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Training Adam, Training Eve

MUSCULOSKELETAL STRUCTURE

Although male and females have the same basic anatomical systems they have several gender specific differences. These differences are said to be the result of the cells of the body that are responsible for reproduction (Wells, 1991), as opposed to those dedicated to the individuals survival.

- ***Height and Weight***

Up until adolescents, there is little difference between the male and female anatomical structures (Wilmore & Costill, 1994; deVries & Housh, 1994; Fox, Bowers & Foss, 1993; Wells, 1991). At around 11 years of age girls ‘spurt’ ahead of boys in both height and weight but this is reversed at around age 13 when the boys experience puberty (deVries & Housh, 1994; Wells, 1991). Once puberty begins hormones have a distinct effect and gender specific differences begin to immerge (Wilmore & Costill, 1994; deVries & Housh, 1994; Fox, Bowers & Foss, 1993; Wells, 1991). With the onset of menarche, usually around 12 years to 14 years old, linear growth begins to slow as oestrogen hastens the fusing of the epiphyseal (growth) plates (Wells, 1991). Therefore girls who begin menarche at a younger age usually are shorter than those who mature at a later age (Wells, 1991). In regards to adults, the average female is 10% or 10 to 13 cm shorter and 15 to 22 kg lighter than their male counter part (Ebben & Jensen, 1998; Wilson, 1995; Wilmore & Costill, 1994; Fox, Bowers & Foss, 1993; McArdle, Katch & Katch, 1991; Wells, 1991).



- ***Pelvis Width and Levers***

With the height advantage the average male has longer limbs than the average female, this does not however mean that they are biomechanically disadvantaged and relationships between the upper and lower portions of a limb need to be considered, (Usually determined by indexes like the crural and brachial index). Other biomechanical factors, like pelvis size, shape and width need also be considered.

Due to the sex specific role of the female in relation to gestation and child birth, females tend to have a wider relative pelvis. This increase in pelvic width combined with shorter femurs increases their Quadriceps Angle or Q – Angle (Lee et al, 1996; Wells, 1991; Cavanagh, 1990; Totoro & Anagnostakos, 1987). This needs to be taken into account when prescribing certain limb positions for leg exercises, eg. narrow squats, lunges and plyometrics, and when examining exercise technique. For example, females performing running based activities require a greater pelvic displacement or shift to keep their centre of gravity over the foot during its stance (weight bearing) phase. However this mechanical defficiency has been shown to have little effect on running speed (Fox, Bowers & Foss, 1993).

With the relatively broader hips, women usually have narrow shoulders (deVries & Housh, 1994; Wells, 1991), whilst their male counter parts tend to have a larger frame, broader shoulders and relatively narrower hips, thus providing a lever advantage (Ebben & Jensen, 1998; Wells, 1991). Due to the relatively narrower shoulders and wider hips, many women portray a marked valgus angle or carrying angle at the elbow to clear their hips. This effect also increases their biomechanical disadvantage, which means that throwing mechanisms may be different for the female athlete (Australian Coaching Council, 1990). However Wells (1991) reminds us that this is not always the case and some males may have narrow shoulders whilst some females may have the broad shoulders.

Male		Female
> 90*	Pubic Arch	< 90 *
Turned Inward	Ischial Tuberosity	Turned Outward
Small Heart Shaped	Pelvic Inlet	Large and more Oval
Long and Narrow	Sacrum	Broad and Flat
Heavy and Thick	General Structure	Light and Thin
Large	Joint Surfaces	Small

The centre of gravity, which represents the balance point across three dimensions (Transverse plane, Sagittal plane and Frontal plane), is generally considered lower in females. This lower centre of gravity is beneficial in sports that require a stable base and balance, like gymnastics and detrimental in sports that require the acquisition of height, like high jump. However although the differences is quoted at being between 1% to 6% (Seiler, 1995) lower, one must remember that the difference is dominantly due to the size of the individual more than their sex, women being shorter in general tend to have a generally lower centre of gravity. Wells (1994) states that for the same standing height and somatotype, *'the difference in center of gravity would probably be less than 1 inch.'* With this in mind centre of gravity and its sporting implications should be judged by height and somatotype rather than gender.

- **Flexibility**

Both the female athlete and the female in general display a greater general flexibility than males (Australian Coaching Council, 1991; Dorkamph, 1987). This can be seen in the normative data scoring for males and females in the sit and reach flexibility test (Australian Coaching Council, 1991; Dorkamph, 1987). Higher flexibility has its requirements in several sports, thus providing a female advantage, the most notable being rhythmic and artistic gymnastics (Australian Coaching Council, 1990)

HORMONAL DIFFERENCES

The male androgen Testosterone, of which males have considerably more, (Chu, 1996; Wilson, 1995; Baechle, 1994; Wilmore & Costill, 1994; McArdle, Katch & Katch, 1991) is responsible for protein synthesis (building muscle) and bone formation. It is due to a greater exposure of this hormone that males are taller and heavier.

As females have a significantly lower amount of this tissue building Testosterone (10 to 30 times lower) it is more difficult for them to put on muscle mass. This would indicate that the fears many women have of becoming “big and bulky” are unjustified. Hypertrophy (gains in muscle size) will occur but not to the extent many woman fear (Cadogan, 1996; Chu, 1996; Wilson, 1995).

Oestrogen, the female reproductive hormone, is primarily responsible for the storage of fat (Marieb, 1998; Wilmore & Costill, 1994) particularly in the hips and thighs (Wilmore & Costill, 1994). This predisposes women to have a higher fat mass (3 to 6 kg higher) (Ebben & Jensen, 1998; Wilmore & Costill, 1994; Fox, Bowers & Foss, 1993). The effects of this higher fat mass on a smaller frame is shown when the average total percent body fat is expressed, these being 13% to 16 % for males and 22 % to 26 % for females (Costa & Guthrie, 1994; McArdle, Katch & Katch, 1991; Wells, 1991). With this in mind, as Wilmore and Costill (1994) state ‘*Many women are constantly fighting fat deposition on the thighs and hips, but they are usually fighting a losing battle*’ however they also state that ‘*women can reduce fat stores well below what is considered normal for their age.*’ As such female athletes have a lower difference in percentage fat when compared to a male athlete, being between 2 % to 6 %, (as opposed to the average sedentary female difference of around 10 % when compared to the average sedentary man) (Wells, 1991).

Women do still have more fat mass in general however which means that, not only is fat loss hormonally harder, but they are also disadvantaged in sports that require a rapid acceleration of the body (eg. jumping) as they have a lower lean body mass (LBM) (deVries & Housh, 1994).

This is shown by deVries and Housh (1994) in their book, *Physiology of Exercise 5th Edition - Table 31.1 pg 603*, which lists the ratios of performance in 1991 (determined by world records) comparing females to males. The ratios of note were those for the Long Jump and the High Jump, which were 84 % and 86 % of male performance respectively (deVries & Housh, 1994).

This increased fat mass in women need not always be a disadvantage. Fat provides buoyancy and protection from the cold, which may be an advantage in swimming sports. As such females, although having a lower LBM, have a counter balance (by means of a higher fat mass.) which reduces the effect of gender differences in swimming performance (deVries & Housh, 1994; Fox, Bowers & Foss, 1993). This is again shown in the table mentioned above with the female ratio of performance for the 800 m freestyle being 95% that of a males (deVries & Housh, 1994).

CARDIO RESPIRATORY DIFFERENCES

Due to their smaller stature, women have a lower blood volume and smaller hearts (therefore smaller left ventricles). However Q or cardiac output for the same absolute power output is generally the same in both sexes (Wilmore & Costill, 1994). With heart rate and stroke volume being the predominant determinants of Q, the virtual equality would mean that an increased heart rate in females is needed to compensate their smaller stroke volumes (Wilmore & Costill, 1994).

Being smaller of frame also predisposes the female to have a lower tidal and ventilatory volume. Combine this with a lower haemoglobin (Hb) content (10 to 15% less per 100ml of blood) (Costa & Guthrie, 1994; deVries & Housh, 1994; Fox, Bowers & Foss, 1993; McArdle, Katch & Katch, 1991; Wells, 1991) and the active muscles receive less oxygen, this in turn effects the metabolic systems (Wilmore & Costill, 1994).

Metabolic Variations

- **VO₂MAX.**

Although post puberty the average female VO₂ max is 15 % to 30 % lower than that of a males (Wilmore & Costill, 1994; McArdle, Katch & Katch, 1991), elite female athletes show only an 8 % to 12 % lower value than those of elite male athletes (Wilmore & Costill, 1994). Many references mention studies which compared females to their male counterparts, the most intriguing had the men wear padded clothing around their waists in an attempt to simulate the extra fat free mass (FFM) carried by women. The results showed lower mean gender differences and that '*women's greater sex - specific essential body fat stores are major determinants of gender differences in metabolic responses to running.*' (Wilmore & Costill, 1994). Although absolute VO₂max values are shown to be lower, VO₂ gains in men and woman are said to be the same (Wells, 1991).

- **Lactate Thresholds .**

Women tend to reach their lactate threshold sooner than men at the same absolute workload (Wilmore & Costill, 1994; Wells, 1991). This may be because women have a lower oxidative capacity (due to >Hb) and would therefore rely more heavily on the anaerobic systems. When expressed in terms of percentage VO₂max, however, lactate thresholds do not differ between the sexes (Wilmore & Costill, 1994; Wells, 1991).



Strength Variations

As already stated males have a greater average weight than their female counter parts. This heavier mass gives them a distinct advantage in the development of absolute strength and leads to Holloway's (1994) statement that woman have approximately two thirds the absolute strength and power than that of a man.

These differences vary between the upper and lower body as shown below. With this basic weight variation, it can be seen why males have an approximate 33 % greater absolute strength (Wilson, 1995; Wilmore & Costill, 1994; Holloway; 1994; McArdle, Katch & Katch, 1991).

	Ebben et al. (1998)	Wilson (1995)	Wilmore & Costil (1994)
<i>Upper Body</i>	40 - 60 %	60 %	43 - 63 %
<i>Lower Body</i>	25 - 30 %	30 %	25 - 30 %

The above authorities also agree that when expressed as relative strength **the gap** between the genders decreases rather rapidly and, in the comparisons of the lower body, may actually disappear (Ebben & Jensen, 1998; Wilson,1995; Holloway,1994; Wilmore & Costill,1994; McArdle, Katch & Katch,1991). Costa and Guthrie. (1994) boldly claim that *'In fact, relative strength measures have shown the lower body strength of females to be slightly greater than that of males.'*

Programming

RESISTANCE TRAINING PROGRAMMING

Holloway (1994) makes an important statement when discussing the differences in weight training regimes for men and women. *'This (the) similarity at cellular level is what strongly supports the use of the same training procedure for men and women.'* This statement is agreed with by Chu et al, (1996). It can now be seen why prescribing higher repetition ranges for woman because they are women is unjustified.

For prescription purposes, the training variables (repetitions, sets, rest, etc) should be governed by goal and training history as opposed to gender (Ebben & Jensen, 1998; Chu et al, 1996; Holloway, 1994; Costa & Guthrie, 1994).



ANAEROBIC / AEROBIC CONDITIONING

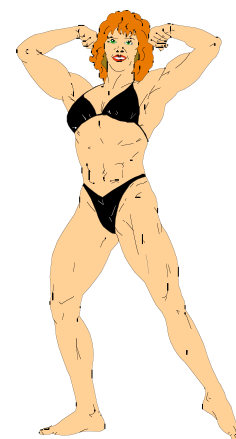
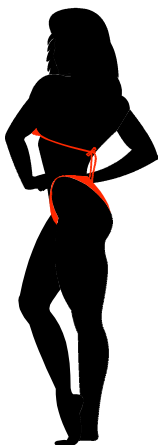
Several gender differences in hormones, metabolic responses and the cardio respiratory system have been identified. These in essence show that for the same absolute workload females generally have to work harder. How much harder they have to work depends on the type of activity they are performing.

NOTE : We are discussing the comparative differences for both the average male / female sedentary person and average male / female athlete. The individuality in the subject will play a large part in determining specific comparisons and as such a female athlete with a higher fitness level can out perform a male of a lower level.

Although overall performance outputs by females are lower when compared to males the adaptation to training has been shown to be similar regardless of gender. Therefore in regards to programming Fox, Bowers and Foss (1993) acknowledge that *'..ample evidence exists to demonstrate that men and women respond to training programmes in a similar fashion. Therefore the same general approach to physiological conditioning can be used in planning programmes for men and women.'*

'It is the opinion of the American College of Sports Medicine that females should not be denied the opportunity to compete in long distance running. There exists no conclusive or medical evidence that long - distance running is contra - indicated for the healthy, trained female athlete. The American College of Sports Medicine recommends that females be allowed to compete at the national and inter - national level in the same distances in which their counterparts compete.'

(deVries & Housh, 1994)





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