Waist-to-Hip Ratio: An Indicator of Female Mate Value

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Abstract

One of the adaptive problems faced by ancestral males was to assess the mate value or ability of the potential mate to promote their reproductive success. The female mate value depends on variables that cannot be directly observed such as reproductive endocrinological status, parity, health, and resistance to major diseases. It has been proposed that males assess mate value from the body, as specific characteristics of the female body convey reliable information about otherwise concealed variables compromising mate value.

One such bodily feature is sexually dimorphic body fat distribution, as measured by waist-to-hip ratio (WHR). Female WHR is a reliable indicator of reproductive endocrinological status and fecundity; female-typical low WHR appears only after puberty and is maintained only until females reach menopause. Females with low WHR are fertile as measured by successful conception after artificial insemination. The WHR accurately reflects disease risk profile for major diseases such as cardiovascular disorders, diabetes type II, endometrial, breast, and ovarian cancer.

Finally, change in the size of female WHR is a reliable indicator of parity in early stages of pregnancy. I will present cross-cultural data showing that Indian tribal men, unexposed to Western culture and media, also judge photographs of models with low WHR as more attractive than models with high WHR, as do Western men. Furthermore, the preference for low WHR is not of recent origin, as ancient sculptures from major civilizations depict sexually dimorphic WHR. This historical data, along with the cross-cultural data, suggests that WHR, a unique feature of Homo, acts as an honest signal of female mate value and, therefore, may play a critical role in mate choice.

Introduction

According to evolution-based theories of mate selection, one of the adaptive problems faced by human ancestral male was to assess a woman's mate value or the degree to which she would enhance his reproductive success. Women's mate value is determined by numerous variables such as hormone profile, reproductive age, fecundity, parity, and health, none of which can be directly observed. Thus, it is proposed that selection produced psychological

mechanisms in men to attend to indirect cues to assess the women's mate value. It is the fundamental assumption of evolutionary mate selection theories that physical attractiveness is largely a reflection of reliable cues to a woman's mate value (Buss 1994; Symons 1979, 1995). Consistent with this assumption is that men universally desire to mate with women with "good looks."

Two different research approaches have been used to demonstrate the link between physical attractiveness and mate value. First are those studies which identify the bodily features which people find attractive and then investigate whether such features are correlated with some aspect of mate value. The early research of categorizing various facial features which people find attractive, recent research of Johnston and Franklin (1993) on computer generated beautiful faces, and research by Perrett and his associates (1994) on facial composite illustrate this approach. These researchers have found that sex hormone mediated facial features—size of chin, height of cheekbones, size of eyes relative to face size, jaw thickness—impact the judgment of attractiveness. This research approach of first identifying attractive bodily features and then exploring their link to degree of mate value has been primarily restricted to facial features. The second approach is to identify bodily features which are known to be related to genetic quality, capacity to cope with environmental stress or health and then investigate whether people judge such features attractive. The research of Gangestad, Thornhill, and their associates (Gangestad, Thornhill & Yeo 1994; Thornhill 1993) on fluctuating asymmetry (FA)—a marker of developmental stability—and its effect on judgment of attractiveness exemplify this approach. These researchers have found that women with low degree of facial and/or bodily FA are judged as more attractive than women of the same age except with higher FA.

Another bodily feature which has been shown to signal hormonal status, susceptibility to endocrinological disorders and other major diseases, and fertility is sex-specific body fat distribution as measured by the ratio of waist to hip circumference (WHR). The link between indication of health and fertility and WHR would suggest that WHR should also play an important role in judgments of women's attractiveness.

In this presentation I will summarize the evidence that WHR is a sexually dimorphic feature which a) reliably tracks women's reproductive age; prior to puberty, sex differences in the size of WHR are minimal, but afterward and until the onset of menopause, healthy women have lower WHR than men; b) systematically varies with endocrinological and physiological mechanisms regulating components of fitness such as health, fecundity, or the capacity to sustain pregnancy, and c) affects the judgment of female attractiveness in men and women of various ages, socioeconomic status, and ethnicity; within each body weight categories (underweight, normal and overweight) women with lower WHR are judged to be more attractive than women with similar body weight and age, but higher WHR.

WHR is an Indicator of Women's Reproductive Age

Fat in humans is not evenly distributed over the body; the thickness of fat varies widely between individual body parts and is poorly correlated with total body fat (Garn 1954). The nature of this uneven distribution of body fat in humans is affected both by age and sex. Differences in amount of fat and its distribution are greatest from early teens until late middle age. Sex differences in body fat distribution are a fundamental and essential feature of homo sapiens. While the basic humanlike anatomical distribution of fat deposits is evident in primates, it is not a sexually dimorphic characteristic (Pond 1992; Pond & Mattacks 1987). The deposit and utilization of fat from various anatomical areas is regulated by sex hormones (Bjorntorp 1987, 1991). Simply stated, testosterone stimulates fat deposits in the abdominal region and inhibits fat deposits in the gluteofemoral (buttocks and thighs) region. Estrogen, in contrast, inhibits fat deposits in the abdominal region and maximally stimulates fat deposits in the gluteofemoral region more than any other region of the body. The increase in estrogen during puberty enables women to deposit fat on gluteofemoral region and peripheral (except to the stomach) or subcutaneous fat. Men, on the other hand, lose fat from lower body parts after puberty and deposit centrally (or intra-abdominally) and on the upper body. When sexual dimorphism in body frame sizes are equalized, sex differences become more dramatically evident in the lower body segment than in any other region of the body. Thus, the shape and relative size of lower body can reliably differentiate women and men in the absence of breast and facial cues (Figure 1).

The sexually dimorphic body fat distribution can be quantified by measuring and computing the ratio of the circumferences of waist and hip (Figure 2).

WHR has a bimodal distribution with relatively little overlap between the sexes (Marti et al. 1991; Molarius et al. 1999). The typical range of WHR for healthy premenopausal women has been shown to be .67-.80 and in the range of .85-.95 for healthy men (Marti et al. 1991). Women typically maintain a lower WHR than men throughout adulthood, although after menopause WHR approaches the masculine range (Kirschner & Samojlik 1991). As is evident from Figure 3, the size of WHR is positively correlated with degree of obesity; severely obese women have higher WHR in their twenties than non-obese women at menopause.

It should be pointed out that there are population-specific variations in the size of WHR in both men and women. These population-specific variations in WHR are probably determined by a combination of genetic variations, socioeconomic status, and lifestyle variables. However, it is notable that despite such variations, male WHR has exceeded female WHR in all published reports.

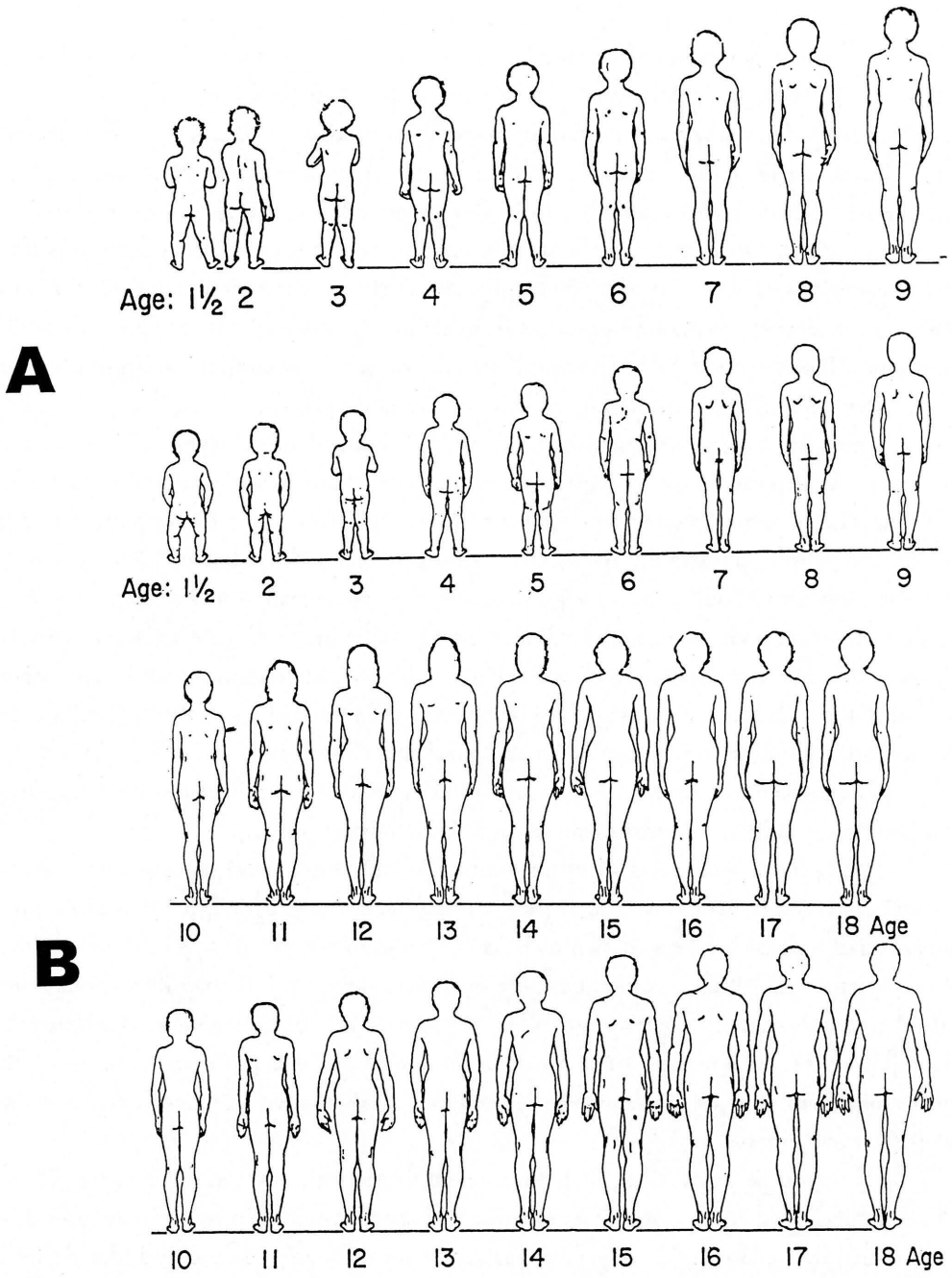

Figure 1. Schematic drawings of sexually dimorphic body shape from age 1-9 years (panel A) and from age 10-18 years (panel B). The body shape differences become strikingly different after puberty, and the sex of the figure can be accurately judged in the absence of any facial features or other secondary sex characteristics.

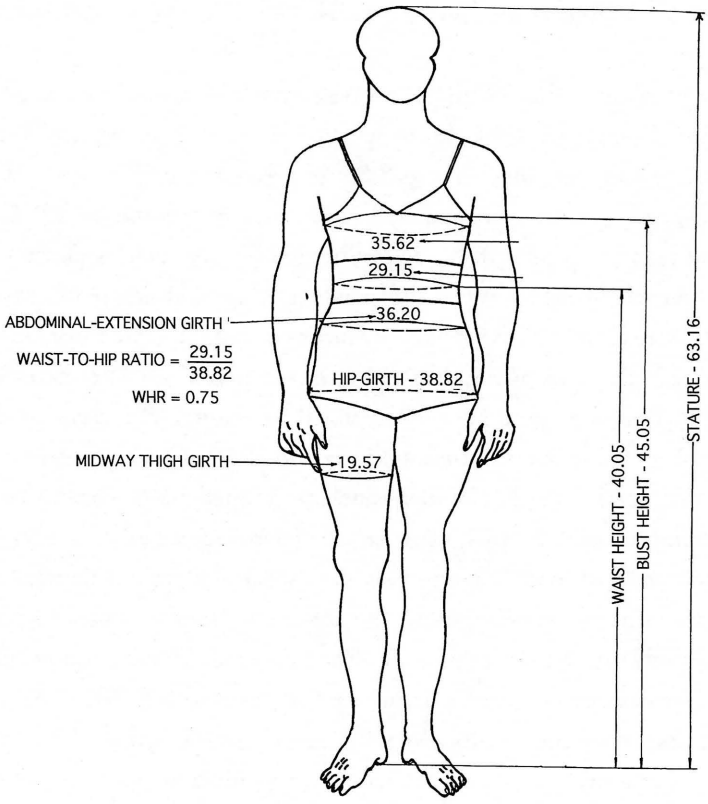

Figure 2. Standard measurement sites for measuring circumference of waist and hips.

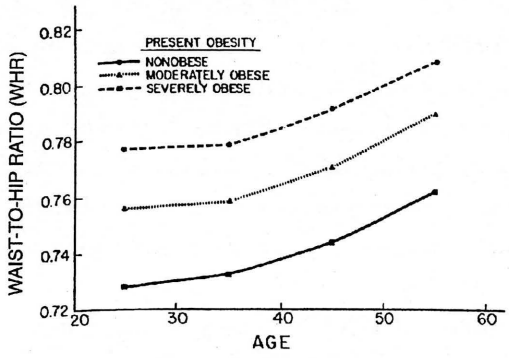

Figure 3. Effect of age and degree of obesity on the mean size of WHR in women. Obesity is positively correlated with WHR, but the functional relationship between the size of WHR and age is similar in nonobese, moderately obese, and severely obese women.

WHR is an Indicator of Women's Reproductive Capability

There is ample evidence that WHR is positively related to testosterone and negatively related to estrogen (Evans et al. 1987; for review, see Singh 1993a). Hence, WHR can be reliably used to assess the reproductive capability of premenopausal women. Women who suffer from polycystic ovarian syndrome and are invariably infertile have WHRs in the male range (Rebuffe-Scrive et al. 1989). Reproductive history such as parity or lactation can increase the size of a woman's WHR independent of age and degree of obesity (Bjorkelund et al. 1996). Tonkelaar et al. (1990) report means of .74 for Dutch women who have never given birth, .76 after two births, and .79 after seven births. The increase in the size of WHR as a function of parity cannot be explained by abdominal muscle stretching caused by pregnancy. Magnetic resonance studies during and after pregnancy have shown greater adipose tissue levels tend to localize in abdominal area (Sohlstrom & Forsum 1995).

More importantly, WHR is negatively correlated with ease of getting pregnant. Data from a Dutch artificial insemination clinic shows that for every 0.1 increase in WHR, the probability for conception decreases by 30 percent independent of age, degree of obesity, cause of infertility and regularity of cycle (Zaadstra et al. 1993). Successful conception in in-vitro fertilized embryo transfer is negatively correlated with WHR (Waas et al. 1997). In summary, unlike any other morphological feature investigated to date, WHR accurately reflects hormonal activity pattern associated with reproductive age and fertility and therefore could act as a reliable signal of a woman's reproductive potential.

WHR is an Indicator of Women's Risk for Major Diseases

A large body of clinical and epidemiological evidence suggests that the risk-factor profile for major obesity-related diseases such as diabetes, heart attack, and stroke varies with the distribution of fat as measured by WHR, independent of total amount of fat (for review, see Guo et al. 1994; Kissebah & Krakower 1994). To summarize, a higher WHR in women, independent of total body fat, is positively correlated with menstrual irregularity, hirsutism, elevated plasma lipids, risk for adult-onset diabetes, hypertension, cancer (endometrial, ovarian, and breast), and gallbladder disease. Women with higher WHRs also have greater prevalence of psychiatric disorders as inferred from the greater use of antidepressant drugs and tranquilizers, and a greater risk for accidents and bone fractures (Lapidus et al. 1989; see also Nelson et al. 1999).

WHR is also associated with premature mortality. Folsom et al. (1993) report a positive monotonic function between the size of WHR and total mortality in postmenopausal women. These investigators report that for every 0.2 unit increase in WHR, death risk increases 1.45 total independent of age, body weight, and history of prior diseases.

The risk for diseases as inferred from a woman's WHR would provide important

information about the woman's success as a childcare provider. An unhealthy woman would not be able to give quality care to her offspring. Furthermore, as many of these diseases have a significant genetic component, women prone to diseases could not give the genetic gift of good health and longevity to their offspring.

WHR and Female Attractiveness

To recapitulate, WHR is the only known species-specific morphological feature which reliably signals human female reproductive age, fertility, present health, and susceptibility to future illness. However, to establish that WHR was designed by selection to solve the problem of identifying a female's mate quality, it needs to be demonstrated that males possess perceptual mechanisms to detect and use information conveyed by WHR in determining a woman's attractiveness as a potential mate. If so, it should be possible to systematically change men's evaluation of women's attractiveness by manipulating the size of WHR alone.

To investigate this issue, I developed twelve line drawings of female figures differing solely in the size of their WHRs. As degree of obesity, as measured by body mass index (BMI), is positively correlated with WHR, line drawings also depicted three levels of body weight: underweight (5'5 tall, 90 lbs.), normal weight (5'5 tall, 120 lbs.), and overweight (5'5 tall, 150 lbs.). The size of WHR was manipulated by changing waist size only, as many studies have demonstrated that size of waist is positively correlated with altered hormonal profile and risk for disease more so than any other body feature (Bjorkelund et al. 1996; Han, Lean & Seidell 1996; Lean, Han & Morrison 1995). Figure 4 shows the female line-drawing figure developed to investigate the role of WHR and body weight in judgment of attractiveness and health.

To summarize the main finding: First, WHR and body weight interact in a complex way to affect the judgment of attractiveness; figures with low WHR were judged to be more attractive than figures with high WHR, but only within a body weight category. For example, overweight figures in spite of low WHR were not rated as attractive as normal weight figures with higher WHRs; but within the weight category, figures with low WHR were judged to be more attractive than figures with high WHR. Second, the normal weight figure with low WHR was judged as more attractive than underweight and overweight figures with identical WHR. Third, attractiveness judgment had a high degree of consensus across age (18-85 years old), education, and professional (white collar workers, lawyers, physicians) backgrounds. Finally, there was no sex difference in judgment of attractiveness; both men and women judged normal weight figures with low WHR as most attractive. These original findings now have been replicated by other investigations in various countries (Table 1).

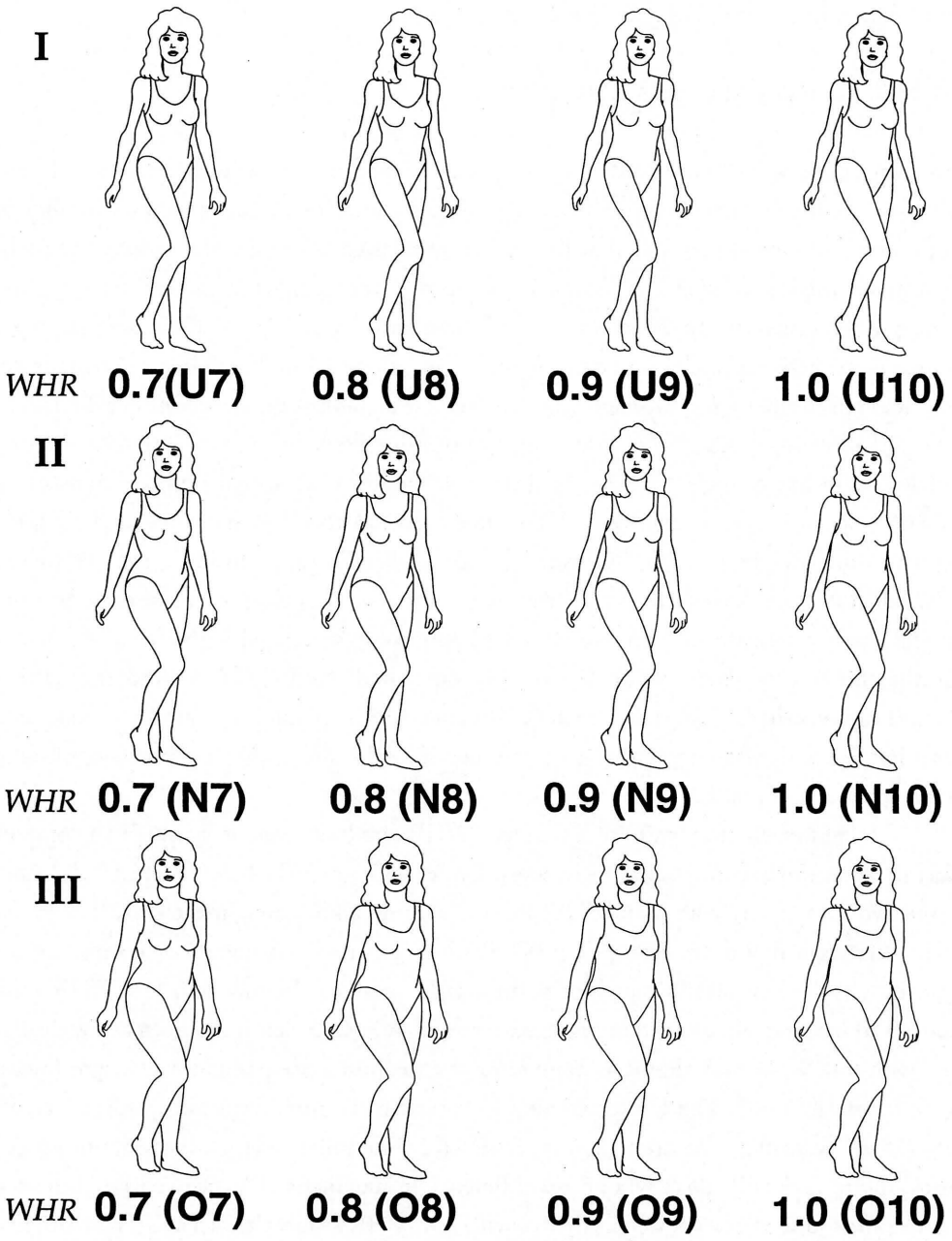

Figure 4. Female line drawings developed by Singh (1993a) to isolate the role of WHR and body weight. The number under each figure represents the size of WHR, and the letter represents the body size (U = underweight; N = normal weight; O = overweight). Thus the figure N7 is normal weight with 0.7 WHR.

Table 1

Previous studies investigating relationship between WHR and judgments of female attractiveness

Country	Population Tested	Stimulus	Low WHR=Attractiveness	Reference
U.S.	18-85 Years Old Caucasian Males and Female (n=522)	12 Line Drawings	Yes	Singh 1993a,b
U.S.	19-23 Years Old African-American Males and Females	12 Line Drawings	Yes	Singh 1994a
U.K.	18-47 Years Old Males and Females (n==90)	12 Line Drawings	Yes	Furnham, Tan & McManus 1997
Australia	Children, Adolescents, Adults Males and Females (n=564)	12 Line Drawings	Yes	Connolly, Slaughter & Mealey 2000
Germany	16-50 Years Old Males and Females (n==360)	Photographs	Yes	Henss 1995, 2000
Indonesia	18-24 Years Old Males and Females	12 Line Drawings	Yes	Singh & Luis 1995
Peru (Gombato Group)	13-60 Years Old Males (n=18)	6 Line Drawings	No	Yu & Shepard 1998
Peru (Shipetiari & Alto Madre Group)	14-60 Years Old Males	6 Line Drawings	Yes	Yu & Shepard 1998
Tanzania (Hadza)	18-68 Years Old Males (n=73)	6 Line Drawings	No	Wetsman & Marlowe 1999
India (Sugali & Yanadi)	24-55 Years Old Males (n=68)	Photographs	Yes	Singh et al. 2000
Guinea-Brissan (African)	20-55 Years Old Males and Females (n=109)	12 Line Drawings	Yes	Singh 1997
Azore Island	19-60 Years Old Males and Females (n=78)	12 Line Drawings	Yes	Singh 1997

As evident from Table 1, only two studies out of twelve have failed to replicate the original findings. Furthermore, in both dissenting studies, investigators tested tribal populations, and used only six figures rather than the twelve figures originally developed to investigate the role of WHR and body weight in attractiveness. Therefore, it is not possible to assess whether failure to replicate is due to cultural differences or failure to use the full set of stimulus figures.

Of course, the use of line drawings to depict variations in WHR lacks ecological validity. While line drawings allow one to depict and systematically vary WHR and hold other bodily features constant, such representation does not allow one to investigate whether a) such manipulation causes people to pay more attention than usual to it and b) WHR would affect the judgment of female attractiveness when other bodily features such as breast and facial attractiveness are also observed. Some recent studies have used photographs and have replicated the original findings (Henss 2000; Singh 1994b).

Attractiveness: Is it WHR or Overall Body Weight?

As already pointed out, judgments of attractiveness are affected by both WHR and degree of obesity as measured by body mass index (BMI; body weight/height^2); low WHR in an obese woman or exceptionally skinny woman does not make such a woman attractive. The main reason is that WHR and BMI are positively correlated and therefore the range of WHR within extremes of BMI is greatly reduced. For example, due to the positive relationship between WHR and BMI, the probability of observing a women with 0.65 WHR and a BMI of 35 (markedly obese) or higher is vanishingly small. This can explain why women with normal body weight who have higher probability of exhibiting a greater range of WHR —not extremely obese or skinny—are judged to be more attractive if they have lower WHR than women of same body weight but higher WHR (Singh 1993b).

In a recent study, Tovee et al. (1998) have used photographs of women with known BMI (degree of obesity) and the size of WHR. However, these investigators used photographs of women ranging from emaciated (5th percentile) to superobese (95th percentile) and unsurprisingly have found that BMI is more important in determining attractiveness than WHR. Use of such an abnormal range of obesity rules out the possibility of choosing from a range of WHR. As stated before, all previous studies have demonstrated extremely underweight and overweight figures are not judged attractive even if they have low WHR. In the ancestral populations, exceptional obesity would be arguably uncommon. Obesity is so rare in extant non-Western preliterate societies that some of them do not have any term for obesity and people are classified only as thin or not thin. For example, the Tupinamba of Brazil do not have a term for obesity, but they do have one for thinness (Evereux 1864, cited in Brown & Konner 1987). Both extreme thinness (invariably indicative of sickness) and obesity would be rare in the potential mate sample. Thus, if the majority of women were

neither extremely thin or obese, attending to WHR would have allowed our male ancestors to reliably infer the mate value of their potential mates.

Recently, I have used photographs (standardized for light exposure, distance to camera and posture) of young women (22 years old) showing only the back, head to calf, so as to eliminate any contribution of breast size or facial attractiveness. Women represented a wide range of BMI from 15 (10th percentile) to 24 (75th percentile) and their waist and hip circumferences were measured to compute WHR. When photographs of women with BMI in normal range (19-22) are selected, BMI accounts for less than 2 percent of variance in attractiveness ratings and WHR explains 16 percent (Figure 5). However, when photographs of women ranging from 15-24 are used, BMI indeed accounts for more variance (18 percent) than WHR (2 percent).

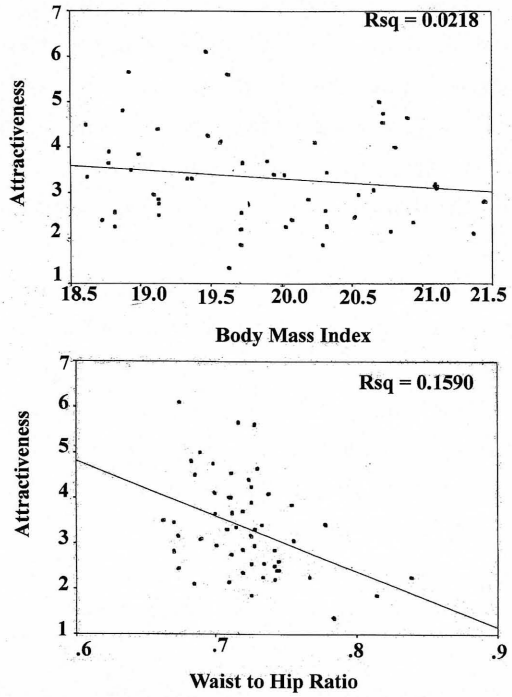

Figure 5. When photographs of women in the normal range of BMI (19-22) are used, BMI explains only 2% whereas WHR explains 16% of variance in judgment of attractiveness. When BMI range includes photographs of emaciated women (BMI > 14) and overweight women (BMI < 125), BMI accounts for 18% and WHR 2% of variance in attractiveness judgments.

My associates in India have used these photographs with two isolated tribes (Sugali and Yanadi) and have found results strikingly similar to the U.S. population. Thus when female photographs with normal weight are used, the role of WHR and attractiveness is observed as found with line drawings. Taken together, these findings reaffirm the findings that the relationship between WHR and attractiveness is neither strictly monotonic, nor independent of extreme body size. The optimum is significantly, but not very much, below

the female population mean. Thus, WHR is in line with a lot of other bodily features that are most attractive if there is a slight deviation from the population mean that goes into the sex-typical or the species-typical direction.

WHR and Attractiveness: Is it Due to Exposure to Western Media?

There is a widespread belief among laymen and many social scientists that people's behavior and aesthetic choices are shaped by unique cultural influences. Thus, observed differences among cultural groups are used to justify this belief, but whenever lack of differences are observed, it is argued that it is due to exposure to a dominant culture. Very rarely, if ever, it is specified whether all behavior and choices are equally pliable. For example, people from India, being exposed to Western influence for more than 250 years, have adopted various material habits such as shoes and Western clothing which can be readily explained by exposure to dominant (Western) culture. However, even today, a very large majority of marriages in India are arranged, women wear saris, and men and women do not engage in romantic courtship prior to getting married. Why are these behaviors not affected by Western culture? Why do African American people not have aesthetic choices like Caucasian Americans?

In absence of any precise formulations of variables regulating culture or (now) media effect, any similarity across cultures is explained by media effect, and lack of similarity is taken as evidence for uniqueness of culture. Using this type of logic, Yu and Shepard (1998) have pointed out that culturally isolated indigenous Peruvian men find women with high WHR (using six line drawings) most attractive. However, men from the same population exposed to Western media for 20-30 years judge women with low WHR attractive as do the men in Western cultures. By arguing that even exposure of brief duration (20-30 years) can change the beauty ideals of a culture makes it practically impossible to examine their theory, as one cannot locate a cultural group in the world which can be claimed to be free of exposure to the Western media.

As a way out, consider the ancient sculptures of Rome and India. The archetypical female body form epitomized by Aphrodite, the goddess of beauty, in spite of differences in representational style is remarkably similar to ancient Indian erotic female sculpture. Artists use naturally occurring responses to biologically significant stimuli in order to influence belief and behavior. Tarui et al. (1991) found that ancient female statuettes of Venuses of Central Europe and Turkey share a markedly emphasized lower body; lower body segment clearly differentiate maleness from femaleness and thus it appears that ancient aesthetic princples were in accord with biological laws. Fertility-linked changes in WHR of a woman would have been observed by artists universally and they should have used this feature to convey a woman's beauty and fertility. The continued representation of sexual dimorphism among sculptures from Greece, India, and Egypt suggest almost an obsessive and universal

interest in specific body parts for depicting alluring body form. Haywood (personal communication) points out that body form epitomized by Aphrodite, goddess of beauty and fertility, was by her "ideal" body, whereas Hera, the goddess of the home and wifely virtues, by her sexually less alluring body. A cursory examination of these sculptures reveals that the narrow waist in Aphrodite is highlighted, whereas clothing hides the waist and lower body part in Hera.

It can be argued that since artists universally isolate core features of what constitutes maleness and femaleness, the sexual dimorphism in the size of WHR should be evident in depictions of male and female body shape by artists in spite of local canons of aesthetic representation. Such findings would rule out the possibility that preference for low WHR is due to cultural contamination. To explore this possibility, we measured waists and hips in 286 ancient sculptures from India, Egypt, Greece (Greco-Roman), and some African tribes. The source books of our measurements, suggested by art history professors unfamiliar with the WHR hypothesis, contain a broad spectrum of sculptures from various time periods. All sculptures, whether of mythological or real persons, were measured if they were depicted in a frontal (standing or kneeling) pose, unobscured by shadows or objects, and with minimal clothing. The waist was measured at the narrowest part of the torso, and the hips at the widest at the upper portion of the pubic area.

As is evident from Figure 6, in all four cultures the mean female WHR is significantly lower than the mean male WHR, despite cultural variability. The mean male WHR in

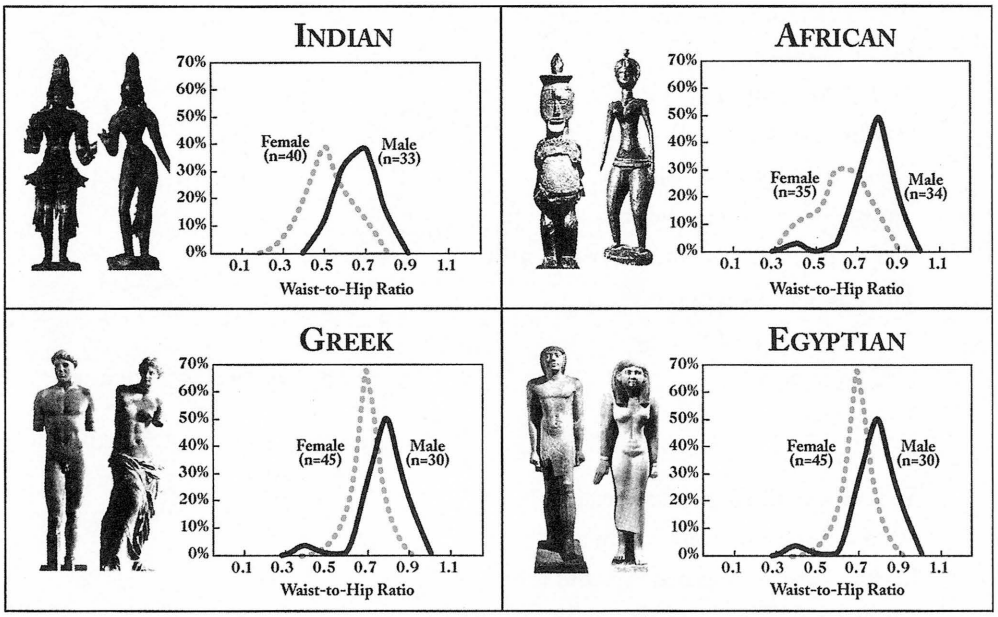

Figure 6. Depiction of sexual dimorphism in representation of WHR in four cultures. In spite of variation between cultures, a greater proportion of female sculptures have lower WHR than males in each culture.

Indian and African sculptures is significantly lower than the mean male WHR in Greek and Egyptian sculptures. Such population-specific variations are also observed in present-day societies. Therefore, it follows that evolved preference for female WHR would not be for an absolute size but for lower than male WHR; some societies may prefer low female WHR and others higher WHR, but rarely should the preference for "higher female and lower male WHR" be evident in historical or current societies (Figure 6).

Poetic Descriptions of the Body of Attractive Women

One can argue that ancient sculptures are emphasizing sexual dimorphism, such as in body size and height, and not dealing with what makes men and women attractive. Of course, the sculptures like that of Venus de Milo and fifth-sixth century Indian erotic sculptures are meant to convey beauty and sensuality, but this may not be true of other sculptures which we have measured.

A more direct test of WHR as an attractiveness marker would be to examine romantic poetry written prior to exposure to Western culture and media. There are some instances in which the descriptions of a beautiful female body in British (15th century), Chinese (6th century), and Indian (3rd century) poetry are remarkably similar. Consider the following:

1. British

Thou hath the fayrest shappe
I have ever seyne
With a hey and a ho and a hey noneyno
White as snowe
And frishe as spring
Hey ho noneyno
But onne thing abuve alle else
I muste proclamme in verse
With a hey and a ho and a hey noneyno
Thy middle it is as emptye
As a paupere's purse
Hey ho noneyno — Theydor Bois (15th century)

2. Chinese:

So lovely, both are painted beauties,
Who can separate reality from art?
Each has sharply defined eyes and brows,
Their slender waist line are one and the same.
The only difference between them:
One forever has that lively spirit — Yu Hsin (6th century)

3. Indian

> By her magic powers she assumed the form of a beautiful woman... her hips and breasts were full, her waist slender — Bhagavata Purana (2nd-3rd century)

Clearly the size of the waist is considered by early writers of these three countries to be an integral part of body of a beautiful woman. As I have summarized in the introductory section of this presentation, waist size is the most reliable body part indicative of reproductive age, hormonal condition (postmenopausal women on hormonal replacement therapy have narrower waists than those who do not take hormone replacement—Haarbo et al. 1991), parity (Molarius et al. 1999), and risk for major diseases (Han, Lean & Scidell 1996). This link between fertility and health would have influenced the selection of waist as an attractive and sensuous feature.

To investigate this issue, I have asked writers and professors of Indian and Chinese literature to send me narrative (poetry or prose) descriptions of beautiful women in ancient romantic literature (prior to the 12th century). So far I have received fifteen Indian and twelve Chinese descriptions of attractive women. In both Indian and Chinese ancient literature, facial features are universally present, but whenever the description of the body is involved, it invariably includes references to the waist as making women beautiful. Body part descriptions in the ancient Indian literature samples have more references to waist (60 percent) than breast (29 percent) and thighs/legs (13 percent). Every ancient Chinese literature sample invokes waist (100 percent) as the marker of beauty but not breasts or thighs/legs. [It should be pointed out that unlike Indian literature, Chinese literature has descriptions of eyebrows as beautiful; there are many poems in which a beautiful face is solely defined by expressiveness of the eyebrow. This is an intriguing fact which needs to be systematically explored to understand its functional significance.]. The beauty and sensuality assigned to narrow waist by authors of diverse cultures prior to being exposed to Western media make the inference of media effect highly untenable.

General Discussion

To summarize, people differing in age, cultural and educational background, socioeconomic status, and ethnicity show an overwhelming preference for female figures depicting normal weight and low WHR. The cross-cultural and cross-generational (based on ancient sculptures and romantic poetry) consensus regarding WHR's relationship to female attractiveness suggest that WHR may play a critical role in the assessment of female mate values.

Various bodily features, some proximate, such as facial features, skin complexion, breasts, and other distal (body size, WHR) would determine a man's decision to pursue a potential mate. Body weight and WHR which determine body shape are distal cues which

are orientation-free; the shape of the body remains constant whether viewed from the front, from behind, or from the side. Such a distal cue may play an important role in the initial selection of a mate rather than randomly making such a selection. It could be this factor that magnifies the sexual attractiveness of an hour-glass figure with wider breasts and hips set against a narrower waist. In the same vein, pregnancy dramatically alters the waist: a high WHR may mimic pregnancy, rendering women less sexually attractive. Likewise, schistosomiasis, a complex parasitic infection that is widespread in various non-industrialized societies and is most prevalent in young (12-19 years old) people, induces distended abdomen. Schistosomiasis may remain asymptomatic for 8-10 years, with one notable exception: those with high parasite load develop a distended abdomen. Thus enlarged waist size would be indicative of severe parasitic infection or early stages of pregnancy, making a woman appear to be a less sexually alluring mate.

As women also judge a female figure with low WHR as attractive, this knowledge would allow a woman to exaggerate her low WHR with the help of ornamentation, clothing, and currently with cosmetic surgery in order to make herself more sexually appealing to men. The popularity of the corset, in spite of the internal injury it caused women, and clothing fashions that stress tiny waists, are testimonials of the importance of the waist in women's desire to appear attractive. Morris (1985) reported that the earliest cosmetic surgery in England consisted of removing two lower ribs to enhance the narrowness of the waist. Presently, abdominoplasty (tummy tuck) is the cosmetic surgical procedure most commonly performed in the U.S. after eyelid lift and face lift (Melamed 1983). The desire to make the waist narrower is also evident from the manner of deceptive behavior of young women; when asked how they embellish their appearance around men, young women reported "sucking in" their stomachs as the most frequently used tactic after facial makeup and clothing (Tooke & Camire 1991).

On the other hand, clothes can be used to hide an otherwise attractive body. In societies where women are considered the property of men (and thus not allowed to select their own males), women are required to wear only loose-fitting clothes in public so their body shape is hidden (eg the chaddor in Iran, the burka worn by Orthodox Muslim women in Pakistan and India). Such body-shape-hiding clothing minimizes women's attractiveness to random males. Whereas in societies in which women choose their own mates, they would be expected to vary their efforts to conceal or highlight their sexual attractiveness depending on their desire to have men react to them as potential sexual partners. Nun's habits, for example, disguise WHR and send a message to males that the women inside the costume are not potential sexual mates.

Ecological conditions undeniably shape the selection of romantic mates and the pattern of reproductive behavior. Human societies that face frequent food shortage, or must depend primarily on hard labor to acquire and store food, may find strong legs and arms or overall plumpness of the body more attractive than narrow waist. Women with high WHR

give birth to more sons than women with low WHR (Singh & Zambarano 1997). Women with high WHR have higher levels of testosterone and their sons have higher testosterone levels (Manning et al. 1999). Obviously, in certain ecological conditions, having sons and traits associated with higher testosterone (eg assertiveness, greater upper body muscular strength) would enable women to be more successful in competing for resources and acquire social status. Such conditions would induce variations in the size of female WHR and in such societies, men may have preferences for women with higher WHR than those with lower WHR.

Human females have other exaggerated sexual characteristics in addition to WHR. Hence, it is necessary to investigate whether all sexual characteristics equally reflect potential mate value. It could be that multiple sexual characteristics—facial and bodily—provide more accurate information about the overall genetic quality of a mate by pooling the incomplete information provided by each sexual characteristic. If different sexual characteristics reflect the influences of different conditions, potential mates would benefit from attending to multiple sexual characteristics in order to obtain as complete a picture as possible. Thus, facial secondary sex characteristics that are sex-hormone dependent (e.g., of cheekbone, jaw, chin) and have been shown to influence perceived attractiveness (Johnston & Franklin 1993; Perrett et al. 1996) could convey information about hormonal conditions prior to and during puberty. Facial and body asymmetry can be indicative of past parasitic infestation or developmental stresses on the immune system (Gangestad et al. 1994) but may not be sensitive to current hormonal levels, health status, and reproductive history. Current conditions may be signaled by the proximal cue of the skin complexion (Symons 1979) or by distal morphological feature, like WHR. If so, multiple sexual characteristics would provide a more accurate representation of a female's overall mate quality than would a single sexual characteristic.

The value of research in WHR and attractiveness primarily lies in identifying any visible morphological feature which reliably signals women's reproductive age, fertility, and health status, but that is not intuitively seen to be a component of female attractiveness. The large amount of research on facial characteristics and on facial and body asymmetry needs to be integrated with body shape and WHR to more precisely define female attractiveness and its functional significance. A better understanding of interrelationships between, and unique contribution of various sexual characteristics (facial, WHR, breasts, etc) to the judgment of female mate quality could emerge from an examination of various sexual characteristics simultaneously.

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