

Original Article

Cite this article: Damone AL, Joham AE, Loxton D, Earnest A, Teede HJ, Moran LJ (2019). Depression, anxiety and perceived stress in women with and without PCOS: a community-based study. *Psychological Medicine* **49**, 1510–1520. <https://doi.org/10.1017/S0033291718002076>

Received: 28 March 2018

Revised: 10 June 2018

Accepted: 19 July 2018

First published online: 22 August 2018

Key words:

Anxiety; depression; PCOS; stress

Author for correspondence:

Lisa J. Moran, E-mail: lisa.moran@monash.edu

Depression, anxiety and perceived stress in women with and without PCOS: a community-based study

Anna L. Damone¹, Anju E. Joham^{1,2}, Deborah Loxton³, Arul Earnest¹,
Helena J. Teede^{1,2} and Lisa J. Moran^{1,4}

¹Monash Centre for Health Research and Implementation, School of Public Health and Preventive Medicine, Monash University, Locked Bag 29, Clayton, VIC 3168, Australia; ²Diabetes and Vascular Medicine Unit, Monash Health, Locked Bag 29, Clayton, VIC 3168, Australia; ³Research Centre for Generational Health and Ageing, University of Newcastle, University Drive, Callaghan, NSW 2308, Australia and ⁴The Robinson Research Institute, Discipline of Obstetrics and Gynaecology, University of Adelaide, Adelaide, South Australia, 5000, Australia

Abstract

Background. Polycystic ovary syndrome (PCOS) is associated with increased psychological distress in clinical populations. We aimed to assess depression, anxiety and perceived stress in women with and without PCOS in a large community-based sample and investigate the role of stress in contributing to and mediating the relationship between PCOS, depression and anxiety.

Methods. A cross-sectional analysis was performed from the Australian Longitudinal Study of Women's Health (ALWSH) comparing women with ($n = 478$) or without ($n = 8134$) a self-reported diagnosis of PCOS. Main outcome measures were depression, anxiety and perceived stress measured using validated scales. The χ^2 and t tests were used to assess differences between groups. Univariable and multivariable regression were performed to determine factors contributing to each outcome.

Results. Women reporting PCOS, compared with women not reporting PCOS, reported higher prevalence of depression (27.3% *v.* 18.8%), anxiety symptoms (50% *v.* 39.2%) and greater score for perceived stress (1.01 ± 0.03 *v.* 0.88 ± 0.01). After adjusting for body mass index, infertility and socio-demographic factors, women with PCOS were still more likely to be depressed, anxious and to have a higher level of perceived stress. There was a high-level mediation effect of stress between PCOS and both depression and anxiety.

Conclusion. Compared with women not reporting PCOS, women reporting PCOS have increased depression, anxiety and perceived stress. Stress may play a role in the association between PCOS, depression and anxiety. Further studies should consider assessment and management of stress in PCOS as it may be relevant for understanding the aetiology and treatment of psychological distress.

Introduction

Polycystic ovary syndrome (PCOS) is the most frequent endocrine disorder in women of reproductive age with a reported prevalence of 9–18% (March *et al.*, 2009). Its main clinical and diagnostic features include menstrual irregularity, biochemical and/or clinical hyperandrogenism and presence of polycystic ovaries on ultrasound (Aziz *et al.*, 2006). Women with PCOS can have severe metabolic and reproductive manifestations (Azziz *et al.*, 2004). PCOS is often also associated with excess body weight which can worsen the clinical presentation (Lim *et al.*, 2013). Compared with women without PCOS, women with PCOS show an increased prevalence of clinical depression (28–64% *v.* 7.1–8%), anxiety (34–57% *v.* 18%) (Deeks *et al.*, 2011) and other manifestations of psychological distress (Himelein and Thatcher, 2006; Kerchner *et al.*, 2009; Açmaz *et al.*, 2013; Rowlands *et al.*, 2016).

The aetiology of this observed increased prevalence of depression and anxiety in PCOS is still unclear. Possible explanatory factors that have been investigated as a source of distress include visible features such as excess weight, clinical hyperandrogenism (hirsutism, acne or androgenic alopecia) (Barry *et al.*, 2011; Veltman-Verhulst *et al.*, 2012), medical consequences such as infertility (Himelein and Thatcher, 2006; Tan *et al.*, 2008; Deeks *et al.*, 2010), concerns relating to diagnosis and fear regarding long-term health complications (Trent *et al.*, 2003; Moran *et al.*, 2010; Deeks *et al.*, 2011). However, the contributing factors to depression and anxiety are currently unclear and results from studies are often conflicting. Only a few of the existing studies (Himelein and Thatcher, 2006; Benson *et al.*, 2009b; Moran *et al.*, 2010; Deeks *et al.*, 2011) have adjusted for factors known to have an association with depression and anxiety in the general population such as body mass index (BMI) (Simon *et al.*, 2006),

infertility (Cousineau and Domar, 2007) and socio-demographic factors such as ethnicity, household income and marital status (Moreno-Peral *et al.*, 2014). It is also well documented that a chronic illness is a stressful condition and chronic stress is associated with depression and anxiety in the general population (De Ridder *et al.*, 2008; Hammen *et al.*, 2009; Lahey, 2009). While women with PCOS reported a significantly increased physiological reaction to stress compared with controls (Benson *et al.*, 2009a; Farrell and Antoni, 2010), there is a paucity of studies investigating the relationship of stress with psychological health in PCOS (Guidi *et al.*, 2015). The prevalence of stress and its potential contribution to depression and anxiety in PCOS therefore warrants further investigation.

Furthermore, the majority of studies in PCOS have utilised clinic-based samples, convenience control groups, internet surveys (Benson *et al.*, 2009a) or health service databases (Altinok *et al.*, 2014; Hung *et al.*, 2014). This limits the generalisability of their findings as referral bias may lead to findings of higher rates of overweight and obesity in such studies (Ezeh *et al.*, 2013) and consequently higher rates of depression and anxiety as excess adiposity is related to worsened psychological health both in women with PCOS and in the general population (Simon *et al.*, 2006; Álvarez-Blasco *et al.*, 2010). The limited research in community-based studies in PCOS reports greater psychological distress in adolescents and young adults (Guidi *et al.*, 2015; Rowlands *et al.*, 2016) but none in adult women.

The aim of the present study was to assess depression, anxiety, perceived daily stress, psychotropic medication use and health-seeking behaviours with regards to managing psychological health in a large community-based, representative sample of Australian women, comparing women with a self-reported medical diagnosis of PCOS to those who did not report PCOS. We additionally aimed to evaluate the role of stress in contributing to the relationship between PCOS, depression and anxiety.

Methods

Study population and protocol

This study is based on data from the Australian Longitudinal Study on Women's Health (ALSWH), a longitudinal population-based study of four age cohorts of Australian women. The study aims are to examine the physical and mental health of women across the life span assessing biological, psychological, social and lifestyle aspects as well as use and satisfaction with health care services. The ALSWH first collected mailed survey data from three age cohorts studied in 1996. Women were randomly selected from the national health insurance database Medicare (which includes all permanent residents of Australia) and invited to participate in the project. Women were recruited nationally with intentional oversampling from rural and remote areas (Lee *et al.*, 2005). Further information about the methods used and sample characteristics has been reported elsewhere (Brown *et al.*, 1999; Powers and Loxton, 2010) and are available on the ALSWH website (<http://www.alswh.org.au>). The Human Research Ethics Committees of the University of Newcastle and the University of Queensland approved the study methods and informed written consent was obtained from each participant. The current study is based on data from the cohort born between 1973 and 1978 who first completed the survey at age 18–23 years. We analysed data from survey 4 (2006) and included women who responded to the question on PCOS (online Supplementary Fig. S1).

Demographic measures and participant characteristics

- (1) PCOS: Women were asked 'In the last three years, have you been diagnosed or treated for polycystic ovary syndrome?'. Women who responded 'yes' were classified as PCOS, whereas all other women who responded to the question were classified as not having PCOS.
- (2) BMI: Weight and height were self-reported. BMI (weight in kg/height in metres²) was calculated from self-reported height and weight. BMI was then classified into categories, with overweight and obesity defined by the World Health Organization criteria (BMI 25.0–29.9 kg/m² for overweight and ≥ 30 kg/m² for obese classification) (World Health Organization, 1999). Socio-demographic variables included age, education, occupation, marital status, number of children, ethnicity and personal income.
- (3) Fertility was assessed by the question 'Have you and your partner (current or previous) ever had problems with fertility – that is, tried unsuccessfully for 12 months or more to get pregnant?' with the answers: (1) no never tried to get pregnant; (2) no, had no problem with fertility; (3) yes, but have not sought help/treatment and (4) yes, and have sought help/treatment available. Women who responded 'no never tried to get pregnant' or 'no, had no problem with fertility' were classified as not knowing/not experiencing infertility. Those who responded 'yes, but have not sought help/treatment' or 'yes, and have sought help/treatment' were classified as having experienced infertility.

Psychological outcomes

Both validated scales and more self-reported questions were used to investigate psychological features. Primary outcomes were depression and anxiety using standardised and validated tools.

- (4) Depression: Depression symptoms were assessed using the 10-item *Centre for Epidemiologic Studies Depression Scale* (CESD-10) with a score of ≥ 10 used as a categorical cut-off for clinically significant symptoms (Andresen *et al.*, 1994).
- (5) Anxiety: Anxiety symptoms were assessed using the anxiety subscale of the *Goldberg Depression and Anxiety Scale* (GADS) with a score of ≥ 5 used as a categorical cut-off for risk of clinical anxiety as previously described (Goldberg *et al.*, 1987, 1988).
- (6) Perceived stress: Perceived stress was analysed as a continuous variable assessed by the *Perceived Stress Questionnaire* (PPQ) (Bell and Lee, 2002, 2003) which is a scale that has been developed for and validated in the ALSWH. The total score ranges from 0 to 4 with a score >2 indicating moderate levels of stress and a score >3 or >4 indicating, respectively, a very and extremely stressful condition.

Secondary measures included self-reported information concerning medical diagnosis of mental illness, psychological symptoms and health-seeking behaviours relating to mental health management.

- (7) Mental illness diagnosis: A self-reported medical diagnosis of depression, anxiety or other major mental illnesses was assessed with the question 'In the last three years have you been diagnosed or treated for'. Women could respond to these questions with either 'yes' or 'no' responses (yes/no).

- (8) Psychological symptoms and seeking behaviours: Self-reported symptoms of depression, episodes of intense anxiety (e.g. panic attacks) or other mental problems and the proportion of women seeking help for those symptoms were investigated asking 'in the last 12 months have you had one of the following? (no, rarely, sometimes, often)'. Only women who responded 'often' were categorised as reporting symptoms. The question was then asked 'If yes, did you seek help for this problem? (yes/no)' and these data were also included in the analysis.
- (9) Other health-seeking behaviours relating to mental health management: psychotropic medication use was investigated using the following two questions: 'During the past 4 weeks have you used medications that were: prescription medication for depression (e.g. Zoloft, Aropax, Lexapro, Cipramil, etc.), prescription medication for your nerves/anxiety (e.g. Valium, Serapax, Kalma, Ducene, etc.)'. Women could respond to these questions with either 'yes' or 'no' responses (yes/no). We also included the question 'Have you consulted a counselor or other mental health worker for your own health in the last 12 months?' with '(yes/no)' responses in the analysis.

Statistical analysis

Data were analysed using Stata software version 11.0 (StataCorp, Texas, Lakeway, USA).

Categorical data were expressed as proportion and continuous data as mean \pm standard deviation. Comparison between women with and without PCOS was performed by χ^2 for categorical variables and independent Student's *t* test for continuous variables. Binary logistic regression analyses were used to assess the relationship between depression or anxiety and PCOS, and linear regression models were used to assess the association between perceived stress and PCOS. Potential confounding variables in these relationships were assessed and incorporated in the model including socio-demographic factors, BMI (categorical variable) and infertility. The selection of variables was based on identifying all measured variables of known or suspected relevant effect on depression, anxiety and perceived stress, and/or exhibiting $p < 0.10$ on univariable analysis. In addition to examination as a dependent variable, perceived stress was also considered as a potential confounding variable in the association between PCOS, depression and anxiety. Since stress was also considered to be a mediator in the relationship between PCOS, depression and anxiety, binary mediation analysis was performed to partition the indirect effect of PCOS on both depression and anxiety. The significance level was set at a two-tailed 5%. Analysis was also weighted by area of residence to adjust for the deliberate oversampling in rural and remote areas.

Results

On 9145 responders to the survey, 8612 answered to the question of PCOS status and were included in the analysis (online Supplementary Fig. S1). Four hundred and seventy-eight were classified as reporting PCOS and 8134 as not reporting PCOS (abbreviated as with and without PCOS, respectively), with an estimated prevalence of self-reported PCOS of 5.8% (95% CI 5.3–6.3). Participant characteristics for the entire group and the PCOS and non-PCOS groups are reported in Table 1. The mean age was 30.6 ± 1.5 years and the mean BMI was 25.2 ± 5.7 kg/m². As previously reported (Teede *et al.*, 2013), women

with PCOS reported a greater BMI compared with women without PCOS (PCOS 28.1 ± 7.2 kg/m² *v.* non-PCOS 25.1 ± 5.6 kg/m²) and a significantly higher proportion were in the overweight (PCOS 26.1% *v.* non-PCOS 23.2%) and obese range (PCOS 33.2% *v.* non-PCOS 16.2%) ($p < 0.001$). Women with PCOS were more likely to report experiencing infertility (PCOS 47.4% *v.* non-PCOS 9.2%) ($p < 0.001$) (Table 1). Women with and without PCOS did not differ significantly in socio-demographic variables.

On unadjusted analysis, a significantly higher proportion of women with PCOS reported clinically significant depression (PCOS 27.3% *v.* non-PCOS 18.8%) and anxiety symptoms (PCOS 50.0% *v.* non-PCOS 39.2%) ($p < 0.001$). Women with PCOS also had higher levels of perceived stress compared with women without PCOS (PCOS 1.06 ± 0.6 *v.* non-PCOS 0.88 ± 0.5) ($p < 0.001$) (Table 2). On univariable regression analysis, the odds of reporting depression symptoms or a score in the clinical risk range of depression was 1.61-fold higher in women with PCOS (95% CI 1.29–2.03, $p < 0.001$). The odds of reporting anxiety symptoms risk score was 1.46-fold higher in women with PCOS (95% CI 1.20–1.79, $p < 0.001$). The odds of reporting perceived stress was 0.16 in women with PCOS (95% CI 0.11–0.22, $p < 0.001$) (Table 2). Women with PCOS reported a significantly higher score than those without PCOS in all secondary psychological outcomes with the exception of seeking help for anxiety symptoms and other mental problems in the last 12 months. Women with PCOS were more likely to report psychotropic medication use both for depression (PCOS 12.6% *v.* non-PCOS 7.03%, $p = 0.001$) and anxiety (PCOS 5.4% *v.* non-PCOS 2.8%, $p = 0.001$) (Table 1, online Supplementary Data).

In multivariable regression analysis, after adjusting for age, BMI, infertility, education, occupation, marital status, number of children, ethnicity and personal income, the effect size was slightly reduced for the outcomes of depression (OR 1.39, 95% CI 1.04–1.86, $p = 0.027$), anxiety (OR 1.37, 95% CI 1.07–1.76, $p = 0.012$) and perceived stress (coefficient β 0.15, 95% CI 0.09–0.23, $p < 0.001$) (Tables 3–5). A second multivariable analysis was performed both for depression and anxiety, adding perceived stress to the other potential confounding variables described above. On these analyses, the association between PCOS with both depression and anxiety symptoms was no longer significant (Tables 4 and 5). On adjusted analyses, for a one-unit increase in stress, the odds of being clinically depressed and anxious increased by a factor of 9.93 and 11.36 ($p < 0.001$), respectively.

On mediation analysis, we found that stress showed a high-level mediation effect between the relationship between PCOS and depression, with a proportion of total effect moderated = 0.71. The indirect effect of PCOS on depression was given by OR 1.18 (95% CI 0.92–1.51). A high-level mediation effect of stress between PCOS and anxiety was also found, with a proportion of total effect moderated = 0.71. The indirect effect of PCOS on anxiety was given by OR 1.18 (95% CI 0.95–1.47).

Discussion

The present study assessed for the first time depression and anxiety symptoms and perceived stress in adult women with PCOS in a large community-based cohort study. Women reporting PCOS reported an increased prevalence of depression and anxiety symptoms, perceived stress, self-reported medical diagnoses of depression, anxiety or other major mental illnesses and treatment for psychological conditions or mental illness. We also report here for the first time the confounding and the mediating effect of

Table 1. Characteristics for women with and without PCOS

Outcomes	Overall sample (<i>n</i> = 8612)	PCOS (<i>n</i> = 478)	non-PCOS (<i>n</i> = 8134)	<i>p</i> value
Age (years) (mean ± s.d.)	30.6 ± 1.5	30.5 ± 1.4	30.6 ± 1.5	0.127
BMI kg/m ² (mean ± s.d.)	25.2 ± 5.7	28.1 ± 7.2	25.1 ± 5.6	<0.001
BMI WHO categories <i>n</i> (%)				<0.001
<25 kg/m ²	5139 (59.7)	183 (40.8)	4638 (60.5)	
25.0–29.9 kg/m ²	2017 (23.4)	117 (26.1)	1780 (23.2)	
≥30 kg/m ²	1456 (16.9)	149 (33.2)	1245 (16.2)	
Infertility <i>n</i> (%)				<0.001
Experienced infertility	1010 (11.1)	224 (47.4)	747 (9.2)	
Unknown/not experienced infertility	8105 (88.9)	249 (52.6)	7363 (90.8)	
Education <i>n</i> (%)				0.183
No formal qualification	90 (1.2)	9 (2.2)	78 (1.1)	
Year 12 or less	2211 (28.7)	107 (25.8)	1952 (24.8)	
Trade/certificate	292 (3.8)	14 (3.3)	259 (3.8)	
University/higher university degree	5120 (66.4)	284 (68.6)	4565 (66.6)	
Occupation <i>n</i> (%)				0.649
No job	2436 (27.2)	90 (19.2)	1565 (19.8)	
Professional, associate professional, manager	1740 (19.4)	211 (45.1)	3770 (47.3)	
Tradesperson, intermediate production or transport, labourer or related worker	4226 (47.2)	33 (7.1)	481 (6.1)	
Elementary, intermediate, advanced clerical	554 (6.2)	134 (28.6)	2157 (27.1)	
Marital status <i>n</i> (%)				0.562
Never married	2107 (23.1)	118 (24.8)	1850 (22.8)	
In couple (married, <i>de facto</i> opposite or same sex)	6587 (72.3)	339 (71.4)	5877 (72.5)	
Separated, divorced	401 (4.4)	18 (3.8)	366 (4.5)	
Widowed	11 (0.1)	0 (0.0)	11 (0.1)	
Number of children <i>n</i> (%)				0.356
No children	4688 (51.2)	258 (54.0)	4126 (50.7)	
1–2 children	3624 (39.6)	172 (36.0)	3260 (40.1)	
3–4 children	786 (8.6)	45 (9.4)	707 (8.7)	
5 or more children	47 (0.5)	3 (0.6)	41 (0.5)	
Ethnicity <i>n</i> (%)				0.596
Australian born	7572 (88.8)	414 (87.3)	7158 (88.9)	
Other English-speaking country born	542 (3.8)	24 (5.1)	352 (4.4)	
Europe	149 (1.1)	5 (1.1)	124 (1.5)	
Asia	381 (2.7)	24 (5.1)	322 (4.0)	
Other	134 (0.9)	7 (1.5)	99 (1.2)	
Average gross income per year Aus\$ <i>n</i> (%)				0.615
Not applicable	421 (4.7)	17 (3.7)	378 (4.8)	
0–15,999	2355 (26.6)	125 (26.9)	2117 (26.9)	
16,000–36,999	2225 (25.1)	117 (25.2)	1962 (24.9)	
37,000–77,999	3281 (37.1)	168 (36.2)	2910 (36.9)	
≥78,000	578 (6.5)	37 (7.9)	514 (6.5)	

Values are reported as mean (±s.d.) or number (%).

Data were analysed by *t* test for continuous variables and χ^2 test for categorical variables. PCOS, polycystic ovary syndrome; BMI, body mass index; WHO, World Health Organization.

Table 2. Depression, anxiety and perceived stress in women with and without polycystic ovary syndrome

Outcome	PCOS	Non-PCOS	OR unadjusted (95% CI)	OR adjusted ^a	OR adjusted ^b
Depression CESD-10 <i>n</i> (%)	129 (27.3)	1505 (18.8)	1.61 (1.29–2.03)	1.39 (1.04–1.86)	1.04 (0.74–1.46)
Anxiety GADS <i>n</i> (%)	239 (50.0)	3175 (39.2)	1.46 (1.20–1.79)	1.37 (1.07–1.76)	1.02 (0.76–1.38)
Perceived stress PSQ mean \pm s.d.	1.06 \pm 0.61	0.88 \pm 0.53	0.16 (0.11–0.22)	0.92 (0.22–3.79)	n/a

Values are reported as mean (\pm s.d.), number (%) or mean, 95% CI.

Data were analysed by *t* test for continuous variables and χ^2 test for categorical variables and survey-weighted univariable and multivariable logistic analysis.

PCOS, polycystic ovary syndrome; CESD-10, Centre for Epidemiologic Studies Depression Scale; GADS, Goldberg Anxiety Depression Scale; PSQ, Perceived Stress Questionnaire.

^aAdjusted for BMI, infertility and socio-demographic factors (age, education, occupation, marital status, number of children, ethnicity, personal income).

^bAdjusted for perceived stress, BMI, infertility, socio-demographic factors (age, education, occupation, marital status, number of children, ethnicity, personal income).

stress in the association between both depression and anxiety and PCOS.

We report here an increased prevalence of clinical depression of 27.3% and 18.8% and anxiety of 50.0% and 39.2% in women with and without PCOS, respectively, compared with 7.1–8% and 18% in the general population (Deeks *et al.*, 2011). In agreement with previous research (Barry *et al.*, 2011; Dokras *et al.*, 2011; Veltman-Verhulst *et al.*, 2012), women with PCOS had increased risk of clinically significant depression and anxiety symptoms (1.39- and 1.37-fold respectively). These increased odds were lower than reported in a recent meta-analysis (4.03- and 6.88-fold) (Dokras *et al.*, 2011, 2012), which may be because the meta-analysis included clinical-based studies while our study used a community-based sample. Many factors in women may contribute to depression including hormonal and biological (e.g. infertility, child birth and premenstrual syndrome) and psychosocial (e.g. stress, socio-economic advantage and violence) factors (National Institute of Mental Health, 1995). We considered in our study BMI, infertility and socio-demographic variables as specific risk factors for depression for the general population (Simon *et al.*, 2006). While some of these factors have been previously considered in investigating the relationship between PCOS and psychological variables (Himelein and Thatcher, 2006; Benson *et al.*, 2009b; Moran *et al.*, 2010; Deeks *et al.*, 2011; Rowlands *et al.*, 2016), to our knowledge, this is the first community-based study considering all of them together in one analysis.

In the present study, the association between PCOS, depression and anxiety was attenuated but maintained on adjustment for BMI, infertility and socio-demographic variables. This indicates that although the presence of overweight or obesity and infertility may worsen depression and anxiety as reported in the general population (Simon *et al.*, 2006), PCOS status *per se* is likely to have an independent effect on psychological function (Deeks *et al.*, 2010). This may be related to visible features, the frustration of having a chronic condition (Kozica *et al.*, 2013) or the perceived risk of future health complications (Moran *et al.*, 2010).

In agreement with prior results (Guidi *et al.*, 2015), being stressed was more prevalent in PCOS even after consideration of BMI, infertility and socio-demographic variables. The questionnaire used here assesses perceived sources of stress in several domains of daily life (Bell and Lee, 2002, 2003) rather than being designed for the assessment of health-related stress. However, it also assesses perceived stress in life domains potentially impacted

by PCOS such as health, motherhood or social relationships (Farkas *et al.*, 2014). Future work should investigate if women with PCOS display higher stress related to their condition rather than other daily life domains or if stress precedes PCOS. We also report here for the first time the role of stress both as confounder and mediator variable between the relationship between PCOS and psychological outcomes. The significant association between PCOS and depression and anxiety was lost on adjustment for stress, and stress showed a strong association both with depression and anxiety. This suggests an independent confounding relationship of stress both with PCOS status and with depression or anxiety and that higher depression and anxiety in PCOS may be related to higher stress levels in PCOS. Mediation analysis gave further clarification as stress mediated for a large proportion of the relationship between PCOS and both depression and anxiety. This could suggest that stress can have a relevant direct effect in depression and anxiety symptoms in women with PCOS, rather than other factors considered up to now. This is consistent with prior research on the relationship between stress, chronic illness and psychological morbidity in the general population (Hammen *et al.*, 2009; Lahey, 2009). This may explain why previous studies have not found any direct causal relationship between PCOS and depression or anxiety.

As endocrine systems may be more vulnerable to the physiological effects of stress due to the pathophysiological features of PCOS such as hypothalamic–pituitary–adrenal axis (HPA) and sympathetic nervous system (SNS) hyperactivity or low-grade immune system inflammation (Benson *et al.*, 2008), even low levels of perceived stress may have a clinically significant impact in PCOS (Farrell and Antoni, 2010; Barry *et al.*, 2011). In light of this, the evaluation of coping and adjustment strategies in PCOS is relevant as key factors relating to psychological outcomes (Benson *et al.*, 2010) and preliminary trials of stress management interventions have reported encouraging results on the amelioration of psychological outcomes in PCOS (Raja-Khan *et al.*, 2015; Stefanaki *et al.*, 2015).

The findings of the present study therefore confirm the importance of consideration of assessment and management of stress, even at non-clinical levels, in PCOS in addition to depression and anxiety. Furthermore, the independent association of BMI and infertility with both depression and anxiety was also lost on inclusion of stress into the multivariable models. Stress may therefore have a stronger impact on psychological distress than other factors previously highlighted as risk factors for

Table 3. Univariable and multivariable regression analysis – depression

	OR (95% CI) unadjusted	OR (95% CI) adjusted ^a	OR (95% CI) adjusted ^b
PCOS	1.61 (1.29–2.03)	1.38 (1.03–1.86)	1.04 (0.74–1.46)
Stress	10.32 (9.01–11.83)	–	9.9 (9.93–11.74)
Age (years)	0.99 (0.95–1.03)	1.00 (0.95–1.05)	1.01 (0.96–1.07)
BMI WHO categories			
<25.0 kg/m ²		1	
25.0–29.9 kg/m ²	1.25 (1.08–1.45)	1.24 (1.05–1.47)	1.17 (0.96–1.42)
≥30 kg/m ²	1.93 (1.66–2.25)	1.61 (1.35–1.92)	1.24 (1.01–1.55)
Experienced infertility	1.26 (1.06–1.50)	1.27 (1.01–1.60)	1.21 (0.93–1.58)
Education			
No formal qualification		1	
Year 12 or less	0.50 (0.31–0.81)	0.64 (0.34–1.22)	0.47 (0.22–0.99)
Trade/certificate	0.34 (0.19–0.62)	0.47 (0.22–0.99)	0.31 (0.13–0.71)
University/higher university degree	0.36 (0.22–0.57)	0.52 (0.27–0.99)	0.36 (0.17–0.75)
Occupation			
No job		1	
Professional, associate professional, manager	0.70 (0.60–0.82)	0.77 (0.60–0.99)	0.67 (0.51–0.90)
Tradesperson, intermediate production or transport, labourer or related worker	1.28 (0.99–1.66)	1.15 (0.83–1.59)	1.03 (0.72–1.48)
Elementary, intermediate, advanced clerical	1.11 (0.93–1.30)	0.99 (0.79–1.25)	0.84 (0.64–1.10)
Marital status			
Never married		1	
In couple (married, <i>de facto</i> opposite or same sex)	0.60 (0.49–0.64)	0.54 (0.45–0.65)	0.62 (0.51–0.77)
Separated, divorced	1.90 (1.48–2.43)	1.68 (1.23–2.30)	1.21 (0.83–1.78)
Widowed	2.94 (0.79–10.98)	8.41 (1.60–44.39)	6.55 (1.49–28.72)
Number of children			
No children			
1–2 children	0.91 (0.81–1.03)	0.82 (0.67–0.99)	0.72 (0.57–0.89)
3–4 children	1.20 (0.98–1.47)	0.84 (0.63–1.12)	0.66 (0.48–0.90)
5 or more children	2.52 (1.30–4.90)	2.14 (0.96–4.80)	2.30 (0.92–5.81)
Ethnicity			
Australian born		1	
Other English-speaking country born	1.21 (0.93–1.58)	1.03 (0.74–1.44)	1.06 (0.73–1.53) <i>p</i> =
Europe	0.87 (0.52–1.45)	0.98 (0.55–1.74) <i>p</i> =	1.40 (0.71–2.78) <i>p</i> =
Asia	0.90 (0.66–1.22)	0.90 (0.62–1.32)	1.02 (0.66–1.57)
Other	0.53 (0.28–0.96)	0.77 (0.38–1.55)	0.88 (0.36–2.14)
Average gross income per year Aus\$ <i>n</i> (%)			
Don't know/don't want to tell		1	
0–15.999	0.78 (0.60–1.03)	0.97 (0.68–1.40)	0.92 (0.59–1.43)
16.000–36.999	0.91 (0.69–1.21)	0.94 (0.66–1.35)	0.78 (0.50–1.22)
37.000–77.999	0.67 (0.51–0.88)	0.86 (0.59–1.26)	0.81 (0.51–1.27)
≥78.000	0.48 (0.33–0.69)	0.72 (0.44–1.18)	0.75 (0.42–1.33)

Data were analysed by survey-weighted univariable and multivariable logistic analysis.

PCOS, polycystic ovary syndrome; BMI, body mass index; WHO, World Health Organization.

^aAdjusted for BMI, infertility and socio-demographic factors (age, ethnicity, education, marital status, number of children, personal income).

^bAdjusted for perceived stress, BMI, infertility, socio-demographic factors (age, ethnicity, education, marital status, number of children, personal income).

Table 4. Univariable and multivariable regression analysis – anxiety

	OR (95% CI) unadjusted	OR (95% CI) adjusted ^a	OR (95% CI) adjusted ^b
PCOS	1.46 (1.20–1.79)	1.37 (1.07–1.76)	1.02 (0.76–1.37)
Stress	10.32 (9.20–11.57)	–	11.36 (9.64–13.40)
Age	0.98 (0.95–1.01)	0.97 (0.94–1.01)	0.97 (0.93–1.02)
BMI WHO categories <i>n</i> (%)			
<25 kg/m ²		1	
25–0–29.9 kg/m ²	1.01 (0.90–1.13)	0.98 (0.85–1.12)	0.88 (0.75–1.03)
≥30 kg/m ²	1.60 (0.90–1.13)	1.34 (1.15–1.56)	1.03 (0.86–1.23)
Infertility	1.28 (1.11–1.49)	1.13 (0.94–1.36)	1.07 (0.88–1.33)
Education			
No formal education		1	
Secondary school (up to 10–12 years)	0.62 (0.38–1.01)	0.57 (0.31–1.06)	0.44 (0.24–0.82)
Certificate diploma	0.62 (0.36–1.07)	0.57 (0.29–1.13)	0.41 (0.21–0.82)
Tertiary school (trader qualification, degree, higher degree)	0.47 (0.29–0.76)	0.45 (0.24–0.84)	0.32 (0.17–0.60)
Occupation			
No job		1	
Professional, associate professional, manager	1.45 (1.19–1.77)	1.04 (0.85–1.28)	0.99 (0.78–1.24)
Tradesperson, intermediate production or transport, labourer or related worker	1.39 (1.25–1.56)	1.17 (0.89–1.52)	1.12 (0.81–1.53)
Elementary, intermediate, advanced clerical	1.19 (1.05–1.34)	1.23 (1.02–1.48)	1.16 (0.94–1.42)
Marital status			
Never married		1	
In couple (married, <i>de facto</i> opposite or same sex)	0.76 (0.68–0.85)	0.76 (0.66–0.88)	0.92 (0.77–1.10)
Separated, divorced	1.65 (1.30–2.09)	1.46 (1.10–1.96)	0.98 (0.70–1.10)
Widowed	1.54 (0.41–5.79)	5.99 (1.02–35.16)	3.76 (1.02–13.79)
Number of children			
No children		1	
1–2 children	0.91 (0.81–1.03)	0.94 (0.81–1.10)	0.90 (0.76–1.06)
3–4 children	1.20 (0.98–1.47)	0.99 (0.78–1.24)	0.84 (0.65–1.09)
5 or more children	2.52 (1.30–4.90)	1.37 (0.62–3.03)	1.41 (0.57–3.45)
Ethnicity <i>n</i> (%)			
Australian born		1	
Other English-speaking country born	0.95 (0.76–1.19) <i>p</i> = 0.7	0.87 (0.66–1.15)	0.86 (0.60–1.23)
Europe	0.74 (0.50–1.10)	0.83 (0.52–1.31)	1.09 (0.60–1.23)
Asia	1.16 (0.93–1.47)	1.14 (0.86–1.51)	1.33 (0.96–1.83)
Other	0.62 (0.40–0.96)	0.62 (0.36–1.05)	0.65 (0.37–1.15)
Average gross income per year Aus\$ <i>n</i> (%)			
Don't know/don't want to tell		1	
0–15.999	0.93 (0.74–1.18)	0.91 (0.68–1.22)	0.79 (0.57–1.11)
16.000–36.999	1.08 (0.86–1.37)	0.92 (0.68–1.22)	0.72 (0.51–1.01)
37.000–77.999	0.84 (0.67–1.06)	0.82 (0.61–1.11)	0.71 (0.50–1.00)
≥78.000	0.75 (0.57–0.99)	0.81 (0.56–1.19)	0.79 (0.51–1.21)

Data were analysed by survey-weighted univariable and multivariable logistic analysis.

PCOS, polycystic ovary syndrome; BMI, body mass index; WHO, World Health Organization.

^aAdjusted for BMI, infertility and socio-demographic factors (age, ethnicity, education, marital status, number of children, personal income).

^bAdjusted for perceived stress, BMI, infertility, socio-demographic factors (age, ethnicity, education, marital status, number of children, personal income).

Table 5. Univariable and multivariable regression analysis – stress

	β -coefficient (95% CI) unadjusted	β -coefficient (95% CI) adjusted ^a
PCOS	0.15 (0.11–0.22)	0.16 (0.09–0.23)
Age (years)	–0.01 (–0.01 to 0.01)	–0.01 (–0.01 to 0.01)
BMI WHO categories		
<25 kg/m ²		1
25.0–29.9 kg/m ²	0.04 (0.02–0.07)	0.04 (0.01–0.07)
≥30 kg/m ²	0.17 (0.13–0.20)	0.14 (0.10–0.18)
Infertility	0.05 (0.01–0.09)	0.03 (–0.02 to 0.07)
Education		
No formal education		1
Secondary school (up to 10–12 years)	0.02 (–0.11 to 0.15)	0.07 (–0.07 to 0.21)
Certificate diploma	0.02 (–0.12 to 0.17)	0.10 (–0.06 to 0.26)
Tertiary school (trader qualification, degree, higher degree)	0.01 (–0.12 to 0.13)	0.08 (–0.06 to 0.22)
Occupation		
No job		1
Professional, associate professional, manager	–0.003 (–0.04 to 0.14)	0.03 (–0.02 to 0.08)
Tradesperson, intermediate production or transport, labourer or related worker	0.08 (0.01–0.14)	0.04 (–0.02 to 0.11)
Elementary, intermediate, advanced clerical	0.07 (0.03–0.10)	0.05 (0.01–0.10)
Marital status		
Never married		1
In couple (married, <i>de facto</i> opposite or same sex)	–0.11 (–0.14 to –0.08)	–0.11 (–0.15 to 0.07)
Separated, divorced	0.25 (0.18–0.32)	0.21 (0.13–0.29)
Widowed	0.27 (–0.06 to 0.59)	0.30 (0.01–0.61)
Number of children		
No children		1
1–2 children	0.01 (–0.02 to 0.03)	0.02 (–0.02 to 0.06)
3–4 children	0.06 (0.01–0.10)	0.08 (0.01–0.14)
5 or more children	0.06 (–0.16 to 0.27)	0.06 (–0.17 to 0.29)
Ethnicity		
Australian born		1
Other English-speaking country born	–0.01 (–0.07 to 0.05)	–0.01 (–0.09 to 0.07)
Europe	–0.09 (–0.18 to –0.01)	–0.14 (–0.23 to –0.05)
Asia	–0.01 (–0.07 to 0.5)	–0.03 (–0.11 to 0.36)
Other	–0.08 (0.17–0.91)	–0.05 (–0.15 to 0.05)
Average gross income per year Aus\$ <i>n</i> (%)		
Don't know/don't want to tell		1
0–15.999	0.01 (–0.06 to 0.07)	0.36 (–0.04 to 0.11)
16.000–36.999	0.10 (0.04–0.17)	0.08 (0.01–0.16)
37.000–77.999	0.01 (–0.05 to 0.07)	0.03 (–0.05 to 0.10)
≥78.000	–0.06 (–0.13 to 0.01)	–0.02 (–0.11 to 0.07)

Data were analysed by survey-weighted univariable and multivariable regression analysis. PCOS, polycystic ovary syndrome; BMI, body mass index; WHO, World Health Organization.

^aAdjusted for BMI, infertility and socio-demographic factors (age, ethnicity, education, marital status, number of children, personal income).

depression and anxiety both in PCOS and in the general population.

We report here a more comprehensive assessment of psychological distress in women with and without PCOS than previously reported. A significantly higher proportion of women with PCOS reported having been diagnosed or treated for depression, anxiety or other mental illness, used psychotropic medications and suffered from or sought help for psychological distress symptoms or consulted a mental health professional. This is in keeping with the higher prevalence of depression and anxiety in PCOS. However, the self-reported prevalence of symptoms or episodes of depression or anxiety and the percentage of women engaged in psychological health-seeking behaviours was also lower than the prevalence of depression and anxiety symptoms using validated scales. This suggests that further research is warranted investigating if women with PCOS are aware of treatment options and strategies to encourage them to seek help for psychological distress. While there are numerous studies assessing psychological distress in women with PCOS, there is relatively limited literature either examining health-seeking behaviours relating to mental health management (Benson *et al.*, 2009b; Moran *et al.*, 2010; Altinok *et al.*, 2014) or psychological treatments (Rofey *et al.*, 2008; Raja-Khan *et al.*, 2015) either in clinical or community samples. As far as we know that is only the second study (Altinok *et al.*, 2014) investigating the use of psychotropic medication among women with PCOS. In accordance with these previous results, we found that women with PCOS were more likely to use psychotropic medication than women without PCOS. This is an important aspect of health-seeking behaviours that need to be further explored.

There is therefore a need to report community-based data on current uptake of management strategies for psychological health. This may encourage clinicians to discuss management options with patients for psychological features.

Strengths of this study include the use of a community-based cohort which reduces the bias of clinical-based studies in overestimating overweight and obesity (Ezeh *et al.*, 2013), reproductive (Khan *et al.*, 1996) and potentially psychological issues. Further strengths include the consideration of a broad range of potential confounding variables, the use of valid and reliable psychological measures as primary outcomes, the assessment of multiple less commonly investigated psychological outcomes and the examination of the effect of stress in psychological distress in women with PCOS. This is a cross-sectional analysis and neither causality nor a longitudinal evaluation between PCOS and psychological distress can be established. The major limitations of this study are the use of self-reported information such as PCOS status, infertility, BMI and psychological outcomes. However, this is reasonable in large epidemiologic studies due to feasibility and economy. Furthermore, validation studies have previously reported the validity of self-report measures for anthropometric measures as well as medical and psychological records in the general population or primary care setting (Von Korff *et al.*, 1996; Haapanen *et al.*, 1997; Spencer *et al.*, 2002). Another limitation is the lack of information about treatments such as antiandrogen therapy and contraception which may have potential effect on mood (Davis and Tran, 2001; Oinonen and Mazmanian, 2002). The women in this study were also all aged between 28 and 33 years, and these results may not be applicable to women in other age groups. This is the first study assessing depression, anxiety symptoms and perceived stress in adult women with and without PCOS in a large, unselected community cohort. This

study confirms findings of worsened psychological distress and highlights the role of even non-clinical stress levels in potentially playing a role in the association among PCOS, depression and anxiety. It emphasises the need for a multidisciplinary approach to this increasing and debilitating condition. Future work should consider more specific assessments of health-related stress in women with PCOS and the potential role for stress management in the treatment of psychological distress in PCOS.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/S0033291718002076>.

Acknowledgements. The research on which this paper is based was conducted as part of the Australian Longitudinal Study on Women's Health undertaken by The University of Newcastle and The University of Queensland. The authors are grateful to the Australian Government Department of Health for funding and to the women who provided the survey data.

Author contributions. AJ, DL, HT and LM were responsible for substantial contributions to the study conception and design. DL and HT were responsible for data acquisition. ALD, AJ, AE and LM were responsible for the analysis and interpretation of data. ALD, AJ, DL, AE, HT and LM were responsible for drafting the article or revising it critically for important intellectual content, and final approval of the version to be published.

Financial support. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. The ALSWH is funded by the Australian Government Department of Health. ALD received a scholarship from the University of Bologna (Italy) for her secondment at Monash University. HJT holds a National Health and Medical Research Council of Australia (NHMRC) Practitioner fellowship. AJ holds a NHMRC early career fellowship. HJT holds a National Health and Medical Research Council of Australia (NHMRC) Practitioner fellowship. LM is supported by a SACVRDP fellowship; a program collaboratively funded by the NHF, the South Australian Department of Health and the South Australian Health and Medical Research Institute and a NHF Future Leader fellowship.

Conflict of interest. None.

References

- Açmaz G, Albayrak E, Acmaz B, Başer M, Soyak M, Zarsarsız G and İpekMüderis İ (2013) Level of anxiety, depression, self-esteem, social anxiety, and quality of life among the women with polycystic ovary syndrome. *The Scientific World Journal* 2013, 1–7.
- Altinok M, Glinborg D, Depont Christensen R, Hallas J and Andersen M (2014) Prescription of antidepressants is increased in Danish patients with polycystic ovary syndrome and is associated with hyperandrogenism. A population-based cohort study. *Clinical Endocrinology* 80, 884–889.
- Álvarez-Blasco F, Luque-Ramírez M and Escobar-Morreale HF (2010) Obesity impairs general health-related quality of life (HR-QoL) in premenopausal women to a greater extent than polycystic ovary syndrome (PCOS). *Clinical Endocrinology* 73, 595–601.
- Andresen EM, Malmgren JA, Carter WB and Patrick DL (1994) Screening for depression in well older adults: evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *American Journal of Preventive Medicine* 10, 77–84.
- Aziz R, Carmina E, Dewailly D, Diamanti-Kandarakis E, Escobar-Morreale H and Futterweit W (2006) Position statement: criteria for defining polycystic ovary syndrome as a predominantly hyperandrogenic syndrome: an androgen excess society guideline. *The Journal of Clinical Endocrinology & Metabolism* 91, 4237–4245.
- Azziz R, Woods KS, Reyna R, Key TJ, Knochenhauer ES and Yildiz BO (2004) The prevalence and features of the polycystic ovary syndrome in an unselected population. *The Journal of Clinical Endocrinology & Metabolism* 89, 2745–2749.

- Barry JA, Kuczmierczyk AR and Hardiman PJ (2011) Anxiety and depression in polycystic ovary syndrome: a systematic review and meta-analysis. *Human Reproduction* **26**, 2442–2451.
- Bell S and Lee C (2002) Development of the perceived stress questionnaire for young women. *Psychology, Health & Medicine* **7**, 189–201.
- Bell S and Lee C (2003) Perceived stress revisited: the Women's Health Australia project young cohort. *Psychology, Health & Medicine* **8**, 343–353.
- Benson S, Janssen O, Hahn S, Tan S, Dietz T, Mann K, Pleger K, Schedlowski M, Arck P and Elsenbruch S (2008) Obesity, depression, and chronic low-grade inflammation in women with polycystic ovary syndrome. *Brain, Behavior, and Immunity* **22**, 177–184.
- Benson S, Arck P, Tan S, Hahn S, Mann K, Rifaie N, Janssen O, Schedlowski M and Elsenbruch S (2009a) Disturbed stress responses in women with polycystic ovary syndrome. *Psychoneuroendocrinology* **34**, 727–735.
- Benson S, Hahn S, Tan S, Mann K, Janssen O, Schedlowski M and Elsenbruch S (2009b) Prevalence and implications of anxiety in polycystic ovary syndrome: results of an internet-based survey in Germany. *Human Reproduction* **24**, 1446–1451.
- Benson S, Hahn S, Tan S, Janssen OE, Schedlowski M and Elsenbruch S (2010) Maladaptive coping with illness in women with polycystic ovary syndrome. *Journal of Obstetric, Gynecologic, & Neonatal Nursing* **39**, 37–45.
- Brown WJ, Bryson L, Byles JE, Dobson AJ, Lee C, Mishra G and Schofield M (1999) Women's Health Australia: recruitment for a national longitudinal cohort study. *Women & Health* **28**, 23–40.
- Cousineau TM and Domar AD (2007) Psychological impact of infertility. *Best Practice & Research Clinical Obstetrics & Gynaecology* **21**, 293–308.
- Davis SR and Tran J (2001) Testosterone influences libido and well being in women. *Trends in Endocrinology & Metabolism* **12**, 33–37.
- De Ridder D, Geenen R, Kuijjer R and van Middendorp H (2008) Psychological adjustment to chronic disease. *The Lancet* **372**, 246–255.
- Deeks AA, Gibson-Helm ME and Teede HJ (2010) Anxiety and depression in polycystic ovary syndrome: a comprehensive investigation. *Fertility and Sterility* **93**, 2421–2423.
- Deeks A, Gibson-Helm M, Paul E and Teede H (2011) Is having polycystic ovary syndrome a predictor of poor psychological function including anxiety and depression? *Human Reproduction* **26**, 1399–1407.
- Dokras A, Clifton S, Futterweit W and Wild R (2011) Increased risk for abnormal depression scores in women with polycystic ovary syndrome: a systematic review and meta-analysis. *Obstetrics & Gynecology* **117**, 145–152.
- Dokras A, Clifton S, Futterweit W and Wild R (2012) Increased prevalence of anxiety symptoms in women with polycystic ovary syndrome: systematic review and meta-analysis. *Fertility and Sterility* **97**, 225–230. e2.
- Ezeh U, Yildiz BO and Azziz R (2013) Referral bias in defining the phenotype and prevalence of obesity in polycystic ovary syndrome. *The Journal of Clinical Endocrinology & Metabolism* **98**, E1088–E1096.
- Farkas J, Rigó A and Demetrovics Z (2014) Psychological aspects of the polycystic ovary syndrome. *Gynecological Endocrinology* **30**, 95–99.
- Farrell K and Antoni MH (2010) Insulin resistance, obesity, inflammation, and depression in polycystic ovary syndrome: biobehavioral mechanisms and interventions. *Fertility and Sterility* **94**, 1565–1574.
- Goldberg D, Bridges K, Duncan-Jones P and Grayson D (1987) Dimensions of neuroses seen in primary-care settings. *Psychological Medicine* **17**, 461–470.
- Goldberg D, Bridges K, Duncan-Jones P and Grayson D (1988) Detecting anxiety and depression in general medical settings. *British Medical Journal* **297**, 897–899.
- Guidi J, Gambineri A, Zanotti L, Fanelli F, Fava GA and Pasquali R (2015) Psychological aspects of hyperandrogenic states in late adolescent and young women. *Clinical Endocrinology* **83**, 872–878.
- Haapanen N, Miilunpalo S, Pasanen M, Oja P and Vuori I (1997) Agreement between questionnaire data and medical records of chronic diseases in middle-aged and elderly Finnish men and women. *American Journal of Epidemiology* **145**, 762–769.
- Hammen C, Kim EY, Eberhart NK and Brennan PA (2009) Chronic and acute stress and the prediction of major depression in women. *Depression and Anxiety* **26**, 718–723.
- Himelein MJ and Thatcher SS (2006) Depression and body image among women with polycystic ovary syndrome. *Journal of Health Psychology* **11**, 613–625.
- Hung J-H, Hu L-Y, Tsai S-J, Yang AC, Huang M-W, Chen P-M, Wang S-L, Lu T and Shen C-C (2014) Risk of psychiatric disorders following polycystic ovary syndrome: a nationwide population-based cohort study. *PLoS ONE* **9**, e97041.
- Kerchner A, Lester W, Stuart SP and Dokras A (2009) Risk of depression and other mental health disorders in women with polycystic ovary syndrome: a longitudinal study. *Fertility and Sterility* **91**, 207–212.
- Khan KS, Daya S, Collins JA and Walter SD (1996) Empirical evidence of bias in infertility research: overestimation of treatment effect in crossover trials using pregnancy as the outcome measure. *Fertility and Sterility* **65**, 939–945.
- Kozica SL, Gibson-Helm ME, Teede HJ and Moran LJ (2013) Assessing self-efficacy and self-help methods in women with and without polycystic ovary syndrome. *Behavioral Medicine* **39**, 90–96.
- Lahey BB (2009) Public health significance of neuroticism. *American Psychologist* **64**, 241.
- Lee C, Dobson AJ, Brown WJ, Bryson L, Byles J, Warner-Smith P and Young AF (2005) Cohort profile: the Australian longitudinal study on women's health. *International Journal of Epidemiology* **34**, 987–991.
- Lim S, Norman R, Davies M and Moran L (2013) The effect of obesity on polycystic ovary syndrome: a systematic review and meta-analysis. *Obesity Reviews* **14**, 95–109.
- March WA, Moore VM, Willson KJ, Phillips DI, Norman RJ and Davies MJ (2009) The prevalence of polycystic ovary syndrome in a community sample assessed under contrasting diagnostic criteria. *Human Reproduction* **25**, 544–551.
- Moran L, Gibson-Helm M, Teede H and Deeks A (2010) Polycystic ovary syndrome: a biopsychosocial understanding in young women to improve knowledge and treatment options. *Journal of Psychosomatic Obstetrics & Gynecology* **31**, 24–31.
- Moreno-Peral P, de Dios Luna J, Marston L, King M, Nazareth I, Motrico E, GildeGómez-Barragán MJ, Torres-González F, Montón-Franco C and Sánchez-Celaya M (2014) Predicting the onset of anxiety syndromes at 12 months in primary care attendees. The predictA-Spain study. *PLoS ONE* **9**, e106370.
- National Institute of Mental Health DAC (1995) Depression: What Every Woman Should Know Pub No. 95-3871.
- Oinonen KA and Mazmanian D (2002) To what extent do oral contraceptives influence mood and affect? *Journal of Affective Disorders* **70**, 229–240.
- World Health Organization (1999) Obesity: preventing and managing the global epidemic: report of a WHO consultation. *WHO Technical Report* 894.
- Powers J and Loxton D (2010) The impact of attrition in an 11-year prospective longitudinal study of younger women. *Annals of Epidemiology* **20**, 318–321.
- Raja-Khan N, Agito K, Shah J, Stetter CM, Gustafson TS, Socolow H, Kunselman AR, Reibel DK and Legro RS (2015) Mindfulness-based stress reduction for overweight/obese women with and without polycystic ovary syndrome: design and methods of a pilot randomized controlled trial. *Contemporary Clinical Trials* **41**, 287–297.
- Rofey DL, Szigethy EM, Noll RB, Dahl RE, Lobst E and Arslanian SA (2008) Cognitive-behavioral therapy for physical and emotional disturbances in adolescents with polycystic ovary syndrome: a pilot study. *Journal of Pediatric Psychology* **34**, 156–163.
- Rowlands I, Teede H, Lucke J, Dobson A and Mishra G (2016) Young women's psychological distress after a diagnosis of polycystic ovary syndrome or endometriosis. *Human Reproduction* **31**, 2072–2081.
- Simon GE, Von Korff M, Saunders K, Miglioretti DL, Crane PK, Van Belle G and Kessler RC (2006) Association between obesity and psychiatric disorders in the US adult population. *Archives of General Psychiatry* **63**, 824–830.
- Spencer EA, Appleby PN, Davey GK and Key TJ (2002) Validity of self-reported height and weight in 4808 EPIC-Oxford participants. *Public Health Nutrition* **5**, 561–565.
- Stefanaki C, Bacopoulou F, Livadas S, Kandaraki A, Karachalios A, Chrousos GP and Diamanti-Kandaraki E (2015) Impact of a mindfulness

- stress management program on stress, anxiety, depression and quality of life in women with polycystic ovary syndrome: a randomized controlled trial. *Stress* **18**, 57–66.
- Tan S, Hahn S, Benson S, Janssen O, Dietz T, Kimmig R, Hesse-Hussain J, Mann K, Schedlowski M and Arck P** (2008) Psychological implications of infertility in women with polycystic ovary syndrome. *Human Reproduction* **23**, 2064–2071.
- Teede HJ, Joham AE, Paul E, Moran LJ, Loxton D, Jolley D and Lombard C** (2013) Longitudinal weight gain in women identified with polycystic ovary syndrome: results of an observational study in young women. *Obesity* **21**, 1526–1532.
- Trent ME, Rich M, Austin SB and Gordon CM** (2003) Fertility concerns and sexual behavior in adolescent girls with polycystic ovary syndrome: implications for quality of life. *Journal of Pediatric and Adolescent Gynecology* **16**, 33–37.
- Veltman-Verhulst SM, Boivin J, Eijkemans MJ and Fauser BJ** (2012) Emotional distress is a common risk in women with polycystic ovary syndrome: a systematic review and meta-analysis of 28 studies. *Human Reproduction Update* **18**, 638–651.
- Von Korff M, Ustun TB, Ormel J, Kaplan I and Simon GE** (1996) Self-report disability in an international primary care study of psychological illness. *Journal of Clinical Epidemiology* **49**, 297–303.