Journal of Biological Research **1**: 63–74, 2004
J. Biol. Res. is available online at http://www.jbr.gr

Prevalence of hirsutism in a hellenic female population

JOANNA LEONDARIDOU[1*], ATHENA PENTZOU-DAPONTE[1], ANASTASIA KOUVATSI[1] and SOTIRIS K. MANOLIS[2]

[1]*Department of Genetics, Development & Molecular Biology, School of Biology, Aristotle University, Thessaloniki 54124, Greece*
[2]*Department of Animal & Human Physiology, School of Biology, National & Kapodistrian University, Athens 15784, Greece*

Received: 22 September 2003 Accepted after revision: 17 December 2003

Five hundred ninety two Greek women, selected in random and ranged from 18 to 35 years of age, were evaluated by individual interviews based on a questionnaire and some of them by further hormonal investigations in order to estimate the prevalence of hirsutism. Hirsutism is rather common among Greek women with a percentage of 16.4%. Manifestations of androgen excess, especially of testosterone (T) and dehydroepiandrosterone sulfate (DHEAS) which stimulate hair follicle and function of the sebaceous gland and were elevated in most hirsute women, can have significant effects on body image. There are strong family and racial influence on hirsutism and the body mass index, acne, menses and PCOS, are factors that influence hair growth in women.

Key words: hirsutism, distribution, hellenic female population.

INTRODUCTION

Hirsutism is a term that refers to the presence of excess body and facial hair in women that is more typical of the hair growth pattern in men. Areas where hirsutism appears include the face (upper lip, chin), and the body (chest, upper and lower back, upper and lower abdomen, forearms and pelvic areas). Hirsutism should be clinically distinguished from hypertrichosis, which is referred as an increased hair growth at normal sites such as the arms.

Hair follicles develop at 10 weeks of gestation but the total endowment of hair follicles is determined by 22 week of gestation. They appear as epidermal derivatives and initially exist as a single column of cells that proliferate from epidermis to dermis. Within dermis, this unit envelops a cluster of mesodermally derived cells known as the dermal papillae. Hair growth occurs as epithelial cells in contact with the dermal papillae proliferate (Speroff *et al.*, 1994). There are approx. 5 million hair follicles covering the body. Very few new hair follicles are formed after birth and the number of hair follicles begins to decrease after the age of 40 (Azziz *et al.*, 2000). Hair texture in humans can be classified into 2 basic types; vellus and terminal. Vellus is thin in quality, soft and unpigmented, whereas terminal is coarse and dark pigmented. A given hair follicle can produce either a vellus or a terminal hair in response to hormone stimulus. Hirsutism is the transformation of a fine vellus hair to a visible, thickened terminal hair under androgenic stimulus (Delahnut, 1993).

Morphological differences in hair growth and predisposition toward hirsutism are observed among different ethnic groups. There are strong family and "racial" influences in hirsute women, but one must be aware that race accounts for major variations in the normal pattern of growth. It has been suggested that Mediterranean people, where Greeks belong, show the greatest tendencies in hirsutism (Speroff *et al.*, 1994) and frequently accept excessive facial and body hair as part of their genetic background. While a woman's family history is very important in her overall workup of hirsutism, a positive family histo-

* Corresponding author: tel.: +30 2310 449044, fax: +30 2310 449044

ry does not rule out an endocrine etiology of abnormal hair growth.

Most hirsute women worry about the possibilities of having a disease, impaired fertility, experiencing an alteration of their social acceptance. Besides being cosmetically distressing, hirsutism may also signal the presence of a hormone imbalance or a hormone-producing tumor. Of the sex steroids, androgens are the most important in determining the type and distribution of terminal hair seen in hirsutism. Androgens are required for sexual hair and sebaceous gland development (Deplewski & Rosenfield, 2000). Under the influence of androgens, hair follicles that are producing vellus-type hairs can be stimulated to begin producing terminal hairs. The ovaries and adrenal glands produce androstenedione, which is peripherally converted to testosterone. Testosterone itself is secreted from both the ovaries and adrenal glands, although the ovary is almost always the primary source in hirsute women. Dehydroepiandrosterone sulfate (DHEAS) arises almost exclusively from the adrenals and is also converted peripherally to testosterone. About 80% of circulating testosterone is bound to a carrier protein called sex binding globulin (SHBG), 18% is bound to albumin and only the unbound 2% is biologically active. Testosterone is transformed into the potent androgen dihydrotestosterone (DHT) by 5-alpha-reductase at the level of hair follicle, and DHT induces terminal hair growth (Harsoulis, 1998).

The evaluation of hirsutism should include a complete medical history and physical examination. The history may give information including weight gain, menstrual regularity, scalp hair loss, deepening of the voice, medication, rate of hair growth, date of onset and patterns of mechanical methods used to treat hirsutism (shaving, plucking, electrolysis, laser epilation). The amount and distribution of hair is uncovered by the physical examination. Hair growth on the scalp, legs and arms depends on growth hormone and thyroid hormone and is categorized as nonsexual. Vellus hair growth in the axilla and pelvic area depends on the low levels of androgens present in women as well as men and thus is classified as ambisexual. Vellus hair on the chin, upper lip, lower abdomen and sternum depends on high levels of androgens and is associated with normal sexual development in men. The most common technique used for the evaluation of facial and body hair is the Ferriman-Gallwey method, which scores the amount and arrangement of body hair on a scale of 1 to 4 in nine different body areas (Panidis, 1991).

The purpose of this study was to evaluate the prevalence of hirsutism among Greek women by (a) physical examination, (b) personal and family history, and (c) hormone measurements used clinically in the diagnosis of abnormal hair growth (hirsutism).

MATERIALS AND METHODS

Biological material: Study subject was a sample of five hundred ninety two female students of Technological Educational Institution of Thessaloniki, ranged from 18 to 35 years of age, descending from different areas all over Greece, as representative of a random Greek female population. They were evaluated by individual interviews based on a questionnaire and some of them by further hormonal investigations.

Structure of used questionnaire: Segregation of questionnaire in three relative units that included demographic elements, elements that composed individual's background and elements that resulted from the women's physical examination.

More analytically, in the demographic elements have been recorded the year of birth, the place of birth and residence, with classification of region in urban, semi-urban, province and flat, semi-mountainous, mountainous and the origin, with classification in Pontiac (Pontos: area around the Black Sea), Vlachiki (Vlachs: population in North and North-West Greece, whose mother tongue is Vlach) and native Greek.

The following parameters were taken into consideration in individual's background evaluation: stature (height) and weight, body mass index (BMI), acne, menstruation, galactorrhea, pregnancy, previous pathological status incriminated or related with hirsutism and the presence and distribution of hirsutism in the familial environment. BMI, is an anthropometric measurement very useful in the evaluation of obesity that results from the fraction of body weight in milligrams to the square of stature in meters (Harsoulis, 1998). BMI had been grouped in 5 categories (rBMI). BMI below 18.50 (rBMI, cat. 1) indicated the woman was extremely thin. BMI between 18.51-24.99 (rBMI, cat. 2) indicated the woman was normal. BMI between 25.00-29.99 (rBMI, cat. 3) indicated the woman was overweight. BMI between 30.00-39.99 (rBMI, cat. 4) indicated the woman was obese. Finally, BMI over 40.00 (rBMI, cat. 5) indicated the woman was severe obese.

Menstrual history was carefully recorded and menstrual cycle lengths shorter than 21 days and longer than 35 days were considered abnormal (Carmina, 1998). Drug history was examined to exclude a source of androgens as many drug components are relatively androgenic and this is often cited as a cause of hirsutes, (e.g. anabolic steroids, Copperthwaite, 1998).

The last unit of the questionnaire included the results arisen from women's clinical investigation and hirsutism, which were calculated by the Ferriman-Gallwey Index (Ferriman & Gallwey, 1961). More specifically, according to this method, the amount of facial and body hair was marked in nine hormone-dependent regions. The degree of hair was expressed by the summary of these nine areas. The severity of hirsutism in each of these areas was graded from 1 (least severe) to 4 (most severe), with a maximum score of 36. A total of more than eight indicated hirsutism, that was more severe as long as the sum was increased.

Of 592 women screened, 97 were recorded as hirsute but only 48 of them and 52 of those recorded as non-hirsute (control group) accepted to participate in further hormonal investigations. Serum hormone levels were evaluated in the early follicular phase (days 4-7) and a blood sample was obtained between 09.00 and 11.00 am. Hormone evaluation included serum testosterone (T), dehydroepiandrosterone sulphate (DHEAS), sex hormone binding globulin (SHBG), the two gonadotropins (luteinizing hormone-LH and follicle stimulating hormone-FSH), prolactin (PRL) and thyroid-stimulating hormone (TSH). All hormone levels were evaluated by radioimmunoassay-RIA (Yalow & Berson, 1960).

Data were recoded and subjected to further statistical elaboration.

Statistical analysis: Statistical sample was initially described completely and a first picture for the under investigation parameters was acquired. Qualitative characteristics-that constituted the majority of characteristics in the study-were described through the tables of distribution of frequencies. Quantitative characteristics were described by calculating the statistical meters.

Through Analytic Statistics, relations among characteristics were investigated analyzing data from preexisting contingency tables. More specifically, independence control (x^2-test) was applied to check out correlation between two qualitative criteria that classify a statistical population (e.g. statistically significant correlation between two parameters such as monthly utterance and presence of hirsutism) (Foster, 1998). Moreover, medium prices comparison (t-test), there are samples of people drawn from the potential population which need to be estimated whether any difference obtained between the two sets of scores is statistically significant (Howitt & Cramer, 1999). Value of chi-square and medium prices comparison (t-test) were statistically significant whenever P-value was considered less than 0.05. Statistical data were computerized using the SPSS (Statistical Package for Social Sciences) version 11.5 for Windows.

RESULTS

Using the physical examination of each individual of the sample examined, 97 out of 592 (16.4%) were considered hirsute.

Statistical analysis: Correlations between the presence of hirsutism in women and age, place of birth and residence, origin, women's height, medical and drug history were non-significant.

Although statistically significant correlation between the presence of hirsutism and women's height was not observed, statistically significant correlation between hirsutism and body weight (rBMI), acne and menstruation, was observed. When examining rBMI, it was found that thin women were hirsute in a percentage of 5.5% and normal women were hirsute in 16.8%, while overweight women were hirsute in 25.9% and obese women in 25% (Table 1). Trying to investigate correlation between hirsutism and acne, it was found that women with acne were hirsute in 20.9%, whereas women without acne were hirsute in 13,1% (Table 2A). The investigation of the correlation between hirsutism and menstruation, showed that 13.2% of the women with normal menses were hirsute, whereas 27.7% of the women with abnormal menses were hirsute (Table 2B).

From medical history, only a clue was observed in correlation between hirsutism and diabetes. Two women were diabetic and both were hirsute.

By examining familial background, 65.3% of hirsute women mentioned their mother was also hirsute (Table 3A) and 65.5% of hirsute women mentioned their father was hypertrichotic (Table 3B). Sisters, grandmothers, aunts and cousins of hirsute women, whenever they existed, were also mentioned to correlate with the presence of hirsutism.

We did not note any rapid progression of hair

TABLE 1. Correlation and chi-square test between hirsutism and rBMI

			rBMI			
			Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Total**
hirsutism	Yes	Count	4	77	14	2	97
		% within hirsutism	4.1	79.4	14.4	2.1	100.0
		% within rBMI	5.5	16.8	25.9	25.0	16.4
		% of Total	0.7	13.0	2.4	0.3	16.4
	No	Count	69	380	40	6	495
		% within hirsutism	13.9	76.8	8.1	1.2	100.0
		% within rBMI	94.5	83.2	74.1	75.0	83.6
		% of Total	11.7	64.2	6.8	1.0	83.6
Total		Count	73	457	54	8	592
		% within hirsutism	12.3	77.2	9.1	1.4	100.0
		% within rBMI	100.0	100.0	100.0	100.0	100.0
		% of Total	12.3	77.2	9.1	1.4	100.0

chi-square test for hirsutism vs rBMI

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson chi-square	10.430[a]	3	0.015
No of valid cases	592		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 1.31

growth in hirsute women except for one, and the onset of hirsutism started mostly in puberty. Women with galactorrhea and symptoms of virilization were not detected, except for one with no breast development and irregular menses. Statistically significant correlation between the presence of hirsutism in women and receiving contraceptives was observed, as 35.0% of women treated with contraceptives were hirsute, whereas 13.5% of the women not treated with contraceptives were hirsute (Table 4A).

Distribution of facial hair in the upper lip and chin was more intense in hirsute women and body hair in the chest, upper and lower back, upper and lower abdomen, arm and thigh was also more intense in hirsute women.

Hormone measurements: The results indicated that all hirsute and non-hirsute women that were further examined by hormonal measurements had normal TSH levels and were normoprolactinemic. In many cases, LH levels were elevated although FSH levels were normal. The increased ratio LH/FSH revealed women with polycystic ovary syndrome (PCOS). In the sample examined, women with PCOS were hirsute in 51.6%, whereas women without PCOS were hirsute in 14.4% (Table 4B). Serum androgen levels (total testosterone and DHEAS) were increased in most hirsute women. SHBG concentrations were not related to the presence of hirsutism.

DISCUSSION

Prevalence: It is well known that hirsutism manifests in women as excessive growth of terminal hairs in androgen-dependent regions of the body (Kalve & Klein, 1996; Hatch *et al*., 1981; Kirschner, 1984) and it is a common clinical problem faced by doctors (Leshin, 1987).

Several investigators have examined the prevalence of hirsutism in selected populations, (e.g. McKnight, 1964; Ferriman & Gallwey, 1961; Azziz *et al*., 2000). In the present study, we examined the prevalence of hirsutism in a random Greek female population. Our results showed that hirsutism is relatively common with a prevalence of 16.4% in the sample examined. In contrast, a study by McKnight (1964), in a sample of 400 English and Welsh University women showed that 9% of them were considered to be hirsute. Ferriman & Gallwey (1961) in their study (in a sample of 430 women aged from 15 to 74 years), have found varying degrees of increased hair growth by approx. 10%. Similar studies have showed that 5 to 10% of North American women have hirsutism and Azziz *et al*., (2000) have present-

TABLE 2. Correlation and chi-square tests between hirsutism and (A) acne and (B) menstruation

A			**acne**		**Total**	**chi-square test of hirsutism vs acne**					
			Yes	**No**			**Value**	**df**	**Asymp Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
hirsutism	Yes	Count	52	45	97	Pearson chi-square	6.348[b]	1	0.012		
		% within hirsutism	53.6	46.4	100.0	No of valid cases	592				
		% within acne	20.9	13.1	16.4						
		% of Total	8.8	7.6	16.4						
	No	Count	197	298	495	*a) Computed only for a 2 × 2 table.*					
		% within hirsutism	39.8	60.2	100.0	*b) 0 cells (0.0%) have expected count less than 5.*					
		% within acne	79.1	86.9	83.6	*The minimum expected count is 40.80*					
		% of Total	33.3	50.3	83.6						
Total		Count	249	343	592						
		% within hirsutism	42.1	57.9	100.0						
		% within acne	100.0	100.0	100.0						
		% of Total	42.1	57.9	100.0						

B			**menstruation**		**Total**	**chi-square test of hirsutism vs menstruation**					
			Normal	**Oligo-menorria**			**Value**	**df**	**Asymp Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
hirsutism	Yes	Count	61	36	97	Pearson chi-square	15.545[b]	1	0.000		
		% within hirsutism	62.9	37.1	100.0	No of valid cases	592				
		% within menstruation	13.2	27.7	16.4						
		% of Total	10.3	6.1	16.4						
	No	Count	401	94	495	*a) Computed only for a 2 × 2 table.*					
		% within hirsutism	81.0	19.0	100.0	*b) 0 cells (0.0%) have expected count less than 5.*					
		% within menstruation	86.8	72.3	83.6	*The minimum expected count is 21.30*					
		% of Total	67.7	15.9	83.6						
Total		Count	462	130	592						
		% within hirsutism	78.0	22.0	100.0						
		% within menstruation	100.0	100.0	100.0						
		% of Total	78.0	22.0	100.0						

TABLE 3. Correlation and chi-square tests between hirsutism and (A) family data 1 (mother hirsute) and (B) family data 2 (father hirsute)

A			**family data 1 (mother hirsute)**		**Total**	**chi-square test of hirsutism vs family data 1 (mother hirsute)**				
			Yes	**No**			**Value**	**df**	**Asymp Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
hirsutism	Yes	Count	32	65	97	Pearson chi-square	93.320[b]	1	0.000		
		% within hirsutism	33.0	67.0	100.0	No of valid cases	592				
		% within family data 1	65.3	12.0	16.4						
		% of Total	5.4	11.0	16.4						
	No	Count	17	478	495	*a) Computed only for a 2 × 2 table.*					
		% within hirsutism	3.4	96.6	100.0	*b) 0 cells (0.0%) have expected count less than 5.*					
		% within family data 1	34.7	88.0	83.6	*The minimum expected count is 8.03*					
		% of Total	2.9	80.7	83.6						
Total		Count	49	543	592						
		% within hirsutism	8.3	91.7	100.0						
		% within family data 1	100.0	100.0	100.0						
		% of Total	8.3	91.7	100.0						

B			**family data 2 (mother hirsute)**		**Total**	**chi-square test of hirsutism vs family data 2 (father hirsute)**				
			Yes	**No**			**Value**	**df**	**Asymp Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
hirsutism	Yes	Count	19	78	97	Pearson chi-square	53.729[b]	1	0.000		
		% within hirsutism	19.6	80.4	100.0	No of valid cases	592				
		% within family data 2	65.5	13.9	16.4						
		% of Total	3.2	13.2	16.4						
	No	Count	10	485	495	*a) Computed only for a 2 × 2 table.*					
		% within hirsutism	2.0	98.0	100.0	*b) 1 cells (25%) have expected count less than 5.*					
		% within family data 2	34.5	86.1	83.6	*The minimum expected count is 4.75*					
		% of Total	1.7	81.9	83.6						
Total		Count	29	563	592						
		% within hirsutism	4.9	95.1	100.0						
		% within family data 2	100.0	100.0	100.0						
		% of Total	4.9	95.1	100.0						

TABLE 4. Correlation and chi-square tests between hirsutism and contraceptive medications (A) and personal data PCOS (B)

A		**contraceptives (medications)**		**Total**	**chi-square test of hirsutism vs contraceptive medications**					
		Yes	**No**			**Value**	**df**	**Asymp Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
hirsutism Yes	Count	28	69	97	Pearson chi-square	23.395[b]	1	0.000		
	% within hirsutism	28.9	71.1	100.0	No of valid cases	592				
	% within Contr. Medicat.	35.0	13.5	16.4						
	% of Total	4.7	11.7	16.4						
No	Count	52	443	495	*a) Computed only for a 2 × 2 table.*					
	% within hirsutism	10.5	89.5	100.0	*b) 0 cells (0.0%) have expected count less than 5.*					
	% within Contr. Medicat.	65.0	86.5	83.6	*The minimum expected count is 13.11*					
	% of Total	8.8	74.8	83.6						
Total	Count	80	512	592						
	% within hirsutism	13.5	86.5	100.0						
	% within Contr. Medicat.	100.0	100.0	100.0						
	% of Total	13.5	86.5	100.0						

B		**personal data (PCOS)**		**Total**	**chi-square test of hirsutism vs personal data PCOS**					
		Yes	**No**			**Value**	**df**	**Asymp Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
hirsutism Yes	Count	16	81	97	Pearson chi-square	29.632[b]	1	0.000		
	% within hirsutism	16.5	83.5	100.0	No of valid cases	592				
	% within personal data PCOS	51.6	14.4	16.4						
	% of Total	2.7	13.7	16.4						
No	Count	15	480	495	*a) Computed only for a 2 × 2 table.*					
	% within hirsutism	3.0	97.0	100.0	*b) 0 cells (0.0%) have expected count less than 5.*					
	% within personal data PCOS	48.4	85.6	83.6	*The minimum expected count is 5.08*					
	% of Total	2.5	81.1	83.6						
Total	Count	31	561	592						
	% within hirsutism	5.2	94.8	100.0						
	% within personal data PCOS	100.0	100.0	100.0						
	% of Total	5.2	94.8	100.0						

ed similar results for USA women.

In Greece, hirsutism is a common medical problem and is highly prevalent within families, suggesting a genetic basis for the disorder. By examining familial background, individuals of the same family were observed to have similar hair growth. Greek hirsute women had hirsute mothers in a percentage of 65.3% while hirsutism was very common among the rest of the feminine members (sisters, grandmothers, aunts and cousins) of the same family, starting in puberty. In a previous study, in a sample of 449 Greek hirsute women aged from 15-45 years, it has been also found that hirsutism in 41.8% of cases was familial (Batrinos, 1982).

In pathogenesis of hirsutism, age, race, heredity, endocrine factors of the skin, in particular the reactivity of the hair follicles, testosterone and precursor of androgen, as well as the sexual steroid-binding globulin, play a role (Goretzlehner, 1979). We did not observe a correlation between the presence of hirsutism and the place of birth and residence, as the Greek geographic area is rather small to justify differentiations of hair growth based on this parameter. Moreover, since people have been intermarrying a lot the last decades, specific women origin was proved to be non significant in the presence of hirsutism. We did not also observe a correlation between the presence of hirsutism and age, as the age range of all women that took part in our research was small (18-35 years old). A clinical evaluation of body hair in 236 Chilean women has also revealed no correlations between the hair score and the age (Tellez & Frenkel, 1995). However, in a similar study by Ferriman & Gallwey (1961), it has been observed that after the age period of 45-54 years, hair tended to increase on the face and to disappear from other sites.

Pathogenesis-Hormones: The pathogenesis of hirsutism in most women is not clearly defined (Leshin, 1987). There is a number of hormones that affect hair growth. Thyroid hormone and growth hormone initiate a generalized growth in hair. Progesterone has minimal effect on hair growth while androgens are the most important determinants of the type and distribution of hairs over the body (Azziz, 1989). Androgens when secreted in excess or cause undesirable symptoms such as hirsutism, the term hyperandrogenism is used (Rittmaster, 1995; Rittmaster & Loriaux, 1987; Schwartz & Flink, 1985). There are no definite correlations between circulating androgens and the degree of their biological effects (Pichl & Schell, 1990) since hirsutism often results from a subtle excess of androgens (Hatsh *et al*., 1981). Differences in expression of androgen action may reflect genetic variations in cutaneous sensitivity to androgens (Rosenfield & Lucky, 1993). Hirsutism may also appear, secondarily to increased responsiveness of hair follicles to normal circulating levels of androgens due to hyperactivity of 5a-reductase (Gilchrist & Hecht, 1995; Kuttenn & Mauvais-Jarvis, 1978; Redmond, 1995). Because androgens come from the adrenal glands or gonads or by conversion of precursor steroids in peripheral tissues, the causes of hirsutism are found in these two organs. Adrenal causes include Gushing's disease, adrenal tumors, and congenital adrenal hyperplasia. Ovarian causes include tumors, polycystic ovarian syndrome, and most cases of idiopathic hirsutism (Rittmaster & Loriaux, 1987; Kirschner *et al*., 1976).

In the vast majority of cases, androgen excess is locally found at the level of the hair follicle; that is, the hirsutism is idiopathic (Young & Sinclair, 1998a). A study on 588 hirsute Italian women has revealed that idiopathic hirsutism was a relatively common cause of hirsutism, affecting approx. 6% of that population (Carmina, 1998).

The effect of androgens on hair growth is area-specific. Some skin areas respond only to high levels of androgens and include chest, lower abdomen, lower back, upper thighs, upper arms, chin, upper lip and upper pelvic triangle (Azziz, 1989; Thiboutot, 1995; Lunde & Grottum, 1984). Terminal hair growth in these areas is characteristically masculine and if present in women is considered pathological (Azziz, 1989). In our study, we evaluated hair growth characteristics (density, diameter, growth rate) in all of these areas, the date of onset and we also evaluated hirsutism severity by the Ferriman-Gallwey Index.

Most of the hirsute women need only careful clinical evaluation (Barth, 1992). A detailed medical history and examination can identify women in whom a serious disease is suspected and for whom laboratory evaluation is warranted (Sakiyama, 1996). A minimal workup must include total serum testosterone, DHEAS and prolactin (Bailey-Pridham & Sanfilippo, 1989; Bergfeld & Redmond, 1987). Several studies have demonstrated that plasma testosterone levels are one of the best indexes of androgen production (Hatch *et al*., 1981). Testosterone production rates in normal women average 0.2 mg/day (Kirschner, 1984). There are data supporting that the high-affinity binding of the SHBG for T influences the cir-

culating levels of this sex steroid hormone, its biodisposal to target cells as well as its mutual balance (Pugeat *et al*., 1996). In our study, we found that all hirsute and non-hirsute women that were further examined by hormonal measurements, were normoprolactinemic and had normal TSH serum levels. TSH levels were evaluated to exclude any effect to SHBG concentrations.

We observed a significant difference in serum androgen levels between hirsute and non-hirsute women. In most hirsute women, serum androgen levels were increased (the elevation was more prominent in total T and less so in DHEAS levels). Tsigounis & Tsionis (1984) have evaluated the hormone levels in 50 Greek hirsute women, and the T levels have been also observed to increase. Furthermore, in another study among 250 Mexican women with moderate or severe hirsutism, testosterone level has been elevated in a percentage of 31% (Moran *et al*., 1994).

Among women with hirsutism, an adrenal tumor is unlikely if the patient has normal basal serum concentrations of T and DHEAS (Derksen *et al*., 1994). In a testosterone level of more than 2 ng/ml and a DHEAS level of more than 8000 ng/ml, tumors of the ovaries or the adrenal glands have to be excluded (Pichl & Schell, 1990). Hirsutism secondarily to endocrinopathies and tumors can typically be recognized by the rapid progression of hair growth (Marshburn & Carr, 1995). A rapidly progressing hirsutism has revealed a small ovarian hilus cell tumor (Marshall, 1997). Our study revealed a woman with a severe hirsutism and a rapid growth rate, acne, absent breast development and very high serum concentrations of testosterone (8,74 ng/ml) and DHEAS (>8000 ng/ml), who proved to have an adrenal tumor. No other women with serious diseases or virilisation were found in our sample.

The most common causes of hirsutism are familial, idiopathic, or polycystic ovarian disease (Delahnut, 1993; Kalve & Klein, 1996; Sakiyama, 1996). Women with polycystic ovary syndrome often complain of excessive facial hair, obesity, dysfunctional uterine bleeding, or infertility (Derman, 1996). The PCOS is the most common observation in hirsute patients (Spona & Aydinlik, 1989; Bassaw *et al*., 1992; Barth, 1997). Hirsutism is present in 70% of women with PCOS (Hatch *et al*., 1981). In 250 hirsute Mexican women ranging from 13 to 38 years, PCOS has been observed in a percentage of 53% (Moran *et al*., 1994).

It has been suggested by Barth (1992), that as most hirsute women have mild ovarian hyperandrogenism, they only require the appropriate tests for polycystic ovaries, and only those women who are virilised need intensive investigation. A simple protocol of investigation for PCOS besides the hormonal evaluation would ideally include pelvic ultrasonography (Morris, 1985), which was unfortunately not included in our study. However, we evaluated gonadotropin levels (LH and FSH) and while the FSH level was normal, the LH level in many cases was found elevated. While pituitary LH secretion is increased in PCOS, it does not appear that its ratio to FSH is always elevated in PCOS. Hair changes in PCOS are produced by the actions of circulating androgens, not by gonadotropins (Redmond, 1995). The elevated ratio LH/FSH when found (>2,5), among other factors (e.g. hirsutism, abnormal menses, obesity), made us to suggest a further ultrasonographic examination which led to the revelation of 16 out of 97 hirsute women (16.5%) with PCOS whereas 15 out of 495 non-hirsute women (3%) were found with PCOS (Table 4B). However, the real PCOS frequency is rather difficult to be defined. In bibliography, there is a great fluctuation for PCOS percentage. It has been observed in 1-5% of the general female population and in 3.5-7.5% of the reproductive women population, although it has been mentioned a percentage of 22% in this population (Panidis, 1991).

Obesity influences many endocrine functions, including alterations in sex hormone metabolism. Several studies on this subject have reported an increase in androgen production rate. Furthermore, obesity is associated with a decrease in SHBG, and consequently with an increase in free-hormone levels (Bernasconi *et al.*, 1996). In previous studies, it has also been observed that the vast majorities of hirsute women were overweight and had acne (Barth, 1992; Botwood *et al*., 1995; Pugeat *et al.*, 1996). We revealed that the body mass index was definitely correlated to hirsutism, as thin and normal Greek women were hirsute in 5.5% and 16.8%, whereas overweight and obese women were hirsute in 25.9% and 25.0% respectively. In a similar study, in 250 hirsute Mexican women (from 13 to 38 years), obesity was observed in a percentage of 18% (Moran *et al*., 1994). Although many Greek hirsute women were overweight, we did not observe any significant difference in serum SHBG concentrations between hirsute and non-hirsute women.

It has been suggested by Strauss *et al.* (1962) that

increased sebaceous gland function is of major importance in the etiology of acne. Since the sebaceous gland is a target of androgens, hormonal influences play an important role in the multifactorial pathogenesis of acne (Beylot *et al*., 1998). In our study, we also observed a statistically significant correlation between hirsutism and acne as it was detected in 53.6% of Greek hirsute women, which was expected (Table 2A).

We also observed a significant correlation between hirsutism and menstruation, since 36 out of 97 women (37.1%) with abnormal menses were hirsute, whereas 94 out of 495 women (19.0%) with abnormal menstrual cycles were non-hirsute (Ratio 2:1), (Table 2B).

Our sample was also questioned for receiving any pharmaceutical products that might affect hair growth. All "hair causing" drugs fall into one of two types: those that contain natural or synthetic hormones and those that do not contain hormones but do have the capacity to disturb the normal functioning of the body's endocrine system (Copperthwaite, 1998). We did not observe any significant correlation between the presence of hirsutism in women and drugs except for oral contraceptives (progesterone or estrogen/progesterone). Twenty eight hirsute women out of 97 (28.9%) and 52 out of 495 non-hirsute women (10.5%) had been treated with oral contraceptives (Table 4A). Oral contraceptives are reducing androgen expression and are suggested among others (anti-androgens, androgen receptor blockers) for the pharmacological treatment of hirsute (Young & Sinclair, 1998b), although some of them have the potential for initiating hair growth.

Increased hair growth constitutes a major problem for many women (von Werker & Muller, 1981; Rittmaster & Loriaux, 1987; Tews & Stoger, 1986). Manifestations of androgen excess at any age, especially in the female adolescent at a crucial time in personality development, can have significant effects on body image and should not be taken lightly (Nestler, 1989; Wild, 1992). Few hirsute women appear in public without removing as much visible hair as possible. While it may be surprising, in a similar study by Derogatis *et al*. (1993), in a sample of 20 hirsute women that were evaluated with regard to levels of serum androgens, nature and prevalence of psychological symptoms and mood effects, it has been suggested that depression among hirsute women appeared more likely to have its basis in a derangement in neuroendocrine mechanism rather than in psychological causes. Hirsutism, in spite of its frequency among Greek female population, causes psychological troubles to affected women. The majority of hirsute women of our sample were psychologically distressed, especially due to facial hirsutism that cannot be covered by clothing.

CONCLUSIONS

Our study revealed the prevalence of hirsutism in a random sample of Greek women and demonstrated the presence of hirsutism in correlation to factors that influence hair growth in women. Hirsutism is rather common among Greek women with a percentage of 16.4% and there are strong family influences. It is correlated to the body mass index, acne, menses, and PCOS. Androgens, especially testosterone (T) and dehydroepiandrosterone sulfate (DHEAS) that stimulate hair follicle and function of the sebaceous gland, were found elevated in most hirsute women. Hirsute women usually feel uncomfortably over their condition and try to get rid of unwanted hair.

REFERENCES

Azziz R, 1989. Reproductive endocrinologic alterations in female assymptomatic obesity. *Fertility sterility*, 52: 703-725.

Azziz R, Carmina E, Sawaya M, 2000. Idiopathic hirsutism. *Endocrine reviews*, 24: 347-362.

Bailey-Pridham DD, Sanfilippo JS, 1989. Hirsutism in the adolescent female. *Pediatrics clinics of north america*, 36: 581-599.

Barth JH, 1992. Hirsute women: should they be investigated? *Journal of clinical pathology*, 45: 188-192.

Barth JH, 1996. How robust is the methodology for trials of therapy in hirsute women? *Journal of clinical endocrinology*, 45: 379-380.

Barth JH, 1997. Investigations in the assessment and management of patients with hirsutism. *Current opinion on obstetrics and gynaecology*, 9: 187-192.

Bassaw B, Maharaj R, Ali A, Roopnarinesingh S, 1992. Therapeutic alternatives for the hirsute woman. *West indian medicine journal*, 41: 12-14.

Batrinos ML, 1982. *Endocrinology* (in Greek). Paschalidis Publications, Athens, Greece.

Bergfeld WF, Redmond GP, 1987. Hirsutism. *Dermatology clinics*, 5: 501-507.

Bernasconi D, Del Monte P, Meozzi M, Randazzo M, Marugo A, Badaracco B, Marugo M, 1996. The impact of obesity on hormonal parameters in hirsute and non-hirsute women. *Metabolism*, 45: 72-75.

Beylot C, Doutre MS, Beylot-Barry M, 1998. Oral contra-

ceptives and cyproterone acetate in female acne treatment. *Dermatology*, 196: 148-152.

Botwood N, Hamilton-Fairley D, Kiddy D, Robinson S, Franks S, 1995. Sex hormone-binding globulin and female reproductive function. *Steroid biochemistry molecular Biology*, 53: 529-531.

Carmina E, 1998. Prevalence of idiopathic hirsutism. *European journal of endocrinology*, 139: 421-423.

Copperthwaite D, 1998. Drugs and superfluous hair. *International hair route*, 76: 42-47.

Delahnut JW, 1993. Hirsutism. Practical therapeutic guidelines. *Drugs*, 45: 223-231.

Deplewski D, Rosenfield RL, 2000. Role of Hormones in pilosebaceous unit development. *Endocrine reviews*, 21: 363-392.

Derksen J, Nagesser SK, Meinders AE, Haak HR, Van de Velde CJ, 1994. Identification of virilizing adrenal tumors in hirsute women. *English medicine*, 331: 968-973.

Derman RJ, 1996. Androgen excess in women. *International journal of fertility and menopausal studies*, 41: 172-176.

Derogatis LR, Rose LI, Shulman LH, Lazarus LA, 1993. Serum androgens and psychopathology in hirsute women. *Journal of psychosomatic on obstetrics and gynaecology*, 14: 269-282.

Ferriman D, Gallwey JD, 1961. Clinical assessment of body hair growth in women. *Journal of clinical endocrinology and metabolism*, 21: 1440-1447.

Foster J, 1998. *Data Analysis Using SPSS for Windows.* SAGE Publications, Ltd.

Gilchrist VJ, Hecht BR, 1995. A practical approach to hirsutism. *American family physician*, 52: 1837-1846.

Goretzlehner G, 1979. Hirsutism–diagnosis and therapy. *Zeitschrift für Gesamte Innen Medizin*, 34: 624-628.

Harsoulis F, 1998. *Clinical Endocrinology* (In Greek). Pub. University Studio Press, Thessaloniki, Greece.

Hatch R, Rosenfield RL, Kim MH, Tredway D, 1981. Hirsutism: implications, etiology and management. *American journal of obstetrics and gynaecology*, 140: 815-830.

Howitt D, Cramer D, 1999. *A guide to computing Statistics with SPSS for Windows.* Pearson Education Limited Edinburg.

Kalve E, Klein JF, 1996. Evaluation of women with hirsutism. *American family physician*, 54: 117-124.

Kirschner MA, 1984. Hirsutism and virilism in women. *Special topics on endocrinology and metabolism*, 6: 55-93.

Kirschner MA, Zuckeer IR, Jespersen D, 1976. Idiopathic hirsutism-an ovarian abnormality. *North english medicine*, 294: 637-640.

Kuttenn F, Mauvais-Jarvis P, 1978. Hirsutism. *Gynaecology and obstetrics in biology of reproduction*, (Paris) (3 Pt 2): 693-701.

Leshin M, 1987. Hirsutism. *American journal of medical sciences*, 294: 369-383.

Lunde O, Grottum P, 1984. Body hair growth in women: normal or hirsute. *American journal of physical anthropology*, 64: 307-313.

Marshall LA, 1997. Facial hair on a woman: Diagnosing and treating a pathological twist on a common problem. *Medscape womens health*, 2:3.

Marshburn PB, Carr BR, 1995. Hirsutism and virilization. A systematic approach to benign and potentially serious causes. *Postgraduate medicine*, 97: 99-102.

McKnight E, 1964. The prevalence of hirsutism in young women. *Lancet*, 1:410-413.

Moran C, Tapia MC, Hernandez E, Vazquez G, Garcia-Hernandez E, Bermudez JA, 1994. Etiological review of hirsutism in 250 patients. *Archives of medical research*, 25: 311-314.

Morris DV, 1985. Hirsutism. *Clinics of Obstetrics and Gynaecology*, 12: 649-674.

Nestler JE, 1989. Evaluation and treatment of the hirsute woman. *Va Medicine*, 116: 310-315.

Panidis D, 1991. *The polycystic ovarian syndrome (PCOS).* Monography, (in Greek) Melissa Publications, Asprovalta, Greece.

Pichl J, Schell H, 1990. Endocrinologic diagnosis in hirsutism and androgenetic alopecia in women. *Zeitschrift für Hautkrankheiten*, 54: 1103-1104.

Pugeat M, Crave JC, Tourniaire J, Forest MG, 1996. Clinical utility of sex hormone-binding globulin measurement. *Hormone research*, 45: 148-155.

Redmond GP, 1995. Androgenic disorders of women: diagnostic and therapeutic decision making. *American journal of medicine*, 98: 120S-129S.

Rittmaster RS, 1995. Clinical relevance of testosterone and dihydrotestosterone metabolism in women. *American journal of medicine*, 98: 17S-21S.

Rittmaster RS, Loriaux DL, 1987. Hirsutism. *Annals of international medicine*, 106:95-107.

Rosenfield RL, Lucky AW, 1993. Acne, hirsutism, and alopecia in adolescent girls. *Endocrinology and metabolism clinics of north america*, 22: 507-532.

Sakiyama R, 1996. Approach to patients with hirsutism. *West journal of medicine*, 165: 386-391.

Schwartz FL, Flink EB, 1985. Hirsutism. Pathophysiology, clinical evaluation, treatment. *Postgraduate medicine*, 77: 81-86.

Speroff L, Glass RH, Kase NG, 1994. *Clinical Gynecologic Endocrinology and Infertility*. 5th ed. Baltimore: Williams and Wilkins.

Spona J, Aydinlik S, 1989. *Hirsutism and Endocrine Dermatological Problems. Proceedings of a symposium held at the XII World Congress of Gynecology and Obstetrics, Rio de Janeiro. October 1988.* The Parthenon Publishing Group Ltd. UK, USA.

Strauss JS, Klingman AM, Pochi PE, 1962. The effect of

androgens and estrogens on human sebaceous glands. *Journal of investigation in dermatology*, 39: 139-155.

Tellez R, Frenkel J, 1995. Clinical evaluation of body hair in healthy women. *Review in medicine CM*, 123: 1349-1354.

Tews G, Stoger H, 1986. Hirsutism-diagnosis and therapy. *Wiener Medizinische Wochenschreibe*, 136: 301-307.

Thiboutot MD, 1995. Dermatological manifestations of endocrine disorders. *Journal of clinics on endocrinological metabolism,* 80: 3082-3084.

Tsigounis B, Tsionis CH, 1984. Hormonal levels in hirsute women (In Greek). *Journal of medicine,* 7: 229-302.

von Werker KU, Muller OA. 1981. Hirsutism. Diagnosis and therapy. *Fortschritt in Medizin*, 99: 849-854.

Wild RA, 1992. Hyperandrogenism in the adolescent. *Obstetrics and gynaecological clinics of north america*, 19: 71-89.

Yalow RS, Berson SA, 1960. Immunoassay of endogenous plasma insulin in man. *Journal of investigation*, 39: 1157-1175.

Young R, Sinclair R, 1998a. Hirsutes. I: Diagnosis. *Australas journal of dermatology*, 39: 24-28.

Young R, Sinclair R, 1998b. Hirsutes. II: Treatment. *Australas journal of dermatology*, 39: 151-157.