Beyond the age of 60+

Evidence of an elderly female from the Neolithic-Early Bronze Age using Transition Analysis 3 age estimation

Tornberg, Anna

Published in:
Fornvännen

2022

Document Version:
Publisher's PDF, also known as Version of record

Link to publication

Citation for published version (APA):
Tornberg, A. (2022). Beyond the age of 60+: Evidence of an elderly female from the Neolithic-Early Bronze Age using Transition Analysis 3 age estimation. *Fornvännen*, *117*(2), 134-139.

Total number of authors:
1

Korta meddelanden

Beyond the age of 60+

Evidence of an elderly female from the Neolithic-Early Bronze Age using Transition Analysis 3 age estimation

By Anna Tornberg

Introduction
In 1982, Bouquet-Appel and Masset (1982) bid farewell to paleodemography, although, at that time, being a relatively new discipline. The reason was the low correlation between the existing age indicators in skeletal remains, and actual age at death. They argued that demographic estimations of known-age populations were the best way to go, although still, with little information to gain. In the year 2000, paleodemographers joined in a workshop in Rostock with the aim to welcome paleodemography back through joint efforts to develop age-estimation methods that provided estimates with higher correlation (Hoppa 2002; Hoppa & Vaupel 2002). The Rostock Manifesto was born, which includes parameters that must be met for successful paleodemographic analyses:

i. develop more reliable and validated age stages, based on reference populations,
ii. develop models to estimate the probability of observing specific skeletal characteristics at a given age (Pr(c|a)),
iii. recognize that what is of paleodemographic interest is Pr(c|a) and that this could only be calculated through Bayesian statistics (or equivalent) with information of the probability distribution of age at death in the population (f(a)), and
iv. f(a) must be estimated before Pr(a|c) could be assessed (Hoppa & Vaupel 2002).

The concerns of the manifesto were largely met by the Transition Analysis 2 (Boldsen et al. 2002; Milner & Boldsen 2012), which was based on Bayesian modelling from reference populations. In May 2020 another version of Transition Analysis, the TA^3 (Milner et al. 2020; 2021), was available for public use. The TA^3 provides a new set of scorable characters throughout the skeleton and age is modelled through statistical and machine learning techniques. The TA^3 reduces the risk of age-mimicry in relation to the reference population and have the possibility to provide ages over 50+, which are well-known biases in traditional osteological age estimation methods (Boldsen et al. 2002; Milner et al. 2021).

In this paper, the TA^3 is used for age estimation of a female who was affected with biparietal thinning, a condition normally associated with high age. The case study provides evidence for survival into old ages in prehistoric Scandinavia.

A background to the presence and etiology of biparietal thinning
Incidences of decreased bone density and loss of diploëic structure of the parietal bones (parietal thinning/biparietal thinning/biparietal osteodystrophy; from now only biparietal thinning will be used) are seldom reported in paleopathological literature, especially in recent years. The condition includes symmetrical bilateral thinning and depression of the parietal bones, sometimes leading to transparence upon transillumination, and, on rare occasions, even complete resorption of the parietal bones (Ortner 2003, p. 412). It is evident that the occurrence

of such features is rare, which was demonstrated already by Humphrey (1858, reference in Smith 1907) who could only find six cases when going through European museum skeletal collections. A review of paleopathological literature only resulted in a few reports that did not include Egyptian mummies, with one case of biparietal thinning reported from Indian Harappa, dating to the Bronze Age (c. 2300 BCE) (Dutta 1969), and in one out of 400 Maori and Mariori skeletons of unknown date (Durward 1929).

The etiology of the syndrome has been debated; some consider it to be due to developmental factors (Camp & Nash 1944; Barnes 1994), and some consider senile osteoporosis to be the probable cause (Epstein 1953; Steinbach & Obata 1957; Bruyn & Bots 1978). However, it seems evident that the pathology is seldom found in young individuals. An exception is biparietal thinning in Egyptian mummies. Not only is the frequency of affected individuals dramatically higher, but it also seems to have affected individuals as young as in their thirties (Smith 1907). Smith (1907) suggests that the increased inference in Egyptian mummies was due to the practice of wearing wigs. This seems an unlikely cause considering findings in skeletal remains where the custom of wearing wigs was not present. Considering the rare occurrence in young individuals, senile osteoporosis, as suggested by Epstein (1953), Steinbach & Obata (1957), and Bruyn & Bots (1978), is more likely. However, it is plausible that other types of osteopenia, such as osteomalacia (and rickets), or other forms of osteoporosis could be the cause of biparietal thinning.

In their review of clinical and paleopathological literature, Bruyn & Bots (1978) argue that biparietal thinning (osteodystrophy in named publication) is not an anatomical variant, nor is it a congenital defect or directly related to senility since it only occurs in <1% of the elderly. However, they concluded that this pathological condition has been present throughout history all over the world, with females being affected 2.5 times more often than males and that female onset is later than males' (70.4 vs 60 y) (Bruyn & Bots 1978). It is likely that the rare occurrence in paleopathological literature is a symptom of relatively few individuals of high age in past populations. This is sound considering a late onset of the pathology in relation to low incidence rate in living populations in general (0.4–0.5%).

Material and methods

The burial in which the individual was inhumed was excavated by Folke Hansen in 1934–1935. The burial was one of 15 in a prehistoric grave field in Kyhlbjersbacken, Vellinge parish (fig. 1), which had partially been destroyed by farmers digging for gravel. The site was located on a ridge, c. 40–50 m long and oriented north-south. The graves were typologically dated to late Stone Age or Bronze Age (ATA dnr. 2285, 2252), with radiocarbon dates later confirming a date from the MNB/Late Neolithic-Early Bronze Age period II (Tornberg 2018). The burial of this case study probably corresponds to grave number two, although marked as number three on the bone box. This is however impossible since grave three was an inhumation of a small child. The inventory catalogue at Lund University Historical museum however defines the skeleton in grave two as find number three, which is why this inconsistency might have occurred.

If considering the individual as the one inhumed in grave two, the body was positioned on the back or the right side with the arms bent, and hands probably positioned under the right cheek. The legs were partly bent, but not excessively so. The preservation of the skeleton is relatively good and most skeletal elements are represented. However, the grave was disturbed prior to excavation which is why the correct placement of the skull is unknown. There is no radiocarbon date of the specific individual, but the placement of the body in somewhat of a crouching position on her right side and under a low cairn could suggest that it represent a Battle Axe (BAC) burial, although, a later date cannot be excluded. No artefacts were found in the grave. Three individuals buried in crouching position (grave 1, 8 and 9) have been radiocarbon dated to 2406–1925 calBCE (LuS 11853; LuS 10622; UBA-24002) and indicate as such BAC burials at the site. Although of traditional Late Neolithic (LN) date, there are examples of Scanian BAC burials dated post 2300 BCE (Brink 2009, p. 176).

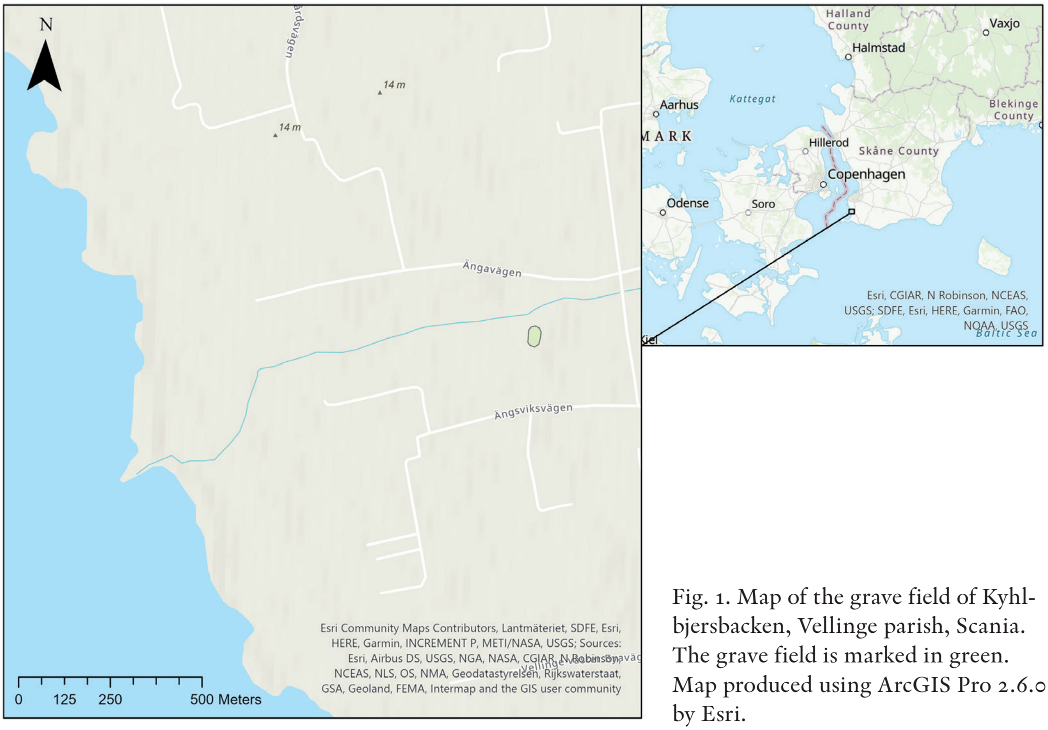

Fig. 1. Map of the grave field of Kyhl-bjersbacken, Vellinge parish, Scania. The grave field is marked in green. Map produced using ArcGIS Pro 2.6.0 by Esri.

Sex was estimated following standard osteological protocol (Phenice 1969; Milner 1992). Age at death was estimated following the procedure of the Transition Analysis 3 (TA³) (Milner et al. 2020, p. 2021). The TA³ age estimation is based on Machine learning modelling of a large variety of skeletal remains of both sexes from a variety of geographical areas as baseline, and is thus not biased towards age mimicry of a specific reference sample (Boldsen et al. 2002). While most traditional osteological age estimation techniques are concentrated to morphological changes of the pelvis, the TA³ includes morphological traits from various parts of the body which allows for more precise age estimates also in poorly preserved remains. The TA³ analysis was run in the software Transition Analysis 3.Ink version 0.8.4. software, downloadable from https://www.statsmachine.net/software/TA3/.

The TA³ is still developing and some of the original traits, i.e. Fibula wings, Ischial spur, Rib 1 fusion, Radius tuberosity crest, Sacral elbow, and Ulna olecranon spur, have been excluded since they show low or no correlation with age (Milner et al. 2020). Further, an exclusion of the DISH trait has been recommended due to its connection to selective mortality (Milner et al. 2018). In addition, the TA³ manual recommends excluding early traits in individuals expressing features of advanced age, since it would limit the analysis. Thus, early traits of vertebral ring fusion and spheno-occipital synchondrosis has been excluded from registration.

Results

The TA³ analysis could be run on a majority of the scorable traits from throughout the body. However, all traits regarding the pubis symphysis, rib-end morphology and clavicle were excluded due to taphonomic loss. The point estimate age produced by the TA³ was 85.2 years with a 95% confidence range of 67–102.4 years. The standard deviation was 8.9 and the correlation Age-Estimated Age was 0.878. Previous analyses of degenerative changes of the sacro-

Fig. 2. Healed blunt force trauma (c. 30 x 18 mm) to the posterior portion of the right parietal. Photo: Anna Tornberg.

Fig. 3. Clear biparietal thinning with significant sloping of both parietals. Note the healed pond fracture (c. 7 x 8 mm) on the left frontal. Photo: Anna Tornberg.

iliac joint (Lovejoy et al. 1985) corresponds to phase 8 and an estimated age of 60+ (Tornberg unpublished). The teeth of the individual were also heavily abraded, and signs of pulp infections were present for three teeth. The right mandibular second molar was lost antemortem.

The bones of the individual were overall light which probably correspond to senile osteoporosis. Some of the criteria in the TA³ registration process include subjective weighing of individual bones; young individuals have relatively heavier bones while older individuals have lighter bones due to bone loss. It should however be noted that disease induced osteoporosis could produce similar bone loss. Further, the spine showed evidence of severe degenerative changes associated with high age. Apart from these age-related changes, the individual also suffered from two healed depressed fractures of the skull, one shallow depression on the left frontal and a deeper and larger depression on the posterior part of the right parietal (fig. 2). These fractures probably do not correlate to the parietal depressions (fig. 3) but should rather be regarded as signs of previous violent encounters. There is a high correlation between depressed fractures of the upper vault and intentional violence (Walker 1989; Lovell 1997; Ehrlich & Maxeiner 2002; Kremer et al. 2008; Symes et al. 2012; Li et al. 2021).

Discussion

It can generally be assumed that finds of biparietal thinning equal high age. However, considering the low occurrence in modern elderly patients, a lack of parietal thinning does not necessarily equal lower age. It is evident that the TA³ has the possibility to provide more detailed estimations of age at death in elderly individuals. When traditional osteological age estimation techniques could only provide an age of 60+, the TA³ managed to provide a point estimate of 85.2 years and an age span of 67–102.4, which means that the entire 95% confidence level correlates to ages over 65 years. Considering the late onset of biparietal thinning in modern populations (>70 years in females), this case study provides strong evidence of survival into senescence also in prehistoric Scandinavia. This means that living into your eighties is not a modern trend entirely connected to increased living standards and modern health care, but could be accomplished also in prehistoric societies, although, plausibly not in equal numbers.

It is likely that the TA[3], and probably other methods forthcoming, will revolutionize paleodemography in the years to come. New age estimation of skeletal remains will probably revise our current understanding of past populations, survival, and ancient health. It is believable that these new methods will provide survival rates more in accordance with "natural" mortality patterns with the highest risk of dying being in childhood and in old ages, and not in mid-life as is often the case for prehistoric populations in southern Scandinavia (Ahlström 2015; Blank et al. 2018; Tornberg 2018).

References

Ahlström, T., 2015. Paleodemography of maritime huntergatherers and the quest for forager baseline demography. Brink, K., Hydén, S., Jennbert, K., Larsson, L. & Olausson, D. S. (eds.). *Neolithic diversities: perspectives from a conference in Lund, Sweden*. Lund.

Barnes, E., 1994. *Developmental defects of the axial skeleton in paleopathology*. Niwot Colo.

Blank, M., Tornberg, A. & Knipper, C., 2018. New perspectives on the Late Neolithic of south-western Sweden: An interdisciplinary investigation of the Gallery Grave Falköping stad 5. *Open Archaeology* 4(1):1–35.

Bocquet-Appel, J. P. & Masset, C., 1982. Farewell to paleodemography. *Journal of Human Evolution* 11(4):321–333.

Boldsen, J. L., Milner, G. R., Konigsberg, L. W., Wood, J. W., Hoppa, R. D. & Vaupel, J. W., 2002. Transition analysis: A new method for estimating age from skeletons. Hoppa, R. D. & Vaupel, J. W. (eds.). *Paleodemography: Age distributions from skeletal samples*. Cambridge.

Brink, K., 2009. *I palissadernas tid: Om stolphål och skärvor och sociala relationer under yngre mellanneolitikum*. Lund.

Bruyn, G. W., & Bots, G. T. A., 1978. Biparietal osteodystrophy. *Clinical neurology and neurosurgery* 80(3):125–148.

Camp, J. D., & Nash, L. A., 1944. Developmental thinness of the parietal bones. *Radiology* 42(1):42–47.

Durward, A., 1929. A note on symmetrical thinning of the parietal bones. *Journal of anatomy* 63(3):356.

Dutta, P. C., 1969. Bilateral parietal thinning in bronze age skull. *British medical journal* 1(5635):55.

Ehrlich, E. & Maxeiner, H., 2002. External injury marks (wound) on the head in different types of blunt trauma in an autopsy series. *Medicine and Law* 21(4):773–782.

Epstein, B. S., 1953. The concurrence of parietal thinness with postmenopausal, senile, or idiopathic osteoporosis. *Radiology* 60(1):29–35.

Hoppa, R. D., 2002. Paleodemography: Looking back and thinking ahead. *Paleodemography: Age distributions from skeletal samples* (9-28). Cambridge: Cambridge University Press.

Hoppa, R. D. & Vaupel, J. W. (eds.), 2002. *Paleodemography: Age distributions from skeletal samples*. Cambridge.

Kremer, C., Racette, S., Dionne, C. A. & Sauvageau, A., 2008. Discrimination of falls and blows in blunt head trauma: Systematic study of the hat brim line rule in relation to skull fractures. *Journal of Forensic Sciences* 53(3):716–719.

Li, H., He, L., Gibbon, V. E., Xiao, X. & Wang, B., 2021. Individual centred social care approach: Using computer tomography to assess a traumatic brain injury in an Iron Age individual from China. *International Journal of Osteoarchaeology* 31:99–107.

Lovejoy, C. O., Meindl, R. S., Pryzbeck, T. R. & Mensforth, R. P., 1985. Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death. *American journal of physical anthropology* 68(1):15–28.

Milner, G. R., 1992. *Determination of skeletal age and sex: a manual prepared for the Dickson Mounds Reburial Team*. Lewiston, IL.

Milner, G. R. & Boldsen, J. L., 2012. Transition analysis: A validation study with known age modern American skeletons. *American Journal of Physical Anthropology* 148(1):98–110.

Milner, G. R., Boldsen, J. L., Ousley, S. D., Getz, S. M., Weise, S., Tarp, P. & Steadman, D. W., 2018. Selective mortality in middle-aged American women with Diffuse Idiopathic Skeletal Hyperostosis (DISH). *PloS one* 13(8):e0202283.

Milner, G. R., Boldsen, J. L., Ousley, S., Weise, S., Getz, S. & Tarp, P., 2020. *TA[3] Installation and Software User Guide Version 0.16*. Downloadable from: https://www.statsmachine.net/software/TA3/docs/TA3_Installation_Software_User_Guide-0.16.pdf. (Last visited: 18 November 2021).

Milner, G. R., Boldsen, J. L., Ousley, S. D., Getz, S. M., Weise, S. & Tarp, P. 2021. Great expectations: The rise, fall, and resurrection of adult skeletal age estimation. Algee, B. & Hewitt, J. K. (eds.). *Remodeling Forensic Skeletal Age*. Cambridge, Mass.
Ortner, D. J., 2003. *Identification of pathological conditions in human skeletal remains*. Cambridge, Mass.
Phenice, T. W., 1969. A newly developed visual method of sexing the os pubis. *American journal of physical anthropology* 30(2):297–301.
Smith G. E., 1907. The causation of the symmetrical thinning of the parietal bones in Ancient Egyptians. *Journal of anatomy and physiology* 41(3):232–233.
Steinbach, H. L. & Obata, W. G., 1957. The significance of thinning of the parietal bones. *The American journal of roentgenology, radium therapy, and nuclear medicine* 78(1):39–45.
Steinbock, R. T., 1976. *Paleopathological diagnosis and interpretation: Bone diseases in ancient human populations*. Springfield, Ill.
Symes, S., L'Abbé, E., Chapman, E., Wolff, I. & Dirkmaat, D. C., 2012. Interpreting traumatic injury to bone in medicolegal investigations. Dirkmaat, D. C. (ed.). *A companion to forensic anthropology*. Chichester.
Tornberg, A., 2018. *Health, cattle and ploughs: Bioarchaeological consequences of the secondary products revolution in Southern Sweden, 2300–1100 BCE*. Lund.
Walker, P. L., 1989. Cranial injuries as evidence of violence in prehistoric Southern California. *American Journal of Physical Anthropology* 80(3):313–323.

Anna Tornberg
Department of archaeology and ancient History
Lund University, Box 192
SE-221 00 Lund, Sweden
anna.tornberg@ark.lu.se