Changes in the prevalence of polycystic ovary syndrome in China over the past decade

Rui Yang,a,b,c,d Qin Li,a,b,c,d Zehong Zhou,e,f Weiping Qian,g Jian Zhang,h Ze Wu,i Lei Jin,j Xueqing Wu,k Cuilian Zhang,l Beihong Zheng,m Jichun Tan,n Guimin Hao,o Shangwei Li,p Tian Tian,a,b,c,d Yongxiu Hao,a,b,c,d Danni Zheng,a,b,c,d Yuanyuan Wang,a,b,c,d Robert J. Norman,q Rong Li,a,b,c,d* Ping Liu,a,b,c,d* and Jie Qiao,a,b,c,d*

aCenter for Reproductive Medicine, Department of Obstetrics and Gynecology, Peking University Third Hospital, Beijing 100191, China
bNational Clinical Research Center for Obstetrics and Gynecology, Beijing 100191, China
cKey Laboratory of Assisted Reproduction (Peking University), Ministry of Education, Beijing 100191, China
dBeijing Key Laboratory of Reproductive Endocrinology and Assisted Reproductive Technology, Beijing 100191, China
eGuangzhou Institute of Pediatrics, Guangzhou Women and Children’s Medical Center, Guangzhou Medical University, Guangzhou 510623, China
fDepartment of Obstetrics and Gynecology, Guangzhou Women and Children’s Medical Center, Guangzhou Medical University, Guangzhou 510623, China
gDepartment of Obstetrics and Gynecology, Peking University Shenzhen Hospital, Shenzhen 518036, China
hDepartment of Pathophysiology, Key Laboratory of Cell Differentiation and Apoptosis of Chinese Ministry of Education, Shanghai Jiao Tong University, School of Medicine, Shanghai 200240, China
iDepartment of Reproductive Medicine, The First People’s Hospital of Yunnan Province, Kunming 650021, China
jReproductive Medicine Center, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China
kReproductive Medicine Center, Children’s Hospital of Shanxi and Women Health Center of Shanxi, Affiliated Hospital of Shanxi Medical University, Taiyuan 030000, China
lReproductive Medical Center, Henan Provincial People’s Hospital, Zhengzhou 450003, China
mReproductive Medicine Center, Fujian Maternity and Child Health Hospital, College of Clinical Medicine for Obstetrics & Gynecology and Pediatrics, Fujian Medical University, Fuzhou 350001, China
nCenter of Reproductive Medicine, Department of Obstetrics and Gynecology, Shengjing Hospital of China Medical University, Shenyang 110022, China
oDepartment of Reproductive Medicine, The Second Hospital of Hebei Medical University, Shijiazhuang 050000, China
pDivision of Reproductive Medical Center, West China Second University Hospital of Sichuan University, Chengdu 610041, China
qDiscipline of Obstetrics/Gynecology, Robinson Research Institute, The University of Adelaide, Adelaide, SA 5005, Australia

Summary

Background Polycystic ovary syndrome (PCOS) has become a major international public health concern. However, because of controversy about the diagnostic criteria and patient selection, estimates of its absolute prevalence and change with time vary greatly.

Methods We conducted two consecutive nationwide epidemiological surveys of the prevalence of PCOS in representative samples of reproductive-aged women in China in 2010 and 2020. Face-to-face interviews were performed by trained interviewers in each survey. All participants completed a questionnaire and underwent a physical examination, blood sampling, and transvaginal pelvic ultrasound. We assessed hyperandrogenism (H), chronic anovulation (O), and polycystic ovaries (P) to classify the presence of PCOS using the Rotterdam criteria. The prevalence of PCOS among reproductive-aged women was estimated after consideration of differential probabilities of selection and population distribution. We conducted a logistic regression analysis by using the probability of PCOS as a function of the survey year to acquire the trend information across the years.

Findings 28,739 respondents completed the survey, including 15,924 in the previously published 2010 survey and 12,815 in the new 2020 survey. In 2020, 826 participants could be diagnosed as having PCOS, with a weighted prevalence of 7.8% (95% CI: 7.0%, 9.0%) among women aged 20-49 years, leading to an estimate of 24.0 million

*Correspondences to: Jie Qiao, Rong Li, or Ping Liu.
E-mail addresses: roselao01@sina.com (R. Li), pingliuy7703@sina.com (P. Liu), jie.qiao@263.net (J. Qiao).
# Rui Yang and Qin Li were listed as joint first authors.
women of reproductive age affected by this condition in China as a whole. The estimated prevalence in 2020 was higher than that of a decade ago despite identical research methods suggesting a two-thirds increase over the study period. Women with PCOS in 2020 also appeared to have a more severe phenotype overall than those of a decade ago, possibly reflecting a significantly higher prevalence of obesity, hyperandrogenism, and infertility.

**Interpretation** The prevalence of PCOS in Chinese women has increased significantly over the past 10 years. PCOS is a significant public health problem in women of reproductive age in China and national policy and guidelines should be re-examined in the light of the current data.

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**Research in context**

**Evidence before this study**

We searched PubMed and the China National Knowledge Infrastructure database for articles published up to Dec 31, 2021, using the terms “polycystic ovary syndrome”, “PCOS”, “prevalence”, and “epidemiology”. We screened papers by reviewing abstracts to identify full-text reports that were relevant to the study aims and identified two large community population-based studies which were conducted in China during 2007-2010 with a prevalence of 5.6% and in Sri Lanka during 2005-2006 with a prevalence of 6.3%. However, in the study from Sri Lanka, only ‘probable cases’ who were identified by an interviewer-administered questionnaire underwent clinical, biochemical, and ovarian ultrasound assessments. Both the two studies did not consider the difference in age distribution between the sample population and the total population. We also identified a meta-analysis based on the Global Burden of Disease Study 2017 estimated that the global PCOS incidence rate increased by 1.45% (1.43-1.47%) from 2007 to 2017. However, reliable and accurate information on the trends in the prevalence of PCOS among women of reproductive age during the last decade is urgently needed.

**Added value of this study**

We report what is, to our knowledge, the largest and most comprehensive PCOS survey to date from a nationally representative sample of 15,924 participants in 2010 and 12,815 participants in 2020. It is also the first to carry out ultrasounds and blood tests using the same methodology on all participants who were recruited through a random sampling process. Our results show that the estimated overall prevalence of PCOS was 7.8% (95%CI: 7.0%, 9.0%) in 2020, leading to an estimate of 24.0 million women of reproductive age affected by this condition in China as a whole. The estimated prevalence was higher than that of a decade ago despite identical research methods. Women with PCOS in 2020 also appeared to have a more severe phenotype overall than those of a decade ago.

**Implications of all the available evidence**

Our study shows that estimated PCOS prevalence in China increased significantly from 2010 to 2020 and women with PCOS in 2020 have a more severe phenotype overall. Guidelines aimed at the prevention and management of PCOS in women in the community should be re-examined in light of the current data. However, education, self-empowerment, multidisciplinary care, and lifestyle intervention should be prioritized to optimize hormonal and reproductive outcomes, as well as the quality of life across the life course.

**Introduction**

Polycystic ovary syndrome (PCOS) is a major endocrinopathy among women of reproductive age characterized by a clustering of hyperandrogenism, hyperinsulinemia, metabolic syndrome, menstrual dysfunction, and infertility, hirsutism, and pregnancy and neonatal complications.¹ PCOS also contributes significantly to other long-term health risks, such as type II diabetes mellitus (DM2), predisposition to cardiovascular disease (CVD) as well as anxiety and depressive disorders.² However, even though this disorder has become a major international public health concern, prevalence estimates vary greatly among different populations, ranging from 4% to 20%,³ indicating a need to accurately identify the proportion of women affected so appropriate national health policies can become devised.

The diagnosis of PCOS has been historically based on the National Institutes of Health (NIH) consensus now superseded by the Rotterdam criteria.¹ Both of the
criteria are logistically difficult with the necessity to carry out blood and ultrasound tests. As a result, there are few genuine prevalence studies with those available being based on special samples such as employees or hospital populations and generally not exceeding 1,000 participants. Only two large community-based studies have been reported which were conducted in China during 2007-2010 with a prevalence of 5.6% and in Sri Lanka during 2005-2006 with a prevalence of 6.3%. However, in the study from Sri Lanka, only ‘probable cases’ who were identified by an interviewer-administered questionnaire underwent clinical, biochemical, and ovarian ultrasound assessment. Both the two studies did not consider the difference in age distribution between the sample population and the total population.

There have been rapid changes in lifestyle in China over the past decade which may have changed the prevalence of PCOS in Chinese women of reproductive age. In addition, because of diversity in the diagnostic criteria and participant selection, estimates of the absolute prevalence vary greatly among populations and even among studies from the same population. The lack of identical research methods makes it difficult for us to estimate changes in the prevalence with time.

To address the shortfalls discussed, this present study reports detailed analyses of two consecutive large community-based, highly inclusive surveys for reproductive health which were carried out in 2010 and 2020. We aimed to provide representative estimates of PCOS in Chinese women of reproductive age. We also sought to examine the long-term trends in the prevalence of PCOS over the past decade, with specific emphasis on changes in subtypes and complications.

Methods
Participants
The China Fertility Survey of Married Women (CFSMW) program was established in 2005 to monitor the fertility and allied risk factors of Chinese women of reproductive age. We have previously reported the results of the survey we conducted in 2010. In the 2020 CFSMW survey we used identical methods to repeat the survey. A representative sample was selected using a multistage stratified sampling scheme. Briefly, we firstly selected 15 provinces from mainland China, geographically distributed in southeast, southwest, central, and northeast regions. Secondly, we selected 3 towns or districts from each province according to their degree of urbanization and population size. Finally, a random sampling method was used to select 2-4 villages/residential areas from each township or district. Married women who were aged 20–49 years and had lived in the selected village/residential area for 6 months or longer were identified, and 100 eligible women of ethnic Han lineage were invited to participate in the study. A total of 13,508 married women respond to the invitation and signed informed consent forms. They were visited by medical workers from January 2019 to December 2020. After the exclusion of 408 women who were <20 or >49 years of age at the time of the visit and 285 women for whom data on their fertility condition was lacking, 12,815 participants were involved in the final analysis. We had recruited 15,924 participants aged 20-44 years from the 2010 CFSMW for the analysis; the selection processes have been described elsewhere and are summarized in the appendix (pp. 1 and Figure S1). The survey was approved by the Ethics Committee of Peking University Third Hospital, Beijing, China (2019ZS-054).

Questionnaire, ultrasound, and laboratory examinations
All the participants underwent a free medical evaluation, including a questionnaire, physical examination, blood testing, and transvaginal pelvic ultrasound. We used the same questionnaire to collect details regarding demographic information, menstrual history, marital history, obstetric history, and skin problems associated with endocrine and metabolic diseases (i.e., acne and hirsutism) in the 2010 and 2020 surveys. After the questionnaire, every participant received a physical examination, including a modified Ferriman–Gallwey (mF-G) score, assessments of acne, premature alopecia, and any possible uterine and/or ovarian issues. Participants also underwent a blood test for the levels of sex hormone-binding globulin (SHBG), total testosterone (TT), and androstenedione (A), and a transvaginal ultrasound examination for the status of the uterus and ovaries. Endocrine measurements were performed using a Siemens Immulite 2000 immunoassay system (Siemens Healthcare Diagnostics, Shanghai, P. R. China). All investigators were fully trained by the chief investigators to ensure consistency across teams. Qualified clinical staff performed physical examinations, venipuncture, and transvaginal ultrasound examinations in each survey site according to a standard protocol. Detailed information about the examinations has been described elsewhere.

Outcome Definitions
According to the Rotterdam diagnostic criteria, participants with the presence of two or more of the following three criteria: oligo/amenorrhea (O), clinical and/or biochemical hyperandrogenism (H), and polycystic ovaries (P) and exclusion of other aetiologies are diagnosed as PCOS. Detailed information about the diagnostic process has been described elsewhere. Briefly, oligo/amenorrhea (O) was defined as irregular cycles of duration ≥35 days; hyperandrogenism (H) included clinical and
biochemical hyperandrogenism (the former is defined as an mF-G score of ≥4 [or ≥2 in the lower abdomen, thighs, and upper lip] with/without acne).13 and/or androgenic alopecia; the latter is defined as a total testosterone level of ≥2.81 nmol/L or an androstenedione level of >10.8 nmol/L.13) These values were identical between the two surveys. A positive finding of polycystic ovaries (P) required 12 or more follicles measuring 2-9 mm in diameter. We did not count cases with increased ovarian volume (>10 cm) as ovarian volume is affected by the menstrual cycle and it is difficult to examine at a particular time of the menstrual cycle in a field survey. We used the same criteria for diagnosis and the same transducer frequency as in 2010. PCOS patients were divided into four phenotypes: type I, oligo/amenorrhea and hyperandrogenism (O+H); type II, polycystic ovaries and hyperandrogenism (P+H); type III, oligo/amenorrhea and polycystic ovaries (O+P); and type IV, oligo/amenorrhea, polycystic ovaries and hyperandrogenism (O+P+H). These correspond to types A-D described by Azziz et al.13

Statistical analysis
We estimated the weighted prevalence of PCOS among all participants based on sampling weight and post-stratification weight.44 Sampling weights at each stratum were equal to the reciprocal of the relevant sampling probability. Post-stratification weight was estimated based on age (20-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, or 45-49 years) according to the sixth national population census of 2010.13 We estimated standard errors (SEs) and then determined the 95% CI for the prevalence estimates using the Taylor series linearization method.44 A multivariate logistic regression model was used to estimate the odds ratio (OR) and 95% confidence interval (95%CI) of PCOS, by several socio-demographic characteristics (e.g., age at interview, academic attainment; annual household income per capita). To acquire the trend information across years, we conducted logistic regression by using the percentage change of 66% (p<0.05). However, we did not observe an increased trend for the H+O subtypes (Table 2). We repeated the above analysis in participants under 30 years old and 30 years old and above, respectively, and found the same trend of change (Table S2).

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Results
In the 2020 survey, 12,815 participants aged 20-49 years were involved in the final analysis. The mean age of all participants was 36.8 ± 7.1 years. 6,884 (53.7%) of the participants were urban citizens, 7,223 (55.5%) had a college education, and 2,290 (17.9%) had not raised a child until surveyed. Most of the participants reported that they were free from tobacco (95.0%) and alcohol (84.2%) exposure. 1,192 (9.3%) of the study participants were obese, 3,220 (25.1%) were overweight, and 734 (5.7%) were underweight (Table S1).

Of the 12,815 women interviewed, 1,695 were classified as hyperandrogenemia, 1,703 had had a history of oligo/amenorrhea and 1,267 had polycystic ovaries on ultrasound (Figure 1). According to the Rotterdam criteria, 826 of them could be diagnosed as having PCOS, with a weighted prevalence of 7.8% (95%CI: 7.0%, 9.0%).

The prevalence of PCOS decreased sharply with age, dropping from 14.7% (95%CI: 11.6%, 18.6%) in women aged 20 to 24 years to 1.2% (95%CI: 0.7%, 1.8%) in women aged 45 to 49 years (Table 1). However, with the age-specific prevalence, it was estimated that there were 24.0 million women who had PCOS in China (Figure S2). We found that educational attainment and BMI were associated with PCOS in univariate analysis (p<0.05). However, in multivariate logistic regression models, we only confirmed that PCOS was more likely among overweight (OR, 1.64; 95% CI, 1.36 to 1.97) or obese (OR, 2.77; 95% CI, 2.20-3.48) women when compared with normal-weight women. Rural women, women with higher education or lower income, smoking, and drinking also tended to have a higher risk of PCOS. But the associations were not statistically significant due to larger standard errors.
4.2% and 13.0%, which had increased to 9.2% and 18.1% in the 2020 survey ($p < 0.001$). The proportion of PCOS patients with hyperandrogenemia, defined as a free androgen index (FAI) $> 5.0$, increased from 36.1% in the 2010 survey to 47.0% in the 2020 survey ($p < 0.001$). We repeated the above analysis in participants of different age groups, and the upward trend did not change (Table S3). In addition, a significant proportion of non-hyperandrogenic PCOS women exhibited metabolic dysfunction such as overweight, obesity and high blood pressure, and this number was comparable to that of women with hyperandrogenic PCOS (Table S4).

We performed sensitivity analyses involving 8 provinces (Liaoning, Beijing, Tianjin, Shanxi, Henan, Sichuan, and Guangdong provinces) which were covered in both surveys with no changes in geographical boundaries. We observed similar results to the main analyses, including an increasing trend in the prevalence of PCOS and an increased

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**Figure 1.** Flow charts of inclusion and process for identifying women with PCOS in 2020 CFSMW.
Discussion
This study is the first to carry out ultrasounds and blood tests using the same methodology on all participants who were recruited through a random sampling process. With these methodological strengths, we estimated the prevalence of PCOS under the Rotterdam criteria to be 7.8% (95%CI: 7.0%, 9.0%) among Chinese women of reproductive age in 2020. We found that the prevalence of PCOS has increased by nearly 65% over the past decade, and we also found women with PCOS had a more severe phenotype overall than that a decade ago, with a significantly higher prevalence of obesity, hyperandrogenism, and primary infertility. Guidelines aimed at the prevention and management of PCOS in women in the community should be re-examined in light of the current data.

Few published studies which estimated the prevalence of PCOS among the general population can be used for comparative purposes. However, the prevalence of PCOS in our sample was slightly lower than the 11.9% to 21.3% obtained in other studies that relied upon convenience samples that also used the Rotterdam criteria. Ethnic variations may be one of the reasons for the lower prevalence reported by the present study as most of the previous studies were conducted in Caucasian populations. Ethnic variations may also contribute to the severity of the disease as Hispanic women with PCOS may have a more severe phenotype, both in terms of hyperandrogenism and metabolic criteria than comparable non-Hispanic black women. This emphasizes the necessity to analyze the phenotypes of PCOS in different populations. A more important reason may be the influence of the age structure of the samples, as we found young women had a higher prevalence of PCOS highlighting the need to consider the age structure of the sample when reporting the prevalence of PCOS in the general population.

| Characteristics                  | N       | Prevalence (95%CI) | P value for Chi-square test | Odds Ratio (95%CI)* |
|----------------------------------|---------|--------------------|-----------------------------|---------------------|
| All                              | 12,815  | 7.8 (7.0, 9.0)     | -                           | -                   |
| Age at interview                  |         |                    |                             |                     |
| 20-24                            | 518     | 14.7 (11.6, 18.6)  | <0.001                      | ref                 |
| 25-29                            | 1,944   | 14.0 (12.4, 15.9)  | 0.86 (0.65, 1.16)           |                     |
| 30-34                            | 3,017   | 8.1 (7.0, 9.3)     | 0.44 (0.33, 0.60)           |                     |
| 35-39                            | 2,731   | 4.1 (3.3, 5.0)     | 0.20 (0.15, 0.26)           |                     |
| 40-44                            | 2,383   | 1.3 (0.8, 1.9)     | 0.07 (0.04, 0.10)           |                     |
| 45-49                            | 2,222   | 1.2 (0.7, 1.8)     | 0.05 (0.03, 0.08)           |                     |
| Household registration           |         |                    |                             |                     |
| Urban citizens                   | 5,821   | 6.4 (5.5, 7.5)     | 0.092                       | ref                 |
| Rural citizens                   | 6,884   | 9.2 (7.9, 10.7)    | 1.01 (0.85, 1.21)           |                     |
| Educational level                |         |                    |                             |                     |
| Primary education                | 5,449   | 6.8 (5.6, 8.3)     | <0.01                       | ref                 |
| College education                | 7,223   | 8.5 (7.4, 9.7)     | 1.08 (0.90, 1.30)           |                     |
| Annual household income per capita (RMB) |     |                    |                             |                     |
| <20,000                          | 4,497   | 8.4 (6.9, 10.2)    | 0.796                       | 1.03 (0.86, 1.24)   |
| 20,000–50,000                    | 4,459   | 8.5 (7.1, 10.2)    | ref                         |                     |
| >50,000                          | 3,593   | 5.7 (4.7, 7.0)     | 0.96 (0.79, 1.17)           |                     |
| Current tobacco smoke exposure   |         |                    |                             |                     |
| No                               | 12,170  | 7.7 (6.9, 8.7)     | 0.240                       | ref                 |
| Yes                              | 548     | 10.2 (5.9, 17.0)   | 1.11 (0.78, 1.55)           |                     |
| Current alcohol consumption      |         |                    |                             |                     |
| No                               | 10,795  | 7.7 (6.8, 8.8)     | 0.120                       | ref                 |
| Yes                              | 1,567   | 8.1 (6.0, 10.9)    | 1.02 (0.82, 1.27)           |                     |
| Body Mass index (kg/m²)          |         |                    |                             |                     |
| <18.5                            | 734     | 7.3 (4.7, 11.0)    | <0.001                      | 0.86 (0.62, 1.17)   |
| 18.5–23.9                        | 7,528   | 7.0 (5.9, 8.2)     | ref                         |                     |
| 24.0–27.9                        | 3,220   | 7.7 (6.2, 9.5)     | 1.64 (1.36, 1.97)           |                     |
| ≥28.0                            | 1,192   | 14.8 (11.3, 19.2)  | 2.77 (2.20, 3.48)           |                     |

Table 1: Weighted prevalence of PCOS among women aged 20-49 years in 2020 CFSW.
* Odds ratio estimated by multivariate logistic regression model with all the listed covariables.
† Weighted prevalence based on sampling weights and post-stratification weights.
The NIH criteria used previously did not consider ultrasonographic evidence of polycystic ovaries while ultrasound is a prerequisite for applying Rotterdam criteria for diagnosis if one of the other criteria is missing. Our data (Type I, Table 2) allows for the estimation of the prevalence of the previously described NIH consensus grouping and shows an increase over 10 years in the prevalence, independent of ultrasound. In many of the previously published epidemiological studies, ultrasound or blood measurements were not carried out on women who did not present with clinical symptoms of PCOS. This limitation may increase the error associated with estimating the number of women with PCOS but it is unlikely this would have been pronounced given a previous study noted women who had biochemical hyperandrogenemia and polycystic ovaries without irregular cycles were likely to be less than 1% in the population. Our strategy covers many of the deficiencies of previous PCOS prevalence studies, and is confined to a single ethnic group, thereby reducing heterogeneity of populations. In our sample, we identified 158 women as having PCOS by the presence of biochemical hyperandrogenemia in combination with polycystic ovaries, which accounts for 19% of all women with PCOS. This means that a considerable proportion of PCOS patients would be missed for not having clinical hyperandrogenemia or menstrual dysfunction thereby underestimating the prevalence of PCOS. Further epidemiologic data are required among unbiased populations to better understand the natural course of this syndrome.

A strength of our study was the use of large-scale data from two consecutively representative population surveys covering a period from 2010 to 2020 with the same methodology and investigative team. A comparison of the two study periods was highly instructive as to changes in the prevalence of PCOS which under the Rotterdam criteria increased from 5.6% to 8.6% among women aged 20-44 years. This was shown in all age groups

| Characteristics | Prevalence in 2010 (95%CI) | Prevalence in 2020, % (95%CI) | Percentage change (95% CI) |
|-----------------|-----------------------------|-------------------------------|---------------------------|
| Type I (H+O)    | 1.0 (0.9, 1.1)              | 1.5 (1.2, 2.0)                | 58.3 (25.5, 99.8)         |
| Type II (H+P)   | 2.0 (1.8, 2.1)              | 2.7 (2.1, 3.0)                | 32.0 (10.7, 57.3)         |
| Type III (O+P)  | 0.7 (0.6, 1.0)              | 2.9 (2.3, 4.0)                | 225.7 (161.6, 307.6)      |
| Type IV (H+O+P) | 1.6 (1.3, 2.0)              | 1.5 (1.1, 2.0)                | 7.7 (-12.6, 32.3)         |
| Overall         | 5.6 (5.1, 6.0)              | 8.6 (7.6, 10.0)               | 65.5 (49.0, 83.7)         |

Table 2: Decadal change in weighted prevalence of different subtypes of PCOS among women aged 20-44 years during 2010 to 2020. * Weighted prevalence based on sampling weights and post-stratification weights.
brackets studied. This suggests that the number of patients with PCOS is increasing in China with an estimate of at least 24.0 million persons currently in the country. Given the long-term health risks of PCOS, we suggested that PCOS is not only a reproductive endocrine disease among women, but it has also become an important public health problem in China. This is reflected in the associated features we highlight in Table 3. It is therefore important that policy and guidelines affecting the education, detection, and management of PCOS are prioritized especially among younger women who had the highest prevalence. The development of the international guideline for PCOS and associated patient-friendly information will further advance rational detection and treatment of this condition.17

We did observe an increasing trend for the prevalence of hyperandrogenic PCOS which is similar to that defined by the NIH criteria and is generally accepted as being more severe, particularly with respect to metabolic features. Women with hyperandrogenism suffer more from difficulties with ovulation induction,18 have more pronounced metabolic problems such as insulin resistance, metabolic syndrome, and forms of atherogenic dyslipidemia,1 leading to long-term health risks.19 In addition, they may have more pronounced metabolic problems during pregnancy. Therefore, education, self-empowerment, multidisciplinary care and lifestyle interventions such as healthy eating and regular physical activity should be prioritized to optimize hormonal and reproductive outcomes, as well as the quality of life across the life course.21 Unfortunately, we were not able to assess metabolic issues in this field cohort.

We also noted that non-hyperandrogenic PCOS (type III) exhibits the highest increase in prevalence in our study. According to Rotterdam criteria, women would be classified as non-hyperandrogenic PCOS if they present with the combination of chronic oligo- or anovulation and polycystic ovaries. It is argued that functional hypothalamic amenorrhea (FHA) associated with stress in modern society may contribute to the increasing prevalence of non-hyperandrogenic PCOS, although this was excluded on clinical and other grounds in our study.22 Patients with non-hyperandrogenic PCOS have the mildest degree of endocrine and metabolic dysfunction as compared with healthy controls.3 Interestingly, in our previous study, we found that the metabolic complications of PCOS, such as MS, IR, hypertension, and hyperlipidemia, did not differ between hyperandrogenic PCOS and non-hyperandrogenic PCOS.7 Thus, lifestyle intervention should be prioritized for women with non-hyperandrogenic PCOS.

Women with PCOS had a more severe phenotype overall than those of a decade ago, with a significantly higher prevalence of obesity, hyperandrogenism, and infertility. We identified the proportion of obesity increased from 13.0% to 18.1% among PCOS, with an adjusted odds ratio of 2.22 (95%CI: 1.60, 3.12), which was higher than that of non-PCOS women (adjusted odds ratio: 1.32, 95%CI, 1.16 to 1.46, Table S5). When we expressed hyperandrogenemia as free androgen index >5.0, there was an increase from 16.1% to 47.0%, although obesity-related alteration of SHBG in the population may also contribute to the difference in FAI. However, these numbers indicated that a higher proportion of PCOS women have present with metabolic and/or endocrine abnormalities than a decade ago. It is possible that women affected by PCOS should concentrate on lifestyle and weight change before considering other medical approaches.7,27

Some aspects of our study need to be considered when interpreting these results. Firstly, only 8 (Liaoning, Beijing, Tianjin, Shanxi, Henan, Sichuan, and Guangdong provinces) of the 15 provinces in the 2020 survey were covered in the 2010 survey, which may cause bias in the estimated change of the prevalence. Second, we found younger women had a higher

| Characteristics     | Proportion in 2010 (95%CI)* | Proportion in 2020 (95%CI)** | P for trend |
|---------------------|-----------------------------|------------------------------|------------|
| Overweight          | 21.4 (18.5, 24.2)           | 25.6 (22.6, 28.7)            | 0.003      |
| Obesity             | 13.0 (10.7, 15.4)           | 18.1 (15.5, 20.8)            | <0.001     |
| High blood pressure1| 15.6 (13.1, 18.1)           | 13.9 (11.5, 16.3)            | 0.399      |
| Primary infertility | 4.2 (2.8, 5.6)              | 9.2 (7.2, 11.2)              | <0.001     |
| Oligo/amenorrhea    | 62.0 (58.6, 65.4)           | 70.7 (67.5, 73.9)            | 0.013      |
| Polycystic ovary    | 79.7 (76.9, 82.5)           | 75.4 (72.4, 78.4)            | 0.707      |
| Hyperandrogenism    |                             |                              |            |
| FAI >5.0            | 36.1 (32.8, 39.4)           | 47.0 (43.5, 50.4)            | <0.001     |
| Hirsutism           | 17.6 (15.0, 20.2)           | 10.6 (8.5, 12.8)             | <0.001     |

Table 3: Comparison of the features of PCOS from 2010 to 2020.

* Age-standardized proportion based on China’s 2010 census population survey.
1 Defined as the systolic blood pressure reading is ≥140 mmHg and/or the diastolic blood pressure reading is ≥90 mmHg.
2 PCOM, polycystic ovary morphology (defined by ultrasound).
3 Defined as a mF-G score >4.
prevalence of PCOS than older women. However, diagnosing PCOS in middle-aged and elderly women is challenging. The menopausal transition of peri- and post-menopausal women with PCOS is not well understood, although it seems that as women with PCOS age may experience a decrease in the ovarian volume and number of ovarian follicles and maintain serum androgen levels — all of which can change the clinical presentation of PCOS.27 Third, we were unable to compare the changing trends of metabolic problems of women with PCOS, as metabolic data was unavailable in the 2020 survey. The participants of the study are all of Han nationality, and there may be bias when extrapolating to other races.

Advantages of our study include identical assays and cutoff points to the 2010 survey as well as the same frequency ultrasound transducer, questionnaire, examination, and statistical analysis. As a result, comparisons across the decade are valid and compelling.

Conclusion
In summary, in large-scale data from two consecutively representative population surveys covering a period from 2010 to 2020, we found the prevalence of PCOS in Chinese women of reproductive age reached 7.8% in 2020, an increase of nearly 65% from a decade ago. Guidelines aimed at the prevention and management of PCOS in women in the community should be re-examined in light of the current data.

Contributors
RY and QL contributed equally to this work as joint first authors. RL, PL, and JQ contributed equally to this work as joint last authors. QL, RL, PL, and JQ designed the study and contributed to the protocol. ZZ, WQ, JZ, ZW, LJ, XW, CZ, BZ, JT, GH, SL were responsible for the rollout and quality assurance data collection. YH, DZ, YW managed the data. QL conducted the initial analysis, under the supervision of RL, PL, JQ. RY and QL drafted the initial manuscript, and RY provided clinical interpretation and all authors contributed to the revision of the manuscript. JQ is the guarantor. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Data sharing statement
Data sharing: Requests can be made to the data access committee of Peking University Third Hospital Ethics Board for extracts of the larger-scale data, which cannot be released openly owing to information governance requirements. All R code is accessible from the corresponding author.

Ethical approval
Ethical approval: This study was approved by the research ethics committees at all participating centers and by the Peking University Third Hospital Ethics Board through protocol 2019SZ-054.

Declaration of interests
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The lead authors (JQ) affirm that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Supplementary materials
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