

The Application of “Digit Ratio 2D:4D” in Predicting Male-Female Hands on Prehistoric Cave Hand Stencils in Indonesia

R. Cecep Eka Permana*, Karina Arifin, and Ingrid HE Pojoh

Universitas Indonesia
Indonesia

*Corresponding author's email: cecep1permana [AT] yahoo.com

ABSTRACT---- *Hand print/stencil is one object that is common found at prehistoric caves. Many aspects can be studied using hand stencils as sources, and one of them is the study of gender identity of the maker of the hand stencils, whose hands were printed on cave walls.*

It is John T. Manning who introduced the idea about “ratio 2-digit/4-digit (2D/4D)” to differ male palm/hand and female. It is said that the length of forefinger and ring finger can differ whether they belong to male or female. Manning’s idea is tested and applied on the hand stencils from prehistoric cave Petta Kere in Maros District, South Sulawesi, particularly from the panel where hand stencils are in a context with big belly wild boar.

1. INTRODUCTION

Hand stencils is one or archaeological remains that often found in prehistoric caves’ wall, and is known as oldest cave drawing in the world. Hand stencils is made by giving color on stretched faced-down hand on cave wall. Coloring is made around the hands so the part where the palm facing on the wall surface will not get colored, resulting a hand print is formed. This kind of technique is known as negative hand stencil or hand stencil, and will produce picture of hand in the same size of the hand itself. Another technique is positive hand stencil; the way producing hand stencil by coloring the palm of hands and imprint or stamp it on the wall. This technique is also known as hand print or imprint technique (Clegg, 1983: 94-95; Lewis-Williams, 2002: 216-218; Maynard, 1977: 391-401).

Some hand image is made using painting and drawing technique. By painting technique hand image is painted using brush and liquid color material, while by drawing technique hand image is drawn using dry color material, such as charcoal (Maynard, 1977: 391-401; Clegg, 1983: 90, 94-95). Most of cave hand images is made using negative hand stencil technique.

South Sulawesi is known as area that rich with hand stencils. It was Fritz and Paul Sarasin who in 1902 started cave research in *leang* (cave) Cakondo dan Balisao, both located in Maros area (Heekeren, 1972:106-120; Kosasih, 1985:165; Soejono, 2009:187). In 1950, C.H.M. Heeren-Palm started to explore the hand stencils from PattaE cave in Barru area, where and stencils with red color background are found in this cave, and also an image of a jumping *babirusa* (hog deer) with red lines drawn on the body. Hand stencils are also found in Leang Burung and Leang JariE (Heekeren, 1952:22-35, 1972:106-120; Arifin, 1992:8-9; Kosasih, 1995:16; Soejono, 2009:187), dating from 1,000-3,000 years ago as shown from the joined research between Research Center of National Archaeology (Indonesia) and Prehistory Department, Australia National University led by D.J. Mulvaney and R.P Soejono in 1969. C-14 charcoal analysis from those caves showed the date 1030±275 CE (ANU-392) (the Batu Ejaya cave), and 870±210 CE (ANU-391) and 1470±400 BCE (ANU-390) (the Burung cave) (Arifin, 1992: 8-9; Kosasih, 1995:16).

Researches are still carried on within the South Sulawesi region, not only in the Maros District but also the northern area, i.e. District of Pangkep. Discoveries and inventory are held by the Office of Cultural Heritage Preservation, Office of Archaeology Makassar, universities, and other agencies such as Coordinating Agency for Surveys and Mapping Agency (Badan Koordinasi Survei dan Pemetaan Nasional/Bakosurtanal) and Indonesian Institute Of Sciences (Lembaga Ilmu Pengetahuan Indonesia/LIPI)

Available research sources on cave from South Sulawesi (until 2011) show that more than 130 caves have archaeological remains inside, including hand stencils. But many of the images have vanished or fading. In this article only one panel of

hand stencils is used as sample, that is the panel of hand stencils in context with *babirusa* image from Petta Kere (Maros District).

Petta Kere cave is located within the area of Leang-leang dorp, Kalabbirang village, Bantimurung Sub-district, Maros District. Geographically lies in coordinate 04° 58' 48" South latitude and 119° 46' 21" East longitude, and 40 meters above sea level, and facing southwest (240°). The mouth of the cave have 3 meters width and 5 meters height. The cave has only one room, 3 meters long, 3 meters width, and 2.5 meters height. The shape of the cave is irregular and narrowed on the back. Drawing or painting images are located on the left side of the mouth of the cave in the form of hand stencils and images of pigs.



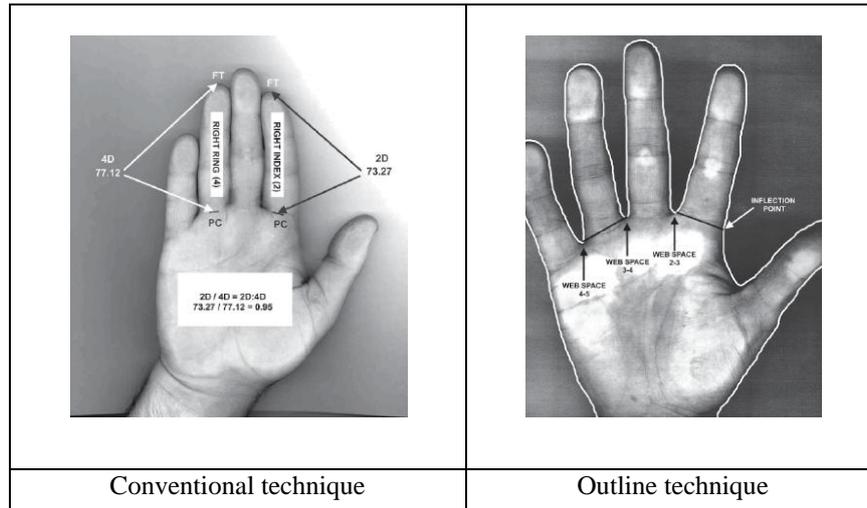
Mouth of Petta Kere cave (left) and the placement and shape of images (right)
(Photo: R. Cecep Eka Permana)

2. DIGIT RATIO 2D:4D

Many aspects can be studied from cave hand stencils. One of them is the study on the hand stencils placement on cave wall (Permana, 2008). But this time the study will be focused on gender identity, as revealed by Bahn dan Vertut (1997:189) who mention “is it male or female who use their own hands to make the hand stencils on prehistoric cave wall?” This is important regarding the reconstruction of gender role in the tradition of cave human habitation in prehistoric times.

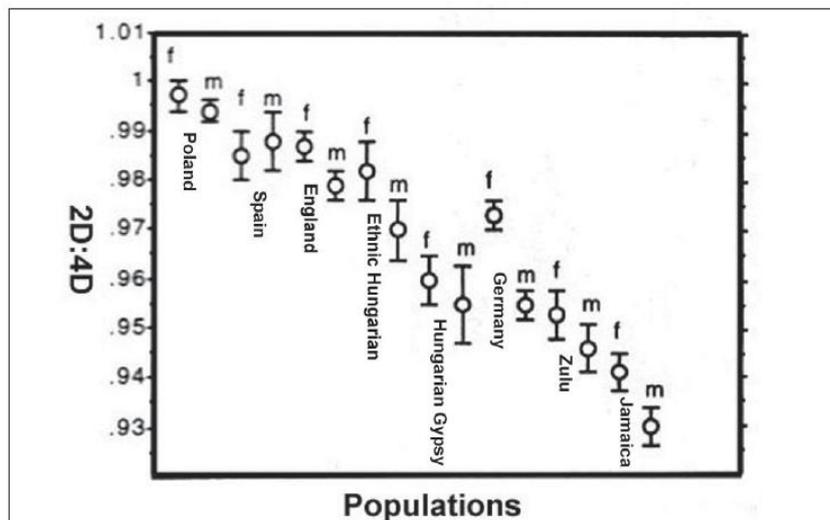
The issue on identifying male or female hand on prehistoric hand stencils was first brought in the conference of International Federation Rock Art Organization (IFRAO) on December 2004, based on researches conducted by J.T. Manning, D. Schutt, J. Wilson, and D.I Lewis-Jones (1998) and J.T Manning (2002) about “*digit ratio 2D:4D*” that said the ratio forefinger and ring finger can reveal gender identity. Manning, Schutt, and Lewis-Jones (1998) mentioned that hormones play part in the formation of fingers during the first months of fetus development. Estrogen hormone influence the development of forefinger and testosterone on ring finger, therefore the ratio of forefinger and ring finger of male and female will not be the same.

There are two ways in doing the measure of forefinger (2D) and ring finger (4D). The first or the conventional way, is by measuring the length of finger from the finger tip to the proximal crease. And the second way is by first making the hand outlines, and then the length of fingers is measured from the finger tip to the web space. The ratio 2D:4D is obtained from length of forefinger (2D) divided by the length of ring finger (4D), for example, length 2D = 73.27 and length 4D = 77.12, the ratio is 0.95 (Nelson, Manning, and Sinclair, 2006:4).



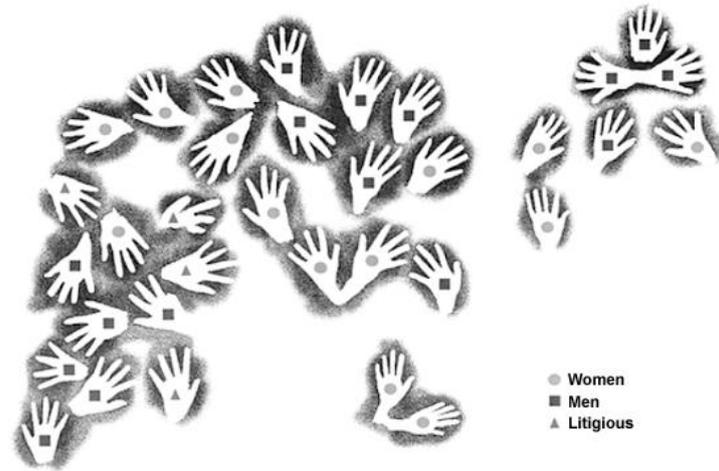
Measuring Forefinger and Ring Finger
(Source: Nelson, Manning, and Sinclair, 2006:4)

Statistic study on sex ratio shows that sex ratio varies based on the people group. Mostly show that female ratio 2D:4D is greater than male ratio (Manning, Schutt, and Lewis-Jones, 1998). For example, recent Polish female have average ratio 1, while male have 0.99, and English female have ratio 0.99 while male have 0.98. Female Hungarian gypsy have ratio 0.96 and the male have 0.93. Most equatorial people have smaller ratio compared to European (Nelson, Manning, and Sinclair, 2006:3).



Mean Digit Ratio Graphic of Some Tribes
(Source: Nelson, Manning, and Sinclair, 2006)

Dean R. Snow (2006) and J.M Chazine and A. Noury (2006) then tried to apply the study on prehistoric hand stencils. Snow studied six hand stencils from several caves in France and the result showed the hand stencils were from four female adult, two male adult and juvenile. What Chazine and Noury do on 34 hand stencils from Masri II cave in East Kalimantan show that they were from 16 male adult, 15 female, and 3 unidentified.



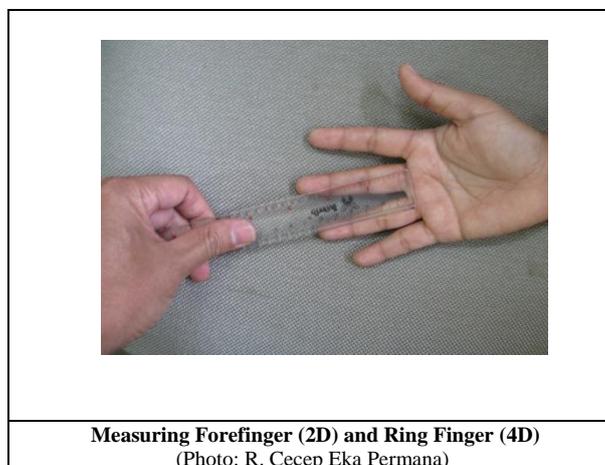
Male and Female Hand Stencils from Masri II Cave
(Source: Chazine and Noury, 2006)

Chazine and Noury's article published in International Newsletter on Rock Art (INORA) 2006/44:21-26, titled "Sexual determination of hand stencils on the main panel of the Gua Masri II cave (East-Kalimantan/Borneo-Indonesia)" was responded by J.M Manning, Emma C. Nelson and Anthony GM Sinclair, in their article published in *Before Farming* (2006/1 article 6:1-7) titled "Using the length of the 2nd to 4th digit ratio (2D:4D) to sex cave art hand stencils: factors to consider". Manning appreciated Chazine and Noury applying the digit ratio 2D:4D method on hand stencils from prehistoric cave Masri II in East Kalimantan, but regretting that they use the ratio of Europe people hands (0.96 for male and 1.0 for female) as reference. To be accurate and valid, the ratio of local Kalimantan people should be used (Nelson, Manning, dan Sinclair, 2006:4).

3. HAND MEASURING IN SOUTH SULAWESI

Considering what Nelson et al. have suggested, forefinger (2D) and ring finger (4D) measuring is applied to local people who live around the caves of the Maros area. They have been living there from one generation to the next so it is assumed that they might have line of descent relationship with people who traditionally made the prehistoric hand stencils. Forefinger and ring finger measuring is held in three villages, i.e. Leang-leang dorp (Leang-leang village, Bantimurung Sub-district, Maros District), Samanggi dorp (Jenetaisa village, Bantimurung Sub-district, Maros District), and Belae dorp (Biraeng village, Pangkajene Sub-district, Pangkep District).

Conventional method is used for measuring the forefinger and ring finger. Before measuring is taken, both hands are stretched with palm facing up. Measure of the length of the forefinger (2D) and ring finger (4D) of left and right hands are counted from finger tip to the proximal crease using a ruler. Beside forefinger and ring finger data, information about gender identity, age, and occupation is also collected and recorded.



In Leang-leang dorp, we collected finger data from 57 people (31 male and 26 female), while in Samanggi dorp we collected finger data from 49 people (27 male and 22 female), and from Bellae dorp we collected finger data from 75 people (22 male and 53 female). All is 181 people, and measuring is done for both right and left fingers of adult people and juvenile as well considering the hand stencils on the wall of the caves are varies in size.

Ratio analysis formula $R = 2D: 4D$ (that is, dividing the average length of the forefinger and the average length of the ring finger) is used to get the ratio of the forefinger and ring finger of the population living around the prehistoric caves. The counting from Leang-leang dorp shows the ratio of male and female right forefinger and ring finger is 0,926 : 1,128, and the ratio of male and female left forefinger and ring finger is 1,178 : 0,996. This shows that average ratio 2D:4D of right and left fingers of male and female is not similar. The mean ratio 2D:4D of female right finger is greater than male, but male left finger is greater than female.

Ratio Statistics for 2D:4D Right & Left

Location	Group	Mean (right)	Mean (left)
LEANG-LEANG	MALE	0.926	1.178
	FEMALE	1.128	0.966

Average length of right forefinger and ring finger in Samanggi dorp shows the ratio between male and female is 0,940 : 1,160, while the left forefinger and ring finger shows the ratio 1,134 : 0,974. This shows that the ratio 2D:4D of right hand is greater on female but left hand ratio 2D:4D is greater on male.

Ratio Statistics for 2D:4D Right & Left

Location	Group	Mean (right)	Mean (left)
SAMANGGI	MALE	0.940	1.134
	FEMALE	1.160	0.974

The average ratio of male right forefinger and ring finger and female right forefinger and ring finger in Bellae is 0.954 : 1.098, while the ratio of left fore finger and ring finger of male and female is 0.941 : 1.192. This shows that the ratio 2D:4D of male and female right and left hand in the Bellae dorp is quite similar, that female is larger than male.

Ratio Statistics for 2D:4D Right

Location	Group	Mean (right)	Mean (left)
BELLAE	MALE	0.954	0.941
	FEMALE	1.098	0.920

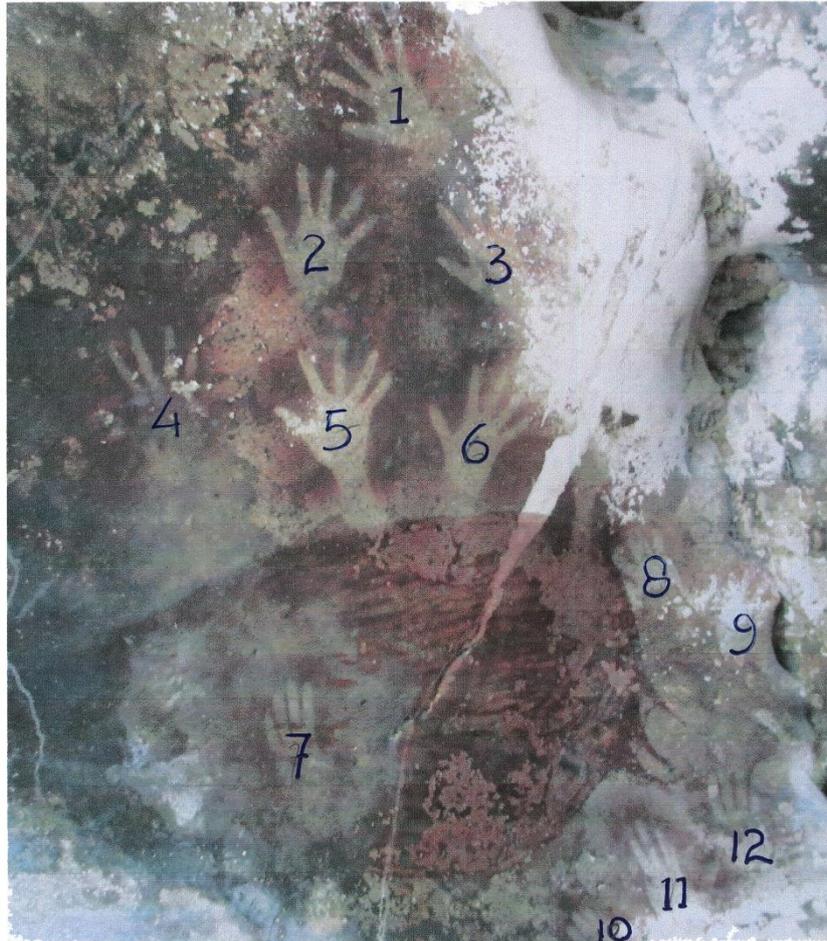
Analysis on that three locations show that mean ratio 2D:4D of right hand female is greater than male, but male left hand is greater than female left hand (see following table).

Ratio Statistics for 2D:4D Right & Left

Location	Group	Mean (right)	Mean (left)
SOUTH SULAWESI	MALE	0.940	1.084
	FEMALE	1.128	0.953

4. APPLICATION OF DIGIT RATIO 2D:4D ON PETTA KERE CAVE

There are two panels on the wall of Petta Kere cave. One panel shows hand stencils together with a big belly boar, and the other panel show hand stencils together with a smaller belly boar. Twelve hand stencils used as sample are from the panel with big belly boar. Six of the twelve hand stencils located above the boar (1-6), one on the belly (7), two on the right side of the boar (8-9), and three below the boar (10-12). All hand stencils are in good condition and can be measured the length of the fingers except the 8 and 9 (see the picture below).



Sample of Studied Panel
(Photo: R. Cecep Eka Permana)

Nine from the twelve hand stencils are right hands (1-6, 8, and 12), three are left hands (7, 10, 11), and one is unidentified (9). Hand stencils 9 and 10 can not be measured because they are worn out. From ten measured hand stencils, the length of forefingers (2D) varies from 6.0 to 9.3 cm and the ring fingers (4D) varies from 6.3 to 9.7 cm, and the 2D:4D ratio shows 0.926 to 1.071. By using local people mean ratio as reference, those hand stencils show seven male hands (2, 4, 5, 7, 8, 11, and 12) and three female hands (1, 3, and 6) (see the following table).

NO	LENGTH (cm)		RIGHT/ LEFT DIGIT (cm)	RATIO	SEX
	2D	4D			
1	7,2	7,0	right	1,028	female
2	7,6	8,2	right	0,926	male
3	8,2	8,0	right	1,025	female
4	7,7	8,0	right	0,962	male
5	8,0	8,1	right	0,987	male
6	8,4	8,2	right	1,024	female
7	9,0	8,4	left	1,071	male
8	6,0	6,3	right	0,952	male
9	?	?	?	?	?
10	?	?	right	?	?
11	9,3	9,7	left	0,958	male
12	7,1	7,4	right	0,959	male

5. CONCLUSION

The using of *ratio 2D:4D* to study male and female hands is still new in archaeology, especially for prehistoric rock art, but it is important considering no method and technique are yet available. It is hoped that the study of digit ratio 2D:4D will reveal more about the mystery of the past.

Attempt is done in using the digit ratio 2D:4D on one panel in the Patta Kere cave, South Sulawesi, and the temporary result show as follows:

1. There are at least twelve person whose hand stencils were imprinted on the wall of the cave.
2. Based on the mean ratio of local people 2D:4D and the mean ratio of the 2D:4D of the cave hand stencils, it can be assumed that both male and female were active in the making of cave hand stencils.
3. In relation with the image of hand stencils together with big belly boar which was assumed have relation with hunting ceremony, it could be said that both male and female were involved in the ceremony.

Still many questions need to be answered and elaborated, and comprehensive study is certainly needed. Hopefully this article can be a trigger to further develop the topics and archaeological studies in Indonesia as well..

6. REFERENCES

- Arifin, Karina
1992 Lukisan Batu Karang di Indonesia: Suatu Evaluasi Hasil Penelitian. Laporan Penelitian DPP UI. Depok: Lembaga Penelitian Universitas Indonesia
- Arifin, Karina dan Philippe Delanghe
2004 *Rock Art in West Papua*. Paris: UNESCO.
- Banh, P. & Vertut, J.
1997 *Journey Through the Ice Age*. Berkeley: University of California Press
- Chazine, Jean-Michel & Noury, Arnaud
2006 “Sexual Determination of Hand Stencil on the Main Panel of the Gua Masri II Cave (East-Kalimantan/Borneo-Indonesia)”, *International Newsletter On Rock Art (INORA)*44:21-26.
- Clegg, John
1983 “Recording Prehistoric Art”, in Graham Connah (ed.) *Australian Field Archaeology a Guide to Techniques*. Canberra: Australian Institute of Aboriginal Studies.
- Forge, Anthony
1991 “Handstencils: Rock Art or Not Art”, in Paul Bahn dan Andrée Rosenfeld (ed.), *Rock Art and Prehistory*. Oxford: Oxbow Book, Park and Place, p. 39-44.
- Heekeren, H.R. van
1958 “Rock-Paintings and Other Prehistoric Discoveries Near Maros (South West Celebes)”, in *Laporan Tahunan 1950 Dinas Purbakala Republik Indonesia: Archaeological Service of Indonesia*. Djakarta, p. 22-35.
1972 “The Stone Age of Indonesia”, in *Verhandelingen van Het Koninklijk voor Taal Land en Volkenkunde*: 61, The Hague-Martinus Nijhoff.
- Kosasih, E.A.
1986 “Studi Komparatif tentang Lukian-Lukisan Gua Prasejarah di Kawasan Asia Tenggara (Indonesia, Thailand, dan Pilipina)”, *PIA IV* (vol. II-b). Jakarta: Ikatan Ahli Arkeologi Indonesia, p. 377-394.
1995 Lukisan gua di Sulawesi Bagian Selatan: Refleksi Kehidupan Masyarakat Pendukungnya. Master thesis. Universitas Indonesia.
- Lewis-William, David
2002 *The Mind in the Cave: Consciousness and the Origins of Art*. London: Thames & Hudson Ltd.
- Maynard, L.
1977 “Classification and terminology in Australian rock art”, in P.J. Ucko (ed.) *Form in Indigeneous Art: Schematisation in the art of Aboriginal Australia and Prehistoric Europe*. Canberra: Australian Institute of Aboriginal Studies.
- Manning, J.T., Schutt, D., Wilson, J., & Lewis-Jones, D.I.
1998 “The ratio of 2nd and 4th digit length: a predictor of sperm number and concentrations of testosterone, luteinizing hormone and oestrogen” in *Human Reproduction*, 13: 3000-3004.
- Nelson, Emma C., Manning, John T., Sinclair, Anthony G.M.

2006 “Using the length of the 2nd to 4th digit ratio (2D:4D) to sex cave art hand stencils: factors to consider” in *Before Farming* 1 article 6: 1-7.

Permana, R. Cecep Eka,

2005 “Bentuk Gambar Telapak Tangan pada Gua-gua Prasejarah di Kabupaten Pangkajene Kepulauan, Sulawesi Selatan” in *WACANA* Vol 7 No. 2.

Oktober: 161-174

2008 Pola Gambar Tangan Pada Gua-Gua Prasejarah di Wilayah Pangkep-Maros Sulawesi Selatan. Dissertation. Universitas Indonesia

Snow, Dean R.

2006 “Sexual dimorphism in Upper Palaeolithic hand stencils” in *Antiquity*, June, 308: 390-404.

Soejono, R.P., & Leirissa, R.Z. (eds.)

2009 “Zaman Prasejarah di Indonesia” dalam *Sejarah Nasional Indonesia* Vol.I (updated edition). Jakarta: Balai Pustaka