



## RESEARCH ARTICLE

## Role of Testosterone on Waist to Hip Ratio in Women with Hirsutism

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### Abstract

Hirsutism is a series problem faced women in the present days. It is usually associated with elevated levels of androgen hormones. This study aims to investigate the role of testosterone in the waist-to-hip ratio (WHR), and body mass index (BMI) of 54 women with hirsutism and 54 healthy women match in age, in a case control study. Free testosterone and thyroid stimulated hormone (TSH) were determined using ELISA technique. WTR, BMI and hirsutism score were examined in the study groups. Free testosterone, TSH, WTR, BMI and hirsutism score found to be significantly increased when compared with control group. The result of the present study may hypothesize that testosterone has a central role in the path physiological changes occur in hirsutism, such as fat storage pattern and as consequence the HWR and the stimulation effect to induce TSH and its effect on hair growth.

**Keywords:** *Hirsutism, WTR, Testosterone, TSH, BMI.*

### Introduction

Hirsutism is a disease affect women which characterized by an excessive presence of terminal hair in a manner similar to that of the male pattern [1]. It affects about 5-10 % of women worldwide. In most cases, it is associated with increase androgen levels [2].

The regulation of hair growth is subject to local and systemic factors such as sex steroids particularly androgens, cytokines and growth factors, as well as, growth and thyroid hormones which are reported to change the patterns of hair-growth [3]. Accumulated evidence are grown concerning the essential function of androgens in the kind of hair formation and distributed over the body.

These reports are shown direct proportion between androgen levels and development of terminal hair during puberty [4]. The main cause of hirsutism is the interaction between the amount of androgen and the hair follicle sensitivity to androgens [5]. Many factors determine if vellus hair turns into terminal hair such as the period of their exposure to high androgens concentration, the adequate activity of enzyme 5- $\alpha$ -reductase and the intrinsic sensitivity to androgen action by the follicle of hair [6]. The previous study found a positive correlation between

hirsutism and waist-to-hip ratio (WHR), and when this study adjusts both of body mass index (BMI) and age; it was found a significant positive correlation between WHR and blood pressure. This study attributed their results to the effect of local metabolism of the androgenic steroids [7]. The most commonly used criteria in anthropometric measurement by physicians are BMI and WHR as indexes of metabolic abnormalities and risk of cardiovascular diseases in both gender, in favor to WHR increment in many pathogenic conditions ranging from hypertension and cardiovascular disease to cancer, diabetes mellitus and infertility [8].

On the other hand, sex hormones such as estradiol and testosterone play an important role in the regulation of WHR. Previous studied found high estradiol levels are responsible for low WHR due to its role in the regulation of fat accumulation in the hip, buttocks, bosom, and thighs [9, 10]. In contrast, testosterone plays a contrary role to estradiol, particularly in psychological and metabolic processes involving WHR. High testosterone is correlated with an increment of WHRs in women with pre- and perimenopausal, morbid obesity and polycystic syndrome [11, 12]. Generally,

females have a fold of body fat more than males but the distribution of this fat is distinctly different. Through adulthood, men deposit adipose tissues in the upper part of the body, while women deposit adipose tissues in the lower part of the body particularly in the buttocks and thighs [13]. Sex hormones especially estrogens and testosterone play the central role in the distribution of body fat in human, where at puberty estrogens regulate the women body shape (gynoid), while testosterone regulates men body shape (android) [14]. Administration of sex hormones was reported to affect the body fat distribution in both genders, where it was found that males treated with estrogens were developed the gynoid fat pattern, while females that treated with testosterone were developed the pattern of android fat [15]. The previous study carried out on normal men was reported that aging process is accompanied by low concentrations of testosterone that leads to increase abdominal fat deposition and decrease lean body mass [16]. The current study aims to investigate the role of testosterone in the WHR and BMI of women with hirsutism and healthy women.

### Patients and Methods

Fifty-four females with hirsutism attended to the private dermatology clinic for laser hair removal during a period extended from September 2016 to March 2017, as well as fifty-four non-hirsute females match in age as a control group in case control study in Hilla city, Babylon Province, Iraq. The severity of hirsutism was evaluated by a physician using modified Ferriman- Gallway scoring system [17]. This study was approved by the local ethical committee, and all persons participated in this study were

signed an informed consent. The onset and duration of disease, family history, and the rate of progression, marital status, and menstrual history, the method of hair epilation and its frequency and therapy history were recorded. Physical examination such as participant's height, weight, hip and waist circumference was measured.  $WHR \geq 0.85$  was indicated android obesity and  $BMI \geq 25-29 \text{ kg/m}^2$  indicate over weight and  $BMI$  of  $30 \text{ kg/m}^2$  indicate obesity. The exclusion criteria were included patients administrated any hormonal or ant androgenic therapy three months before the present study. Serum free testosterone and thyroid stimulating hormone (TSH) was determined by use ELISA Monobind Inc. (USA) kits and obeyed the manufacturer manual.

### Results

The mean age of patients was  $29.24 \pm 7.43$  years, whereas the mean age of control group was  $30.65 \pm 5.52$  years. The mean of disease duration of patients was  $8.85 \pm 5.34$  years and the onset of disease was  $18.78 \pm 5.34$ . The hirsutism score of patients was  $13.79 \pm 4.05$ . Family history of hirsutism (with first or second degree relatives in more than two members of family) was recorded in 38 (84.44%) hirsute females. Twenty (44.04%) patients were married, five (11.11%) of them were not yet have children. Twenty two (48.88%) suffer from irregular menstrual cycles.

The mean of body weight and BMI of hirsute females found to be significantly increased when compared with control group. Whereas, there was no statistically deference in mean length in the same groups, as shown in Table 1.

**Table 1: Mean weight, length and body mass index of hirsute females and control group**

Parameters	Patients	Control	P value
	Mean $\pm$ SD	Mean $\pm$ SD	
Weight (kg)	$70 \pm 18.34$	$60 \pm 5.67$	0.02
Length (M)	$1.59 \pm 0.05$	$1.55 \pm 0.03$	0.31
BMI	$27.63 \pm 4.87$	$24.14 \pm 2.25$	0.04

Thirty one (68.88%) of hirsute females found to be over weight ( $BMI \geq 25$ ), twenty two of them had android obesity, and the remaining nine had non-android obesity. Waist, hip and

WHR of hirsute females found to be significantly increased when compared with control group, as shown in Table 2

**Table 2: Waist, hip and waist/hip ratio of hirsute females and control group**

Parameters	Patients	Control	P value
	Mean $\pm$ SD	Mean $\pm$ SD	
Waist (cm)	$81 \pm 14.03$	$69.5 \pm 13.52$	0.012
Hip (cm)	$97 \pm 14.64$	$91.5 \pm 11.3$	0.027
W/H Ratio	$0.83 \pm 0.15$	$0.75 \pm 0.13$	0.019

Free testosterone and TSH of hirsute females found to be significantly increased

when compared with control group, as shown in Table 3.

**Table 3: Free testosterone and thyroid stimulating hormone of hirsute females and control group**

Parameter	Patient	Control	P value
	Mean $\pm$ SD	Mean $\pm$ SD	
Free Testosterone pg/ml	3.2 $\pm$ 1.71	1.6 $\pm$ 0.58	0.001
TSH $\mu$ IU/ml	1.87 $\pm$ 1.11	1.18 $\pm$ 0.78	0.04

The correlation among study parameters were investigated to conclude the benefits of

this study and shown positive significant correlations, as shown in Table 4.

**Table 4: The correlation among study parameters of hirsute females**

Study Parameters	Hirsutism Score	BMI	WHR	Free Testosterone	TSH
Hirsutism Score Person Correlation P value	1.00	0.3872 0.0012	0.6866 0.004	0.7351 0.001	0.7954 0.0001
BMI Person Correlation P value	0.3872 0.0012	1.00	0.6414 0.0001	0.3598 0.038	0.3313 0.0421
WHR Person Correlation P value	0.6866 0.004	0.6414 0.0001	1.00	0.6061 0.0004	0.6166 0.0031
Free testosterone Person Correlation P value	0.7351 0.001	0.3598 0.038	0.6061 0.0004	1.00	0.4740 0.0023
TSH Person Correlation P value	0.7954 0.0001	0.3313 0.0421	0.6166 0.0031	0.4740 0.0023	1.00

## Discussion

Hirsutism represents a serious problem due to its psychological impact on hirsute females making them distress [18]. In the present study, patients with hirsutism found to be with a high degree of distress as a consequence of its interaction with women femininity, marital and social life, and this is agreed with previous studies [18,19]. The onset age and disease progression of hirsute females in this study are approximately similar to other studies [18-20].

The family history is reported in the present study to be 84.44% of hirsute females and this result is in agreement with other previous studies [18],[21], [22] [19], whereas, family history were found in other Iraqi studies less than the result of present study [23, 24].

The family history of hirsute females may point to the genetic base of hyperandrogenism disorders like congenital adrenal hyperplasia and polycystic ovary syndrome [21, 25]. The results of the present study found appreciated percentage of patients with irregular menstrual cycles and decreased rate of infertility and this is agreed with previous studies [18- 21]. The weight and BMI of hirsute females in the present study were significantly elevated in comparison with the control group and this is in agreement with other studies carried out in Iraq [18, 19, 26]. All of this studies

mentioned that obesity is a common feature in females with hirsutism and another hyperandrogenism disease such as polycystic ovary syndrome [18, 19, 26]. There are about half (48.88%) of hirsute females participated in the present study with android obesity and with significant increase in WHR when compared with control group, and this is in agreement with other studies done in Iraq and Iran, which attributed their finding to the anomaly androgen behavior that in turn may cause increase WHR, decrease fertility rate and irregular menstrual cycles. [18, 19, 27].

The levels of free testosterone in the current study were significantly increased in comparison with control, and this result is agreed with the previous study [18,19] [21] and disagreed with another study [24]. The elevated free testosterone levels thought to play the central role in hyperandrogenism manifestation of hirsute females and the hirsutism severity is associated with high free testosterone levels (the high free testosterone level the more hirsutism score) [28-29]. The level of TSH in the present study increased significantly when compared with control and this is agreed with previous studies, [30, 31] which attributed their finding to hypophyseal hypothyroidism that can act as a cofactor in hirsutism resulting in elevated TSH. The study parameters were examined and found positive correlation

among hirsutism score, BMI, WHR, free testosterone and TSH with each other. The significant correlation among hirsutism score with each of BMI and WHR are agreed with previous studies [18, 27].

There was also a significant correlation between hirsutism score and free testosterone levels in the present study, and this finding is agreed with the result of previous studies [18, 25] and disagrees with other [32]. This study also found a significant positive correlation between testosterone and TSH concentrations, and this could be explained by the finding of the earlier study carried out on rats [33, 34]. These animal studies were indicated that testosterone possesses a primary stimulatory role in the controlling and secretion of TSH in circulation, in that testosterone result in raise levels of both of baseline TSH and thyrotropin releasing hormone [33, 34]. The TSH elevation may affect the hair growth because the human hair follicle responds to the stimulation by TSH [35], and hypothyroidism is a clinical feature of hirsutism [31]. An epidemiological study that done on healthy men, reports that free

testosterone has a negative relation with intra-abdominal fat mass, risk of coronary artery disease and type 2 diabetes mellitus. This study was also found that the treatment of middle-aged men with testosterone is associated with a decrease in blood glucose concentrations and visceral fat in addition to insulin sensitivity improvement [36]. Other studies indicate that when testosterone depleted with a progress of age, the adiposity of visceral is being high in men [37,38].

Whereas the situation is different in hyperandrogenism women such as PSOS and hirsutism, the testosterone concentration behaves in a manner similar in the men. It is usually, but not consistently is accompanied with high abdominal adiposity [39, 40], and this is agreed with the result of the current study. In conclusion, the result of this study may hypothesize that testosterone has a central role in the path physiological changes occur in hirsutism, ranging from the change in fat storage pattern and as consequence the HWR, to the stimulation effect of testosterone to induce TSH and its effect on hair growth. Figure 1 illustrates the role of testosterone on HWR in hirsute women.

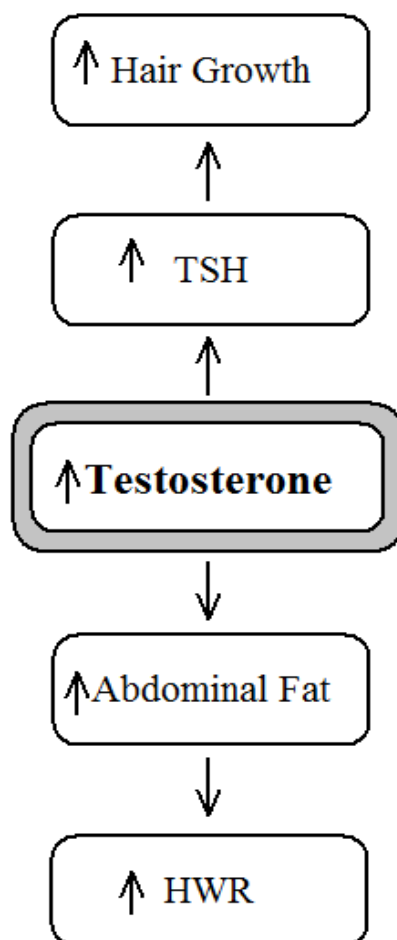


Figure 1: Role of the testosterone on HWR in hirsute women

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