The Morphology of Iron Age Storage Jars and Its Relation to the Handbreadth Measure (Biblical *Tefach*)

Avshalom Karasik, Ortal Harush, and Uzy Smilansky

*In this paper we compare morphological features of three groups of Iron Age storage jars that were unearthed in several Judahite and Israelite sites. The most famous group is the royal Judahite storage jars with stamped handles (“*lmlk*,” “rosette,” etc.). The other two groups are the “Hippo” jars found abundantly in Israelite sites and the jars from Khirbet Qeiyafa (Judah), assigned chronologically to the early 10th century* B.C.E. *We scanned most of the available jars in 3D and compared them in a detailed morphological study. We extracted several metric measures and observed large variations between jars within a group and, to a larger extent, between jars from different groups. The only exception is the inner rim diameter, which shows surprising uniformity. Moreover, the distribution of inner rim diameters is consistent with anthropometric measurements of the handbreadth of the human male. We provide a detailed description of our methodology and findings and offer a few alternative explanations for the clear correlation between the measured inner rim diameter and the human* tefach.

Keywords: Iron Age pottery; 3D scanning; handbreadth; *tefach*

Storage jars are one of the main ceramic types produced and used abundantly since pottery was invented. The need to collect, store, and distribute large amounts of agricultural products, which requires large closed vessels, has influenced their shape and design through time and space. Archaeological research has revealed many groups of storage jars that come from different areas or belong to different periods. Usually, archaeologists consider a group of storage jars as a type if they have relatively uniform morphological and stylistic attributes, such as volume, metric dimensions, and a distinctive shape. In some cases, we found storage jars with imprinted marks that may be used to identify their contents, destination, manufacturer, or owner.

Here we shall focus on three Iron Age groups of storage jars that represent distinct phases within the period. The earliest group was uncovered at the site of Khirbet Qeiyafa in a rich destruction layer, ^{14}C-dated to the early 10th century B.C.E. (Garfinkel and Ganor 2009). Petrographic analysis shows that most of the Qeiyafa jars were made of the same clay, suggesting that they were produced in one centralized pottery workshop (Ben-Shlomo 2009). Their volumes range between 20–40 liters, they are similar in shape, and most bear one or several finger impressions on their handles (see **Figs. 1–2**). These potter marks were impressed during the fabrication process, i.e., prior to firing. According to the site excavators, the production of the jars is associated with the first stage of the Iron Age II predating the *lmlk* assemblage (Kang and Garfinkel 2015).

A somewhat later group consists of storage jars from northern Israel. These jars have a unique shape (see **Figs. 1–2**) that earned them the nickname “Hippo” jars: a rounded base; large bulbous body; broad, slightly rounded

Avshalom Karasik: The National Laboratory for Digital Documentation and Research in Archaeology, Israel Antiquities Authority, Jerusalem, Israel; *avshalom@israntique.org.il*

Ortal Harush: The Computational Archaeology Laboratory, The Hebrew University of Jerusalem, Mount Scopus, Jerusalem 91905, Israel; *ortal.haroch@mail.huji.ac.il*

Uzy Smilansky: The Computational Archaeology Laboratory, The Hebrew University of Jerusalem, Mount Scopus, Jerusalem 91905, Israel. Department of Physics of Complex Systems, The Weizmann Institute of Science, Rehovot 76100, Israel; *uzy.smilansky@weizmann.ac.il*

Electronically Published August 11, 2020.

BASOR 384 (2020). © 2020 American Schools of Oriental Research. 0003-097X/2020/384-00X$10.00. All rights reserved. DOI 10.1086/710529.

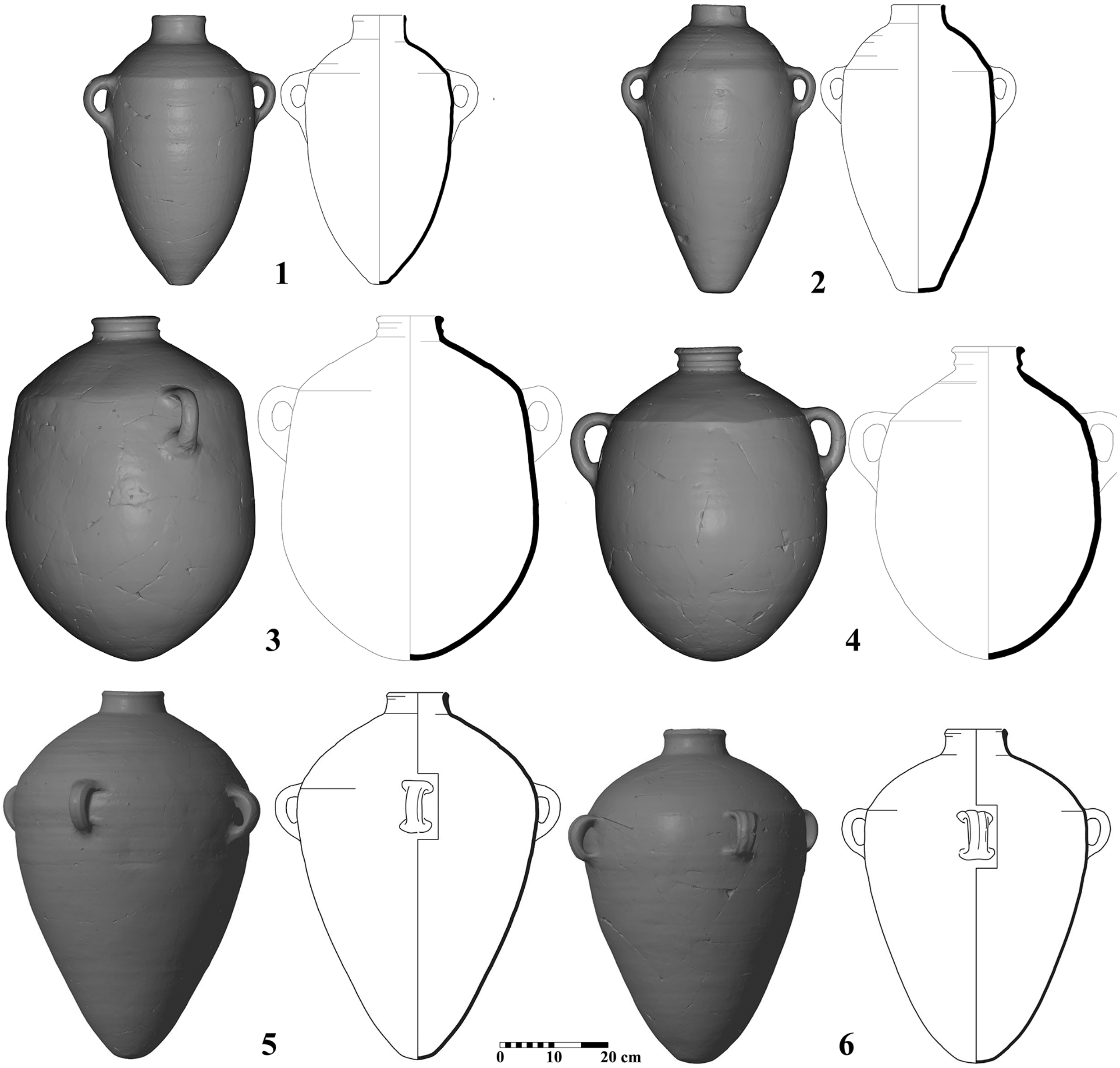

Fig. 1. Examples of two representative jars and their profile for each of the three groups: Jars 1 and 2 from the Qeiyafa group (with thanks to the excavator, Y. Garfinkel); 3 and 4 from the Hippo group (with thanks to the excavator of Tel Rehov, A. Mazar); and 5 and 6 from the Judah group (after Sergi et al. 2012). (Scanning and image by A. Karasik)

shoulders sloping down to a distinct carination with two large loop handles; a ridged neck; and a rounded rim turned out and over (Alexandre 1995). They are dated to the Iron IIA–Iron IIB periods, with a significant peak during the late Iron Age IIA (9th century B.C.E.) (Mazar 2003). The Hippo jars appear both in living quarters and in storage facilities, mainly around the territory of the northern Israelite kingdom.[1] Almost every jar has two incised circles in the middle of the shoulder and sometimes an incised potter's mark on one handle (Alexandre 1995). Their volumes range between 30–50 liters. In addition, inscriptions on the Hippo jars found at Tel Rehov and Tel Amal highlight the importance of these jars in epigraphic contexts (Mazar and Ahituv 2011). Provenance studies show that all of the Hippo jars belong to the same fabric with some variability in subgroups (Harush 2014).

The latest Iron Age group in our analysis are the royal storage jars from Judah. Those jars first appeared as a local phenomenon that was limited to the Shephelah. During

[1] For a recent summary about the role of the Hippo jars in the Israelite kingdom, see Kleiman 2017.

Fig. 2. Rendered views of jars with potter marks on their handles. Left: finger impressions (Qeiyafa); middle: incised lines (Hippo); right: royal stamping (*lmlk*). (Scanning and image by A. Karasik and O. Harosh)

the 8th century B.C.E., their production became standardized, and by the late 8th century, the workshops that produced, theses jars were integrated into the royal Judahite administrative system that stamped the handles of the jars. Numerous studies have been published about these jars, especially the stamp designs (*lmlk*, rosette, etc.), their subgrouping typology, and chronology (Sergi et al. 2012). In the current research we focus on the shape of the vessels regardless of the stamps and therefore we shall consider them as one group (**Figs. 1–2**).

It is well accepted that the stamped *lmlk* jars from the 8th–7th centuries B.C.E. testify to a taxation or product-distribution system in Judah (Kletter 2002, 2009a; Ussishkin 2004; Zapassky, Finkelstein, and Benenson 2009; Lipschits, Sergi, and Koch 2010; Sergi et al. 2012). The *lmlk* jars were examined by Neutron Activation Analysis showing that they were produced from the same clay (Mommsen, Perlman, and Yellin 1984). Later petrographic study of the jars from Lachish and Bet-Shemesh showed that the clay originated in the Elah Valley or its vicinity (Goren and Halperin 2004). The volumes of the Judahite storage jars range between 30–50 liters.

As a control group we analyzed another assemblage of storage jars from an ancient Roman settlement near present-day Shoafat, dated to the 1st century C.E. (Bar-Nathan 2007).

In the present manuscript we describe a surprising discovery made while conducting a comparative morphological study of the Iron Age groups mentioned above. All of the jars were documented in high resolution 3D models from which accurate measurements were extracted. Comparing various metric measures, we observed large variations in jars within the same group, and certainly between jars from different groups. The only measure that is common to the entire collection of Iron Age storage jars, and to a high degree of accuracy, is the inner rim diameter. This finding will be discussed below, where it will be shown that the observed distribution of the inner rim diameter is identical—within statistical uncertainty—to anthropometric results of the distribution of the handbreadth of the modern male. We refer to the term "handbreadth" as the width at the base of the four fingers (the palm) (Clagett 1999: 109); throughout the text we will refer to this unit as the "*tefach.*" It is important to note that we compare the *tefach* or the palm to the actual measure of modern soldiers, and therefore we use it as a concept and not as an exact measurement. A thorough discussion about the various versions of cubit or palm and their exact definition in different ancient societies can be found in the literature (Stern 1971; Kletter 2009b; Monnier, Petit, and Tardy 2016).

Similar behavior was observed in the Roman ensemble, with one important difference—the observed distribution of the inner rim diameter is similar (but not identical) to the distribution of the handbreadth of the modern female. Following the presentation of our recorded measurements, we speculate below on three alternative ways or scenarios by which our findings might be explained. The proposed scenarios all support the proposition that the agreement between the measured inner rim distribution and the anthropometric data is not accidental. Rather, it can be linked with either the method used for the production of the jars, their possible use, or to demands imposed by cultural or religious rules.

The Database, Deduction of Metric Information, and Data Analysis

The combined jar assemblage—the database of this work—consists of 307 Iron Age jars and 259 jars from the Shoafat control group and their high precision 3D-digitized models. In the following we denote the subgroups of storage jars described above as Q (Qeiyafa), H (Hippo), J (Judah), and S (Shoafat). **Table 1** provides details of the four groups of jars. Drawings of representative jars from the three Iron Age groups are shown in **Figure 1**, and representatives of the identification marks are illustrated in **Figure 2**. The cross-section profiles were accurately measured from the 3D models and some typical drawings from the three Iron Age groups are shown in **Figure 1**.[2]

Even though the general characteristics of a group's shapes are quite similar, their dimensions still span a large range of values. The only parameter which seems to be common to all the jars in all three Iron Age groups is the minimal interior diameter of the neck (see **Fig. 3** and **Table 2**).

In order to quantify the above visual observations, we computed several metric parameters for each of the jars.

1. *Volume:* Since many of the jars are complete, the only volume which can be directly computed is their exterior volume, which includes the volume of the ceramic vessel itself (Karasik and Smilansky 2006). The interior volume (capacity) could not be accessed because the interior surface could not be reached by the optical scanner. One could estimate the capacity by assuming that the ceramics have a uniform thickness, however, this is not done here because this assumption cannot be accurately substantiated.
2. *Height and maximal width*: This is the height of each jar from base to rim, as well as the maximal width (diameter) of its body. The height was measured only for complete jars.
3. *Inner rim diameter*: This is the minimal diameter of the rim (neck) interior.

Figure 3 displays the averages of all four parameters for the three groups together with the range of one standard deviation to each side. These values are also quoted in **Table 2**. Note that the standard deviations for the inner rim diameter, as shown in **Figure 3**, are so small that they can hardly be noticed on the figure, while the standard deviations of the other parameters are large and reflect the variability of these measures. Nevertheless, if we normalized the standard deviations by the mean of each measurement, the deviations would be on the same scale (as appear in **Table 2** in brackets).

The most uniform measure is the inner rim diameter. This is even more remarkable if we consider the absolute deviation, which is within the level of 1 cm. Moreover, the most surprising result came from a detailed study of the distributions of the inner rim diameter for the three Iron Age groups, as shown in the top frame of **Figure 4**. Within the statistical accuracy, the distributions share the same mean and variance, as well as the same functional form. This is rather surprising since the jars were produced during different periods, spanning more than 350 years, and in sites spread over hundreds of kilometers.

A crucial feature in the present study is illustrated in the middle frame in **Figure 4**. It compares the distribution of the inner rim diameters of the jars from the entire Iron Age assemblage with the distribution of the handbreadth of male soldiers in the US Army (White 1980). The two distributions are identical within statistical accuracy, sharing the same mean, variance, and functional form. The mean value of handbreadth for male US soldiers is 8.67 ± 0.48 cm, which is consistent with the values quoted in **Table 2**.

The distribution of the inner rim diameters of the Roman jars from Shoafat is shown in the bottom frame of **Figure 4**, where it is compared with the distribution of the handbreadth of female US soldiers. These distributions are markedly different from those of male US soldiers and the Iron Age numbers shown above them. Quantitatively, the mean handbreadth for female soldiers is 7.82 ± 0.39 cm and for the Shoafat group it is 7.87 ± 0.79, compared with 8.67 ± 0.48 for male US soldiers and 8.6 ± 0.6 for the mean Iron Age jars. The Shoafat distribution is somewhat broader and has a slightly lower mean, however, the means are consistent within the statistical uncertainty.

Interpretation and Discussion

We will start by stating three hypotheses that underlie the subsequent discussion.

1. It is assumed that the ancient potters were fully aware of the shrinkage of clay during drying and firing and knew their influence while producing vessels of larger dimensions on the wheel. No doubt that the ancient potters were familiar with the shrinkage phenomenon and could take it into account, e.g., adding appropriate tempers (Goren, Finkelstein, and Naʾaman 2004: 4) and by slightly enlarging the dimensions of the formed vessel.

[2] Note that for complete jars only the interior of the neck can be seen and optically scanned, such that the inner continuation of the lower part of the profiles were drawn by assuming a constant wall thickness (Karasik and Smilansky 2008).

Table 1. The Distribution of the Jars by Group

Group	*Number of Complete Jars*	*Number of Fragments*[3]	*Total*	*Sites*
Q	39	0	39	Khirbet Qeiyafa
H	78	80	158	Rehov, Beth-Shean, Amal, Hammah, Megiddo, Rosh Zayit
J	110	0	110	Tell eṣ-Ṣâfi, Gezer, Beth-Shemesh, Lachish, Ira, Batash, Arad, Beer-Sheba, Ein Gedi, City of David, Malḥata, Ḥorvat Titora
S	3	256	259	Shoafat

The storage jars were not subject to temperatures higher than approximately 600 °C, and were not glazed, thus, the expected shrinkage is of only a few percentage points.

2. The fact that the inner rim diameter is constant throughout space and time during the Iron Age, and the coincidence between its distributions and the human handbreadth, is not accidental. In other words, we argue that the measured distribution of inner rim diameters reflects the distribution of handbreadths of the ancient potters.
3. We assume that the physical handbreadth has not changed during the last 3,000 years, as was shown by Randall Susman (1994).

There are various possible reasons why the handwidth would be a natural and convenient standard for the inner rim diameter. As was mentioned previously, the storage jars were used not only to store, but also to transport the liquids or grains which they contained. There is no reason to doubt that each jar was used several times. To optimize their utility, their openings had to be determined as a compromise between opposing demands. On the one hand, the openings should not be so small that they will not allow for cleaning after their contents are drained and before refilling. There is sufficient evidence to believe that the storage jars were produced by attaching two or three parts which were separately created on the wheel. To facilitate molding them together, as well as a convenient attachment of handles, the potter sometimes insert his/her hand into the opening. The minimal diameter of the opening should be the handbreadth—the largest width of the hand between palm to elbow. On the other hand, the opening could not be too large, as the larger the opening, the more difficult it is to minimize spilling during transport or accidental falls in storage. The natural optimum would therefore be to choose the handbreadth itself as the standard diameter of the jar opening. This was easy to implement when working on the wheel, as the potter could use his/her palm as a tool.

[2] Fragments include the vessel's entire rim and the neck.

It was suggested that the opening of the jars was restricted to an exact measure by the existence of a uniform set of stoppers used to seal the jars (Raban 2001). We beg to differ on this point, since it is highly unlikely that the production of the stoppers was so strict as to shape the size of the rim of the jars. Moreover, the known stoppers that were excavated were rather primitive, consisting of a mass of clay that was fitted to the jars and not the other way around.

Finally, it was also natural for the ancient potters to adopt the handbreadth standard. It was as a unit of length (*tefach*) that was widely used in ancient times, and is mentioned both in Assyrian and Egyptian (Clagett 1999) sources, and in the Old Testament (for instance, Num 25:25 and 37:12).

We would like to mention another aspect that may justify the connection between the observed neck diameters and the *tefach*. It is based on the context of impurity laws in the book of Numbers. The Old Testament deals specifically with the question of the impurity of jars that were left in the vicinity of a corpse.

> [14] *This is the law, if a man dies in a tent, anyone entering the tent and anything in the tent shall be unclean for seven days.* [15] *Any open vessel which has no seal fastened around it becomes unclean.* (Numbers 19)

It is clear from the passage that the content of a jar becomes unclean, unless there is a special seal on its top. Much later Jewish traditions that interpret and expound the rules of impurity, quantified the minimal opening size through which the impurity may enter to be a square of a handbreadth by a handbreadth.

The following two citations are taken from the lows of impurity of Maimonides in his book *Mishneh-Torah*:

> *Impurity does not enter a shelter, nor does it depart from it if there is an opening less than a handbreadth by a handbreadth.* (14.1)

> *According to the Oral Tradition, it was taught that the verse is speaking only about a ceramic container, for it is a container that contracts impurity only through its opening.* (21.1)

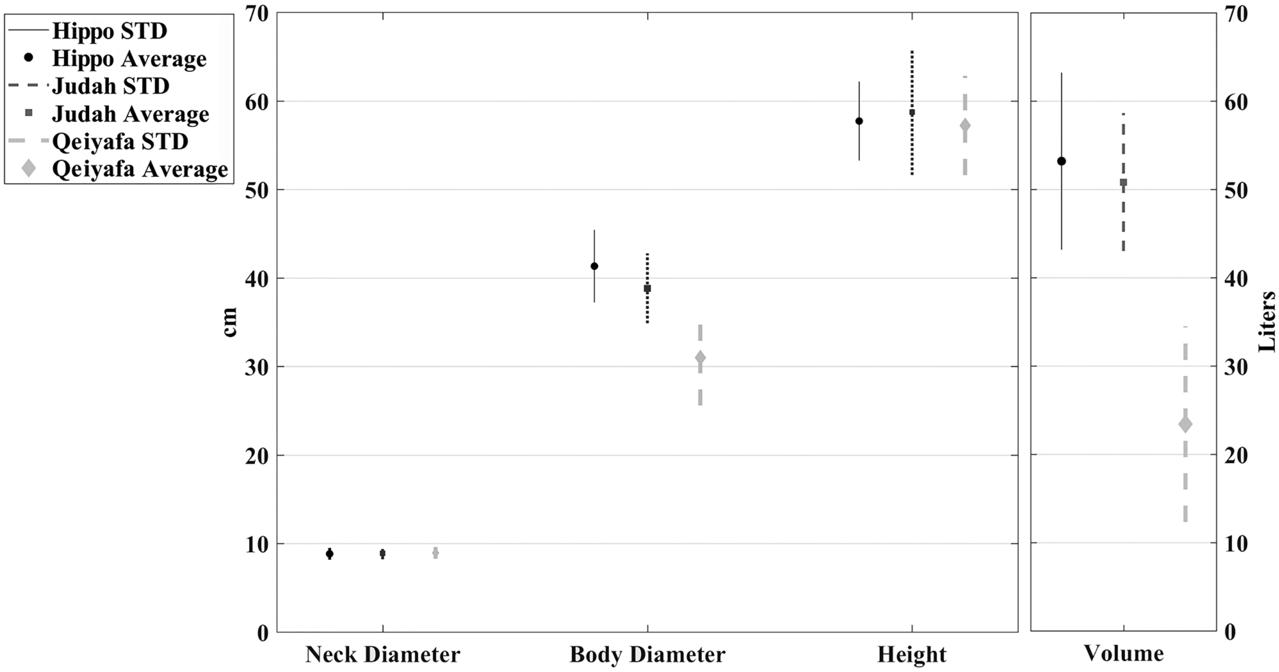

Fig. 3. The mean values and a range of one standard deviation of the morphological measures for the three groups of Iron Age jars. (Chart by A. Karasik)

Thus, a round opening with a diameter of one handbreadth would suffice to ensure that the opening is small enough for good isolation and, therefore, the jar's content will continue to be pure even if the jar is stored in the vicinity of a corpse.

Conclusions

In this research we have compared various basic measurements of three groups of jars from the Iron Age II. Each of these groups has its unique typological and chronological characteristics in the archaeological record. While the volume, height, and maximal diameter show a considerable variability, the inner rim diameter basically remains the same for all three groups. The resemblance between the distribution of the opening of the jars and the handbreadth of men convinced us that there is a connection between them. We believe this testifies to the jars being produced by males and that the potters used their bare hands in order to control the opening of the jars to be around the measurement of one handbreadth (biblical *tefach*). In our control group from Shoafat, something in the configuration of jars production was changed. This can be evidenced by a systematic shift in the diameters of the jar necks between the two assemblages. However, one cannot conclude beyond a reasonable doubt that it is the outcome of transference from production by males to females. The picture is more complicated and perhaps other social or economic changes influenced that as well.

As for the reason why it was so important to control the opening of the jars so uniformly, we have suggested several theories. For the purpose of safe storage and transporting there is a need for a small and closed opening. On the other hand, for pouring, cleaning, or ease of manufacture, there is a need for a large opening that allows for the insertion of the hand into the jars. A final convergence on the specific value of one handbreadth in diameter may

Table 2. Group Averages and Standard Deviations of the Measurements Discussed

Group	*Exterior Volume (Liter)*	*Maximum Width (cm)*	*Total Height (cm)*	*Inner Rim Diameter (cm)*
Q	23.4 ± 11 (47%)	29.5 ± 4.2 (14%)	53.8 ± 5.7 (11%)	8.97 ± 0.86 (10%)
H	53.2 ± 10 (19%)	41.5 ± 3.8 (9%)	57.7 ± 4.4 (8%)	8.85 ± 0.57 (6%)
J	50.8 ± 7.8 (15%)	40.2 ± 3.5 (9%)	58.7 ± 7.1 (12%)	8.85 ± 0.55 (6%)
S	—	—	—	7.87 ± 0.79 (10%)

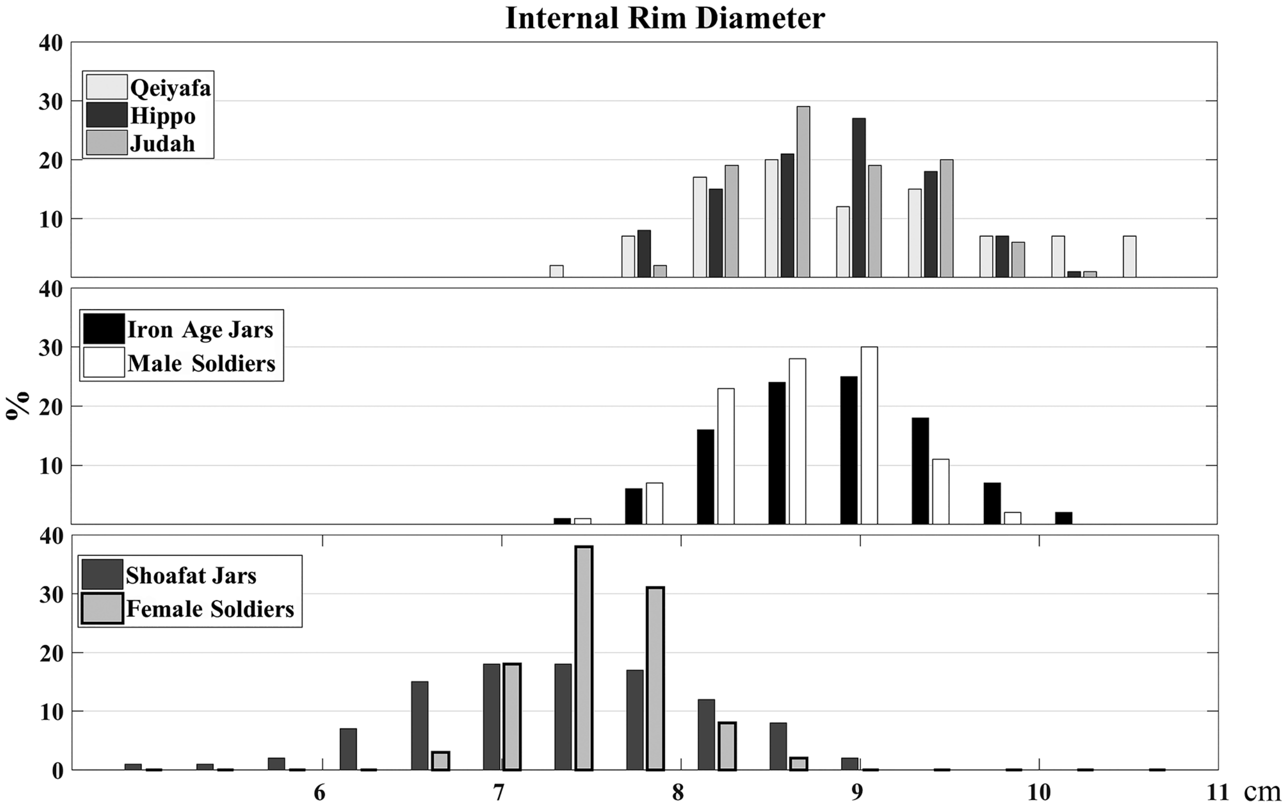

Fig. 4. Top: the distribution of the inner rim diameter of the jars from the three Iron Age per groups; center: the distribution of the inner rim diameter of the entire Iron Age data, and the handbreadth distribution of men from the US Army (White 1980); bottom: the distribution of inner rim diameters of the Shoafat group together with the handbreadth distribution of female US soldiers (White 1980). (Chart by authors)

have also been influenced by spiritual traditions regarding the minimal window through which impurity can defile the contents of a ceramic vessel.

Obviously, this kind of theory cannot be proven without contemporary written documents and we would like to leave it as a possible theory. The overall picture of pottery production during the Iron Age is especially complicated. The similar distributions of the inner rim diameters of jars during more than 350 years and throughout the country probably reflects more than one constraint.

References

Alexandre, Y.
1995 The 'Hippo' Jar and Other Storage Jars at Hurvat Rosh Zayit. *Tel Aviv* 22 (1): 77–88. https://doi.org/10.1179/tav.1995.1995.1.77

Bar-Nathan, R.
2007 *A Jewish Settlement in Orine Between the Two Revolts*, ed. J. Patrich and D. Amit. New Studies in the Archaeology of Jerusalem and Its Region. Jerusalem: Israel Antiquities Authority (Hebrew).

Ben-Shlomo, D.
2009 Petrographic Analysis of Iron Age Pottery. Pp. 161–73 in *Khirbet Qeiyafa, Vol. 1. Excavation Report 2007–2008*, ed. Y. Garfinkel and S. Ganor. Jerusalem: Israel Exploration Society.

Clagett, M.
1999 *Ancient Egyptian Science: A Source Book, Vol. III, Ancient Egyptian Mathematics*. Memoirs of the American Philosophical Society 232. Philadelphia, PA: American Philosophical Society.

Garfinkel, Y., and Ganor, S.
2009 *Khirbet Qeiyafa Vol. 1. Excavation Report 2007–2008*. Jerusalem: Israel Exploration Society.

Goren, Y., and Halperin, N.
2004 Selected Petrographic Analyses. Pp. 2553–86 in *The Renewed Archaeological Excavations at Lachish (1973–1994)*. Sonia and Marco Nadler Institute of Archaeology Monograph Series 22. Tel Aviv: Emery and Claire Yass Publications in Archaeology, Institute of Archaeology, Tel Aviv University.

Goren, Y.; Finkelstein, I.; and Na'aman, N.
2004 *Inscribed in Clay, Provenance Study of the Amarna Tablets and Other Ancient Near Eastern Texts*. Sonia

and Marco Nadler Institute of Archaeology Monograph Series 23. Tel Aviv: Emery and Claire Yass Publications in Archaeology, Institute of Archaeology, Tel Aviv University.

Harush, O.
2014 Regional, Chronological, Typological and Technological Aspects of "Hippo" Jars from North Israel in the Iron Age IIA. M.A. thesis. Jerusalem: The Hebrew University.

Kang, H. G., and Garfinkel, Y.
2015 Finger-impressed Jar Handles at Khirbet Qeiyafa: New Light on Administration in the Kingdom of Judah. *Levant* 47 (2): 186–205. https://doi.org/10.1179/0075891415Z.00000000062

Karasik, A., and Smilanksy, U.
2006 Computation of the Capacity of Pottery Vessels Based on Drawn Profiles. Pp. 392–94 in *Excavations at Tel Beth Shean 1989–1996, Vol. I, From the Late Bronze Age IIIB to the Medieval Period*, ed. A. Mazar. Jerusalem: The Israel Exploration Society, The Institute of Archaeology, The Hebrew University of Jerusalem.
2008 3D Scanning Technology as a Standard Archaeological Tool for Pottery Analysis: Practice and Theory. *Journal of Archaeological Science* 35 (5): 1148–68. https://doi.org/10.1016/j.jas.2007.08.008

Kleiman, A.
2017 A North Israelite Royal Administrative System and Its Impact on Late-Monarchic Judah. *Hebrew Bible and Ancient Israel* 6 (3): 354–71. https://doi.org/10.1628/219222717X15162808430793

Kletter, R.
2002 Temptation to Identify: Jerusalem, *mmšt*, and the *lmlk* Jar Stamps. *Zeitschrift des Deutschen Palästina-Vereins* 118 (2): 136–49.
2009a Comment: Computational Intelligence, *Lmlk* Storage Jars and the *Bath* Unit in Iron Age Judah. *Journal of Archaeology Method and Theory* 16: 357–65. https://doi.org/10.1007/s10816-009-9072-1
2009b Weights and Measures. Pp. 831–41 in *New Interpreters Dictionary of the Bible, Vol. V, S–Z*, ed. K. D. Sakenfeld. Nashville, TN: Abingdon.

Lipschits, O.; Sergi, O.; and Koch, I.
2010 Royal Judahite Jar Handles: Reconsidering the Chronology of the Lmlk Stamp Impressions. *Tel Aviv* 37 (1): 3–32. https://doi.org/10.1179/033443510x12632070179306

Mazar, A.
2003 The Excavations at Tel Rehov and Their Significance for the Study of the Iron Age in Israel. *Eretz Israel* 27: 143–60.

Mazar, A., and Ahituv, S.
2011 Inscriptions from Tel Rehov and Their Contribution to the Study of Writing and Literacy During the Iron Age IIA. *Eretz Israel* 30: 300–16 (Hebrew).

Mommsen, H.; Perlman, I.; and Yellin, J.
1984 The Provenience of the *lmlk* Jars. *Israel Exploration Journal* 34 (2): 89–113.

Monnier, F.; Petit, J.; and Tardy, C.
2016 The Use of the 'Ceremonial' Cubit Rod as a Measuring Tool. An Explanation. *The Journal of Ancient Egyptian Architecture* 1: 1–9.

Raban, A.
2001 *Jars and Standard Volume*. Pp. 11–14 in *Measuring and Weighing in Ancient Times*, ed. O. Rimon and R. Schori. Haifa: Reuben and Edith Hecht Museum, University of Haifa.

Sergi, O.; Karasik, A.; Gadot, Y.; and Lipschits, O.
2012 The Royal Judahite Storage Jar: A Computer-Generated Typology and Its Archaeological and Historical Implications. *Tel Aviv* 39 (1): 63–93. https://doi.org/10.1179/033443512X13226621280660

Stern, E.
1971 Weights and Measures. Pp. 376–92 in *Encyclopedia Judaica*, ed. C. Roth. Jerusalem: Keter.

Susman, R. L.
1994 Fossil Evidence for Early Hominid Tool Use. *Science* 265 (1578): 1570–73. https://doi.org/10.1126/science.8079169

Ussishkin, D.
2004 The Royal Judean Storage Jars and Seal Impressions from the Renewed Excavations. Pp. 2133–47 in *The Renewed Archaeological Excavations at Lachish (1973–1994)*, ed. D. Ussishkin. Sonia and Marco Nadler Institute of Archaeology Monograph Series 22. Tel Aviv: Emery and Claire Yass Publications in Archaeology, Institute of Archaeology, Tel Aviv.

White, R. M.
1980 Technical Report – Comparative Anthropometry of the Hand. U. S. Army Natick Research and Development Laboratories.

Zapassky, E.; Finkelstein, I.; and Benenson, I.
2009 Computing Abilities in Antiquity: The Royal Judahite Jars as a Case Study. *Journal of Archaeology Method and Theory* 16: 51–67. https://doi.org/10.1007/s10816-008-9059-3