

# Body mass index and waist : hip ratio are not enough to characterise female attractiveness

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**Abstract.** The assessment of characteristic body features of Miss Poland beauty contest finalists compared with the control group, can contribute to recognising the contemporary ideal of beauty promoted by the mass media. The studies of *Playboy* models and fashion models conducted so far have been limited to the following determinants of attractiveness: body mass index, waist : hip ratio, and waist : chest ratio, which only partially describe the body shape. We compared 20 body features of the finalists of Miss Poland 2004 beauty contest with those of the students of Medical Academy in Bydgoszcz. Discriminant analysis showed that the thigh girth–height index, waist : chest ratio, height, and body mass index had the greatest discrimination power distinguishing the two groups. A model of Miss Poland finalists figure assessment is presented which allows one to distinguish super-attractive women from the control group.

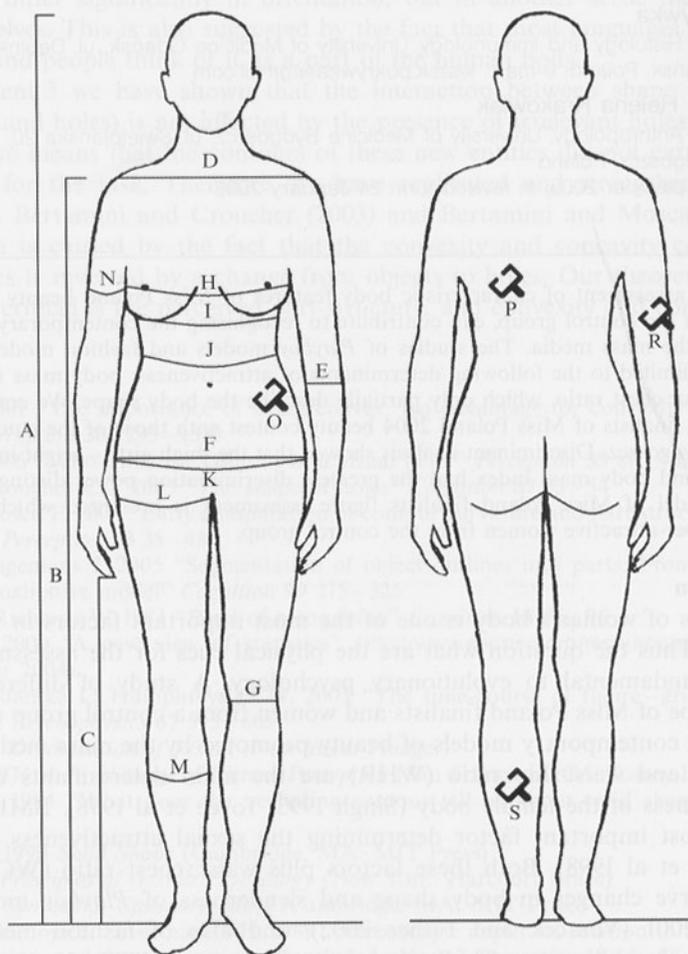
## 1 Introduction

Attractiveness of woman's body is one of the most important factors in mate selection (Buss 1989). Thus the question what are the physical cues for the assessment of attractiveness is fundamental to evolutionary psychology. A study of differences between the body shape of Miss Poland finalists and women from a control group can contribute to identifying contemporary models of beauty promoted by the mass media. Body mass index (BMI) and waist : hip ratio (WHR) are the main determinants used to assess the attractiveness of the female body (Singh 1993; Tovee et al 1998). BMI is considered to be the most important factor determining the sexual attractiveness of the female figure (Tovee et al 1998). Both these factors plus waist : chest ratio (WCR) have been used to observe changes in body shape and slenderness of *Playboy* models over the years 1953–2001 (Voracek and Fisher 2002), and also of fashion models, glamour models, normal, anorexic, and bulimic women (Tovee et al 1997). However, the beauty of the body is correlated with many body features (Grammer et al 2001). Therefore, we suggest that taking into consideration only BMI, WHR, and WCR may not show crucial differences between the finalists and the control group.

## 2 Materials and methods

We compared the body shape of the twenty-four finalists of the 2004 Miss Poland beauty contest (average age  $19.8 \pm 0.5$  years) with that of one hundred and fifteen students of Medical Academy in Bydgoszcz from the Institute of Physiotherapy (average age  $20.3 \pm 0.5$  years). We calculated the type of the body shape for each tested person according to the Heath–Carter method. This method of somatotyping is commonly used today (Carter and Heath 1990). The somatotype is defined as the quantification of the present shape and composition of the body. It is expressed in a three-number rating representing endomorphy, mesomorphy, and ectomorphy components. Endomorphy is the relative fatness; mesomorphy is the relative musculo-skeletal robustness; and ectomorphy is the relative linearity or slenderness of the physique (Carter and Heath 1990).

Apart from that, we used 19 anthropometric parameters in accordance with the IBP (International Biology Program—see figure 1). To assess which of the anthropometric parameters discriminates within the groups of women to the greatest extent, we conducted a forward seven-step analysis of the discriminant function using Statistica 6.1 by StatSoft Inc program.



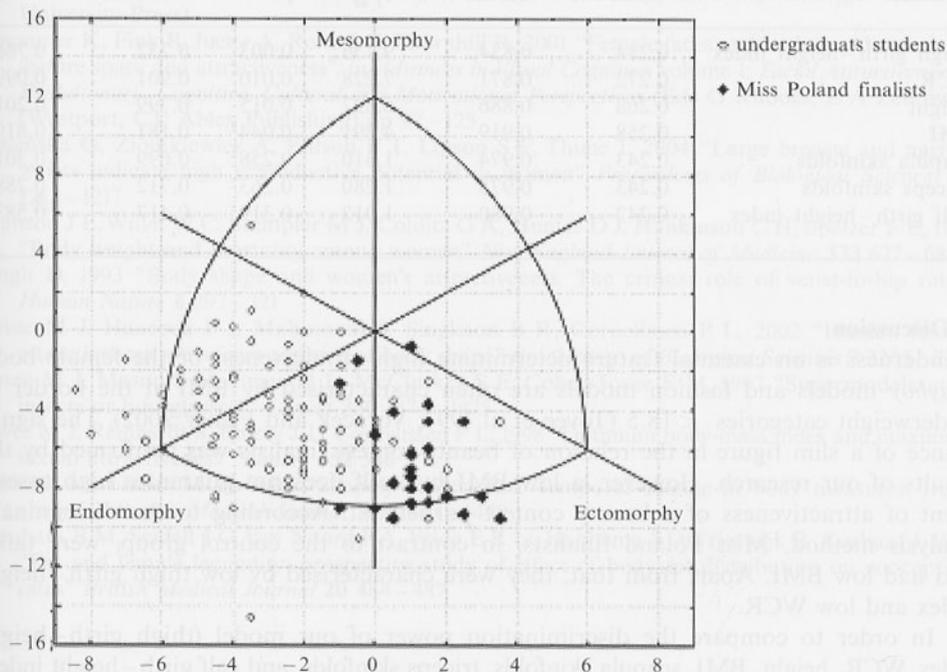
**Figure 1.** Anthropometric measures of Miss Poland finalists ( $n = 24$ ) and undergraduate students ( $n = 115$ ). A, height; B, shoulder height; C, 3 digit height; D, shoulder width; E, elbow width; F, hip width; G, knee width; H, bust girth, I, underbust girth, J, waist girth; K, hip girth; L, thigh girth; M, calf girth; N, arm girth; O, suprailiac skinfold; P, scapula skinfold; R, triceps skinfold, S, calf skinfold.

### 3 Results

Applying the somatotype according to the Sheldon method later revised by Heath and Carter gave the following results (endomorphs, mesomorphs, and ectomorphs, respectively—see figure 2): in the Miss Poland group 4.0–1.0–5.0; in the students group 5.0–1.5–3.0.

In terms of the type of body constitution, ectomorphy type prevails in the group of Miss Poland finalists, whereas in the control group endomorphy is more common. The differences in the anthropometric parameters between Miss Poland finalists and the control group ( $t$ -test) are listed in table 1. In the discriminant analysis, the greatest discrimination power had thigh girth–height index, followed by WCR, height, and BMI (table 2).

Discriminant analysis of popular indicators of estimation of attractiveness of female body gave for Miss Poland and the controls the values of Wilks's  $\lambda$ : BMI = 0.866; BMI and WHR = 0.798; BMI, WHR, and WCR = 0.461.



**Figure 2.** Somatogram of Miss Poland finalists ( $n = 24$ ) and undergraduate students ( $n = 115$ ).

**Table 1.** Differences in the anthropometric parameters of Miss Poland finalists ( $n = 24$ ) vs control group ( $n = 115$ ) ( $t$ -test).

Measure	Miss Poland ( $\pm$ SD)	Control group ( $\pm$ SD)	$p$
Height/cm	175.0 $\pm$ 3.8	165.3 $\pm$ 5.6	0.000
BMI	18.5 $\pm$ 1.2	21.6 $\pm$ 3.2	0.000
WHR	0.71 $\pm$ 0.03	0.75 $\pm$ 0.05	0.000
WCR	0.76 $\pm$ 0.03	0.81 $\pm$ 0.04	0.000
Bust size (bust–underbust girth index)	1.19 $\pm$ 0.05	1.14 $\pm$ 0.04	0.000
Underbust girth–height index	41.7 $\pm$ 1.6	46.2 $\pm$ 3.8	0.000
Bust girth–height index	49.3 $\pm$ 2.1	52.2 $\pm$ 2.3	0.000
Calf girth–height index	19.5 $\pm$ 0.9	21.3 $\pm$ 1.6	0.000
Arm girth–height index	13.8 $\pm$ 1.1	15.5 $\pm$ 1.8	0.000
Thigh girth–height index	29.7 $\pm$ 1.3	33.9 $\pm$ 1.9	0.000
Hip girth–height index	53.1 $\pm$ 1.7	57.1 $\pm$ 4.6	0.000
Waist girth–height index	37.5 $\pm$ 1.6	42.7 $\pm$ 4.3	0.000
Scapula skinfold/mm	10.2 $\pm$ 2.9	14.7 $\pm$ 7.1	0.003
Triceps skinfold/mm	12.7 $\pm$ 2.3	18.5 $\pm$ 7.3	0.000
Suprailiac skinfold/mm	13.8 $\pm$ 4.3	18.9 $\pm$ 8.8	0.007
Calf skinfolds/mm	15.0 $\pm$ 3.1	18.2 $\pm$ 7.9	0.053
Shoulder width–height index	20.9 $\pm$ 0.7	20.9 $\pm$ 1.5	0.786
Knee width–height index	5.3 $\pm$ 0.2	5.3 $\pm$ 0.4	0.522
Hip width–height index	16.4 $\pm$ 1.2	16.8 $\pm$ 1.5	0.201
Elbow width–height index	3.6 $\pm$ 0.2	3.5 $\pm$ 0.3	0.349
Arm length–height index	43.0 $\pm$ 1.3	43.7 $\pm$ 1.6	0.041

**Table 2.** Discriminant analysis of some important measures of Miss Poland finalists and undergraduate students. Step seven, Wilks's  $\lambda = 0.237$  ( $F_{7,49} = 22.54$ ,  $p < 0.000$ ).

Measure	Wilks's $\lambda$	Partial $\lambda$	$F_{1,49}$	$p$	Tolerance	$1 - R^2$
Thigh girth–height index	0.284	0.834	9.756	0.003	0.232	0.768
WCR	0.272	0.871	7.228	0.010	0.901	0.099
Height	0.268	0.886	6.327	0.015	0.799	0.201
BMI	0.258	0.919	4.291	0.044	0.181	0.819
Scapula skinfolds	0.243	0.974	1.310	0.258	0.699	0.301
Triceps skinfolds	0.243	0.975	1.280	0.263	0.712	0.288
Calf girth–height index	0.242	0.980	1.012	0.319	0.417	0.583

#### 4 Discussion

Slenderness is an essential feature determining high attractiveness of the female body. *Playboy* models and fashion models are often characterised by BMI at the border of underweight categories  $< 18.5$  (Tovee et al 1997; Voracek and Fisher 2002). The significance of a slim figure in the relation of beauty-contest finalists was confirmed by the results of our research. However, a low BMI by itself does not guarantee high assessment of attractiveness of a beauty contest participant. According to the discriminant analysis method, Miss Poland finalists, in contrast to the control group, were taller and had low BMI. Apart from that, they were characterised by low thigh girth–height index and low WCR.

In order to compare the discrimination power of our model (thigh girth–height index, WCR, height, BMI, scapula skinfolds, triceps skinfolds, and calf girth–height index) with other methods of assessing female sexual attractiveness we calculated the Wilks's  $\lambda$  for the chosen anthropometric parameters. When we used only BMI for discrimination between Miss Poland and the control group; or BMI together with WHR; or BMI, WHR, and WCR, we found that our model had the greatest discrimination power with Wilks's  $\lambda = 0.237$ . By taking these seven anthropometric parameters into account, it is possible to distinguish, as precisely as possible, super-attractive women from the control group. Our results confirm that attractiveness of a female body is correlated with many body features.

Evolutionary psychology suggests that a woman's sexual attractiveness is based on cues of health and reproductive potential. The body shapes of Miss Poland finalists seem to confirm this theory. BMI = 18.5 is close to BMI = 19 that is associated with the lowest mortality rate (Manson et al 1995). Tovee suggests that the optimal BMI for health and fertility is around the value of 18–19 (Tovee et al 2002). Miss Poland's WHR = 0.71 corresponds to the optimal fat distribution for high fertility (Zaadstra et al 1995). Miss Poland's large breasts (breast size = 1.19) and narrow waist indicate high reproductive potential (Jasienska et al 2004).

Our results showed that assessment of attractiveness of a woman's body ought to be completed with the estimation of the slenderness of legs. The traditional measurements of the beauty of a female figure: BMI, WHR, WCR, supplemented with the thigh girth–height index become highly discriminative with Wilks's  $\lambda = 0.278$ . Calculating the beauty of super-attractive women we should pay attention not only to the thinness and curvaceousness of the body (hour-glass), but also to slender legs. According to the Heath and Carter method, beauty-contest participants are distinguished from the control group by a thinner body, lower content of body fat, and slender muscles.

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