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OSTEOARCHAEOLOGICAL ANALYSIS OF THE HUMAN SKELETAL REMAINS AT LEANG KADO'4 SITE, MAROS, SOUTH SULAWESI

Osteoarkeologi Rangka Manusia Situs Leang Kado'4, Maros, Sulawesi Selatan

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Abstrak

Pembahasan utama dalam penelitian ini adalah uraian osteoarkeologis terkait temuan rangka manusia situs prasejarah Leang Kado' 4 di kawasan karst Simbang, Maros, Sulawesi Selatan. Sebagai bagian dari kajian bioarkeologi, uraian ini meliputi penentuan jenis kelamin, usia kematian, rata-rata tinggi badan, afinitas ras, dan jumlah individu minimal yang ada di Situs Leang Kado' 4 sebagai bagian aktivitas penguburan. Metode penelitian menerapkan langkah kerja analisis dalam kajian bioarkeologi yang juga diterapkan dalam disiplin antropologi ragawi. Langkah kerja analisis tersebut, meliputi: identifikasi, pengukuran, komparasi, dan penghitungan estimasi jumlah individu minimal dalam sebuah himpunan data. Penelitian ini berkesimpulan bahwa sisa rangka manusia di situs Leang Kado' 4 memiliki kesamaan dengan dua jenis ras manusia, yaitu ras populasi Sahul-Pacific dikenal pula sebagai Australo-Papuan atau Australomelanesoid dan ras populasi Asia atau Mongoloid. Hadirnya data ini diharapkan menjadi salah satu bahan pertimbangan rekomendasi kebijakan berwawasan pembangunan karakter budaya bangsa yang mengedepankan kebhinekaan asal usul dengan data temuan rangka manusia.

***Kata Kunci*:** *rangka manusia, afinitas ras, bioarkeologi, rekomendasi, kebhinekaan.*

Abstract

This research aims to provide an osteoarchaeological analysis of the human skeletons found at the prehistoric site of Leang Kado' 4 in Simbang karst area, Maros, South Sulawesi. As a part of bioarchaeological studies, the analysis included the determination of sex, age at death, average height, racial affinity, and the minimum number of individuals at the site as part of the burial activities. The research employed the analytical process that is commonly carried out in bioarchaeological and physical anthropological studies. The analytical process consists of identification, measurement, comparison, and estimation of the minimum number of individuals in a data set. It is concluded that the human skeletal remains at Leang Kado' 4 site share several similarities with two human races, i.e. Sahul-Pacific race also known as Australo-Papuan or Australomelanesoid and Asian or Mongoloid race. It is expected that all this data can be used as a base for developing policies oriented to the development of the national character and culture by emphisizing the diversity of the people's origins, which is supported by data on human skeletal remains.

Keywords: human skeletons, racial affinity, bioarchaeology, recommendations, diversity

INTRODUCTION

The identification of human skeletal remains is a common problem in every archaeological research. Nevertheless, they are sources of data which are as useful as other archeological findings. The data may provide information on human social environments in the past. Even Brothwell argued that the reconstruction of human social environments cannot be conducted without any explanation and physical analysis of human morphology and the health condition in the social environment in which human beings had interaction with each other (Brothwell, 1981, pp. 1-5).

During their activities, humans are influenced by the enviromental conditions around them and they leave biological activity traces, so that their activity remains are well recorded and stored in their skeletons and bones (Evans, 2003; France, 2009). Human skeletal remains in the context of archaeology play a key role in explaining cultural forms and social aspects, describing environmental conditions and human populations, and even identifying the evolution of diseases in a community and other information variables (Brothwell, 1981). Although human skeletal remains have often been found in a small number and in a fragmented condition, they may describe the characteristics of a site - even most of archaeological sites (Hillson, 1996; White & Folkens, 2005; Irish & Nelson, 2008).

Human skeletal findings in archeological sites cannot be separated from the discipline dealing with human skeletal remains, i.e. bones and teeth. In 1972, bioarchaeology or osteoarchaeology was classified by Sir Graham Clarke as a part of zooarchaeology. Human skeletal findings in the context of archaeology are positioned as anatomical parts that are the same as those identified in fauna. Until 1976-1977, Jane Ellen Buikstra, an anthropologist and bioarchaeologist, positioned the study of human skeletal remains specifically into bioarchaeology. In this era, bioarchaeology was focused more on the examination of human skeletal remains from archaeological sites. By involving various disciplines, the discipline uses human skeletal remains as research objects to reconstruct the lifestyle, health problems, social problems, and activities in the past. Terminologically, there has been no general consensus on the boundaries of the discipline specifically dealing with human skeletal remains in the context of archaeology. However, most scholars use the term osteoarchaeology to refer to the study of human skeletal remains (Nikita, 2017).

In general, osteoarchaeology has developed and been focused more on human skeletal remains, particularly in the attempt to explore the health, lifestyle, diet, death, and physical conditions of human beings in the past. The discipline covers one of the brances of biology, i.e. the sub-study of anatomy dealing with defects dan anomalies in the morphological conditions of human skeletons (Nikita, 2017, p. ix). In particular, osteoarchaeology is the scientific study of human skeletal remains found in an archaeological site and their morphological defects. In general, osteoarchaeology is the study of human skeletal findings in the context of archaeology. Nonetheless, some scholars still use the term ‘bioarchaeology’ to deal with the same research object of human bone findings (Nikita, 2017, p. 1; White, Black, & Folkens, 2012, pp. 1-3). To examine human skeletons in the context of archaeology, one of the aspects that needs to be analyzed first is the biological aspect of human skeletons. Larsen (2006) defines the study of the biological aspects of human skeletons in three interactional relations, i.e. biological, cultural, and environmental conditions (Larsen, 2006).

Since the discovery of LJ1 human skeletons at Leang Jarie Site, Maros (Hakim, et al., 2019), archeological surveys and

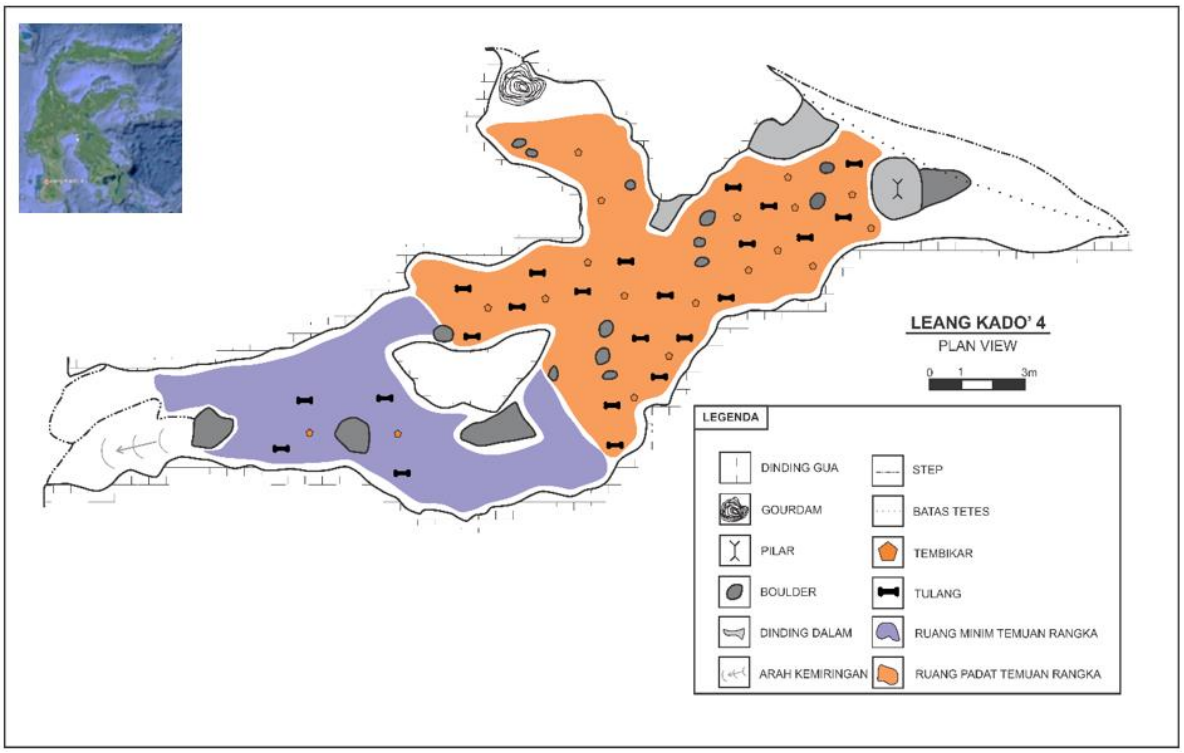

Figure 1. The location of Leang Kado 4 in Sulawesi and its site plan with two entrances; it is situated in a crevice on one of the karst clusters in Maros. Bone fragments are distributed evenly on the whole surface of the site (**Source**: Hakim with some modification, 2019)

excavations have been conducted more intensively around Simbang and its surroundings, a karst area on the south of Maros Pangkep. The prehistoric community inhabiting the karst area of Maros, in particular, left their traces with various data variables which can still be observed until today. The data provides information on the burials in the niches and caves in which they lived.

The use of niches or caves as burial grounds can be identified from the human bone remains on the surface of those sites. Leang Kado' 4 Site is one of such sites. It is situated at the coordinates of 05º 02.532 South Latitude and 119 º 41.344 East Longitude with the elevation of 68 meters above sea level. The cave mouth faces north. It is ±6 meters in width and ±20 meter in length. The site has two entrances on the top of the hill. From the entrances, the cave goes through the west part of the site (Figure 1). The cave is no longer active, as can be seen from its dry and sandy surface. Leang Kado' 4 has cave ornaments, such as stalagmites, stalactites, and pillars. The vegetation around the cave is shrubs dan vines. To reach the cave mouth, it takes ±20 minutes from the foot of the hill. The path is sloped and, at some points, steep with a slope of 85 degrees. The track is covered with roots and limestone, which can be used to step on (Figure 2).

One of the earlier studies on human skeletal remains in Sulawesi is a travel report written by Paul and Fritz Sarasin based on their journey around Lamoncong, Bone, South Sulawesi. The report tells about a community that used caves as residential and burial places. Sarasin brothers reported human skeletal findings from 1902 to 1905 in shallow graves in limestone caves of upper Cakondo, Lamoncong, Bone Regency. The findings indicate the use of shalow burial method. Their research note was supported by the information on the

Figure 2. The condition and position of Leang Kado'4 Site on the top of a hill with some findings of human bone fragments some of which have experienced concretion and been associated with the pottery fragments found on the surface of the site. The red arrow shows the cave mouth covered with bushes and tree roots (**source**: Hakim, 2019)

burial tradition performed by the community around Lamoncong at the time (Bulbeck, 2004).

Another research with data of human skeleton remains in Sulawesi is the observation by van Heekeren in Bola Batu Site, Bone Regency, in 1950. In the site, a skull was found. Based on its morphological features, Bulbeck (2004) identified that the skull originated in the Mid-Holocene period. During this period, Sulawesi had been inhabited for some time and experienced complexity, which can be seen from the abundance of archeological findings with distinctive prehistoric cultural features. One year after the observation by Heekeren, Hooijer conducted an archaelogical research at Leang Lompoa Site, Maros, in which he found human teeth remains. Data on these remains then becomes the data with which the measurements of Bugis and Makassar human teeth are compared. The data can be accessed at Utrecht Institute of Anatomy and Leiden Institute of Anatomy, the Netherlands (Bulbeck, 2004, p. 222).

Another research with data of human teeth remains is the observation at Leang Codong Site conducted by Willems and Mc Carthy in 1937 (Bulbeck, 1992, pp. 445-446). They analyzed and observed 2,500-2,700 loose teeth found in a cave site, representing 267 individuals (Jacob, 1967; Bulbeck, 2000; Soejono & Leirissa, 2007). The analysis was continued by Bulbeck (2004) by measuring the teeth fragments and comparing the results with the human teeth typically having the same characteristics and measurement from Jomon, East Asia. Data

on the teeth from Jomo was provided by Matsumura (1989). Bulbeck's research shows some typical features of sundadont teeth that characterize the teeth from Codong Cave Site (Bulbeck, 2004). The research was continued by Fakhri (2020) by conducting a comparative study and a radiocardon sample testing. Results of the testing show that the date of the site is 1950 BP (Fakhri, et al., 2020). The site provides important data on the method of human burial used in the cave during the palaeometallic period in Sulawesi.

Human skeletal remains in Maros and Pangkep were explored further. From the 1970s to 2000s, more human skeletal remains were discovered during archaeological researches. The skeletal remains were discovered in Leang-Leang, in particular Leang Petta Kere, Ulu Leang 2, Leang Paja, and Leang Burung 1 (Heekeren, 1972; Glover I. C., 1981; Glover I. C., 1978; Glover I. C., 1976; Bulbeck, 2004). Based on all the data on these human skeletal findings, it is known that the people in the areas used the method of shallow burial with the depth of the burial hole being not more than 1.5 meter (Bulbeck, 2004).

During the last decade, especially in 2016, human skeletons have been discovered in several sites during archaeological researches. One of those archaeological researches is the one conducted by the Research Team of Hasanuddin University, Universiti Sains Malaysia, and the Archaeological Center of South Sulawesi (Duli, et al., 2015). The team found human skeletal remains at Panningnge Site, Mallawa, Maros. It is known that the site was inhabited in 7264-7165 cal BP and it is the place where the oldest burial practice of the prehistoric community in the area was conducted (Duli, et al., 2015; Hasanuddin, 2016; Carlhoff, et al., 2021). The features of the skeletal findings show that the burial method used is primary burial in which the body was buried in a shallow pit. In the same year, Fakhri (2017) analyzed human skeletal findings in the plateau of Bontocani karst area, Bone Regency. Prehistoric burials using a cave are part of the traditions of the Austronesian language-speaking communities in this region. Pottery fragments found in the same context as the human skeletal remains strengthen the results of the identification (Fakhri, 2017, pp. 89-99).

In 2017, Budianto Hakim conducted an exploratory research in the prehistoric site of Maros-Pangkep. During the research, he discovered one human skeleton in Leang Jarie Site. The condition was mostly intact and could still be identified bioarchaeologically. Results of the research prove that the burial tradition of prehistoric people in caves was practiced from the early holocene epoch until the coming of the Austronesian language speakers in the region (Fakhri, 2019; Hakim, et al., 2019). Such evidence of burial tradition should be more emphasized in further researches and identifications (Hakim, 2017). To follow up the discovery of the human skeleton by Hakim, during 2017-2019, more intense explorations were carried out around the karst area of Simbang Maros. In 2019, the research team of the Archaeological Center of South Sulawesi found an indication of the utilization of caves as burial places in Leang Kado' 3 and 4. Skeletal identification was then focused on the findings at Leang Kado'4 Site, which provide more complete data than Leang Kado' 3 Site, in which the researchers found only one fragment of femur shaft, one fragment of tibial shaft, and several isolated teeth found on the crevice surface (Hakim, et al., 2018).

The analysis of the data on human skeletal findings in this article will be directed to answer some fundamental questions in osteoarchaeology related to human skeletal findings at Leang Kado' 4 Site. The research questions are as follows:

(1) What are the anatomical parts of the human skeletal remains?

(2) What is the minimum number of individuals that can be identified?
(3) What are the biological profiles and population affiliations of the human skeletal findings at Leang Kado' 4 Site?
(4) What are the sex and average age of the human beings buried at Leang Kado' 4 Site?
(5) How are the individualization and pathological conditions of the human skeletal remains?

METHOD

Human skeletal remains at Leang Kado' 4 Site were identified by using the standard analysis method that is used in physical anthropology in particular and/or osteology in general. The objects of analysis are bone structures and elements; bone functions, pathology and/or anomalies due to cultural modifications; and other attributes and articulations which can be identified from a bone. Such an analysis is often applied in forensic, physical anthropological, and archaeological investigations (White, Black, & Folkens, 2012).

The identification conducted in this research aims to provide an explanation of human skeletal remains found in some archelogocial sites and is not part of the analysis used in anatomical and medical researches. Bone identification in the research was directed to explain the archeological information obtained from the human skeletal findings. The identification in an osteoarchaeological research comprises three stages, i.e. biological profile reconstruction, postmortem reconstruction, and taphonomic process identification (White, Black, & Folkens, 2012; Noerwidi , 2012). In the current research, bone identification was the first step to reconstruct the human skeletal remains found at Leang Kado'4 Site and comprised the identification of sex, age, average stature, population affiliations, and the minimum number of individuals from the assemblage of human skeletal remains. The current research was focused on the first stage in the osteoarchaeological identification, i.e. identification and interpretation related to the reconstruction of the biological profiles of human skeletal findings at Leang Kado' 4 Site.

Sample collection was conducted at Leang Kado'4 Site by selecting some of the human bones which can still be observed and identified. Some of the bones which are very fragmentary were counted and not included in the samples for analysis and identification. The observation of the soil surface in the site was conducted by dividing the site space into two parts, i.e. the space where there are many skeletal findings and the space where there are few skeletal findings (Figure 2). The observation and sample selection were conducted in the space where there are many skeletal findings. The selected bones were then labelled, measured, and identified.

Sex identification referred to mandibular morphological differences between men and women. Sex identification was also conducted by measuring the difference between the caput radii diameter and the caput humeri diameter of the upper extremity of ossa longum based on the framework proposed by Byears (Byers, 2017). Individual age was identified by observing the epiphysis fuse and molar eruption. Average stature was estimated by using the formula for measuring the elements of os radius and os tibia developed by Sjovold (Sjovold, 1990). Population affiliations were revealed by macroscopically observing dental crowns (incisivus, caninus, premolar dan molar) that are still attached to maxilla and isolated teeth (loose teeth from alveolar sockets). The minimum number of individuals (MNI) was calculated by adding the left anatomical parts of the samples found. The calculation of the MNI used data obtained from the assemblages of bones and/or teeth found during the survey. During the survey, the

paired left and right parts were identified. Then, the number of the most parts was calculated by considering the size, form, and taphonomic process of the bone findings (Lyman, 1994, pp. 21-82; 2008; O'Connor, 2000; Davis, 2002, p. 34).

The comparative references for the analysis of the human skeletal findings in the research are *Human Osteology*, a book written by Tim D. White, Michael T. Black, and Pieter A. Folkens, and *The Human Bone Manual*, a book written by Tim D. White and Pieter A. Folkens. The comparative references for the early identification of the human skeletal findings in the sedimentary soil matrix are *Digging up Bones*, a book written by D. R. Brothwell, and *Osteoarchaeology: A Guide to The Macroscopic Study of Human Skeletal Remains*, a book written by Efthymia Nikita (White & Folkens, 2005; White, Black, & Folkens, 2012; Brothwell, 1981; Nikita, 2017). All these works became the comparative references to describe the human skeletal findings at Leang Kado'4 Site.

RESULTS AND DISCUSSION

The survey at Leang Kado' 4 Site was conducted in April 2019. Human skeletal remains were found in a dry condition, scattered on the surface of the cave floor and not in the anatomical position of human skeletal structures. They were found commingled from several individuals due to the taphonomic process which occurred during the decomposition process. They are associated with other findings, i.e. some pottery and faunal fragments. Several skeleton parts were found separated and distributed evenly in the area that we mapped (Figure 1). Leang Kado' 4 is a cave utilized as a place for mortuary or burial. In total, there are 47 bone fragments collected as finding samples. There are also bones found in one soil matrix and several isolated teeth. The 46 bone fragments are 6 os femur (3 on the right and 3 on the left), 5 os tibia (2 on the right and 3 on the left), 4 neurocranium (1 os frontale and 3 os parietale), 5 splanchnocranium (3 maxilla and 2 os zygomatic), 4 mandible, 6 upper extremity of ossa longum (1 left os humerus, 3 left os radius, 1 left os ulna, and 2 right os humerus), 1 os clavicula and 1 os scapula, 2 columna vertebralis, 1 os coxae (acetabulum part), 1 patella, 2 ossa tarsi (talus), 3 ossa metatarsi, and 3 ossa digitorum. From the assemblage of bones in the soil matrix, os femur, os tibia, and os coxae were identified. From the assemblage of isolated teeth, the fragments that were identified are 1 incisivus tooth (I), 2 caninus teeth (C), 4 premolar teeth (P), and 4 molar teeth (M).

Archaeologically, these human skeletal findings are associated with the

Figure 3. The pottery fragments associated with the human skeletal fragments. They seem to have experienced concretion and merged with the precipitating soil matrix at Leang Kado' 4 Site (Source: Hakim, 2019)

Table 1. Burial forms and features during the inhabitancy period in Sulawesi based on the taphonomic condition and process

	Flexed primary burial	Single individuals (disturbed primary?)	Extended primary burial	Commingled burials
Toalean	Panningne Cave[1,2], Balang Metti[3]	Leang Burung 1, Bola Batu[4]	—	—
Toala	—	Upper Cakondo[4]	—	—
Neolithic	—	—	Leang Jarie[5]	—
Paleometallic	—	—	—	Leang Pette Kere, Ulu Leang 2, Leang Paja, Leang Burung 1,[4] Codong Cave[6]

1. Hasanuddin. 2016. *Laporan Penelitian Arkeologi prasejarah di Situs Panningnge, Maros, Sulawesi Selatan.* Makassar: Balai Arkeologi Sulawesi Selatan.
2. Carlhoff, Selina, Akin Duli, Kathrin Nagele, Muhammad Nur, Laurits Skov, Iwan Sumantri, Adhi Agus Oktaviana, et al. 2021. "*Genome of a Middle Holocene Hunter-Gatherer from Wallacea*" *Nature* 543-547.
3. Fakhri. 2017. "Identifikasi Human skeletons Situs Gua Balang Matti, Kabupaten Bone, Sulawesi Selatan." *Walennae* 89-100.
4. Bulbeck, David. 2004. "South Sulawesi in The Corridor of Island Populations along East Asia's Pacific Rim." In *Quaternary Research in Indonesia*, by Susan G. Keates and Juliette M. Pasveer, 221-258. Leiden: A. A. Balkema.
5. Fakhri. 2019. "Identifikasi Awal dan Rekonstruksi Aspek Biologis Temuan Human skeletons LJ-1 Situs Leang Jarie, Maros, Sulawesi Selatan." *Walennae* 113-124.
6. Fakhri, Yadi Mulyadi, Suryatman, Salmia, Muh. Hafdal, Yulastri, Mega Ayu Alfitri, et al. 2020. *Tinjauan Terhadap temuan Gigi Manusia dalam Konteks Kebudayaan Austronesia di SItus Gua Codong, Sulawesi Selatan.* Makassar: Balai Arkeologi Provinsi Sulawesi Selatan.

pottery fragments which are also distributed evenly on the site surface. Some of the pottery fragments seem to have merged with the bones fragments through the process of concretion in the matrix of sedimentary soil (Figure 3). The human skeletal remains also experienced concretion.

Based on the taphonomic condition and the commingling of the human skeletal remains from several individuals, it can be assumed that the skeletal remains in the site originated in the palaeometallic epoch and/or are not older than the date of the oldest pottery remains found in Sulawesi. This assumption is based on the similarities among the data found in several archaeological sites in the same region. Results of the analysis of the human skeletal remains show that the burial site probably dates from the palaeometallic epoch. Several other palaeometallic sites in Sulawesi with commingled human remains can also be seen in the table below.

1. Elements of the Human Skeletal Remains at Leang Kado' 4 Site

Based on the macroscopical observation, the color gradations of the bone fragments are from browny white to brown. This seems to have been affected by the soil on the cave floor surface, which is brown and has a smooth texture. Of the 6 samples of os femur fragments, 3 fragments are the middle parts of corpus femoris (2 right side, 1 left side), and 3 fragments are the distal part of proximal corpus (2 left parts), one of which still has trochanter minor (right side). Of the os tibia fragments, 2 right-side and left-side fragments are one-third of the distalis part with epiphysis distal, and the 3 remaining fragments (1 right, 2 left) are a half of corpus tibia which leads to the distalis side without epiphysis (Figure 4). Of the samples of neurocranium fragments, os frontale fragments are parts of the right-side orbita and three other fragments of os parietale cannot be confirmed whether they are the left or right sides.

Of the samples of splanchnocranium fragments: 2 fragments are the right-side maxilla, one of which still has three molars on the alveolus; 1 fragment of the right maxilla with one full molar and one

Figure 4. Fragments of the lower extremity of *ossa longum* (*os tibia*) (**Source**: Hakim, 2019) .

fractured molar; and 2 fragments of os zygomatic, one of which is the right side (Figure 5). Of the mandible fragments, 1 fragment is a half part of mandible (left) fractured in the middle of area of trigonum mentale; 1 fragment of a half part of mandible (right) with no ramus mandibula; 1 small fragment of the alveolus; and 1 fragment of the lower part of ramus mandibula (right). Of the fragments of the upper extremity of ossa longum, there are 3 fragments of os humerus consisting of 1 fragment of caput humeri, 1 fragment of corpus humerus fractured on the upper part of margo lateralis and without epiphysis distalis, and 1 fragment of corpus humeri; 2

Figure 5. Fragments of *cranium*: *maxilla* and *os zygomatic* (**Source**: Hakim, 2019)

Figure 6. Fragments of the lower extremity of *ossa longum* (*os femur*) indicating the minimum number of 6 individuals (**Source:** Hakim, 2019)

fragments of os radius with caput radii until a small section of the lower part of tuberositas radii, and 1 fragment of caput radii; and 1 fragment of the proximal-side ulna fractured 3 cm under tuberositas ulnae.

It is not known from which parts the fragments of *scapula* and *clavicula* are because of their limited conditions. Of 2 fragments of *columna vertebralis*, one fragment is believed to be *thoracal vertebrae* and the other fragment *lumbar vertebrae*. The fragments of *os coxae* are parts of the right *acetabulum*. It is not know from which parts the fragments of *patella* are because of their limited conditions. The *talus* is from the left and right sides. Of the fragments of *ossa metatarsi*, 2 fragments are the 3rd and 4th left *metatarsi*, and 1 fragment is part of the *corpus metatarsi*. It is not known whether it is on the left or right. Of the fragments of *ossa digitorum*, there are 1 bone of the 1st *digitorum* of the right foot, 1 fragment of *corpus digitorum proksimalis* (it is not known whether it is from the left or right foot), and 1 fragment of the *digitorum distalis* of hands. The isolated teeth found are full right I^1 tooth; right C^1 with only the root remaining and full right C_1; full P^3 tooth (intact condition), P^4 tooth fractured on the *buccal* crown, left P^4 half fractured, and right P_3 fractured on the crown; full right M^1 tooth (intact condition); right M^1 with only crown fragments remaining ; right M_3 whose root is half fractured; and left M^2 half fractured.

2. The Number of Individuals

Based on the survey findings at Leang Kado' 4, the number of individuals was estimated. In general, such an estimation is a stage in the common procedure for the identification of human skeletal remains, particularly the commingled ones (Nikita, 2017, pp. 91-96). The estimation was conducted after the findings were collected and sorted. The estimation was conducted to determine the Minimum Number of Individuals (MNI). To put it simply, the MNI was determined by counting the number of the same bone elements (or bone parts), after being selected based on the their elements, sides, and maturity. Then the biggest number was used to estimate the MNI. With regards to the commingled findings, each fragment used to

Table 2. measurement of femur diameter on each individual Leang Kado 4

Individuals Leang Kado' 4	Measured elements	parts	*directional diameter (mm.)*	
			sagittal	*transversal*
1	*mid-shaft femur*	right	23	23
2	*mid-shaft femur*	right	21	21
3	*mid-shaft femur*	right	23	27
4	*mid-shaft femur*	left	30	23
5	*mid-shaft femur*	left	24	20
6	*mid-shaft femur*	left	24	21

count the MNI must have specific anatomical similarities (e.g, articulation and size) to ensure that they do not represent the same bone.

3. Biological Profiles

The identification of the population affiliations of the skeletal remains at Leang Kado' 4 is based on the findings of the isolated teeth and the teeth still attached to the socket in the maxilla fragments. It was conducted macroscopically (non-metric) by examining the particular characteristics of the incisors, canines, premolars, and molars. The identification refers to the procedure developed by Scott and Turner (Scott & Turner, 1997). The results of the identification are *shoveling* UI1 (score 2, minimum expression); LC1 one root; UP3, UP4 and LP4 one root; UM1 three roots (score 3); hypocone UM2 (score 3.5); metaconule UM1 (2 crowns) and UM2 (score 2, score 2, and score 3) (Figure 7).

From all the characteristics observed, those of the crowns become the main base for determining the population affiliations. With regards to the characteristics of shoveling UI1, score 2 can be understood as the shoveling trace (Scott & Turner, 1997). Shoveling is a dental characteristic whose occurrence frequency is high the Asian population (particularly the East Asian and North Asian), medium among the Sunda-Pacific population (the prehistoric and recent Southeast Asian, Polynesian, Micronesian), and low among the Sahul-Pacific, West Eurasia, dan Sub-Sahara African populations (Scott & Turner, 1997). Based on the above fact, one individual from Liang Kado'4 is believed to be affiliated to the Asian or Sunda-Pacific population.

Another characteristic is that of the molars, i.e. the hypocone characteristic of UM2 (score 3.5). The evolution trend of this characteristic in many populations experienced reduction. Therefore, in general, 3 cusps are commonly found in UM2. The reduction frequency is high among the European, Indian, Northeast Siberian, and Arctic American populations. It is medium among the Sunda-Pacific, East Asian, Jomon, Indian American, and North African populations. It is low among the Sub-Saharan African and Sahul-Pacific populations (Melanesian, Australian, New Guinean) (Scott & Turner, 1997). As to the metaconule characteristic, this characteristic is also known as 5 cusps (the 5^{th} cusp). The frequency of its occurrence is high among the Sahul-Pacific and Sub-Saharan African populations. It is medium among the Sunda-Pacific population. It is low among the West Eurasian and Sino-American populations (Scott & Turner, 1997). Results of the analysis of the hypocone and metaconule characteristics show that several individuals at Leang Kado' 4 have similarities with the Sahul-Pacific or Sunda-Pacific populations.

It should be noted that several populations have different characteristic

Figure 7. Isolated teeth found in Leang Kado' 4. At the top row are maxillary teeth, and at the bottom row are mandibular teeth. Several teeth were used to identify the population affiliation (**Source :** Hakim, 2019)

variabilities in the morphology of crowns. Some Chinese populations have incissors without shoveling, while some Australian Aboriginal populations have incissor shoveling. Meanwhile, the occlusal molars of several individuals of Sahul Pacific were found without metaconule characteristics, while those of some Chinese populations have them. The analysis and determination of every variable of the human race need large samples, so that reliable comparative data can be obtained. Regarding this, we would like to emphasize that the size of the samples that we analyzed is very small and the samples may not or even does not represent the population.

Considering the results of the studies of the prehistoric population in Indonesia, the Asian population, or the Sunda-Pacific population which is believed to be the affiliation of the individuals at Leang Kado'4, the individual to whom the UI tooth with shoveling belongs refers to the Asian population (Bellwood, 2000) or the Mongoloid population (Jacob, 1967). For the individuals with molars with the hypocone and metaconule characteristics (cusp 5), the Sahul-Pacific population is believed to be affiliated to the Australo-Papuan population (Bellwood, 2000) or Australomelanesoid population (Jacob, 1967). Therefore, the group or community using Leang Kado' 4 for burial or mortuary shares similarities with the Asian/Mongoloid and Australo-Papuan/Australomelanesoid populations.

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Figure 8. Some fragments of the upper extremity of ossa longum. Caput humeri (upper right) and caput radii (middle, upper, right) were used as the variables to determine sex. Os radius fragments were also used as variables to estimate height (**Source**: Hakim, 2019)

with the Asian/Mongoloid and Australo-Papuan/Australomelanesoid populations.

4. Sex

The sex of the human skeletal remains at Leang Kado' 4 was determined based on the characteristics of the mandible and upper extremity of ossa longum fragments (os radius and os humerus). From the fragments of the mandible, several characteristics can be seen, namely the obvious widening of the gonion (left mandible), wide chin (square shape), and protruding trigonum mentale remains (right mandible). These characteristics indicate that two mandible fragments belong to a male individual. From the upper extremity of the ossa longum, the characteristics used are the diameter of the caput radii and caput humeri (Figure 8). The results of the metric measurement are that the caput radii diameters of the three os radius fragments are the same, i.e. 21 mm, and the caput humeri diameters are 44 mm. According to (Byers, 2017), the caput radii diameters of 21 mm or below are women's, while longer diameters, including 24 mm, are men's. As to the humerus, 44 mm belongs to women (43-44) (Byers, 2017). Results of the examination of the mandible, os radius, and os humerus fragments show that two individuals are believed to be male and four individuals female.

5. Age

Age was estimated based on the fusion of the epiphysis ossa longum whose fragments still have epiphysis (proximal or distal), the condition of the M3 tooth eruption, and attrition of the occlusal surface of molars. From the upper extremity of the ossa longum, the epiphysis proximalis os ulna and os radius seem to have been fused, indicating an individual older than 19 years (White & Folkens, 2005; White, Black, & Folkens, 2012). For the lower extremity of the ossa longum, the epiphysis distalis os tibia also seems to have been fused, indicating an individual older than 21 years; and the trochanter minor in the os femur has

also been fused, indicating an individual older than 20 years (Ubelaker, 2008).

As to the M3 tooth eruption, the fragments of the right maxilla with molars having fully erupted indicate that the individual was older than 21 years (Ubelaker, 2008). As to the attrition of the occlusal surfaces of molars, both from maxilla molars and isolated teeth, six molars show occlusal surfaces with no attrition (no wear) and the low level of dental erosion on the enamel, indicating that the individual was aged 17-25. One half-fractured molar (left M^2) shows a high level of occlusal attrition, so that a little part of dentin can be seen, indicating an individual aged 25-35 (Brothwell, 1981). Based on the fragments of the ossa longum and teeth, the individuals from Leang Kado' 4 are believed to be on average 17-25 years old, while one individual 25-35 years old.

6. Stature

The stature of human skeletal remains at Leang Kado' 4 was estimated by using the elements of the os radius and os tibia. The stature was based on the length of the os radius fragments (two fragments with the left caput radii) and the os tibia fragments (fragments of the left and right corpus distalis) (Figure 8). The estimation used the formula proposed by Sjovold (Sjovold, 1990) because population affiliation dan sex data were not required. Results of the estimation show that the average statures of the individuals whose skeletal remains were found at Leang Kado' 4 are 147-153 cm (short) and 154-160 cm (tall).

7. Pathology and Individualization

The particular features suggesting the pathological conditions of the bone surfaces of human skeletal remains at Leang Kado' 4 can be observed in the fragments of the os parietale of the cranial bones. The fragments of the os parietale seem to have widened and thickened. The features are believed to be the pattern of *porotic hyperostosis*. This condition is a health disorder caused by *anemia* (a lack of red blood cells), *thalassemia* (triggered by malaria), or nutritional deficiencies (a lack of, for examples, vitamins A, C, and D). During the prehistoric age, *porotic hyperostosis* was relatively common among the populations living with subsistence undergoing a transition from hunter-gatherers to agriculture.

Leang Kado' 4 Site is a burial site used by the people supporting the culture during their inhabitancy in the caves and crevices in the area. The cultural context of the site is not older than that of the palaeometallic epoch, indicated by pottery as the context of finding. It is known that the commingled condition of the human skeletal remains was found not only at Leang Kado' 4 Site, but also at some other sites in which research had been conducted before. Based on the analysis of the number of individuals, it can be seen that at least six individuals were buried in the site primarily and secondarily. Certainly this needs to be analysed further by looking for other data variables which can prove the burial models practiced at Leang Kado' 4. Based on the morphological features of the teeth findings, it can be seen that the inhabitants of the site had an affinity with the Mongoloid and Australomelanesoid populations.

CONCLUSION

An analysis of existing studies on human skeletal remains in several archeological sites in South Sulawesi shows that more data will continuously be obtained. One of the sites with data on human skeletal remains is Leang Kado' 4 Site in Simbang karst area, Maros. The osteoarchaeological identification of the human skeletal remains with 47 bone samples reveals the characteristics of the humans buried there.

Results of the identification show that some anatomical remains of the human skeletons found in the site are os femur, os tibia, neuro_cranium, splanchno_cranium,

mandibular fragments, upper extremity of ossa longum (os humerus, os radius and os ulna), os clavicula, os scapula, columna vertebralis, os coxae, patella, ossa tarsi (talus), ossa metatarsi, and ossa digitorum. From the assemblage of bone fragments in one matrix, os femur, os tibia, and os coxae fragments were identified. Meanwhile, from the isolated teeth, some fragments were identified, namely 1 incisor tooth (I); 2 canine teeth (C); 4 premolar teeth (P); and 4 molar teeth (M). There are at least six individuals, consisting of two men and four women. The stature in the low category is 147-153 cm, while the stature in the tall category is 154-160 cm. In terms of age, five individuals were 17 to 25 years old and one individual was 25 to 35 years old. The population affiliations of those individuals are the Sahul Pacific (Australomelanesoid/Australo-Papuan) and Sunda Pacific (Asian/Mongoloid) populations.

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