Premenstrual Syndrome and Psychological Well-Being Among Adolescent Girls: The Indirect Role of Psychological Distress in a Cross-Sectional Study

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Abstract

Introduction: Premenstrual syndrome (PMS) is associated with elevated psychological distress and diminished well-being among adolescent girls. However, whether psychological distress statistically accounts for the cross-sectional association between PMS screening status and eudaimonic psychological well-being has not been simultaneously examined in an Indian adolescent sample.
Aim: To examine, in a cross-sectional design, whether psychological distress is associated with the indirect statistical pathway linking PMS screening status and psychological well-being among adolescent girls in Bangalore, India.
Methods: A cross-sectional study was conducted with 350 adolescent girls (aged 13–17) from private schools in Bangalore, India. PMS screening status was assessed using the PSST-A (204 [58.3%] screened positive); distress and well-being were measured using the DASS-Y and PWBS-SDCP. A bootstrapped path-analytic indirect-association model was estimated in R using lavaan (5,000 resamples; bias-corrected 95% CIs).
Results: PMS screening status was positively associated with distress ($rpb = .46, p < .001$) and negatively with well-being ($rpb = -.26, p < .001$). The standardised indirect association through distress was significant ($\beta = -0.21$, $B = -10.46$, 95% CI $[-13.98, -7.57]$, $p < .001$), representing 78.7% of the total association; the direct association conditional on distress was not significant ($\beta = -.06, B = -2.82, p = .291$). The full model explained 23.0% of variance in well-being ($R^2 = .230$).
Conclusions: In this Indian adolescent sample, the cross-sectional association between PMS screening status and psychological well-being was statistically accounted for, in substantial part, by psychological distress. Because the design is cross-sectional and the exposure, mediator, and outcome were measured concurrently in a fixed order, these findings should be interpreted as a statistical indirect association rather than evidence of a temporal or causal mediating mechanism. The results are compatible with, but do not establish, a distress-related explanatory pathway, and may inform hypotheses for future longitudinal research on school-based mental health support.

Keywords: premenstrual syndrome, psychological distress, psychological well-being, cross-sectional indirect association, adolescent girls

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1. Introduction

1.1. Premenstrual syndrome and adolescent mental health

Premenstrual Syndrome (PMS) is a cyclical condition characterised by physical, emotional, and behavioural symptoms during the luteal phase of the menstrual cycle, resolving with the onset of menstruation and causing functional impairment (Tawakoli et al., 2025; Upadhyay et al., 2023). Globally, PMS affects an estimated 20–40% of reproductive-age women (Hantsoo et al., 2022); Indian prevalence estimates vary widely, from 38% to 86% (Dutta & Sharma, 2021; Manjrekar & Patil, 2025). This wide range likely reflects methodological heterogeneity across studies rather than true variation in underlying prevalence. The two available Indian sources differ in the screening instrument used, in urban versus rural sampling frames, and in whether a diagnostic versus a screening threshold was applied. Manjrekar and Patil (2025), in particular, sampled late reproductive-age rather than adolescent women, limiting their direct comparability to the present sample. This measurement heterogeneity is directly relevant to the present study, which likewise relies on a screening rather than a diagnostic classification, and underscores the need for standardised, age-appropriate assessment in future Indian research.

Adolescence is a period of particular vulnerability. Pubertal activation of the Hypothalamic-Pituitary-Gonadal (HPG) axis initiates cyclical hormonal fluctuations that dysregulate serotonergic and GABAergic systems governing mood and stress reactivity, in the context of still-maturing emotional regulation capacities (Deecher et al., 2008; Peacock et al., 2012). Despite this, most PMS research has been conducted in adult Western samples, leaving adolescent and non-Western populations substantially underrepresented.

PMS in adolescent girls is associated with elevated depression, anxiety, and stress (Direkvand-Moghadam et al., 2014; Vichnin et al., 2006) and with disruption to academic performance, peer relationships, and daily functioning (Derman et al., 2004). Hormonal sensitivity, maladaptive cognitive responses to cyclical symptoms, and abnormal stress coping are recognised contributors to premenstrual psychological burden (Craner et al., 2014; Liu et al., 2024). Recurrent premenstrual distress may cumulatively decrease positive psychological resources relevant to adolescent development and functioning.

1.2. Psychological well-being as a distinct outcome

Most PMS research operationalises psychological impact through symptom-based negative outcomes such as depression and anxiety. Relatively few studies have examined PMS in relation to eudaimonic psychological well-being, which encompasses autonomy, environmental mastery, personal growth, positive relations, purpose in life, and self-acceptance (Ryff, 1989). Keyes (2005) two-continua model holds that psychological distress and well-being are related but empirically distinguishable dimensions of mental health, i.e., high distress does not automatically correspond to low well-being, nor does the absence of distress guarantee positive functioning. Assessing PMS in relation to well-being thus provides a more comprehensive picture of psychological health than distress measures alone.

1.3. The present study

The individual associations between PMS and distress, and between distress and well-being, have each been studied independently. Based on our review of the literature, the simultaneous examination of all three constructs within a single analytic framework in an adolescent sample and using a multidimensional positive well-being measure has received comparatively little attention. To our knowledge, a limited published study has explicitly examined whether the cross-sectional association between PMS and well-being is statistically accounted for by psychological distress in Indian adolescent girls. This study is presented as a theory-informed, exploratory analysis rather than a test of a previously unconsidered mechanism. The contribution of the present study rests on three dimensions: (a) simultaneous examination of PMS screening status, psychological distress, and psychological well-being within a single statistical indirect-association framework; (b) eudaimonic well-being rather than symptom burden or depression alone as the primary outcome; and (c) contextually grounded evidence from Indian adolescent girls in Bangalore, India, a population underrepresented in the literature. Guided by Hobfoll (1989) Conservation of Resources theory and the diathesis-stress model (Monroe & Simons, 1991) as broad interpretive frameworks, hypothesised (H1) that PMS screening status would be positively associated with distress and negatively associated with well-being; and (H2) that psychological distress would statistically account for a significant portion of the cross-sectional association between PMS screening status and psychological well-being. Consistent with the cross-sectional design, these hypotheses concern statistical association rather than temporal or causal sequence.

2. Materials and Methods

2.1. Design and participants

A cross-sectional quantitative design was employed, and reporting follows the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guideline for cross-sectional studies (von Elm et al., 2007). Recruitment was conducted across private schools in Bangalore, Karnataka, India, through convenience sampling. Participation was limited to private schools because government-funded schools in the region are subject to a multi-tier administrative approval process that requires clearance from district and state education authorities; this process involves extended timelines that were beyond the scope of the present study. Additionally, several government school principals expressed reservations about the sensitive nature of premenstrual symptom assessment among adolescent students,

which further limited access. Private schools, operating with greater institutional autonomy, were able to grant administrative permission for the study directly, enabling research to proceed within the available timeframe.

Eight private schools in Bangalore were approached, of which five agreed to participate. Of 450 eligible students across these schools, 380 provided consent to participate, a consent rate of 84.4% relative to the eligible population. Following application of clinical exclusion criteria (prior clinical diagnosis of PMS or PMDD; PCOD/PCOS; chronic medical or psychiatric condition; prior pharmacological or psychological treatment for premenstrual symptoms), 30 consenting participants were excluded, yielding a final analysable sample of $N = 350$. This final sample represents 92.1% retention rate after exclusion and 77.8% of the originally eligible population. No participant in the final sample had an incomplete questionnaire; the entire reduction from 380 to 350 is accounted for by the clinical exclusion criteria described above, and no additional exclusions for missing or incomplete data were required. Consenting participants initially completed the questionnaire. During post-collection eligibility verification, responses were evaluated, and participants meeting any predefined exclusion criteria were removed prior to statistical analysis. Inclusion criteria were: female sex; aged 13–17 years; attainment of menarche. Participants were classified as screening-positive for PMS (n = 204, 58.3%) or screening-negative (n = 146, 41.7%) based on the PSST-A screening tool.

A priori power analysis (Faul et al., 2007)($f^2 = 0.15$, $\alpha = .05$, $power = 0.80$, two predictors, reflecting a generic multiple-regression benchmark for the well-being regression on PMS status and distress) indicated a minimum of 77 participants. This calculation is a general regression-based benchmark and was not a mediation-specific, design-stage power calculation for the indirect ($a \times b$) association; power for an indirect association depends jointly on both component paths and cannot be inferred from a single-equation calculation. The obtained sample (N = 350) substantially exceeded the regression-based benchmark. Demographic and menstrual characteristics are presented in Table 1.

Table 1

Demographic and Menstrual Characteristics of Adolescent Girls With and Without Premenstrual Syndrome Screening-Positive Status (N = 350)

Characteristic	Total (N = 350)		Screening-positive (n = 204)		Screening-negative (n = 146)	
	M* / *n	***SD* / %**	***M* / *n***	***SD* / %**	***M* / *n***	***SD* / %**
Age (years)	16.03	1.23	16.28	1.03	15.68	1.39
Age at menarche (years)	12.18	1.14	12.11	1.26	12.27	0.94
Menstrual cycle regularity						
Regular	266	76.0%	149	73.0%	117	80.1%
Irregular	84	24.0%	55	27.0%	29	19.9%
Residence						
Urban	311	88.9%	181	88.7%	130	89.0%
Semi-urban	19	5.4%	16	7.8%	3	2.1%
Rural	20	5.7%	7	3.4%	13	8.9%
Family type						
Nuclear	280	80.0%	168	82.4%	112	76.7%
Joint	54	15.4%	27	13.2%	27	18.5%
Single parent	16	4.6%	9	4.4%	7	4.8%
Physical activity level						
Low	54	15.4%	40	19.6%	14	9.6%
Moderate	263	75.1%	149	73.0%	114	78.1%
High	33	9.4%	15	7.4%	18	12.3%

Note. PMS = premenstrual syndrome assessed via PSST-A. Physical activity level was self-reported.

2.2. Measures

2.2.1. PMS screening (PSST-A)

PMS screening status was assessed using the *Premenstrual Symptoms Screening Tool for Adolescents* (PSST-A) (Steiner et al., 2011), a validated adolescent adaptation of the PSST (Steiner et al., 2003) with established internal consistency (Cronbach's $\alpha \approx .91$ in prior validation samples). Consistent with the validated PSST-A classification framework, participants were classified as screening-positive when they endorsed at least one core affective or physical symptom at a moderate-to-severe level of severity together with at least a moderate level of self-reported functional impairment across the specified life domains (e.g., school, relationships, or daily activities); all other participants were classified as screening-negative. Because the present analysis dichotomises the screening outcome, the finer-grained distinction between moderate/severe PMS and probable PMDD-

range presentations within the screening-positive group was not separately analysed since the original multi-category classification was not retained and are therefore unable to report category-specific ns retrospectively. The PSST-A was used solely for screening classification in the present study; accordingly, sample-specific reliability estimation for this instrument was not conducted. The PSST-A is a screening rather than a diagnostic instrument; a screening-positive classification reflects elevated premenstrual symptom burden consistent with a validated screening threshold, not a formal clinical diagnosis of PMS.

2.2.2. Psychological distress (DASS-Y)

Psychological distress was assessed using the *Depression Anxiety Stress Scales–Youth Version* (DASS-Y) (Szabo & Lovibond, 2022), a developmentally appropriate adaptation of the DASS-21 (Lovibond & Lovibond, 1995) that has been validated for use with children and adolescents aged 8–17 years. The full observed age range (13–17 years), therefore, falls within the instrument developers' stated validation range, and no age-based sensitivity analysis was required on this point. The DASS-Y comprises three subscales: Depression (M = 7.16, SD = 6.03), Anxiety (M = 6.07, SD = 5.23), and Stress (M = 10.77, SD = 5.53), summed to yield a composite distress index. The DASS-Y comprises 21 items in total (seven per subscale) rated on a 4-point scale ranging from 0 (not true) to 3 (very true) with reference to the past week. The subscale and composite scores are calculated as the direct sum of the constituent item ratings, giving a possible range of 0-21 per subscale and 0-63 for the composite index in DASS-Y. Internal consistency in the present sample was excellent (Cronbach's $\alpha = .92$), exceeding the range reported in prior validation studies ($\alpha \approx .83$–$.89$) (Szabo & Lovibond, 2022). The study uses the composite as a broad index of general distress; the theoretical rationale for combining the three subscales, rather than modelling them separately, is that the present study's hypotheses concerned overall affective burden rather than differential associations of depression, anxiety, and stress with PMS screening status.

2.2.3. Psychological well-being (PWBS-SDCP)

Psychological well-being was assessed using the *Psychological Well-Being Scale SDCP* (PWBS-SDCP) (Sisodia & Choudhary, 2012), a 50-item scale with sub-domains of Satisfaction, Efficiency, Sociability, Mental Health and Interpersonal Relations, with 10 items in each scale on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) with a range of scores 10 to 50 for each of the five areas and a full scale with 50 to 250. Internal consistency in the present sample was good (Cronbach's $\alpha = .90$), consistent with the $\alpha \approx .87$ reported in the original validation study. The PWBS-SDCP was developed and standardised on Indian samples, including adolescents. Its five domains bear conceptual similarities to several of Ryff (1989) eudaimonic dimensions (e.g., self-acceptance, positive relations); however, the study did not identify an independent psychometric study formally establishing structural correspondence between the PWBS-SDCP and Ryff's six-dimensional model, and therefore describes this alignment as conceptual and approximate rather than empirically demonstrated. Psychological well-being, as operationalised by the PWBS-SDCP, is the outcome measure, reserving the term "eudaimonic" for the broader theoretical framework that motivated the choice of outcome measure. The scale includes a Mental Health domain whose content may overlap conceptually with the distress construct assessed by the DASS-Y (Sisodia & Choudhary, 2012).

2.3. Procedure and ethics

Ethical approval was obtained from the institutional Research Conduct and Ethics Committee (IRB No. RCEC/00578/06/25). Written informed assent was obtained from all adolescent participants; written informed parental or guardian consent was secured prior to data collection. Participants were assured of confidentiality and informed of their right to withdraw at any time, and of their right to skip any item without providing a reason. Data collection occurred during school hours in supervised group sessions administered by researchers; teachers and school staff were not seated among participants during questionnaire completion, and seating was arranged to limit visibility of neighbouring responses. Instruments were administered in a fixed order (PSST-A, DASS-Y, PWBS-SDCP); the order of instruments was not randomised across participants. All instruments were administered in English, which is the medium of instruction in all participating private schools in Bangalore. No specific English proficiency assessment was conducted beyond confirmed school enrolment, and no comprehension difficulties were reported during data collection.

The research team reviewed questionnaires for completeness at the point of collection, using a process designed to identify accidentally skipped pages rather than responses to specific sensitive items. All 350 participants in the final analytic sample had complete data on all measures, and no imputation was required. A referral protocol was in place for participants who disclosed significant distress or risk during data collection. Designated school counsellors were informed and available on-site, and measures were in place to alert a supervising staff member if a participant appeared visibly distressed. A brief data-protection statement was provided to schools and families; individual questionnaires were de-identified prior to data entry and analysis, and school identity was retained only at the level of an anonymised site code for the purpose of the sensitivity checks.

2.4. Statistical analysis

All analyses were conducted in R (version 4.6.0) using the lavaan package (version 0.6-21; Rosseel, 2012). Data completeness was verified through on-site review during collection; no missing data were present and no imputation was required. Normality was examined using the Shapiro-Wilk test, supplemented by visual inspection of Q–Q plots. Zero-order associations with the continuous distress and well-being variables are point-biserial correlations because PMS screening status is a binary variable; although numerically equivalent to Pearson correlations under 0/1 coding, they are labelled as point-biserial (rpb). A bootstrapped path-analytic model was estimated, specifying PMS screening status as the predictor (X), psychological distress as the mediator vari-

able in the statistical model (M), and psychological well-being as the outcome (Y). This observed-variable, three-path model is statistically just-identified (saturated); as such, it cannot be evaluated for model fit, and does not, by itself, establish causal ordering. Both unstandardised (*B*) and standardised (β) path coefficients are reported, along with the coefficient of determination (R^2) for each regression and the proportion of the total association accounted for by the indirect association. Indirect associations were estimated using bias-corrected bootstrap 95% confidence intervals based on 5,000 resamples; the reported *p* value for the indirect association is derived from the bootstrap distribution rather than a normal-theory *z* ratio. Of the 5,000 requested resamples, 4,877 (97.5%) produced an admissible solution; the remaining 123 were discarded by lavaan, most plausibly because some resamples, by chance, contained insufficient variation in the binary PMS-status predictor to support a stable covariance solution. In the cross-sectional indirect-association designs (Hayes & Rockwood, 2017), the indirect association is not labelled as full or partial mediation; instead, the statistical significance of the indirect association and of the direct association conditional on distress are reported separately, and any proportion-mediated statistic is treated as a descriptive ratio of point estimates rather than as an estimate of a causal effect transmitted through distress. All estimates are interpreted as cross-sectional statistical associations; because PMS screening status, distress, and well-being were measured concurrently, in a fixed order, from the same respondents, the data cannot establish temporal precedence and do not imply causal direction (Baron & Kenny, 1986; Imai et al., 2010; Lee et al., 2021). A sensitivity analysis incorporating these covariates, age, menstrual cycle regularity, and physical activity level, is estimated.

3. Results

3.1. Descriptive statistics and correlations

Prior to hypothesis testing, descriptive statistics and distributional properties were examined. The Shapiro-Wilk test, supplemented by visual inspection of Q-Q plots (Figure 1), indicated that psychological well-being was approximately normally distributed ($W = 0.997$, $p = .657$). Psychological distress showed statistically significant deviation from normality ($W = 0.961$, $p < .001$); however, visual inspection of the Q-Q plot indicated moderate positive skewness without extreme outliers, and bootstrapping was employed to address potential violations. Zero-order correlations are presented in Table 2. PMS screening status was positively associated with distress ($rpb = .46$, $p < .001$) and negatively with well-being ($rpb = -.26$, $p < .001$); distress was negatively associated with well-being ($r = -.48$, $p < .001$), consistent with H1.

Table 2

Descriptive Statistics and Intercorrelations Among PMS Screening Status, Psychological Distress, and Psychological Well-Being

Variable	*M*	*SD*	1	2
1. PMS Screening Status	–	–	–	
2. Psychological Distress	24.00	14.48	.46***	–
3. Psychological Well-Being	168.23	24.89	−.26***	−.48***

Note. $N = 350$. rpb = point-biserial correlation. *** $p < .001$.

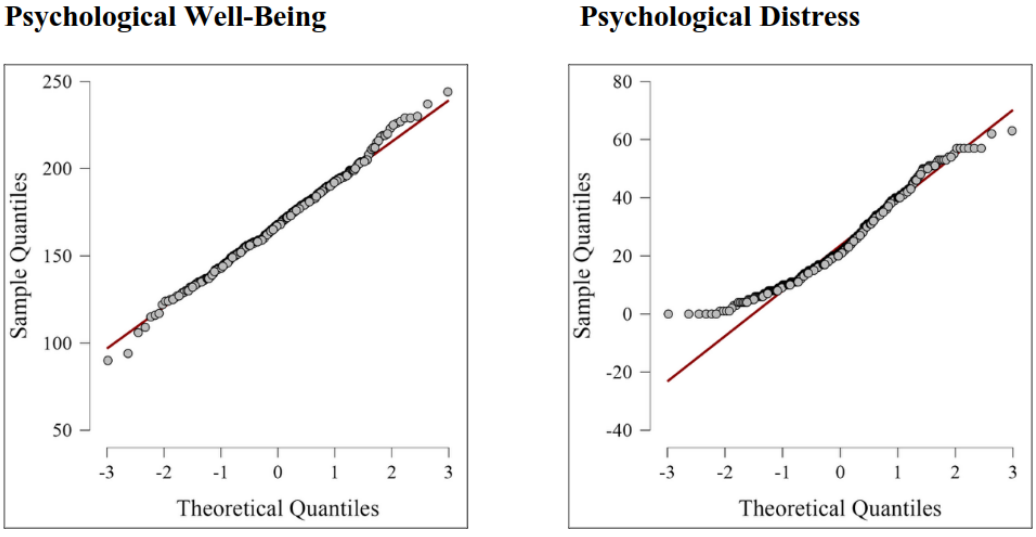

Figure 1. *Normal Q–Q Plots for Psychological Distress and Psychological Well-Being.*

3.2. Path-analytic model

Results are presented in Table 3 and Figure 2. PMS screening status significantly predicted distress (Path *a*: $B = 13.47$, $\beta = .46$, $SE = 1.32$, $z = 10.19$, $p < .001$, 95% CI [10.92, 16.06]; $R^2 = .211$). Distress significantly predicted well-being, conditional on PMS status (Path *b*: $B = -0.78$, $\beta = -.45$, $SE = 0.09$, $z = -8.66$, $p < .001$, 95% CI [−0.95, −0.60]). The direct association of PMS screening status with well-being, conditional on distress, was not statistically significant (*c*′: $B = -2.82$, $\beta = -.06$, $SE = 2.67$, $p = .291$, 95% CI [−8.20, 2.34]). This confidence interval spans a range of plausible negative values as well as zero and should be read as an imprecise estimate rather than evidence that no direct association exists. The bootstrapped indirect association was statistically significant ($B = -10.46$, $\beta = -.21$, $SE = 1.62$, $p < .001$, 95% CI [−13.98, −7.57]), with the confidence interval excluding zero. As a descriptive ratio of point estimates only, the indirect association represented 78.7% of the total association (total $B = -13.28$, $\beta = -.26$; $R^2 = .230$); we do not interpret this percentage as the proportion of a causal effect transmitted through distress. A statistically significant indirect association alongside an imprecisely estimated, non-significant direct association is consistent with H2 as a statistical (not causal) pattern. All estimates reflect cross-sectional statistical associations; no causal or temporal ordering is implied.

Table 3

Path-Analytic Model: Psychological Distress as the Statistical Intermediary Between PMS Screening Status and Psychological Well-Being (Cross-Sectional Indirect Association)

Path	*B*	β	*SE*	*z*	*p*	95% CI LL	95% CI UL
Path *a*: PMS → Distress	13.47	.46	1.32	10.19	< .001	10.92	16.06
Path *b*: Distress → Well-being	−0.78	−.45	0.09	−8.66	< .001	−0.95	−0.60
Direct (*c*'): PMS → Well-being	−2.82	−.06	2.67	−1.06	.291	−8.20	2.34
Indirect association (*a*×*b*)	−10.46	−.21	1.62	−6.46	< .001	−13.98	−7.57
Total association	−13.28	−.26	2.64	−5.03	< .001	−18.60	−8.24

Note. N = 350. Bootstrap resamples = 4,877 of 5,000 admissible replications (97.5%). β = standardised coefficient. CI = bias-corrected bootstrap confidence interval; LL = lower limit; UL = upper limit. c′ is the direct association of PMS status with well-being conditional on distress, not a demographically adjusted estimate.

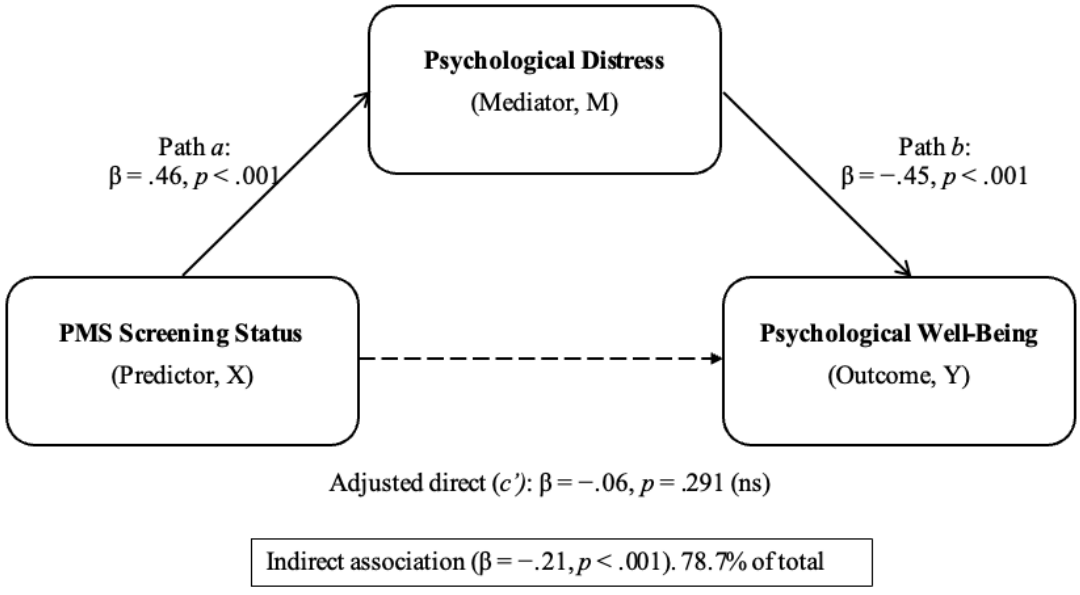

Figure 2. *Path diagram of the statistical model*

3.3. Sensitivity analysis: adjustment for demographic and menstrual covariates

Age and physical activity level were treated as plausible pre-exposure confounders on conceptual grounds, as both are established, non-cyclical correlates of adolescent mood and well-being that are unlikely to be direct consequences of PMS screening status. Menstrual cycle regularity is a more ambiguous case, since irregular cycles could themselves represent an early correlate of the same underlying hormonal-symptom pathway rather than an independent temporally prior confounder. It is therefore retained here as a sensitivity covariate rather than as a confirmed confounder.

Table 1 indicated descriptive differences between screening-

positive and screening-negative participants in age, menstrual cycle regularity and physical activity level, a sensitivity analysis was conducted in which these variables were added as covariates to both regression equations of the path model (age modelled as continuous; cycle regularity coded as regular versus irregular; physical activity level coded as low and high with moderate as the reference category) as parsimonious adjusted sensitivity model presented in Table 4.

After adjustment, PMS screening status remained significantly associated with distress ($B = 13.70$, $\beta = .47$, $SE = 1.38$, $z = 9.93$, $p < .001$), and distress remained significantly associated with well-being conditional on PMS status ($B = -0.80$, $\beta = -.47$, $SE = 0.09$, $z = -9.21$, $p < .001$). The indirect association through distress remained statistically significant and similar in magnitude to the unadjusted model (adjusted $B = -10.97$, $\beta = -.22$, 95% CI [−14.50, −8.04], $p < .001$, versus unadjusted $B = -10.46$, $\beta = -.21$). The direct association of PMS status with well-being, conditional on distress, remained non-significant ($B = 1.58$, $\beta = .03$, $SE = 2.52$, $z = 0.63$, $p = .516$). Its point estimate changes sign relative to the unadjusted model (−2.82 unadjusted vs. +1.58 adjusted); because both estimates are imprecise and non-significant, with both 95% CIs spanning zero, we interpret this sign change as reflecting the imprecision of this particular estimate rather than a substantive reversal.

The descriptive proportion-mediated statistic reported for the unadjusted model (78.7%) is not meaningful here and is not reported for the adjusted model; ratios exceeding 100%, or of indeterminate sign, are a recognised artefact of this statistic when component associations diverge in sign, rather than a substantive finding because the indirect and the non-significant direct association take opposite signs in the adjusted model (MacKinnon et al., 2000). Adjustment for these three covariates increased explained variance in both the distress model ($R^2 = .211$ unadjusted vs. .226 adjusted) and the well-being model ($R^2 = .230$ unadjusted vs. .327 adjusted); age ($B = -4.82$) and high physical activity level ($B = 13.24$, relative to moderate) showed the largest independent associations with well-being among the added covariates. Overall, the pattern of statistical significance for both the indirect and direct associations was unchanged by adjustment for these three covariates, supporting the robustness of the primary (unadjusted) result.

Table 4

Sensitivity Analysis: Path-Analytic Model Adjusted for Age, Menstrual Cycle Regularity, and Physical Activity Level

Path	*B*	β	*SE*	*z*	*p*	95% CI LL	95% CI UL
Path *a*: PMS → Distress	13.70	.47	1.38	9.93	< .001	10.92	16.30
Path *b*: Distress → Well-being	−0.80	−.47	0.09	−9.21	< .001	−0.97	−0.63
Direct (*c*′): PMS → Well-being, conditional on distress	1.58	.03	2.52	0.63	.516	−3.50	6.51
Indirect (*a* × *b*)	−10.97	−.22	1.62	−6.76	< .001	−14.50	−8.04
Total association	−9.39	−.19	2.68	−3.50	< .001	−14.61	−4.25

Note. $N = 350$. Bootstrap resamples = 5,000 (case resampling; all replications admissible). Both regression equations additionally include age (continuous), menstrual cycle regularity (0 = regular, 1 = irregular), and physical activity level (reference = moderate; coded low and high) as covariates. β = standardised coefficient. CI = bias-corrected bootstrap confidence interval; LL = lower limit; UL = upper limit. Proportion-mediated is not reported for this model because the indirect and direct point estimates take opposite signs.

4. Discussion

The present cross-sectional study examined whether psychological distress statistically accounts for the association between PMS screening status and psychological well-being in 350 adolescent girls attending private schools in Bangalore, India. The indirect association through distress was statistically significant ($\beta = -.21$, representing 78.7% of the total association), while the direct association conditional on distress was not significant ($\beta = -.06$), consistent with H2. These results do not demonstrate that PMS causes distress or that distress causes diminished well-being; the exposure, mediator, and outcome were measured concurrently in a single session, and a mediation model of this kind requires temporal precedence that these data cannot supply. The findings are statistically compatible with a distress-related explanatory pathway and provide a basis for future longitudinal investigation, but they should not be read as demonstrating one.

The positive association between PMS screening status and psychological distress ($\beta = .46$) is broadly consistent with findings from adult samples (Rapkin & Akopians, 2012). The present findings extend prior work to an Indian adolescent population attending private schools in Bangalore. The magnitude of the group difference was statistically robust, which is not characterised as clinically notable, since no validated clinical cut-point or minimally important difference for the DASS-Y composite was available for comparison in this study. Luteal-phase hormonal shifts are hypothesised to dysregulate serotonergic and HPA-axis systems (Rubinow & Schmidt, 2006), and maladaptive cognitive responses to cyclical symptoms may further amplify affective burden (Craner et al., 2014; Liu et al., 2024); these mechanisms are offered as plausible background rather than as processes demonstrated by the present cross-sectional data.

The negative association between distress and well-being ($\beta = -.45$, conditional on PMS status) is consistent with

Keyes (2005) two-continua model, which holds that distress and well-being are related but distinguishable dimensions of mental health. Some of this association may also reflect item-content overlap between the DASS-Y and the Mental Health domain of the PWBS-SDCP, shared negative affect, and common-method variance arising from same-source, same-session reporting. The full model explained 23.0% of the variance in well-being (R^2 = .230), with the indirect pathway (β = −.21) exceeding the direct pathway (β = −.06) in magnitude; this indicates that, in this cross-sectional sample, distress accounts for the greater share of the observed statistical association between PMS screening status and well-being, without inferring that this reflects the proportion of a causal effect.

4.1. Implications

If a distress-related pathway of this kind is supported by future longitudinal or experimental research, schools may consider integrating psychological support and mental health awareness into existing menstrual health programmes, for example, through psychoeducation about the menstrual cycle, peer support, and access to counselling. The study presents these as tentative, research-informed considerations rather than clinical recommendations; any such approaches warrant evaluation through prospective longitudinal and intervention studies before implementation is considered.

Theoretically, the study extends descriptive association research toward a more integrated statistical account of how PMS screening status, distress, and well-being co-occur, consistent with the diathesis-stress model (Monroe & Simons, 1991) and Hobfoll (1989) Conservation of Resources theory as interpretive frameworks. The findings are compatible with an extension of Keyes (2005) two-continua model into the domain of adolescent menstrual health, in the sense that distress and well-being are shown to be statistically linked in this population. The study does not claim that this cross-sectional analysis demonstrates a specific mediating process or establishes that a distress-related pathway is present from the earliest stages of menstrual experience. Descriptively, participants' mean age was 16.03 years and mean age at menarche was 12.18 years, so the sample was, on average, several years post-menarche; the data therefore speak to concurrent associations among post-menarcheal adolescents rather than to processes unfolding from menarche onward. By focusing on adolescents, the present study addresses an adult-centric gap in the existing literature, treating this as its primary contribution rather than demonstrating a novel causal mechanism.

4.2. Limitations

Several limitations must be acknowledged. First, and most fundamentally, the cross-sectional design does not establish temporal ordering or causal direction. Findings are more accurately described as a statistically significant cross-sectional indirect association, compatible with, but not demonstrating, a causal chain. Longitudinal daily-diary studies across multiple menstrual cycles, or experimental distress-reduction studies, are needed before temporal or causal interpretations are warranted.

The exposure, mediator, and outcome measures show conceptual and item-level overlap. The PSST-A screening classification is partly defined by affective symptoms (e.g., depressed mood, anxiety, irritability, concentration difficulties) that closely resemble DASS-Y content, and the PWBS-SDCP includes a Mental Health domain that may be inversely related to distress independent of any intervening process. This overlap, together with same-source, same-session reporting and the fixed administration order (PSST-A, then DASS-Y, then PWBS-SDCP), may inflate the apparent strength of the statistical associations and cannot be fully disentangled with the present observed-variable design.

The primary analytic model included only PMS screening status, distress, and well-being, despite meaningful demographic variability in the sample (Table 1). To assess the robustness of this unadjusted result, a sensitivity analysis adjusting for age, menstrual cycle regularity, and physical activity level was subsequently conducted (Table 4); the pattern of statistical significance for both the indirect and direct associations was unchanged by this adjustment, and the indirect association remained similar in magnitude. Residence and family type were not included as covariates in either model, and the reported associations may still be subject to confounding by these and other unmeasured variables, including menstrual cycle phase at assessment, dysmenorrhea, sleep, body mass index, and socioeconomic position, none of which were incorporated into any model in this analysis. Future studies should incorporate a fuller, pre-specified, theory-based adjustment strategy rather than stepwise selection.

Participants were recruited from only five schools, and the analysis treats all 350 observations as statistically independent. Shared school-level characteristics may induce within-school correlation that is not reflected in the reported standard errors and confidence intervals; given the small number of clusters, standard multilevel or cluster-robust adjustments may themselves be unstable and unable to obtain reliable cluster-adjusted estimates. Any future reanalysis should include school-level descriptive statistics, intraclass correlations, and a leave-one-school-out sensitivity check, ideally in consultation with a statistician experienced in small-cluster inference.

No information on menstrual cycle day, luteal-phase estimate, or date of last menstrual period was collected. The distress and well-being measures, therefore, cannot be characterised as specifically premenstrual; some participants may have completed these measures during the luteal, menstrual, or follicular phase. Findings should be interpreted as concurrent associations among adolescents who screened positive for elevated premenstrual symptom burden, not as evidence of phase-specific premenstrual distress.

Recruitment was limited to private schools in Bangalore because of the multi-tier administrative approval requirements and access constraints in government-funded schools; this limits

generalisability to government-school students and to adolescent girls in other cities and regions of India. The predominantly urban sample (88.9%) further restricts external validity to rural populations. Excluding adolescents with a prior PMS/PMDD diagnosis or psychiatric treatment history may also have removed some of the most clinically affected students, which should be considered when generalising findings.

The 58.3% screening-positive rate substantially exceeds many epidemiological PMS prevalence estimates, reflecting the screening rather than diagnostic nature of the PSST-A and the convenience sampling design, which should not be interpreted as the prevalence of clinically confirmed PMS in this population.

The reported sample-size calculation was a generic multiple-regression benchmark, not a design-stage power calculation for the indirect association; a mediation-specific calculation (e.g., Monte Carlo simulation based on anticipated a and b paths) was not conducted.

Finally, while the PWBS-SDCP was selected for its Indian normative base, we did not identify independent psychometric evidence formally establishing its structural correspondence with Ryff (1989) six-dimensional model; internationally standardised well-being measures with confirmatory factor-analytic validation in Indian adolescent samples, alongside continued use of Indian-normed instruments, are recommended for future research.

5. Conclusions

The present cross-sectional study found a statistically significant indirect association between PMS screening status and psychological well-being, operating through psychological distress, in 350 adolescent girls from private schools in Bangalore, India. These findings are statistically compatible with a distress-related explanatory pathway linking elevated premenstrual symptom burden to diminished psychological well-being, but, given the cross-sectional design and the item-level and administrative overlap among measures, they should not be read as demonstrating a temporal or causal mediating mechanism. The primary contribution of the study lies in the simultaneous statistical examination of all three constructs in a population underrepresented in prior research, using psychological well-being rather than symptom burden alone as the outcome. Longitudinal and experimental studies, with cycle-timing data, adjustment for available confounders, and attention to the clustered sampling structure, are necessary to evaluate temporal ordering and causal direction. If a distress-related pathway is confirmed by such research, targeting psychological distress may represent a plausible, empirically grounded focus for school-based mental health support for adolescent girls who screen positive for elevated premenstrual symptom burden in India.

Conflict of Interest

The authors declare no conflict of interest. No financial or personal relationships with other people or organisations have inappropriately influenced (biased) this work.

Ethics Approval

Ethical approval for the study was granted by the Research Conduct and Ethics Committee, CHRIST (Deemed to be University) (IRB No. RCEC/00578/06/25). All procedures were performed in accordance with the ethical standards of the Research Conduct and Ethics Committee, CHRIST (Deemed to be University), Bangalore, India, and with the principles of the Declaration of Helsinki.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and institutional approval.

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Trial Registration

Not applicable. This study is an observational cross-sectional survey and was not registered as a clinical trial.

Author Contributions

Keziah Mary Sam: conceptualisation, methodology, investigation, data curation, formal analysis, writing - original draft, writing - review and editing. Hemanthakumara Venkatappa: conceptualisation, methodology, supervision, validation, writing - review and editing. All authors approved the final version of the article, including the results and the conclusions.

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Abbreviation

PMS = premenstrual syndrome; PSST-A = Premenstrual Symptoms Screening Tool for Adolescents; DASS-Y = Depression Anxiety Stress Scales-Youth Version; PWBS-SDCP = Psychological Well-Being Scale SDCP; HPA = hypothalamic-pituitary-adrenal; COR = Conservation of Resources; IRB = Institutional Review Board.

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