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# The prevalence of polycystic ovary syndrome in Iranian women based on different diagnostic criteria

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**Abstract**

**Background:** This study aimed to determine the prevalence of polycystic ovary syndrome (PCOS) in Iranian women based on different diagnostic criteria.

**Material and methods:** This cross-sectional study was conducted in 2009 in Isfahan, Iran among females referred to the mandatory pre-marriage screening clinic. Menstrual irregularity was assessed as the presence of chronic amenorrhea or a menstrual cycle length of less than 21 days or more than 35 days, or more than four days of variation between cycles. Clinical hyperandrogenism was assessed as the self-reported degree of hirsutism using the modified Ferriman Gallwey (mF-G) scoring method based on a chart displaying degree of hair growth in nine regions. Those participants who reported menstrual irregularity and/or who had an mF-G score of ≥ 8 were invited for a clinical examination. Those who did not have these criteria were not further evaluated and were deemed not to have PCOS. Participants with abnormal findings underwent blood test and abdominal sonography of their ovaries. In those with hirsutism, serum was obtained on the 22$^{nd}$–24$^{th}$ day of the cycle for the measurement of progesterone; free testosterone was measured in those with menstrual irregularity.

**Results:** The estimated prevalence of PCOS was 7% based on the NIH criteria, 15.2% under the Rotterdam criteria, and 7.92% according to the AES criteria.

**Conclusion:** The Rotterdam prevalence estimates were double those obtained with the NIH criteria. This study can be used for international comparisons because it was conducted on a representative sample of females using different criteria for the definition of PCOS.
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***Key words:*** *polycystic ovary, hirsutism, menstrual dysfunction, prevalence*

## Introduction

Polycystic ovary syndrome (PCOS) is the commonest endocrine disorder in women of reproductive age [1]. These patients are at higher risk of developing infertility, dysfunctional uterine bleeding and a number of metabolic disorders including insulin resistance, diabetes mellitus, hypertension and dyslipidemia [2].

In spite of the potential public health impact of PCOS, estimates regarding its prevalence are surprisingly scarce, with wide variations ranging from 2.2% to as high as 26% [3]. This variability could be due to several factors, one of the most important being the difference in diagnostic criteria used. Currently there are three definitions of PCOS usually used.

The first arose from the proceedings of an expert conference sponsored in part by the National Institute of Child Health and Human Disease of the U.S. National Institute of Health (NIH) in 1990.The NIH diagnostic criteria state that women have PCOS if they present with the combination of chronic oligo- and/or anovulation and clinical or biochemical signs of hyperandrogenism, with the exclusion of related disorders [4].

The second expert conference was convened in Rotterdam, the Netherlands in 2003 by the European Society for Human Reproduction and Embryology and the American Society for Reproduction Medicine. The meeting recommended that PCOS be defined when at least two of the following three features were present:
— oligo- and/or anovulation
— hyperandrogenism
— polycystic ovaries.

These criteria also recognise that other causes of androgen excess and related disorders should be excluded before confirming the diagnosis of PCOS [5–6].

The third and the most recent set of criteria was defined by a task force of the Androgen Excess Society (AES) in 2006, which recommended the following diagnostic criteria for PCOS:
— hirsutism and/or hyperandrogenism;

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— oligo- and anovulation and/or polycystic ovaries;
— other androgen excess or related disorders should be excluded [7].

Another suggestion for the marked differences in the prevalence of PCOS is that the clinical characteristics and biochemical features of these patients may vary according to race and ethnicity [8]. Furthermore, the prevalence of PCOS may differ according to the age and the population studied. The prevalence of PCOS seems to be higher in younger women than in those aged over 35 years [9]. Moreover, differing populations in various studies affect the estimated prevalence of PCOS.

For instance, the study by Azziz et al. among 400 non-randomly selected pre-menopausal women, aged 18–45 years, seeking a pre-employment physical at the University of Alabama found a PCOS prevalence of 8% in black and 4.8% in white women based on the NIH criteria [10]. The study by Asuncion et al. conducted among 154 white female blood donors Spain found 6.5% to have PCOS based on NIH criteria [11]. Compared to the general population, university employees are likely to have higher socio-economic status, and blood donors are likely to be healthier. Thus such information cannot be representative and should not be generalised.

Information about the prevalence of PCOS in the Iranian population is scarce. The aim of this study was to estimate the prevalence of PCOS in a representative sample of Iranian females, and to compare it according to different sets of criteria.

## Material and methods

This cross-sectional study was conducted in 2009 in Isfahan, the second largest city in Iran. The study population comprised females referred to the mandatory pre-marriage screening clinic affiliated to Isfahan University of Medical Sciences. These females were invited to participate in PCOS screening. This study was approved by the Ethics Committee of Isfahan University of Medical Sciences. Written informed consent was obtained from all participants.

A resident of Obstetrics and Gynaecology conducted interviews by taking a medical history and focusing on symptoms of PCOS, specifically menstrual irregularities, clinical hyperandrogenism and medication use including hormone therapy. Weight and height were measured by standard protocol and calibrated instruments. Body mass index (BMI) was calculated as weight (kg) divided by height squared ($m^2$). Menstrual irregularity was assessed as the presence of chronic amenorrhea or a menstrual cycle length of less than 21 days or more than 35 days, or more than four days variation between cycles. Clinical hyperandrogenism was assessed as the self-reported degree of hirsutism using the modified Ferriman Gallwey (mF-G) scoring method based on a chart displaying degree of hair growth in nine regions.

Those participants who reported menstrual irregularity and/or had an mF-G score of 8 were invited for a clinical examination. Those who did not have these criteria were not further evaluated and were deemed not to have PCOS.

All participants with abnormal findings consented to a blood test and an abdominal sonography of their ovaries; vaginal sonography was not considered because they were virgins. Serum TSH (TSH.IRMA Pooyesh Tashkhis, Tehran, Iran), prolactin (PRL, IRMA Pooyesh Tashkhis, Tehran, Iran) and 17-hydroxyprogesterone levels were measured. In addition, in participants with only hirsutism, serum was obtained on the $22^{nd}$–$24^{th}$ day of the menstrual cycle for the measurement of progesterone to confirm ovulatory function. A progesterone level of less than 4 ng/ml indicated anovulation for evaluation purposes. In women with only menstrual irregularity, free testosterone was measured. Free testosterone was used to assess hyperandrogenemia because it was considered one of the more sensitive methods in the Rotterdam ESHRE/ASRM-sponsored PCOS consensus workshop group [5]. Free testosterone was calculated from the total testosterone and SHBG levels. A testosterone level higher than 0.75 ng/dl considered to be high. Clinical hirsutism was defined by an mF-G score ≥ 8 derived from the $95^{th}$ percentile of this population of healthy non-hirsute eumenorrheic women. Ultrasonography (US) was performed for participants with menstrual dysfunction and/or hirsutism.

Polycystic ovaries were identified on ultrasonography (ALOKA 1000, 7.5 MHz probe) by either 12 or more follicles with a 2–9 mm diameter, or increased ovarian volume ( > 10 cm) in at least one of the ovaries [11, 12].

Then, participants were subdivided according to the presence or absence of menstrual dysfunction or anovulation, hirsutism or high free testosterone (HA) and polycystic ovary on US into four groups:
— menstrual dysfunction and hirsutism or hyperandrogenemia;
— menstrual dysfunction and PCO morphology in US;
— hirsutism or hyperandrogenemia and PCO morphology in US;
— menstrual dysfunction and hyperandrogenemia or hirsutism and PCO morphology in US.

Confirmed PCO was established in those individuals whose evaluation was complete and met the abovementioned criteria. Possible PCOS was considered when the evaluation was not complete or was unavailable, but the clinical phenotype was suggestive of this disorder.

The individual probability of PCOS in women with possible PCOS was assigned a weight based on the find-

ings in similar subjects whose evaluation was complete, i.e. number of confirmed PCOS in category/number of patients with complete evaluation. The number of additional calculated PCOS was considered as equal to the number of women with possible PCOS probability that patients with possible PCOS have PCOS.

Data analysis was performed using SPSS version 15.0 (SPSS Inc., Chicago, USA).

## Results

Between May 1–28, 2009, a total of 1,182 females, aged 17–34, attended the aforementioned pre-marriage clinic. They were invited to participate in PCOS screening. Two subjects were excluded due to thyroid hormone replacement therapy, and 360 (30.5%) refused to participate, giving a total of 820 subjects (69.5% of invited individuals) available for the current study. Those individuals who refused to participate in this study did not differ from the participants in terms of mean age (24.2 ± 5.3 *vs.* 24.8 ± 5.1 years, respectively), or BMI (25 ± 6.7 *vs.* 25.7 ± 4.3 kg/m$^2$, respectively) (Table I).

Overall, 19% of participants were overweight (BMI: 25.0–29.9 kg/m$^2$) and 9% were obese (BMI 30 kg/m$^2$). Hormone therapy for treatment of menstrual dysfunction or hirsutism was documented in 15 individuals; as the prevalence of hirsutism and menstrual dysfunction before hormone therapy did not differ from those not under treatment, they were not excluded from the study. For determination of PCOS, participants were subdivided based on the presence or absence of menstrual dysfunction and hirsutism into four groups (Figure 1):

1. Individuals without menstrual dysfunction and hirsutism: of the 820 participants, 599 were eumenorrheic and non-hirsute, therefore the diagnosis of PCOS was ruled out.
2. Individuals with menstrual dysfunction only: 175 subjects (21.3% of the total) had menstrual dysfunction without hirsutism. Of these 175 subjects, six (3.42%) had amenorrhea, 16 (9.10%) and 99 (56.5%) had menstrual cycle length of less than 21 days and more than 35 days respectively, and 54 (30.8%) had more than four days' variation between cycles. Overall, 91 subjects had complete evaluation by US and blood tests (Figure 1). The remaining 77 subjects had incomplete evaluations, and were considered to have possible high testosterone or PCO morphology in US. The individual's probability of high testosterone or PCO morphology was calculated within each phenotype by multiplying the proportion with high testosterone or PCO morphology in the group completing evaluation, by the number not undertaking an evaluation (e.g. for calculation of probability of high testosterone and PCO morphology 4/91 77 (91 subjects completed evaluation of whom four had high testosterone and PCO morphology, and 77subjects in this group had incomplete evaluation).
3. Individuals with hirsutism only: 33 subjects had hirsutism without menstrual dysfunction, 22 had complete evaluation (Figure 1).
4. Individuals with menstrual dysfunction and hirsutism: 25 subjects had hirsutism + MD. The cumulative number of PCOS subjects in the study population included 57.77 subjects among 820 women in the group with the NIH criteria, and 124.67 subjects among 820 women in the group with the Rotterdam criteria, and 67.70 subjects among 820 in the AES group. The prevalence of PCOS according to the NIH, AES and Rotterdam criteria was 7, 7.92 and 12.50 per cent respectively.

## Discussion

In spite of the considerable reproductive, endocrine and metabolic morbidity of PCOS, little is known of its prevalence in the general population. Because of differences in terms of ethnicity and the clinical characteristics

**Table I.** *Mean (SD) of characteristics and F-G grade for hirsutism in four groups of patients with polycystic ovary syndrome*

| | HA+ MD | HA + PCO | MD + PCO | MD + HA + PCO |
|---|---|---|---|---|
| Age (years) | 29.11 ± 3.59 | 38.31 ± 2.9 | 28.98 ± 8.9 | 28.89 |
| Height [cm] | 160 ± 5.4 | 161 ± 4.4 | 160 ± 65 | 160 ± 9.1 |
| Weight [kg] | 67 ± 17.9 | 63 ± 9.2 | 65 ± 12.1 | 64 ± 13.1 |
| Body mass index [kg/m$^2$] | 25.7 ± 4.3 | 25.3 ± 5.6 | 25.12 ± 4.6 | 25 ± 6.7 |
| Waist circumference [cm] | 80.7 ± 11 | 80 ± 13 | 78 ± 9.9 | 79 ± 15 |
| Hip circumference [cm] | 102.5 ± 8 | 101.6 ± 11 | 99 ± 8.4 | 101 ± 13 |
| F-G grade | 7.8 ± 6.5 | 7.9 ± 2.9 | 3.92 ± 1.92 | 7.8 ± 4.5 |

PCO — polycystic ovary syndrome; HA — hirsutism; MD — menstrual dysfunction

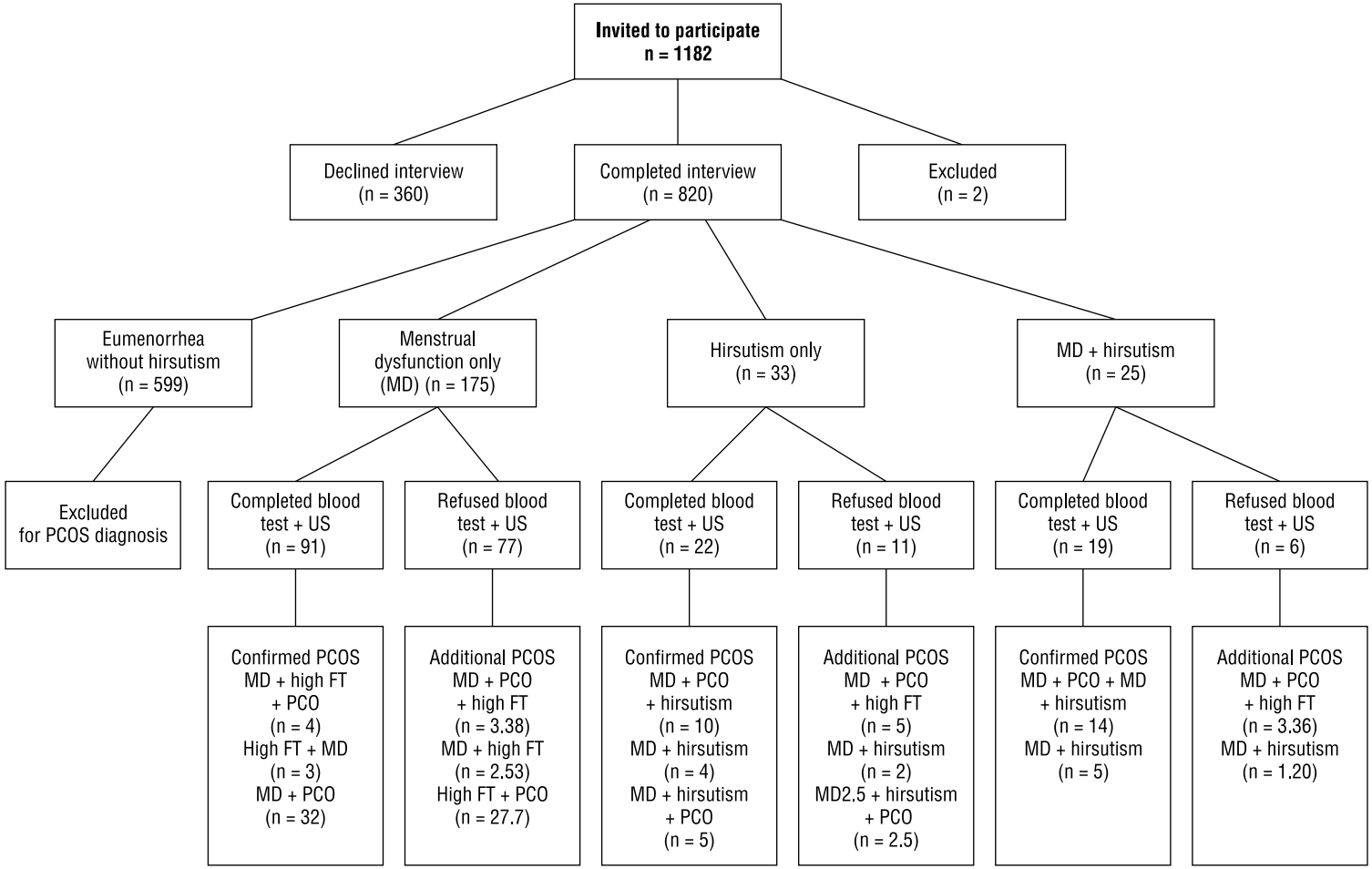


**Figure 1.** *Flow chart of the study*

and biochemical features, Iranian PCOS patients may differ from those of other populations [8].

In the current study, participants were of similar ethnic origin and included a population who were mandated to attend the pre-marriage clinic. In our study, the prevalence of PCOS was 7% based on NIH criteria. The corresponding figures were 6.5% in the study by Asuncion et al., conducted among 154 Caucasian women of reproductive age referred for blood donation [11], and 6.6% in the study by Azziz et al., performed among 400 non-random samples of pre-menopausal women seeking pre-employment physical examination [10]. The higher prevalence obtained in our study may be because of the larger number and the community-based nature of the participants included in our study. These are the main strengths of our study.

The prevalence of PCOS in our study was 15.2% based on Rotterdam criteria, i.e. more than twice the prevalence obtained based on NIH criteria. This prevalence was 12% in the study by Lowe et al., conducted among 100 subjects non-randomly selected from female partners of azospermic men [13], and 17.8% in the study by March et al. performed among 728 women [14]. Taking into account that the prevalence of PCOS is reported to be somewhat higher by using trans-vaginal US [9, 15], the lower prevalence of PCOS, based on Rotterdam criteria, in our study compared to the study by March et al. might be because they used trans-vaginal US, whereas we used trans-abdominal US.

By considering the AES criteria, the prevalence of PCOS was 7.92 % in our study, and was lower than the prevalence of 12% documented in the study by March et al. [14]. This difference might be because of ethnic differences and variations in androgen assay.

Given that a healthy lifestyle, notably exercise training, is documented to have beneficial effects on the cardiopulmonary system in PCOS women [16], screening and early detection of this syndrome would be helpful in advising lifestyle change, and in turn reducing the risk of cardiovascular diseases.

## Conclusion

The concept that many cases of PCOS can be diagnosed based on the Rotterdam criteria, but not based on the NIH and AES criteria, should be considered in new sets of diagnostic criteria for PCOS in the community. The representative sample of participants studied, and the use of different criteria for the definition of PCOS in the current study, provide useful data for international comparisons.

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## Conflict of interest

None to disclose.

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