

## Men's preferences for women's profile waist-to-hip ratio in two societies

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### Abstract

Women's waist-to-hip ratio (WHR) varies with age, and a lower WHR is associated with a higher estrogen-to-androgen ratio and possibly higher fecundity, at least in some populations. Consequently, it has been argued that selection has favored a universal male preference for a low female WHR. In previous studies using frontal pictures, men in the United States preferred a low WHR of 0.7, but men among Hadza hunter-gatherers and a few other small-scale societies preferred higher ratios. Unlike the actual WHR of women, measured with a tape around the waist and the hips and buttocks, the WHR in frontal pictures excludes the buttocks. Because frontal WHR gives only a partial picture, we used profile views of women to measure men's preferences for the profile WHR. Hadza men preferred a lower profile WHR (more protruding buttocks) than American men. Since Hadza men preferred higher frontal WHR but lower profile WHR, and since both contribute to the actual WHR, these results imply there is less disparity between American and Hadza preferences for the actual WHR of real women. We suggest men's preferences vary with the geographic variation in the shape of women who have wider hips in some populations and more protruding buttocks in others.

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## 1. Introduction

A woman's waist-to-hip ratio (WHR) may be one cue to her mate value, at least in some populations. For example, a lower WHR is associated with a lower risk of cardiovascular disease in the United States (Guo, Salisbury, Roche, Chumela, & Siervogel, 1994; Kissebah & Krakower, 1994). In a sample of Dutch women, a lower WHR was associated with higher fecundity and was a better predictor than other variables such as body mass index (Zaadstra et al., 1993). If a lower WHR is everywhere associated with greater reproductive potential, we should expect men everywhere to prefer lower ratios (Singh, 1993, 1995). Several studies in the United States and United Kingdom and a few other countries have found that men prefer a low ratio, usually 0.7 (Furnham, Tan, & McManus, 1997; Henss, 1995; Singh, 1994; Singh & Luis, 1995). If American men prefer a low WHR because that was a reliable cue to a woman's mate value over a long period in our evolution, then we ought to find a similar preference among hunter-gatherers living under conditions more similar to those of our preagricultural ancestors. Here, we test that expectation among Hadza hunter-gatherers of Tanzania.

In two previous studies of the Hadza, men did not prefer a low frontal WHR (Marlowe & Wetsman, 2001; Wetsman & Marlowe, 1999), neither did men in a horticultural society in Peru (Yu & Shepard, 1998) or a forager-horticultural society in Ecuador (Sugiyama, 2004); although in the latter, lower ratios were preferred after confounding effects of weight were eliminated. In the first Hadza study, men were indifferent in their preferences for a female frontal WHR of 0.7 and 0.9, but among the three weight categories (thin, normal, and heavy), they preferred heavy (Wetsman & Marlowe, 1999). In a second study, without the weight categories and with frontal WHR ranging from 0.4 to 1.0, Hadza men preferred the highest ratios of 0.9 and 1.0 (Marlowe & Wetsman, 2001). This may be because women with a larger waist appear heavier.

Most studies have assessed men's preferences for WHR using pictures of women viewed from the front. Frontal pictures show the hips but not the buttocks. In contrast, studies reporting associations between WHR and health or fecundity measure the actual WHR of women with a tape measure. The actual WHR includes the buttocks as well as the hips because measuring the circumference of a woman's hips requires pulling the tape measure across her buttocks as well. To avoid confusion, we use the following terms: *actual WHR*, for measurements with a tape measure around the waist and hips/buttocks of actual women; *frontal WHR*, for the measurement of the waist and hips in a two-dimensional frontal picture; and *profile WHR*, for the measurement of the waist and buttocks in a two-dimensional profile picture (see Fig. 1A and B). The frontal WHR does not reflect the buttocks, and the profile WHR does not reflect the hips, whereas the actual WHR reflects both hips and buttocks.

If the relative contribution of the hips and buttocks to the actual WHR did not vary among women across continents, then frontal views would suffice; but if some women have wider hips and others more protruding buttocks, a frontal view will not give us a reliable estimate of a woman's actual WHR, neither will frontal pictures tell us the full story of men's preferences for the actual WHR of women. To get a fuller picture, we need to know men's preferences for women's profile WHR. In the only study of women's WHR in profile, body mass index was a better predictor of attractiveness than WHR in both frontal and profile views of different

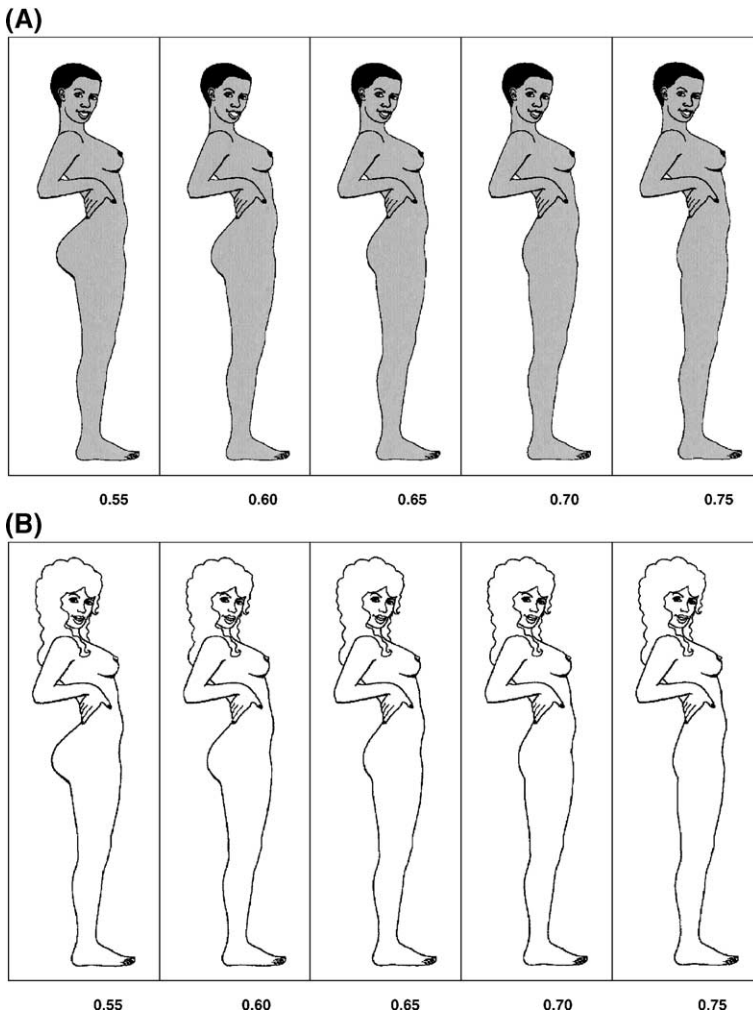


Fig. 1. Profile WHR (range=0.55–0.75) stimuli: (A) black, (B) white.

women wearing leotards among British undergraduates (Tovée & Cornelissen, 2001). Here, we test for profile WHR preferences in American and Hadza men using line drawings of one woman in profile view with the ratio of the waist to buttocks varying (Fig. 1A and B). We also investigate whether men's preferences track the population mean actual WHR of women.

## 2. Methods

### 2.1. Participants

The Hadza are hunter–gatherers who number about 1000 and live in northern Tanzania. Across all ages, females acquire 58% of food calories that come into camp, but married men

with infants bring in more food than do their wives (Marlowe, 2003). Women forage an average of 4.2 h/day and almost daily dig for underground tubers with digging sticks, which is very difficult work. They also fetch water and firewood, and Hadza men place great importance on a wife being hardworking (Marlowe, 2005). The Hadza are often hungry, but nobody remembers any Hadza ever starving to death. Given that one has to use much energy to acquire food and that food is only occasionally super-abundant when, for example, a man kills a giraffe, no one is overweight, but few Hadza are very underweight either. Women have a healthy percent of body fat, but do not exhibit steatopygia, the deposition of great amounts of fat on the thighs and buttocks common among the Khoikhoi of Southern Africa.

Age at menarche is about 16–17 years. The Hadza practice no contraception, and women's median age at first reproduction is 19 years. The total fertility rate (TFR; the mean number of children born to women during their lifetimes, after their reproductive years are over) is 6.2 for Hadza women (Blurton Jones, O'Connell, Hawkes, Kamuzora, & Smith, 1992). Age at first marriage is 17 years for women and 20 years for men. Marriage is not arranged, so mate choice is freely expressed.

All adult men from several different Hadza camps participated in this study ( $n=110$ ). All are fluent in Swahili as a second language, and Marlowe conducted the experiment in Swahili. Reed and Apicella recruited the sample of American men from Harvard undergraduates and from the general population in and around Boston ( $n=108$ ). The Hadza men were 15–75 years old (mean=35, S.D.=14.23,  $n=110$ ). American men were 18–72 years of age (mean=29, S.D.=13.52,  $n=108$ ).

## 2.2. Procedure

All men participated in the experiment individually and in private. Each was presented with five cards showing a woman with profile WHR varying between 0.55 and 0.75 (Fig. 1A and B). These ratios bracket what one would find in actual women in profile view among the Hadza or in the United States, as a cursory glance at Fig. 1 should confirm. We used two pictures of the same woman, one white and the other black. Each man was randomly assigned to either the white or black pictures, 55 men to each among the Hadza and 54 to each among the American men.

The five drawings were placed in a horizontal row in random order in front of the subject, who was then asked to choose the female they found most attractive. After they chose, the card was removed, and the subject asked to choose the most attractive among the four that remained. This process was repeated until all five cards were ranked. The cards were then shuffled, and the same process repeated for the criterion, "who is most healthy," and a third time for the criterion, "whom would you prefer to marry."

In an earlier draft, reviewers noted that several men, especially among the Hadza, jumped more than one ratio going from their first to second to third choice. If men choose based on nonrandom preferences, as reviewers suggested, we should expect their second choice to be one ratio above or below their first choice. If they prefer 0.60, their second choice should be 0.65 or 0.55, rather than 0.70 or 0.75. When we subtracted the second choice from the first choice, we found that 93% to 96% of American men conformed to this expectation on all

three criteria, but only 66% to 73% of Hadza men did. We, therefore, decided to exclude all those men who jumped more than one ratio up or down on any of the three criteria. This left 94 American men and 47 Hadza men. Mean age was 29 years for American men and 33 years for Hadza men. There were no statistical differences in preferences between the black and white stimuli, so they were pooled for all analyses. Because we were mainly interested in a comparison of the most preferred profile WHR of the Hadza and American men, we analyzed their first choices on all three criteria.

### 2.3. Measurement of actual WHR among the Hadza

To test whether men's preferences for actual WHR simply track the population mean WHR, we measured actual WHR of Hadza women to compare with American women. Hadza females were measured using a tape measure around the waist and around the hips/buttocks with thin clothing on but the tape pulled tight enough to compensate for the added girth of clothing. The U.S. MD Medical Database Guideline was followed, and waist was measured as the distance around the smallest area below the rib cage and above the umbilicus (belly button). Hip circumference was the distance around the largest extension of the buttocks. Female subjects included all those in a few camps where other anthropometric traits were being measured ( $n=75$ ). Among women aged 17 years and older, the mean age was 37.5 years (17–82, S.D.=16.1,  $n=53$ ).

### 2.4. Calculation of theoretical preference for actual WHR

Using the frontal and profile preferences, we calculated an estimate of the theoretical preference for actual WHR in real women with a formula that weights the profile WHR 7/10 as much as the frontal WHR. This weighting is based on measurements of the distance across the waist of actual women in front and side view, as well as across the hips in front view and buttocks in side view. The mean distance across the waist and buttocks in profile view is about 7/10 the mean distance across the waist and hips in frontal view. Therefore, the theoretically preferred actual WHR equals  $[(\text{preferred frontal} \times 1) + (\text{preferred profile} \times 0.7)]/1.7$ .

Table 1

Mean profile WHR chosen first by American and Hadza men in the subsample whose second choice was one unit up or down from their first choice

	Attractive	Healthy	Wife
Americans			
Mean±S.D.	65.4±3.9	65.6±4.3	65.2±3.4
<i>n</i>	94	94	94
Hadza			
Mean±S.D.	63.3±5.9	61.2±6.1	62.9±5.9
<i>n</i>	47	47	47
Mann–Whitney <i>U</i> test, <i>p</i> value	1686, .016	1159, <.0005	1566, .002

2.5. Analysis

We used nonparametric Mann–Whitney *U* tests to test for differences between Hadza and American first-choice preferences. Relationships between the three preference criteria within each sample were analyzed with Spearman correlations.

3. Results

The profile WHR chosen first by Hadza men was significantly lower than that chosen by American men on all three criteria (Table 1). As illustrated in Fig. 2, the most common

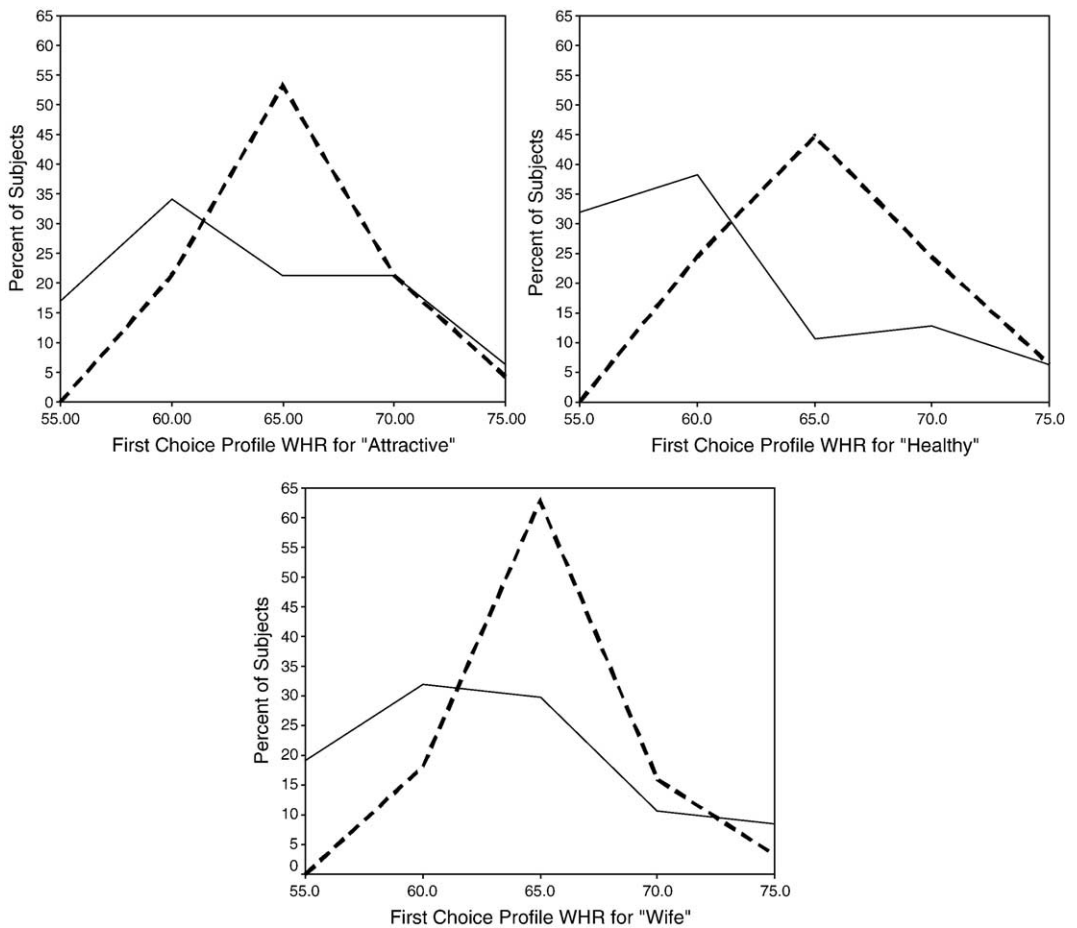


Fig. 2. The percentage of subjects who chose a given profile WHR as their first choice when their second choice was one unit up or down. Solid line indicates Hadza men ( $n=47$ ), and dotted line indicates American men ( $n=94$ ).

first-choice profile WHR on all three questions was 0.60 for Hadza men, while 0.65 was the first choice of American men on all three questions. Between 17% and 32% of the Hadza selected 0.55 first on one of the three criteria, whereas not a single man in the United States selected 0.55 on any question (Fig. 2). In addition, on all three criteria, 0.55 was chosen first more often than 0.75 among the Hadza, while the reverse was true among American men (Fig. 2). To summarize, Hadza men prefer a lower profile WHR (more protruding buttocks) than American men.

For both American and Hadza men, first choices on all three questions were correlated. For the American men, the strongest correlation was between “healthy” and “wife” ( $r_s=.651$ ,  $p<.0005$ ,  $n=94$ ), followed by “attractive” and “wife” ( $r_s=.556$ ,  $p<.0005$ ,  $n=94$ ), and then “attractive” and “healthy” ( $r_s=.494$ ,  $p<.0005$ ,  $n=94$ ). For the Hadza, the correlations between “attractive” and “wife” ( $r_s=.626$ ,  $p<.0005$ ,  $n=47$ ), and between “healthy” and “wife” ( $r_s=.625$ ,  $p<.0005$ ,  $n=47$ ) were virtually the same, with that between “attractive” and “healthy” weaker ( $r_s=.414$ ,  $p<.004$ ,  $n=47$ ). All correlations are significant after Bonferroni correction but none are significantly different from each other using a  $z$  score test.

Among American men, the preferred frontal WHR equals 0.7 (Marlowe & Wetsman, 2001), and the preferred profile WHR equals 0.65. Using the formula described in the Methods section, the theoretical preference of American men for actual WHR therefore equals 0.68. For Hadza men, the preferred frontal WHR equals 0.9 (Marlowe & Wetsman, 2001), and the preferred profile WHR equals 0.6; thus, the theoretical preference for actual WHR equals 0.78.

The mean actual WHR for Hadza women 17 to 82 years old was 0.83 (Fig. 3). This is very close to the mean for Jarawa hunter–gatherers on the Andaman Islands but higher

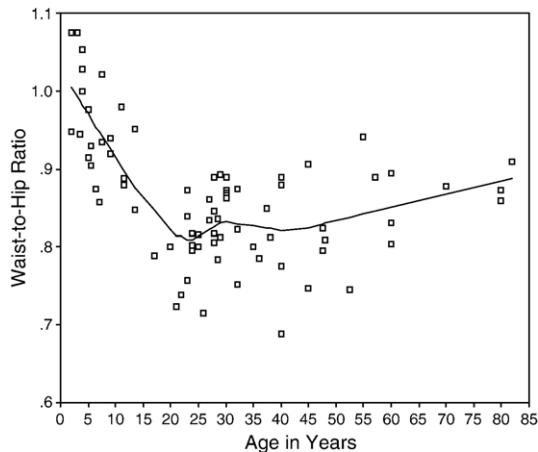


Fig. 3. Actual WHR of Hadza females as measured with a tape measure ( $n=75$ ). Mean WHR=0.83 (range=0.69–0.94, S.D.=0.05) for women 17 years old and up (mean age=37.5, range=17–82, S.D.=16.1,  $n=53$ ). The mean WHR of women aged 17–24 years is 0.79 ( $n=10$ ). Regression line is lowest smoothed.  $y$ -axis does not extend to 0 but includes all data points.



than it is among several other populations, although not as high as among Shiwiar forager–horticulturists in Ecuador (see Table 2). WHR is 0.79 for Hadza women between 17 and 24 years old, which is also a bit higher than among most other populations (Table 2).

Table 2  
Actual WHR of Hadza women compared to women in other populations

Population	Age (in years)	WHR	Reference
Hadza ( $n=53$ )	37.5±16.1 (17–82)	0.83±0.06 (0.69–0.94)	This study
Young Hadza <sup>a</sup> ( $n=10$ )	22±2.23 (17–24)	0.79±0.04 (0.72–0.87)	This study
Jarawa hunter–gatherers of the Andaman Islands ( $n=15$ )	28.2±9.4 (18–50)	0.82±0.07 (0.73–0.95)	Sahani (2003)
Shiwiar horticulturist–foragers of Ecuador ( $n=38$ )	12–70	0.89±0.06 (0.81–1.02), 0.87 after removing 5 pregnant and 1 infertile	Sugiyama (2004)
Americans recruited with ad for study with nude photo taken ( $n=92$ )	23 (18–30)	0.72±0.04	Thornhill and Grammer (1999)
Young American students <sup>a</sup> ( $n=68$ )	19.6±1.1 (18–23)	0.73±0.04 (0.65–0.83)	Chapman (2004)
Poland, longitudinal study ( $n=119$ )	29.9±3.54 (24–37)	0.73±0.049 (0.64–0.86)	Jasienska, Ziolkiewicz, Ellison, Lipson, and Thune (2004)
American students ( $n=55$ )	19.6 (18–44)	0.77±0.049 (0.69–0.87)	Hughes, Gallup, and Gordon (2003)
19 Populations: Europe, China, and Australia	35–64, standardized across nations	0.76 Perth and 0.84 Czech Republic	Molarius, Seidell, Sans, Tuomilehto, and Kuulasmaa (1999)
19 Younger populations: Europe, China, and Australia	25–34	0.72 China and 0.80 Czech Republic	Molarius et al. (1999)
Scottish, representative ( $n=4035$ )	16–74	0.80	Shaw, McMunn, and Field (2000)
Young Scottish representative <sup>a</sup> ( $n=389$ )	16–24	0.76	Shaw et al. (2000)
American nurses recruited for study of reproduction ( $n=69$ )	31.7±6.4 (23–50)	0.74±0.08 (0.59–0.95), 0.78 had more sons and 0.66 had more daughters	Singh and Zambarano (1997)
American, planning to have children but before pregnant ( $n=458$ )	29.5±3.1 (22–35)	0.79±0.53 bore sons and 0.80±0.51 bore daughters	Tovée, Brown, and Jacobs (2001)

Values are given as mean±S.D. (range).

<sup>a</sup> Younger samples or subsamples.



#### 4. Discussion

These results imply that Hadza and American men's preferences for women's actual WHR would not be as different as the two previous studies of frontal WHR would lead us to believe. While Hadza men preferred a higher frontal WHR than American men (0.9 vs. 0.7), they preferred a lower profile WHR (more protruding buttocks) than American men (0.6 vs. 0.65). However, their theoretical preferences for the actual WHR of women still appear to be substantially different (0.68 vs. 0.78).

Hadza women have a higher WHR than women in the United States. Some Hadza women in the sample may have been pregnant, although all who said they were pregnant were excluded from the analysis here. Since WHR rises with parity (Bjorkelund, Lissner, Andersson, Lapidus, & Bergtsson, 1996; Tonkelaar, Seidell, van Noord, Baander-van Halewijn, & Ouwehand, 1990), perhaps Hadza WHR is higher because Hadza women give birth to more children than American women. Hadza TFR is 6.2 births per lifetime compared to 2.1 births per lifetime for the United States (Bachu & O'Connell, 2001) and age at first reproduction is 19 years old compared to 25 years old in the United States (Deardorff, 1997). The WHR of Hadza women 17 to 24 years old was 0.79 compared to 0.73 for American college women 18 to 23 years old (Chapman, 2004) (see Table 2 for other sample results).

Hadza women may have a higher WHR because a larger gut is required to hold the amount of bulky, fibrous tubers in the Hadza diet. Alternatively, forager women may need to be more physically active, which might favor higher androgen levels that could result in more fat being deposited in the abdominal area. Cashdan (n.d.) suggests that selection for assertiveness and higher androgen levels could explain some of the variation in women's WHR, and this might apply to the Hadza and other tropical foragers.

Foraging must entail strong selection for efficient locomotion. A pelvis that is best for locomotion is not optimal for giving birth, and women may have to make different tradeoffs under different ecological conditions in different geographic areas. Among foragers, there is less for women to gather in cold climates. Consequently, the farther from the equator a society is, the less women contribute to the diet, and presumably the less walking they do (Marlowe, 2001). We might therefore predict that closer to the equator, where women contribute more to the diet and presumably walk more, the shape of the female pelvis would be more male-like because women trade off optimality in parturition for more efficient locomotion. Men's preferences may map onto geographic variation in the shape of females, some females having a wider pelvis and hips, and others narrower hips but perhaps more protruding buttocks.

Since WHR reaches a trough soon after menarche (Fig. 3), male preference for a low WHR might be largely an age preference for nubility and maximum reproductive value, as well as nonpregnant and cycling status. If so, perhaps the preferred actual WHR varies across populations with variation in the population mean postmenarcheal WHR. Hadza men appear to prefer an actual WHR (0.78) that is very close to the population mean actual WHR of Hadza females between 17 and 24 years old (0.79), and American men prefer an actual WHR (0.68) close to the mean actual WHR for young American women (range=0.72–0.73) and exactly equal to the mean actual WHR of *Playboy* centerfolds (Katzmarzyk & Davis, 2001;

Singh, 1993), although the centerfold WHR has been rising in recent years (Voracek & Fisher, 2002).

In conclusion, Hadza men preferred a lower profile WHR (more protruding buttocks) than American men. This is in contrast to their preference for a higher frontal WHR. Consequently, there is less disparity in their theoretical preferences for actual WHR. In all women, WHR in profile view is lower than WHR in frontal view, which is why a range of 0.55–0.75 in the stimuli brackets the range of variation in actual women. Mean profile WHR of young Hadza women is probably close to the preferred 0.60, while mean profile WHR of young American women is probably close to the 0.65 preferred by American men. By combining frontal and profile WHR views, we get a ratio closer to the actual WHR. When we did this, we found men's preferences for actual WHR approximate the actual WHR of young women in their respective populations. We suggest that variation in subsistence and the accompanying variation in activity, diet, and TFR may affect actual WHR of women. If there is geographic variation in the shape of women's bodies, there may not be one universally preferred frontal, profile, or even actual WHR.

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