

# Patterns of Physical Activity and Material Culture on Gotland, Sweden, During the Middle Neolithic

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**ABSTRACT** Linking MSM (Musculoskeletal Stress Markers) to specific activities is difficult. This problem is explored by combining and comparing patterns of MSM and material culture. Sex- and age-related patterns for MSM and grave goods distributions are analysed and compared from five Pitted Ware (c. 3400–2300 BC) sites on Gotland, Sweden. Possible links between MSM patterns, burial objects, faunal remains and subsistence are explored for a better understanding of some of the irregularities surrounding the Pitted Ware culture hunter-gatherer complex on Gotland. Fifty-two muscle and ligament attachments on seven skeletal elements were scored on adult skeletal remains ( $n = 126$ ) from the five Middle Neolithic Pitted Ware sites at Ajvide, Västerbjers, Visby, Ire and Fridtorp. Noteworthy differences were observed in MSM mean scores between the sexes as well as significantly increased scores with increased age. Distributions for ten selected grave goods categories were also examined for the adult individuals as well as for 50 subadult individuals. The grave goods frequencies showed the opposite pattern from that of MSM: young individuals had higher frequencies of the selected grave goods than the old, and females generally more than males. Burial find distributions also differ at the five sites, as well as faunal refuse proportions, while isotopic data indicate homogeneous subsistence all over the island. Circumstances surrounding the faunal remains in graves and surrounding cultural layers indicate site-specific utilisation, but also ritual handling of animals. An image of common identity on the island and membership of the local community is visible in the material culture. In addition, individual differences are apparent through MSM patterns and grave goods, but not in direct correlation to activities implied by the artefacts in the grave. Copyright © 2008 John Wiley & Sons, Ltd.

*Key words:* Pitted Ware culture; Sweden; musculoskeletal stress markers; burial goods; grave gifts

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## Introduction

During the Middle Neolithic, people lived in coastal areas around the Baltic Sea, as fishers,

hunters and gatherers. On the island of Gotland, off the southeast coast of Sweden, a number of burial sites attributed to the Pitted Ware Culture (c. 3400–2300 BC) were excavated during the last century (Fig. 1). These sites share many uniting features such as locality, burial practice, characteristic material culture, dietary patterns, zooarchaeology and anthropology. Studies of human and animal remains from the Pitted Ware Culture on Gotland show evidence of a strong

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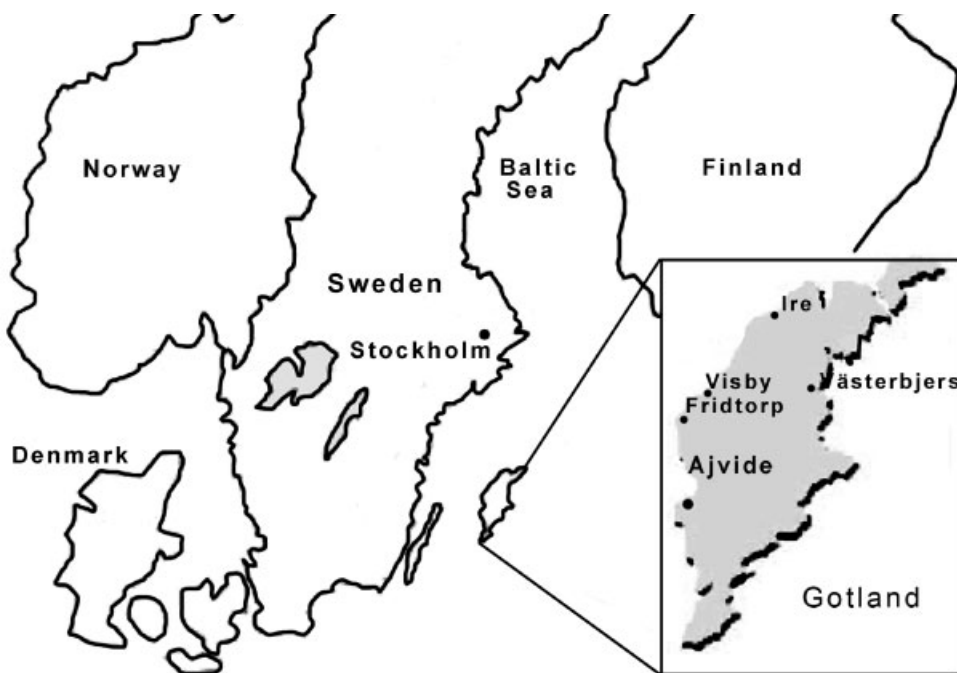


Figure 1. Studied sites on Island of Gotland in the Baltic Sea.

reliance on marine resources. Isotopic data indicate seal meat as the main source of protein for all Gotland sites (Lidén, 1996; Eriksson, 2003), while the faunal remains have varying frequencies of distribution on different sites on the island (Ekman, 1974; Lindqvist & Possnert, 1997; Storå, 2001; Olson & Walther, 2007). The hunting of wild boar, small game, birds and fish is evident, as well as the wide use of the resources that these animals can provide. The different contexts of the faunal remains imply that the animals were consumed as well as kept for social and/or ritual purposes, which is also visible in the material culture (Ekman, 1974; Wallin & Martinsson Wallin, 1992; Burenhult, 1997a,b; Taffinder, 1998; Storå, 2001). There is no evidence of domesticated animals being kept at the sites, or indications of agriculture on Gotland during this period (Burenhult, 1997a,b). However, there has been some debate on whether the Middle Neolithic pigs were wild, tame or even crossbred. The general consensus is that it is more likely that they were wild, possibly 'under some form of domestic control' (Ekman, 1974; Lindqvist, 1997; Rowley-Conwy & Storå, 1997).

However, the question is not fully resolved (Jonsson, 1986; Benneke, 1993).

Pitted Ware Culture burials on Gotland typically consist of single individuals in shallow graves; however, double and triple graves are also present. The skeletal and archaeological remains are generally very well preserved due to calciferous soils, and provide favourable conditions for osteoarchaeological analysis. Skeletal remains are seldom preserved on contemporary sites in other areas, making the Gotland sites especially valuable. Grave goods and other artefacts at the sites are abundant, and to a large extent reflect subsistence and lifestyles through hunting and fishing equipment: arrowheads of stone, flint and bone, and harpoons and fishhooks of bone. Other recovered objects are large amounts of pottery, flint and stone axes, flint chisels and blades, bone awls, boars' tusks and jaws, perforated seal teeth, amber beads, and beads made from bird diaphyses (Fig. 2). More unusual and spectacular finds include small, finely worked pieces of mother-of-pearl, bone flutes, perforated bone plates, hedgehog pins and mandibles, a comb made of antler, and many

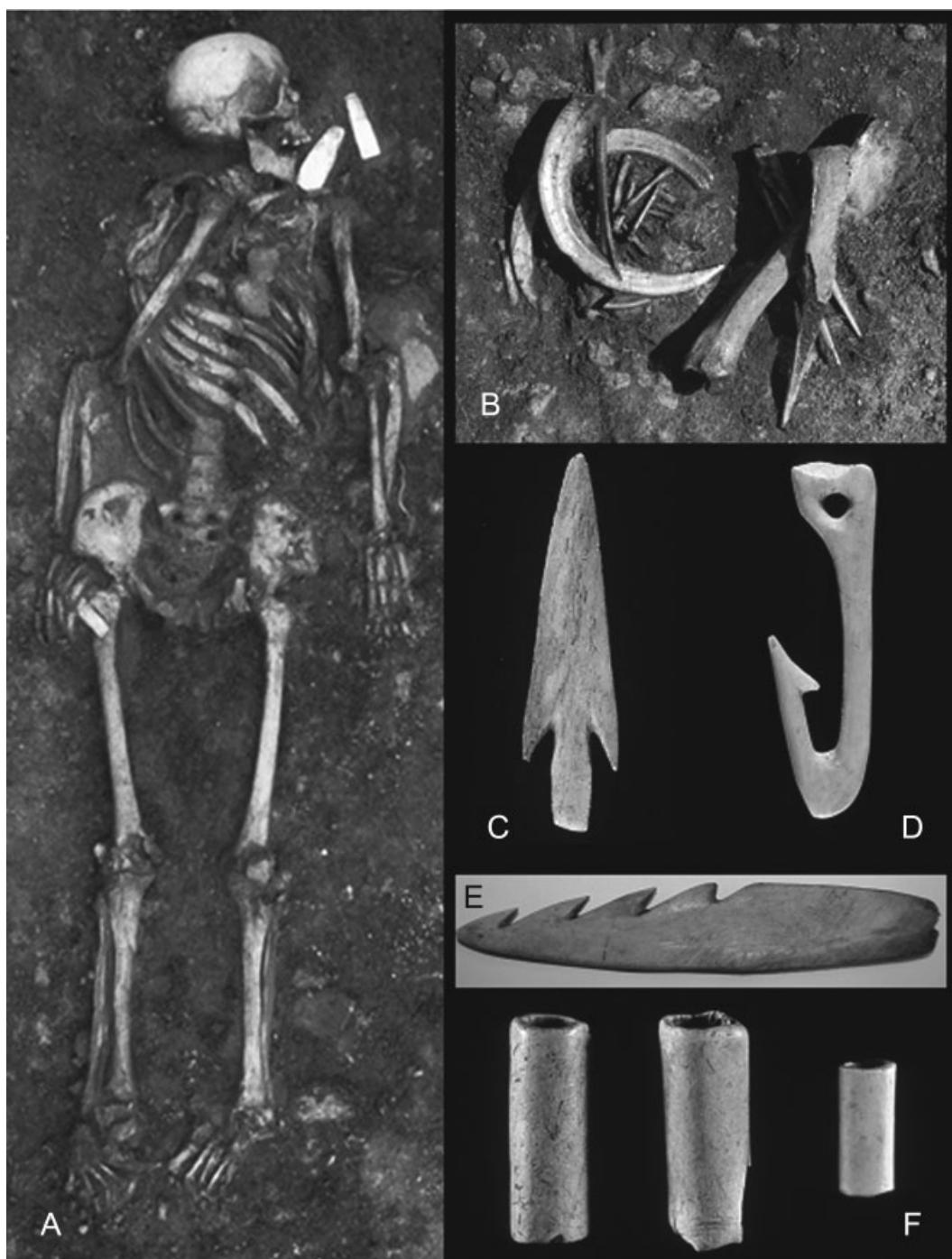


Figure 2. Objects found at Ajvide. (A) Grave 13 from Ajvide; an old adult female with two (out of six) axes visible in the grave. Note also the flint knife still in position in the right hand and a selection of characteristic Pitted Ware Culture finds. (B) Collection of awls, canine paw bones, boar tusks and bones. (C) Arrowhead. (D) Fish hook. (E) Harpoon. (F) Beads from bird diaphyses.

more (see also Stenberger *et al.*, 1943; Janzon, 1974; Burenhult, 2002). The number of items in each grave is most commonly under ten, but figures up to 70 have been recorded (Burenhult, 2002). A wide variety of artefact types was placed in the graves of males, females, infants and children. The considerable amount of grave goods in children's graves has been proposed as being indicative of inherited status, since children would not yet have acquired it (Burenhult, 1997a: 62).

The significance of burial objects and patterns of material culture in Pitted Ware Culture graves from the Middle Neolithic on Gotland has been elaborately examined (Stenberger *et al.*, 1943; Janzon, 1974; Österholm, 1989; Knutsson, 1995; Andersson, 1997, 2001; Burenhult, 1997a; Taffinder, 1998). The grave goods bear witness to an implicit view of these objects as a statement of cultural identity, but also of individuality. A pertinent question concerns their significance as individual grave goods and/or manifestation of the collective consensus of a Stone-Age community (Wallin & Martinsson Wallin, 1992: 8; Fahlander, 2003: 76). Homogeneity versus heterogeneity within and between Pitted Ware Culture sites has also been discussed through anthropological studies of non-metric traits and stature (Sjøvold, 1974), and also with reference to ethnicity and identity using zooarchaeological (Wallin & Martinsson Wallin, 1992) and archaeological (Knutsson, 1995; Andersson, 2001) approaches. Distinct differences are discernible between the Gotland sites, which have been attributed to affiliation to clans or regional groups (Sjøvold, 1974; Österholm, 1989; Wallin & Martinsson Wallin, 1992; Knutsson, 1995; Burenhult, 1997a; Andersson, 2001).

In the light of the grave goods, Andersson suggested that people were not given tasks or roles according to biological sex. Instead, she distinguished other groupings that include both sexes (Andersson, 1997: 20). Taffinder (1998) suggested that imported objects were predominantly found in male graves, possibly indicating male leadership. However, there are some problems with these results as absolute frequencies of finds in male graves ( $n = 23$ ) and female graves ( $n = 10$ ) are presented and compared

(Taffinder, 1998: 88; Fig. 3:30). The variation in Pitted Ware Culture burial practices has also been recognised by Knutsson (1995), and is reflected in the positioning of graves and circumstances surrounding the grave goods. Consequently, patterns in material culture are few and in some cases ambiguous, indicating a multifaceted burial tradition.

In a previous osteological study of the skeletal remains from one of the Pitted Ware sites, Ajvide, musculoskeletal stress marker (MSM) analysis resulted in noteworthy differences in mean scores between the sexes and different age groups (Molnar, 2006). The conclusion from these results is that general patterns of physical strain are undeniably identifiable in prehistoric settings. However, the direct linking of specific skeletal markers to specific prehistoric activities has proven to be more challenging. In some cases, historical records or material culture have provided clues to plausible activities and interpretations (Molleson, 1989; Larsen, 1997; Peterson, 1998; Robb, 1998; Stirland, 1998; Sofaer Derevenski, 2000; Eshed *et al.*, 2004; Molnar, 2006; Weiss, 2007). Changes at the origin of the medial gastrocnemius muscle on male femora from some of the Gotland Neolithic sites were observed by Gejvall (1974). Obviously, the material culture influenced the proposal of several possible, although tentative, actions as causes for this skeletal alteration: the paddling of a canoe, harpooning or the casting of a spear (Gejvall, 1974: 165).

Recently, analysis of upper body MSM sites from Ajvide indicated that specific activities such as archery and the sexual division of labour had been practised at the site (Molnar, 2006). In the present study, both upper and lower body MSM were used, the skeletal sample was increased to including four additional contemporaneous sites and research questions were expanded. Material culture patterns observed in previous research from Middle Neolithic sites on Gotland have been few and in some cases unclear. MSM analysis is used here as a means to further explore grave goods in association to sex and/or age-related activities. Connections between individual grave goods and activity patterns may possibly even reflect individual characteristics and social functions.



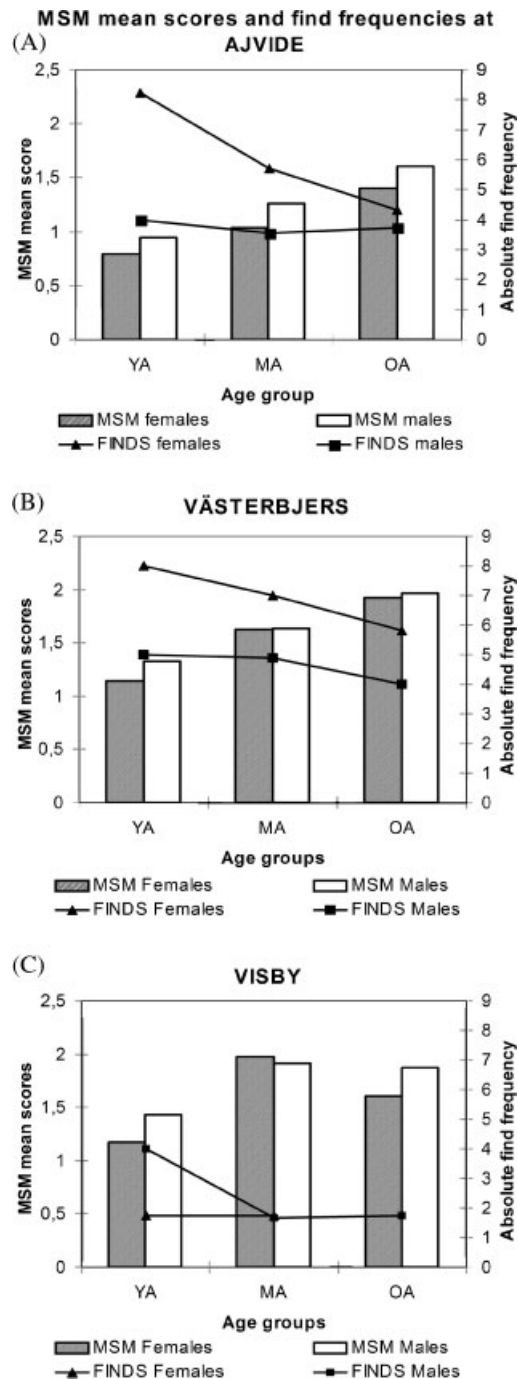


Figure 3. Mean MSM scores and find frequencies for males and females in the three age groups at (A) Ajvide, (B) Västerbjers, and (C) Visby. YA, young adults, 17–24 years; MA, middle adults, 25–39 years; OA, old adults, >40 years. *Note:* Variables are not continuous: grave goods values are connected with a line to highlight the opposed patterns for MSM means and grave goods frequencies in relation to age.

The aim of this study is to examine patterns of MSM and selected grave goods in relation to sex and age at five Pitted Ware sites. The relationships between patterns of physical activity, material culture, and subsistence evidence such as faunal remains and isotopic data are explored in order to gain further knowledge of the Pitted Ware Culture on Gotland.

## Materials and methods

For this study, skeletal remains and associated grave goods were examined from the Pitted Ware Culture burial grounds at Ajvide, Västerbjers, Visby, Ire and Fridtorp (Fig. 1, Table 1). A total of 126 graves with adult skeletal remains, where muscle and ligament attachments were preserved, were investigated. The grave goods from 50 children's burials were furthermore incorporated.

For ageing and sexing the skeletal remains, methods described in Buikstra & Ubelaker (1994) were used. Brothwell's classification of age based on molar wear was additionally used for age estimation (Brothwell, 1981). Three age groups were employed in the study: young adults of 17–24 years, middle adults of 25–39 years, and old adults > 40 years. The subadults were divided into three age groups, each including an equal number of years (where possible): 0–5, 6–10, and 11–16 years. Age and sex distributions for adult and subadult individuals are presented in Table 2.

For the recording of the musculoskeletal stress markers, Hawkey's and Merbs' visual scoring method (Hawkey, 1988; Hawkey & Merbs, 1995) with modifications by Nagy (2000) was used. Modifications did not include distinctions between Hawkey's and Merbs' robusticity markers and stress lesions, as the different appearances represent a range of expressions rather than two diverse expressions. Exostoses were furthermore excluded, as they were not present in the sample. The skeletal markers were scored from 0 to 3, 3 being the most distinct. Fifty-two musculoskeletal stress markers were scored on seven bone elements (Table 3), and arithmetic means were used to calculate the MSM scores. MSM patterns associated with archery were correlated with graves containing arrowheads, and graves containing harpoons were correlated

Table 1. Descriptive demographic, chronological, faunal and isotopic data from the five Middle Neolithic sites on Gotland

Site	Males	Females	Subadults	Mean age in years for females/males	Main refuse fauna	$\delta^{13}\text{C}$
Ajvide	18	28	24	33/33	Marine <sup>a</sup>	Marine <sup>g,h</sup>
Västerbjers	20	15	13	42/37	Terrestrial <sup>b</sup>	Marine <sup>h,i</sup>
Visby	10	13	11	29/40	Terrestrial <sup>c,d</sup>	Marine <sup>h</sup>
Ire	8	4	2	29/40	Marine <sup>b,e,f</sup>	Marine <sup>j</sup>
Fridtorp	8	2	—	40/42	—	—

<sup>a</sup>Rowley-Conwy & Storå (1997).<sup>b</sup>Ekman (1974).<sup>c</sup>Wallin & Eriksson (1985).<sup>d</sup>Nihlén (1927).<sup>e</sup>Hegert (1982).<sup>f</sup>Landin (1981).<sup>g</sup>Lindqvist & Possnert (1997).<sup>h</sup>Lidén (1996).<sup>i</sup>Eriksson (2004).<sup>j</sup>Lidén & Nelson (1994).

with both harpooning MSM and kayaking MSM (Table 3).

Three criteria were set for the grave objects included in the study: (1) the object was clearly man-made; (2) the object occurs twice or more on three or more sites; and (3) the object had a plausible primary use. Ten objects were included: amber beads, beads from bird diaphyses, boars' tusks, perforated animal teeth, axes, miniature blades, bone awls, fish hooks, harpoons and arrowheads. It was assumed that harpoons were used for hunting seal, while boar and possibly birds were hunted using bows and arrows. Flint and other stone axes were pooled into one group, as were arrowheads made from different raw materials. All objects may additionally have had a non-functional significance (i.e. social or ritual).

In each grave, the frequencies for the ten find categories were added up; each object counted as one. Numerous perforated animal teeth and diaphyseal bone beads, however, were counted as one item since these very likely were parts of a decorative ornament, as necklaces or possibly sown onto skins. Furthermore, they can occur in the hundreds, which would gravely skew the results. Pottery and animal bones as grave goods were omitted from the study due to their presence in all graves, as well as in surrounding layers, and differentiating between them is sometimes difficult.

Results from zooarchaeological and isotopic studies from the different sites were furthermore used to explore the relationship between levels of physical activity and hunting or fishing implements found in graves and surrounding cultural layers.

Table 2. Number of individuals in the four age groups

Site	Subadults ( <i>n</i> = 50)			Females ( <i>n</i> = 55)			Males ( <i>n</i> = 71)			Combined adults ( <i>n</i> = 126)		
	0–5	6–10	11–16	YA	MA	OA	YA	MA	OA	YA	MA	OA
Ajvide	16	7	1	6	8	4	8	11	9	14	19	13
Västerbjers	6	4	3	2	5	8	3	9	8	5	14	16
Visby	5	2	4	5	4	1	1	5	7	6	9	8
Ire	1	0	1	1	3	0	2	3	3	3	6	3
Fridtorp	0	0	0	1	2	5	1	0	1	2	2	6
Total	28	13	9	15	22	18	15	28	28	30	50	46

Subadults, 0–16 years; YA, young adults, 17–24 years; MA, middle adults, 25–39 years; OA, old adults >40 years.

Table 3. Scored postcranial MSM sites in the Gotland skeletal remains and attachments associated with specific activities

Bone element	Upper body sites <sup>a</sup>	Specific activities
Clavicula	o: deltoideus i: trapezius o: pectoralis major l: trapezoideum l: conoideum l: costoclavicularis	<sup>c</sup> AL, <sup>d</sup> H, <sup>e</sup> K  <sup>e</sup> K
Scapula	i: triceps brachii	<sup>c</sup> AL, <sup>e</sup> K
Humerus	i: teres minor <sup>b</sup> i: infraspinatus i: supraspinatus i: subscapularis i: teres major i: latissimus dorsi i: pectoralis major i: deltoideus o: extensor carpi radialis longus o: extensors o: flexors	<sup>c</sup> AR, <sup>d</sup> H <sup>c</sup> AR, <sup>d</sup> H <sup>c</sup> AR, <sup>d</sup> H <sup>c</sup> AR, <sup>d</sup> H  <sup>e</sup> K <sup>d</sup> H <sup>c</sup> AL, <sup>d</sup> H, <sup>e</sup> K  <sup>c</sup> AR
Radius	i: biceps brachii i: supinator i: pronator teres i: pronator quadratus i: brachioradialis	
Ulna	i: anconeus o: supinator i: brachialis o: pronator teres o: abductor pollicis longus o: pronator quadratus	
Femur	l: iliofemorale i: obturator internus et gemellus i: gluteus minimus i: obturator externus i: gluteus medius i: quadratus femoris i: psoas major i: gluteus maximus i: pectineus i: adductors o: gastrocnemius mediale o: gastrocnemius laterale l: cruciatum posterius l: cruciatum anterius	
Tibia	l: patellae i: adductors i: semimembranosus l: collaterale i: popliteus o: soleus l: cruciatum anterius l: cruciatum posterius i: gastrocnemius	

<sup>a</sup>o, origin; i, insertion; l, ligament.

<sup>b</sup>The teres minor, infraspinatus, supraspinatus and subscapularis are commonly known as the 'rotator cuff' or 'muscle-tendon cuff' and often work together (Platzer, 1992: 138).

<sup>c</sup>AL, Archery muscle, left side; AR, Archery muscle right side (Molnar, 2006).

<sup>d</sup>H, Harpooning muscle (Molnar, 2006).

<sup>e</sup>K, Kayaking muscle (Molnar, 2006) and ligament (Kaya-ker's clavicle) (Hawkey & Merbs, 1995).

A *t*-test for independent samples was used for comparisons between the sexes, and a one-way ANOVA was used for comparisons between the age groups as well as the sites. Bonferroni's post-hoc test was used. Spearman's rank-order correlation coefficient was used for non-parametric correlation analyses of MSM scores and finds. All statistical testing was performed using SPSS for Windows statistical software, version 15.0. Accepted alpha-values were set at 5%.

## Results

Average total MSM scores were significantly higher for males than females in the combined material. The MSM mean score for males was 1.56, and for females 1.35 ( $p = 0.014$ ). Significant differences between the sexes were also found at two of the sites: Ajvide (males: 1.29; females: 1.04,  $p = 0.020$ ) and Ire (males: 1.62; females: 0.86,  $p = 0.006$ ). Significant differences were also noted in the mean MSM scores between the sites Ajvide and Västernbiers, and Ajvide and Visby for the males and the sexes combined. Females showed the same differences, and additionally between Västernbiers and Ire (Table 4). Differences in MSM scores between the age groups were especially apparent in the larger samples. When the sexes and sites were pooled, significant differences in MSM were obtained in all but one age group (Table 5).

The relative frequencies of burial finds do not show statistically significant diverse distributions (Table 6). There are, however, a few notable patterns in these distributions: there is a clear trend that females were buried with more grave goods compared with the males, especially at Ajvide and Västernbiers. At the two sites, seven of the ten find categories were found more frequently in female graves. Boars' tusks and harpoons were found more commonly in male graves at four of the sites (Table 6).

Noteworthy differences were also observed in the find distributions between the sites as well as between the sexes on the different sites: fish hooks occur in 33% of the female and 18% of the male graves at Ajvide, and only in 13% in the female and none of the male graves at Västernbiers. At Ajvide, harpoons are present in 11% of the

Table 4. MSM total body mean scores and *P* values for significant differences between sites.

Site	Males		Females		Combined	
	MSM	<i>P</i>	MSM	<i>P</i>	MSM	<i>P</i>
Ajvide	1.29 ( <i>n</i> = 28)	Västerbjers: 0.020 Visby: 0.005	1.04 ( <i>n</i> = 18)	Västerbjers: 0.000 Visby: 0.002	1.19 ( <i>n</i> = 46)	Västerbjers: 0.000 Visby: 0.000
Västerbjers	1.72 ( <i>n</i> = 20)	NS	1.72 ( <i>n</i> = 15)	Ire: 0.009	1.72 ( <i>n</i> = 35)	Ire: 0.028
Visby	1.85 ( <i>n</i> = 13)	NS	1.54 ( <i>n</i> = 10)	Ire: 0.006	1.72 ( <i>n</i> = 23)	NS
Ire	1.62 ( <i>n</i> = 8)	NS	0.86 ( <i>n</i> = 4)	NS	1.36 ( <i>n</i> = 12)	NS
Fridtorp	1.49 ( <i>n</i> = 2)	NS	1.35 ( <i>n</i> = 8)	NS	1.38 ( <i>n</i> = 10)	NS

NS, not significant.

female and 14% of the male graves. At Västerbjers, harpoons are present in 45% of the male graves, and none in female graves. On all sites combined, arrangements of perforated seal teeth were found in 23% of the female and 1% of the male graves (Table 6).

Young adults had a higher prevalence of finds than the older adults. This pattern was again especially clear in the two largest samples (Fig. 3C). Young children, on the other hand, received less finds than the older ones. The only site with a large enough subadult sample for comparison is Ajvide, and even here the two older

age categories were pooled, because there was only one individual in the oldest subadult age group. The other sites showed similar trends, but the subadult sample was too small for comparisons. Another dilemma is that children were often buried together with adults, and on some of the sites it was not reported to whom the objects were attributed (Table 7).

The find frequencies for the adults in many cases decrease with age. However, the trend was not statistically significant. The find frequencies at Visby (Figs. 3A–C) were generally low compared with the other samples. The Visby, Ire and Fridtorp

Table 5. Total body MSM mean scores (arithmetic mean) and *P* values for significant differences between the three age groups (using ANOVA) for the five Gotland sites

Site		Females ( <i>n</i> = 50)			Males ( <i>n</i> = 71)			Combined ( <i>n</i> = 126)		
		YA	MA	OA	YA	MA	OA	YA	MA	OA
Ajvide ( <i>n</i> = 46) mean MSM		0.79	1.04	1.40	0.96	1.27	1.61	0.88	1.18	1.55
<i>P</i> value	YA		NS	0.016		0.023	0.000		0.012	0.000
	MA			NS			0.011			0.002
Västerbjers ( <i>n</i> = 35) mean MSM		1.14	1.63	1.92	1.33	1.64	1.96	1.25	1.63	1.94
<i>P</i> value	YA		NS	NS		NS	0.010		NS	0.000
	MA			NS			NS			0.031
Visby ( <i>n</i> = 23) mean MSM		1.17	1.98 <sub>a</sub>	1.61	1.43	1.91 <sub>a</sub>	1.87	1.22	1.94	1.84
<i>P</i> value	YA								0.041	NS
	MA									NS
Ire ( <i>n</i> = 12) mean MSM		0.59	0.95 <sub>a</sub>	ND	1.31	1.71	1.73	1.07	1.33	1.73
<i>P</i> value	YA					NS	NS		NS	NS
	MA						NS			NS
Fridtorp ( <i>n</i> = 10) mean MSM		1.05	1.10 <sub>a</sub>	1.50	1.21	ND <sub>a</sub>	1.78	1.13	1.10	1.55
<i>P</i> value	YA								NS	NS
	MA									NS
Total ( <i>n</i> = 126) mean MSM		0.97	1.34	1.67	1.13	1.55	1.79	1.05	1.46	1.75
<i>P</i> value	YA		0.028	0.000		0.004	0.000		0.000	0.000
	MA			0.041			NS			0.002

Bonferroni's post-hoc test was used. YA, young adult; MA, middle adult; OA, old adult. NS, not significant. ND, no data.

<sup>a</sup>Sample size too small for ANOVA.



Table 6. Relative frequencies (percentages) of find categories for adult females (F) and males (M) respectively: higher frequencies in bold, equal frequencies in italics

	Ajvide		Västerbjers		Visby		Ire		Fridtorp		Total sample	
	F	M	F	M	F	M	F	M	F	M	F	M
	(n = 18)	(n = 28)	(n = 15)	(n = 20)	(n = 10)	(n = 13)	(n = 4)	(n = 8)	(n = 8)	(n = 2)	(n = 55)	(n = 71)
Amber bead	<b>17</b>	11	<b>13</b>	5	—	—	<b>25</b>	—	12	—	<b>16</b>	6
Diaphysis bead	<b>33</b>	18	<i>20</i>	<i>20</i>	10	15	<i>25</i>	<i>25</i>	38	—	<b>24</b>	18
Boars' tusk	39	<b>43</b>	33	<b>45</b>	—	8	—	<b>12</b>	25	—	31	<b>32</b>
Teeth arrangement	<b>22</b>	4	<b>33</b>	—	<b>30</b>	—	—	—	12	—	<b>23</b>	1
Axe	<b>44</b>	21	53	35	30	38	—	<b>38</b>	—	—	<b>33</b>	30
Edge blade	<b>11</b>	7	7	—	<b>20</b>	15	—	<b>12</b>	—	—	<b>13</b>	7
Awl	50	<b>57</b>	<b>47</b>	25	<b>40</b>	23	25	<b>38</b>	62	<b>100</b>	40	<b>41</b>
Fish hook	<b>33</b>	18	<b>13</b>	—	—	—	—	<b>12</b>	12	<b>50</b>	<b>14</b>	10
Harpoon	11	<b>14</b>	—	<b>45</b>	—	15	<i>25</i>	<i>25</i>	—	<b>50</b>	5	<b>25</b>
Arrowhead	<b>11</b>	4	<b>13</b>	10	—	8	—	—	—	—	7	6

sample sizes were unfortunately too small for comparisons of age patterns and artefacts.

The analysis of MSM patterns for the specific activities and grave goods, such as harpoons and arrowheads, showed no significant correlation at any site. A compilation of zooarchaeological, archaeological and anthropological data, however, implies a possible relationship between the composition of the site refuse fauna, differences in MSM scores between males and females, and find frequencies. This was especially prominent when comparing the patterns at Västerbjers and Ire. The two sites show nearly opposite patterns in MSM sex differences, grave goods proportions and faunal remains assemblages, indicating that these characteristics may be positively or negatively correlated. Isotopic

data, conversely, show no obvious differences to indicate diverse subsistence at the sites (Table 8).

The mean age at death differs somewhat between the sites and this may affect the high MSM scores for females at, for example, Västerbjers. However, Visby and Ajvide have comparable MSM mean differences between the sexes, but dissimilar age patterns. At Ajvide the mean age is 33 for both sexes, and at Visby it is 29 for females and 40 for males (Table 8). Consequently, age alone does not explain these between-site irregularities.

## Discussion

### *Physical activity and material culture*

Results of this study showed that males generally had higher mean MSM scores than females. The differences in MSM scores between the sexes varied between the five sites, which may be an indication of local individuality and possibly differences in sexual division of labour. An increase of muscle attachment expression was also seen with increasing age, which may be the result of a life-long accumulation, or in fact an increase of workload with age (Table 5). In addition, there were differences in the mean MSM scores between the five samples, indicating local diversity in levels of physical strain.

Females were buried with higher frequencies of grave goods than males, and seven out of ten find categories were found more frequently in female

Table 7. Relative frequencies (percentages) of find categories for subadults at Ajvide. Higher frequencies in bold

%	<5 years (n = 14)	5–16 years (n = 10) <sup>a</sup>	Total (n = 24)
Amber bead	14	<b>20</b>	17
Diaphysis bead	29	<b>50</b>	38
Boar's tusk	7	<b>29</b>	21
Teeth arrangement	14	<b>20</b>	17
Axe	<b>14</b>	10	8
Edge blade	0	<b>20</b>	8
Awl	29	<b>43</b>	42
Fish hook	7	<b>50</b>	25
Harpoon	0	<b>30</b>	8
Arrowhead	<b>21</b>	0	12

<sup>a</sup> The two older age groups at Ajvide (6–10 and 11–16 years) have been pooled due to small sample size.

Table 8. Compared characteristics of the Pitted Ware Culture sites on Gotland

Site	MSM difference <sup>a</sup>	Female MSM mean	Male MSM mean	Finds <sup>b</sup>	Mean age (years) difference for females	Terrestrial fauna%	$\delta^{13}\text{C}$ mean value ‰
Ajvide	0.25	1.04	1.29	7/10	0	36 <sup>c</sup>	-16 <sup>g,h</sup>
Västerbjers	0	1.72	1.72	7/10	+5	87 <sup>d</sup>	-14.5 <sup>h,i</sup>
Visby	0.31	1.54	1.85	3/10	-11	69 <sup>e</sup>	-16.2 <sup>h</sup>
Ire	0.76	0.86	1.62	1/10	-3	11 <sup>f</sup>	-14.7 <sup>j</sup>
Fridtorp	0.14	1.35	1.49	4/10	-2	ND	ND

<sup>a</sup> Difference in MSM mean scores between males and females.

<sup>b</sup> Proportion of find categories found more commonly in female burials.

<sup>c</sup> Rowley-Conwy & Storå (1997).

<sup>d</sup> Ekman (1974).

<sup>e</sup> Wallin & Eriksson (1985), Nihlén (1927).

<sup>f</sup> Ekman (1974), Hegert (1982), Landin (1981).

<sup>g</sup> Lindqvist & Possnert (1997).

<sup>h</sup> Lidén (1996).

<sup>i</sup> Eriksson (2004).

<sup>j</sup> Lidén & Nelson (1994).

burials in the combined sample (Table 6). Some burial objects may be characterised mainly as 'male' or 'female', such as harpoons which are found mainly in male graves, and perforated animal teeth arrangements in female graves.

In a previous study of the Ajvide sample, archery was suggested as being performed mainly by males, due to correlations of certain MSM patterns in male individuals (Molnar, 2006). Unfortunately, few arrowheads were found in graves, and the linking of individual MSM scores to burial objects such as arrowheads and harpoons showed no significant correlations.

Another trend is that younger individuals were buried with more objects than the older (Figs. 3A–C). The correlation between levels of MSM and find frequencies in the different age groups furthermore proved to be negative. There was no obvious preference in any of the adult age groups for specific objects. However, young females especially seemed to have a wider range as well as higher quantities of artefacts. This was especially visible at Ajvide and Västerbjers, the two larger samples.

### *Children's graves*

Interpreting the significance of burial object patterns is difficult, since the meaning of each find may be multifaceted. However, the compari-

sons indicate that women and also young individuals were given special attention in the Pitted Ware Culture society. The recording of finds from children's graves has in many cases been insufficient, and patterns are difficult to detect. At Ajvide, however, many of the children received as many, and similar, finds as the adults. Certain finds occurred in larger numbers in children than adults, such as beads of bird bone diaphyses, which appear in the hundreds in children's graves and on occasion very young adults. This suggests that in burial practices children were treated differently. Further indication of this is visible in the burial practices, where children are present in 21 out of 25 of the multiple burials on Gotland. In addition, the older children have relatively more grave goods than the young ones and received higher frequencies of all finds except for axes and arrowheads, which occur more commonly with children under the age of five, including infants. This furthermore suggests that the grave goods were not directly linked to the buried individual, at least not in the sense that the individual would have performed the implied activity.

### *The diversity of the homogeneous Pitted Ware Culture on Gotland*

Stable isotopic data indicate a homogeneous diet on Gotland, consisting of seal meat for four of the

sites (Lidén, 1996; Lindqvist & Possnert, 1997; Eriksson, 2003). However, the faunal assemblages also show the significance of the wild boar, as its bones and teeth were used as raw material for tools, fishing implements and decorations. The mandibles have been opened on the buccal sides, in all probability in order to extract marrow while keeping the jaw intact. The jaws have sometimes been discarded, or are in some cases assembled as a burial feature of up to 32 jaws. Tusks occur on all sites and have in some instances been perforated or decorated and placed around the neck of the deceased (Fig. 2).

The proportions of terrestrial versus marine archaeofauna at the different sites, however, are noteworthy (Table 8) (Nihlén, 1927; Ekman, 1974; Landin, 1981; Hegert, 1982; Wallin & Eriksson, 1985; Lindqvist & Possnert, 1997; Rowley-Conwy & Storå, 1997). Surprisingly, the highest incidence of harpoons as grave goods was found at Västernbys, the site with the lowest frequency of seal bones (Table 6). Perforated teeth from predominantly seal occur in female graves as arrangements around the hips, thighs or knees. The teeth can occur in the hundreds, and derive from as many as 42 individual animals (Janzon, 1974). Ire, which has the highest frequency of marine mammals, is somewhat unexpectedly the only site where arrangements of seal teeth do not occur in any grave.

The number of fish hooks also varies between the sites, where Ajvide has the most with six hooks in female and five hooks in male graves. In total, over 300 fish hooks have been found at Ajvide. At Västernbys, only two hooks have been found on the entire site, in female graves. On the other three sites, they are comparatively uncommon.

This diversity in grave goods between sites is in opposition to the many uniting features that Pitted Ware Culture burials on Gotland share. The question remains to what extent seal, boar and fish were eaten, and whether the differences in occurrence of hunting and fishing implements are in fact evidence of local differences in subsistence or perhaps ritual expressions. All the animals were utilised for dietary, ritual or other reasons. Wallin & Martinsson Wallin (1992: 23) pointed out that totemism and food taboos may have been an explanation for the significant

differences in faunal remains between Ire and Västernbys. The faunal remains patterns would be in agreement with some sort of totemism or local specialisation involving selected animals. Although there may have been local food regulations, the concept of varying food taboos on different sites is not in agreement with Eriksson's (2004) results, which show that the diet was homogeneous on all sites.

When it comes to both grave goods and MSM patterns, there is a great deal of variation within the sites between buried individuals that are not associated with sex or age. There are examples of exceptionally individual objects, such as a comb, pieces of mother-of-pearl, and the many bone flutes with which the woman in grave 62 from Ajvide was buried. In that particular case, it seems reasonable to conclude that the objects somehow represent individuality. However, none of the above-mentioned objects have been found at Ajvide, or any other of the Gotland sites, which would make further interpretations tentative. Furthermore, nearly all the burials are single graves, and it therefore seems as if individuality also was of some importance, in contrast to the communal burial sites that appear in contemporary megalithic cultures on the Swedish mainland.

In this study, the MSM analysis has resulted in little direct evidence of sexual division of activities. A social pattern may be discernible, where physical work and grave goods were not analogous. This may imply that the objects themselves do not mirror the individual, but are rather an expression of the community, and perhaps those present at the interment. Had the grave goods been a means of exclusively reflecting the person in the grave, it is likely that a stricter division of grave goods would have been visible between males and females, and also between children and adults.

## **Conclusion**

The skeletal remains from 126 adults and 50 children and associated grave goods from five Pitted Ware Culture sites on Gotland were analysed for this study. The aim was to study MSM and grave goods patterns in order to explore the possible relationship between MSM

and grave goods distributions in relation to age and sex, as well as comparing these with subsistence data from the sites. Patterns from 52 upper and lower body MSM were compared with ten selected artefact categories found in the graves.

General MSM patterns showed significant between-site differences. There were also noteworthy differences in patterns of MSM mean scores between the sexes, and nearly all groups had significantly increased scores with advancing age. Patterns for grave goods showed quite a different pattern: young individuals had higher frequencies of the find categories than the old, and females had generally higher frequencies than males. This was especially noticeable in the larger samples where females had higher incidences for seven out of ten grave goods categories. Results show that perforated seal teeth arrangements were generally more common in female graves and harpoons in male graves. The analysis of MSM patterns for specific activities, such as archery and harpooning and corresponding grave goods, showed no significant correlation at any site.

Results indicate that there was a common sense of identity on the island, reflected in the clearly common assemblages of material culture and isotopic dietary patterns. However, affiliation with the local group and individuality also seem to have been important. Activity patterns, material culture and faunal remains, contribute to a complex image of great diversity and individuality between and within the different Pitted Ware sites. The individual in each grave is clearly visible, but not as a performer of the specific activities suggested by the grave goods.

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