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Research Article

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Everything Has a Role to Play: Reconstruction of Vessel Function From Early Copper Age Graves in the Upper Tisza Region (Eastern Hungary)

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Abstract: Investigation into the utilitarian function of mortuary vessels is often a neglected aspect of ceramic examination. Since, in most cases, a direct link can be assumed between the vessels' size, form, and most optimal utilitarian function, morphometry-based ceramic categories – along with ethnoarchaeological examples – can help to understand the role of these vessels in funerary contexts. This article focuses on the relationship between the utilitarian function of ceramics and their roles in graves through the analysis of eight Early Copper Age (4400/4300–4000/3900 BC) burial sites, associated with Tiszapolgár and Bodrogkeresztúr ceramic styles, from the Upper Tisza Region (Hungary). The deposition of ceramic assemblages in graves became common in this period; however, a systematic analysis of their function has never been carried out before. In this study, a morphometry-based methodology was developed to establish the vessels' utilitarian function. These functions were considered in the analysis of the composition of mortuary assemblages, and how they may reflect social status or gender roles of the deceased individual. Results indicate that the Tiszapolgár and Bodrogkeresztúr assemblages cannot be unequivocally distinguished from each other based on morphometric and functional criteria, suggesting similar functional roles in the past funerary contexts.

Keywords: morphometric analysis, vessel function, mortuary traditions, Great Hungarian Plain, Early Copper Age

1 Introduction

The relationship between the form, size, and function of ceramic vessels represents one of the key cornerstones of archaeological thought (Boudreaux, 2010, p. 8; Braun, 1983, p. 108; Kramberger, 2015, p. 233; Rice, 1987, p. 208; Skibo, 1992, p. 36; Van der Veen, 2018); however, the exact use of ceramics cannot be ascertained based simply on this assumption. To better understand the exact use of a certain vessel type, the difference between the intended and the actual function needs to be clarified (Figure 1). According to James M. Skibo and Michael B. Schiffer, the intended function is a mental image of a particular ceramic vessel – and its use – the potter creates the vessel based on this image, which could be social, ideological, or utilitarian (Skibo, 1992, pp. 34–35; 2013, p. 3; Skibo & Schiffer, 2008, pp. 4, 11). The social function

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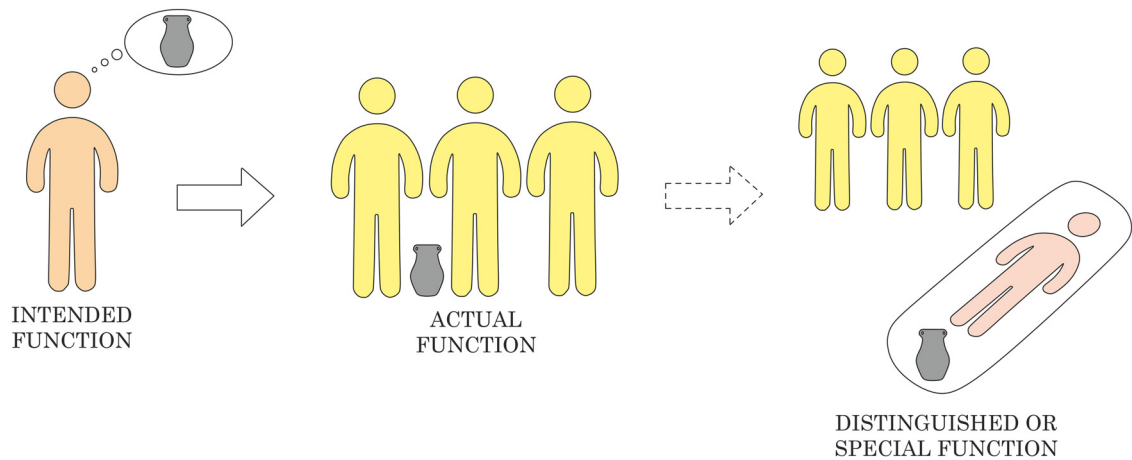


Figure 1: The intended, actual, and distinguished or special function of the vessels.

communicates social phenomena in the framework of a specific activity or performance (Skibo & Schiffer, 2008, p. 110). The ideological function reflects ideas, values, or knowledge symbolised by vessels (Skibo & Schiffer, 2008, p. 110). The utilitarian function expresses the optimal use of vessels – for example, for cooking or transporting liquid (Santacreu, Trias, & Rosselló, 2017; Sinopoli, 1999; Skibo, 1992, 2013; Skibo & Schiffer, 2008). This can be identified by the examination of the vessels' morphometry (i.e. the form and the size), along with the additional elements – such as handles – manufacturing techniques and decoration (Read, 2007; Rice, 1987, p. 207; Skibo, 2013, p. 29).

However, the intended function does not always correspond to the actual function, i.e. the way(s) how the ceramic vessel was actually used by people (Abbink, 1999, p. 163; Rice, 1987, p. 211; Skibo, 1992, p. 33; 2013, p. 4). The actual function of a particular pot can be wide ranging, until it reaches a stage when it is no longer able to contain foods or liquids. At this point, it may either be deposited or reused, as temper for instance, or discarded altogether (Skibo, 1992, pp. 42–45). The actual function of a vessel could be clarified by scientific testing, such as residue (e.g. Barnard & Eerkens, 2017; Craig et al., 2003; Fanti et al., 2018; Heron & Evershed, 1993; Hoekman-Sites, 2011) and use-wear analyses (e.g. Banducci, 2014; Debels, 2018; Fanti et al., 2018; Vieugué, 2014; Vieugué, Mirabaud, & Regert, 2008); however, the re-assessment of the circumstance of discovery and contextual descriptions can also be helpful in this regard.

The vessels which were deposited and later found *in situ* in unique archaeological contexts, such as in ritual depositions or graves, imply that these pots could have had a distinguished or special function, at least in the final phase of their lives (Skibo, 2013, p. 5). The deposition of ceramic vessels in such unique contexts could potentially alter the vessels' intended function, but even in these special circumstances, pots retain some of their original functions, such as their utilitarian function, which could explain why these vessels were deposited in burials in the first place. Combining the observations on ritual and mortuary contexts, and the morphometric examinations carried out on the ceramic assemblages, several aspects of the intended and actual function of the vessels could be distinguished.

Although the functionality of potteries is not a clear concept and vessels could have had multiple usages during their life span (Gosselain, 1992; Kempton, 1981; Longacre, Xia, & Yang, 2000; Rice, 1987, p. 29), general tendencies can be described between the form, size, and function since the basic morphometry of potteries is not accidental but related to some functional idea (Fowler, 2006, pp. 104–106; Kramberger, 2015; Rice, 1987, p. 208; Skibo, 1992). Formerly, a number of studies had demonstrated that the utilitarian function of ceramic vessels can be outlined by taking a closer look at the vessels' morphometry (Fowler, 2006, p. 116; Santacreu et al., 2017, p. 189; Sinopoli, 1999, p. 126; Skibo, 1992, p. 36). Ethnoarchaeological research has played a key role in establishing the morphometric-based ceramic categories (Hally, 1986; Henrickson & McDonald, 1983; Smith, 1986, 1988). In these works, first, an overall vessel typology was established on the basis of anthropological examinations, before the usage of vessels was discussed in archaeological contexts.

Initially, Marion F. Smith defined three basic determining factors for form and size: (1) the relative openness of the vessel's profile, (2) the absolute diameter of the rim, and (3) the total volume of the vessel based on the absolute height and diameter of the body. However, other analyses demonstrated the volume being the poorest predictor compared to the other two factors (Smith, 1988, pp. 914–915). This suggests the vessel's form and openness to be the key elements in determining the utilitarian function of ceramic pots.

Through the morphometric review of ceramic vessels, four broad function categories could be outlined: (1) storage, (2) transport, (3) processing, and (4) serving/eating (Orton, Tyers, & Vince, 1993, p. 217; Rice, 1987, p. 208). However, in the case of burials, a slightly modified system of classification is required considering the partial change to the vessels' intended function.

The aim of this article is to develop a morphometry-based methodology to examine the utilitarian vessel function in the context of burials based on an Early Copper Age case study from the Upper Tisza Region on the northern fringes of the Great Hungarian Plain (Eastern Hungary). The morphometry-based utilitarian function analysis of mortuary ceramics is particularly relevant in this period, when a new social and ritual system emerged, along with the appearance of multiple ceramic styles (Bognár-Kutzián, 1963, 1972; Parkinson, 2006a,b; Parkinson & Gyucha, 2007; Raczky, Anders, & Siklósi, 2014; Raczky & Siklósi, 2013; Siklósi & Szilágyi, 2021). Formerly, over-detailed ceramic typology hindered the recognition of the utilitarian function of these vessels and, therefore, the understanding of why these potteries were deposited in burials. Thus, the present study has the virtue of being the first to analyse the functional patterns in the selection of vessels for mortuary purposes during the Early Copper Age through the statistical examination of simplified geometric forms of ceramics.

2 Background to the Case Study

The Early Copper Age signalled the beginning of a new era on the Great Hungarian Plain: a new technological and social system was emerging out of the traditions of the Late Neolithic Tisza-Herpály-Csőszhalom complex. This, for example, included the establishment of a dense network of small-sized settlements (Parkinson, 2006a, 2006b; Parkinson & Gyucha, 2007; Sherrat, 1982, 1983a,b) and the first appearance of formal cemeteries (Bognár-Kutzián, 1963, 1972; Raczky et al., 2014; Raczky & Siklósi, 2013; Siklósi & Szilágyi, 2021) – while at the same time, the tradition of burial depositions continued at settlement sites as well (Gyucha, 2015; Parkinson, Gyucha, & Yerkes, 2021; Raczky et al., 2014; Szilágyi, 2015). Although the mortuary practice of gender specific burials dates back to Late Neolithic (Anders & Nagy, 2007), this particular funerary custom only became fixed and normative during the Early Copper Age: women were placed on their left side and men on their right, both in a crouched position (Bognár-Kutzián, 1963; Chapman, 2000; Kadrow, 2010; Lichter, 2001; Meisenheimer, 1989; Raczky et al., 2014; Sofaer Derevenski, 1997).

Until recently, the Early Copper Age on the Great Hungarian Plain has been associated with the so-called Tiszapolgár culture, followed by the Middle Copper Age Bodrogkeresztúr culture (Banner & Bognár-Kutzián, 1961; Bognár-Kutzián, 1963, 1972, 1985; Kalicz, 1958; Patay, 1961, 1974). In the 1960s–70s, the Tiszapolgár and the Bodrogkeresztúr cultures were identified and came to be treated as separate entities, mostly on the basis of detailed ceramic typologies drawn from cemeteries (Bognár-Kutzián, 1963, 1972; Patay, 1961, 1974). By the 1990s, calibrated radiocarbon dates reinforced their absolute chronology and their chronological succession (Raczky, 1995). However, the recent AMS data and Bayesian modelling carried out at a number of Tiszapolgár and Bodrogkeresztúr sites imply the partial contemporaneity of the two cultures, dating both of them to the Early Copper Age (Raczky & Siklósi, 2013; Siklósi et al., 2022; Siklósi & Szilágyi, 2016, 2021). Although the Tiszapolgár culture still appears to date to a slightly earlier period (from 4435 (68.2%) 4385 cal BC to 4220 (68.2%) 4165 cal BC) than the Bodrogkeresztúr culture (from 4400 (68.2%) 4325 cal BC to 4020 (68.2%) 3930 cal BC) (Siklósi & Szilágyi, 2021, p. 35). The most recent ceramic stylistic analysis assumes high levels of homogeneity among the domestic assemblages of the two cultural groups (Szilágyi, 2016); therefore, currently, many experts call for the term 'ceramic style' instead of 'culture' (Raczky et al., 2014; Raczky & Siklósi, 2013; Siklósi & Szilágyi, 2016, 2021; Szilágyi, 2016).

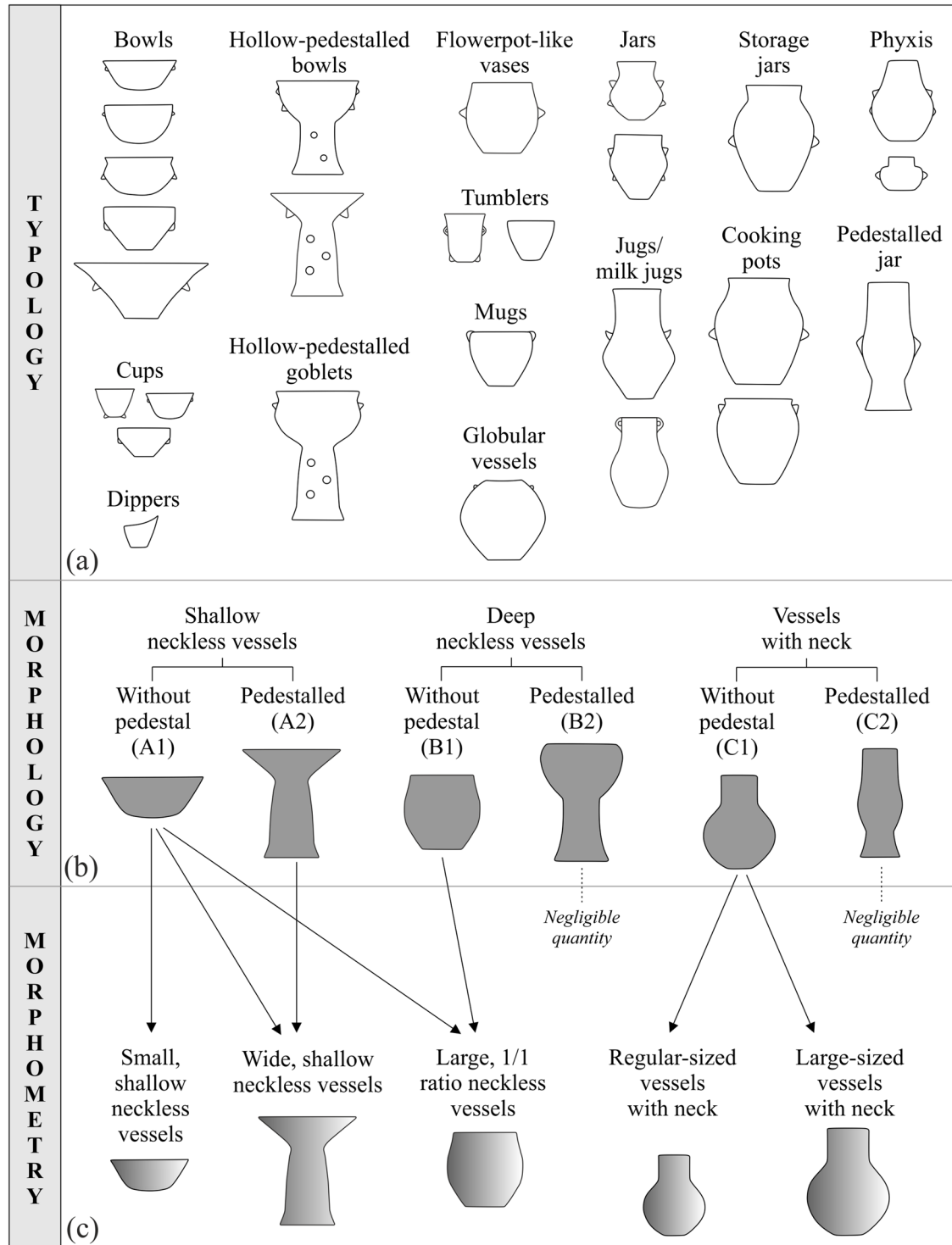


Figure 2: Categorisation of the Early Copper Age vessels: (a) typological categories; (b) morphometrical categories (with sematic images using simplified geometric forms); and (c) morphologic categories (with sematic images using simplified geometric forms).

The majority of studies that dealt with the ceramic grave goods of Early Copper Age burials applied a typological approach, fully developed by Bognár-Kutzián (1963, 1972) and Patay (1961, 1974) in the 1960s–70s (Figure 2a). These works published in the past decades only put forward generic, largely

typological statements regarding the composition of Tiszapolgár and Bodrogkeresztúr burial assemblages. The so-called ‘milk jugs’ – upon which the definition of the Bodrogkeresztúr culture as a whole was determined previously – represent the leading ceramic type of the Bodrogkeresztúr culture (Hillebrand, 1927). Milk jugs generally occur in graves along with a few cups and/or bowls (Lichter, 2001, p. 332; Patay, 1974, p. 21). The Tiszapolgár style graves are characterised by a large quantity of pottery (Lichter, 2001, pp. 280–281) and the presence of vessels with hollow-pedestals (Bognár-Kutzián, 1963, 1972). Moreover, some vessel types were defined as ‘non-culture-specific’ ceramics – like the flowerpot-like vessels or storage jars – due to their occurrence in both Tiszapolgár and Bodrogkeresztúr burials (Bognár-Kutzián, 1963, pp. 241–244, 271–275; 1972, pp. 121–122; Patay, 1974, p. 29), as well as the lack of distinctive decoration styles. However, these generalisations and complicated ceramic typologies often hinder the recognition of the utilitarian function and make it difficult to compare the two ceramic assemblages. Therefore, a more general ceramic classification was required to analytically recognise the utilitarian function and to better understand the Tiszapolgár and Bodrogkeresztúr mortuary practices.

There have been a number of works published on the function of the Early Copper Age ceramic grave goods. The study carried out by Meisenheimer (1989) analysed the functions of ceramics that occurred in the 155 Early Copper Age graves of Tiszapolgár-Basatanya cemetery, where both the Tiszapolgár and the Bodrogkeresztúr styles can be found (Bognár-Kutzián, 1963). However, contrary to the approach of the present article, Meisenheimer worked out a detailed typochronology for the burials – similarly to Bognár-Kutzián’s pioneering study – upon which she was able to outline the two cultural phases of the cemetery. Meisenheimer analysed the ceramic functions of the two periods separately within the framework of her detailed typology and focused on the general function of the ceramic offerings, instead of defining the function of each vessel type (Meisenheimer, 1989, pp. 30–32). More recently, István Zalai-Gaál published his results on the metric examination of the ceramics dating to the Early Copper Age, similarly what the present article is set out to achieve. However, in the centre of his study was the comparison of the vessels of Tiszapolgár and Bodrogkeresztúr style and metric examinations were used for the purpose of chronological questions, not to understand the composition of ceramic assemblages in the graves and past mortuary practices (Zalai-Gaál, 2016). Therefore, the reconstruction of the composition of ceramic assemblages and the assessment of the vessels’ utilitarian function in Early Copper Age burials are yet to be completed.

Therefore, the aim of the present case study is to examine the morphometric similarities and differences between the Tiszapolgár and the Bodrogkeresztúr ceramic styles, along with a closer look at the possible reconstructions of burial assemblages, and the utilitarian functions of ceramics within these, followed by a discussion of possible selection patterns reflected by Early Copper Age burials. In this way, the article attempts to shed more light on why exactly certain vessels were selected for mortuary purposes and, thus, the similarities and differences between the functions of ceramics that accompanied the Tiszapolgár and the Bodrogkeresztúr graves.

3 Case Study

The case study area is situated in the Upper Tisza Region in Northeast Hungary, along the northern fringes of the Great Hungarian Plain, with a focus on eight cemeteries and grave clusters with fully published ceramic material concentrating within a radius of 50 km (Figure 3).

3.1 First Group of Selected Sites

Within the remits of this article, four (major) undisturbed and published (including the metric data on ceramics) Early Copper Age cemeteries or grave clusters (all situated away from the settlements) were examined: (1) Tiszapolgár-Basatanya (Bognár-Kutzián, 1963), (2) Tiszavalk-Kenderföld (Patay, 1978b), (3)

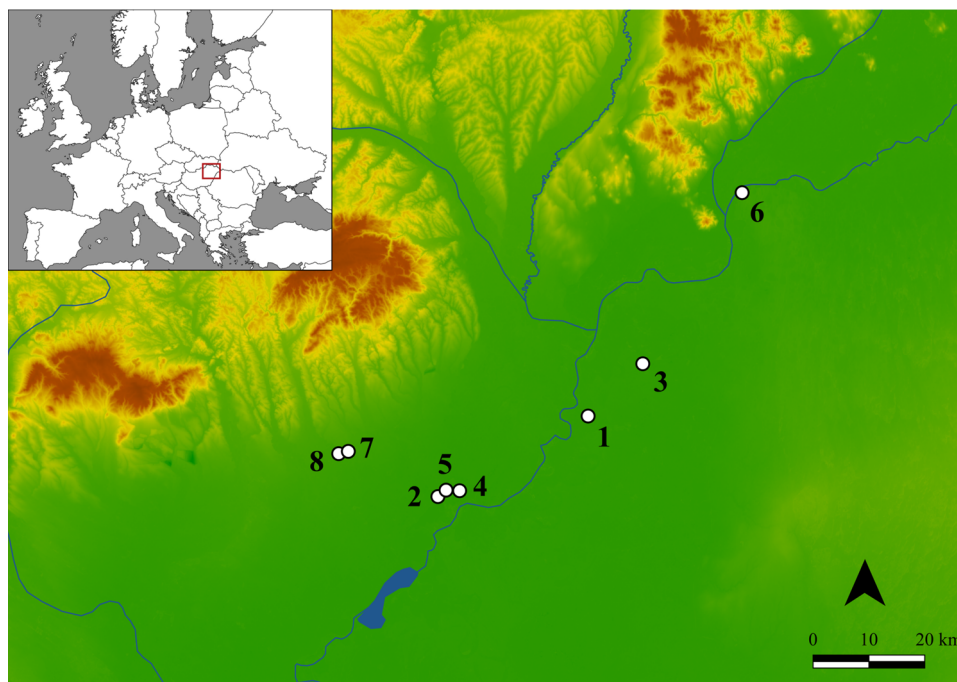


Figure 3: Location of the analysed sites: (1) Tiszapolgár-Basatanya; (2) Tiszavalk-Kenderföld; (3) Polgár-Nagy-Kasziba, (4) Tiszabábolna-Szilpuszta, (5) Tiszavalk-Tetes, (6) Szabolcs-Kisfalud, (7) Szihalom-Sóhajtó, and (8) Szihalom-Pamlényi-tábla.

Polgár-Nagy-Kasziba (Solnay, 2018), and (4) Tiszabábolna-Szilpuszta (Hillebrandt & Patay, 1977, pp. 41–47). The analysis included only undisturbed burials and well-preserved vessels whose form and size can be reconstructed. The morphometric examination is primarily based on the published metric data occasionally along with photographs (Supplement File 1).

Tiszapolgár-Basatanya represents one of the most thoroughly studied Early Copper Age burial grounds in Hungary, excavated between 1950 and 1954. The site is located on the area of the so-called Polgár Island (Raczky et al., 2014, p. 323, Figure 4) between the Selypes Stream and the Szandalik Canal. The cemetery containing 156 graves served as a basis for outlining the Early Copper Age ceramic typochronology in the region. At the Tiszapolgár-Basatanya site, both Tiszapolgár and Bodrogkeresztúr style graves were identified, as well as the transitional graves (i.e. representing the transition between the two styles) (Bognár-Kutzián, 1963). Most recent chronological examinations show that the cemetery was established after 4420–4280 cal BC and was utilised until 4040–3910 cal BC (Raczky & Siklósi, 2013, p. 566). For this article, altogether 90 burials along with 417 vessels were selected for analysis.

Tiszavalk-Kenderföld, another Early Copper Age burial ground, is located on the western bank of the Nyárad Stream. Although a large part of the site was presumably demolished (Patay, 1978b, p. 7), altogether 54 graves were excavated between 1966 and 1967. The burials were furnished with Bodrogkeresztúr style grave-goods (Patay, 1978b). 30 burials with 90 vessels were deemed suitable for examination.

At Polgár-Nagy-Kasziba, a group of four Early Copper Age graves with Tiszapolgár style vessels (Raczky et al., 1997; Solnay, 2018) was excavated in 1996 (Hajdú & Nagy, 1999, p. 149). The site is situated on Polgár Island (Raczky et al., 2014, p. 323, Figure 4), on the eastern bank of the Kengyel Stream. It can be assumed that the grave group was part of a larger – so far uninvestigated – cemetery (Raczky et al., 1997, p. 47). Most recent studies estimate the establishment of the site to 4520 (68.2%) 4360 cal BC until 4335 (68.2%) 4180 cal BC (Siklósi & Szilágyi, 2021, p. 16). Three of the burials with 27 vessels were selected for further investigations.

The site of Tiszabábolna-Szilpuszta, located near the Szili Canal, was excavated in 1974 and 1976. During the excavations, seven Tiszapolgár burials were found. It can also be presumed that the graves belonged to a larger – but now destroyed – cemetery (Hillebrandt & Patay, 1977, pp. 41–47). Four burials were included in the analysis along with 18 ceramic grave-goods.

At these four selected sites, the sample size of both the Tiszapolgár and the Bodrogkeresztúr style ceramics were approximately equal, making the comparison between the two mortuary practices possible. The statistics for the study were generated by the PAST 3.21 software (Hammer, Harper, & Ryan, 2001).

3.2 Second Group of Selected Sites

Furthermore, four additional burial grounds and grave clusters were included in the present case study: (1) Tiszavalk-Tetes (Patay, 1978a), (2) Szabolcs-Kisfalud (Ecsedy, 1977), (3) Szihalom-Sóhajtó (Marton & Patay, 2004; Szabó, 1997), and (4) Szihalom-Pamlényi-tábla (Marton & Patay, 2004; Váradi, 1997). The ceramic metric data have not been fully published from these sites; therefore, the examination and the identification of the vessels were based on the previously defined morphometric categories along with photographs and descriptions (Supplement File 2). The analysis of these additional four cemeteries and grave groups aims to refine the picture outlined by the four initially investigated cemeteries (with larger grave counts) to better understand the practice of mortuary ceramic offerings in the Upper Tisza Region in Hungary.

The burial ground of Tiszavalk-Tetes contained 25 Early Copper Age graves with Bodrogkeresztúr style vessels. The site located on the bank of the Tetes Stream was excavated between 1968 and 1975 (Patay, 1978a). Along with the burials, two Early Copper Age pits were also discovered (Patay, 1979). Most recent chronological studies estimate the beginnings of the burial ground to around 4490 (68.2%) 4230 cal BC until 4315 (68.2%) 4030 cal BC (Siklósi & Szilágyi, 2021, p. 23). For this article, 17 burials with 84 vessels were selected for analysis.

Szabolcs-Kisfalud, an Early Copper Age grave cluster, is situated on the bank of an old meander of the Tisza River, where 10 Tiszapolgár burials were found during an archaeological investigation between 1971 and 1972 (Ecsedy, 1977). Three of them with 11 vessels were suitable for examination.

The two Early Copper Age sites of Szihalom-Sóhajtó and Szihalom-Pamlényi-tábla were excavated between 1995 and 1997, in the vicinity of Szihalom. At Szihalom-Sóhajtó, 56 Bodrogkeresztúr burials and a settlement were unearthed (Marton & Patay, 2004; Szabó, 1997), while at Szihalom-Pamlényi-tábla, a single Bodrogkeresztúr grave (Marton & Patay, 2004; Váradi, 1997) was discovered separated only by a shallow depression from the previous site, which flooded periodically (Marton & Patay, 2004, p. 294; Szabó, 1997, p. 54). Contrary to the other sites, Szihalom-Sóhajtó and Szihalom-Pamlényi-tábla have not been fully published yet; therefore, only the two known graves – one from each site – with nine vessels are included in the analysis.

4 Methods

The methodology for this analysis involved two steps (Figure 2). First, the vessels' simplified geometric forms were determined to establish the basic morphological categories for the analysis of the graves' ceramic composition (Figure 2b). The second step included the metric analysis of the established morphological categories to draw up morphometric groups, from which the utilitarian function of certain vessel types can be inferred (Figure 2c). Finally, the morphological composition of the graves was re-examined with regard to ceramics, in the light of the metric analysis, to gain a better insight into Early Copper Age funerary practices.

To determine the simplified geometric form of burial ceramics, eight metric measurements were recorded on each vessel (Figure 4): (1) the absolute height of the entire vessel, (2) the height of the bowl part (for pedestalled vessels, this value is different from the absolute height), (3) the diameter of the rim, (4) the diameter of the base (for pedestalled vessels, the base diameter of the bowl part), (5) the height of the neck, (6) the maximum width of the body, (7) the height of the pedestal, and (8) the diameter of the pedestal (Martinez-Carrillo & Barcelo, 2017, p. 589; Read, 2007, pp. 230–239). Since the main focus was to simplify

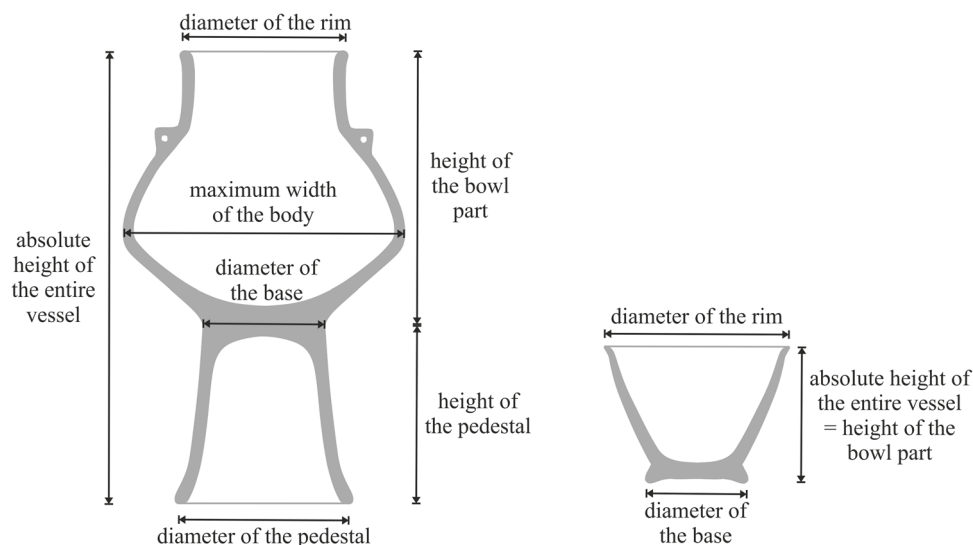


Figure 4: Metric data recorded on each vessel.

the over-detailed traditional typology by defining the primary geometric form of vessels, restricted and unrestricted forms were not divided if the basic geometric form was similar (for example, between vessels called conical and biconical bowls in traditional typology). For neckless potteries, the maximum width of the body generally differs from the diameter of the rim by only a few centimetres. Therefore, the definition of the maximum width of the body was considered irrelevant in the case of these vessels.

Following the methodological steps described by Read (2007, pp. 228–240) and Kramberger (2015, p. 233), the vessels were divided into neckless variants and types with necks in the first round of examinations and were analysed separately. Then, following the method by Prudence Rice, the neckless variants were compared in a scatter plot by the ratio of their rim diameter and the height of their bowl-part (Figure 5) (Rice, 1987, pp. 215–216). According to this, two groups could be identified; the shallow (rim diameter \geq bowl-part height) and the deep (rim diameter $<$ bowl-part height) vessels. In contrast, vessels with necks could not be examined by these parameters, because the height of the bowl-part is always larger than the rim diameter, as well as the maximum width of their body (Figure 6). Therefore, the vessels with necks cannot be separated only by these ratios. Finally, to determine the simplified geometric forms of the ceramics, the pedestalled vessels and the vessels without pedestals had to be separated in each previously defined category (i.e. to shallow and deep vessels and vessels with necks). As a result, six simplified geometrical categories were established (Figure 2); (1) shallow neckless vessels (A1 = without pedestal, A2 = pedestalled), (2) deep neckless vessels (B1 = without pedestal, B2 = pedestalled), and (3) vessels with necks (C1 = without pedestal, C2 = pedestalled). However, the quantity of the deep neckless pedestalled vessels (B2) and the pedestalled vessels with necks (C2) is low. Based on these categories, the ceramic morphological composition of burials was examined at each site, using a series of correspondence analyses and Kernel density estimations, where the number of burials allowed it.

The morphological analysis was followed by the metric examination of the simplified geometric form categories aided by scatter plots and Kernel density estimations to distinguish between vessels of the same form but different size and to establish morphometric categories (Figures 7 and 8). However, the exact metric boundaries of these categories can vary within the range of a few centimetres across the sites examined. This could be explained by different potting traditions at these sites, but other factors, such as technological knowledge, experience, and skills of the potters, as well as community or individual preferences, might also have influenced the size of the vessels (Apel, 2008; Crown, 2001; Gandon et al., 2011; Kamp, 2001; Stark, 1999, p. 40; Wayessa, 2011, p. 308). However, these differences were presumably too minor to affect the general use of the vessels (Smith, 1988, pp. 914–915). The metric examination of the neckless ceramics resulted in the identification of three vessel groups (Figure 2): (1) small, shallow neckless

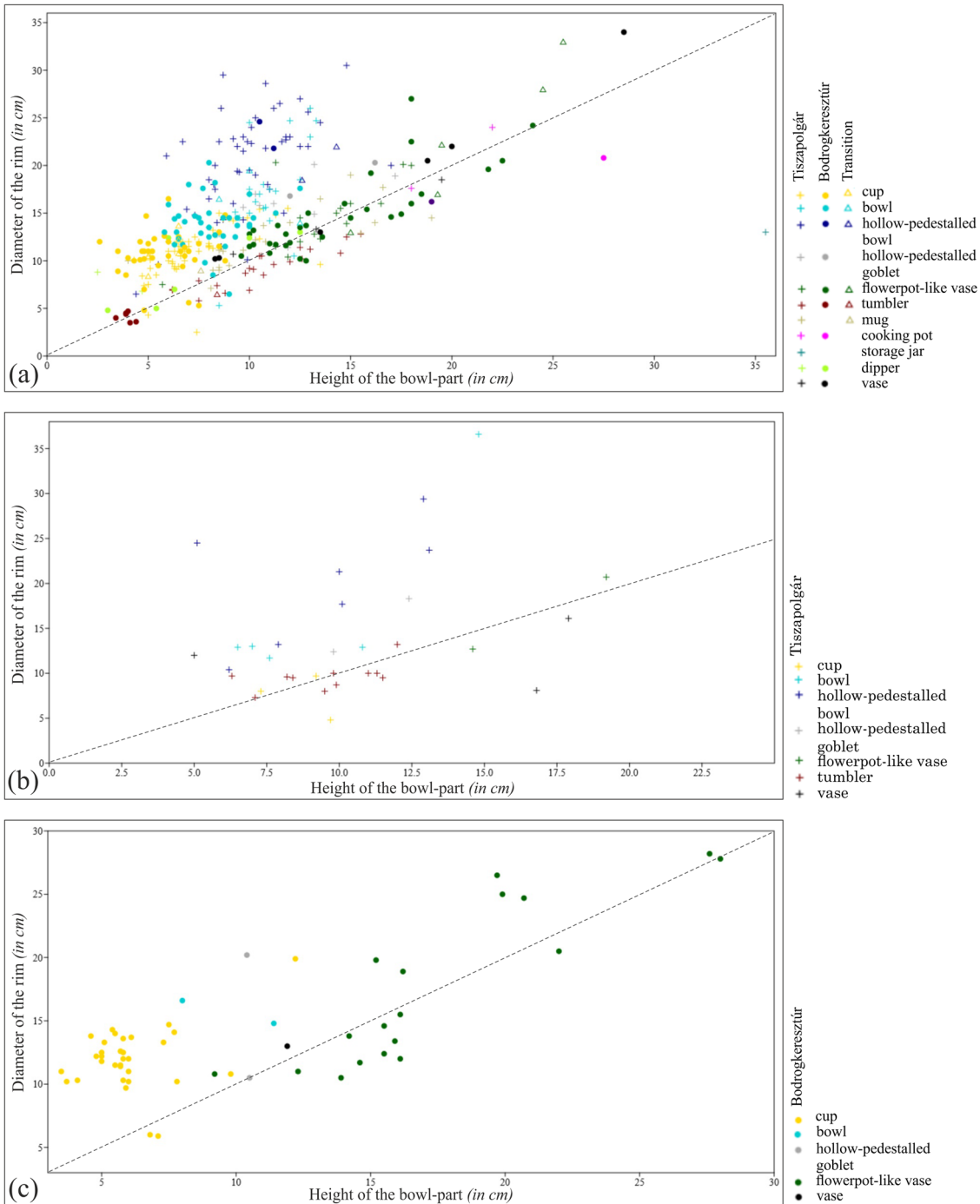


Figure 5: Scatter plot of neckless vessels at: (a) Tiszapolgár-Basatanya; (b) Tiszavalk-Kenderföld; and (c) Polgár-Nagy-Kasziba and Tiszabábolna-Szilpuszta (the legends contain the traditional typological terms to visualise their metrical distribution).

pieces (almost entirely represented by form A1) was the most dominant vessel category: rim diameter < 18 cm or ≤ 8 cm; bowl height < 14 cm, depending on the site, (2) wide, shallow neckless vessels occurring with or without pedestal (classified mainly as form A2, but some pieces resembling form A1 also belong here): rim diameter ≥ 18 cm; bowl height < 14 cm, and (3) large, 1/1 ratio neckless vessels (represented by form B1 and form A1): bowl height < 14 cm or < 8 cm, depending on the site, but their rim diameter and height increase equally to almost 1:1. Metric examinations focusing on vessels with neck parts were able to distinguish two groups (Figure 2): (1) regular-sized ceramics with necks (the vast majority of which

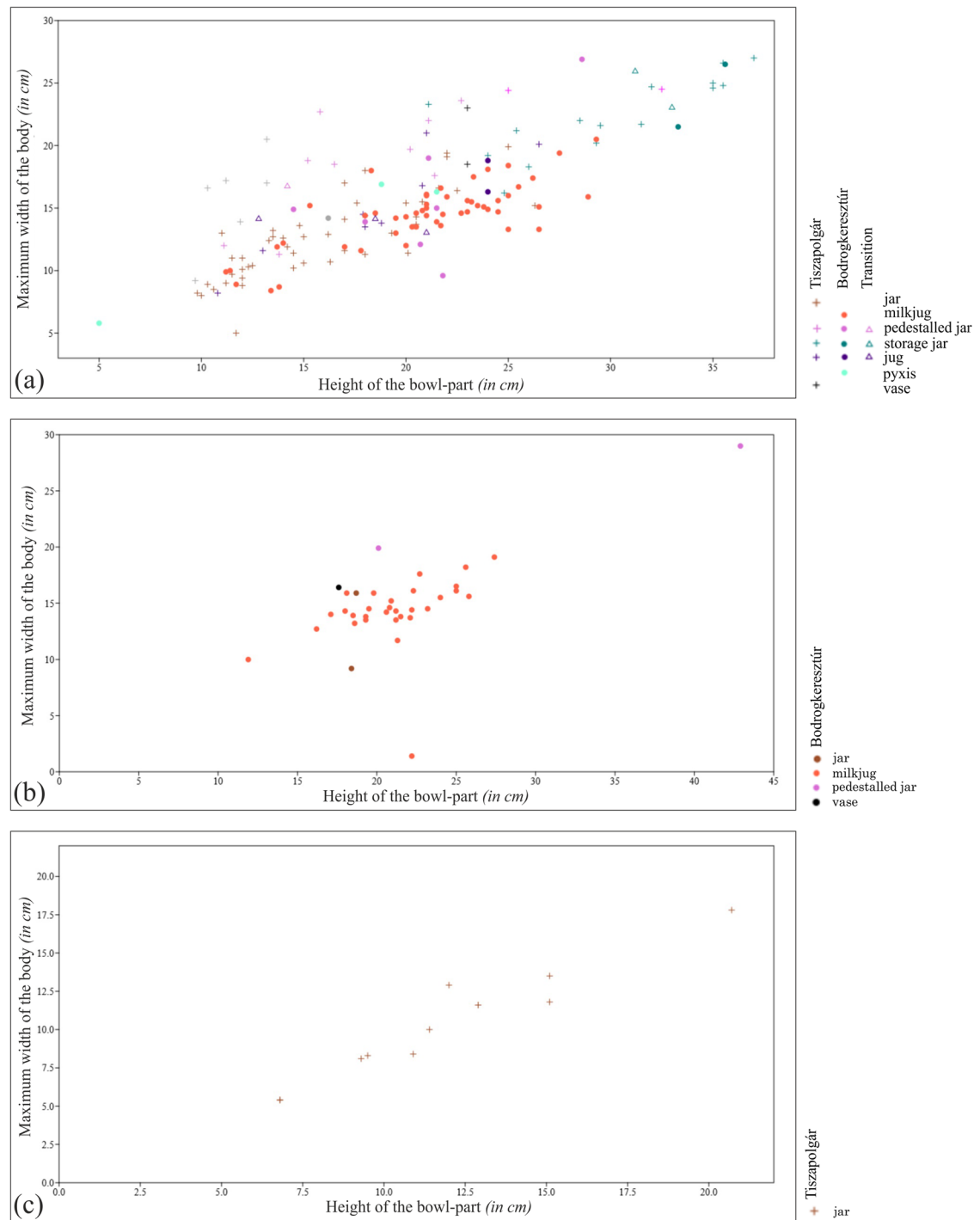


Figure 6: Scatter plot of vessels with neck at: (a) Tiszapolgár-Basatanya; (b) Tiszavalk-Kenderföld; and (c) Polgár-Nagy-Kasziba and Tiszabólna-Szilpuszta (the legends contain the traditional typological terms to visualise their metrical distribution).

belonged to form C1): widest point of body ≤ 20 cm and (2) large-sized vessels with necks (represented by form C1): widest point of body > 20 cm. Due to the small amount of the deep, neckless pedestalled vessels (B2) and the pedestalled vessels with necks (C2), these morphological categories fell below significant representation during the metric analysis. Finally, after the establishment of the morphometric categories, the morphological composition of the burials was re-examined and morphometric-based vessel assemblages in each burial were defined.

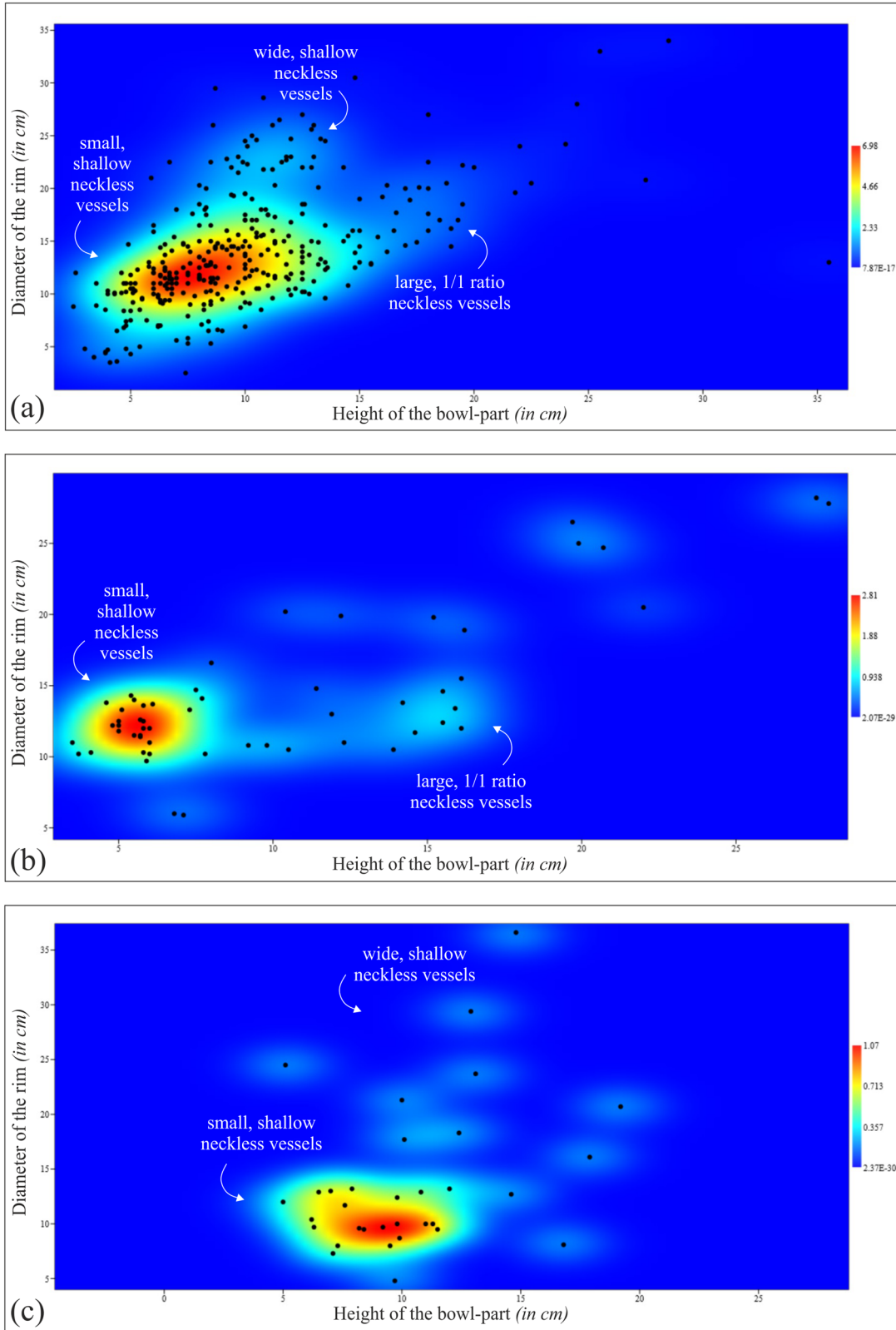


Figure 7: Kernel density plot of neckless vessels at: (a) Tiszapolgár-Basatanya; (b) Tiszavalk-Kenderföld; and (c) Polgár-Nagy-Kasziba and Tiszabábolna-Szilpuszta.

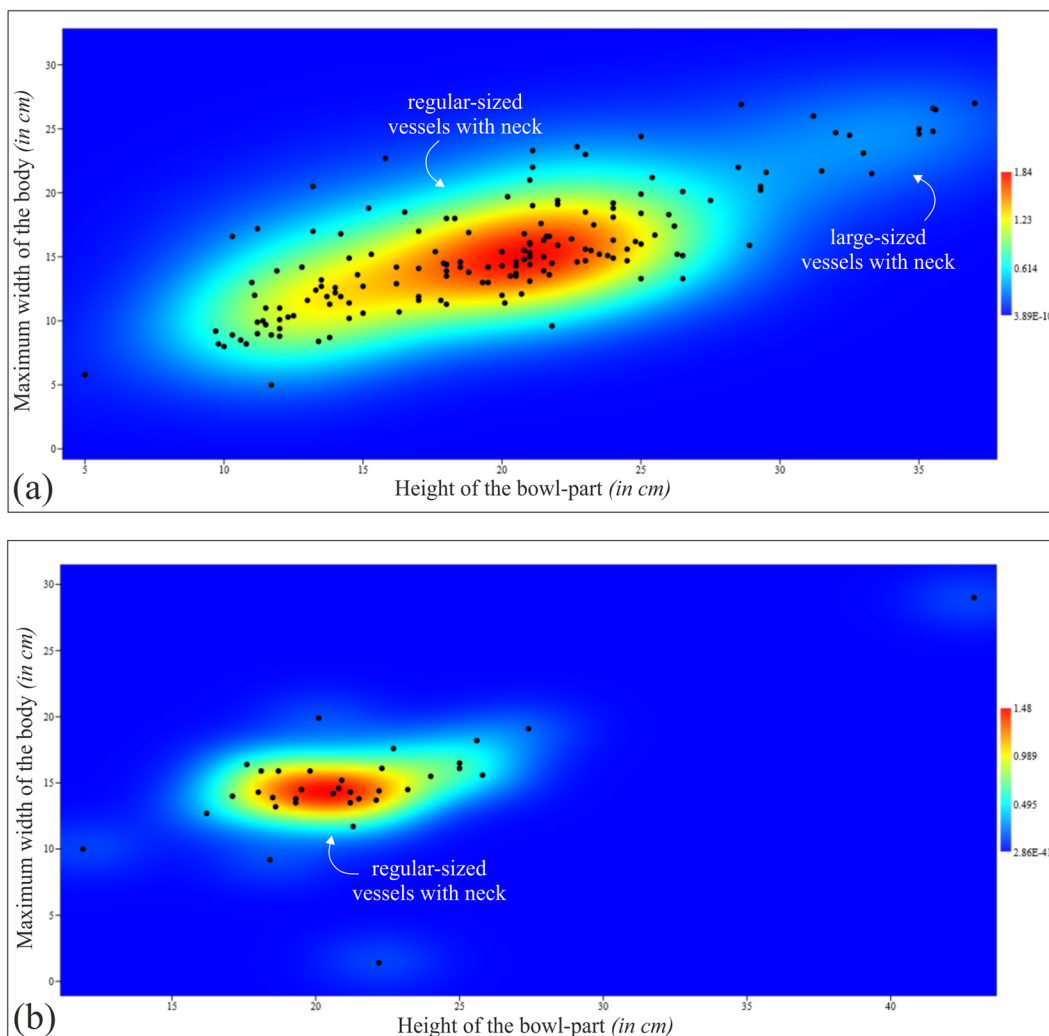


Figure 8: Kernel density plot of vessels with neck at: (a) Tiszapolgár-Basatanya and (b) Tiszavalk-Kenderföld.

5 Results

5.1 Tiszapolgár-Basatanya

Ninety burials ($\Sigma = 417$ vessels) and their ceramic assemblages were suitable for examination, which included 48 Tiszapolgár, 38 Bodrogkeresztúr, and 8 transitional graves. Morphological analyses concluded that the shallow neckless vessels (A1) and vessels with necks (C1) occurred most frequently, but the amount of the shallow neckless ceramics with pedestals (A2) and deep neckless vessels (B1) was also significant (Table 1).

The first correspondence analysis showed the transitional graves to be independent of both the Tiszapolgár and the Bodrogkeresztúr burials (Figure 9a), which could be explained by the lack of so-called ‘culture-specific’ ceramic types (i.e. the shallow neckless vessels [A1], vessels with necks [C1], and shallow neckless open ceramics with pedestals [A2]), and the large number of undiagnostic, deep neckless ceramics (B1). However, the second correspondence analysis with the omission of transitional graves suggested a different vessel distribution, by which two groups could be identified (Figure 9b and 9c): (1) burials where the presence of the shallow neckless vessels (A1) and vessels with necks (C1) was dominant and (2) burials where these ceramic forms could be present but were not dominant in the ceramic assemblage as a whole.

Table 1: The number and percentage of graves containing various vessel forms at Tiszapolgár-Basatanya

	Shallow neckless vessels without pedestal (A1)	Shallow neckless vessels with pedestal (A2)	Deep neckless vessels without pedestal (B1)	Deep neckless vessels with pedestal (B2)	Vessels with necks without pedestal (C1)	Vessels with necks with pedestal (C2)
Tiszapolgár style burials ($\Sigma = 45$)	40 (89%)	39 (87%)	20 (44%)	1 (2%)	37 (82%)	7 (16%)
Bodrogkeresztúr style burials ($\Sigma = 37$)	32 (86%)	6 (16%)	14 (38%)	0	30 (81%)	6 (16%)
Transitional burials ($\Sigma = 8$)	1 (13%)	0	7 (88%)	0	0	2 (25%)
Total ($\Sigma = 90$)	73 (81%)	45 (50%)	41 (46%)	1 (1%)	67 (74%)	15 (17%)

The table includes binary data indicating only the presence or absence of these forms in the graves, not the exact quantity of each ceramic form.

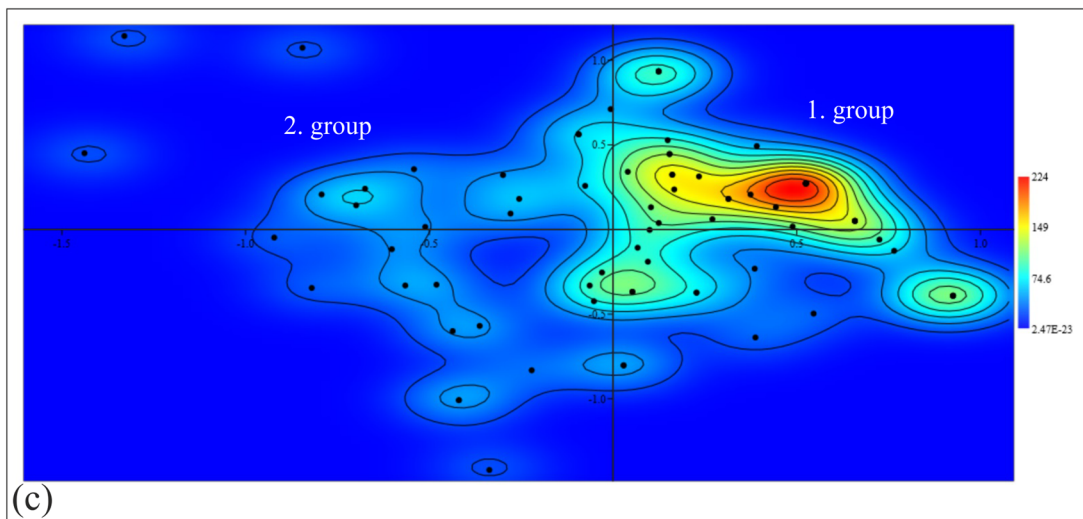
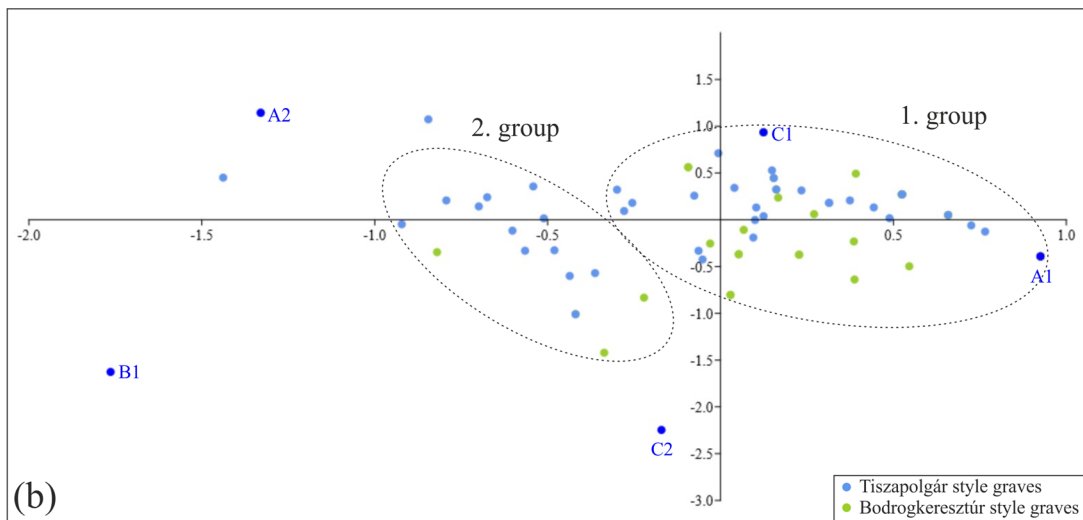
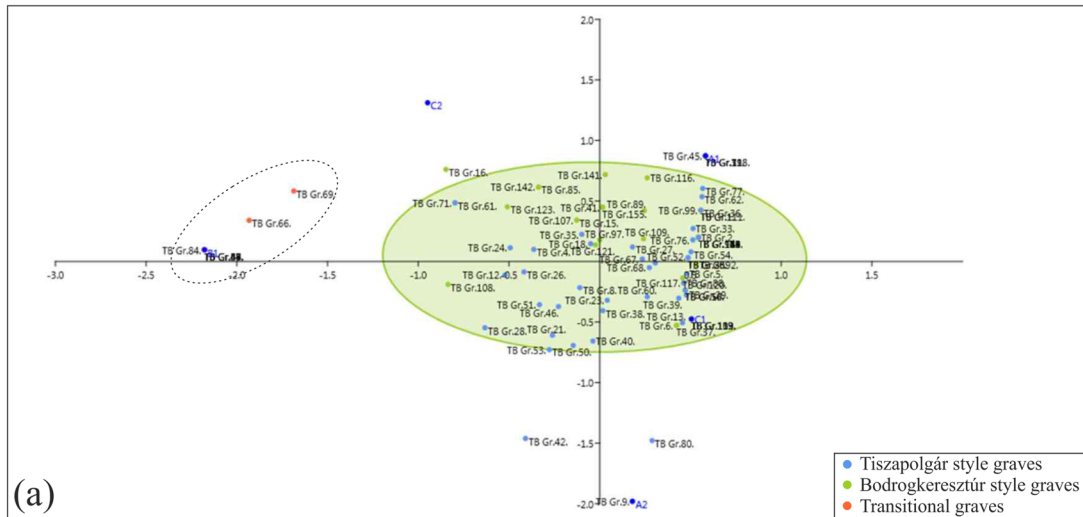


Figure 9: (a) Correspondence analysis of the graves from Tiszapolgár-Basatanya with 1σ ellipse and the separation of the transitional graves. (b) Correspondence analysis of the graves from Tiszapolgár-Basatanya with the omission of transitional graves. (c) Kernel density plot generated from the second correspondence analysis from Tiszapolgár-Basatanya.

Table 2: The number of graves containing minimum one small, shallow neckless vessel and minimum one regular-sized vessel with neck at Tiszapolgár-Basatanya

	Vessel combination of minimum one small, shallow neckless vessel and minimum one regular-sized vessel with neck
Tiszapolgár style burials ($\Sigma = 45$)	35 (78%)
Bodrogkeresztúr style burials ($\Sigma = 37$)	25 (68%)
Transitional burials ($\Sigma = 8$)	0
Total ($\Sigma = 90$)	60 (67%)

The first scenario was typical of the graves of both ceramic styles, while the second was mainly characteristic of the Tiszapolgár burials.

Based on the metric analysis of the simplified morphological ceramic categories, the following morphometric vessel assemblages could be observed: the most commonly occurring vessel combination included small, shallow neckless vessels and regular-sized vessels with necks found in 67% of the burials at Tiszapolgár-Basatanya (Tables 2 and 3).¹ The difference between the Tiszapolgár and the Bodrogkeresztúr burial assemblages is also reflected by the third ceramic category included in the graves (Table 4). In the Tiszapolgár burials, the wide, shallow neckless vessels represented the most frequently occurring ceramic category, while in the Bodrogkeresztúr burials, this particular ceramic category was rare. The presence of the large, 1/1 ratio neckless vessels is notable too, occurring in an approximately equal number of graves of both ceramic styles. The number of large-size vessels with necks was limited and found mainly in the Tiszapolgár graves.

5.2 Tiszavalk-Kenderföld

Thirty Bodrogkeresztúr style burials ($\Sigma = 90$ vessels) were included in the examinations. The morphological analysis showed that shallow neckless vessels (A1) and vessels with necks (C1) were by far the most dominant forms, but deep neckless ceramics (B1) were significant too (Table 5).

Table 3: The vessel combinations in graves which did not contain minimum one small, shallow neckless vessel and minimum one regular-sized vessel with neck at Tiszapolgár-Basatanya

	Vessel combination of minimum one small, shallow neckless vessel and minimum one large, deep vessel	Vessel combination of minimum one large, 1/1 ratio neckless vessel and minimum one wide, shallow neckless vessel	Just one ceramic morphometric type
Tiszapolgár style burials ($\Sigma = 12$)	3 (25%)	3 (25%)	4 (33%)
Bodrogkeresztúr style burials ($\Sigma = 10$)	5 (50%)	0	6 (60%)
Transitional burials ($\Sigma = 8$)	0	0	6 (75%)
Total ($\Sigma = 30$)	8 (27%)	3 (10%)	16 (53%)

Vessel combinations not mentioned here were of negligible quantity.

¹ Generally, one or two shallow neckless ceramics (A1) and a single vessel with a neck (C1).

Table 4: The third ceramic morphometric type in graves containing the vessel combination of minimum one small, shallow neckless vessel and minimum one regular-sized vessel with neck at Tiszapolgár-Basatanya

	Wide, shallow neckless vessels with or without pedestal	Large, 1/1 ratio neckless vessels	Large-sized vessels with necks
Tiszapolgár style burials ($\Sigma = 35$)	31 (89%)	13 (3%)	14 (40%)
Bodrogkeresztúr style burials ($\Sigma = 25$)	5 (20%)	8 (32%)	2 (8%)
Transitional burials ($\Sigma = 0$)	0	0	0
Total ($\Sigma = 60$)	36 (60%)	21 (35%)	16 (27%)

The correspondence analysis identified two groups (Figure 10a and 10b): (1) burials accompanied only by shallow neckless vessels (A1) and vessels with necks (C1) (53%) and (2) burials with deep neckless ceramics (B1) as well as shallow neckless vessels (A1) and vessels with necks (C1) (30%).

Morphometric analyses of the burial assemblages have shown that the most frequently occurring vessel combinations were of small, shallow neckless ceramics and regular-sized vessels with neck found in 90% of the graves. The presence of the large, deep vessels was also significant; however, the wide, shallow neckless vessels were completely absent, contrary to the situation documented at Tiszapolgár-Basatanya.

5.3 Polgár-Nagy-Kasziba and Tiszabábolna-Szilpuszta

Altogether seven Tiszapolgár style burials ($\Sigma = 45$ vessels) from the sites of Polgár-Nagy-Kasziba ($\Sigma = 27$ vessels) and Tiszabábolna-Szilpuszta ($\Sigma = 18$ vessels) could be included in the analysis (Table 6). These two sites are discussed together due to the small number of graves deemed suitable for analysis, to provide a better understanding of the occurring vessel categories. The morphological analysis indicated that the most numerous ceramic forms were the shallow neckless vessel (A1), but vessels with necks (C1) and shallow neckless ceramics with pedestals (A2) also occurred frequently, while the number of the deep neckless vessels (B1) was significant too. Due to the small number of burials, multivariate statistics could not be carried out at these sites.

The two main ceramic combinations based on morphometrics were (1) small, shallow neckless vessels and regular-sized vessels with necks and (2) small, shallow neckless vessels and wide, shallow neckless vessels.

5.4 Szabolcs, Tiszavalk-Tetes, Szihalom-Sóhajtó, and Szihalom-Pamlényi-tábla

The morphometric analysis of mortuary ceramics from the first four sites (Tiszapolgár-Basatanya, Tiszavalk-Kenderföld, Polgár-Nagy-Kasziba, and Tiszabábolna-Szilpuszta) has shown high levels of homogeneity among the Tiszapolgár and Bodrogkeresztúr style graves, the key difference being the representation of wide, shallow neckless vessels. This could be due to either the variations between the two ceramic styles or the different individual characters of the sites under study. To investigate this issue further, altogether 21 graves ($\Sigma = 104$ vessels) were examined from four other, not fully published Tiszapolgár and Bodrogkeresztúr sites (in terms of the ceramic metric data) and achieved the identification of the morphometric categories established by the analyses based on the four major, fully published sites (Table 7).

The results have shown the clear dominance of the small, shallow neckless vessels and regular-sized ceramics with necks in the assemblages, independent from the style (Table 8). However, wide, shallow neckless vessels were represented mainly among the Tiszapolgár style graves and were generally absent from the Bodrogkeresztúr style burials. At Tiszavalk-Tetes, almost 70% of the analysed burials contained

Table 5: The number and percentage of graves containing various vessel forms at Tiszavalk-Kenderföld

	Shallow neckless vessels without pedestal (A1)	Shallow neckless vessels with pedestal (A2)	Deep neckless vessels without pedestal (B1)	Deep neckless vessels with pedestal (B2)	Vessels with necks without pedestal (C1)	Vessels with necks with pedestal (C2)
Total ($\Sigma = 30$)	29 (97%)	2 (7%)	10 (33%)	0	28 (93%)	2 (7%)

The table includes binary data indicating only the presence or absence of these forms in the graves, not the exact quantity of each ceramic form.

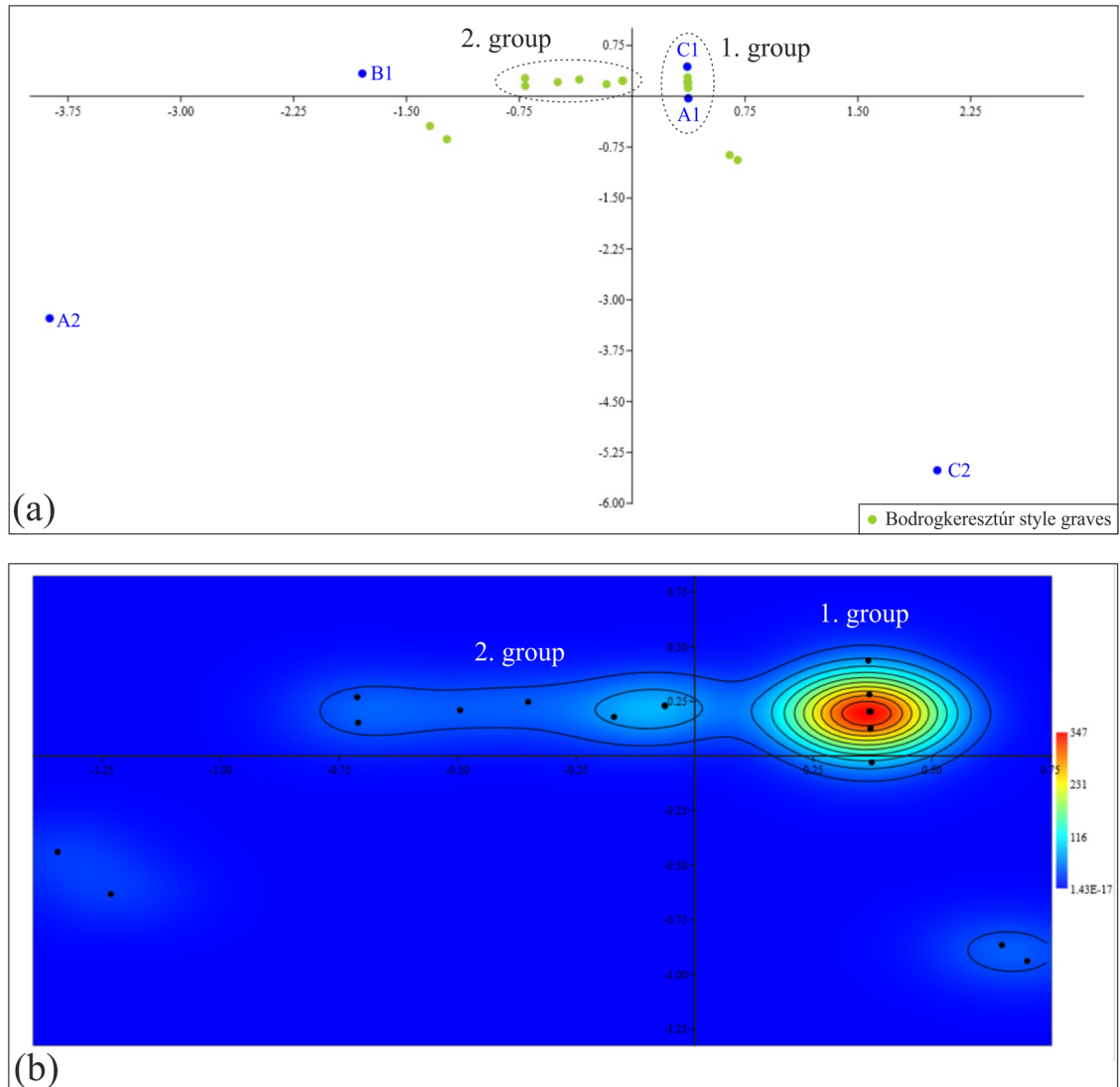


Figure 10: (a) Correspondence analysis of the graves from Tiszavalk-Kenderföld. (b) Kernel density plot generated from the correspondence analysis from Tiszavalk-Kenderföld.

wide, shallow neckless vessels, despite that the cemetery was previously classified as Bodrogkeresztúr style. This implies that the presence of this particular morphometric type in graves cannot be seen automatically as ‘culture-specific’, even if they were dominant at sites associated clearly with a certain ceramic style.

6 Discussion

Instead of a typological assessment, the definition of basic morphological categories and the establishment of morphometric groups made it possible for the ceramic assemblages of the Tiszapolgár and Bodrogkeresztúr burials can be compared, and the utilitarian function of the vessels to be outlined (Figure 11). The morphometric analyses demonstrated very similar funerary ceramic assemblages present in the graves of both the Tiszapolgár and the Bodrogkeresztúr styles in the Upper Tisza Region. Generally, the ceramic assemblages in the burials of both ceramic styles contain a regular-sized vessel type with

Table 6: The number and percentage of graves containing a variety of vessel forms at Polgár-Nagy-Kasziba and Tiszabólna-Szilpuszta

	Shallow neckless vessels without pedestal (A1)	Shallow neckless vessels with pedestal (A2)	Deep neckless vessels without pedestal (B1)	Deep neckless, vessels with pedestal (B2)	Vessels with necks without pedestal (C1)	Vessels with necks with pedestal (C2)
Total ($\Sigma = 7$)	6 (97%)	5 (71%)	4 (33%)	2 (29%)	5 (71%)	0

The table includes binary data indicating only the presence or absence of these forms in the graves, not the exact quantity of each ceramic form.

Table 7: The number and percentage of graves containing various vessel forms at Szabolcs, Tiszavalk-Tetes, Szihalom-Sóhajtó and Szihalom-Pamlényi-tábla

	Shallow neckless vessels without pedestal (A1)		Shallow neckless vessels with pedestal (A2)		Deep neckless vessels without pedestal (B1)		Deep neckless vessels with pedestal (B2)		Vessels with necks without pedestal (C1)		Vessels with necks with pedestal (C2)	
Total at Szabolcs ($\Sigma = 3$)	3 (100%)	1 (33%)	2 (67%)	0	2 (67%)	0	2 (67%)	1 (33%)	2 (67%)	1 (33%)	0	1 (33%)
Total at Tiszavalk-Tetes ($\Sigma = 16$)	16 (100%)	9 (56%)	9 (56%)	2 (13%)	15 (94%)	2 (13%)	15 (94%)	4 (25%)	15 (94%)	4 (25%)	0	4 (25%)
Total at Szihalom- Sóhajtó ($\Sigma = 1$)	1 (100%)	0	0	0	1 (100%)	0	1 (100%)	0	1 (100%)	0	0	0
Total at Szihalom- Pamlényi-tábla ($\Sigma = 1$)	1 (100%)	0	0	0	1 (100%)	0	1 (100%)	0	1 (100%)	0	0	0

The table includes binary data indicating only the presence or absence of these forms in the graves, not the exact quantity of each ceramic form.

Table 8: The number of graves containing minimum one small, shallow neckless vessel and minimum one regular-sized vessel with neck at Szabolcs, Tiszavalk-Tetes, Szihalom-Sóhajtó, and Szihalom-Pamlényi-tábla

Vessel combination of minimum one small, shallow neckless vessel and minimum one regular-sized vessel with neck	
Szabolcs ($\Sigma = 3$)	2 (67%)
Tiszavalk-Tetes ($\Sigma = 16$)	14 (88%)
Szihalom-Sóhajtó ($\Sigma = 1$)	1 (100%)
Szihalom-Pamlényi-tábla ($\Sigma = 1$)	1 (100%)

neck and at least one small, shallow neckless vessel type, which can be identified as a ‘basic set’ – as it is going to be referred to henceforth. In the ‘basic set’, small, shallow neckless vessels correspond with the cups and small bowls described by the typology of Bognár-Kutzián (1963, pp. 259–264, 288–292), while regular-sized vessel types with necks equate mainly to jars, jugs, and milk jugs (Bognár-Kutzián, 1963, pp. 244–247, 276).

One of the key pieces of the ‘basic set’ is the regular-sized vessel with neck. As ethnoarchaeological examples have shown, the presence of the neck indicates either a long-term storage function or the storage of liquids of some kind (Kramberger, 2015, p. 233; Rice, 1987, p. 241; Skibo, 2013, pp. 30–31; Smith, 1988, p. 914). However, given the relatively small size of these vessels under study here – compared to an average-sized storage vessel – makes the long-term storage of everyday goods, such as cereal grains, fruits or vegetables, highly unlikely (Henrickson & McDonald, 1983, p. 634; Smith, 1988, p. 914). These vessels seem more suitable for the transportation of liquids (Pechtl, 2015, p. 565, Figure 29.4), serving, or short-term storage functions (Blitz, 1993, p. 84), but could have been used for the long-term storage of small amounts of valuable goods, for example, special herbs, or fruits. Lipid analyses carried out on milk jugs showed evidence of animal fat residues in a significant number of vessels, as opposed to signatures related to dairy fats, which only one of the vessels contained (Craig et al., 2003, p. 258; Hoekman-Sites, 2011, pp. 176–178). However, only one examined sample came from a site included in the present article from Tiszavalk-Tetes (Craig et al., 2003, p. 254).

Another key element of the ‘basic set’ is the class of small, shallow neckless vessels, which could have been intended for personal use at mealtimes (Pechtl, 2015, p. 565, Figure 29.4), as demonstrated by ethnographic examples (Henrickson & McDonald, 1983, p. 632; Trias, Rosselló, Molina, & Santacreu, 2015, p. 91). Depending on the depth, these small shallow potteries could have equally been suitable for the consumption of liquid or solid foods (Hally, 1986, p. 270). However, in burials, these vessels were generally placed near regular-sized vessels with necks – particularly in Bodrogkeresztúr style graves (Bognár-Kutzián, 1963, p. 290; Patay, 1978b, pp. 36, 49)² – which could have been connected to smaller amount of liquid or solid food. Thus, this close position of the small, shallow neckless vessels suggests a function for the consumption of liquids or solid food, while in some burials, they could have also served as lids (Bognár-Kutzián, 1963, pp. 290, 298).

The ‘basic sets’ are likely to have been associated with, or belonged to single individuals. Elements of the ‘basic set’, particularly the regular-sized vessels with necks, were placed in front of the face of the deceased or around the skull in the Bodrogkeresztúr style burials (Patay, 1978b, p. 37). Such vessels were deposited in a similar position in the Tiszapolgár graves too, although in some cases they also occur beside the legs. This characteristic vessel placement appears to have roots in the Late Neolithic Tisza-Herpály-Csőszhalom complex, where – in the rare cases when ceramics were found in graves – the vessels were largely installed near the skull or around the legs (Sebők, 2012, p. 108, Tables 3 and 4). However, the Early Copper Age ‘basic set’ – containing one small, shallow neckless vessel type and a regular-sized vessel type

² These could be represented mainly by the jugs and milk jugs in the typology of Bognár-Kutzián (1963, p. 276).

with neck – could not yet been identified in the Late Neolithic period. Therefore, following on from these early deposition practices of ceramic grave goods, it could be suggested that a highly individualised ‘basic set’ was established only by the period of the Early Copper Age.

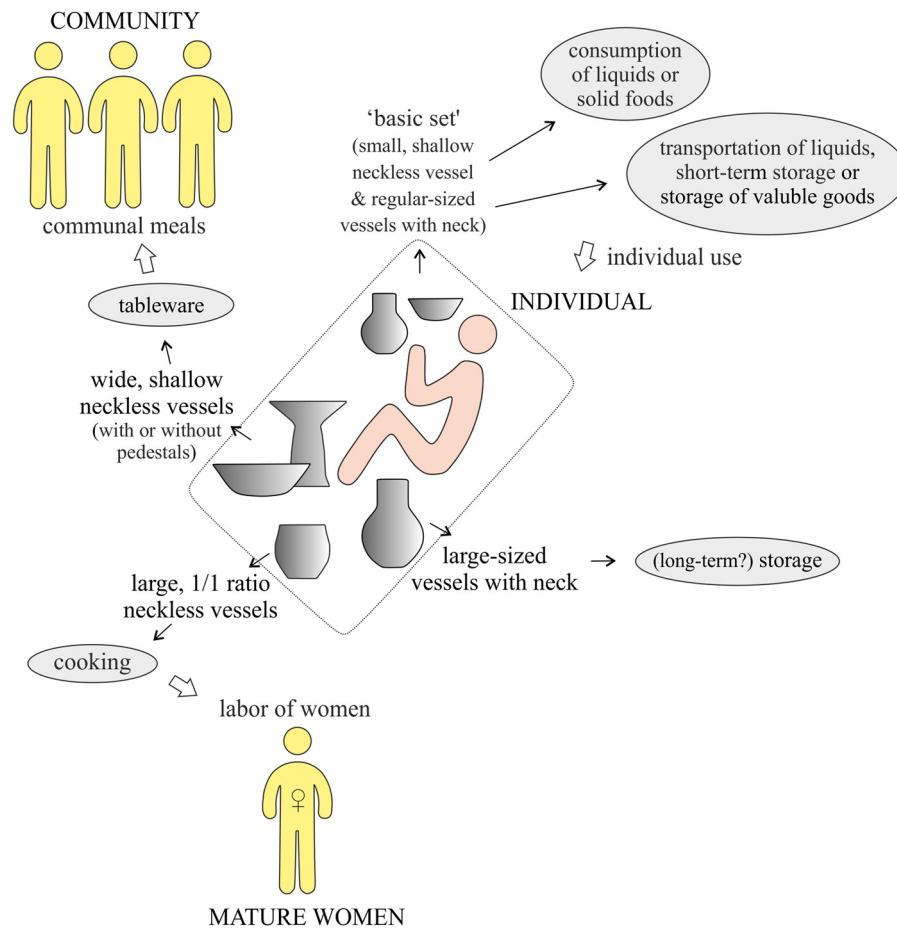


Figure 11: The different ceramic morphometric categories and their possible function in Early Copper Age graves.

Besides the ‘basic set’, the other regularly occurring ceramic types are the wide, shallow neckless vessels with or without pedestals, which generally, but not exclusively, are found in Tiszapolgár style graves. These could be equated to the hollow-pedestalled bowls or goblets and the wide bowls described in the typology by Bognár-Kutzián (1963, pp. 248–258, 285–286). Depending on their depths (not including their pedestal, if they had one), they could have been used for serving liquids, or more likely solid foods (Henrickson & McDonald, 1983, p. 632; Kramberger, 2015, p. 241; Smith, 1988, p. 914). Their potential utilisation as tablewares may have been emphasised even further by the tall hollow-pedestals in some instances, as pedestals may have made access to food easier (Kramberger, 2015, pp. 241–242, 245). Based on ethnographic examples, the wide, shallow neckless vessel types could have generally been used for communal meals by a family or household (Hally, 1986, p. 289; Mills, 1999, pp. 102–103, 2007). The wide, shallow neckless vessel types with or without pedestals could have been used during communal feasts; however, their size is only suitable for serving about a dozen people at one time. It is more likely that they were used by nuclear families or smaller households. Some of these vessels might have already been emptied by the time they were placed into the grave (Csányi, Raczky, & Tárnoki, 2009, p. 17), which implies a funerary meal or small feasting event prior to the burial.

Another frequently occurring morphometric category is the large, 1/1 ratio neckless vessels. These could be represented mainly by the flowerpot-like vessels in the typology of Bognár-Kutzián (1985, pp. 240–242, 271–274). Due to their aperture being quite wide, and their overall size much smaller than an average storage vessel, their function as long-term storage containers seems unlikely (Henrickson & McDonald, 1983, pp. 632–633; Skibo, 2013, p. 33). However, large, deep vessels could have been suitable for cooking (Bognár-Kutzián, 1985, pp. 242, 274, 250), as their thick, coarse walls (Bognár-Kutzián, 1963, p. 355; Solnay, 2018, p. 185) and traces of secondary burning detected on their exterior indicate. Furthermore, small, shallow neckless vessels (which do not form part of the ‘basic set’) were often found inside these large, 1/1 ratio neckless vessels (Bognár-Kutzián, 1963, p. 264), perhaps functioning as scoops or ladles. This suggests that these large, 1/1 ratio neckless vessels could have contained liquids or small pieces of solid foods.

The group of the large, 1/1 ratio neckless vessels was the only morphometric group where a regularly occurring association was observed between the placement of the vessels and the age of the deceased individual. Large, 1/1 ratio neckless containers were found placed next to the body in inhumation burials laid on their left side – i.e. mainly women (Bognár-Kutzián, 1963, p. 355; Chapman, 2000, p. 82; Kadrow, 2010, p. 58; Lichter, 2001, pp. 277–278; Meisenheimer, 1989, p. 3; Raczky et al., 2014, p. 329; Sofaer Derevenski, 1997, p. 877) – almost in every case in the examined cemeteries (Bognár-Kutzián, 1963, p. 242) and grave clusters. Furthermore, more than a half of these vessels were placed in the graves of females over 40 years of age at Tiszapolgár-Basatanya and at Polgár-Nagy-Kasziba (osteological examinations had not been carried out on burials from other cemeteries and grave clusters). The relationship between cooking pots and the female gender can be observed in wide ranging ethnographic contexts since these vessels are strongly linked to the labour and domestic roles of women (Anderson, 2019, p. 142; Haaland, 1997, p. 378; Hastorf, 2016, p. 183). It is possible that there could be a certain symbolic association between the large, 1/1 ratio neckless vessels and mature women in the Early Copper Age burials.

The last morphometric ceramic category was the large-sized vessels with necks, which are only known from Tiszapolgár-Basatanya. These could be represented mainly by the cooking pots and storage jars in the typology of Ida Bognár-Kutzián (Bognár-Kutzián, 1963, pp. 242–244, 247–248, 274–275). Due to the presence of the neck, the long-term storage function or storage of liquids of some kind can be assumed (Kramberger, 2015, p. 233; Rice, 1987, p. 241; Skibo, 2013, pp. 30–31; Smith, 1988, p. 914). However, based on ethnographic examples, their size is slightly smaller than the average long-term storage vessels of liquid or solid foods (Henrickson & McDonald, 1983, pp. 632–633): the diameter of the rim is 10.7–21 cm, the maximum width of the body is 20–27 cm, and the absolute height of the entire vessel was 21–37 cm. Thus, these were probably used for long-term storage of medium quantities. In comparison, on the Late Neolithic Great Hungarian Plain, the diameter of the rim of storage jars was defined around 21–36 cm, the maximum width of the body was around 21–36 cm, and the absolute height of the entire vessel was around 26–46 cm (Füzesi & Raczky, 2018, pp. 142–146). Moreover, on the Middle Bronze Age Great Hungarian Plain, the absolute height of storage jars was between 60 and 80 cm (Szathmári, 2009, p. 298).

7 Conclusions

Since the previous Early Copper Age studies of ceramic usage were always based on some generalisations – like the previously discussed issue of milk jugs – and complicated typologies, the identification of the utilitarian function of mortuary pottery assemblages has never been carried out before. This study has shown the effectiveness of the morphometric analysis on potteries not only for identifying the most optimal use of ceramics but also for exploring the consistent pattern in the selection and deposition of mortuary vessels. Moreover, this approach helps to clarify and compare the functional concept in Tiszapolgár and Bodrogkeresztúr style burials, which could not be studied with the previously applied analytical methods.

The morphometric analysis of Early Copper Age graves in the Upper Tisza Region (Eastern Hungary) revealed five main categories of ceramic function, each of which could be interpreted as fulfilling different utilitarian functions. In the vast majority of the graves, the most dominant category is the highly

individualised ‘basic set’, which contained at least one small, shallow neckless vessel type and a regular-sized vessel type with neck. Besides, the wide, shallow neckless vessels with or without pedestals (could have served as tableware), as well as the large, 1/1 ratio neckless vessels (can be linked to mature women and the roles they played), were often found in the burials. The large-sized vessels with neck – presumably used for long-term storage – were the least common category.

In the case study area of the Upper Tisza Region, neither the Tiszapolgár nor the Bodrogkeresztúr style funerary assemblages could unequivocally be distinguished from one another based on ceramic morphometry.³ The ceramic assemblages of both the Tiszapolgár and the Bodrogkeresztúr styles contained identical morphometric categories with similar utilitarian functions associated with them. Although there could be some level of difference observed in the preferences of certain vessel types in funerary assemblages between the two ceramic styles (especially with regard to the wide, shallow neckless vessel forms), as the site of Tiszavalk-Tetes clearly demonstrates, these differences are due to local variations rather than differences between the Tiszapolgár and the Bodrogkeresztúr ceramic style overall.

This case study highlights the issue of the utilitarian function of ceramic grave-goods and provides a possible interpretation of the vessel function through the morphometric analysis of the ceramic assemblages in the burials.

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³ István Zalai-Gaál made the same remark in his general analysis of the Early Copper Age pottery size (Zalai-Gaál, 2016, p. 89).

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