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A New Analysis of Population History in Sabah and Sarawak

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ABSTRACT

Objective - This study is a comprehensive account of contemporary knowledge concerning pre-historic communities in Sabah and Sarawak based on newly available evidence from genomic and archaeological research.
Methodology/Technique – The data presented in this review was obtained from primary literature including recent reports on several Neolithic excavation sites including Gua Sireh, Bukit Tengkorak, Melanta Tutup, and Bukit Kamiri.
Findings - Pre-neolithic populations existed in Borneo long before the arrival of Austronesians as is evident from Niah Cave remains. These considerably pre-date the arrival of the latter new immigrants around 3,500 years ago. Further genetic research is needed, as the current view of the history of the population is based on a limited number of ethnic groups among those currently living in Borneo and to date, no trace has been found of any surviving genetic lineages from the earliest settlers.
Novelty – This review paints a contemporary picture from existing information. In particular, it highlights the need for further research on the topic, as the current view of the genetic history of the population in Sabah and Sarawak is only available on a limited number of ethnic groups currently living in Borneo. Developing a conclusive and composite view on this topic will require widespread genetic surveys of many more ethnic groups scattered throughout the Sabah and Sarawak areas. This will require large-scale next-generation techniques (such as genome-wide SNP surveys and whole genome sequencing etc.). These methods should be enhanced by examination of ancient materials including human remains and their associated artefacts. These initiatives will require a number of well-planned excavations of recent settlements (last 10,000 years) and the application of trace and ancient DNA methodology.
Type of Paper: Review.

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1. Introduction

Sabah and Sarawak are located on the island of Borneo which, together with the Malay Peninsula, in Sumatra and the surrounding islands, was once part of the greater Sundaland region

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This emergent landmass existed throughout the last glacial period (~2 million years ago) and enabled overland migrations of early humans into the region (de Bruyn et al., 2014). The region was first populated by an archaic species known as Homo erectus which was followed by the dispersal of an anatomically modern human, Homo sapiens, from Africa between 126 – 81,000 years ago (Thiel, 1987). The climate in Sundaland during the late and early Pleistocene was more arid and seasonal than modern times, however, some isolated pockets of rainforest did exist during that time (Batchelor, 1979; Cannon & Manos, 2003). The tropical rainforest that we see today likely spread gradually throughout the region during the later Pleistocene era into the Holocene period, as is evident from the presence of the Orang Utan in both Borneo and Java (Bird et al., 2005). Successive millennia saw further temperature fluctuations, peaking 8,000 years ago, which resulted in the rise of sea-levels (Bellwood, 1985). Changes in climate, the ecozone and geographical settings across the region have clearly affected migration patterns and cultural development of early humans, particularly in Sabah and Sarawak; made particularly evident by the extinction of Homo erectus (Simajuntak, 2006). This paper provides a contemporary account of the prehistoric communities in Sabah and Sarawak based on newly available evidence from genetic and archaeological research.

2. Human Settlement in Sabah: Anthropological, Archaeological and Historical Evidence

The history of Sabah can be traced to as early as 200,000 years ago (Saidin, 2014). Recent archaeological research by Universiti Sains Malaysia and the Sabah Museum at Mansuli in Lahad Datu has produced a new radiocarbon age for the site, being 235,000 years (Abdullah, 2013). Other significant Paleolithic sites in Sabah include Pulau Balambangan, Keningau, Gua Samang Buat, Madai, Baturong, Tingkayu, Menteri, Temonggong, Permai, and Makua. Archaeological discoveries from these sites have mainly been lithic artefacts such as hammer stone cores, used and waste stone flakes (Harrisson & Harrisson, 1971; Bellwood, 1988; Abdullah, 2013).

In Sabah, several Neolithic and Metal sites have been identified by the inland regions of Kunak and Lahad Datu. These sites include Pusu Lumut in Tapadong (Segama, Lahad Datu), Hagop Bilo and Lobang Tinggalan in Baturong (Kunak) and Agop Sarapad, Pusu Samang, Tas Agop Alag and Agop Atas in Madai (Kunak) (Harrisson & Harrisson, 1971; Bellwood, 1988). Archaeological explorations in the east coast region of Sabah has also uncovered several Neolithic and Metal sites. These include: Melanta Tutup, Bukit Tengkorak, Bukit Kamiri and Bugaya in the district of Semporna (Bellwood, 1989; Chia, 2003; Chia, 2016). The Neolithic cultural remains found at these sites include pottery sherds, polished adzes, faunal remains and ornaments made of shells and bones. Metal artefacts in the form of bronze celts, kettledrums, iron knives, spearheads and fragments of parang-like implements have been discovered at the burial site of Pusu Lumut in Tapadong, Agop Atas in Madai Caves, Timbang Dayang in Pulau Banggi and Bukit Kamiri and Melanta Tutup in Semporna (Harrisson, 1965; Harrisson & Harrisson, 1970; Chia, 2016). Further, the use of wooden coffins for burials has been reported at sites in the Madai-Baturong region of Kunak, Gua Tapadong in Segama and Melanta Tutup and Bugaya in Semporna (Harrisson & Harrisson, 1970; Chia & Koon, 2003; Chia, 2016).

Early archaeological research in Sabah, particularly in the inland regions, has not produced any formal reports on prehistoric human remains. However, some information has been provided by Cranbrook on the discovery of human bones at Hagop Bilo in Baturong (Bellwood, 1988). Moreover, three human teeth were found during the excavation of Gua Balambangan in Pulau Balambangan in 1998. These teeth were found at the depth of 120cm, believed to be 15,520 years old, belonging to modern Homo sapiens of the Paleolithic period with an Australoid affinity (Abdullah, 2005).

More detailed and comprehensive work on prehistoric human burials in Sabah has been produced by the region of Semporna in the mid-2000s. There are two burial sites containing prehistoric human remains: Melanta Tutup and Bukit Kamiri. A total of eight human skeletons were unearthed from Melanta Tutup in 2004, and two were found at Bukit Kamiri in 2007 (Eng, 2009). Palaeoanthropological studies on these skeletal remains confirm that the Melanta Tutup specimens are recent. The remains found consisted of four

adults (one female and three males), two children and two infants. These bones were radiocarbon dated between AD 890 and 1,170 years old (Chia & Matsumura, 2007). The Bukit Kamiri specimens, on the other hand, consist of two adult males believed to be approximately 3,330 to 2,930 years old (Chia et al., 2005). A detailed examination of these individuals using dental metric clustering analysis shows that the Melanta Tutup and Bukit Kamiri specimens both have close affinities with Island Southeast Asian groups, Neolithic South China and other Mainland Southeast Asia specimens. They were identified to be different from the Australo-Melanesian stock (Eng, 2009).

Although no prehistoric human skeletons have ben found at Bukit Tengkorak in Semporna, the site has been identified as a major pottery-making center in Southeast Asia during the Neolithic period (Chia, 2003; Chia, 2016). The cultural and familial relations of the Semporna Bajau Potters and people of the Sulu Archipelago in the southern Philippines has been established by a previous genealogical study (Narayanen, 2011, 2017). However, the exact year of their migration from the Sulu Archipelago to Semporna is difficult to determine. Despite this, there is evidence of their presence on the islands of Semporna prior to the arrival of the British North Borneo Chartered Company in 1878. In addition, ethnoarchaeological and comparative studies of the present pottery styles, with those used in the past in Semporna, show that Bukit Tengkorak prehistoric pottery shares similarities with Bajau traditional pottery, particularly in terms of its shape, function and method of production (Narayanen, 2011, 2017). Interestingly, both the prehistoric and traditional ceramics of Semporna are closely linked to Samal pottery which is made in the islands of Sulu, in the southern Philippines (Narayanen, 2011, 2017). All these facts indicate that potting communities with the same cultural background had lived and made pottery for long periods of time in Semporna and the Sulu archipelago. Similar potting traditions have continued in many parts of these two regions up to the present day. Based on the past environment and dietary items found at Bukit Tengkorak, the prehistoric sites in Semporna were probably occupied by coastal marine-oriented people, similar to those seen in the present day Bajau Darat and Bajau Laut communities of Semporna, Sabah (Chia, 2003; Chia, 2016).

3. Human Settlement in Sarawak: Anthropological, Archaeological and Historical Evidence

Archaeological investigations in Sarawak have provided ample evidence of prehistoric human occupation from the Paleolithic to the late prehistoric period. Some of the most important archaeological sites in Sarawak include: Gua Bungoh, Gua Sireh, Gua Tupak, Lubang Angin, West Mouth, Bukit Sarang and Santubong. Archaeological excavations at these sites reveal a large number of cultural artefacts such as earthenware sherds, stone tools, faunal remains, iron objects, beads, and ceramics. Further evidence of prehistoric human remains has also been recovered from sites such as West Mouth, Gua Sireh and Lobang Tinggalan (Harrisson, 1965; Datan, 1993).

Paleolithic period human settlement began in Sarawak around 40,000-45,000 years ago at Gua Niah in the Subis Limestone Complex of the Miocene Tangap Formation. Choppers, axe-adzes, pounders, sharpeners, hammerstones, knives, mortars, scrapers, and flakes are among the major types of stone artefacts found in the Niah Caves. The most impressive finding from Gua Niah site was a human cranium from West Mouth discovered in 1958 (Harrisson, 1959; Harrisson, 1967). Since then, more than 200 human burials have been recovered from the site and these specimens have been extensively studied by researchers such as Krigbaum and Datan (1999), Zuraina and Pfister (2005), and Zuraina et al. (2005). The ‘Niah 1977’ skeleton was excavated by Zuraina in 1977 at West Mouth and has close affinities to the Sunda type or Southern Mongoloid race (Zuraina et al., 2005).

Reconstruction of the Neolithic period in Sarawak has been controversial among archaeologists as some believe that the Neolithic began around 3,000 - 3,500 years ago while others argue that it is traceable as fat back as 4,000 – 4,500 years ago (Datan, 1993; Chia, 2007). Some of the notable Neolithic sites in Sarawak include: Niah Caves, Gua Sireh, Lubang Angin, Gua Tupak, Bukit Sarang and Gua Bungoh. Common artefacts found at these sites include earthenware pottery, stone tools, and food remains consisting of freshwater shells and animal bones (Datan, 1993; Velat, 2005; Gani, 2010). Human bones have also been

recovered from Gua Sireh and Lubang Angin. The human remains were typically found along with grave goods such as imported monochrome glass, carnelian beads, gold beads, modern ceramics, fragments of an iron knife, exotic stones and metal objects (Datan, 1993). The presence of glass beads and metal objects confirms that the Gua Sireh and Lobang Angin burials belong to the Iron Age dating back to not more than 1,500 years ago (Chia, 2007). No information has been reported to date on population affinities of people from Gua Sireh and Lubang Angin.

The Iron Age of Sarawak is best represented by the archaeological sites of Sungai Jaong, Sungai Buah and Bongkissam in the Santubang region of Sarawak Delta River. Artefacts found at these sites include iron slags, crucibles and clay cylindrical tubes. Stone artefacts in the form of hammer stones, 'ritual and wasted' stones, pounders and anvils, gold objects, Chinese trade ceramics, glass beads and a 'Tantric' shrine have also been identified (Harrisson & O'Connor, 1968). Another site excavated in Santubang is Tanjong Kubor, a cemetery site, has also uncovered earthenware pottery, Chinese stoneware and coins, bronze bangles, beads, iron and gold objects (Harrisson & Harrisson, 1957). Apart from these two sites, iron implements have been found at Gua Bungoh in Bau and Lobang Batu Puteh in Bukit Sarang, Bintulu, Sarawak (Harrisson & Tweedie, 1951; Velat, 2005).

4. Genetic Genealogy in Sabah and Sarawak

Natives of Sabah and Sarawak are Austronesian speakers. These languages are similar to those of Proto-Malays and Malays in Peninsular Malaysia and Polynesians in Oceania. However, does not necessarily imply a genetic link. They may simply have become Austronesian speakers due to linguistic and cultural shifts. Such changes are a common phenomenon among indigenous communities, including the Semang in Peninsular Malaysia and Negritos in the Philippines. These indigenous people have abandoned their aboriginal languages and adopted those introduced by their Austroasiatic or Austronesian neighbors (Norhalifah et al., 2016a). However, multidisciplinary approaches (i.e. gathering evidence from archaeology, anthropology, linguistic and genetic researches) have revealed the distinctive features between Semang, Negrito and other linguistically related populations (Bellwood, 1997; Norhalifah et al., 2016a).

From a genetic point of view, the gene-pool of a particular descendant population is expected to be more or less similar to that of their ancestors. However, several events such as admixture and adaptation towards local selective forces may skew allele frequencies in the gene-pool of the descendant population towards those found in the population with which they have been admixed. Alternatively, it may better reflect their geographical location, rather than just being similar to those of their putative ancestors. A good example of genetic admixture is in present-day Maori and Polynesians in New Zealand; their gene-pools contain material from their putative Taiwanese aboriginal ancestors (70% to 90%) together with a Papuans heritage (30%-10%) (Wollstein et al., 2010). This is the result of genetic introgression from Papuan into Proto-Polynesians in Near Oceania before the latter voyaged to the eastern and central Pacific region, i.e. The Cook Islands, Samoa, Tonga, Easter Island and New Zealand (Chambers, 2006; Chambers et al., 2016).

Extensive population genetic screening has been conducted in Peninsular Malaysia using genetic samples collected from Malays, Orang Asli (Proto-Malays, Semang and Senoi), Indians and Chinese (e.g. recently reviewed by Edinur & Chambers, 2017 and Norhalifah et al., 2016a). The important finding from the research on the Malays and Orang Asli is that genes which are important in medical genetics have a whole different repertoire in various sub-populations in Peninsular Malaysia. These include allelic variations in many cytokine, human leukocyte antigen, killer cell receptors, and blood group genes which determine donor and recipient compatibility in transfusion and transplant medicine, as well as being important in the recognition of pathogens and tumors. These differences reflect the various ancestral fractions across the region. A similar genetic structure was also reported from the genome-wide SNP and whole genome sequencing data (Wong et al., 2013; Deng et al., 2015). These observations are related to three major waves of prehistoric settlements of Peninsular Malaysia by the Semang (~50,000 years ago), Austroasiatic Senoi (5,000-6,000 years ago) and Austronesian Proto-Malays (from 5,000 years ago in Taiwan to 3,500 years ago

over most parts of ISEA). This was then followed by the historic arrival of immigrants from China, Arabia, Europe and India to Peninsular Malaysia (Chambers & Edinur, 2013).

However, an initial detailed search in a Web of Science literature for the population genetic research in Sabah and Sarawak returned several reports on human leukocyte antigens, short tandem repeat, single nucleotide polymorphism and mitochondrial DNA work on one or more Austronesian population groups, including Kadazan, Bajau, Murut, Iban, Bidayuh and Melanau (e.g. see Xing et al., 2009; Dhaliwal et al., 2010; Simonson et al., 2011). The population data from these studies reveals genetic fractions that are comparable to those of other Austronesian populations in ISEA which was later supported by the genome-wide SNP data collected from several ethnic groups (Bidayuh, Dusun, Rungus and Murut) in Sarawak and Sabah (Lipson et al., 2014, Deng et al., 2015, and Yew et al., 2018a).

In addition, comparative analysis of dental and craniofacial metrics reveals morphological similarities between modern Australian Aborigines and Papuans and pre-Neolithic samples excavated from the Philippines (Tabon Cave), Sarawak (Niah Cave), Gua Kepah (Penang) and Gua Runtuh in Perak (Bellwood et al., 1997; Matsumura & Oxenham, 2014) which supports the general account of the late Pleistocene colonization of SEA by Anatomically Modern Humans (AMH). Surviving settlers in this region is represented by the Semang Orang Asli group in Peninsular Malaysia, Negrito in the Philippines, and Papuans and Australian Aboriginals in Near Oceania, however, no single representative descendant population has been identified in Borneo to date. Thus, the most appropriate explanation is that the early AMH people who first occupied and colonized Borneo during the Pleistocene period were subsequently replaced or entirely absorbed by the farming populations who migrated there from the north (Taiwan) through Luzon to occupy Borneo and finally settled Peninsular Malaysia and Indonesia, Melanesia, near Oceania and remote Oceania (Bellwood et al., 1997).

This view is consistent with the genomic data; no trace of a pre-Neolithic genetic component has been detected in Bidayuh, Dayak, Dusun, Sonsogon, Lingkabau, and Murut-Paluan (Yew et al., 2018a; Yew et al., 2018b). In contrast, the gene-pools of Austronesian populations in Peninsular Malaysia (Kelantanese, Minangkabau, Malays, and Temuans) do contain components of other genetically unrelated populations from Senoi and Semang that were obtained through inter-marriage (Deng et al., 2015; Norhalifah et al., 2016a). Recent authors have analyzed genome-wide SNP data from the DNA of ancient and modern individuals and claim that a separate branch of Austronesian speakers associated with the Lapita culture left the Philippines to settle coastal Papua New Guinea and its offshore islands. From there, one ultra-express group of Austronesian speakers traveled as far as Vanuatu and remained there. Later, a second wave, and now partially admixed group, left New Britain to colonize the rest of Oceania (Lipson et al., 2018).

Two observations are frequently reported in genetic studies of SEA populations, including those from genome-wide SNP typing and whole genome sequencing. The first observation is that the SEA populations may often share a common ancestral fraction, regardless of their cultural or linguistic affiliations. This shared heritage was formed well before the ancestors of modern lineages of people split. In SEA, an "unknown" genetic fraction was also detected in the gene-pools of Negrito/Semang, Senoi and Austronesian populations, which most probably represent the ancestral component from before the ancestors of these populations diverged (Lipson et al., 2018; Norhalifah et al., 2016a; Yew et al., 2018a). The second is that a similar interpretation can be applied to the Neanderthal and Denisovan gene fractions of SEA and East Asian populations from the recent genome sequencing based on work reported by Yew et al. (2018b). This has helped in part to explain how Denisovan genes are so highly represented in Melanesian people when there is no fossil evidence linking them with the Denisovan remains found in Siberia (Chambers & Edinur, 2013). Small variations between the gene-pools of linguistically and geographically related populations, particularly in those living in or surrounded by genetically unrelated populations or in those who live as a small isolated population have also been found. These scenarios may contribute towards gene-flow between co-local ancestrally unrelated populations, or lead to genetic drift and/or reduced genetic diversity in the isolated population. Our own genetic screening programmes have revealed varying degrees of admixture in Maori

and Polynesian populations with Europeans in New Zealand, and genetic depletion in isolated and small Orang Asli groups (Semang, Senoi and Proto-Malays) in Peninsular Malaysia (Edinur et al., 2012; Norhalifah et al., 2016b).

5. Conclusion

It is widely accepted that pre-Neolithic populations arrived in Borneo long before the arrival of Austronesians (Barker et al., 2007). What is odd is that they seem to have subsequently vanished from Borneo and have established themselves elsewhere, such as in Negrito and Semang, with the exception of Taiwan, where they have become extinct along with several Austronesian tribes from the western plains region (Hseih et al., 2011). Thus, we can speculate that Borneo, including Sabah and Sarawak, is still widely settled by descendants of the first pre-Neolithic populations prior to the arrival of Austronesian immigrants some 3,500 years ago (Bellwood et al., 2007). Further research is needed in this area, as the current view of the genetic history of the population is based on the limited number of ethnic groups currently living in Borneo. A conclusive and composite view of the history of the population in Borneo will require widespread genetic surveys of the many more ethnic groups that are scattered throughout Borneo using large-scale techniques (genome-wide SNP and whole genome sequencing etc.) and by examination of ancient human remains and artefacts. The latter will require well-planned excavations of recent (last 10,000 years) settlements and the careful ancient DNA work.

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References

Abdullah J. (2005). Human Teeth of the Palaeolithic Period from Gua Balambangan, Sabah. In: Perak Man and Other Prehistoric Skeletons in Malaysia (ed. Majid Z.), 229-237. Universiti Sains Malaysia Press, Malaysia.

Abdullah J. (2013). Lembah Mansuli, Lahad Datu, Sabah; Dalam Prasejarah Asia Tenggara (Siri Arkeologi Perdana). Universiti Sains Malaysia Press, Penang.

Barker G., Barton H., Bird M., Daly P., Datan I., Dykes A., et al. (2007). The 'human revolution' in lowland tropical Southeast Asia: The Antiquity and Behavior of Anatomically Modern Humans at Niah Cave (Sarawak, Borneo). Journal of Human Evolution, 52(3), 243-261.

Batchelor B.C. (1979). Discontinuously rising late Cainozoic Eustatic Sea-levels, with Special Reference to Sundaland, Southeast Asia. Geologie en Mijnbouw, 58(1), 1-20.

Bellwood P. (1985). Prehistory of the Indo-Malaysia Archipelago. Academic Press, Sydney.

Bellwood P. (1988). Archaeological Research in South-eastern Sabah. Sabah Museum Monograph 2. Sabah Museum Department, Kota Kinabalu, Sabah.

Bellwood, P. (1989). Archaeological Investigations at Bukit Tengkorak and Segarong, Southeastern Sabah. Bulletin of Indo-Pacific Prehistory Association, 9, 122-162.

Bellwood, P. (1997). Taiwan and the Prehistory of the Austronesian-speaking Peoples. The Review of Archaeology, 18(2), 39-48.

Bird, M. I., Taylor, D., & Hunt, C. (2005). Palaeoenvironments of insular Southeast Asia during the Last Glacial Period: a savanna corridor in Sundaland?. Quaternary Science Reviews, 24(20-21), 2228-2242.

Cannon C. H. and Manos P. S. (2003). Phylogeographical evolution of the last 40 000 years. Sarawak Museums Journal, 55, 217-228.

Bujeng V. (2005). Prehistoric culture (860BP to 420BP) at Batu Puteh Lobby, Bukit Sarang, Ulu Kakus, Bintulu, Sarawak. Unpublished MA Thesis. Universiti Sains Malaysia, Penang.
Chambers G.K. (2006). Polynesian genetics and Austronesian prehistory. In: Austronesian Diaspora and the Ethnogeneses of People in Indonesian Archipelago (eds. Simanjuntak T., Pojoh I. and Hisyam M.), 299-319. Indonesian Institute of Sciences (LIPI), Jakarta.
Chambers, G. K., & Edinur, H. A. (2013). Genetic relationships between Malays and Maori. The Changing Values of Malays, Maori and Pacific Islanders, 6.
Chambers G.K. Edinur H.A. and Dunn P.P.J. (2016). New insights into ancestry and health of Polynesians and New Zealand Maori. New Zealand Science Review, 73(1), 3-10.
Chia S. (2003). The prehistory of Bukit Tengkorak as a major prehistoric pottery making site in Southeast Asia. Sabah Museum Monograph 8. Sabah Museum Department, Kota Kinabalu, Sabah.
Chia S. (2007). Scientific studies of prehistoric pottery in Malaysia. In: Archaeological Heritage of Malaysia (eds. Saidin M. and Chia S.), 81-95. Centre for Archaeological Research Malaysia, USM, Penang.
Chia, S. (2016). Arkeologi Bukit Tengkorak, Sabah (Penerbit USM). Penerbit USM.
Chia S. and Koon P. (2003). Recent discovery of an ancient log coffin in Semporna, Sabah. Sabah Society Journal, 20:, 35-43.
Chia S. and Matsumura H. (2007). Late prehistoric burials at Melanta Tutup, Semporna, Sabah. Archaeological Studies on Cultural Diversity in Southeast Asia and Its Neighbors, 361-370. Sophia University, Tokyo, Japan.
Chia S., Arif J. and Matsumura H. (2005). The dental characteristics of prehistoric human teeth from Melanta Tutup, Semporna, Sabah. In: The Perak Man and other Prehistoric Skeletons of Malaysia (ed. Majid Z.), 239-251. Universiti Sains Malaysia Press, Penang.
De Bruyn, M., Stelbrink, B., Morley, R. J., Hall, R., Carvalho, G. R., Cannon, C. H., ... & Maiorano, L. (2014). Borneo and Indochina are major evolutionary hotspots for Southeast Asian biodiversity. Systematic Biology, 63(6), 879-901.
Datan, I. (1993). Archaeological Excavations at Gua Sireh (Serian) and Windmills (Mount Mulu National Park), Sarawak, Malaysia. Sarawak Museum Journal, 45 (66). Sarawak Museum Department, Kuching, Sarawak.
Deng, L., Hoh, B. P., Lu, D., Saw, W. Y., Ong, R. T. H., Kasturiratne, A., ... & Teo, Y. Y. (2015). Dissecting the genetic structure and admixture of four geographical Malay populations. Scientific reports, 5, 14375.
Dhaliwal, J. S., Shahnaz, M., Azrena, A., Irda, Y. A., Salawati, M., Too, C. L., & Lee, Y. Y. (2010). HLA polymorphism in three indigenous populations of Sabah and Sarawak. Tissue antigens, 75(2), 166-169.
Edinur, H. A., Dunn, P. P. J., Hammond, L., Selwyn, C., Velickovic, Z. M., Lea, R. A., & Chambers, G. K. (2012). Using HLA loci to inform ancestry and health in P olynesian and M aori populations. Tissue antigens, 80(6), 509-522.
Edinur, H. A., & Chambers, G. K. (2017). Genetic Ancestry and Health. MOJ Immunol, 5(2), 00151.
Eng K.K. (2009). Palaeoanthropological Study of Late Prehistoric Human Skeletal Remains in Semporna, Sabah. Unpublished MA Thesis. Universiti Sains Malaysia, Penang.
Gani N. (2010). The Archaeology of Gua Tupak from 1,190 B.P. to 170 B.P. in Bau, Sarawak. Unpublished MA Thesis. Universiti Sains Malaysia, Penang.
Harrisson B. (1967). A classification of Stone Age burials from Niah Cave, Sarawak. Sarawak Museum Journal, 15, 126-200.
Harrisson T. (1959). New archaeological and ethnological results from Niah Caves, Sarawak. Man, 59, 1-8.
Harrisson T. (1965). A stone and bronze tool cave in Sabah. Journal of the Sabah Society, 4, 151-159.
Harrisson T. and Harrisson B. (1957). The Prehistoric Cemetery of Tanjong Kubor. Sarawak Museum Journal, 8(10) (New Series), 18-50.
Harrisson T. and Harrisson B. (1969/70). The prehistory of Sabah. Sabah Society Journal, 4. Kota Kinabalu, Sabah.
Harrisson T. and Harrisson B. (1971). The Prehistory of Sabah. Sabah Society, Kota Kinabalu, Sabah.
Harrisson T. and O'Connor S.J. (1968). The prehistoric iron industry in the Sarawak river delta: evidence by association. Sarawak Museum Journal 16(32-33) (New Series), 1-54.
Harrisson, T., & Tweedie, M. W. F. (1951). Excavation of Gua Bungoh in south-west Sarawak. The Journal of the Polynesian Society, 60(2/3), 164-186.
Krigbaum J. and Datan I. (1999). The deep skull of Niah. Borneo, 5:13-17.
Lipson, M., Loh, P. R., Patterson, N., Moorjani, P., Ko, Y. C., Stoneking, M., ... & Reich, D. (2014). Reconstructing Austronesian population history in island Southeast Asia. Nature communications, 5, 4689.
Lipson, M., Skoglund, P., Spriggs, M., Valentin, F., Bedford, S., Shing, R., & Rohland, N. (2018). Population turnover in remote Oceania shortly after initial settlement. Current Biology, 28(7), 1157-1165.

Matsumura H. and Oxenham M.F. (2014). Demographic transitions and migration in prehistoric East/Southeast Asia through the lens of non-metric dental traits. American Journal of Physical Anthropology, 155(1), 45-65.

Saidin M. (2014). Chronological Chronology of Sabah Prehistory. In: Sabah Contribution to Archeology of Southeast Asia: Research Results 20 Years (1993-2013) (eds. Saidin M. and Abdullah J.), 1-14. Sabah Museum Department, Kota Kinabalu.

Norhalifah, H. K., Syaza, F. H., Chambers, G. K., & Edinur, H. A. (2016). The genetic history of Peninsular Malaysia. Gene, 586(1), 129-135.

Norhalifah, H. K., Syafawati, W. U. W., Mat, N. F. C., Chambers, G. K., & Edinur, H. A. (2016). Distribution of cytokine gene polymorphisms in six Orang Asli subgroups in Peninsular Malaysia. Human immunology, 77(4), 338-339.

Simanjuntak, T. (2006). Indonesia–Southeast Asia: climates, settlements, and cultures in Late Pleistocene. Comptes Rendus Palevol, 5(1-2), 371-379.

Simonson, T. S., Xing, J., Barrett, R., Jerah, E., Loa, P., Zhang, Y., & Mowry, B. (2011). Ancestry of the Iban is predominantly Southeast Asian: genetic evidence from autosomal, mitochondrial, and Y chromosomes. PLoS One, 6(1), e16338.

Narayanen S. (2011). The Past and Present Pottery in Semporna, Sabah. Unpublished MA Thesis. Universiti Sains Malaysia, Penang

Narayanen S. (2017). Past and Present Pottery-Making Traditions in Malaysia: An Ethnoarchaeological Perspective. Unpublished Ph.D. Thesis. Universiti Sains Malaysia, Penang

Thiel, B. (1987). Early settlement of the Philippines, Eastern Indonesia, and Australia-New Guinea: a new hypothesis. Current Anthropology, 28(2), 236-241.

Wong, L. P., Ong, R. T. H., Poh, W. T., Liu, X., Chen, P., Li, R., ... & Sim, N. L. (2013). Deep whole-genome sequencing of 100 southeast Asian Malays. The American Journal of Human Genetics, 92(1), 52-66.

Xing, J., Watkins, W. S., Witherspoon, D. J., Zhang, Y., Guthery, S. L., Thara, R., & Jorde, L. B. (2009). Fine-scaled human genetic structure revealed by SNP microarrays. Genome research, 19(5), 815-825.

Yew, C. W., Lu, D., Deng, L., Wong, L. P., Ong, R. T. H., Lu, Y., ... & Hoque, M. Z. (2018). Genomic structure of the native inhabitants of Peninsular Malaysia and North Borneo suggests complex human population history in Southeast Asia. Human genetics, 137(2), 161-173.

Yew, C. W., Hoque, M. Z., Pugh-Kitingan, J., Minsong, A., Voo, C. L. Y., Ransangan, J., & Teo, Y. Y. (2018). Genetic relatedness of indigenous ethnic groups in northern Borneo to neighboring populations from Southeast Asia, as inferred from genome-wide SNP data. Annals of human genetics.

Zuraina Majid and Pfister, L.A. (2005). The Niah collection of 122 skeletons at the University of Nevada. In Zuraina Majid (ed.), Perak Man and Other Prehistoric Skeletons in Malaysia. Universiti Sains Malaysia Press, Malaysia, 155-173.

Zuraina Majid, Lim, A., Arif, J., Samsuddin, A.R., Nizam, A. Zafarina, Z. and Norazmi, M.N. (2005). Niah 1977: A skeleton with bilateral absent radius. In Zuraina Majid (ed.), Perak Man and Other Prehistoric Skeletons in Malaysia. Universiti Sains Malaysia Press, Malaysia, 207-228.