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THE ADIPOSITY PARADOX IN THE MIDDLE DANUBIAN GRAVETTIAN

ABSTRACT: Two of the best-known Gravettian female figurines, those from Willendorf II and Dolní Věstonice I, are anatomically accurate depictions of obese women. Given the human paleontological evidence for the musculoskeletal hypertrophy of these populations, inferred high activity levels throughout the life cycle, burden carrying, and periods of stress, as well as the archaeological evidence for considerable human movement and raw material transport across the landscape, it is unclear how the artists involved could have become so familiar with normal human patterns of corpulence (the adiposity paradox). Seasonal semi-sedentism and short term high caloric input, as is suggested by archaeological evidence, may explain the occasional presence of such obesity, sufficiently frequently to permit accurate artistic renditions of the resultant human form.

KEY WORDS: Upper Paleolithic – Europe – Gravettian – Paleolithic art – Human paleontology – Mobility

INTRODUCTION

Two of the most famous, and certainly most frequently illustrated, Upper Paleolithic artifacts are two small female figurines, each measuring *ca* 11 cm high, found in 1908 and 1925 respectively at the sites of Willendorf II and Dolní Věstonice I. With their minimal or absent facial features, lack of feet, diminutive upper limbs, pronounced breasts, and broad hips and buttocks, they have come to represent Upper Paleolithic human figurines generally and Middle Upper Paleolithic (or Gravettian) art in particular. They and the now abundant series of Middle Upper Paleolithic human figurines from across Europe have generated an enormous literature concerned with methods of manufacture, raw material, stylistic patterns, artistic symbolism, gender roles, reproductive biology, clothing, body ornamentation, self perception, interregional communication, religion, human cognition, and interpretive biases. Through the discussion of these two statuettes and their artistic kin from the Middle Upper Paleolithic, one feature has been noted but little considered in terms of its broader implications. The human models for the Dolní Věstonice and Willendorf statuettes were obese women. They were fat!

Since obesity reflects a situation in which the calories consumed dietary exceed the calories expended for some extended period of time, depictions of obesity have implications for the biology and behaviour of the populations of concern. It is that interplay between bulges, biology and behaviour that is of concern here. Therein lies the adiposity paradox.

THE FEMALE STATUETTES FROM WILLENDORF AND DOLNÍ VĚSTONICE

The Willendorf statuette

The statuette from Willendorf II ("Venus I") (*Figure 1*) was found in 1908 during excavation in the relatively rich archaeological level 9, in loess derived sediments (Szombathy 1910, see: Felgenhauer 1959, Angeli 1989, Delporte 1993, Neugebauer-Maresch 1999, Antl-Weiser 2000). It was carved from limestone and originally contained ochre over much of the surface. About 11 cm tall and 5.5 cm wide across the hip region, the specimen is average in size for a Gravettian statuette. Four radiocarbon dates for level 9 (GrA-5005: 23,180±120; GrN-21898:

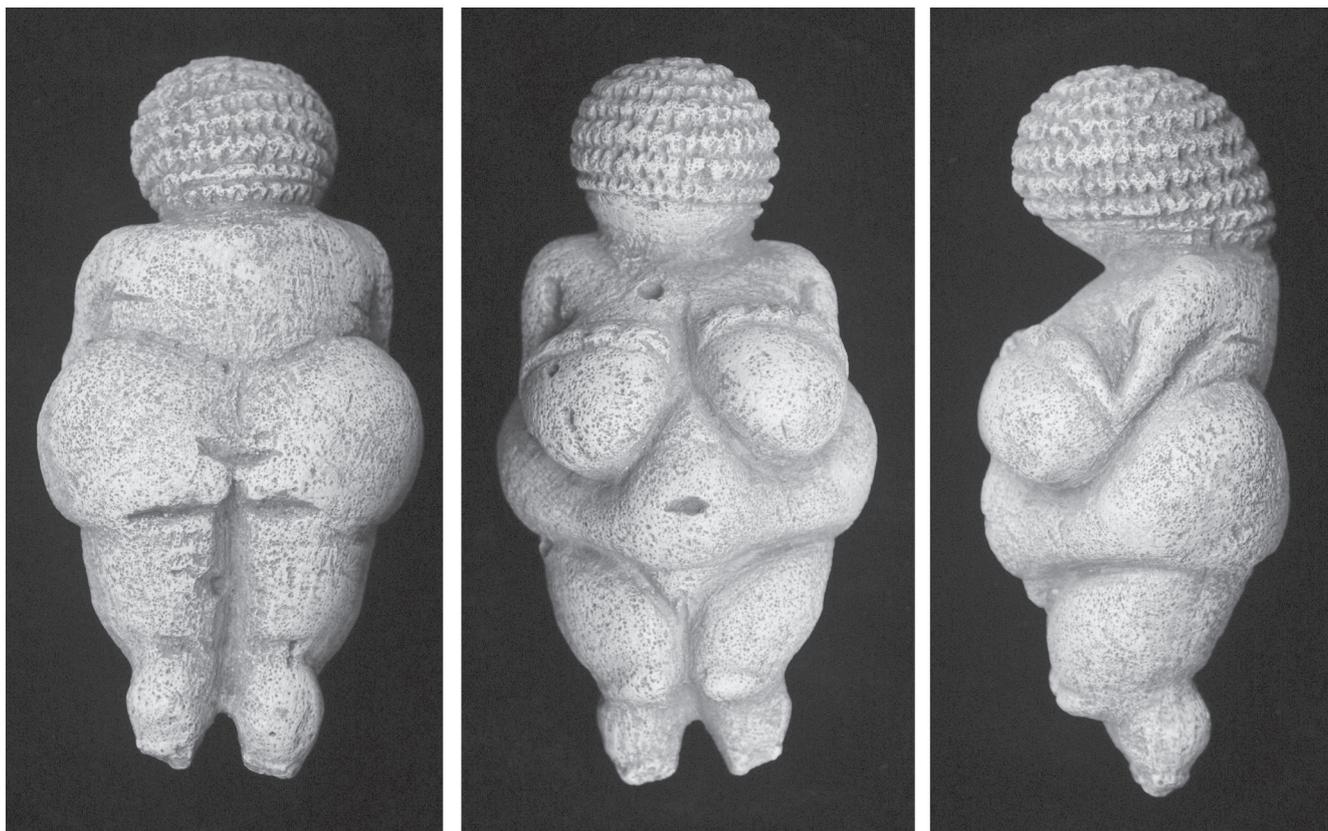


FIGURE 1. Dorsal, ventral and left lateral views of a cast of the Willendorf II female figurine in limestone. Cast courtesy of the Naturhistorisches Museum Wien.

23,860±270; GrN-22208: 24,370±290; GrA-5006: 24,910±150) place it between 25,000 and 23,000 yrs. B.P. (Haesaerts *et al.* 1996).

Previous assessments of it have primarily emphasized the stylistic and sexual elements of the figurine, including the absence of facial features, the head decoration which may represent a hair style or a woven cap, the disproportionately small arms and hands placed over unusually large breasts, explicit external genitalia, and the absence or only a suggestion of feet. It has also been noted (e.g. Sauser 1965, Duhard 1988, Delporte 1993, Neugebauer-Maresch 1999) that the individual represents an obese individual, but only Neugebauer-Maresch (1999) provided details regarding the depiction of this excess of subcutaneous adipose tissue.

The observation that the statuette represents an obese woman is evident in a series of anatomical details, ones which go beyond stylistic concerns emphasizing or de-emphasizing personal or sexual characteristics. The depictions are of sufficient detail to permit identification of superficial anatomical features, ones which are accentuated in the living by the laying down of subcutaneous fat.

The gluteal region is not only large, but it protrudes markedly laterally, rises cranially on the dorsal surface to form distinct bilateral supragluteal folds. It is demarcated from the thigh by a modest inferior gluteal fold dorsally and

pronounced gluteal folds dorsolaterally. The midsagittal gluteal or sacral fold is distinct but less pronounced than the others, as would be appropriate with the general enlargement of the buttocks. The buttocks remain relatively flat transversely, and therefore they do not represent the steatopygia identified in some Gravettian female figurines (Duhard 1988).

More cranially there are bilateral depictions of the sub-axillary dorsal skin folds associated with obesity, particularly in older women (Neugebauer-Maresch 1999).

The lower abdomen is ventrally protruding along the midline, accentuated by a prominent umbilicus. It is expanded principally on the midline, and it is debated whether it reflects the abdominal enlargement associated with pregnancy (Duhard 1988 vs. Neugebauer-Maresch 1999). The abdominal bulge is demarcated above by a small raised ridge, which corresponds to the change in skin cleavage lines between the lower and upper abdomen (Tortora 1983); the extent of the depiction of this line may have been reduced by the artist, since the lower portions of the breasts and the groove demarcating them from the abdomen impinge on the dermal transition across the mid-abdomen slightly above the umbilicus. The lower margin of the abdominal enlargement is set off from the anterior thighs

by pronounced sulci, ones which parallel the inguinal ligament and extend from the pubic region to the iliac crest region (the inguinal fold). The Willendorf figurine is particularly anatomically accurate in showing the abdominal enlargement extending out over this ventral pelvic skin fold.

The external genitalia are explicitly delineated. There is a clear enlargement of the mons pubis, the fat pad that covers the pubic symphysis in human females and differentially enlarges with obesity (Countouris 1990). Again, it is both protuberant and separated from the abdomen by a transverse sulcus, the sulcus formed by the attachment of the skin to the underlying structures across the superior pubic symphysis. The prominence of the labia majora may represent a stylistic focus on sexual attributes, or it may be a recognition that they become enlarged with an excess accumulation of adipose tissue, since they include a continuation of the mons pubis fat pad through fascia (Countouris 1990).

The thighs are large and bulbous in all directions, but the exaggeration is particularly evident in the anterior aspect and the proximolateral portions. These proportions

give the impression of a pronounced bicondylar angle to the thighs, but they are merely an accurate representation of the differential deposition of subcutaneous fat on the proximolateral thigh. The knees are also anteriorly protruding, giving the impression of exceptionally hypertrophied patellae. However, these bulges, along with the marked constrictions of the legs below the knees, are accurate depictions of fat distributions around the knee, as constrained by changes in skin cleavage lines and fibrous attachments of the skin to underlying fascial planes.

The large size of the breasts may be primarily stylistic, emphasizing sexual aspects of the figurine. However, human female breasts, which consist extensively of adipose tissue (Tortora 1983), can become enlarged in obese women (Boyd *et al.* 1998). Adipose tissue is a secretor of estrogen (Ailhaud 2000), and breast adipose tissue levels are sensitive to circulating estrogen levels (Houserková *et al.* 2003). It remains uncertain to what extent the mammary depiction is stylistic/symbolic versus anatomical, but obesity-related enlargement may account for a large part of this distinctive feature of the figurine.

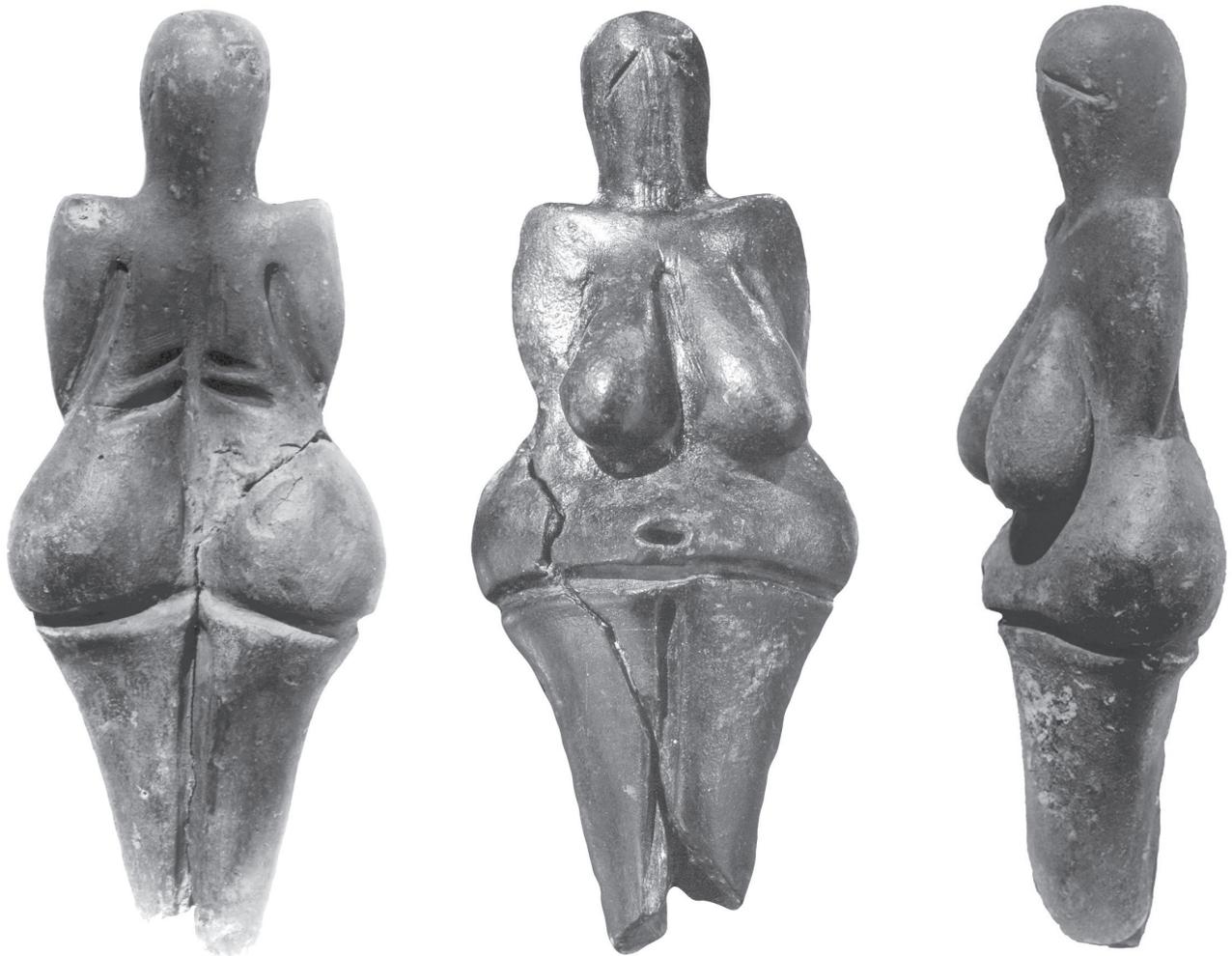


FIGURE 2. Dorsal, ventral and left lateral views of the original Dolní Věstonice I female figurine in dark ceramic in the Moravské zemské muzeum.

It is therefore apparent that the Willendorf II statuette is an accurate depiction of an extensively obese woman. The anatomical details go beyond simply providing large buttocks, abdomen and thighs, but they are found in the careful carving of the various skin folds and distributions of the corporeal enlargements. There may have been some stylistic exaggeration of these features, since there were stylistic decisions in the forms of the head and upper limbs, but any stylistic modifications of the form are built upon a careful rendition of the surface anatomy of a woman who consumed an excess number of calories, converted them to adipose tissue, and laid that tissue down subcutaneously.

The Dolní Věstonice statuette

The statuette ("Venus I") from Dolní Věstonice I (*Figure 2*) was discovered in 1925 in the upper part of the Dolní Věstonice I site, in a rich cultural layer and not far from the burial of the Dolní Věstonice 3 adult female (Absolon 1929, 1938, 1949, Klíma 1963, Svoboda 1995, Verpoorte 2001). It was made in fired ceramic, produced by hand modelling, sculpting and firing of the local loess sediment (Vandiver *et al.* 1989). It is similar in length (*ca* 11 cm) to the Willendorf II figurine but slightly narrower (*ca* 4.5 cm at the hips). It was found in two adjacent pieces, one of the right leg, hip and buttocks, and the other of the remainder of the statuette; the two pieces fit with minimal loss of material along the break. The lower legs were broken off, and it is not known what form the feet had.

The site of Dolní Věstonice I spans considerable time, since the lower portion of the site yielded radiocarbon dates of 29,300+750 / -690 BP (GrN-18187) and 27,250+590 / -570 BP (GrN-18189) and the upper portion yielded a date of 25,950+630 / -580 BP (GrN-18189) (Svoboda 1991, 1995). It is not clear how these dates relate to the age of the figurine, but the one for the upper portion of the site should approximate its age.

The Dolní Věstonice I figurine is more schematic than the Willendorf one, but it still shows features of a fat woman. The head is schematic, with only two lines for the eyes and four holes on the top. The shoulders are flattened and normal in breadth, but the arms are schematic and separated from the torso only by two grooves on the dorsal surface; there may be a line separating the left arm from the left breast (the right side is damaged in this region), but it blends with the groove modelled along the lateral breast. The large and pendulous breasts and the pelvic region are modelled in more detail, but the legs taper distally with little detail beyond their midline separation.

There is considerable artistic choice in the differential presentation of features and attention to detail on this figurine. One would expect more detail than on the Willendorf specimen, given the relative ease of modelling clay. Moreover, some of the clay animal heads from Pavlov I provide exquisite detail of facial and other anatomical features (Klíma 1958), indicating that these artists knew how to produce fine features in the local clay. In addition, the small ivory human head ("Venus XV") found in 1936

in the middle part of Dolní Věstonice I (Absolon 1949) shows fine, anatomically accurate details of the face. The Dolní Věstonice "Venus I" figurine therefore reflects both anatomical description and stylistic preferences. Yet, there are several aspects of this figurine that can only be viewed as indicating obesity.

Dorsally, the buttocks are not differentiated from the back by a groove, but there are two, bilaterally symmetrical lines in the inferior thoracic region which represent the anatomical transition from the thoracic region to the expanded lumbar and gluteal area. The two sides of the lower back (but not the upper back) are separated by a midsagittal groove, reflecting the connection of the midline skin primarily to the more caudal vertebral spinous processes. The buttocks are laterally and inferiorly bulbous, and they are separated from the proximal thigh by a groove which continues around the full circumference of the hip region (the inferior gluteal fold dorsally). The midsagittal gluteal fold is pronounced, and it continues the groove that emerges in the lower thoracic region and becomes more pronounced caudally through the lumbar region. It is not clear whether this groove stopped at the inferior gluteal level or continued distally between the legs, since the postdepositional break occurred along the midline at this level. The buttocks are widest inferiorly, and there is a suggestion of the effects of gravity on the excess lateral tissue. There is no indication of steatopygia.

The abdominal area has a prominent but simple umbilicus in the middle of a discrete inferior abdominal fat pad. This bulge is evident especially in lateral view. It is separated from the anterior thighs by a semi-schematic inguinal fold, a portion of the groove that goes around the circumference of the figurine. The lower abdominal region is separated from the thorax by a transverse hollow just below the pendulous breasts, but there is no indication of a mid-abdominal skin fold. The external genitalia and the mons pubis are not depicted.

The highly stylised legs are notable for their marked breadth just below the inferior gluteal/inguinal skin fold line, with a rapid tapering toward the knees. There is no detail in the knee region. The bicondylar tapering is less pronounced than on the Willendorf figurine, in part due to the less exaggerated hip breadth.

The breasts are less pronounced than those of the Willendorf and some other Gravettian statuettes, owing their relatively large size more to their pendulous depiction than to their breadth. They may nonetheless in part reflect obesity related enlargement.

A number of the features of the Dolní Věstonice female statuette could be ascribed to artistic preferences and/or sexual/reproductive symbolism. However, the abdominal and gluteal regions in particular are anatomically accurate, if stylised, depictions of a relatively obese woman. The distinctive protrusion of the lower middle abdomen and the laterally expanded buttocks, relative to the other dimensions of the figurine, can only have been modelled on such a woman. Moreover, there are several other fragments of

ceramic figurines from Dolní Věstonice I, all found in the 1930s, that preserve portions of the torso and/or legs. Three of these ("Venus VI, VII and XVI"), are anatomically and stylistically very similar to the "Venus I" from the site, indicating that this specimen is not an isolated example of such a depiction.

The issues of pathology and pregnancy

It has been suggested (e.g. Sausser 1965, Dobson 1998) that the proportions of these figurines depict the obesity associated with endocrine abnormalities or dietary trace element deficiencies. Although it is not possible to completely reject such interpretations for all cases (abundant subcutaneous fat tends to follow similar distributions), three factors make them unlikely. None of the known Gravettian human skeletons exhibit the kinds of developmental disorders that would necessarily promote obesity, even though congenital abnormalities are present in some of these remains (Trinkaus *et al.* 2005). The presence of depictions of obese women from Atlantic Europe to the Russian Plain (cf. Gvozdover 1989, Delporte 1993, Abramova 1995, Mussi *et al.* 2000) argues against a single pathological cause for their imagery. And the widespread presence of such impaired individuals, rare in any modern population, is unlikely in highly mobile Gravettian foraging populations.

It is also unlikely that this obesity is reflecting the tendency of some pregnant women to lay down extra fat to carry them through the energetic demands of pregnancy and lactation (Ulijaszek 2000). Some Gravettian figurines probably depict pregnant women (Duhard 1993), and the Willendorf statuette could be such a portrayal. However, the degree to which women accumulate fat reserves during pregnancy is variable and may be minimal, especially in non-industrial societies (Ulijaszek 2000), indicating that the obesity evident in these figurines cannot be attributed solely to their reproductive status.

The Gravettian context

These two statuettes span several thousand years, and the Dolní Věstonice figurines are associated with an earlier phase of the central European Gravettian, the Pavlovian, whereas the Willendorf II one derives from the more recent Willendorf-Kostenkian phase. There are likely to have been stylistic differences in the art over this time period, as there were in technology (Svoboda *et al.* 1996). However, the Dolní Věstonice I figurines came from relatively late in the Pavlovian, and there is little evidence for other major adaptive changes between *ca* 26,000 BP and 24,000 BP, although climatic fluctuations and deterioration leading toward the last glacial maximum may have produced greater mobility and more long distance contacts (Svoboda *et al.* 1996). Moreover, there is little evidence for significant change in human biology between the Pavlovian remains from Dolní Věstonice I and II, Pavlov I and Předmostí (Matiegka 1934, 1938, Vlček 1991, 1997, Trinkaus, Svoboda 2005) and the Willendorf-Kostenkian ones from

Brno-Francouzská, Dolní Věstonice I and Willendorf I and II (Jelínek 1959, Trinkaus *et al.* 1999, Teschler-Nicola, Trinkaus 2001).

Although the above discussion has emphasized the aspects of these statuettes that indicate depictions of obesity, they are not representative of all Gravettian human statuettes. There is considerable variation in the degree to which Gravettian artists depicted corpulent individuals (see Duhard 1988, Nelson 1993). This is apparent among the Gravettian specimens from the Middle Danube Basin, those from Moravany (Zotz 1968), Willendorf II ("Venus II") (Bayer 1930), Petřkovice (Klíma 1955, Svoboda 1995), and Pavlov I (Klíma 1994, Verpoorte 2001). The first is corpulent, the second two are rather slender, and the last are modest but show some expansion of the pelvic region. The same variation in depicted body form is apparent from Atlantic Europe to the Russian Plain, within some sites and across regions (cf. Duhard 1988, Gvozdover 1989, Delporte 1993, Abramova 1995, Mussi *et al.* 2000).

It should also be noted that human body proportions during this time period (Holliday 1997, 2005) included relatively long limbs compared to trunk length and moderately broad bodies, with overall proportions approximating those of linear sub-tropical humans. They were distinct in body shape from stocky recent arctic humans and, to a lesser degree, those of Holocene Europeans. Therefore, the broad bodies of some of these statuettes are not due to the body proportions of the Gravettian humans that made them; they must be the product of some combination of artistic license and familiarity with fat women.

PALEOANTHROPOLOGICAL INDICATORS OF MOBILITY AND STRESS IN THE MIDDLE DANUBIAN GRAVETTIAN

Mobility, both logistical and residential, as well as the transportation of materials over long distances, were important components of the hunting and gathering adaptation of central European Middle Upper Paleolithic human populations. This is documented in both their skeletal remains and the associated archaeological record.

Human paleontological indications

The Middle Danubian Gravettian human remains are characterized by an elevated level of lower limb skeletal hypertrophy compared to many recent (and more sedentary) Holocene human populations (Matiegka 1938, Ruff *et al.* 2000, Teschler-Nicola, Trinkaus 2001, Holt 2003, Trinkaus 2005). This is evident in their femoral and tibial diaphyseal hypertrophy, since those portions of the skeleton remain plastic throughout the life span (Trinkaus *et al.* 1994, Carter, Beaupré 2001, Pearson, Lieberman 2004). They therefore reflect cumulative habitual loading levels on the limbs. This is combined with the prominent development of femoral pilasters in a number of the individuals, which reflect the anteroposterior hypertrophy associated with high

levels of mobility (Holt 2003, and references therein). In addition, their low femoral neck-shaft angles (Matiegka 1938, Sládek *et al.* 2000) imply that this level of mobility characterized immature as well as mature individuals (Anderson, Trinkaus 1998). This lower limb skeletal hypertrophy probably reflects both mobility and burden carrying; however, given that forces within the lower limb from locomotion can reach several times body weight (Duda *et al.* 1997, Van den Bogert *et al.* 1999) and hunter-gatherer burden carrying loads rarely exceed body mass (Hilton, Greaves 2004), it is principally mobility levels that promotes such skeletal hypertrophy.

These patterns are reinforced by several pathological aspects of this sample. Dolní Věstonice 15 sustained an undetermined form of congenital dysplasia, which resulted in deformities, small body size and short legs (Trinkaus *et al.* 2005). Despite these developmental difficulties, Dolní Věstonice 15 had a level of locomotor robusticity similar to those of the other Gravettian individuals (Trinkaus 2005), indicating both that he participated in the locomotor mobility characteristic of the group as a whole and that this was a necessary part of survival. Dolní Věstonice 13 and 15 had unilateral idiopathic pronounced osteoarthritis of the manual second ray proximal interphalangeal joint, accompanied by a similar degeneration on the fifth ray of Dolní Věstonice 15 (Trinkaus *et al.* 2005). The most plausible explanation for this localized osteoarthritis in young adults is biomechanical joint overloading from carrying or dragging heavy loads, a behaviour commensurate with high levels of landscape use. And finally, despite a number of cranial and upper limb injuries, there is no evidence for lower limb injuries that would impede locomotion; if they occurred the individuals were probably left behind.

In these skeletal analyses, there is no perceptible difference between the females and the males. All individuals, irrespective of gender, were participating in the physical activities and mobility patterns indicated by their skeletal remains.

Archaeological indications

The majority of the Gravettian sites in the Middle Danube basin are located along major valley systems, in positions that would provide access to the primary routes available for human movement during the Late Pleistocene (Svoboda *et al.* 1996). The individual sites vary in size and inferred activity patterns, indicating a hierarchy of settlement and mobility for specialized tasks (Klíma 1963, 1995, Svoboda 1991, 1997).

In the southern Moravian sites of Dolní Věstonice and Pavlov, the majority of the lithic raw material (both flint and radiolarite) is from sources in the northern Czech Republic and southern Poland (Klíma 1963, Přichystal 1994, Svoboda 1994); this indicates continued transportation from regions over 200 km distant. In addition, there is evidence for occasional connections over longer distances, such as the transportation of eastern Carpathian obsidian

to southern Moravia. A further indication for both direct and indirect contacts over vast areas of Eurasia can be found in the technical, formal and symbolic similarities in Gravettian art and burial practices, as well as the spread of the Kostenki shouldered points across central and eastern Europe during the later Gravettian (Svoboda *et al.* 1996, Roebroeks *et al.* 2000, Zilhão, Trinkaus 2002).

The weaving impressions on clay at Pavlov (Adovasio *et al.* 1996) indicate that they were creating a variety of textiles. The overall forms of the textiles cannot be determined from the fragmentary impressions, but a range of artifacts from clothing to nets to bags is implied by the weaving patterns (Soffer *et al.* 2000). Since these populations were processing fur-bearing animals [including wolf (*Canis lupus*) and especially fox (*Alopex lagopus* and *Vulpes vulpes*)] (Musil 1997, Trinkaus *et al.* 2000), it is likely that use of these textiles as clothing was supplementary (despite depictions on some figurines), and that they were mainly used for other items, of which carrying bags would likely be one of the roles.

Even though the degree of human involvement in the initial procurement of mammoth carcasses remains uncertain (Svoboda *et al.* 1996), it is apparent from the abundance, locations and condition of mammoth remains in and adjacent to the Dolní Věstonice, Pavlov and Předmostí sites that mammoth remains were being extensively exploited for food, fuel and fabrication (Klíma 1963, 1995, Absolon, Klíma 1977, Svoboda 1991, 1997). Such remains, even if transported from nearby localities, would place considerable mechanical loads on the people involved, whether carried or dragged across the landscape.

In other words, from a behavioural perspective, the central European Gravettian paleontological and archaeological record demonstrates the exploitation of an extensive territory, long-distance lithic transport, harvesting of largest terrestrial mammals of that time, the technology to facilitate such activities, and a suite of human biological responses to the loads placed on their limbs (Svoboda *et al.* 2000, Trinkaus, Svoboda 2005).

Fossil evidence of stress

The Dolní Věstonice/Pavlov human sample exhibits a number of developmental defects of the enamel (hypoplasias), which reflect periods of stress during growth (Hillson 1996). All (N=7) of the individuals that preserve more than one tooth possess such defects, and 30.8% of the isolated teeth (N=13) have them (Trinkaus *et al.* 2005). Although such frequencies of defects are not unusual among recent human hunter-gatherers (Guatelli-Steinberg *et al.* 2004), they indicate that these Gravettian human populations were subject to relatively frequent periods of systemic stress, most likely from seasonal shortages of food availability.

THE ADIPOSITY PARADOX

From the female figurines of Willendorf and Dolní Věstonice and from the human paleontological and archaeological records left behind by the same people come two contrasting views of these populations. The latter data set indicates people who were highly mobile, covering large distances, transporting considerable (and sometimes heavy) material over variable distances, and needing to do this for survival. Given their relatively linear body forms, elevated strength, and probable high physical endurance, one would expect them to be slender, muscular and especially lean. The last feature, leanness, is reinforced by the moderately high level of developmental enamel defects, since they imply that food was not always in abundance.

Yet, the multiple depictions of obese women in the statuettes, and especially the exquisite detail of normal human female patterns of obesity and skin folds in the Willendorf statuette, bespeak intimate knowledge of the surface anatomy of fat women. It is recognized that a feminine ideal of corpulence is common in many societies, especially ones in which such fat is possible only with high social status, and there may have been an artistic preference for depicting obese women. It is also possible that, since extra subcutaneous fat helps to sustain women through pregnancy and lactation, a preference for these depictions may be related to ideals of fertility. Yet, it is difficult to conceive how artists, whatever their preferences, could so consistently accurately depict the anatomical pattern of human female fatness without some personal knowledge of such women.

Herein lies the adiposity paradox. When, and how often, were there Gravettian women who achieved the level of corpulence evident in these Central European and other Gravettian statuettes? Was there a level of social differentiation that led to a few women having differential access to food? If yes, it is not reflected in the differential robusticity of individuals from the more elaborate ritual burials, either in Central Europe or elsewhere in the Gravettian range. Were there periods of the year when the populations were semi-sedentary, had an abundance of food, and rapidly accumulated subcutaneous adipose tissue to help them through the leaner periods of the year? If so, the first few days of long distance mobility must have been difficult for the individuals involved.

The last suggestion has some archaeological support. It has been argued that there is evidence for at least seasonal sedentism, based on the various seasons of human occupation at sites, the intensity of the occupation layers and richness of the artifacts, the stability of dwelling structures, the existence of storage pits, and the presence of time-consuming and delicate technologies (microliths, fine ivory carvings, textiles, ceramics, etc.) (Soffer 1989, Svoboda *et al.* 1996, 2000, Svoboda 2005).

The "fat ladies" may therefore be one more line of evidence indicating a complex behavioural mix of long distance mobility, high levels of physical activity,

and variable levels of stress, combined with periods of abundance and sedentism. In addition to the wealth of other social and technological innovations of this time period, these Gravettian populations appear to have also had (at least occasionally) the opportunity to live comfortably off of the land, consuming excess calories to tide them over leaner times of the year.

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