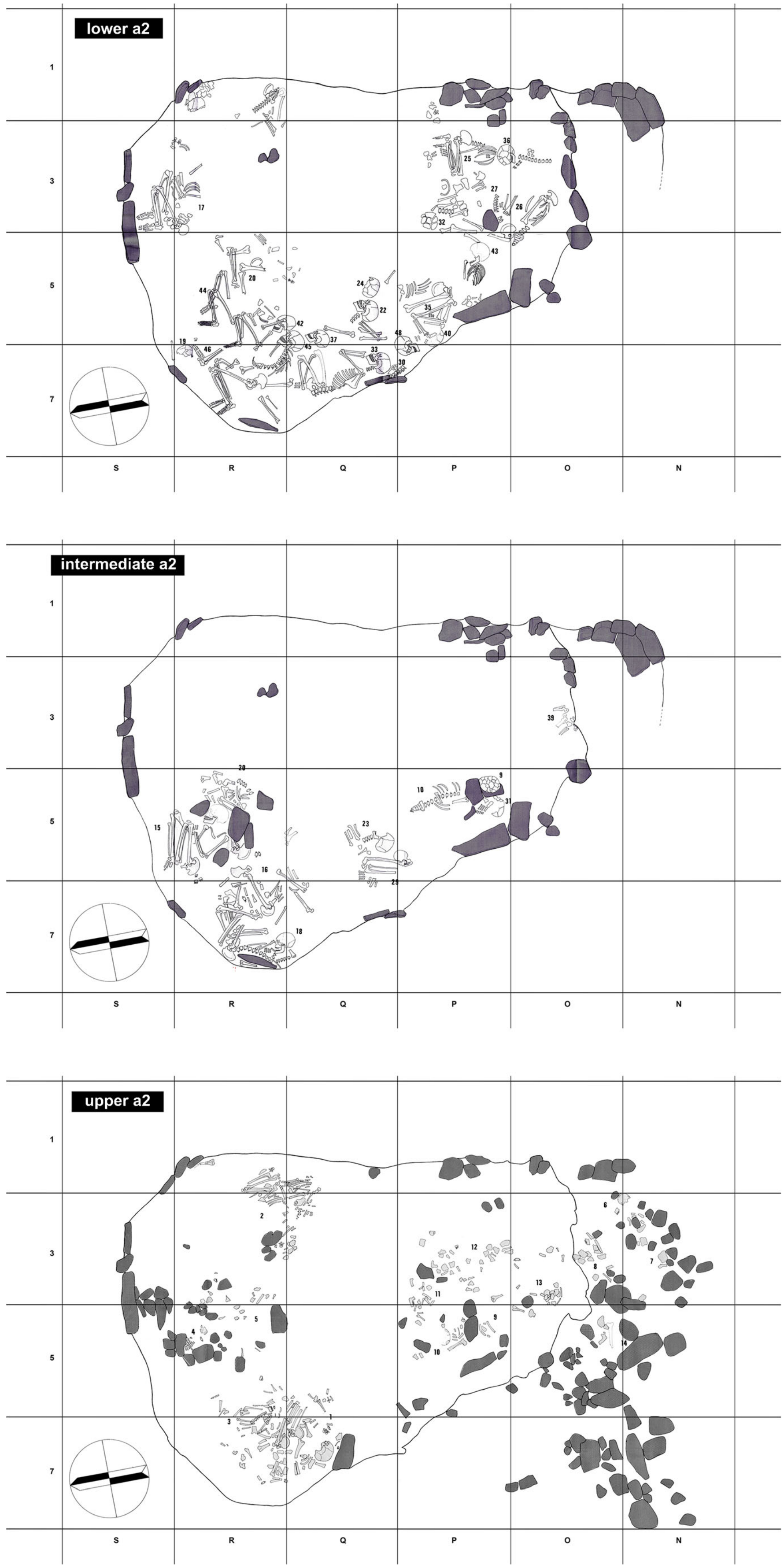

Fig. 4 General plan of La Atalayuela burial deposit, divided in the three sublayers established by the excavators (Andrés and Barandiarán 2004), i.e., *lower a2*, *intermediate a2* and *upper a2*

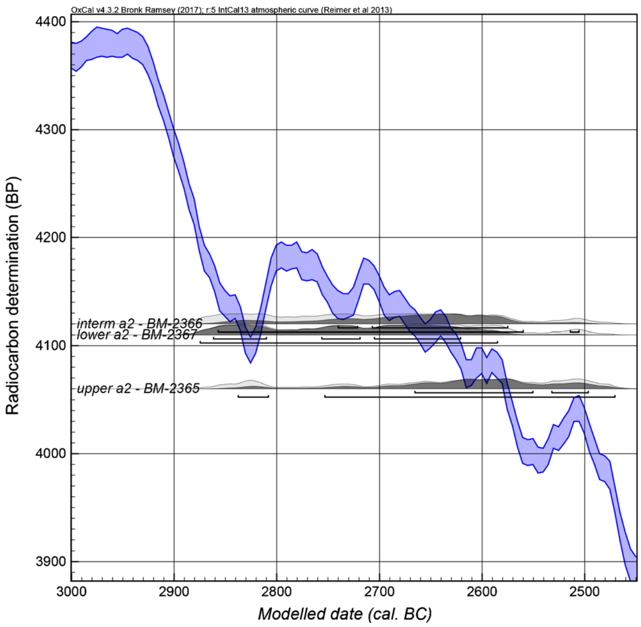

Fig. 5 Available radiocarbon dates from La Atalayuela (Harrison 1988). The dates are Bayesian modeled as phase sequence using OxCal 4.2.2. (Bronk Ramsey 2013; Reimer et al. 2013)

that was reported before the excavation of the site (Barandiarán 1978: 393).

In view of the sparse anthropological data available, a new review of the collection was undertaken prior to the isotopic study. The loss of part of the original collection currently available in the Museo de La Rioja (Logroño, Spain) is evident as demonstrated by the absence of individuals that were clearly distinguished and labeled during the excavations (e.g. E2, E4, E9, E24, E28, E29, E30, E38, E47, E55), by the absence of bone fragments and by the notably lower number of non-adult skeletal remains in contrast to Basabe's study (Basabe 1978). This unfortunate loss must be attributed to the several transfers and trials (e.g. a fire in the laboratory where the materials were firstly studied that forced their urgent evacuation) suffered by the collection after the excavation (Andrés and Barandiarán 2004: 86).

Non-adult age was determined based on dental development (Ubelaker 1989), when possible ($n = 11$). The grade of ossification of post-cranial bones (Buikstra and Ubelaker 1994) and the size of long bones (Stloukal and Hanakova 1978; Scheuer and Black 2000) were used as criteria in the remaining non-adult cases ($n = 4$). Adult age was estimated based on the pubic symphyseal and auricular surfaces (Brooks and Suchey 1990; Lovejoy et al. 1985) where coxae were available ($n = 15$), with the results being broadly consistent with those obtained through the closure of the cranial sutures (Zambrano 2005) and tooth wear (Brothwell 1989). These cranial and dental indicators were used for the remaining adult individuals whose age could be estimated ($n = 11$). Finally, adolescent and adult sex estimation focused on coxal and cranial morphological indicators (Buikstra and Ubelaker 1994; Ferembach et al. 1980). Coxae were used when possible ($n = 21$), showing a good match with skull features, which indicates a reliable sexual dimorphism for the skull in this assemblage. The validity of the sex estimation in the remaining cases ($n = 12$) exclusively through cranial and mandibular features was, therefore, assumed.

The results of this review provide a demographic profile consisting of 31 adults (11 males, 17 females and 3 of indeterminate sex), 7 adolescents (1 male, 4 females and 2 of indeterminate sex), 5 older children and 3 younger children. This clearly differs from the few demographic data outlined by Basabe (Basabe 1978). Thus, the percentage of infants/children (17.4%) is notably lower than the 40% mentioned above, and the sex ratio (0.57) seems to favour females (63.6%) over males (36.4%). It may be that Basabe's category for children also included what we here consider as adolescent individuals (and perhaps even counting some of the youngest adults) and that the study focused on the best preserved adult remains (e.g. skulls) to calculate the sex ratio, but the differences are quite marked.

Dividing the individuals by context (*base*, sublayers *lower a2*, *intermediate a2* and *upper a2*, and *vestibule*) does not show any clear demographic pattern by sex, where females seem to predominate throughout the sequence (Fig. 6b). With regard to age, however, there seem to be some differences (Fig. 6a). Thus, *base* shows a clearly greater representation of children, whereas the later layers show a clear predominance of adults that may, indeed, be evidence for their attribution to a potentially simultaneous burial.

Apart from confirming the original pathologies identified by Basabe, the new review has also shown a low incidence of degenerative joint diseases and osteoarthritis (i.e. mild or moderate cases in E17, E26, E33, E35). No skeletal evidences for possible metabolic or infectious diseases have been observed, except for a case of cribra orbitalia (E6) and a new example of dental abscess on a mandible (E33). Given the potential interpretation of part of the burial as a mass grave, the scarcity of traumatic lesions is also noteworthy. Our study has confirmed the injuries reported by Basabe (Basabe 1978) and identified two new cases: a healed incised trauma on a left parietal bone interpreted as a possible arrowhead injury (E18) and a misaligned healed fracture on a clavicle (E15). Thus, there is no evidence for the interpretation of the burial deposit as representing a violent event. This need not deny the possibility that part of the deposit may have been simultaneous, but the nature of any catastrophe probably needs to be sought elsewhere.

Material

A total of 46 human individuals were sampled for carbon and nitrogen isotope analysis. The number of individuals sampled

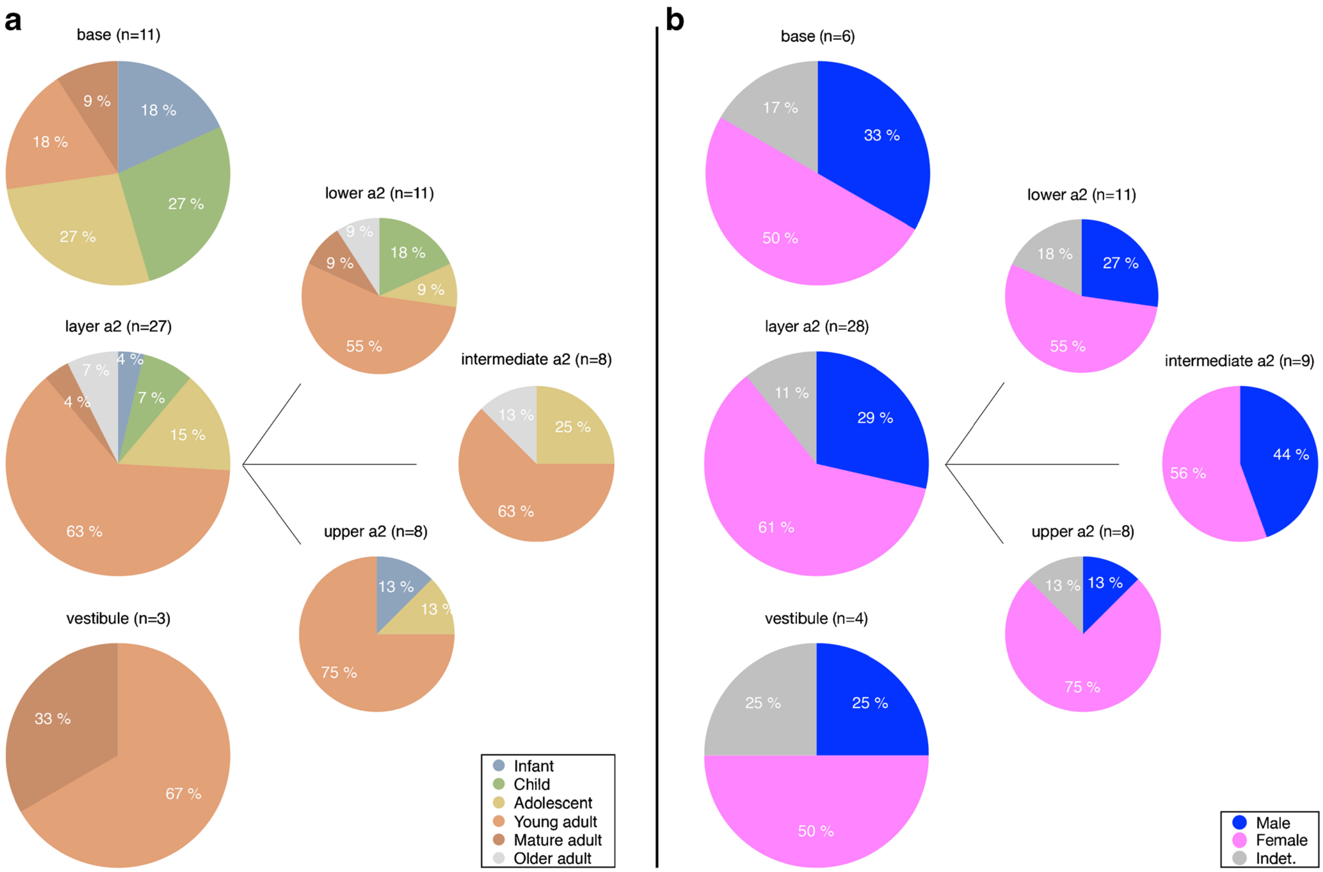

Fig. 6 Percentage distribution of La Atalayuela's population by (**a**) age and (**b**) sex (this study), arranged by context and, in the case of layer *a2*, also by sublayers

corresponds to the total number of individuals that are currently available in the collection hosted by the Museo de La Rioja (Logroño, Spain). Of these, 11 correspond to the deepest burials associated with the earliest funerary use of the site or *base* (house of the dead), 31 to the presumably simultaneous or at least rapid deposit or *a2*, and four to the structure to the south of the pit or *vestibule*. Samples were exclusively taken from bone and belong to different skeletal elements, depending on their availability and preservation, though preferentially from skulls and mandibles, since these are best represented and are instrumental for providing age and sex data. The weight of the samples ranged between 500 and 800 mg. Unfortunately, no animal or plant remains were documented in association with the burials during the excavations, which prevents a site-specific assessment of the variability of baseline isotopic signatures.

Methods

Carbon and nitrogen stable isotope analysis of bone collagen is a commonly used method for the reconstruction of past human and animal diets. This technique is based on the principle that the isotopic composition of the food eaten by both animals and humans is recorded on their body tissues after a predictable isotope fractionation (Ambrose 1993; Katzenberg 2000; Sealy 2001; Lee-Thorp 2008). Stable isotopes are measured as the ratio of the heavier isotope to the lighter isotope ($^{13}C/^{12}C$ or $^{15}N/^{14}N$) and reported in the delta notation (δ) in parts per thousand (‰) relative to the internationally defined VPDB scale (Vienna PeeDee Belemnite) for carbon and to the AIR scale (Ambient Inhalable Reservoir; atmospheric N_2) for nitrogen. Measurements on the organic collagen fraction of the bone are biased towards dietary protein in the case of carbon, representing an averaged signal over approximately the last decade of an adult individual's life (Ambrose and Norr 1993; Hedges et al. 2007). Dietary protein is the only source of nitrogen.

In Holocene Iberia, where edible C_4 plants are thought to be insignificant until the cultivation of millet becomes widespread in the Middle Bronze Age (Buxó and Piqué 2008; Moreno-Larrazabal et al. 2015), $\delta^{13}C$ measurements in human bone collagen can be primarily used to distinguish between the consumption of marine protein (^{13}C-enriched) and terrestrial C_3 protein (^{13}C-depleted). Thus, bone collagen $\delta^{13}C$ values of ca. -12 ± 1‰ generally indicate an exclusively marine protein, while values of ca. -20 ± 1‰ indicate a purely C_3 terrestrial diet (Richards et al. 2003; Richards et al. 2006). Nitrogen isotope measurements of bone collagen are used to establish the trophic position of an organism in the food web,

Table 1 Human isotope values and bone collagen quality indicators of the samples analyzed.

Sample	Inv.[1]	Context	Age[2]	Sex[3]	Element	Coll yield[4]	%C [4]	%N [4]	C:N[4]	d^{13}C	d^{15}N
ATA47	E54	Base	YC (5±1)^{D}	I	Skull	3.2	30.4	*10.7*	3.3	-20.0	9.4
ATA19	E19	Base	YC (5±1)^{D,P}	I	Mandible	14.6	43.6	15.9	3.2	-19.7	10.0
ATA37	E43	Base	OC (9±3)^{D}	I	Mandible	7.5	39.0	14.0	3.3	-19.7	9.6
ATA24	E25	Base	OC (12±3)^{P}	I	Coxal bone	13.9	43.8	15.9	3.2	-19.6	9.0
ATA45	E52	Base	OC (12±3)^{D}	I	Mandible	9.4	38.2	13.8	3.2	-19.5	9.5
ATA39	E45	Base	J (15±3)^{D}	F^{C,S}	Mandible	7.6	38.7	13.9	3.2	-19.7	9.4
ATA40	E46	Base	J (15±3)^{D}	I	Skull	13.3	43.7	15.7	3.2	-20.5	9.3
ATA27	E32	Base	J (ca. 20)^{D}	I	Skull	1.8	*26.2*	*9.2*	3.3	-19.5	9.7
ATA25	E26	Base	YA^{C,S}	M^{C,S}	Coxal bone	25.7	42.3	15.4	3.2	-18.7	9.5
ATA31	E36	Base	YA^{C,S}	F?^{C,S}	Skull	15.8	43.5	15.9	3.2	-19.3	10.7
ATA46	E53	Base	MA^{S}	M^{S}	Mandible	2.1	*29.8*	*10.4*	3.3	-19.4	10.1
ATA43	E50	Lower a2	OC (8±2)^{P}	I	Clavicle	9.2	40.6	14.7	3.2	-19.3	9.5
ATA44	E51	Lower a2	OC (12±3)^{P}	I	Humerus	4.9	*29.7*	*10.6*	3.3	-19.2	9.5
ATA17	E17	Lower a2	J (ca. 20)^{D}	M?^{C,S}	Mandible	5.8	*44.2*	*16.0*	3.2	-19.2	9.9
ATA22	E22	Lower a2	YA^{S}	M^{S}	Mandible	2.4	41.4	14.5	3.3	-19.4	10.0
ATA32	E37	Lower a2	YA^{C,S}	F^{C,S}	Mandible	7.9	39.6	14.4	3.2	-19.4	10.2
ATA34	E40	Lower a2	YA^{S}	F^{S}	Mandible	9.2	42.4	15.3	3.2	-19.4	10.1
ATA35	E41	Lower a2	YA^{C,S}	F^{C,S}	Maxilla	16.2	41.6	15.1	3.2	-19.4	9.6
ATA41	E48B	Lower a2	YA^{C,S}	F^{C,S}	Mandible	11.0	42.2	15.1	3.3	-19.7	9.8
ATA29	E34	Lower a2	YA^{S}	I	Skull	14.7	39.7	14.4	3.2	-19.5	9.9
ATA30	E35	Lower a2	MA^{C,S}	F^{C,S}	Skull	7.9	39.1	14.1	3.2	-19.3	9.2
ATA28	E33	Lower a2	OA^{C,S}	M^{C,S}	Mandible	10.5	39.4	14.4	3.2	-19.0	9.8
ATA38	E44	Lower a2	IA	F^{S}	Fibula	22.8	*45.7*	*16.7*	3.2	-19.5	8.9
ATA42	E49	Lower a2	IA	I	Humerus	6.0	36.5	13.1	3.3	-19.1	10.4
ATA36	E42	Intermediate a2	J (15±3)^{D}	F?^{C,S}	Mandible	4.7	41.4	14.8	3.3	-19.2	9.5
ATA20	E20	Intermediate a2	J (ca. 20)^{D}	F?^{C,S}	Humerus	14.3	42.6	15.6	3.2	-19.6	9.0
ATA23	E23	Intermediate a2	YA^{S}	M^{S}	Mandible	12.8	40.5	14.7	3.2	-19.3	10.5
ATA18	E18	Intermediate a2	YA^{C,S}	F^{C,S}	Mandible	14.7	39.4	14.2	3.3	-19.5	9.8
ATA33	E39	Intermediate a2	YA^{C,S}	F^{C,S}	Skull	10.0	36.3	13.0	3.3	-19.4	9.6
ATA26	E31	Intermediate a2	YA^{S}	F?^{S}	Skull	9.9	41.5	14.7	3.3	-19.8	10.6
ATA15	E15.61	Intermediate a2	OA^{C,S}	M^{C,S}	Mandible	17.0	44.9	15.3	3.4	-19.6	9.8
ATA6	E5.2	Upper a2	YC (3±1)^{P}	I	Clavicle	12.1	42.0	15.1	3.3	-19.2	9.2
ATA5	E5.5	Upper a2	J (ca. 20)^{D}	F^{C,S}	Mandible	13.6	*48.2*	*17.5*	3.2	-19.1	9.3
ATA2	E1	Upper a2	YA^{C,S}	M?^{C,S}	Skull	13.4	42.7	15.2	3.3	-19.3	9.6
ATA11	E11	Upper a2	YA^{S}	F^{S}	Mandible	18.9	41.1	14.8	3.2	-19.1	9.2
ATA10	E10.12	Upper a2	YA^{C,S}	F^{C,S}	Mandible	*0.8*	34.9	11.6	3.5	-19.5	9.8
ATA3	E2B	Upper a2	YA^{C,S}	F?^{C,S}	Mandible	7.4	38.4	13.8	3.3	-19.4	10.6
ATA12	E12.3	Upper a2	YA^{S}	I	Mandible	8.3	*46.3*	*17.0*	3.2	-19.4	10.1
ATA13	E13	Upper a2	IA	F?^{S}	Mandible	8.6	*45.5*	*16.6*	3.2	-19.4	9.5
ATA8	E7	Vestibule	YA^{S}	M?^{S}	Mandible	8.6	43.3	15.5	3.3	-19.1	8.8
ATA7	E6	Vestibule	YA^{S}	F^{S}	Maxilla	10.8	42.9	15.4	3.3	-19.1	10.1
ATA14	E14	Vestibule	MA^{C,S}	F^{C,S}	Mandible	9.7	43.5	15.7	3.2	-19.3	9.8
ATA9	E8	Vestibule	IA	M?^{S}	Skull	15.3	42.4	15.2	3.3	-19.1	9.1
Rejected											
ATA16	E16.63	Intermediate a2	YA^{C,S}	M^{C,S}	Mandible	*0.1*	*2.1*	*0.3*	*7.4*	-22.3	3.3
ATA21	E21	Intermediate a2	IA	M?^{S}	Skull	*0.3*	*3.9*	*1.3*	3.4	-19.9	9.5
ATA4	E3.1	Upper a2	YA^{S}	F^{S}	Mandible	*0.2*	*9.0*	*0.4*	*30.1*	-23.4	0.9

[1] Inventory number.

[2] *YC* = younger children; *OC* = older children; *J* = adolescent; *YA* = young adult; *MA* = mature adult; *OA* = older adult; *IA* = indeterminate adult. Adult age estimation: ^{C} = based on coxal bone; ^{S} = based on skull. Non-adult age estimation: ^{D} = based on dental development; ^{P} = based on postcranial skeletal ossification and growth.

[3] *M* = male; *M?* = probable male; *F* = female; *F?* = probable female; *I* = ambiguous/indeterminate. Adult and adolescent sex estimation: ^{C} = based on coxal bone; ^{S} = based on skull.

[4] Anomalous collagen quality indicators are shown in italics.

increasing by 3–6‰ with each trophic level (there is also a small enrichment of ca. 1‰ in δ^{13}C values), meaning that the consumer has higher values than the consumed protein (Minagawa and Wada 1984; Schoeninger and DeNiro 1984; O'Connell et al. 2012). This makes δ^{15}N useful for detecting the presence of high-trophic-level marine and freshwater foods in the diet (Schoeninger et al. 1983). However, the distinction between animal-rich diets and plant-rich diets using δ^{15}N analysis is less straightforward than previously thought, most notably due to the ^{15}N-enriching effects of manuring (Fraser et al. 2011; Hedges and Reynard 2007). Further complicating interpretation is the fact that pulses are N_2 fixers that obtain most of their nitrogen from the atmosphere, meaning that their δ^{15}N values are generally close to that of the standard AIR, i.e., to 0‰ (Högberg 1997).

Collagen extraction was carried out following a modified Longin method (Longin 1971) as described by Richards and Hedges (Richards and Hedges 1999). The carbon and nitrogen isotope ratios were measured in duplicate into a SERCON 20/22 continuous flow isotope ratio mass spectrometer coupled with an elemental analyser at the Research Laboratory for Archaeology and the History of Art (RLAHA) of the University of Oxford. Measurements of samples were randomized, to further ensure that no minor differences in the individual runs on the mass spectrometer would affect the results. Analytical precision is ±0.2‰ (1σ) for δ^{13}C and δ^{15}N based on repeated analyses of internal (alanine, marine seal, cow) and international standards (caffeine IAEA 600). Collagen preservation quality was checked according to several widely used preservation criteria: collagen yield greater than 1%, carbon content between 30 and 44% weight (wt%), nitrogen content between 11 and 16 wt%, and atomic weight C/N ratios between 2.9 and 3.6 (Ambrose 1990; DeNiro 1985; van Klinken 1999; Harbeck and Grupe 2009).

Statistical analysis of results was performed using IBM SPSS software for Windows v17. *Z*-scores were initially calculated to detect the presence of outliers and Shapiro-Wilk tests were used to assess whether or not the data were normally distributed. For two-sample comparisons, Student's *t* tests were employed when the data did not depart significantly from a normal distribution; when they did, non-parametric Mann-Whitney *U* tests were used. For simultaneous comparison of more than two groups, one-way ANOVA tests were conducted, since all the groups analysed were normally distributed with approximately equal variance. Effect size was assessed using Cohen's *d* (Cohen 1988). This statistic refers to the difference between two sample means expressed in pooled standard deviations, assuming approximately equal variances. Conventionally, a *d* value of less than 0.2 is seen as trivial, regardless of the outcome of the significance tests. Statistical power (1-β) was also calculated using G*Power 3.1 (Faul et al. 2009) to measure the probability that a test is correctly rejecting the null hypothesis or, in other words, that it will detect an effect when there is an effect to be detected, especially when comparing small sample sizes. Finally, Pearson's r^2 and Spearman's *rho* coefficients were used to assess correlations as appropriate. A significance level of 0.05 was used for all tests.

Results

The majority of the 46 samples analysed provided C/N ratios, collagen yields, carbon and nitrogen percentages indicating well-preserved collagen (Table 1). However, two samples gave C/N ratios above the expected range (E3.1 and E16.63) and another (E21), despite having an acceptable C/N ratio, provided a collagen yield lower than 1% and anomalous carbon and nitrogen percentages indicating poor preservation. Therefore, they were excluded from further consideration. In addition, 10 samples exhibited %C and/or %N slightly below or above the generally accepted limits but had C/N ratios and collagen yields within the accepted range. The effects of including or excluding these samples have been considered and found not to substantially alter the results, since they are consistent with other fully acceptable δ^{13}C and δ^{15}N measurements (individual *Z*-scores generally $< 1.0\sigma$; Student's *t* tests, $p > 0.05$). Thus, these values do not appear to be diagenetically compromised (cf. Bocherens et al. 2005) and have been retained, providing a total of 43 humans for analysis.

The human carbon and nitrogen isotope measurements cluster reasonably tightly, showing average δ^{13}C values of −19.4 ± 0.3‰ and average δ^{15}N values of 9.7 ± 0.5‰ (n = 43), and are entirely consistent with diets focused on C_3 plants and terrestrial animal resources (Fig. 7), though this does still leave scope for some intra-variability when looking at aspects such as the context, age and sex of the individuals.

Differences by burial context

The comparison between the skeletons corresponding to the house of the dead (*base*) and those to the later simultaneous burial (layer *a2*) shows a statistically significant difference in δ^{13}C (*t* test: $t = 2.232$, $df = 37$, $p = 0.032$, $d = 0.666$, $1\text{-}\beta = 0.58$), with more depleted values in *base*. The Cohen's *d* value falls between what would conventionally be termed medium (ca. 0.5) and large (≥ 0.8) effect sizes (Cohen 1988), supporting the presence of a meaningful difference in average δ^{13}C values despite the small difference in absolute terms of only 0.2‰. No significant difference is observed in δ^{15}N. Taking into account that the attribution of the four individuals found in the structure to the south of the pit grave (*vestibule*) to one or another funerary phase is unknown,

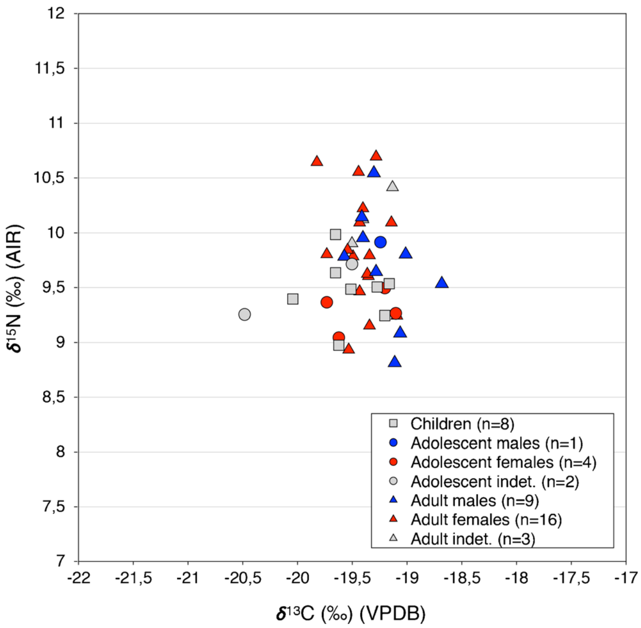

Fig. 7 Scatterplot of δ^{13}C and δ^{15}N isotope results obtained for La Atalayuela's human sample, distributed by age and sex

these have been compared to the other two contexts, showing significant statistical differences only with regard to layer *a2* in carbon isotope values ($t = 2.052$, $df = 30$, $p = 0.049$, $d = 1.322$, $1\text{-}\beta = 0.78$) (Fig. 8). As a heuristic exercise, a one-way ANOVA test has also been applied dividing the simultaneous burial by layers of skeletal deposition (sublayers *lower a2*, *intermediate a2* and *upper a2*) and including both *base* and *vestibule* to check whether or not differences can be observed at a finer scale. The results show that, while not quite attaining statistical significance ($F_{(4,\ 42)} = 2.6$, $p = 0.055$, $d = 0.715$, $1\text{-}\beta = 0.97$), there may be a meaningful variation in carbon isotope values by context, with individuals from *base* and *vestibule* showing the most depleted and most enriched average values, respectively, and very similar values for the three sublayers of the simultaneous deposition (Table 2).

In order to discount the possibility that these results are actually driven by the differences seen in the demographic profiles of the different archaeological contexts (cf. Fig. 6a), the same tests were conducted excluding non-adults (≤ 20 years), trying to avoid any bias caused by the presence of children and/or adolescents that may potentially differ in their diets from adults (cf. Table 2). And indeed, they do seem to differ, since the pattern reverses when comparing only adult individuals from *base* and layer *a2*, the former showing now higher carbon isotope values ($t = 2.124$, $df = 22$, $p = 0.045$, $d = 0.945$, $1\text{-}\beta = 0.44$) (cf. Fig. 8) probably as a result of the effects of subtracting such a notable number of non-adults ($n = 8$) from the context's total sample ($n = 11$). This suggests the presence of isotopic differences by age, addressed below. In contrast, the difference between the adult individuals from *vestibule* and layer *a2* still remains ($t = 2.447$, $df = 23$, $p = 0.022$, $d = 1.573$, $1\text{-}\beta = 0.88$). With regard to the comparison between more specific contexts (i.e. *base*, sublayers *lower a2*, *intermediate a2* and *upper a2*, and *vestibule*), no significant differences are now observed.

Finally, the existence of two clearly outliers in δ^{13}C attributed to the house of the dead (*base*) with more enriched (E26 − 18.7‰, *Z*-score = + 2.4σ) and more depleted (E46 − 20.5‰, *Z*-score = − 3.7σ) isotope values than the rest of the burial population is noteworthy. While the distributions do not depart significantly from a normal distribution, given the presence of these outliers, a non-parametric Mann-Whitney test was also applied, confirming the difference between the *base* and layer *a2* (Mann-Whitney's $U = 78.0$, $Z = 2.373$, $p = 0.018$, $d = 0.666$, $1\text{-}\beta = 0.43$).

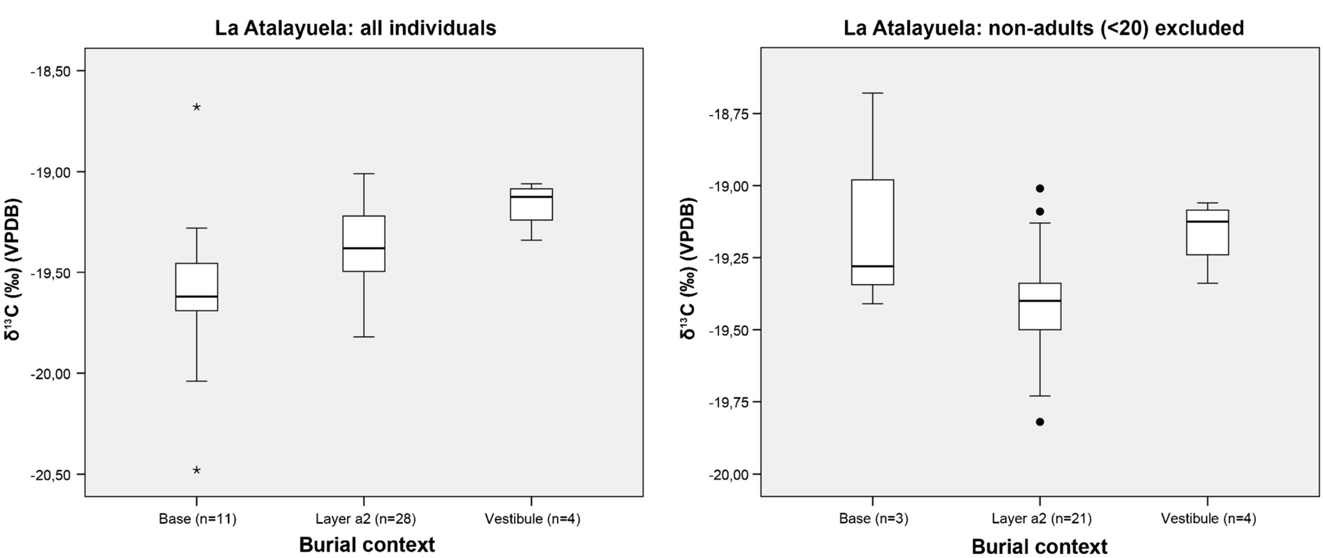

Fig. 8 Boxplot of δ^{13}C values by burial context. All individuals included (left). Excluding non-adults (≤ 20) (right)

Table 2 Average δ^{13}C and δ^{15}N values of the human samples analysed, by context

Context	All individuals					Non-adults (≤ 20) excluded				
	n	δ^{13}C (‰)		δ^{15}N (‰)		*n*	δ^{13}C (‰)		δ^{15}N (‰)	
		$\bar{x}$	σ	$\bar{x}$	σ		$\bar{x}$	σ	$\bar{x}$	σ
Base	11	− 19.6	0.4	9.6	0.5	3	− 19.1	0.4	10.1	0.6
Lower *a2*	13	− 19.3	0.2	9.8	0.4	10	− 19.4	0.2	9.8	0.5
Intermediate *a2*	7	− 19.5	0.2	9.8	0.6	5	− 19.5	0.2	10.1	0.5
Upper *a2*	8	− 19.3	0.2	9.7	0.5	6	− 19.4	0.2	9.8	0.5
Vestibule	4	− 19.2	0.1	9.4	0.6	4	− 19.2	0.1	9.4	0.6
Contexts combined	43	− 19.4	0.3	9.7	0.5	28	− 19.3	0.2	9.8	0.5

Age-related differences

Comparisons between age groups are limited by sample sizes, which are especially small in the case of younger (three younger and five older children) and older (three mature and two older adults) age classes (cf. Table 1).

Non-adults (≤ 20 years) clearly have lower δ^{13}C values than adults (> 20 years) in *base* ($t = 2.776$, $df = 9$, $p = 0.022$, $d = 1.799$, 1-$\beta = 0.79$). By contrast, non-adults from layer *a2* seem to provide higher isotope values than adults (Table 3), although the comparison does not attain statistical significance ($t = 1.862$, $df = 26$, $p = 0.074$, $d = 0.777$, 1-$\beta = 0.54$). This divergence is made evident when comparing the non-adults of both contexts, which show significantly different values ($U = 2.5$, $Z = 2.959$, $p = 0.003$, $d = 1.943$, 1-$\beta = 0.97$), and confirms not only the suspicion that the aforementioned significant isotopic differences between contexts are driven by differing demographic profiles but also the fact that these are maximized because non-adult isotopic values clearly differ from one context to another.

Nitrogen isotopic values, however, seem to show the same trend in all contexts (cf. Table 3), with adults overall showing higher δ^{15}N values than non-adults (*base*: $U = 3$, $Z = 1.837$, $p = 0.066$, $d = 1.398$, 1-$\beta = 0.58$; layer *a2*: $U = 31.5$, $Z = 2.229$, $p = 0.026$, $d = 1.155$, 1-$\beta = 0.81$), also seen in the combined sample ($t = 2.686$, $df = 41$, $p = 0.010$, $d = 0.938$, 1-$\beta = 0.89$). Using more specific age categories (younger children, older children, adolescents, young adults, mature adults and older adults) clearly indicates a general progressive increase in δ^{15}N values from childhood to old age (Pearson's $r^2 = 0.107$, $p = 0.042$; Spearman's *rho* = 0.412, $p = 0.009$) (Fig. 9) (Table 4).

Sex-related differences

Comparisons between females and males are even more limited by sample sizes than age (cf. Table 1) and also by the aforementioned imbalanced sex ratio. Nevertheless, at a general level, differences are seen between females and males in δ^{13}C, with the latter showing higher values ($t = 2.469$, $df = 28$, $p = 0.020$, $d = 0.910$, 1-$\beta = 0.74$). No significant differences are seen in δ^{15}N (Table 5). In principle, this difference would not have any impact on the observations made by context, since sex imbalances are similar throughout the sequence (cf. Fig. 6b).

Discussion

Dietary reconstruction

While the dietary reconstruction of the individuals buried in La Atalayuela is rather tentative due to the lack of archaeological faunal and plant sample isotopic values from the burial

Table 3 Average δ^{13}C and δ^{15}N values of the human samples analysed, by age and context

Context	Non-adults (≤ 20)					Adults (> 20)				
	n	δ^{13}C (‰)		δ^{15}N (‰)		*n*	δ^{13}C (‰)		δ^{15}N (‰)	
		$\bar{x}$	σ	$\bar{x}$	σ		$\bar{x}$	σ	$\bar{x}$	σ
Base	8	− 19.8	0.3	9.5	0.3	3	− 19.1	0.4	10.1	0.6
a2 layer	7	− 19.3	0.2	9.4	0.3	21	− 19.4	0.2	9.9	0.5
Vestibule	–	–	–	–	–	4	− 19.2	0.1	9.4	0.6
Contexts combined	15	− 19.5	0.4	9.4	0.3	28	− 19.3	0.2	9.8	0.5

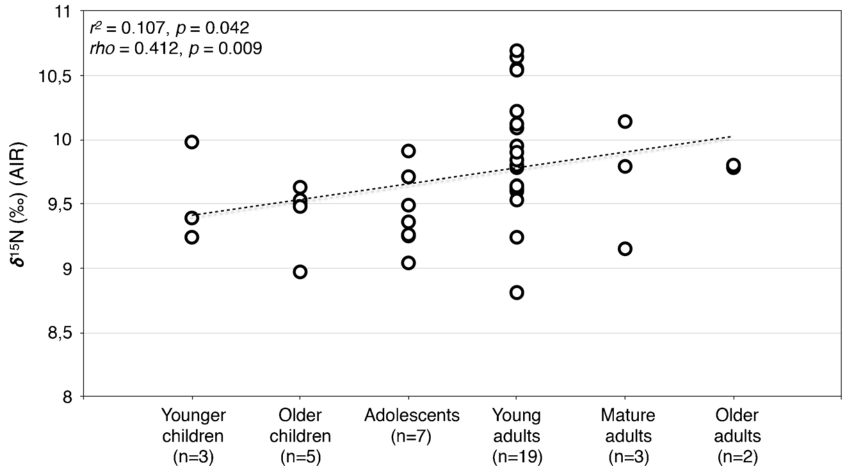

Fig. 9 Correlation observed between δ^{15}N values and specific age groups (younger children (2–7), older children (8–12), adolescents (13–20), young adults (21–40), mature adults (41–55) and older adults (> 55)) at La Atalayuela

and/or nearby coeval sites, the results are consistent with the theoretical and empirical ranges expected in the region for a C_3 plant-based human diet with notable consumption of animal protein for both phases of funerary use.

Thus, the dietary contribution of domestic plants would have come principally from wheat and barley, which are the most commonly found cereals in Iberia from the Neolithic to the Bronze Age. Forest fruits and nuts (e.g. apples, pears, wild berries, hazelnuts, acorns) could also have featured (Zapata 2000; Bueno et al. 2005). Both cereals and fruits would have also played an important role in the production of alcoholic beverages (beer, cider), which were an important part of Bell Beaker feasts as documented in other northern Iberian sites (Guerra-Doce 2006; Rojo-Guerra et al. 2006, 2008). Pulses are also expected to have contributed to diets. However, there is virtually no information on Chalcolithic subsistence practices in the mid-upper Ebro Valley to support this due to the lack of excavation of open-air settlements. Meanwhile, animal contributions would mainly consist of meat and dairy products from cattle and sheep/goat (Castaños 1995; Guerra-Doce et al. 2011–2012; Polo-Díaz et al. 2016). But, the dietary role of meat from domestic and wild pig and other wild animals, which differ in being managed or hunted essentially for meat production, should not be underestimated (Castaños 1995; Pereira et al. 2017). The results do not show any clear indications that freshwater resources contributed significantly to human diet, though some occasional consumption is likely. In this regard, there is evidence of barbell (*Barbus* sp.), porgy (*Pagrus* sp.) and gilt-head bream (*Sparus aurata*) bones and freshwater mussels (*Unio* sp.) in other Iberian Chalcolithic sites (Bueno et al. 2005; Pereira et al. 2017). Finally, given the site's considerable distance from the sea (> 100 km), the lack of evidence for any contribution of marine resources is unsurprising.

Stable isotope data available for other coeval sites of the Ebro Valley also point to diets based on the consumption of cultivated C_3 plants and domestic and, to a lesser extent, wild animals (Dürrwachter et al. 2005; Villalba-Mouco et al. 2017). However, a more detailed examination shows the existence of notable differences in nitrogen isotope values ($F_{(2,\ 75)} = 16.1$, $p < 0.001$) between La Atalayuela ($n = 43$, $\bar{x} = 9.7 \pm 0.5‰$) and two other sites: La Sima mound in Soria ($n = 2$, $\bar{x} = 10.7 \pm 0.1‰$) (Dürrwachter et al. 2005) and San Juan cave in Huesca ($n = 33$, $\bar{x} = 10.3 \pm 0.6‰$) (Villalba-Mouco et al. 2017). The location of the latter in the uplands (around 1000 m asl) and quite distant from the main Ebro River and most fertile lands of the region (in contrast to La Atalayuela) may be evidence for a subsistence economy more dependant on livestock exploitation than on agriculture. This would involve a greater consumption of animal protein, resulting in the

Table 4 Average δ^{13}C and δ^{15}N values of the human samples analysed, by specific age categories

Age category	n	δ^{13}C (‰)		δ^{15}N (‰)	
		$\bar{x}$	σ	$\bar{x}$	σ
Younger children (2–7)	3	− 19.6	0.4	9.5	0.4
Older children (8–12)	5	− 19.4	0.2	9.4	0.3
Adolescents (13–20)	7	− 19.6	0.5	9.4	0.3
Young adults (21–40)	19	− 19.4	0.2	9.9	0.5
Mature adults (41–55)	3	− 19.4	< 0.1	9.7	0.5
Older adults (> 55)	2	− 19.3	0.4	9.8	< 0.1

Table 5 Average δ^{13}C and δ^{15}N values of the human samples analysed, by sex

Sex	n	δ^{13}C (‰)		δ^{15}N (‰)	
		$\bar{x}$	σ	$\bar{x}$	σ
Females	20	− 19.4	0.2	9.7	0.5
Males	10	− 19.2	0.3	9.7	0.5

observed higher human nitrogen isotope values (which cannot be explained by marine protein intake, in view of the sites' considerable distance from the sea). Another possibility is a greater focus on pigs—with enriched ^{15}N levels due to their omnivore diets—in the more forested hills around La Sima and San Juan. Freshwater resources may have been another source for elevated ^{15}N, but this would be expected to show a concomitant effect on ^{13}C, which is often more depleted, as observed in a study of modern fish from the Flix Reservoir in the Ebro River (Soto et al. 2011). As a cautionary note, however, comparisons of stable isotopic results made at different times by different laboratories, and often involving different pre-treatment protocols and the use of various standards and calibration procedures, are not without potential problems, particularly when making comparisons at a relatively fine scale (Pestle et al. 2014).

Insights into group and individual identity and mortuary practices

With regard to group identity and to the mortuary practices performed in La Atalayuela, the significant difference identified in δ^{13}C values between the lowest (*base*) and uppermost (layer *a2*) burials may be understood as evidence of the existence of different phases of funerary use (i.e. the putative house of the dead and the possible simultaneous mass grave) in the site. While it is true, as already mentioned, that these results seem to be conditioned by the different demographic composition of both contexts (with a greater number of children in *base*), it also is the case that non-adult δ^{13}C values from *base* and *a2* clearly diverge (being lower than those from adults in the former, and *vice versa* in the latter). This meaningful difference between the non-adults of both contexts, together with the presence of two δ^{13}C outliers among the earliest burials, suggests the existence of potentially different subsistence practices or even origins (e.g. in locations with shifted isotope ecologies, whether due to climate, forestation, or both) between the individuals interred in both contexts. Moreover, there is other archaeological evidence supporting the existence of at least two funerary stages, as differences detected in: (a) the preservation and location of human remains (partial and more spread skeletons in *base* vs. complete and superimposed skeletons in *a2*, especially in the northwestern corner); (b) the demographic profiles (greater non-adult presence in *base* vs. clear predominance of adults in *a2*); and (c) the grave goods, diagnostic of different time periods. The pit's size, which would have been more modest if this had been dug *ex-profeso* to hold the available simultaneous burial of the deceased, also seems to point in the same direction.

By contrast, tentatively distributing the isotopic values of layer *a2* by the three sublayers established during the excavation of the site (i.e. *lower a2*, *intermediate a2* and *upper a2*) has not only provided no significant differences between these but has also shown great homogeneity, which may be due to the simultaneous nature suggested for this part of the burial (Barandiarán 1978). Yet, the available anthropological data do not support violence as the main reason for a mass interment, as previously proposed (Andrés and Barandiarán 2004: 106–107). First, the apparent predominance of female individuals at a general level (cf. Fig. 6b) is not consistent with the sex imbalances that might be expected for so-called war layers, where males usually predominate (Vegas et al. 2012). Second, there are only a few cases of skeletal trauma, all showing signs of healing (Basabe 1978; this study). And third, care taken when placing the bodies (most of them flexed and laying on the right side) is unusual among European prehistoric mass graves related to violent events (Fabián 2009; Liesau et al. 2014) although there are, of course, some exceptions (e.g. Eulau in Germany (Meyer et al. 2009)). It could also be the case that La Atalayuela's simultaneous deposit corresponds to a large number of deaths over a very short—though not necessarily simultaneous—period such as in an epidemic. However, the demographic profile is consistent neither with this type of mortality, where a greater number of infants, younger children and older adults, and overall parity between sexes, would be expected (e.g. DeWitte 2009; DeWitte 2010), nor with the careful arrangement of the bodies. The scarcity of grave goods could fit with either hypothesis, although we do not know if objects made of perishable materials may have also been deposited in the grave.

Finally, another scenario to be considered is that the burial holds the dead of a ritual multiple sacrifice. No such parallels have been documented in the Iberian Chalcolithic record so far, but human collective sacrifice has been identified in other broadly coeval northern and eastern European areas (Gimbutas 1991: 375–376, 382, 385).While it is true that there is no skeletal evidence in La Atalayuela to support this hypothesis, it is also the case that many types of sacrifice (strangulation, poisoning, slitting the throat) would not be evident on human bone, particularly given the often poor preservation of the vertebrae and the absence of the hyoid. The relatively common finding in Spanish Bell Beaker pottery of beer and mead residues (Rojo-Guerra et al. 2006), occasionally together with hyoscyamine, a hallucinogenic but also poisonous substance (Guerra-Doce 2006), is particularly intriguing in this respect. The complete geometric dotted Beaker vessel associated with La Atalayuela's mass grave, interpreted as a communal offering, could have played a key role in the funerary ceremony (e.g. holding a special beverage). Unfortunately, no chemical analyses have been undertaken to determine the possible contents of this vessel. Whatever the case, the singularity of the site among European Bell Beaker burials is clear, where the norm is small mounds and open-air pit graves containing less than 10 individuals (Fabián and Blanco 2012), and some funerary use of caves and megalithic graves, especially in the

Mediterranean region (Besse and Desideri 2005; Weiss-Krejci 2012).

Accepting the idea of a double funerary use of La Atalayuela (first as house of the dead and then as 'mass grave') would also imply the possibility that children may have been more usually selected for secondary burial practices here at least during the Early Bell Beaker period, in view of their greater presence in the house of the dead (*base*), where they would presumably lose their soft tissues before their final burial in another funerary place, hence the partial preservation of their skeletons. In this regard, the increasing finding in Iberia of children and adult women in double or multiple burials is suggestive, sometimes including secondary or intrusive skeletal deposits (e.g. Gómez et al. 2011; Aliaga 2012: 209–219), in contrast with the clear predominance of adult males in individual burials where Bell Beaker items are more frequent (Liesau et al. 2015: 116). This evidence may point to the existence of differences in the status and/or sphere of influence (home, village, region) linked to the age and the sex of the individuals.

In this sense, the detection at La Atalayuela of differences in δ^{13}C between non-adults and adults and a general progressive increase in nitrogen measurements from childhood to old age in δ^{15}N is noteworthy. Such a pattern may be attributable to physiological processes (e.g. skeletal growth), to age-related differences in diet (e.g. different protein intake), to compromised health statuses affecting juveniles (since these did not reach adulthood) or, more likely, to a combination of the three (Beaumont et al. 2013). These factors have also been suggested to explain differences in δ^{15}N detected between juveniles and adults at some coeval Portuguese sites (Waterman et al. 2016). Our results also show sex-related differences in δ^{13}C. Other studies have occasionally reported small but statistically significant differences between the sexes, generally with males having higher δ^{15}N values than females (Nitsch et al. 2010). This has been interpreted as due to either a dietary difference (essentially more meat for males) or physiological differences linked to pregnancy and lactation, although the latter explanation has been challenged (Hedges et al. 2013). Sex-based differences in δ^{13}C values are more unusual in the archaeological literature, however. It is possible that the lower δ^{13}C values of women could imply that they had differential access to certain food sources, perhaps not attaining social, economic and/or political influence as often as males (Fernández-Crespo and Schulting 2017). But, it may also be the case that the origin of this divergence lies in a potential sexual division of labour. In this scenario, female tasks could perhaps be related with the exploitation of more forested areas in the landscape, characterized by lower δ^{13}C values, for example through foraging or herding, as has been suggested for Iberian Neolithic women based on rock art depictions from the lower Ebro Valley and the Iberian Mediterranean Coast (Olària 2011), and with the more common intake of products from these environments (e.g. berries, nuts, tubers) consequently.

With regard to individual identities, the presence of the aforementioned two 'outliers' (E26—young adult male—and E46—adolescent of unknown sex) whose δ^{13}C values are different not only from those of the other individuals of *base* but also from all the individuals interred at La Atalayuela is noteworthy. In the absence of other analyses that provide more data on their life histories, one wonders whether these clear differences in diet and/or lifeways may be due to their social status within the group (e.g. chief, warrior, priest, pariah) or to the fact that they were outsiders with presumably distinct diets, subsistence practices or traditions. Future studies may be able to address these possibilities through the use of other isotopes (strontium, oxygen) in conjunction with sequential sampling of tooth dentine and enamel.

Finally, on the few skulls and mandibles recovered from the structure to the south of the pit (*vestibule*), some archaeological and isotope evidence may point to their potential provenance within the grave. Thus, the already mentioned common decomposition of the bodies in filled space in the presumably simultaneous deposit (*a2*) supports the immediate closing and dismantling of the grave after the mass burial, making it unlikely that the disarticulated skulls and mandibles found in *vestibule* had come from here. This fact, together with the existence of clear differences in adult δ^{13}C values in relation to *a2* and, by contrast, of similarities with those obtained from *base* (cf. Table 2), suggests that the remains from *vestibule* may have come from the house of the dead, perhaps when this was partially cleaned and spatially rearranged to hold the simultaneous deposit. Yet, the possibility that such a secondary deposit actually relates to the transfer of remains of ancestors (perhaps together with some Beaker fragments) from other funerary places to the site (perhaps as part of closing ceremonies) cannot be dismissed. Evidence for multi-stage burial rituals has been found in a number of Iberian Chalcolithic mortuary contexts, mainly caves, with remains occasionally showing signs of active defleshing and burning suggesting bone circulation and, perhaps, a cult of relics or the use of bones for witchcraft and magic (Weiss-Krejci 2012:130).

Conclusion

Some 15 years ago, the Middle Chalcolithic multiple pit grave of La Atalayuela, excavated in the 1970s, was tentatively interpreted as a possible house of the dead (*base*), where at some point, a multiple simultaneous burial (*a2*) was deposited, followed immediately by the definitive closing of the site (Andrés and Barandiarán 2004). The site is now revisited in light of stable carbon and nitrogen isotopes in combination with the available archaeological data. Forty-three human samples are analysed here to offer insights into diet, identity and mortuary practices. The results are consistent with diets mainly focused on C_3 plants and terrestrial animal resources. They also show a significant difference in δ^{13}C values between burial contexts (i.e. *base* vs. *a2,* and *vestibule* vs. *a2*), suggesting the existence of potentially distinct funerary uses for those individuals who differed in their diets and/or origins. This hypothesis also seems to be supported by divergences identified in the demographic profiles, the funerary rituals performed and the material culture associated with the different contexts. In this regard, the more plausible causes behind the mass burial are discussed in view of the current information available. Significant age- and sex-related isotopic differences are also identified. A possible differential access of children and women to certain food sources, perhaps for not attaining social, economic and/or political influence as often as males, and/or a plausible a sexual division of labour are suggested as possible factors. This evidence for social differentiation may also have a reflection in the Iberian funerary record, where men seem to be more commonly buried in single graves with Bell Beaker items than women and children.

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