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Health-related quality of life and mental state in women with polycystic ovary syndrome and migration or minority background – A cross-sectional study

Konstantin Hofmann [a,*], Claire Decrinis [b], Norman Bitterlich [c], Annette Bachmann [d], Petra Stute [e]

[a] Department of Obstetrics and Gynecology, University Medical Center of Johannes Gutenberg University Mainz, Germany
[b] Department of Obstetrics and Gynecology, University of Freiburg Medical Center, Germany
[c] Independent Researcher, Chemnitz, Germany
[d] Department of obstetrics and gynecology, division of gynecological endocrinology and reproductive medicine, University Medicine, Johann Wolfgang Goethe University, Frankfurt, Germany
[e] Department of Obstetrics and Gynecology, University Clinic Inselspital Bern, Switzerland

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ABSTRACT

Introduction: Polycystic Ovary Syndrome (PCOS) is the most prevalent endocrine disorder among women of reproductive age on a global scale. The severity of symptoms and individual distress can vary greatly and may also depend on the respective ethnic and cultural background. This study aimed to investigate potential variations in health-related quality of life (HRQOL), depression, and anxiety between PCOS patients with a migration (MB) or minority background (Min) and those without (Non-MB/Non-Min).
Methods: An online questionnaire was anonymously distributed to gynecologists, hospitals, and women's clinics in Austria, Germany, and Switzerland, along with social media channels to reach women with PCOS. The survey was conducted between November 14th, 2023, and February 5th, 2024. Various aspects including HRQOL, levels of anxiety/depression and self-esteem were evaluated using the Modified-PCOS-Questionnaire (MPCOSQ), Hospital Anxiety and Depression Scale (HADS) and Rosenberg Self-Esteem Scale (RSE) respectively. The participants were screened for migration background and self-identification with a socially relevant minority. The selection of potential confounding variables was based on their plausibility and estimated impact. Adjusted odds ratios and their corresponding 95 % confidence intervals were calculated using regression analysis.
Results: The study involved 587 participants with PCOS. MB and Min exhibited significantly poorer HRQOL, and greater symptoms of depression compared to PCOS patients in the two control groups. (MPCOSQ-Total: MB/Non-MB $p = 0.02$; Min/Non-Min $p < 0.001$; HADS-Depression: MB/Non-MB $p = 0.03$; Min/Non-Min $p = 0.01$) Additionally, MB and Min had significantly lower self-esteem according to the RSE (RSE: MB/Non-MB $p = 0.04$; Min/Non-Min $p = 0.049$). In the univariate analysis, Non-MB and Non-Min were associated with partially better HRQOL and lower depression (or respectively poorer HRQOL and depression for MB and Min). However, in the multivariate analysis only Non-Min showed a statistically significant association with higher HRQOL (B: 0.34; CI: 0.04; 0.63; $p = 0.03$) and only Non-MB was associated with lower depression (B:1.28; CI:2.31; -0.24; $p = 0.02$).
Conclusion: This study highlights the association between MB or Min and poorer HRQOL, higher depression rates, and lower self-esteem among PCOS patients. While genetic and epigenetic factors may contribute, socioeconomic and sociocultural influences likely play significant roles. Healthcare professionals should remain attuned to the diverse needs of women with PCOS, especially those from migration or minority backgrounds, to ensure equitable access to care.

* Corresponding author at: Department of Obstetrics and Gynecology, University Medical Center of Johannes Gutenberg University Mainz, Langenbeckstr. 1, 55131 Mainz, Germany.
E-mail address: Konstantin_hofmann@yahoo.de (K. Hofmann).

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Introduction

Polycystic Ovary Syndrome (PCOS) is the most prevalent endocrine disorder among women of reproductive age on a global scale (Okoroh et al., 2012; Teede et al., 2023; Wolf et al., 2018). According to research conducted by the Global Burden of Disease Study the age-standardized point prevalence is estimated at 1667.8 per 100,000 women globally, showing a rising trend. From 1990 onwards, there has been a 30.4 % increase in the global prevalence of this condition (Liu et al., 2021).

Women diagnosed with PCOS display a range of symptoms that pose challenges for standardized treatment approaches. These symptoms can be categorized into five main areas, each with varying degrees of impact. These areas include body image concerns (such as acne, hirsutism, alopecia, and overweight), issues related to the endometrium (including oligo-/amenorrhea and endometrial carcinoma), metabolic disturbances (such as insulin resistance, metabolic syndrome, type 2 diabetes mellitus, and cardiovascular risk factors), reproductive health challenges (including infertility and pregnancy complications), and mental health issues (such as body image concerns, anxiety, depression, eating disorders, and sleep disturbances) (Teede et al., 2023).

The distinctive symptoms of PCOS, such as signs of androgenization or menstrual irregularities, along with associated distressing factors like the heightened prevalence of depression and body image concerns, lead to a diminished health-related quality of life (HRQOL) for individuals with PCOS (Teede et al., 2023).

The etiology of PCOS has a genetic component, indicating the possibility of a shared genetic foundation for the condition even across diverse ethnicities. Nevertheless, genome-wide association studies (Hiam et al., 2019) showed that only 10 % of all cases can be genetically explained (twin studies demonstrated an association of approximately 70 %), suggesting the involvement of epigenetic, socioeconomic, cultural, and/or environmental factors in PCOS development.

This can also be seen in the varying manifestations of PCOS in international comparison. For instance, women of Middle Eastern, Mediterranean, Indian, and South Asian descent diagnosed with PCOS exhibit a greater occurrence and/or intensity of hirsutism compared to East Asian or Caucasian counterparts (VanHise et al., 2023). However, comparing the conducted studies is difficult, as the diagnosis of PCOS itself can vary internationally based on different diagnostic criteria, and a large proportion of PCOS patients may go unrecognized (Wolf et al., 2018).

The influence of migration background or belonging to a minority group has been investigated little so far. In an Austrian study from 2004 (Schmid et al., 2004a, 2004b), a greater impairment in HRQOL was observed among individuals with a migration background, primarily attributed to socio-cultural differences in the assessment of PCOS-related symptoms.

This study aimed to investigate potential variations in HRQOL and mental state (depression, anxiety, self-esteem) between PCOS patients with a migration (MB) or minority background (Min) and those without (controls: Non-MB/Non-Min).

Methods

This study was a non-interventional cross-sectional investigation. Data collection was conducted using an online questionnaire administered through the SoSciSurvey software (Leiner, 2019). The survey was administered from November 14th, 2023, to February 5th, 2024.

To enroll participants, flyers containing the survey link were disseminated to gynecologists' practices, hospitals, and women's clinics, with a request to distribute them among affected individuals or display them in waiting areas. Additionally, efforts were made to reach potential participants who might not be reached through these methods via social media platforms or internet forums. Recruitment was actively carried out across German-speaking regions including Switzerland, Austria and Germany.

Inclusion and exclusion criteria

All women diagnosed with PCOS were eligible for participation in the study. Participants had to be at least 18 years old, and their involvement in the study had to be voluntary. Within the questionnaire, participants were assessed according to the ESHRE criteria for PCOS diagnosis. Specifically, they were asked detailed questions about the regularity of their natural menstrual cycle to screen for oligomenorrhea or amenorrhea. In addition, the participants were asked whether they had previously been diagnosed with hyperandrogenemia. If not, they were questioned about clinical signs of hyperandrogenism. Hirsutism was evaluated using the Ferriman-Gallwey questionnaire, with a score exceeding 7 indicating pathological hirsutism (Ferriman and Gallwey, 1961). The Ludwig classification was employed to assess alopecia resulting from androgenization triggered by PCOS (Ludwig, 1977). However, these clinical signs of hyperandrogenism were only accepted as a diagnostic marker once the participants reported a pathological value. The participants were asked if they are currently suffering from acne.

For the criterion of polycystic ovarian morphology, participants were asked whether a gynecologist had ever informed after having a transvaginal ultrasound that they showed evidence of polycystic ovarian morphology. Measurement of Anti-Müllerian hormone levels was omitted, as current PCOS guidelines do not specify a clear cut-off value for this parameter.(Teede et al., 2023)

Women who did not meet the diagnostic criteria for PCOS as per the ESHRE recommendation, as well as those who had experienced thelarche less than three years prior, pregnant or breastfeeding women, and those who reported never having menstruated, were not included in the study. Furthermore, individuals with a differential diagnosis inconsistent with PCOS, such as congenital adrenal hyperplasia or prolactinoma, were excluded. As the survey was conducted in German as an online questionnaire, proficiency in German and access to the internet were prerequisites for participation.

The inclusion and exclusion criteria were verified at the outset of the online questionnaire. If a participant met an exclusion criterion, the survey was terminated, and the participant was notified that they did not meet the criteria for inclusion in the target population.

Psychosocial and clinical parameters

Migration and minority background

Participants were asked about their current place of residence and place of birth. Additionally, the same data were collected for the participants' parents. Migration background was defined according to the information provided by the German Federal Statistical Office (Migrationshintergrund [WWW Document] n.d). Thus, the variable "migration background" includes both direct and indirect migration background. If the country of birth of the parents was not provided and the place of residence was stated as Germany, Switzerland or Austria and this corresponded to the country of birth, the migration background was assessed as unknown. (Migration background [MB], control: no migration background [Non-MB])

Moreover, the questionnaire included questions from the Anti-Discrimination Survey of the Federal Ministry for Family Affairs, Senior Citizens, Women, and Youth in Germany (Baumann et al., 2018) to inquire about participants' self-identification. The participants were asked to assign themselves a self-designation based on the geographical references and self-designations of numerically large groups in Germany as well as the groups worthy of protection under the UN Convention against racism. The information could be supplemented with personal details. Multiple answers were possible. Belonging to a minority was defined as all other information than "white" (Minority background [Min], control: no minority background [Non-Min]). Free text statements such as "human" or "European" as a self-designation were not counted as belonging to a minority.

Health-related quality of life (HRQOL)

The PCOSQ was utilized to assess HRQOL. It consists of 26 items covering different symptom areas associated with PCOS, including emotions, body hair, weight, infertility problems, and menstrual problems. Participants rated their responses on a Likert scale ranging from one to seven, with seven indicating the lowest level of impairment (Böttcher et al., 2018).

The Modified PCOS-Questionnaire (MPCOSQ) has been updated to include four additional questions pertaining to the "acne" subscale. This revised version is widely used and has undergone validation in multiple languages. The questionnaire validated in German was used in our study (Böttcher et al., 2018). There is no universally recognized cut-off for this questionnaire (Barnard et al., 2007; Bazarganipour et al., 2012; Luo et al., 2020).

Mental state

Anxiety and depression levels were evaluated using the Hospital Anxiety and Depression Scale (HADS). This self-administered questionnaire comprises two subscales, one for anxiety and the other for depression, each containing seven questions. Participants responded to each item using a scale ranging from zero (no symptoms) to three (severe symptoms), with higher scores indicating increased levels of anxiety or depression. A score of eight or higher was considered the cut-off for both symptom domains. Scores between eight and ten indicated mild anxiety or depression, 11 to 14 indicated moderate levels, and 15 to 21 indicated severe anxiety or depression (Zigmond and Snaith, 1983). The HADS questionnaire is a validated questionnaire to measure depression and anxiety and is widely used in science.(Bjelland et al., 2002) In this study, the validated German version of the questionnaire was used (Herrmann and Buss, 1994).

The Rosenberg Self-Esteem Scale (RSE) was utilized to assess overall self-esteem. The RSE is a widely used questionnaire in the survey of self-esteem. The validated German version of the questionnaire was used in this study (Collani and Herzberg, 2003). This scale comprises 10 statements pertaining to self-worth, self-acceptance, and general feelings of adequacy. Participants expressed their agreement or disagreement with each statement, typically using a four-point Likert scale ranging from "strongly agree" to "strongly disagree." Scores on the scale range from 10 to 40, with scores falling between 20 and 30 generally considered average, while scores below 20 indicated lower levels of self-esteem (Meston et al., 2020; "Society and the Adolescent Self-Image | Princeton University Press," 2016).

Theory and calculation

The theory of this study is that PCOS patients with a migration or minority background suffer from reduced HRQOL, lower self-esteem, and higher levels of anxiety and depression compared to PCOS patients without a migration or minority background. Therefore, the following calculations were carried out.

The results of the aforementioned measurement tools were compared to values reported in existing literature. A sample size of 200 participants was deemed sufficient to statistically detect differences ranging from at least 7 % (when occurrence rates in the general population are below 5 %) to at least 11 % (when occurrence rates in the general population are around 20 %) with 80 % power for binomial proportions. For changes in point scores (ordinal or cardinal scaled), a sample size of 200 participants could detect small effects with Cohen's effect sizes of at least 0.25 with 80 % power. Since we used multivariate statistical tests, there was no multiple testing present. Therefore, no correction methods are necessary. The reliability of the HADS, MPCOSQ, and Rosenberg Scale was tested using tau-equivalent reliability to evaluate their internal consistency and measurement precision. A tau-equivalent reliability coefficient (ρ_T) of ≥ 0.70 was considered acceptable for determining the reliability of the assessed scales.

The data underwent exploratory data analysis and descriptive statistical analysis such as mean ± standard deviation, frequency, and percentages using "IBM SPSS Statistics Version 29″.

Percentages were compared using $\chi 2$ test or exact Fisher's test. Differences in means between independent groups were assessed using the *t*-test, with p-values indicating the degree of difference.

Linear regression analyses were utilized to evaluate the influence of migration or minority background on parameters. For inclusion in the regression analysis, the highest level of education was categorized (higher education) into secondary level I (completion of 10th grade or below), secondary level II (university entrance qualification), and university degree. Subsequently, results of the MB/Non-MB and Min/Non-Min with p-values below 0.05 in the univariate regression model were included in the final multivariate regression model using backward stepwise selection to ascertain their independence. All variables in the linear regression model were tested for heteroscedasticity using the Levene/Welch test, with those yielding p-values below 0.05 being identified as heteroscedastic.

Before incorporation into the multivariate model, parameters underwent correlation assessments. If the Spearman correlation coefficient exceeded 0.7, parameters were not simultaneously included in the model to prevent multicollinearity. . Confounding variables were selected from a set of clinically relevant factors, including age, BMI, diabetes mellitus, insulin resistance, hormone medication, menopausal status, desire for children, fertility problems, current fertility treatment, PCOS-type, higher education, employment status, relationship status, Ludwig-Score, and Ferriman-Gallwey-Score. Model adjustment was conducted using a change-in-estimate approach, where potential confounders were included in the final multivariate regression model if they altered the regression coefficient (B) by >10 %. Effects were estimated using B, p-value, and 95 % confidence interval (CI).

Ethical considerations

The research protocol was exempt from ethical review by the Rhineland Palatinate committee and the Swiss Association of Research Ethics Committees, as per German and Swiss legal statutes and regulations. These regulations state that studies involving anonymous data collection do not need formal ethical approval (2023-17312/BASEC Req-2023-01259). Both the study center and SoSciSurvey comply with German and European data protection legislation. The study was conducted in accordance with the principles outlined in the "Declaration of Helsinki" (German version of the declaration of Helsinki, 2013).

Results

The survey received a total of 1786 responses, with 778 people participating, but only 690 fully completed the questionnaire. Exclusions were made: 60 due to pregnancy or lactation, eight because less than three years had passed since thelarche, four due to not having experienced menstruation yet, and 32 because they did not meet the ESHRE criteria for PCOS. The subsequent data presents the findings from the 587 fully completed questionnaires. The migration status of 11 participants could not be assigned.

Characteristics of the cohort

The average age of the study participants was 32.5 ± 5.9 years. The MB/Non-MB and Min/Non-Min groups differed significantly in their highest educational attainment (MB/Non-MB: $p = 0.04$; Min/Non-Min: $p = 0.01$), with MB and Min achieving lower educational attainment. (Table 1) Further data on the self-identification of the study participants can be found in the appendix. (Appendix 1)

Health-related quality of life

While there isn't a specified threshold for the MPCOSQ-subscales,

Table 1
Anthropometric characteristics of the study population (BMI: Body Mass Index; MB: migration background; Min: minority background; Non-MB: no migration background; Non-Min: no minority background; PCOS: Polycystic Ovary Syndrome; SD: standard deviation), absolute number of study participants is indicated in brackets next to the percentages; the World Health Organization defines Body Mass Index (BMI) ≤24.9 kg/m2, 25–29.9 kg/m2, ≥ 30 kg/m2 and ≥ 35 kg/m2 as healthy weight, overweight and obesity I and II; "Currently under metabolic medication" was defined as the current intake of Metformin, Insulin, incretin mimetics, or other antidiabetic medications; "Fertility- Problems" was defined as trying to get pregnant (= regular, unprotected sexual intercourse at the right time) for over one year; Definition of PCOS-type: *A*= hyperandrogenism + ovulatory dysfunction + PCO-morphology; *B*= hyperandrogenism + ovulatory dysfunction; C= hyperandrogenism + PCO-morphology; *D*= ovulatory dysfunction + PCO-morphology.

	Overall *n* = 587	MB 20.1 % (116)	Non-MB 79.9 % (460)	p	Min 11.9 % (70)	Non-Min 88.1 % (517)	p
Age (years)				0.75			0.24
Mean ± SD	32.5 ± 5.9	32.3 ± 0.6	32.5 ± 0.3		32.0 ± 6.2	32.6 ± 5.8	
BMI (kg/m^2)				0.20			0.31
Mean ± SD	31.3 ± 7.8	31.1 ± 0.8	31.8 ± 0.4		32.1 ± 7.4	31.6 ± 7.9	
Diabetes mellitus		3.4 % (4)		0.54			0.42
Yes	2.7 % (16)	96.6 % (112)	2.6 % (12)		4.3 % (3)	2.5 % (13)	
No	97.3 % (571)		97.4 % (448)		95.7 % (67)	97.5 % (504)	
Insulin resistance				0.25			>0.99
Yes	45.1 % (265)	39.7 % (46)	45.9 % (211)		45.7 % (32)	45.1 % (233)	
No	54.9 % (322)	60.3 % (70)	54.1 % (249)		54.3 % (38)	54.9 % (284)	
Currently under metabolic medication				0.75			0.16
Yes	41.7 % (245)	39.7 % (46)	41.5 % (191)		50.0 % (35)	40.6 % (210)	
No	58.3 % (342)	60.3 % (70)	58.5 % (269)		50.0 % (35)	59.4 % (307)	
Currently under hormone medication				0.11			0.38
Yes	15.7 % (92)	10.3 % (12)	16.7 % (77)		11.4 % (8)	16.2 % (84)	
No	84.3 % (495)	89.7 % (104)	83.3 % (383)		88.6 % (62)	83.8 % (433)	
Menopause status				>0.99			0.74
Postmenopausal	3.1 % (18)	3.4 % (4)	3.5 % (16)		4.3 % (3)	3.7 % (19)	
Premenopausal	96.9 % (569)	96.6 % (112)	96.5 % (444)		95.7 % (67)	96.3 % (498)	
Current desire to have children				0.25			0.25
Yes	43.8 % (257)	38.8 % (45)	45.0 % (207)		37.1 % (26)	44.7 % (231)	
No	56.2 % (330)	61.2 % (71)	55.0 % (253)		62.9 % (44)	55.3 % (286)	
Fertility-Problems				0.12			0.25
Yes	48.6 % (285)	42.2 % (49)	50.4 % (232)		41.4 % (29)	49.5 % (256)	
No	51.4 % (302)	57.8 % (67)	49.6 % (228)		58.6 % (41)	50.5 % (261)	
Currently undergoing fertility treatment				0.79			0.75
Yes	19.4 % (114)	18.1 % (21)	19.6 % (90)		17.1 % (12)	19.7 % (102)	
No	80.6 % (473)	81.9 % (95)	80.4 % (370)		82.9 % (58)	80.3 % (415)	
PCOS-type				0.56			0.27
A	75.5 % (443)	75.9 % (88)	75.0 % (345)		78.6 % (55)	75.0 % (388)	
B	7.8 % (46)	5.2 % (6)	8.7 % (40)		5.7 % (4)	8.1 % (42)	
C	14.7 % (86)	18.1 % (21)	14.1 % (65)		12.9 % (9)	14.9 % (77)	
D	1.9 % (11)	0.9 % (1)	2.2 % (10)		1.4 % (1)	1.9 % (10)	
Highest level of education				**0.04**			**0.01**
Currently attending school	0.2 % (1)	0.9 % (1)	0.0 % (0)		1.4 % (1)	0.0 % (0)	
School-leaving qualification	6.3 % (37)	3.4 % (4)	7.0 % (32)		2.9 % (2)	6.8 % (35)	
Secondary school certificate	25.2 % (148)	27.6 % (32)	24.3 % (112)		27.1 % (19)	25.0 % (129)	
Polytechnic secondary school	0.7 % (4)	1.7 % (2)	0.4 % (2)		1.4 % (1)	0.6 % (3)	
Advanced college certificate	14.5 % (85)	10.3 % (12)	15.9 % (73)		12.9 % (9)	14.7 % (76)	
Abitur	17.9 % (105)	14.7 % (40)	18.3 % (84)		14.3 % (10)	18.4 % (95)	
University	31.7 % (186)	34.5 % (8)	31.5 % (145)		31.4 % (22)	31.7 % (164)	
Other	3.6 % (21)	6.9 %	2.6 % (12)		8.6 % (6)	2.9 % (15)	
Employment				0.11			0.33
Yes	87.7 % (515)	86.2 % (100)	88.3 % (406)		82.9 % (58)	88.4 % (457)	
No	12.3 % (72)	13.8 % (16)	11.7 % (54)		17.1 % (12)	11.6 % (60)	
Partnership				0.39			0.60
Yes	84.7 % (497)	81.9 % (95)	85.4 % (393)		82.9 % (58)	84.9 % (439)	
No	15.3 % (90)	18.1 % (21)	14.6 % (67)		17.1 % (12)	15.1 % (78)	
Ludwig-Score				0.30			0.29
Mean ± SD	1.0 ± 0.24	1.1 ± 0.04	1.1 ± 0.02		1.1 ± 0.3	1.1 ± 0.2	
Ferriman-Gallwey-Score				0.47			0.050
Mean ± SD	14.1 ± 6.6	15.8 ± 1.0	15.2 ± 0.5		15.3 ± 6.5	13.9 ± 6.6	

the participants in the study exhibited low scores across all subscales as well as the overall score. The exception was the acne subscale, which demonstrated values in the normal range. However, Min consistently showed the lowest values in all subscales compared to all other groups. The Min/Non-Min differed significantly in the subscales MPCOSQ-Emotion, MPCOSQ-Body hair, MPCOSQ-Weight, MPCOSQ-Menstrual problems and MPCOSQ-Total. In MB/Non-MB, MB showed significantly lower results in MPCOSQ-Emotion and MPCOSQ-Total. (Table 2) Except for the MPCOSQ-Menstrual problems subscale (ρ_T=0.46), all questionnaire subscales (MPCOSQ-Emotion ρ_T=0.81, MPCOSQ-Body hair ρ_T=0.91, MPCOSQ-Weight ρ_T=0.95, MPCOSQ-Infertility problems ρ_T=0.72, MPCOSQ-Acne ρ_T=0.96, MPCOSQ-Total ρ_T=0.89) proved to be fully reliable.

Mental state

The study participants reported an average anxiety score of 10.3. The proportion of results in the pathological range HADS >8 is higher in the MB and Min groups compared to their control groups. There was a significant difference in the HADS-Depression subscale between the groups in terms of absolute values and the proportion of pathological results, as well as in RSE, where MB and Min achieved lower scores.

Table 2
Health-related quality of life assessed with the Modified PCOS-Questionnaire (MPCOSQ) (MB: migration background; Min: minority background; Non-MB: no migration background; Non-Min: no minority background; SD: standard deviation).

MPCOSQ	Overall Mean ± SD	MB Mean ± SD	Non-MB Mean ± SD	p	Min Mean ± SD	Non-Min Mean ± SD	p
Emotion	3.4 ± 1.1	3.2 ± 1.1	3.5 ± 1.05	**0.01**	3.0 ± 1.0	3.5 ± 1.1	**<0.001**
Body hair	3.5 ± 1.8	3.3 ± 1.8	3.5 ± 1.8	0.09	3.0 ± 1.8	3.5 ± 1.8	**0.01**
Weight	2.8 ± 1.8	2.7 ± 1.9	2.9 ± 1.8	0.16	2.3 ± 1.5	2.9 ± 1.8	**0.004**
Infertility problems	3.6 ± 1.7	3.4 ± 1.7	3.7 ± 1.7	0.10	3.3 ± 1.7	3.7 ± 1.7	0.06
Menstrual problems	3.5 ± 1.2	3.4 ± 1.2	3.5 ± 1.2	0.12	3.2 ± 1.1	3.5 ± 1.2	**0.02**
Acne	4.9 ± 2.0	4.8 ± 2.1	4.9 ± 1.9	0.23	4.6 ± 2.1	4.9 ± 1.9	0.13
Total	3.6 ± 1.0	3.4 ± 1.0	3.6 ± 0.9	**0.02**	3.2 ± 1.0	3.6 ± 0.9	**<0.001**

Table 3
Mental state; absolute number of study participants is indicated in brackets next to the percentages (HADS: Hospital Anxiety and Depression Scale; MB: migration background; Min: minority background; Non-MB: no migration background; Non-Min: no minority background; SD: standard deviation).

HADS	Overall	MB	Non-MB	p	Min	Non-Min	p
Anxiety-Subscale Mean ± SD	10.3 ± 4.0	10.8 ± 3.9	10.1 ± 4.0	0.12	11.1 ± 3.5	10.2 ± 4.1	**0.04**
Anxiety > 8	75.0 % (440)	78.4 % (91)	73.9 % (340)	0.34	81.4 % (57)	74.1 % (383)	0.24
Depression-Subscale Mean ± SD	8.3 ± 4.1	9.2 ± 4.4	8.0 ± 4.00	**0.01**	9.5 ± 4.0	8.1 ± 4.1	**0.01**
Depression >8	67.6 % (397)	66.4 % (77)	54.8 % (252)	**0.03**	72.9 % (51)	55.5 % (287)	**0.01**
Rosenberg Self-esteem Score Mean ± SD	25.9 ± 6.8	24.8 ± 6.8	26.3 ± 6.7	**0.04**	24.4 ± 6.3	26.1 ± 6.8	**0.049**

(Table 3, Fig. 1) The HADS-Anxiety (ρ_T=0.77), HADS-Depression (ρ_T=0.76) subscales as well as RSE (ρ_T=0.92) demonstrated reliability based on tau-equivalent reliability analysis.

Association between migration and minority background and HRQOL and mental state

In the univariate analysis, Non-MB and Non-Min exhibited a significant association with the subscales of the MPCOSQ and HADS. Potential confounders were also assessed for association with HRQOL and mental state and are listed in Table 4.

A multivariate regression analysis was performed on all subdomains of the MPCOSQ and HADS but MPCOSQ-Infertility problems, MPCOSQ-Acne, and HADS-Anxiety because the p-value for Non-Min and Non-MB in the univariate analysis was not <0.05. Potential confounding variables were incorporated into the model if they satisfied the change in estimate criterion. Prior to their inclusion, all parameters underwent correlation checks, with none displaying a correlation coefficient exceeding 0.7. In the multivariate analysis, Non-Min was statistically significant for MPCOSQ-Weight (B: 0.50; CI: 0.01; 0.99, $p = 0.05$) and MPCOSQ-Total (B: 0.34; CI: 0.04; 0.63; $p = 0.03$). Only in HADS-Depression, Non-MB was significant (B: −1.28; CI: −2.31; −0.24; $p = 0.02$). Further details of the multivariate regression can be found in the appendix.

Discussion

To our knowledge this is the first study investigating HRQOL, self-esteem and mental state in women with PCOS and migration or minority background. The results of this study clearly showed that MB and Min have poorer HRQOL compared to PCOS patients in the comparison group. It is already known that the characteristic symptoms of PCOS,

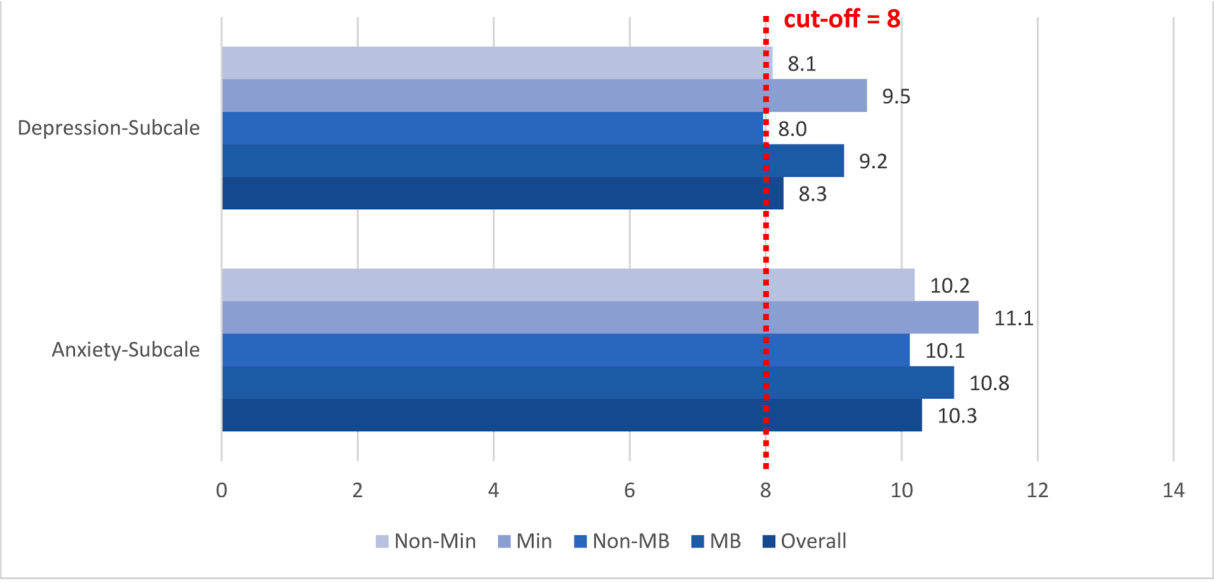

Fig. 1. Results of the Hospital Anxiety and Depression Scale (HADS) (MB: migration background; Min: minority background; Non-MB: no migration background; Non-Min: no minority background).

Table 4
Association between Health-related quality of life (HRQOL), anxiety, depression and migration and minority background; univariate linear regression; values marked with an asterisk (*) had p-values below 0.05 in the Levene/Welch test (B: regression coefficient; BMI: Body Mass Index; CI: confidence interval; HADS: Hospital Anxiety and Depression Scale; MPCOSQ: Modified PCOS-Questionnaire; Non-MB: no migration background; Non-Min: no minority background; PCOS: Polycystic Ovary Syndrome).

	MPCOSQ-Emotions	MPCOSQ-Body hair	MPCOSQ-Weight	MPCOSQ-Infertility problems	MPCOSQ-Menstrual problems	MPCOSQ-Acne	MPCOSQ-Total	HADS-Anxiety	HADS-Depression
Age	B: 0.25 (CI: 0.01; 0.04) ***p* < 0.001**	B: −0.02 (CI: −0.04; 0.01) *p* = 0.15	B: −0.05 (CI:−0.07; −0.02) ***p* < 0.001**	B: 0.06 (CI: 0.04; 0.08) ***p* < 0.001**	B: 0.05 (CI: 0.03; 0.06) ***p* < 0.001**	B: 0.06 (CI: 0.03; 0.09) ***p* < 0.001**	B: 0.02 (CI: 0.00; 0.03) ***p* = 0.01**	B: −0.01 (CI: −0.06; 0.05) *p* = 0.78	B: 0.10 (CI: 0.04; 0.16) ***p* < 0.001**
BMI	B: −0.02 (CI: 0.04; −0.01) ***p* < 0.001***	B: −0.06 (CI: −0.08; 0.05) ***p* < 0.001***	B: −0.14 (CI: −0.16; −0.13) ***p* < 0.001**	B: −0.04 (CI: −0.06; −0.03) ***p* < 0.001***	B: −0.003) (CI: −0.02; 0.10) *p* = 0.67	B: 0.03 (CI: 0.01; 0.05) ***p* = 0.01**	B: −0.04 (CI: −0.05; −0.03) ***p* < 0.001***	B: 0.07 (CI: 0.02; 0.11) ***p* = 0.002***	B: 0.11 (CI: 0.06; 0.15) ***p* < 0.001**
No diabetes mellitus	B: 0.30 (CI: −0.23; 0.84) *p* = 0.27	B: 0.54 (CI: −0.38; 1.45) *p* = 0.25	B: 0.75 (CI: −0.15; 1.65) *p* = 0.10	B: 0.30 (CI: −0.53; 1.14) *p* = 0.48	B: 0.18 (CI: −0.41; 0.76; *p* = 0.56	B: −0.47 (CI: −1.44; 0.51) *p* = 0.35	B: 0.30 (CI: −0.18; 0.77) *p* = 0.22	B: 0.05 (CI: −1.94; 2.05) *p* = 0.96	B: 0.21 (CI: −1.85; 2.26) *p* = 0.85
No insulin resistance	B: 0.24 (CI: 0.07; 0.42) ***p* = 0.01**	B: 0.50 (CI: 0.20; 0.79) ***p* = 0.001***	B: 0.95 (CI: 0.67; 1.24) ***p* < 0.001***	B: 0.32 (CI: 0.05; 0.59) ***p* = 0.02**	B: 0.19 (CI: 0.00; 0.38) ***p* = 0.05**	B: −0.03 (CI: −0.35; 0.29) *p* = 0.86	B: 0.37 (CI: 0.22; 0.52) ***p* < 0.001**	B: −0.64 (CI: −1.29; 0.01) *p* = 0.05	B: −0.98 (CI: −1.65; 0.31) ***p* = 0.004**
Currently not under hormone medication	B: −0.08 (CI: −0.32; 0.16) *p* = 0.50	B: −0.27 (CI: −0.60; 0.14) *p* = 0.19	B: 0.36 (CI: −0.05; 0.76) *p* = 0.08	B: −0.71 (CI: −1.08; 0.34) ***p* < 0.001***	B: −0.01 (CI: −0.28; 0.25) *p* = 0.92	B: 0.04 (CI: −0.40; 0.47) *p* = 0.88	B: −0.10 (CI: −0.31; 0.11) *p* = 0.36*	B: −0.22 (CI: −1.12; 0.67) *p* = 0.62	B: 0.66 (CI: −0.26; 1.58) *p* = 0.16
premenopausal	B: 0.59 (CI: 0.13; 1.046) ***p* = 0.01**	B: 0.89 (CI: 0.11; 1.67) ***p* = 0.03***	B: 0.90 (CI: 0.13; 1.67) ***p* = 0.02***	B: 0.20 (CI: −0.51; 0.92 *p* = 0.58	B: 0.04 (CI: −0.47; 0.54) *p* = 0.89	B: 0.97 (CI: 0.13; 1.80) ***p* = 0.02**	B: 0.62 (CI: 0.21; 1.02) ***p* = 0.003**	B: −0.49 (CI: −2.20; 1.22) *p* = 0.57	B: −1.10 (CI: −2.86; 0.67) *p* = 0.22
No current desire to have children	B: 0.2 (CI: 0.06; 0.41) ***p* = 0.01**	B: −0.01 (CI: −0.31; 0.29) *p* = 0.96	B: −0.20 (CI: −0.49; 0.10) *p* = 0.19*	B: 2.16 (CI: 1.95; 2.37) ***p* < 0.001***	B: 0.18 (CI: −0.01; 0.37) *p* = 0.06	B: −0.33 (CI: −0.65; 0.01) ***p* = 0.04**	B: 0.30 (CI: 0.14; 0.45) ***p* < 0.001**	B: 0.03 (CI: −0.63; 0.68) *p* = 0.93	B: −0.24 (CI: −0.91; 0.44) *p* = 0.49
No fertility-Problems	B: 0.08 (CI: −0.10; 0.25) *p* = 0.39	B: 0.23 (CI: −0.06; 0.53) *p* = 0.12	B: 0.43 (CI: 0.13; 0.72) ***p* = 0.004***	B: 1.18 (CI: 0.93; 1.44) ***p* < 0.001**	B: −0.08 (CI: −0.27; 0.16) *p* = 0.43	B: −0.34 (CI: −0.66; 0.02) ***p* = 0.04**	B: 0.23 (CI: 0.08–0.39) ***p* = 0.003**	B: 0.16 CI: −0.49; 0.81) *p* = 0.63	B: −0.60 (CI: −1.26; 0.07) *p* = 0.08
Currently not undergoing fertility treatment	B: −0.01 (CI: −0.23; 0.21) *p* = 0.90	B: −0.49 (CI: −0.86; 0.12) ***p* = 0.01**	B: −0.40 (CI: −0.77; −0.03) ***p* = 0.03***	B: 1.66 (CI: 1.34; 1.97) ***p* < 0.001***	B: −0.14 (CI: −0.38; 0.10) *p* = 0.25	B: −0.47 (CI: −0.87; −0.07) ***p* = 0.02**	B: −0.01 (CI: −0.21; 0.18) *p* = 0.90	B: 0.85 (CI: 0.03; 1.67) ***p* = 0.04**	B: 0.60 (CI: −0.25; 1.44) *p* = 0.17
PCOS-type	B: 0.13 (CI: 0.02; 0.24) ***p* = 0.02**	B: 0.12 (CI: −0.07; 0.30) *p* = 0.21	B: −0.001 (CI: −0.18; 0.18) *p* = 0.99	B: 0.20 (CI: 0.03; 0.36) ***p* = 0.02**	B: 0.13 (CI: 0.01; 0.25) ***p* = 0.03**	B: −0.02 (CI: −0.22; 0.17) *p* = 0.82*	B: 0.09 (CI: 0.00; 0.19) ***p* = 0.049**	B: 0.05 (CI: −0.35; 0.45) *p* = 0.81	B: 0.07 (CI: −0.34; 0.48) *p* = 0.72
PCOS-type A	B: 0.14 (CI: −0.06, 0.34) *p* = 0.18	B: 0.10 (CI: −0.24; 0.45) *p* = 0.56	B: −0.09 (CI: −0.43; 0.25) *p* = 0.59	B: 0.42 (CI: 0.11; 0.73) ***p* = 0.01**	B: 0.24 (CI: 0.01; 0.46) ***p* = 0.04**	B: −0.05 (CI: −0.42; 0.32) *p* = 0.81	B: 0.12 (CI: −0.06; 0.30) *p* = 0.19	B: −0.01 (CI: −0.76; 0.75) *p* = 0.99	B: 0.04 (CI: −0.74;0.82) *p* = 0.92
PCOS-type B	B: 0.35 (CI: 0.02; 0.67) ***p* = 0.04**	B: 0.12 (CI: −0.43; 0.67) *p* = 0.67	B: 0.19 (CI: −0.36; 0.73) *p* = 0.51	B: −0.22 (CI: −0.73; 0.28) *p* = 0.39	B: 0.05 (CI: −0.31; 0.40) *p* = 0.80	B: −0.43 (CI: −1.02; 0.16) *p* = 0.15	B: 0.06 (CI: −0.23; 0.35) *p* = 0.67	B: 1.15 (CI: −0.05; 2.40) *p* = 0.06	B: 1.06 (CI: −0.18; 2.31) *p* = 0.09
PCOS-type C	B: −0.30 -(CI: −0.55; −0.06) ***p* = 0.02**	B: 0.06 (CI: −0.36; 0.48) *p* = 0.79	B: 0.22 (CI: −0.20; 0.63) *p* = 0.30	B: −0.51 (CI: −0.89; −0.13) ***p* = 0.01**	B: −0.39 (CI: −0.66; −0.12) ***p* = 0.01**	B: 0.57 (CI: 0.12; 1.01) ***p* = 0.01**	B: −0.08 (CI: −0.30; 0.14) *p* = 0.48	B: −1.09 (CI: −2.01; −0.18) ***p* = 0.02**	B: −1.06 (CI: −2.0; −0.11) ***p* = 0.03**
PCOS-type D	B: −0.65 -(CI: −1.26; −0.03) ***p* = 0.04**	B: −1.74 (CI: −2.78; −0.70) ***p* = 0.001**	B: −1.17 (CI: −2.20; −0.14) ***p* = 0.03**	B: 0.11 (CI: −0.85; 1.07) *p* = 0.83	B: 0.06 (CI: −0.61; 0.74) *p* = 0.86	B: −1.55 (CI: −2.67; −0.44) ***p* = 0.01***	B: −0.84 (CI: −1.38; −0.30) ***p* = 0.002**	B: 2.69 (CI: 0.41; 4.97) ***p* = 0.02**	B: 2.40 (CI: 0.04; 4.75) ***p* = 0.05**
Higher education	B: 0.34 (CI: 0.16; 0:53) ***p* < 0.001**	B: 0.49 (CI: 0.18; 0.81) ***p* = 0.002**	B: 0.61 (CI: 0.30; 0.92) ***p* < 0.001***	B: 0.57 (CI: 0.28; 0.86) ***p* < 0.001**	B: 0.19 (CI: 0.01; 0.39) *p* = 0.07	B: −0.12 (CI: −0.23; 0.46) *p* = 0.51	B: 0.36 (CI: 0.20; 0.52) ***p* < 0.001**	B: −0.58 (CI: −1.27; −0.12) *p* = 0.10	B: −0.80 (CI: −1.51; −0.08) ***p* = 0.03**
Not employed	B: −0.03 (CI: −0.11; 0.05) *p* = 0.49	B: −0.09 (CI: −0.23; 0.05) *p* = 0.21*	B: 0.06 (CI: −0.08; 0.20) *p* = 0.40	B: 0.05 (CI: −0.08; 0.18) *p* = 0.41	B: −0.11 (CI: −0.20; −0.02) ***p* = 0.02**	B: 0.03 (CI: −0.12; 0.19) *p* = 0.67	B: −0.02 (CI: −0.09; 0.06) *p* = 0.67	B: 0.17 (CI: −0.14; 0.48) *p* = 0.29	B: 0.19 (CI: −0.14; 0.51) *p* = 0.26
Not living in a partnership	B: 0.01 (CI: −0.06; 0.07) *p* = 0.79	B: −0.002 (CI: −0.11; 0.11) *p* = 0.98	B: −0.09 (CI: −0.19; 0.02) *p* = 0.11	B: −0.11 (CI: −0.21; −0.01) ***p* = 0.03***	B: 0.03 (CI: −0.04; 0.10) *p* = 0.36	B: 0.12 (CI: 0.01; 0.24) ***p* = 0.04**	B: −0.01 (CI: −0.06; 0.05) *p* = 0.82	B: 0.11 (CI: −0.13; 0.34) *p* = 0.38	B: 0.18 (CI: −0.07; 0.42) *p* = 0.16

(*continued on next page*)

Table 4 (*continued*)

	MPCOSQ-Emotions	MPCOSQ-Body hair	MPCOSQ-Weight	MPCOSQ-Infertility problems	MPCOSQ-Menstrual problems	MPCOSQ-Acne	MPCOSQ-Total	HADS-Anxiety	HADS-Depression
Ludwig-Score	B: −0.54 (CI: −1.05; −0.017) ***p* = 0.04**	B: −0.18 (CI: −1.03; 0.67) $p = 0.68$	B: −0.75 (CI: −1.56; 0.07) $p = 0.07$	B: −0.76 (CI: −1.65; 0.14) $p = 0.10$	B: 0.05 (CI: −0.55; 0.64) $p = 0.88$	B: −0.04 (CI: −1.04; 0.97) $p = 0.95$	B: −0.40 (CI: −0.86; 0.07) $p = 0.10$*	B: 1.53 (CI: −0.47; 3.53) $p = 0.13$*	B: 1.38 (CI: −0.65; 3.41) $p = 0.18$
Ferriman-Gallwey-Score <7	B: 0.36 (CI: 0.12; 0.61) ***p* = 0.004**	B: 1.99 (CI: 1.67; 2.31) ***p* < 0.001**	B: 0.60 (CI: 0.19; 1.01) ***p* = 0.004***	B: 0.20 (CI: −0.19; 0.60) $p = 0.32$*	B: 0.23 (CI: −0.04; 0.50) $p = 0.10$*	B: −0.13 (CI: −0.59; 0.33) $p = 0.58$	B: 0.57 (CI: 0.36; 0.77) ***p* < 0.001**	B: −0.88 (CI: −1.81; 0.04) $p = 0.06$	B: −1.65 (CI: −2.59; −0.71) ***p* < 0.001**
Rosenberg Self-esteem Score >20	B: 0.98 (CI: 0.82; 1.13) ***p* < 0.001**	B: 1.05 (CI: 0.76; 1.33) ***p* < 0.001***	B: 0.98 (CI: 0.70; 1.26) ***p* < 0.001***	B: 0.61 (CI: 0.34; 0.87) ***p* < 0.001***	B: 0.49 (CI: 0.30; 0.68) ***p* < 0.001**	B: 0.74 (CI: 0.42; 1.05) ***p* < 0.001***	B: 0.84 (CI: 0.70; 0.98) ***p* < 0.001***	B: −3.54 (CI: −4.13; −2.96) ***p* < 0.001***	B: −4.55 (CI: −5.11; 3.99) ***p* < 0.001**
Non-MB	B: 0.29 (CI: 0.07; 0.51) ***p* = 0.01**	B: 0.25 (CI: −0.12; 0.63) $p = 0.19$	B: 0.19 (CI: −0.18; 0.56) $p = 0.31$	B: 0.23 (CI: −0.11; 0.58) $p = 0.18$	B: 0.15 (CI −0.10; 0.39) $p = 0.23$	B: 0.16 (CI −0.24; 0.56) $p = 0.44$	B: 0.22 (CI: 0.03; 0.42) ***p* = 0.02**	B: −0.65 (CI: −1.469; 0.16) $p = 0.12$	B: −1.186 (CI: −2.019; -0.352) ***p* = 0.01**
Non-Min	B: 0.52 (CI: 0.26; 0.79) ***p* < 0.001**	B: 0.56 (CI: 0.10; 1.02) ***p* = 0.02**	B: 0.54 (CI: 0.09; 0.99) ***p* = 0.02**	B: 0.34 (CI: −0.08; 0.76) $p = 0.11$	B: 0.31 (CI: 0.01–0.60) ***p* = 0.04**	B: 0.30 (CI: −0.20; 0.79) $p = 0.24$	B: 0.45 (CI: 0.21; 0.68) ***p* < 0.001**	B: −0.94 (CI: −1.94; 0.06) $p = 0.07$	B: −1.39 (CI: −2.42; −0.36) ***p* = 0.01**

such as menstrual irregularities, contribute to a decreased HRQOL in affected patients. Clinical manifestations of hyperandrogenism, including hirsutism, alopecia, and acne, are also significant contributors. Numerous studies (Castelo-Branco and Naumova, 2020; Teede et al., 2023) have identified PCOS as an independent factor associated with reduced HRQOL. Furthermore, Buchcik et al. (Buchcik et al., 2021) demonstrated in their study on mental health and HRQOL in Germany that individuals with migration background exhibited significantly lower mental health scores compared to natives. Additionally, education was identified as a significant predictor of mental health within the migrant group: mental health improved with higher levels of education (Buchcik et al., 2021). In a Danish study (Rubin et al., 2019), it was demonstrated that a higher prevalence and severity of PCOS were associated with migration background. At the same time, it was known that a migration background was often associated with a lower socio-economic profile and poorer education (Merkin et al., 2011;Soziale Klassen in Deutschland nach Migrationshintergrund [WWW Document] n.d).

Consequently, a higher rate of PCOS should be associated with a migration background. This was partially evident in our study. For instance, the highest educational attainment achieved in this cohort differed between both groups, MB and Min, compared to the control group, but not in the rate of employment. However, the type of work, level of income, or general wealth was not queried in our study.

Women with PCOS are more likely to experience depression and anxiety. In a meta-analysis (Cooney et al., 2017) comprising 30 cross-sectional studies across 10 countries, findings consistently indicated a 3.78-fold higher risk of depressive symptoms and a 5.62-fold higher risk of anxiety and anxiety disorders compared to control groups. This is in line with the results of our study. In general, the PCOS patients in our cohort showed elevated indices indicating higher levels of depression and anxiety. Nevertheless, Non-MB and Non-Min were less affected by these phenomena compared to MB and Min. In the univariate analysis, Non-MB and Non-Min were associated with partially better HRQOL and lower depression (or respectively poorer HRQOL and depression for MB and Min). However, in the multivariate analysis only Non-Min showed a statistically significant association with higher HRQOL (B: 0.34; CI: 0.04; 0.63; $p = 0.03$) and only Non-MB was associated with lower depression (B: −1.28; CI: −2.31; −0.24; $p = 0.02$). Additionally, MB and Min had lower self-esteem according to the RSE.

However, how should these results be interpreted: Did inherited genetic traits play a role here, or was it rather the epigenetic, economic or sociocultural influence that had a greater impact?

According to the German Federal Statistical Office (German Federal Office of statistics, 2023), in 2022, 23.8 million people, representing 28.7 % of the population in Germany, had a migration background (German Federal Office of Statistics n.d). Of these, 15.3 million migrated to Germany themselves (first generation), while the remainder was born in Germany as descendants of immigrants (second/third generation) (German Federal Office of statistics, 2023).

There are numerous connections between migration and health. It is believed that the migrant population was not representative of their countries of origin but rather the result of positive self-selection and selection by the host countries. Accordingly, it was assumed that the health of individuals with a migration background would generally be better and their mortality rate lower than that of native populations, as younger and healthier individuals tend to migrate (“healthy migrant effect”) (Constant et al., 2018).

With increasing duration of stay of people with a migration background, however, health disadvantages also became apparent: The differences in mortality in favor of people with a migration background gradually decreased. In some areas, it is also evident that the health status of people with a migration background is worse than that of the native population. There is evidence that people with a migration background subjectively assess their health status as poorer and that the mental health of the population without a migration background is better. Furthermore, people with a migration background are less likely to use certain health services (Rommel et al., 2015).

It is important for healthcare professionals to become sensitive towards individuals with migration backgrounds or from non-native cultural backgrounds. This illustrates an example from the USA: African American, Asian American, and Hispanic women tended to seek infertility care through self-referral or referrals from friends or family members, whereas doctors more commonly referred Caucasian women. Additionally, the findings from this study indicated racial and ethnic variations in concerns regarding infertility treatment seeking. For instance, African American, Asian American and particularly Chinese American women expressed greater concern about the social stigma associated with infertility compared to Caucasian women. These findings underscore the concept of a "culture of silence," wherein certain women may refrain from seeking medical care for conditions like infertility and PCOS (Missmer et al., 2011; VanHise et al., 2023).

There is a risk that specific demographic groups may be excluded from healthcare services, including those related to PCOS. This is particularly worrying given the rising number of individuals with a migration background in Germany, Austria and Switzerland (German

Federal Office of Statistics, 2023; Migrationshintergrund [WWW Document] n.d;Zuwanderungsstatistik [WWW Document] n.d).

Strengths and limitations

The method of enrollment employed may have introduced bias into the study cohort. The survey was circulated in hospitals and shared on social media platforms, potentially attracting younger and more educated PCOS patients due to their greater access to the internet and information. This scenario might explain the underrepresentation of postmenopausal patients in the group.

Despite requiring each participant to generate a personalized code, the possibility of multiple participations could not be ruled out. This possibility could have impacted on the reliability and credibility of the data. Moreover, uncertainties arose regarding whether inaccurately marked or unanswered questions in the web-based survey reflected genuine lack of knowledge or if some responses were omitted due to time constraints or lack of attentiveness. Putting the subscale related to fertility of the MPCOSQ into consideration, fertility problems on both sides of the regression equation may introduce bias into our estimates. An additional potential limitation of our study is the inclusion of both PCOS-type and the Ferriman-Gallwey-Score as covariates in the multivariate linear regression model, as PCOS-type is partially determined by the Ferriman-Gallwey-Score in our study. However, a prior Spearman correlation test showed no significant correlation between the two variables, suggesting minimal risk of collinearity. Nonetheless, the possibility of residual confounding cannot be entirely ruled out.

A notable limitation of this study is that the MPCOSQ-Menstrual Problems subscale demonstrated inadequate reliability, with a tau-equivalent coefficient of 0.46, making it the only subscale that did not meet the acceptable reliability threshold. A small portion of the univariate regression analyses exhibited heteroscedasticity, as indicated by the Levene/Welch tests. The presence of heteroscedasticity may also impact the validity of the original research question, as it can lead to biased standard errors and affect the reliability of statistical inferences. However, the interpretation of these tests is subject to limitations, as their sensitivity can be influenced by sample size and distributional characteristics, potentially affecting the robustness of the conclusions.

Additionally, it remains uncertain whether all individuals included in the survey truly suffered from PCOS. Some participants did not meet the ESHRE criteria but claimed to have received the diagnosis from a healthcare professional. Furthermore, the assessment of androgenization is susceptible to subjective bias, which cannot be dismissed.

Moreover, no conclusions could be drawn about the ethnic and cultural background of the individuals. While a significant portion indicated a migration or minority background, the absolute numbers in the respective self-assignments were too low to yield meaningful results. Also, for example, the term "Asian-German" is very broad, considering that there can be various PCOS phenotypes within Asia. This could obscure the fact that PCOS patients in specific social niches or PCOS profile may suffer more than others.

It should also be considered that evaluation tools may not be suitable for all individuals. Just the assessment of hirsutism varies in prevalence and severity, so much so that a Ferriman-Gallwey-Score for assessing "Asian hirsutism" has been proposed, where lower cut-off values are needed to evaluate hirsutism (Huang and Yong, 2016).

Nevertheless, this method of enrollment facilitated the inclusion of numerous PCOS patients within a short period, surpassing the power estimation for participant numbers, thereby enhancing the statistical significance of the study. Moreover, the study assessed a high number of potential confounders. For example, it is recognized that metabolism plays a role in the onset of depression and anxiety, with overweight individuals being at an elevated risk of experiencing depression (Luppino et al., 2010). Various parameters were examined and incorporated into the analysis, thereby strengthening the reliability of the findings in this study. To obtain a more precise analysis of the level of suffering in PCOS patients with a migrant or minority background, future studies would also have to carry out the distribution of a possibly more suitable questionnaire and possibly target people from these groups in their socio-cultural environment to achieve better representation.

Conclusion

This study highlights the association between MB or Min and poorer HRQOL, higher depression rates, and lower self-esteem among PCOS patients. While genetic and epigenetic factors may contribute, socioeconomic and sociocultural influences likely play significant roles. Healthcare professionals should remain attuned to the diverse needs of women with PCOS, especially those from migrant or minority backgrounds, to ensure equitable access to care.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT 3.5 (OpenAI; USA) in order to increase readability. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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Ethical considerations

The research protocol was exempted from ethical review by the committee of Rhineland Palatinate and the Swiss Association of Research Ethics Committees, in accordance with German and Swiss legal statutes and regulations, which stipulate that studies involving anonymous data collection do not require formal ethical approval (2023-17312 [22nd December 2023] / BASEC Req-2023-01259 [1st November 2023]). Both the study center and SoSci Survey adhered to German and European legislation regarding data protection. The study was conducted according to the requirements of the "Declaration of Helsinki" (German version of the declaration of Helsinki, 2013).

Glossary

B: regression coefficient
BMI: Body Mass Index
CI: confidence interval
FG: Ferriman-Gallwey-Score
HADS: Hospital Anxiety and Depression Scale
HRQOL: health-related quality of life
MB: PCOS patients with a migration background
Min: PCOS patients with a minority background
MPCOSQ: Modified-PCOS-Questionnaire
Non-MB: PCOS patients without a migration background
Non-Min: PCOS patients without a minority background
PCOS: Polycystic Ovary Syndrome
RSE: Rosenberg Self-Esteem Scale
SD: standard deviation
Stat: statistically tau-equivalent reliability coefficient: ρ_T

CRediT authorship contribution statement

Konstantin Hofmann: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data

curation, Conceptualization. **Claire Decrinis:** Writing – review & editing, Resources, Project administration. **Norman Bitterlich:** Writing – review & editing, Supervision. **Annette Bachmann:** Writing – review & editing, Funding acquisition. **Petra Stute:** Writing – review & editing, Supervision, Resources, Funding acquisition.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Konstantin Hofmann reports financial support was provided by Besins Healthcare Germany GmbH. Konstantin Hofmann reports a relationship with Besins Healthcare Germany GmbH that includes: funding grants. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Distribution of membership of a relevant social group (multiple answers were possible)

Minority background (total)	11.9 % (70)
White	91.3 % (536)
Person of color	1.5 % (9)
Black	0.2 % (1)
Jewish	0.0 % (0)
Russian-speaking Jewish	0.0 % (0)
Muslim	1.4 % (8)
Sinti and Roma	0.7 % (4)
Afro-German	0.7 % (4)
Asian-German	0.3 % (2)
Polish-German	4.3 % (25)
Russian-German	2.4 % (17)
Turkish-German	3.1 % (18)
Other	1.2 % (7)

Appendix B. Association between Health-related quality of life (HRQOL), anxiety, depression and migration and minority background; multivariate linear regression (B: regression coefficient; BMI: Body Mass Index; CI: confidence interval; FG: Ferriman-Gallwey-Score; HADS: Hospital Anxiety and Depression Scale; MB: migration background; Min: minority background; MPCOSQ: Modified PCOS-Questionnaire; Non-MB: no migration background; Non-Min: no minority background; PCOS: Polycystic Ovary Syndrome, RSE: Rosenberg Self-Esteem Scale; stat.: statistically)

	MPCOSQ-Emotions	MPCOSQ-Body hair	MPCOSQ-Weight	MPCOSQ-Infertility problems	MPCOSQ-Menstrual problems	MPCOSQ-Acne	MPCOSQ-Total	HADS-Anxiety	HADS-Depression
Variables included in the model	BMI, no insulin resistance, Ludwig-Score, FG<7, RSE>20	Ludwig-Score, FG<7, RSE>20, higher education	BMI, Ludwig-Score, RSE>20, higher education	–	Age, Ludwig-Score, FG<7, RSE>20, higher education	–	BMI, no insulin resistance, currently not under hormone medication, premenopausal, no current desire to have children, no fertility-problems, higher education, Ludwig-Score, FG<7, RSE>20	–	BMI, Ludwig-Score, FG<7, RSE>20
Other stat. significant results of the multivariate model	RSE>20: B: 0.92 (CI: 0.69;−1.14) $p < 0.001$	FG<7: B: 1.68 (CI: 1.14;2.21) $p < 0.001$ RSE>20: B: 0.40 (CI: 0.05; 0.74) $p = 0.03$	BMI: B: −0.12 (CI: −0.14; −0.10) $p < 0.001$ RSE>20: B: 0.69 (CI: 0.37–1.01) $p < 0.001$	–	Age: B: 0.05 (CI: 0.02–0.07) $p < 0.001$ RSE>20: B: 0.53 (CI: 0.25–0.80) $p < 0.01$	–	BMI: B: −0.02 (CI: −0.04; -0.01) $p < 0.001$ No current desire to have children: B: 0.47 (CI: 0.27–0.66) $p < 0.001$ RSE>20: B: 0.73 (CI:0.53–0.92) $p < 0.001$	–	FG<7: B: −1.59 (CI: −2.88; -0.30) $p = 0.02$ RSE>20: B: −4.22 (CI: −5.08; -3.37) $p < 0.001$
Stat. significant results of the MB/Non-MB and Min/ Non-Min	–	–	Non-Min: B: 0.50 (CI: 0.01;0.99) $p = 0.05$	–	–	–	Non-Min: B: 0.34 (CI: 0.04;0.63) $p = 0.03$	–	Non-MB: B: −1.28 CI: (−2.31; −0.24) $p = 0.02$
R^2/adjusted R^2/ N	0.22/ 0.21/ 237	0.16/ 0.15/ 234	0.38/ 0.38/ 249	–	0.11/ 0.10/ 253	–	0.31/ 0.30/ 249	–	0.31/ 0.30/ 237

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