

Newborn twins from prehistoric mainland Southeast Asia: birth, death and personhood

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Double infant burials in unusually high numbers occurred at Khok Phanom Di during a phase associated with immigration and some evidence of early agricultural practices. A study of their stratigraphic context and relative ages led to the interpretation that these were twins. Through an exploration of the medical and anthropological literature of twins, and in conjunction with their mortuary context, the authors conclude that these babies died of natural causes at, or soon after, birth.

Keywords: Southeast Asia, prehistoric, twins, mortuary practice, mortality, social identity

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Introduction

Worldwide, twins have special social significance, and, as such, are often integral to social and cultural systems of belief. This paper outlines a method for identifying the occurrence of twin burials in archaeological contexts, using an approach that incorporates both the biological and archaeological evidence within a social theoretical framework for understanding their significance in past societies. The approach examines age-at-death using long bone lengths, archaeological evidence for whether or not infants were buried simultaneously, and mortuary ritual data to infer social information.

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Using these methods we present evidence of the rare occurrence of at least two, and possibly four, sets of burials containing newborn twins from the prehistoric site of Khok Phanom Di in south-east Thailand. Although the twins' burial rites were generally consistent with the normal burial context for infants at this site, their bodies were differently placed, indicating their special status in the community.

Twins as a special category of being

Multiple births are significant to families and communities on a number of levels. They entail additional physical care and subsistence requirements from their families and the wider social group (Granzberg 1973; Ball & Hill 1996). Just as most societies have a social age category for infants based, in part, on their fragility and susceptibility to morbidity and death, especially around birth (Halcrow & Tayles 2008, 2011), there is a heightened awareness of vulnerability of multiple births to mortality and morbidity (Pector 2002). This greater vulnerability is documented in the medical literature today (Kiely 1990; Martin & Park 1999). Monozygotic ('identical') twins also have a higher rate of congenital abnormalities than singletons or dizygotic ('non-identical') twins (Schinzel *et al.* 1979). Related to the recognition of the vulnerability and their impact on caregivers, as well as the relative rarity of human twins, cross-culturally multiple births are considered as special, a class apart from the norm (Corney 1975; Stewart 2000). There is a range of social and cultural responses to twin birth, from being considered a misfortune or dangerous, or taboo, to being revered and a sign of good fortune (Chappel 1974; Corney 1975; Ball & Hill 1996: 856; Stewart 2000; Pector 2002). These different social responses are illustrated in the diverse birth rituals as well as burial and mourning practices for twins observed among different cultures (Goldschmidt 1973; Pector 2002). While there is diversity in responses to human twins among different societies, one unifying factor is the recognition of their special status, and central place in social and cultural rituals and customs (Stewart 2000; Pector 2002). Consequently, the recognition and interpretation of these burials may reveal factors of social and cultural significance to past communities.

Archaeological background of Khok Phanom Di

The prehistoric site of Khok Phanom Di is a high mound that dominates the flood plain of the Bang Pakong River in Chonburi province, Thailand. Initially occupied in about 2000 cal BC, the site holds a commanding position on the river estuary, with easy access to the rich food resources of the mangrove shore, the river and the open sea. However, rice cultivation was ruled out by the saline conditions, and there is no evidence for agriculture or domestic animals. Seven mortuary phases (MP) were identified during the excavation (Figure 1) (Higham & Bannanurag 1990). It was during MP3B, when the sea level temporarily fell, that several significant environmental and cultural changes incorporating rice cultivation occurred (Mason 1991; Thompson 1996; Vincent 2004). At the same juncture, preserved human faeces and stomach contents examined using micromorphological criteria were found to contain the remains of cultivated rice (Thompson 1996), and the artefacts now included granite hoes and shell reaping knives also indicative of rice cultivation. This interval

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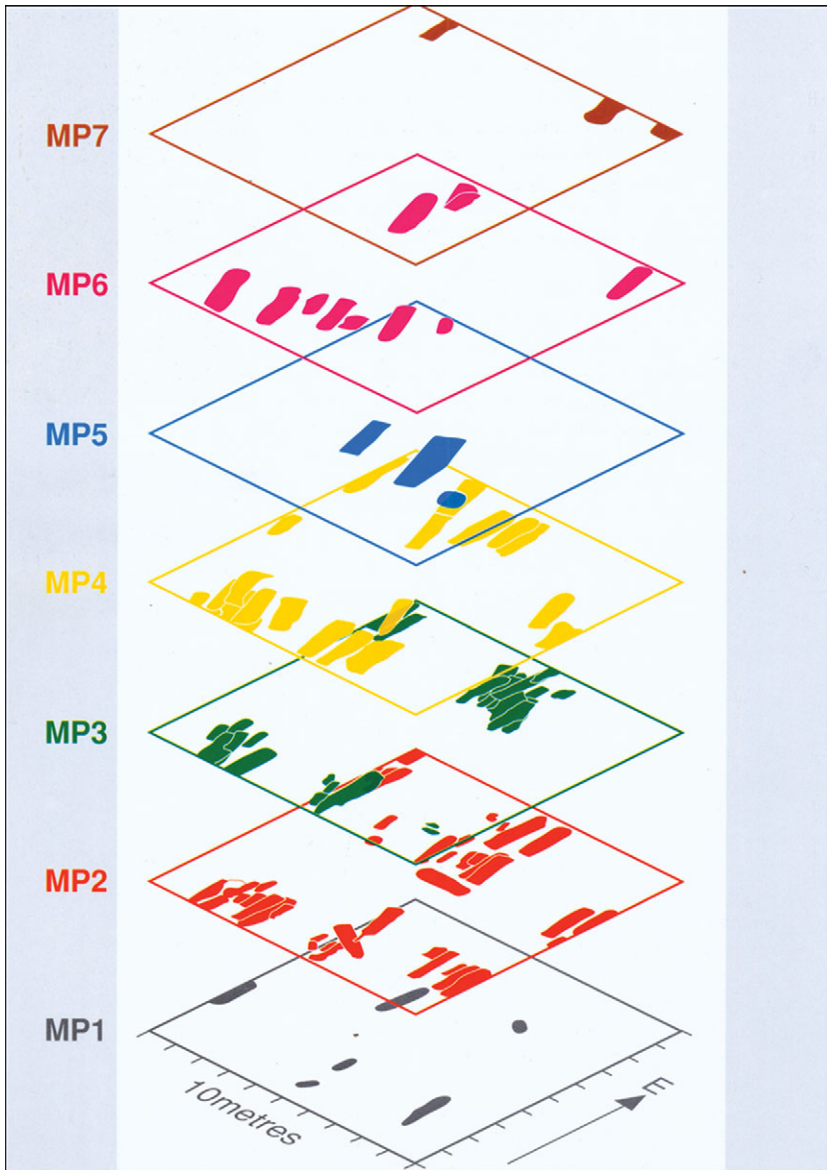


Figure 1. The mortuary phases (MP1 being the earliest) identified at Khok Phanom Di.

was however of relatively brief duration, for by MP5 the sea level had risen and marine conditions ruled out further rice cultivation (Mason 1991). Analysis of pottery technology also indicates that there was a major socio-economic change at the end of MP3B, during which time pottery manufacture almost doubled. Vincent (2004: 702) argues that people immigrating into the area, as evidenced by the presence of exotic burial jars and pottery tools, may have stimulated this increased production. MP3B also witnessed the immigration of some women as indicated by heterogeneity in the female strontium values (Bentley *et al.* 2007).

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For most of the mortuary sequence, there are few differences in grave wealth among the individuals, which may indicate that wealth was attained through personal attributes rather than through family lines (Vincent 2004). Rather, wealth as represented by grave goods, seemed to oscillate among the different grave clusters, purported to represent kinship groups (Higham & Thosarat 1994: 110).

In total, 154 individuals were uncovered, including 86 infants (defined as younger than one year old) and children (from one to younger than 15 years old), of which newborn babies (birth to less than one month old) comprise over 70%. Tayles (1999) has produced a comprehensive study of the health and disease of the human remains, which were interpreted in the context of a changing environment. A detailed palaeopathological analysis of the sample found evidence of thalassaemia, indicating a long-term adaptation to a malarial environment, but at the expense of anaemia (Tayles 1996, 1999). The children who lived beyond infancy at Khok Phanom Di showed evidence of a high rate of skeletal pathology compared with other Southeast Asian sites, also indicating higher levels of infection and biological stress (Halcrow 2006). Growth disruption, in the form of deciduous dental hypomineralisation defects, was relatively low compared with other sites from mainland Southeast Asia, with 43.8% of teeth ($n = 78/178$) and 57.1% of individuals ($n = 12/21$) affected, and there is evidence of moderate levels of growth disruption in the children in the form of linear enamel hypoplasia, where 43.8% of teeth ($n = 78/178$) and 57.1% of individuals ($n = 12/21$) were affected (Halcrow 2006). However, the prevalence of linear enamel hypoplasia was extremely high in the adults (survivors) compared with other sites in mainland Southeast Asia, where 14.7% of teeth ($n = 28/191$) and 86.5% of individuals ($n = 45/52$) were affected (Tayles 1999). Although the comparative levels of developmental enamel defects may appear contradictory, it shows that the stronger individuals, who were able to survive past the vulnerable childhood period, were subject to high levels of stress (Halcrow 2006).

Potential twin burials: archaeological evidence

There were four double burials of infants that were identified as potential twins. Burials 5 (a & b) belong to MP6 (Figure 2). The babies were buried in a shallow scoop forming part of a row with eight other individuals (Figures 3 & 4), including adults, one infant and one child burial. Burial 5 had no grave goods, which is consistent with the burial group and for the general mortuary ritual at the site, whereby mortuary offerings placed with young infants were very rare (Higham & Bannanurag 1990). The preservation of burials 5a and 5b is very good, with most surviving bones complete. However, burial 5a was disturbed in prehistory, resulting in the loss of most of the skull and thorax. Observation of the grave *in situ* shows that, although there is disturbance of burial 5a, the legs of 5a and arms of 5b are entwined indicating that they were interred simultaneously and as an inverted mirror image. Burial 5b was placed in a crouched or foetal position with the head directed east-north-east, similar to the orientation of all the other individuals in this phase. The ages of burials 5a and 5b were 35 weeks gestation (see online supplement, Table 1).

Burials 80 and 81 belong to MP3 and were buried in a shallow grave alongside an adult male (Figure 5). They had no grave goods and their heads point north-east, similar to the

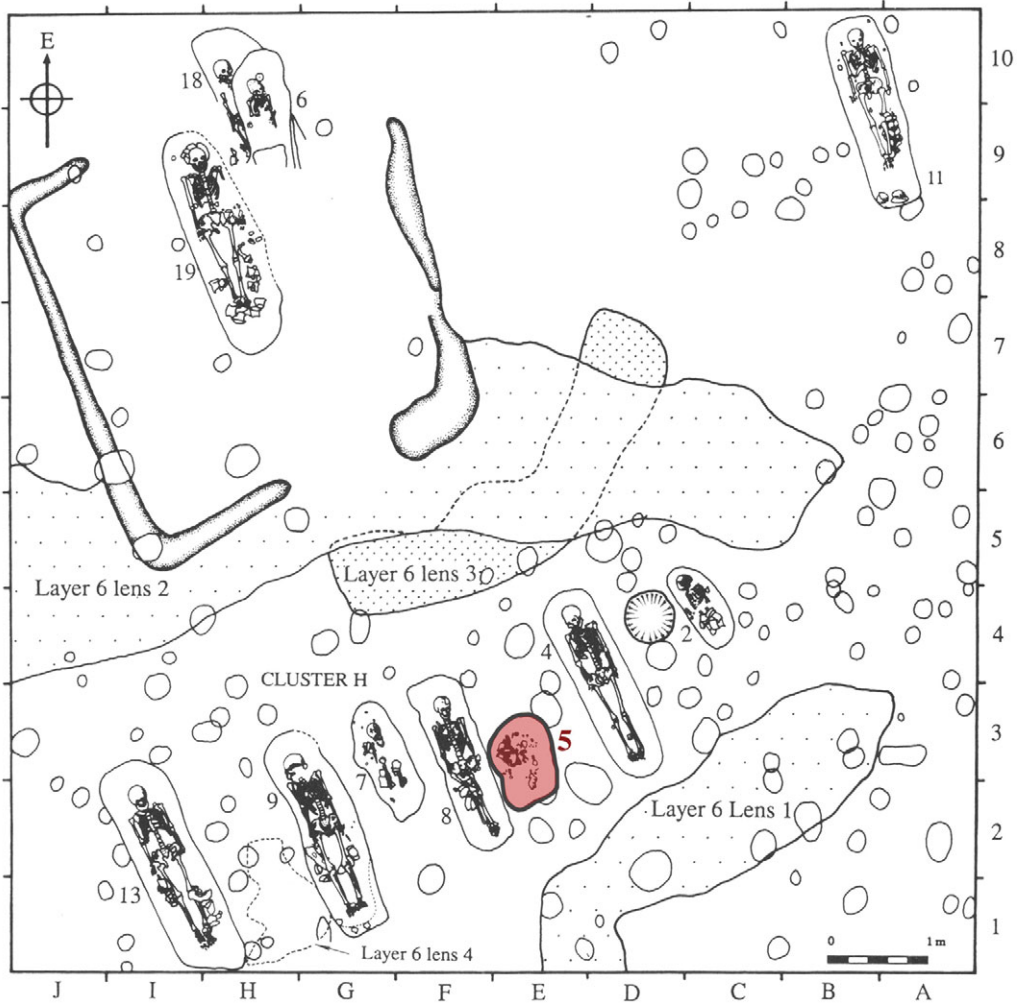


Figure 2. The burials of mortuary phase 6 with burial 5 shown in red. Pits are hatched. Postholes or areas of disturbance are unfilled.

adult male (Figure 6). The legs of the burials are flexed with the right leg of burial 81 and the left leg of burial 82 entwined. Burials 81 and 82 were about 38 weeks gestation, or full-term.

There are a further two sets of possible twins from MP3, burials 51 and 52 and burials 65 and 66 (Figure 5). Burials 51 and 52 are not interred close to any other burials. However, because they were near the eastern edge of the excavation square, it is not possible to tell whether or not they were buried as part of a mortuary cluster or row located beyond the excavation area. Each newborn was buried in an individual shallow scoop containing no grave goods, with their heads oriented north (Figure 7). Burial 52 is flexed at the hip, but burial 53 is disturbed from the pelvis down, so its position cannot be determined. Burials 65 and 66 are within a cluster of other burials, including two adults and another infant. They were buried in the same small pit (Figure 8), covered in red ochre, with their legs flexed



Figure 3. Photograph of burials 5a (right) and 5b, cluster H, MP6 (scale graduated in centimetres).

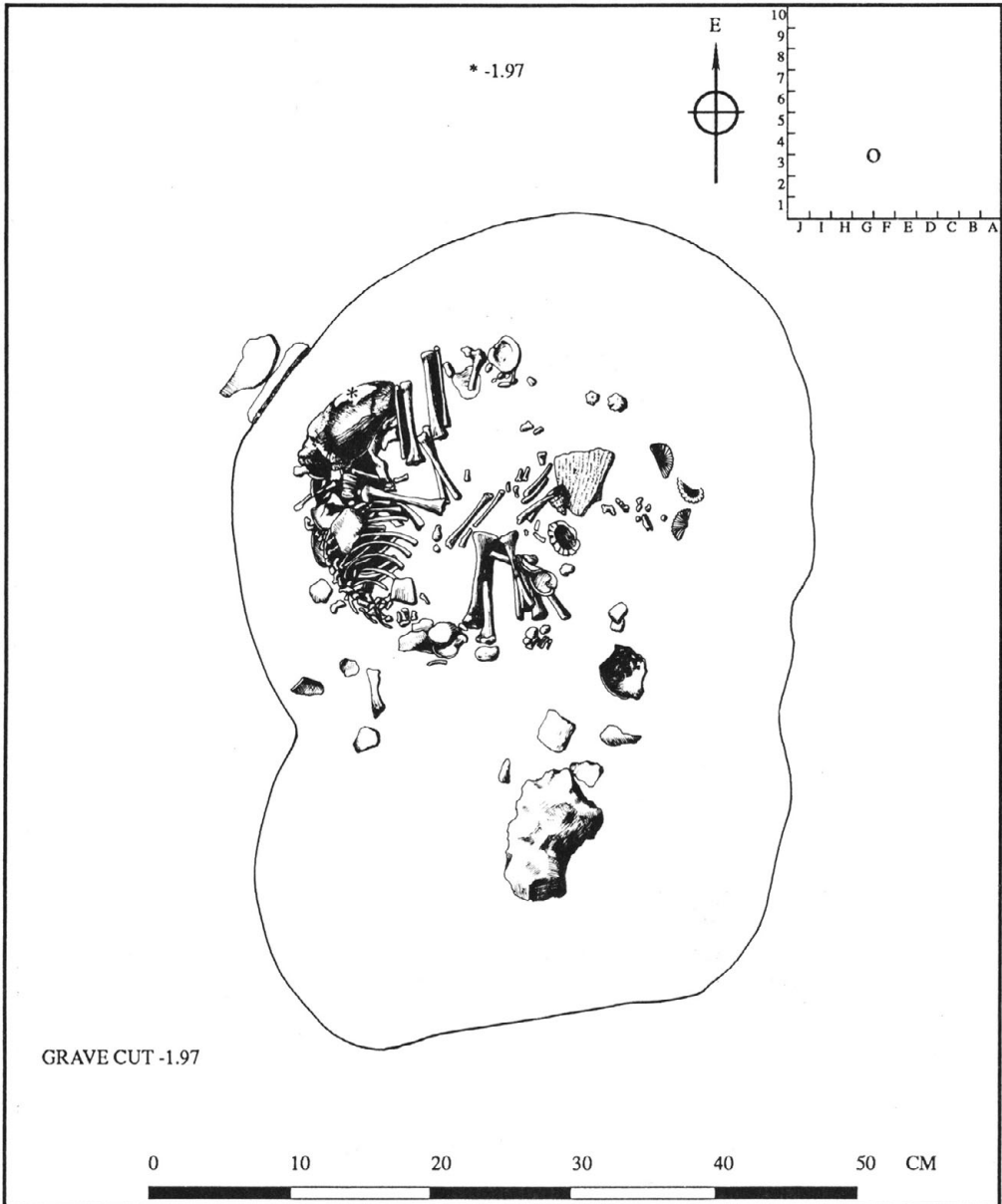


Figure 4. Plan of burials 5a (right) and 5b, cluster H, MP6.

and heads oriented to the east. The ages of the burials 51 and 52 were about 36 weeks, and burials 65 and 66 were 38–39 weeks gestation.

Biological analysis

Estimates of age using long bone lengths, with the methods detailed, are given in the online supplement. Although long bone growth is considered more variable in relation

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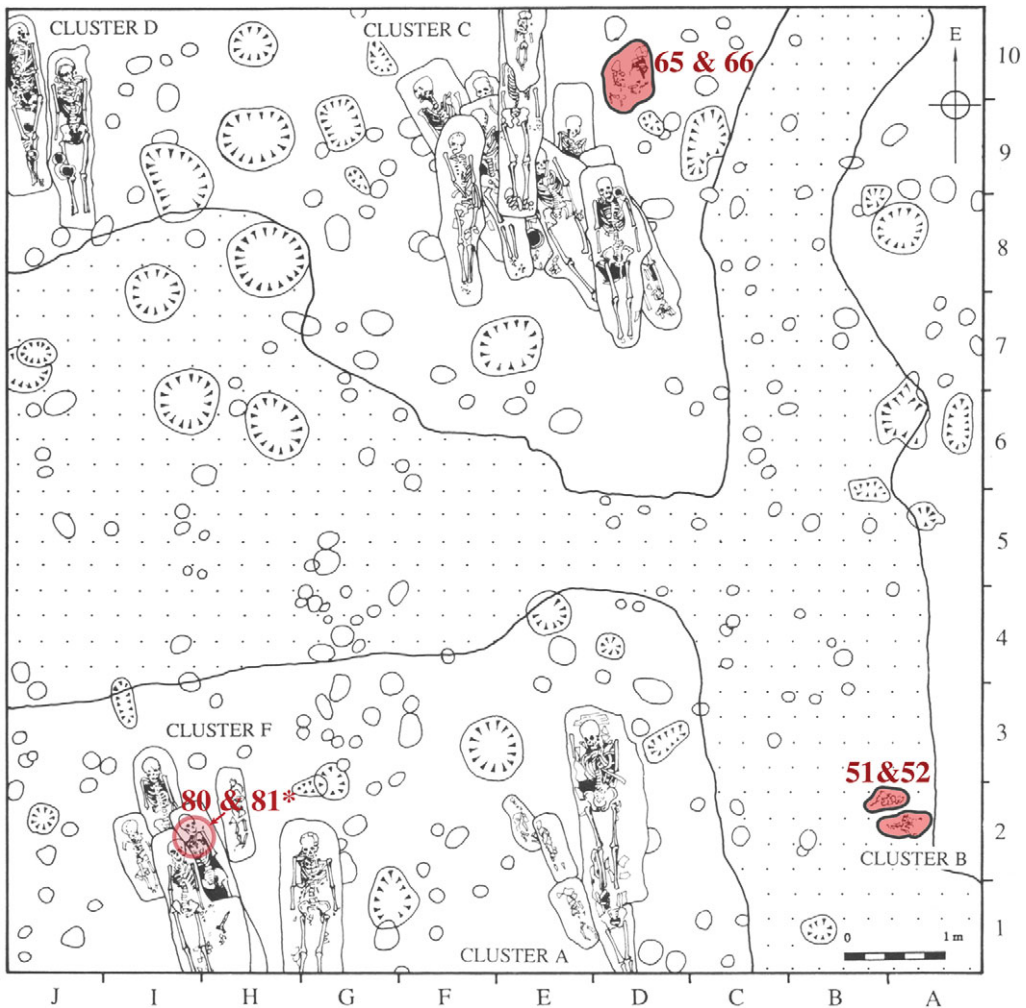


Figure 5. The burials of mortuary phases 3 with burials 51 & 52, 65 & 66 and 80 & 81 shown in red. Pits are hachured. Postholes or areas of disturbance are unfilled.

to chronological age than dental formation, the forming deciduous teeth in newborns are tiny and often not recovered in archaeological contexts, as was the case with one of the babies from burial 5 (5a). The estimation of dental age using standards that have categorical age stages (e.g. Moorrees *et al.* 1963) results in less precise age estimations compared with long bone lengths in infancy. The use of long bone lengths for the estimation of age is advantageous because bone growth and development is very rapid at this time, which results in large differences in bone length between age categories (Jeanty & Romero 1984).

It is also recognised that a valuable contribution to confirmation of the identification of these infants as twins could come from aDNA analysis, as twins share the same mtDNA, and monozygotic twins would share identical nuclear DNA. Unfortunately efforts to recover DNA from the burials at this site so far have been unsuccessful (Pearson 1998).

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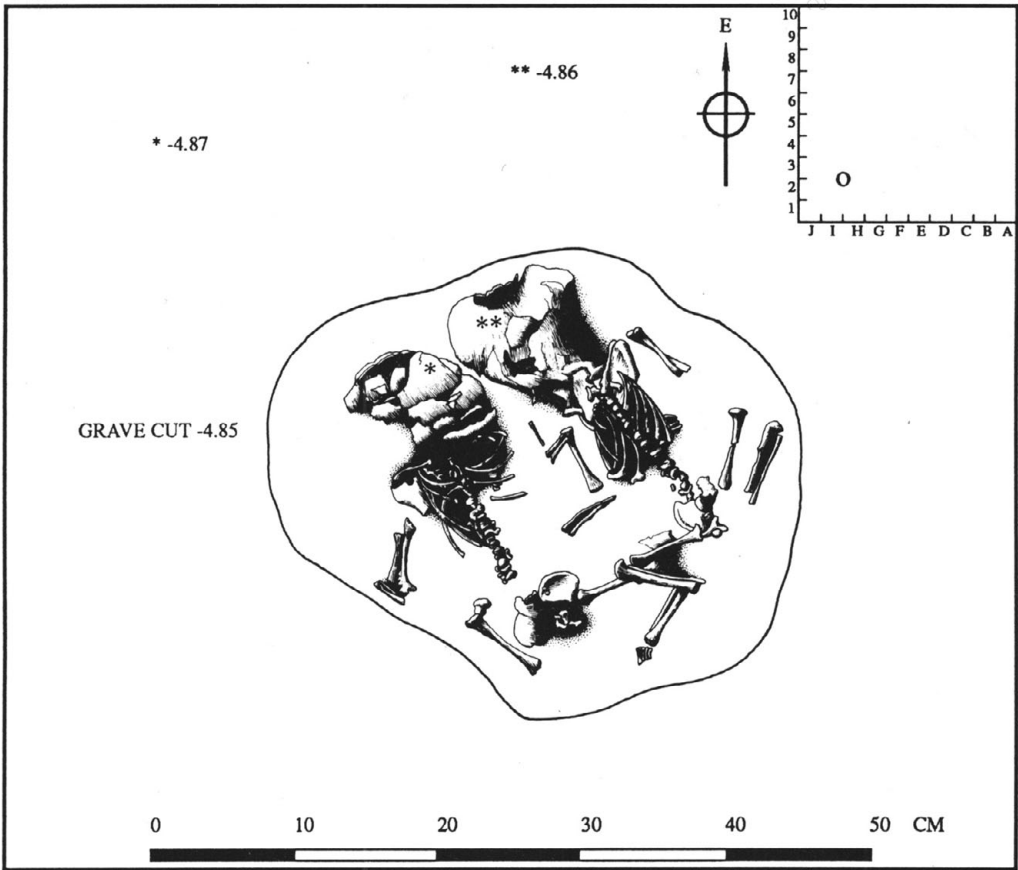


Figure 6. Plan of burials 80 (left) and 81, cluster F, MP3.

Interpretation

Both burials 5a and 5b and burials 81 and 82 were interred simultaneously and are of nearly identical size, which supports the argument that they are twins who died during or soon after birth. Clinical research shows that approximately 80% of twins are the same size, and that twins of discordant weight (more than 15% difference in weight) have higher mortality rates *in utero*, so would not necessarily be represented in the archaeological record (Branum & Schoendorf 2003). Burials 5a and 5b are aged less than 36 weeks gestation. The Khok Phanom Di mortuary sample had a very high, narrow peak of death around full-term (Halcrow *et al.* 2008). A large proportion ($n = 38/49$, 77.6% of the perinates from Khok Phanom Di with measurable long bone lengths) were aged as full-term (between 38 and 41.99 weeks gestation), with only three individuals aged less than 36 gestational weeks (Halcrow *et al.* 2008). The burial 5 babies were among the youngest and smallest of the sample, which also supports the argument that they are twins. Twins are generally smaller for gestational age than singletons (Kilpatrick *et al.* 1996) and/or born at a younger gestational age (Alexander & Salihu 2005). There is no evidence of congenital abnormalities

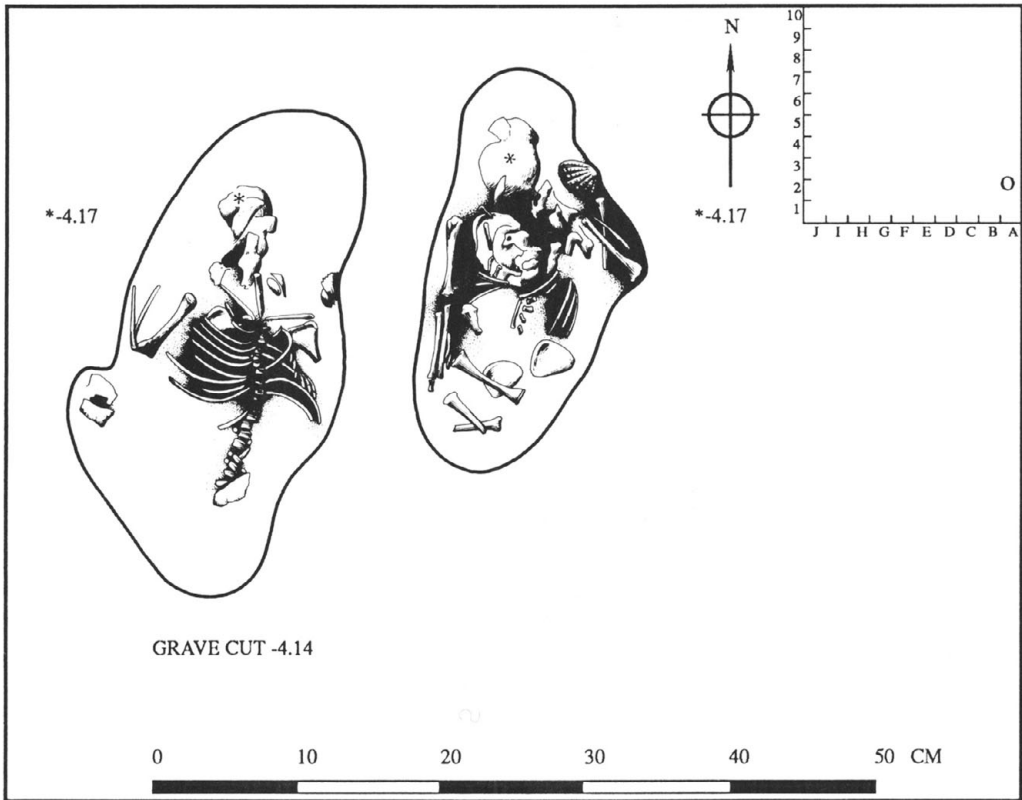


Figure 7. Plan of burials 51 (left) and 52, cluster B, MP3.

from the skeletal remains of any of the twins. However, many of these abnormalities involve only the soft tissue (Layde *et al.* 1980), so would leave no evidence in the skeletal remains of the infants. One of the other possible sets of twins (burials 51 and 52) are also small and young compared to the other perinate sample, which also supports the argument that these may be twins.

Given the close proximity of the skeletons of burials 5a and 5b, the possibility of a case of conjoined twins needs to be considered. The incidence of conjoined twins is extremely rare and reported to be in the range of 1 in 50 000 to 1 in 100 000 births (Spitz & Kiely 2003). Furthermore, given that conjoined twins are almost always mirror images to each other (Spitz & Kiely 2003), it is extremely unlikely that burials 5a and 5b, which are orientated as an inverted mirror image to one another, are a type of conjoined twin.

Discussion

Human twins are rare compared with singleton births, with approximately one occurrence for every 100 births (Ball & Hill 1996), although birth rates vary between different cultures (Nylander 1969; Madrigal *et al.* 2001) and throughout history (Stewart 2000). For example, while some African populations have very high frequencies of twin births (Nylander 1969;

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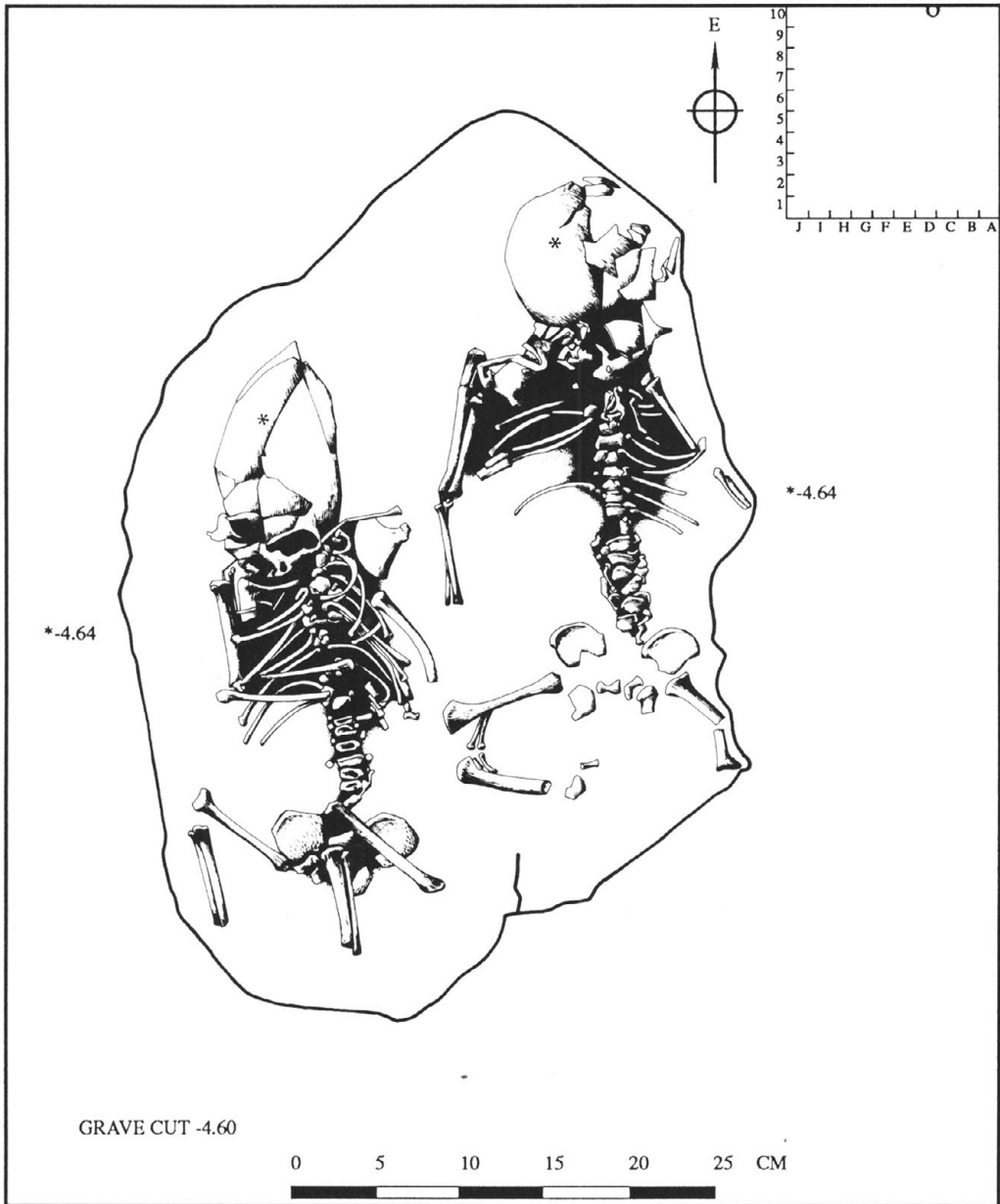


Figure 8. Plan of burials 65 (left) and 66, cluster C, MP3.

Hall 2003), the figure is low in Asian populations (Shek *et al.* 1997). For instance, in Japan only 1 in 250 live births are twins, whereas in Nigeria the figure is 1 in 11 (Hall 2003) (see online supplement, Table 2).

Identification of twins from archaeological contexts is rare. For example, Crespo *et al.* (2011) discuss reports of possible multiple births from archaeological sites in Spain, but these

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were interpreted as non-twin burials due to a lack of stratigraphic details and burial placement information. Given the rarity of twins in the archaeological record, it is extraordinary that there are two sets of twins, and potentially another two, from one archaeological site. This could mean that there was a high rate of twinning in this population. It is difficult to estimate the rate of twins per number of births, partly because it is more likely that twins will die than singletons and therefore enter the mortuary record as perinates (Martin & Park 1999; Alexander & Salihu 2005). However, even if we assume that the total number of births of the Khok Phanom Di population is that of the total excavated cemetery sample ($n = 154$), the presence of two sets of twins (four individuals), means that the estimated rate of twinning is at least four out of 154 births or 2.6–5.2 for every 100 births. The rate could be even higher as we cannot account for any adult twins in the population, and have not included burials 51 and 52 and 65 and 66 in this estimation. An estimated rate of 2.6 per 100 births is significantly higher than the rate of spontaneous twinning in present-day Asian populations, which is low compared with other populations (Shek *et al.* 1997) (see online supplement, Table 2). Although there is a lot of variation in the twinning rates among Asian populations (Shek *et al.* 1997), the rates are lower than for African and Euro-American ones.

There are many factors that may influence the spontaneous generation of twins (Campbell 1998). Genetics plays a role in dizygotic twinning, but there are also regional and temporal trends in dizygotic twinning (Bortolus *et al.* 1999). There is a debate as to whether or not there is a genetic component to monozygotic twinning (Campbell 1998). High twinning rates have been documented in small communities, which could result from successive inbreeding (Campbell 1998). Maternal factors have also been shown to have a relationship with twinning rates including parity, age, nutrition and fecundity (Campbell 1998).

It is interesting that three of the four sets of twins at Khok Phanom Di are from MP3B. As mentioned, Bentley *et al.*'s (2007) isotopic analysis indicated female immigration during this phase. They note that the most significant pattern is that certain females from MP3 comprise most of the non-local strontium signatures, with a transition to predominantly local signatures in MP4. It could be tentatively suggested that there was a genetic component to the high twinning rate as influenced by maternal immigration. However, it could also be argued that it would be more likely for small populations with successive inbreeding, without immigrants widening the gene pool, to have high twinning rates (Matte *et al.* 1996; Campbell 1998).

Anthropological twin studies have focused on the evocative topic of 'twin infanticide' in societies around the world (e.g. Ford 1945; Granzberg 1973; Ball & Hill 1996) and structuralist research on 'incestuous twins', where beliefs around the birth of twins are symbolic of marriage systems and kinship in insular Southeast Asia (Errington 1987; Boon 1990). However, no research to date has investigated the potential they have for contributing to understanding past societies through evidence for their interment.

Although a high peak of mortality around the time of birth, similar to what occurred at Khok Phanom Di, has been interpreted by some to be the result of infanticide (e.g. Mays 1993), this does not take into account the normal high death rate around this age in prehistoric societies (Angel 1971; Boric & Stefanovic 2004; Halcrow *et al.* 2008). Rather, given that the Khok Phanom Di perinates were interred in the normal burial context, it seems unlikely that they were either unwanted or killed (Halcrow *et al.* 2008).

In addition, twins have higher morbidity and mortality than singletons (Martin & Park 1999). In the medical literature preterm fetuses are defined as younger than 37 weeks gestation (McIntosh *et al.* 2003). This is especially relevant to the twin burials 5a and 5b and 51 and 52, as these are preterm (at least in size), so would have probably died at birth as a consequence of their small-for-gestational age, or as a result of their prematurity. There was a very high rate of death of infants at Khok Phanom Di compared with several archaeological sites in north-east Thailand (Halcrow 2006), which has been interpreted as related to the possibility of higher levels of infectious disease, such as outbreaks of malaria, and in particular the effect that this had on pregnant women and their babies *in utero* (Tayles 1999; Halcrow 2006; Halcrow *et al.* 2008). The higher burden of stress supporting twins *in utero* would probably have had deleterious effects on the mother and fetuses.

Burials 5a and 5b and 80 and 81 were crouched, as were burials 51 and 52 and 65 and 66. This is unusual because most ($n = 23/26$) of the other newborns which could be observed for lower limb positioning were in an extended position. Given that other newborn babies were not usually in a crouched position, this could indeed be related to purposeful positioning. The twins were also buried with some type of symmetry to one another, facing towards each other, which may illustrate the perceived connectedness between them. It could be speculated that they resemble the normal positioning of twins within the mother's womb.

This differentiation in mortuary treatment of the very young has been shown in various studies. For example, Murail *et al.* (2004: 275–76) noted that at a cemetery site on the Island of Saï in the Sudan the biological age of the subadults was closely related to their social age as inferred through mortuary treatment. As at Khok Phanom Di, they did not receive similar burial treatment as the adults received until a later stage in infancy (Higham & Thosarat 2004). Similar findings have been observed at the site of Vlasac in south-east Europe where far more elaborate burial rituals were carried out for older infants compared with full-term perinates (Boric & Stefanovic 2004). This was interpreted as differing stages of social embodiment being connected to biological age. This appears to be a universal phenomenon in human societies where different cultural divisions are recognised and linked to different physiological stages (Gilchrist 2000; Kamp 2001; Halcrow & Tayles 2008).

Conclusion

Twins were identified at Khok Phanom Di through a combination of archaeological and biological analysis. There was a high incidence of twin burials in a phase coincident with possible immigrant females. The babies appear to have died at or soon after childbirth, but seem to have attracted special treatment in the cemetery.

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