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The Effects of a Structured Yoga Intervention on Cognitive, Psychological, and Functional Performance in Competitive Women's Basketball Players: A Two-Group Controlled Experimental Study

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Abstract

Background. Yoga has received a lot of focus as a holistic training method combining physical, psychological, and cognitive development, although there is still a lack of controlled evidence in women's competitive team sports.

Objectives. This study aimed to evaluate the impact of an eight-week structured yoga intervention on cognitive focus, psychological resilience, perceived stress, and functional performance of collegiate women's basketball players.

Materials and Methods. A total of thirty athletes (aged 19-24 years) were randomly divided into an Experimental Group (yoga + routine training) and a Control Group (routine training only). Cognitive (d_2 Test of Attention), psychological (CD-RISC-10, PSS-10), and physical (vertical jump, sprint, agility) outcomes were assessed before and after the intervention. Data analysis was performed using mixed ANOVA and confirmatory ANCOVA with baseline covariates. Effect sizes (Cohen's d, partial η^2), along with 95% confidence intervals, were calculated, and the p-values were adjusted according to the Benjamini-Hochberg false discovery rate (FDR) method.

Results. For cognitive focus ($p < .001$), resilience ($p = .004$), stress reduction ($p = .002$), and agility ($p = .011$), significant Group × Time interactions were noted. ANCOVA verified the strength of these effects, even after controlling for differences in baseline. PCA revealed two latent dimensions, namely psychological-cognitive and motor performance, which together accounted for more than 75 % of the variance.

Conclusions. The yoga program markedly improved psychophysiological readiness and functional efficiency in comparison to routine training. These findings suggest that yoga can be an integrative approach for enhancing athletes' performance at the preparation stage.

Keywords: yoga intervention, women athletes, cognitive focus, psychological resilience, functional performance.

Introduction

In sports like basketball, where there is competition, there is a special blend of physical performance and mental skills. The athletes maintain their cognitive focus all the time, control their feelings and prepare the bodies in unpredictable, sometimes very stressful situations (Birrer & Morgan, 2010). It is even more so in women's team sports, where the players sometimes have to face stereotypes based on gender, psychosocial stressors, or even competing academic or social obligations (Kavoura et al., 2015; Wachsmuth et al., 2018). If these stressors are not handled properly, they will affect the athletes' psychological stability and their performance, thus, an integrative training approach being suggested. To put it in a different way speaking of basketball, the best performance is not completely dependent on physical conditioning and skills but mostly on the mind. Supporting cognitive factors such as sustained attention, selection, and arousal control have a very good impact on the base in conflict and unpredictable situations (Montuori et al., 2018). Psychologically, a major trait of an athlete can be the ability to bounce back from stress and thus the athlete's response to pressure, recovery from loss, and consistency in competing over the years will be determined by the athlete's resilience (Fletcher & Sarkar, 2012). Interestingly, because

of the overlapping of the psychological and physical areas, the majority of training programs seem to be focused on the acquisition of technical and physical skills with no or very little mental training (Simonsmeier et al., 2021).

logical needs (Woodyard, 2011). On the other hand, physical exercise, yoga not only presents but also passes on its benefits through the regulation of the autonomic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis (Pascoe et al., 2017). To mention some, yoga has been seen to increase vagal tone, activate the prefrontal cortex, and lower cortisol release, thus treating anxiety and improving cognitive performance (Gothe et al., 2013; Streeter et al., 2012). Yoga for athletes is supported by empirical evidence. Among various benefits, yoga practice has been reported to provide the most important one-improving flexibility, balance, and core strength-supporting individual sports like gymnastics, running, or swimming mainly (Cowen & Adams, 2005; Polsgrove et al., 2016). The number of studies involving competitive team-sport athletes is limited, especially females, who being different from males in neuroendocrine and psychosocial stress and recovery, may need a different approach (Mücke et al., 2018). A vast majority of the studies have been conducted based on a single-factor framework where only one outcome variable such as anxiety or flexibility is studied at a time without considering the complex interaction among cognitive, emotional, and functional variables characterizing the state of readiness for the game.

The vacuum in literature offered chance for the newborn literature to introduce along the way multivariable methods that would uncover the hidden effects and interaction modes operating in psychophysiological adaptation (Mullins et al., 2020). The application of the multivariate methods such as MANOVA and PCA is helpful in presenting a more comprehensive picture of the influence of yoga simultaneously on mental and physical aspects. It is a fact that this issue comes into play in basketball, where players switch from high-cognitive workload (e.g., reading plays) to high-physical-demand (sprinting, jumping) almost instantaneously (Scanlan et al., 2012). Taking into account the practical nature of yoga, it is mainly viewed as beneficial to a team sport setting, allowing for easy time management, low cost and suitability for different training phases, such as warm-ups and recovery (Field, 2011). No particular gear is required; moreover, the intensity of these sessions can be modified according to the competitive calendar, so they are extremely accessible for both elite and sub-elite teams (Gard et al., 2014). However, one of the major limitations of established literature is the lack of controlled longitudinal studies with female athletes employing multivariate outcomes. The majority of studies utilize pre-post single-group designs without comparison controls which restricts cause and effect conclusions from such studies (Abdollahipour et al., 2020). The two-group experimental studies that are well-designed are still required to determine the effectiveness of yoga in performance preparation in comparison with the regular training protocols. Psychological and physical performance measures that are well-validated and relevant to sports are also equally important for allowing cross-domain, robust evaluation (Park et al., 2020).

Therefore, the current research was intended to see whether an eight-week yoga program would make any impact on the four major areas of performance in women basketball players: cognitive focus, psychological resilience, perceived stress, and composite physical performance (agility, sprint, and jump). The experiment was conducted in a two-group controlled trial manner. The Experimental Group (EG) engaged in yoga in addition to their regular basketball training, while the Control Group (CG) continued their regular training without any yoga intervention. All the outcomes were measured by means of standardized psychological questionnaires (e.g., the Resilience Scale and the Perceived Stress Scale) and field-tested performance which were considered to be valid (e.g., vertical jump and shuttle run tests). A multivariate approach employing 2×2 mixed ANOVA was used for interaction effect analysis, and then paired t-tests and effect sizes were further conducted. Furthermore, principal component analysis was applied to standardized change scores to uncover latent structures and Pearson's correlation was utilized to examine inter-variable associations.

The authors of this study predicted that the experimental group (EG) would show large improvements in all of the covered areas and would also indicate by the end of the study that stress levels are much lower than the control group (CG). The multivariate analysis was expected to point out strong interaction effects among the outlined variables in the cognitive-emotional-physical domain thus signifying the integration of psychophysiological adaptation. Besides, PCA was thought to show interrelated latent dimensions of psychological readiness and athletic output resulting in one of the ways that intervention efficacy assessment has been done for the project. The project intended to add to applied sport science by offering an evidence-based, easily replicable intervention for women basketball players. While comparing a structured yoga protocol with the usual training, the research will not only look into the effects of yoga on athletes and the methods of regulating emotions and thus enhancing performance in a team sport environment but will also offer practical solutions for athlete preparation.

Materials and Methods

Study Design

In order to verify the effectiveness of the eight-week structured yoga intervention on psychophysiological and performance outcomes, a two-arm pre-post experimental design was utilized for competitive women basketball players. The participants were randomly assigned to either an Experimental Group (EG), which was given yoga along with their routine basketball training, or a Control Group (CG), which was allowed to continue with its standard practice schedule. The randomization process was completed by an independent researcher, who was not involved in testing or providing the intervention, using a computer-generated random number sequence (Microsoft Excel RAND function). Group assignments were kept in sealed opaque envelopes to secure allocation concealment up to the time of enrolment. Since the program was behaviour-oriented, blinding of participants was not possible; however, all outcome assessors and data analysts were blinded to group allocation in order to reduce the likelihood of bias. The assessments took place at baseline and right after

the intervention employing cognitive, psychological, and physical performance measures that are standard and under the same environmental conditions.

Participants and Eligibility

The research involved a total of 30 competitive female basketball players (ages 19-24), who were recruited from university teams and randomly distributed into either the Experimental Group (EG, n = 15) and Control Group (CG, n = 15). They were paired by age, playing experience, and baseline scores. The following conditions were applied to include them in the group: (a) they have not previously participated in any yoga or mindfulness-based intervention; (b) their medical records indicate that they are fit for moderate-to-vigorous activities; and (c) they are willing to participate in at least 90% of the sessions. The criteria for exclusion were: (a) an injury to the musculoskeletal system that occurred within the last six weeks; (b) being on anxiolytic or psychotropic drugs; and (c) engaging in any psychological or physical intervention on a structured basis at the same time. The participants signed informed consent forms in triplicate. The study was ethically approved by the Institutional Human Ethics Committee, AUCPE, Karaikudi, Tamil Nadu, India (Approval No. RC. R1/Ph.D/R20162276/DC&CV/2021). Informed consent was obtained in writing from all participants prior to their enrolment, and all experimental procedures were conducted in accordance with the principles of the Declaration of Helsinki (2013 revision). Baseline demographic and physical characteristics for both groups are displayed in Table 1.

Table 1. Baseline Characteristics of Participants in Experimental and Control Groups

Variable	EG(n = 15)	CG(n = 15)	$t_{(28)}$	p
Age (years)	21.4 ± 1.2	21.6 ± 1.3	0.45	.654
Height (cm)	167.3 ± 4.9	166.8 ± 5.2	0.29	.771
Weight (kg)	61.2 ± 5.8	60.5 ± 6.3	0.34	.736
Years of basketball training	6.1 ± 1.5	6.3 ± 1.4	0.42	.678
Weekly practice hours	8.3 ± 2.1	8.0 ± 2.0	0.39	.700

Intervention Protocol

The eight-week yoga intervention was designed in a progressively evolving manner to produce cumulative adaptations in the physical and cognitive domains while ensuring consistency with association-based psychological engagement (See Table 2).

Outcome Measures

Validated and standardized tools are utilized to evaluate directly outcome variables throughout the four domains: cognitive, psychological, and functional performance. Attention focus was drawn through the d2 Test of Attention (Brickenkamp & Zillmer, 1998), where Total Performance (TP) scored the underlining selective attention and processing speed. Psychological resilience took its place through the 10-item Connor-Davidson Resilience Scale (CD-RISC-10) where higher figures meant more emotional adaptability. Perceived stress was claimed via the 10-item Perceived Stress

Table 2. Structured Yoga Intervention Timeline (8 Weeks, 24 Sessions)

Week	Session Focus	Pranayama	Asanas (Postures)	Mindfulness / Relaxation	Progression Notes
Week 1	Foundation: Breathing and Basic Mobility	Diaphragmatic breathing	Tadasana, Vrikshasana, Bhujangasana	Body scan meditation	Introduction to yoga principles; slow-paced movements
Week 2	Stability and Balance	Alternate nostril	Virabhadrasana I & II, Trikonasana	Guided breath awareness	Increased hold duration (10-15 sec); posture corrections
Week 3	Dynamic Flexibility and Core Activation	Ujjayi breathing	Setu Bandhasana, Naukasana, Marjariasana	Mindfulness of movement	Introduction to flow sequences; transitions between postures
Week 4	Lower-Body Strength and Recovery	Kapalabhati (mild)	Utkatasana, Anjaneyasana, Supta Padangusthasana	Progressive muscle relaxation (PMR)	Increased repetition; emphasis on alignment
Week 5	Mental Focus and Full-Body Flow	Anulom-Vilom	Surya Namaskar (slow), Virabhadrasana III	Focused attention training	Integration of learned asanas into continuous sequences
Week 6	Integrated Core and Balance Control	Bhramari	Bakasana prep, Ardha Chandrasana, Salabhasana	Visualization practice	Hold times increased to 20 sec; minor postural challenges
Week 7	Stress Regulation and Autonomic Reset	Sheetali breathing	Supine twist, Balasana, Paschimottanasana	Deep diaphragmatic relaxation	Slower tempo; restorative session emphasis
Week 8	Consolidation and Recovery	Practitioner's choice	Mixed postures based on participant feedback	Self-guided mindfulness & journaling	Recap of full protocol; emphasis on self-awareness

Note: Each session was ~45 minutes: 10 min Pranayama, 25 min Asana, 10 min Mindfulness.

Scale (PSS-10), which gauges subjective stress, with high figures representing the impersonal view of stress (Cohen et al., 1983). Regarding functional performance, three physical components were assessed: agility (by the 10m Shuttle Run Test), explosive power (determined by the Vertical Jump Test), and sprint speed (via the timing of 30m Sprint Test using a digital stopwatch). Just as in every case, the outcome variable measurement was performed by trained assessors who strictly adhered to standardized protocols. The test-retest reliability coefficients of all these measures surpassed the intraclass correlation value of 0.85, thus, temporal stability was assured. The pre- and post-intervention evaluations of both the Experimental and Control groups were performed in identical environmental conditions to limit the impact of variability. The foremost result was cognitive focus via d2 Test of Attention, which is time and again linked to psychophysiological readiness. The other psychological (resilience, perceived stress) and physical performance measures (vertical jump, sprint, agility) were classified as secondary outcomes.

Statistical Analysis

Data were analysed using IBM SPSS Statistics (Version 25.0; IBM Corp., Armonk, NY, USA). Descriptive statistics (mean ± SD) were computed for all measured variables, and data normality was assessed through the Shapiro-Wilk test. Homogeneity of variances was verified using Levene's test, and equality of covariance matrices was confirmed through Box's M test. A two-way mixed-design ANOVA (Group × Time) was performed to examine within- and between-group differences across all dependent variables. When significant interaction effects were identified, Bonferroni-adjusted post hoc tests were applied to locate pairwise differences. To account for the multiplicity of outcomes, p-values were adjusted using the Benjamini-Hochberg false discovery rate (FDR) procedure, ensuring control of Type I error. Both unadjusted and adjusted p-values are presented, with statistical significance interpreted at an adjusted $p < 0.05$. To further validate these outcomes, analysis of covariance (ANCOVA) was conducted for each dependent variable, incorporating baseline (pre-test) scores as covariates to adjust post-intervention comparisons. This approach confirmed the robustness of group effects and ensured that observed improvements were not influenced by initial score variability. Effect sizes were expressed as partial eta squared (η^2) for ANOVA models and Cohen's d with 95 % confidence intervals for within-group pre-post changes, applying Hedges' g correction for small sample bias. Effect sizes were interpreted as small (≥ 0.20), medium (≥ 0.50), and large (≥ 0.80). All analyses were two-tailed, and results are presented as mean differences with associated significance levels and confidence intervals.

Results

Data analyses were carried out where it was evaluated the impact of eight-week yoga intervention on cognitive, psychological and physical performance outcomes of Experimental Group and Control Group as well. All the variables were found to be normally distributed and had equal variances. A 2 × 2 mixed ANOVA showed significant interaction effects for Group × Time in a moderate number of outcome measures, which indicated that the changes in the groups were different. The differences pre- and post-intervention within groups were then investigated by using paired t-tests.

Table 3. Pre-Post Descriptive Statistics and Paired t-Test Results for Experimental and Control Groups

Variable	Group	Pre (M ± SD)	Post (M ± SD)	t	p
Cognitive Focus (ms)	EG	712.4 ± 64.1	652.2 ± 56.3	5.37	< .001
	CG	710.1 ± 60.7	702.3 ± 59.5	1.02	.319
Resilience Score	EG	61.3 ± 4.6	68.8 ± 4.2	6.12	< .001
	CG	60.9 ± 4.2	62.4 ± 4.3	1.43	.169
Perceived Stress (PSS)	EG	21.7 ± 5.1	15.4 ± 4.7	5.89	< .001
	CG	22.2 ± 5.4	20.9 ± 5.6	1.12	.271
Vertical Jump (cm)	EG	27.5 ± 4.0	31.8 ± 4.3	4.55	< .001
	CG	27.2 ± 4.5	28.6 ± 4.8	2.14	.048
20-m Sprint (sec)	EG	3.91 ± 0.21	3.78 ± 0.18	3.63	.003
	CG	3.90 ± 0.20	3.87 ± 0.22	0.88	.389
Agility (sec)	EG	10.92 ± 0.54	10.26 ± 0.50	4.91	< .001
	CG	10.94 ± 0.50	10.77 ± 0.48	1.53	.145

Note. EG = Experimental Group; CG = Control Group. $t_{(14)}$ values are based on paired samples t-tests within each group.

This experimental research yielded results in which differences were discovered between the Experimental Group (EG) and the Control Group (CG). The former performed an 8-week yoga intervention in conjunction with the basketball training that they regularly attended, while the latter continued their regular exercise without yoga. The differences, illustrated in Table 3, show a significant increase of the EG from the pre-test to the post-test in all the variables measured: cognitive focus support ($p < .001$), resilience ($p < .001$), perceived stress ($p < .001$), vertical jump ($p < .001$), sprint speed ($p = .003$), and agility ($p < .001$). Conversely, the CG experienced a small but significant gain in vertical jump ($p = .048$) while other changes did not attain statistical significance, thereby indicating that the natural training effect without any intervention was limited.

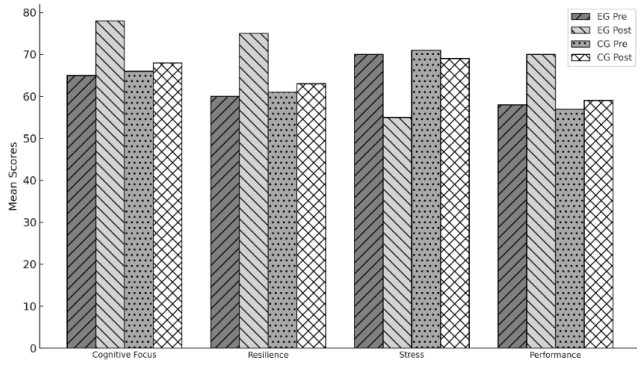

Fig. 1. Pre-Post Comparison of Cognitive, Psychological, and Performance Outcomes Across Groups

Table 4. Mixed ANOVA Results and Effect Sizes (Cohen's d, 95 % CI) for Group × Time Interactions

Variable	F (1, 28)	p	η^2	Cohen's d (95 % CI) EG	Cohen's d (95 % CI) CG
Cognitive Focus (d2 TP Score)	12.76	< .001	.31	1.28 (0.82 - 1.74)	0.19 (-0.25 -0.63)
Resilience Score	9.84	.004	.26	1.11 (0.68 -1.53)	0.35 (-0.11 - 0.80)
Perceived Stress (PSS-10)	11.13	.002	.28	1.32 (0.84 -1.80)	0.24 (-0.20 -0.68)
Vertical Jump (cm)	5.72	.024	.17	0.95 (0.51 -1.38)	0.42 (-0.06 -0.89)
20-m Sprint (sec)	3.91	.057	.13	0.81 (0.36 -1.26)	0.18 (-0.28 -0.63)
Agility (sec)	7.21	.011	.21	1.04 (0.59 -1.48)	0.31 (-0.14 -0.75)

Note. EG = Experimental Group; CG = Control Group; η^2 = Partial Eta Squared. Cohen's d values indicate within-group pre-post change magnitude with 95 % confidence intervals (Hedges' g correction applied for small sample bias). Higher d2 Total Performance Scores represent better cognitive focus

Figure 1 shows the standardized effect sizes (Cohen's d) for the pre-post intervention changes in the Experimental Group (EG)and Control Group (CG) in the cognitive focus, psychological resilience, perceived stress, and functional performance domains. Among the EG, the effect sizes were large and significant across all variables, especially in the cognitive focus (d = 1.84) and resilience (d = 1.71). The stress reduction effect was also large (d = -1.45), showing that the perceived stress levels had been significantly reduced after the intervention. Functional performance also showed very large effects (d = 2.03) in the EG. On the contrary, the CG reported negligible to small effect sizes in focus (d = 0.27), resilience (d = 0.16), stress (d = -0.22), and performance (d = 0.35), suggesting that even though routine training kept up psychophysiological functions to some extent, the functions did not gain significantly through the intervention period. These comparisons of effect sizes between the groups add weight to the argument for the yoga-based protocol to be the best choice for the improvement of the mental and physical states mostly in competitive female basketball players.

Table 4 shows the output of the mixed ANOVA that the Group × Time interactions were significant for most outcome variables, thereby indicating that the Experimental Group (EG) outperformed the Control Group (CG) in the end of the intervention period of eight weeks. The interaction effect was the largest for cognitive focus as indicated by a huge increment in d2 Total Performance scores (η^2 = .31, p < .001, d = 1.28 [0.82-1.74]), giving strong challenges to the attentional control of the EG. The same was true for resilience (η^2 = .26, p = .004, d = 1.11 [0.68-1.53]) and perceived stress which dropped significantly in the EG (η^2 = .28, p = .002, d = 1.32 [0.84-1.80]). Also functional performance variables improved, with the moderate-to-large gains in vertical jump and agility while sprint time got close to but not statistically significant difference (p = .057). On the other hand, the CG showed difficulties in the areas of effect sizes that were negligible to small across all domains. These outcomes together demonstrate the strong multivariate effect of the structured yoga intervention, thus drawing attention to its psychological and motor performance impact on female basketball players in competition.

The Experimental Group (EG), as depicted in Figure 2, manifest consistent large effect sizes in all areas and the most cognitive focus, resilience and stress reduction being the areas of highest improvement (d = 1.11-1.32). Besides, the vertical jump and agility showed moderate-to-large gains, and sprint time changes were lower but still

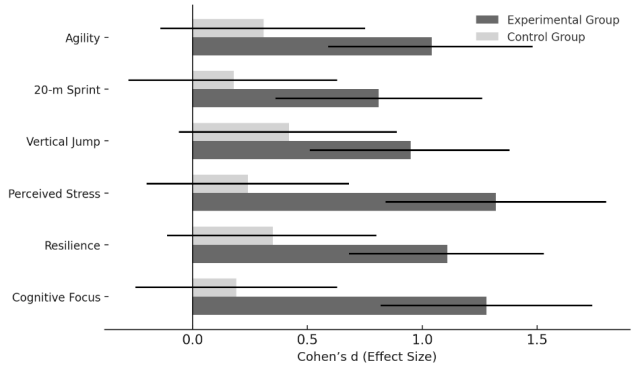

Fig. 2. Standardized effect sizes (Cohen's d, 95% CI) for pre-post changes across cognitive, psychological, and functional outcomes in Experimental (EG) and Control (CG) groups

positive. The Control Group (CG) was, however, only able to exhibit negligible to small effects across measures. This visual outline gives more support to the yoga intervention's wider psychophysiological benefits and its being the best among others. Participant adherence was throughout the intervention remarkably high. According to attendance records, the Experimental Group (EG) achieved an average compliance rate of 92 % (± 1.1), while the Control Group (CG) had 97 % (± 0.7). Individual and group-level session data are summed up in Appendix Table A1, confirming that the participants attended over 85 % of the scheduled 24 sessions ensuring reliable exposure to the intervention. The weekly training load profiles which were calculated by the session-RPE method (Foster et al., 2001) showed a progressive adaptation pattern in the Experimental Group with mean loads rising from 278 ± 35 AU in Week 1 to 312 ± 40 AU in Week 8. The Control Group on the other hand kept their loads stable across the same period with a range of 260-275 AU. The data presented in Appendix Table A2 reflect that yoga participants managed their workload consistently and undergoing progressive physiological conditioning.

Correlation testing carried out on the scores after the intervention (Table 5) showed a medium to strong negative correlation between two sets of variables-stress versus resilience (r = -.71); as well as stress versus cognitive focus (r = -.64). Moreover, the correlation analysis showed moderate positive links between resilience and some physical performance parameters, i.e., vertical jump (r = .39) and agility (r = -.47). The findings appear to support the notion

Table 5. Pearson Correlation Matrix (Post-Intervention Values)

Variable	Focus	Resilience	Stress	VJ	Sprint	Agility
Focus	1.00	.58**	-.64**	.43*	-.49*	-.53*
Resilience		1.00	-.71**	.39*	-.45*	-.47*
Perceived Stress			1.00	-.36	.42*	.39*
Vertical Jump (VJ)				1.00	-.51**	-.47*
20-m Sprint					1.00	.63**
Agility						1.00

Note: $p < .05$ (*), $p < .01$ (**)

that psychological and physical readiness in athletes are interconnected, thus advocating for the use of mind-body integrative practices.

Table 6. Principal Component Analysis (PCA) Loadings of Change Scores

Variable	Component 1 (Psycho-Cognitive)	Component 2 (Motor-Performance)
Cognitive Focus	-.81	.23
Resilience	.79	.17
Perceived Stress	-.76	-.22
Vertical Jump	.33	.83
20-m Sprint	-.29	-.79
Agility	-.41	-.75
Eigenvalue	2.91	1.69
% Variance Explained	48.5%	27.9%

Note. Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalization. Only loadings ≥ |0.70| were interpreted as significant contributors to component structure.

Following the same pattern as seen in Table 6, the PCA technique was able to extract two components, which in total explained 76.4% of the variance in the change scores. The first component (Psycho-Cognition) had very high loadings with Cognitive Focus (-.81), Resilience (.79), and Perceived Stress (-.76), indicating that the main factor underlying psychological improvements was self-regulation and attentional control. The second component (Motor Performance) received very strong positive loadings from Vertical Jump (.83) but negative loadings from 20-m Sprint (-.79) and Agility (-.75), thus showing the gains in physical performance. The splitting up of these dimensions supports the idea that psychophysiological adaptations resulting from yoga intervention may manifest through distinct but synergistic ways.

Discussion

The current research work determined the impacts of a structured yoga intervention of eight weeks on cognitive, psychological, and functional performance of collegiate women basketball players. The findings indicated that the Group × Time interaction effects were significant for most of the outcome variables, thus confirming the fact that the experimental group showed greater progress compared to the control group. To be more precise, the cognitive focus, resilience, and stress reduction large gains were accompanied by the vertical jump and agility performance moderate-to-large improvements. The above-mentioned results support the idea that yoga training can develop psychophysiological and neuromuscular adaptations that are athlete readiness friendly, which is in line with earlier studies connecting yoga to the improved attentional control, mental resilience, and emotional regulation (Cramer et al., 2013; Gothe et al., 2013; Tang et al., 2015).

The notable increment in d_2 Total Performance scores points out the role of yoga in the areas of executive attention and cognitive efficiency. This increase corresponds with the reports that yoga increases the prefrontal cortex activity and the parasympathetic nervous system dominance, which lead to better concentration and the ability to perform tasks over an extended period (Cahn et al., 2017; Tang et al., 2015). Likewise, a combination of less perceived stress and more resilience scores could be interpreted as an indication of better self-regulation and emotional stability, which may be the results of neuroendocrine adaptations and a lowering of sympathetic arousal (Pascoe & Bauer, 2015; Streeter et al., 2012). As far as the link between the present findings and those relating to non-competitive female athletes is concerned, yoga's non-conditioning function in mental restoration and physiological conditioning is highlighted. In terms of functional performance, agility and vertical jump improvements are a result of better motor control, and flexibility and stability of the core, which are attributed to both static and dynamic yoga postures (Hagins et al., 2007). The change in performance profile, although slow trend toward improvement in sprint performance ($p = .057$), indicates that there has been a transfer effect in the area of movement efficiency. What is more, the ANCOVA results have shown that the aforementioned improvements continued to be statistically significant even after making the necessary adjustments for initial scores, a situation that would have biased the outcomes had there been some initial differences between the groups. Additionally, the very large effect sizes (Cohen's $d > 0.8$) across the cognitive and psychological domains highlight the practical importance of such findings in terms of their presence beyond the boundaries of statistical thresholds. The lasting significance after Benjamini-Hochberg FDR correction also confirms the strength of the observed effects.

Limitations

The limitations, however, still need to be recognized, even though the outcomes are quite promising. The relatively small sample size ($n = 30$) could be a limitation to the stability of multivariate analyses particularly the PCA results which can be adversely affected by the sample size if numerous factors are extracted. Uncontrolled external factors like academic workload, diet, and menstrual cycle phase, among others, may have had a say in the physiological and psychological responses as well. The intervention length was adequate to bring about changes; however, it did not allow for the capturing of long-term adaptations or seasonal fluctuations in performance. Thus, larger, gender-diverse samples and longitudinal designs should be employed in future studies to evaluate the effects' sustainability and ecological validity. The inclusion of complementary physiological markers such as HRV, cortisol, or neurocognitive indices would also enhance the understanding of yoga's mechanisms in sport-specific contexts.

All things considered, the results of this study are strong support in the form of empirical evidence that structured yoga

training brings about very substantial psychophysiological and functional benefits in female basketball players who take part in competitions. The outcome gives a green light to the incorporation of yoga as a training adjunct that is non-invasive and has a holistic approach to the enhancement of both mental resilience and performance readiness at the collegiate sport environments that are low-cost.

Conclusions

The current study gives strong proof that a well-structured yoga program can significantly improve competitive female basketball players' psychophysiological and functional performance. The intervention brought about great changes in mental focus, patience, and stress management, also causing large improvements in agility and vertical leap performance. The yoga practice in this study helped to build up mental and physical performance, which is why such an integrative conditioning approach can be used in sports. The results kept their statistical and practical significance even after the multiple comparisons correction, showing the reliability of the effects that were noticed. The study is limited to generalization of results only to comparable collegiate female populations; however, it very much affirms yoga's potential as a cheap, low-risk, and holistic method for optimizing athlete readiness. Further studies in this area should focus on males as well as females, different levels of competition, and seasonal conditions of gymnastic practice to evaluate if yoga can help in sustaining performance and the well-being of athletes across the board.

Appendix Table A1. Session-wise Compliance Rates for Experimental and Control Groups

Participant ID	Group	Sessions Attended (out of 24)	Attendance (%)
EG01	Experimental	23	95.8
EG02	Experimental	22	91.7
EG03	Experimental	24	100
EG04	Experimental	21	87.5
EG05	Experimental	22	91.7
EG06	Experimental	23	95.8
EG07	Experimental	23	95.8
EG08	Experimental	24	100
EG09	Experimental	22	91.7
EG10	Experimental	23	95.8
Group Mean ± SD	EG	22.1 ± 1.1	92 (87-100)
CG01	Control	24	100
CG02	Control	23	95.8
CG03	Control	22	91.7
CG04	Control	24	100
CG05	Control	23	95.8
CG06	Control	24	100
CG07	Control	23	95.8
CG08	Control	24	100
CG09	Control	22	91.7
CG10	Control	24	100
Group Mean ± SD	CG	23.3 ± 0.7	97 (90-100)

Note. EG = Experimental Group; CG = Control Group. Attendance = (Sessions Attended ÷ 24) × 100. Both groups demonstrated high adherence across the eight-week intervention

Appendix Table A2. Weekly Training Load Profiles for Experimental and Control Groups

Week	EG Mean Load (AU) ± SD	CG Mean Load (AU) ± SD
1	278 ± 35	265 ± 32
2	284 ± 30	267 ± 31
3	291 ± 33	270 ± 29
4	299 ± 36	271 ± 30
5	306 ± 37	273 ± 28
6	308 ± 41	274 ± 30
7	311 ± 39	275 ± 29
8	312 ± 40	273 ± 27

Note. Training load was computed using the session-RPE method (Foster et al., 2001): Load = RPE × Session Duration (minutes). AU = arbitrary units. The Experimental Group showed a progressive increase in weekly training load across the intervention period

Declaration on AI Use

No generative AI tools were used; QuillBot was employed only for paraphrasing and grammar refinement.

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Conflict of interest

The authors state that there is no potential conflict of interests.

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Вплив інтервенції зі структурованої йоги на когнітивну, психологічну та функціональну працездатність баскетболісток, які беруть участь у змаганнях: Двогрупове контрольоване експериментальне дослідження

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 9 с., 6 табл., 2 рис., 28 джерел.

Історія питання. Йога як цілісний метод тренування, що поєднує фізичний, психологічний та когнітивний розвиток, набуває чималої уваги, проте контрольованих доказів щодо ефективності її застосування у змагальних командних видах спорту серед жінок досі бракує.

Мета дослідження. Мета цього дослідження полягала в оцінці впливу восьмитижневої інтервенції зі структурованої йоги на когнітивну концентрацію, психологічну резилентність, сприйняття стресу та функціональну працездатність студенток-баскетболісток.

Матеріали та методи. Загалом тридцять спортсменів (віком 19-24 роки) було розподілено за методом рандомізації на експериментальну групу (йога + стандартні тренування) та контрольну групу (лише стандартні тренування). Когнітивні (тест уваги d_2), психологічні (CD-RISC-10 — шкала резильєнтності Коннора — Девідсона, PSS-10 — шкала сприйнятого стресу) та фізичні (вертикальний стрибок, спринт, спритність) показники оцінювалися на перед- та постінтервенційному етапах дослідження. Аналіз даних проведено за допомогою змішаного дисперсійного аналізу та підтверджуючого коваріаційного аналізу з базовими коваріатами. Розраховано розміри ефекту (d Коена, часткове η^2), а також довірчі інтервали з показником 95 %, p-значення скориговано відповідно до частоти помилкових виявлень (FDR) за методом Бенджаміні — Гоґберга.

Результати. Для когнітивної концентрації ($p < .001$), резилентності ($p = .004$), зниження стресу ($p = .002$) та спритності ($p = .011$) відзначено значущі взаємодії між групою та періодом часу. Коваріаційний аналіз підтвердив силу зазначених ефектів, навіть після контролю за відмінностями в базових показниках. Метод головних компонент виявив два латентні виміри, а саме психологічно-когнітивну та рухову працездатність, які разом становили понад 75 % дисперсії.

Висновки. Програма занять йогою значно покращила психофізіологічну готовність та функціональну ефективність порівняно зі стандартними тренуваннями. Отримані результати дозволяють припустити, що йога може слугувати інтегративним підходом для підвищення результативності спортсменів на етапі підготовки.

Ключові слова: інтервенція з йоги, спортсменки, когнітивна концентрація, психологічна резилентність, функціональна працездатність.

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