

EFFECT OF A SCHOOL-BASED AWARENESS PROGRAMME ON KNOWLEDGE OF
POLYCYSTIC OVARY SYNDROME AMONG ADOLESCENT GIRLS IN RURAL
JAIPUR, INDIA: A PRE-EXPERIMENTAL STUDY WITH ITEM-WISE ANALYSISKumesh*¹, Josfeena Bashir²¹Ph.D. Scholar, S.N. Institute of Nursing Sciences, Nirwan University Jaipur, Rajasthan – 302019, India.²Professor & Supervisor, S.N. Institute of Nursing Sciences, Nirwan University Jaipur, Rajasthan – 302019, India.

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) usually begins in adolescence, but rural Indian school girls receive almost no formal information about it. This study measured the effect of a single structured awareness programme on PCOS knowledge and identified, item by item, which aspects of the condition remained least understood after teaching. **Methods:** A one-group pre-test post-test pre-experimental study was conducted among 100 girls aged 14–17 years in selected schools in villages of Jaipur district, Rajasthan, recruited by non-probability convenience sampling. Knowledge was measured with a 19-item structured questionnaire (range 0–19) administered in Hindi and English before and after a lecture-based awareness programme. Total scores, five content subscales and individual items were analysed using paired t-tests, McNemar tests and chi-square tests of association. **Results:** All 100 girls completed both assessments. Only 22.0% had heard of PCOS before the programme. Mean knowledge rose from 7.38 ± 2.79 to 15.13 ± 2.87 (mean difference 7.75; 95% CI 7.01–8.49; $t(99) = 20.66$; $p < 0.001$; $d = 2.07$). Girls with poor knowledge fell from 78.0% to 4.0% and those with good knowledge rose from 1.0% to 61.0%. Every one of the 19 items improved significantly (McNemar, $p < 0.001$). Gains were largest for the causes and risk factors subscale (17.3% to 66.0% of maximum) and smallest for prevention and complications, which started highest (63.7% to 93.5%). Four items remained below 60% correct after teaching: hormones produced by the ovaries (57.0%), menstrual cycles per year in PCOS (53.0%), hormones responsible for PCOS (52.0%) and number of ovaries (69.0%). Post-test knowledge level showed no significant association with any socio-demographic or menstrual variable. **Conclusion:** A single school-based session produced large, uniform improvement in PCOS knowledge among rural adolescent girls, irrespective of background. Endocrine and cycle-related content was learned least well and needs stronger teaching methods than a one-off lecture.

KEYWORDS: Polycystic ovary syndrome; adolescent; health education; knowledge; school health; India.

INTRODUCTION

Polycystic ovary syndrome (PCOS) is the commonest endocrine disorder of women of reproductive age. The 2023 international evidence-based guideline consolidated 254 recommendations for its assessment and management and stressed that diagnosis remains delayed and that the metabolic, cardiovascular and psychological burden of the condition is poorly recognised.^[1] Adolescence is the critical window: the guideline's paediatric recommendations require both irregular

cycles, defined relative to time since menarche, and clinical or biochemical hyperandrogenism, and exclude ovarian ultrasound and anti-Müllerian hormone from the adolescent diagnostic pathway. Girls with only one feature are regarded as "at risk" and need symptom management and follow-up rather than a label.^[2]

The Indian burden is large. A nationwide study of 8,993 women across five zones estimated a prevalence of 19.6% by Rotterdam criteria and 7.2% by National

Institutes of Health criteria, with dyslipidaemia in 91.9% and obesity in 43.2% of affected women.^[3] Among 1,164 college-going females in Delhi and the National Capital Region the prevalence was 17.4%, and almost a third of those cases were identified for the first time during the study itself.^[4] A substantial reservoir of unrecognised disease therefore exists in young Indian women.

Awareness is uneven and appears to follow the urban–rural and educational gradient. Among 382 female adolescents in educational institutions in Hyderabad, over 89% showed good knowledge across PCOS domains and knowledge rose with level of education.^[5] By contrast, in a hospital-based Indian survey of 334 reproductive-age women, 60.5% had poor knowledge of PCOS.^[6] In an Indian mixed-method study of 275 women attending a tertiary gynaecology clinic, roughly 45% had no information about PCOS at all and only 9.1% had received any from a doctor, with treatment typically delayed because symptoms were normalised and endured.^[7] Women also report being dismissed at the point of diagnosis and given nothing on lifestyle management.^[8]

School-based reproductive-health education is a plausible remedy. In government schools across three Indian states, girls attending schools with a focused menstrual education programme were far more likely to have been informed before menarche (56% versus 36%) and had half the menstruation-related absenteeism of girls in regular schools,^[9] although coverage remains patchy, particularly outside the formal school system.^[10] Evidence for PCOS-specific school programmes in rural India is scarce, and existing studies report total scores only. Total scores conceal which parts of a condition are actually learned, which matters when the teaching has to be redesigned. This study therefore measured the effect of a structured awareness programme on PCOS knowledge among rural school girls, analysed the result item by item and subscale by subscale, and tested whether outcomes varied with socio-demographic and menstrual characteristics.

METHODS

Design and setting

A quantitative, one-group pre-test post-test pre-experimental design was used, in selected government and private schools located in villages of Jaipur district, Rajasthan, India. The independent variable was the awareness programme; the dependent variable reported here is knowledge of PCOS.

Relationship to the companion report

Knowledge, attitude and quality of life were all measured in the same 100 participants at the same two time points as part of a single doctoral study. The present paper reports the knowledge outcome together with its item-wise and subscale analysis; the attitude and quality-of-life outcomes from the same cohort are reported separately in a companion paper by the same authors. No

participant, measurement occasion or knowledge result is duplicated between the two reports, and editors and readers should treat them as two analyses of one study rather than as independent studies. The companion report is cited in the submission letter and will be cross-referenced on acceptance.

Participants and sampling

One hundred school girls were enrolled by non-probability convenience sampling. Girls were eligible if they were aged 14–17 years, were studying in one of the selected rural schools, could read and write Hindi or English, were present during the data-collection period and were willing to participate. Girls residing in urban areas and those absent at the time of data collection were excluded. The sample size of 100 was fixed a priori in the approved research protocol rather than derived from a power calculation.

Instrument

Socio-demographic and menstrual characteristics were recorded on a structured proforma covering age, religion, educational status, dietary pattern, weight group, frequency of junk-food intake, daily water intake, age at menarche, cycle regularity, cycle duration, bleeding pattern, pads used per day, severity of monthly menstrual problems, family history of PCOS, and prior awareness of PCOS with its source.

Knowledge was measured with a structured questionnaire of 19 multiple-choice items developed by the researcher and content-validated by subject experts, administered in parallel Hindi and English versions. The items cover five content areas: general information about PCOS (4 items), causes and risk factors (3 items), signs and symptoms (3 items), diagnosis and treatment (5 items) and prevention and complications (4 items). Each correct answer scored 1 and each incorrect answer 0, giving a total range of 0–19, graded as poor (0–6), average (7–13) and good (14–19).

Procedure

After permission from school authorities and written assent from participants with parental consent, the pre-test was administered. The awareness programme was then delivered as a structured lecture developed by the researcher, covering the meaning, causes, signs and symptoms, risk factors, prevention, management and lifestyle modification of PCOS, supported by visual aids in Hindi. The identical questionnaire was re-administered as the post-test in the same paper format.

Data analysis

Categorical variables are reported as frequency and percentage and scores as mean and standard deviation. Paired t-tests compared pre-test and post-test total and subscale scores, with 95% confidence intervals for the mean difference and Cohen's d for paired data as the effect size. Item-level change in the proportion answering correctly was tested with McNemar's test with

continuity correction. Chi-square tests of independence examined the association between post-test knowledge level and each socio-demographic and menstrual variable. A two-sided p value below 0.05 was taken as significant. Analyses used the complete data set of 100 participants; there were no missing values and no withdrawals.

Ethical considerations

The study was approved by the Research and Development Cell, Nirwan University, Jaipur (Ref. No. NUJ/RDC/2025/1076, dated 3 November 2025). Written permission was obtained from each participating school, assent from every girl and consent from a parent or guardian. All responses were anonymised.

RESULTS

All 100 girls enrolled completed both assessments, a response rate of 100%.

Participant characteristics are shown in Table 1. Girls were distributed across the three age bands, with 30.0% aged 14–15 years and 35.0% each in the 15–16 and 16–17 year bands; none was older than 17 years and all were unmarried. Most were Hindu (87.0%), studying at secondary level (60.0%) and vegetarian (75.0%). Menarche had occurred between 13 and 14 years in 70.0%, cycles were irregular in 27.0%, and 48.0% reported moderate or severe monthly menstrual problems. A family history of PCOS was reported by 11.0%. Only 22 girls (22.0%) had heard of PCOS before the programme; among these, teachers (8 girls) and health personnel (7 girls) were the commonest sources, with parents, mass media and friends together accounting for 7 girls.

Table 1: Socio-demographic and menstrual characteristics of participants (N = 100).

Variable	Category	n (%)
Age	14–15 years	30 (30.0)
	15–16 years	35 (35.0)
	16–17 years	35 (35.0)
Religion	Hindu	87 (87.0)
	Muslim	10 (10.0)
	Christian	1 (1.0)
	Others	2 (2.0)
Educational status	Secondary	60 (60.0)
	Higher secondary	40 (40.0)
Dietary pattern	Vegetarian	75 (75.0)
	Non-vegetarian	25 (25.0)
Weight group	40–43 kg	20 (20.0)
	44–47 kg	32 (32.0)
	48–51 kg	30 (30.0)
	52–55 kg	18 (18.0)
Junk-food frequency	Daily	13 (13.0)
	Within two days	22 (22.0)
	Within 4–5 days	29 (29.0)
	Weekly once	25 (25.0)
	Do not like junk food	11 (11.0)
Water intake per day	1–2 glasses	25 (25.0)
	3 glasses	40 (40.0)
	Above 4 glasses	35 (35.0)
Age at menarche	Before 12 years	16 (16.0)
	13–14 years	70 (70.0)
	After 14 years	14 (14.0)
Menstrual cycle	Regular	73 (73.0)
	Irregular	27 (27.0)
Monthly menstrual problem	Mild	52 (52.0)
	Moderate	36 (36.0)
	Severe	12 (12.0)
Family history of PCOS	Yes	11 (11.0)
	No	89 (89.0)
Prior awareness of PCOS	Yes	22 (22.0)
	No	78 (78.0)

Note: Marital status is not tabulated because all 100 participants were unmarried. Source of information was asked only of the 22 girls reporting prior awareness of PCOS.

Mean total knowledge rose from 7.38 ± 2.79 before the programme to 15.13 ± 2.87 afterwards, a mean gain of 7.75 points (95% CI 7.01–8.49; $t(99) = 20.66$; $p < 0.001$; Cohen's $d = 2.07$). Every subscale improved significantly, with effect sizes between 1.04 and 1.46 (Table 2). The starting position differed sharply across content areas: girls already answered 63.7% of the

prevention and complications items correctly before teaching, but only 17.3% of the causes and risk factors items. The largest absolute gain, in percentage-of-maximum terms, was in causes and risk factors (+48.7 percentage points), and the smallest in prevention and complications (+29.8 points), which had least room to improve.

Table 2: Total and subscale knowledge scores before and after the awareness programme (N = 100).

Scale (items)	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean difference	t	p	Cohen's d
Total knowledge (19)	7.38 ± 2.79	15.13 ± 2.87	+7.75	20.66	<0.001	2.07
General information (4)	1.00 ± 0.89	2.84 ± 1.02	+1.84	14.27	<0.001	1.43
Causes and risk factors (3)	0.52 ± 0.71	1.98 ± 0.98	+1.46	12.68	<0.001	1.27
Signs and symptoms (3)	1.08 ± 0.77	2.31 ± 0.75	+1.23	11.90	<0.001	1.19
Diagnosis and treatment (5)	2.23 ± 1.18	4.26 ± 0.94	+2.03	14.60	<0.001	1.46
Prevention and complications (4)	2.55 ± 1.01	3.74 ± 0.49	+1.19	10.39	<0.001	1.04

Note: SD = standard deviation; CI = confidence interval. The number of items in each subscale is given in parentheses. All p values are two-sided, from paired t-tests with 99 degrees of freedom. Cohen's d is the mean difference divided by the standard deviation of the differences.

The distribution of graded knowledge levels and the subscale profile are shown in Figure 1. Before the programme 78.0% of girls were in the poor category and

a single girl (1.0%) reached the good category; afterwards 61.0% were in the good category and 4.0% remained poor.

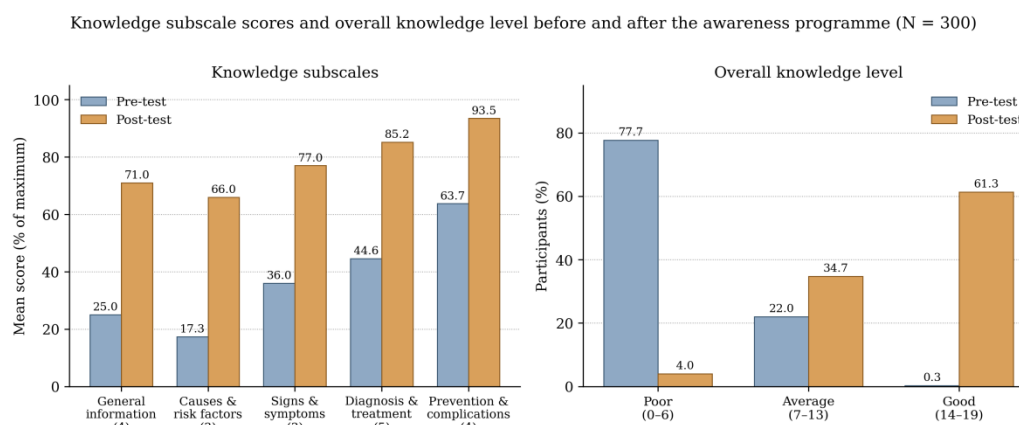


Figure 1: Knowledge subscale scores and overall knowledge level before and after the awareness programme (N = 100).

Note: Subscale scores are expressed as a percentage of the maximum attainable score for that subscale so that areas with different numbers of items can be compared. Knowledge levels: poor (0–6), average (7–13), good (14–19).

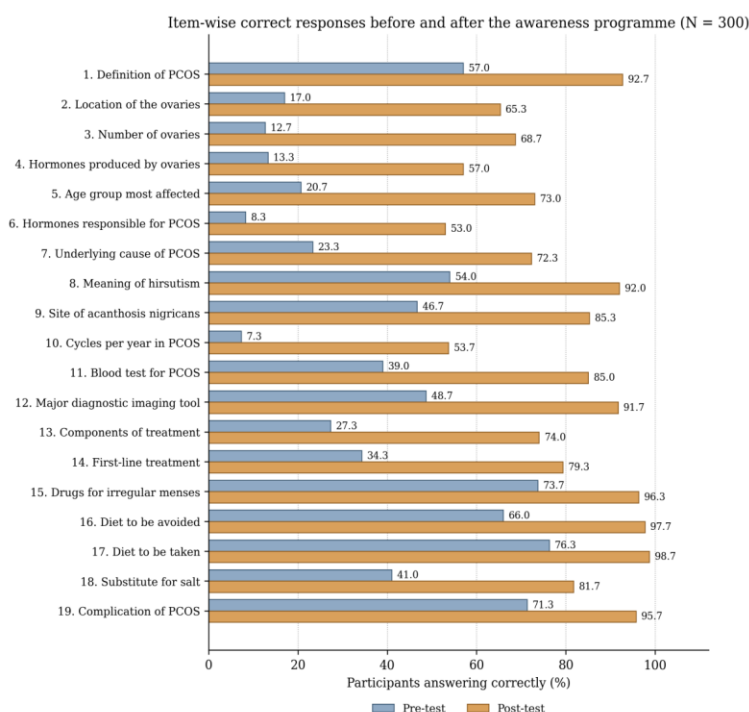
Item-wise results are given in Table 3 and Figure 2. All 19 items showed a statistically significant increase in the proportion answering correctly (McNemar test, $p < 0.001$ for every item). The lowest pre-test scores were for the number of menstrual cycles per year in PCOS (7.0%), the hormones responsible for PCOS (8.0%), the number of ovaries (13.0%) and the female hormones produced by the ovaries (13.0%) — all items requiring specific endocrine or cycle knowledge rather than general familiarity. The highest pre-test scores were on dietary items: the type of diet to be taken (76.0%), the drugs used to correct irregular menstruation (74.0%) and complications of PCOS (71.0%).

After the programme, fifteen of the nineteen items were answered correctly by more than 65% of girls, and seven exceeded 90%. Four items nonetheless remained comparatively weak: the hormones responsible for PCOS (52.0%), the number of menstrual cycles per year in PCOS (53.0%), the female hormones produced by the ovaries (57.0%) and the number of ovaries (69.0%). These are the same items that were weakest at baseline, and all four concern reproductive anatomy and endocrine physiology rather than symptoms, diet or treatment.

Table 3: Item-wise correct responses before and after the awareness programme (N = 100)

Knowledge item	Pre-test n (%)	Post-test n (%)	Change	χ^2	p
1. Definition of PCOS	57 (57.0)	93 (93.0)	+36.0	27.84	<0.001
2. Anatomical location of the ovaries	17 (17.0)	65 (65.0)	+48.0	36.82	<0.001
3. Number of ovaries	13 (13.0)	69 (69.0)	+56.0	48.79	<0.001
4. Female hormones produced by ovaries	13 (13.0)	57 (57.0)	+44.0	33.02	<0.001
5. Age group most affected / at risk	21 (21.0)	73 (73.0)	+52.0	40.64	<0.001
6. Hormones responsible for PCOS	8 (8.0)	52 (52.0)	+44.0	35.56	<0.001
7. Underlying cause of PCOS	23 (23.0)	72 (72.0)	+49.0	40.42	<0.001
8. Meaning of hirsutism	54 (54.0)	92 (92.0)	+38.0	28.52	<0.001
9. Site of acanthosis nigricans	47 (47.0)	86 (86.0)	+39.0	27.25	<0.001
10. Menstrual cycles per year in PCOS	7 (7.0)	53 (53.0)	+46.0	40.50	<0.001
11. Blood test used to identify PCOS	39 (39.0)	85 (85.0)	+46.0	36.16	<0.001
12. Major diagnostic imaging tool	49 (49.0)	92 (92.0)	+43.0	34.59	<0.001
13. Components of PCOS treatment	27 (27.0)	74 (74.0)	+47.0	37.12	<0.001
14. First-line treatment	34 (34.0)	79 (79.0)	+45.0	33.96	<0.001
15. Drugs for irregular menstruation	74 (74.0)	96 (96.0)	+22.0	15.75	<0.001
16. Type of diet to be avoided	66 (66.0)	97 (97.0)	+31.0	25.71	<0.001
17. Type of diet to be taken	76 (76.0)	98 (98.0)	+22.0	18.38	<0.001
18. Substitute for salt in the diet	41 (41.0)	82 (82.0)	+41.0	26.23	<0.001
19. Complication of PCOS	71 (71.0)	95 (95.0)	+24.0	17.63	<0.001

Note: Change is expressed in percentage points. χ^2 values are from McNemar's test with continuity correction, 1 degree of freedom. Items are numbered as they appear in the questionnaire.

**Figure 2: Item-wise correct responses before and after the awareness programme (N = 100).**

Note: Item labels are abbreviated; full wording is given in Table 3. All nineteen items improved significantly (McNemar test, $p < 0.001$).

Table 4 summarises the chi-square tests of association between post-test knowledge level and the study variables. None reached statistical significance, and none approached it; the smallest p values were for family history of PCOS ($p = 0.416$) and dietary pattern ($p = 0.665$). A secondary analysis dichotomising knowledge gain at its median of 8 points showed a higher proportion

of above-median gain among girls with no prior awareness of PCOS than among girls who had heard of PCOS before (46.2% versus 27.3%), although this difference was not statistically significant in this sample ($\chi^2 = 1.80$, $df = 1$, $p = 0.180$); the direction is consistent with their lower pre-test scores (6.89 versus 9.12) rather than with any difference in responsiveness to teaching;

post-test scores in the two groups were almost identical (15.04 versus 15.45).

Table 4: Association between post-test knowledge level and study variables (N = 100)

Variable	χ^2	df	p
Age †	0.92	4	0.922
Religion †	1.19	6	0.977
Educational status †	0.58	2	0.750
Dietary pattern †	0.82	2	0.665
Weight group †	0.80	6	0.992
Junk-food frequency †	4.89	8	0.770
Water intake per day †	0.22	6	>0.999
Age at menarche †	1.01	4	0.908
Menstrual cycle †	0.77	2	0.680
Cycle duration †	1.05	6	0.984
Menstrual bleeding †	0.67	6	0.995
Pads used per day †	2.54	6	0.864
Monthly menstrual problem †	2.15	4	0.708
Family history of PCOS †	1.75	2	0.416
Prior awareness of PCOS †	0.68	2	0.712

Note: df = degrees of freedom. Variables marked with a dagger (†) had one or more expected cell counts below five, so the chi-square approximation is unreliable for these. Marital status was constant across the sample and could not be tested. No correction for multiple testing was applied.

DISCUSSION

A single structured awareness session more than doubled mean PCOS knowledge in this sample of rural adolescent girls and moved almost the entire cohort out of the poor-knowledge category. The item-wise analysis adds what a total score cannot: the gain was universal across all nineteen items, but the residual weakness after teaching was concentrated in a specific and predictable place.

The baseline position was one of near-complete unawareness: only 22.0% of girls had heard of PCOS at all and 78.0% scored in the poor band. This is far worse than the picture among 382 urban female adolescents in Hyderabad, where over 89% demonstrated good knowledge across PCOS domains and knowledge rose with level of education,^[5] and closer to the hospital-based Indian survey in which 60.5% of reproductive-age women had poor knowledge^[6] and the Indian clinic study in which about 45% of women with diagnosed PCOS had no information about their condition.^[7] The gradient between an urban college sample and a rural school sample is the substantive finding, and it argues for targeting awareness programmes where baseline knowledge is lowest rather than where they are easiest to deliver.

The magnitude of gain is consistent with the wider intervention literature. A pre-post study among 306 Nigerian pharmacy students found that a video-based educational intervention raised PCOS knowledge scores from 47.51 ± 25.97 to 90.42 ± 12.85 ($p = 0.001$).^[11] That study reported only a total score, which is the common pattern and the reason the present item-wise analysis is useful. Cross-sectional work among nursing students has

similarly shown that PCOS knowledge tracks with sex, academic seniority and digital health literacy,^[12] implying that prior exposure to health information, rather than teaching intensity alone, shapes what is retained.

The pattern of residual weakness is the most actionable result. The four items still answered correctly by fewer than 70% of girls after teaching — hormones responsible for PCOS, menstrual cycles per year, hormones produced by the ovaries and number of ovaries — all concern reproductive anatomy and endocrine physiology. By contrast, items about diet, treatment and complications were well answered both before and after. Two explanations are plausible and not mutually exclusive. First, dietary and lifestyle content overlaps with general health messaging these girls already receive, so the programme was reinforcing rather than introducing. Second, endocrine concepts are genuinely abstract and are poorly served by a single verbal lecture; they require diagrams, models or repeated exposure. The practical implication is that a lecture format is adequate for symptom recognition and lifestyle advice but not for the physiological basis of the condition, and that the syllabus should be rebalanced accordingly.

The absence of any significant association between post-test knowledge and socio-demographic or menstrual variables is itself informative: the programme worked broadly, without leaving behind girls in any particular age, religious, educational, dietary or menstrual-history subgroup. The larger gain among girls with no prior awareness was not statistically significant in this sample and in any case reflects a lower starting point, since post-test scores in the two groups converged. Programmes of this kind therefore need not be restricted to girls thought

to be at higher risk, and prior awareness is not a useful triage criterion.

Placing these findings in context, school-based delivery already works for adjacent reproductive-health topics in India: girls in government schools with a focused menstrual hygiene programme were more likely to be informed before menarche and had half the menstruation-related absenteeism of girls in regular schools,^[9] though coverage remains incomplete, especially for girls outside school.^[10] Since limited knowledge is one of the main barriers to PCOS care alongside cost and side-effects,^[13] and since psychological morbidity in PCOS is substantial — pooled depression prevalence of 31%, more than two and a half times that in healthy women^[14] — equipping girls with accurate information before symptoms appear is a reasonable public-health investment. Whether knowledge translates into health-seeking behaviour is a separate question this design cannot answer, and early recognition should lead to structured follow-up rather than premature labelling.^[2]

Limitations

The one-group pre-test post-test design has no control group, so secular change, testing effects and regression to the mean cannot be separated from the effect of the programme. Because the same 19 items were used at both time points and the post-test followed the intervention closely, part of the gain may reflect familiarity with the questionnaire rather than learning, and retention over time is unknown. Sampling was by convenience from selected rural schools of a single district and the sample size was fixed by protocol rather than by power calculation, so the findings should not be generalised to Indian adolescent girls as a whole. The knowledge tool was content-validated by subject experts, but formal reliability coefficients and construct validation were not established in this population, and the questionnaire was researcher-developed rather than a previously published instrument, which limits comparison with other studies. Several chi-square tests had expected cell counts below five, as marked in Table 4, and multiple association tests were performed without correction. Finally, no clinical or biochemical assessment for PCOS was undertaken, so this study reports awareness outcomes only and says nothing about disease prevalence in this population. Attitude and quality-of-life outcomes measured in the same cohort are reported in the companion paper described in the Methods.

CONCLUSION

A single structured awareness programme delivered in rural schools of Jaipur district produced a large and statistically significant improvement in adolescent girls' knowledge of polycystic ovary syndrome, moving 61.0% of participants into the good-knowledge category from a baseline of one girl, with every questionnaire item improving significantly. Baseline awareness was strikingly low, which supports prioritising rural schools

for reproductive-health education, and gains were uniform across socio-demographic and menstrual subgroups. Content on reproductive anatomy and endocrine physiology was learned least well and remained below 70% correct after teaching; strengthening that component with visual and repeated methods, and testing retention at a longer interval in a controlled design, are the logical next steps.

DECLARATIONS

Ethics approval and consent to participate. Approved by the Research and Development Cell, Nirwan University, Jaipur (Ref. No. NUJ/RDC/2025/1076, dated 3 November 2025). Permission was obtained from each participating school, written assent from every participant and consent from a parent or guardian. Confidentiality of all data was maintained.

Related publications. This paper reports the knowledge outcome of a doctoral study in which knowledge, attitude and quality of life were measured in the same 100 participants at the same two time points. The attitude and quality-of-life outcomes are reported in a separate companion paper by the same authors, which contains no overlapping knowledge data. Both reports arise from one study and are declared to the editor as such. Neither has been published elsewhere or is under consideration by another journal.

Consent for publication. Not applicable; no individually identifiable data are reported.

Availability of data. The de-identified data set analysed in this study is available from the corresponding author on reasonable request.

Conflicts of interest. The authors declare no conflicts of interest.

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Authors' contributions. Both authors contributed to the conception and design of the study. The first author collected and analysed the data and drafted the manuscript. The second author supervised the study and critically revised the manuscript. Both authors read and approved the final version.

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