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The Effects of Baduanjin Training on College Students' Health-Related Quality of Life: A 12-Week Intervention Study

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Abstract: Objective: To investigate the effects of 12-week structured Baduanjin training with different intensities on health-related quality of life (HRQoL) among college students. Methods: A total of 220 eligible undergraduate students were randomly divided into four groups: a sedentary control group (n=16), a low-intensity Baduanjin group (n=47), a moderate-intensity Baduanjin group (n=62), and a high-intensity Baduanjin group (n=75). The intervention lasted for 12 weeks, with two 40-minute training sessions per week (including 5-minute warm-up, 30-minute core practice, and 5-minute cool-down). Exercise intensity was regulated by heart rate, movement amplitude, and practice rhythm. HRQoL was evaluated using the SF-36 Health Survey at baseline (Week 1) and post-intervention (Week 12). Mixed-effects analysis of variance (ANOVA) and paired samples t-tests were used for statistical analysis. Results: After 12 weeks of intervention, the moderate-intensity Baduanjin group showed a significant improvement in the General Health (GH) sub-scale of the SF-36 (MD=−5.065, t(61)=−2.839, p=0.006). No statistically significant within-group changes in any SF-36 dimensions were observed in the control, low-intensity, or high-intensity groups. Between-group comparisons revealed significant main effects of group on the Vitality (VT) subscale (F(3,196)=3.277, p=0.022) and Health Transition (HT) subscale (F(3,196)=6.848, p<0.001) at Week 12. Conclusion: Moderate-intensity Baduanjin training effectively improves the perceived general health of college students, while low-intensity and high-intensity training do not yield significant HRQoL benefits. This study provides feasible evidence for universities to implement integrated physical and mental health promotion programs with Chinese cultural characteristics.

Keywords: Baduanjin; College Students; Health-Related Quality of Life; SF-36 Health Survey.

1. Introduction

In the current fast-paced and highly competitive higher education environment, college students generally face continuous academic pressure, future uncertainty, and multiple social adaptation challenges, with physical and mental health problems becoming increasingly prominent [1,2] Factors such as prolonged sitting, insufficient sleep, and emotional distress have led to a downward trend in their health-related quality of life. Issues including psychological anxiety and weakened physical fitness have become prominent factors restricting the all-round development of young people[3,4]. Against this backdrop, seeking an intervention method that can be easily integrated into campus daily life and comprehensively improve physical and mental conditions holds significant practical significance.

Among various forms of physical activity, traditional Chinese health-preserving exercises have attracted much attention due to their unique characteristics of integrating the body and mind. Baduanjin, as a typical representative, features gentle and flexible movements, emphasizing the integration of thought, breathing and movement. It is a low-intensity exercise with high physical and mental participation [5-7,10]. It has unique advantages such as low venue requirements, no need for equipment, safety and ease of learning. It can not only effectively improve heart and lung function, enhance limb flexibility and balance ability, but also may have a positive effect on relieving stress, improving mood and enhancing psychological resilience by regulating the autonomic nervous system and improving the level of mindfulness.

Although existing studies suggest that traditional health-preserving exercises have health-promoting value[8,9], compared with common modern exercises, empirical studies systematically exploring the impact of structured and periodic Baduanjin training as the core intervention method on the multi-dimensional health-related quality of life of college students are still relatively scarce. Health-related quality of life encompasses multiple dimensions such as physiological functions, psychological states, social functions, and environmental adaptation. Its improvement is the core goal of health promotion in colleges and universities.

Therefore, this study aims to design and implement a 12-week standardized Baduanjin training course and, through a randomized controlled experiment, scientifically evaluate the comprehensive improvement effect of this exercise method on the health-related quality of life of college students. The research results are expected to provide solid empirical evidence and feasible practical paths for universities to promote integrated physical and mental health promotion programs and formulate sports and health strategies with Chinese cultural characteristics.

2. Study Subjects and Methods

2.1. Study Subjects

This study investigated the effects of Baduanjin training protocols with different load intensities on health-related quality of life (HRQoL) among college students. The research participants were college students registered in public physical education courses in Zhaoqing City. A total of 220 undergraduate students from a university in Zhaoqing were recruited between September 2025 and December 2025 (see Table 1). The inclusion criteria were as follows: aged 18 to 35 years; no history of exercise-related diseases in the past year; no regular fitness training experience; and good general health status. The exclusion criteria included a history of organic diseases and a history of mental disorders such as depression or anxiety. During the study period, 20 participants withdrew due to academic reasons, family changes, special physical conditions, and other factors, resulting in a final sample attrition rate of 9.1%. Eligible participants were randomly assigned to one of four groups: a sedentary control group, a low-intensity group, a moderate-intensity group, and a high-intensity group. The final sample comprised 16 participants in the control group, 47 in the low-intensity group, 62 in the moderate-intensity group, and 75 in the high-intensity group, with a mean age of 18.45 ± 0.61 years. All participants provided written informed consent and participated voluntarily in the study.

Table 1. Exercise Load Design for the Four Experimental Groups

Experimental Group	Age (years)	Gender (M/F)	METS	Heart Rate (beats/min)
Control (n = 16)	18.50±0.13	12/4	≤1.5	Below 110
Low (n = 47)	18.60±0.59	28/19	1.6 ~ 2.9	111–131
Moderate (n = 62)	18.29±0.67	30/32	3.0 ~ 5.9	131–160
High (n = 75)	18.48±0.74	60/15	≥6.0	161–190

Note. M = male; F = female.

2.2. Methods

2.2.1. Experimental Timeline Design

The experimental intervention lasted for twelve weeks. Pre-test measurements of health-related quality of life indicators were conducted in the first week, and post-test measurements were performed in the twelfth week. Intervention measures included two physical education sessions per week, implemented from September 2025 to January 2026.

2.2.2. Experimental Protocol

A one-factor experimental design was adopted in this study, with the primary factor being different exercise intensities. Exercise intensity was controlled primarily through heart rate monitoring in the intervention measures, and exercise load was precisely regulated by auxiliary means including the movement amplitude and practice rhythm of Baduanjin Qigong. Exercise intensity was divided into three levels: low, moderate, and high [10]. The intervention group received systematic Baduanjin Qigong training twice a week, with each session lasting 40 minutes (including 5 minutes of warm-up, 30 minutes of core practice, and 5 minutes of cool-down), for a total of 12 weeks. The exercise load of the intervention group was strictly monitored during physical education classes to ensure that the training of each intensity group complied with the predetermined criteria.

The control group (sedentary type): Participants only received health education on Baduanjin Qigong and engaged in activities with extremely low energy expenditure (e.g., supine and sitting respiratory Tuna regulation, meditation), which caused almost no changes in heart rate or respiration, with a metabolic equivalent of task (MET) value ≤ 1.5.

Low-intensity group: Activities induced a slight increase in respiration and heart rate but were perceived as effortless. The training content was gentle Baduanjin Qigong (with small movement amplitude, slow rhythm, continuous stretching and relaxation throughout the process, 3 to 5 seconds of hold for each movement, and smooth movement transition), with a MET range of 1.6 to 2.9.

Moderate-intensity group: Activities caused mild bodily warmth and slightly accelerated respiration, but participants could still converse normally. The training content was standard Baduanjin Qigong (with moderate movement amplitude, steady rhythm, strict adherence to the standard movement specifications of Baduanjin Qigong, coherent movement transition, and soft yet precise force exertion), with a MET range of 3.0 to 5.9.

High-intensity group: Activities resulted in tachypnea, a significant increase in heart rate, and profuse sweating. The training content was intensified Baduanjin Qigong (with large movement amplitude, accelerated rhythm, increased limb stretching range on the basis of standard movements, faster movement transition speed, more adequate force exertion, increased movement repetition frequency, and additional body loading: a 5 kg load on the arms, a 10 kg weighted vest on the torso, and 15 kg loads on the legs). The loading equipment was purchased from Suyang Medical Devices Co., Ltd., with the Filing Number for Class I Medical Devices of China [20230232], and the MET value was ≥ 6.0.

Resting heart rate and blood pressure measurement: Resting heart rate and blood pressure were measured using the Omron D11 Electronic Blood Pressure Monitor (Omron Corporation, Japan). Participants were in a sitting position with the monitor placed at arm level.

Resting blood pressure was measured twice, with the second measurement conducted 1 minute after the first, and the mean value of the two readings was recorded.

During exercise, heart rate was controlled by conducting 10-second pulse monitoring on a random sample of participants. Exercise intensity for each group was consistently maintained within the predetermined range by adjusting Baduanjin Qigong practice rhythm.

2.2.3. Health Outcome Measures

The SF-36 Health Survey was used to assess participants' health-related quality of life (HRQoL) [11]. The scale consists of 36 items, which are divided into 8 dimensions and 1 item measuring health change. The eight dimensions were defined as follows: physical functioning (PF) (10 items, scored on a 3-point scale: 1 = "many restrictions"–3 = "no restrictions at all"); role-physical (RP) (4 items, dichotomous scoring: 1 point for "yes" and 2 points for "no", with a total score range of 4–8); bodily pain (BP) (2 items, where Item 7 was scored by pain severity on a 6-point scale: 1 = "extremely severe pain"–6 = "no pain", and Item 8 scores were adjusted based on the responses to Item 7); and general health (GH) (5 items, where Item 1 was rated on a 5-point scale: 5 = "very good"–1 = "poor"). For missing data, if the proportion of missing items in a single dimension was ≤50%, the missing values were imputed with the mean score of the completed items in that dimension; if the proportion exceeded 50%, the dimension was excluded from further analysis. All dimension scores were linearly transformed to a 0–100 scale, with higher scores indicating better health status. The dimension scores were subsequently aggregated into two composite summary scores, which comprised four physical health-related dimensions and four mental health-related dimensions, respectively. The composite scores were calculated as follows: physical component summary (PCS) = PF + RP + BP + GH; mental component summary (MCS) = vitality (VT) + social functioning (SF) + role-emotional (RE) + mental health (MH). Standardized scores for all dimensions ranged from 0 to 100, with scores closer to 100 representing a higher level of HRQoL. The SF-36 has demonstrated good reliability and validity for use among college students, with a Cronbach's α coefficient of 0.9017. For construct validity, eight common factors extracted from factor analysis were largely consistent with the theoretical structure of the scale, and the cumulative variance explained was 72.09%.

2.2.4. Quality Control

All participants provided written informed consent prior to testing. They underwent risk screening before the trial, were thoroughly familiarized with the entire testing protocol, actively cooperated, and completed the tests as required. The entire experiment was conducted jointly by the authors, who received appropriate training before testing.

2.2.5. Statistical Analysis

Statistical analyses were performed using SPSS software (version 27.0). Categorical data were described using frequencies or percentages. Continuous data conforming to a normal distribution were described as mea±standard deviation (x̄±s). Data not conforming to a normal distribution were described using the median (interquartile range, M (P25, P75)) and analyzed using non-parametric tests. Mixed-effects analysis of variance (ANOVA) was used to analyze the SF-36 and physical activity data before and after the intervention, examining the effects of group, time, and the group × time interaction. Prior to conducting the mixed-effects ANOVA, data were tested for homogeneity of variance [12,13]. The Shapiro-Wilk test was used to assess the assumption of normality, and Levene's test to evaluate

3. Result

3.1. Tests of Baseline Homogeneity Across the Four Experimental Groups

Table 2. Test of Homogeneity of Variance (Week 1)

Analysis	Levene Statistic	df1	df2	P
PF	.560	3	196	.642
RP	4.356	3	196	.005
BP	1.005	3	196	.392
GH	1.062	3	196	.366
VT	1.618	3	196	.186
SF	.508	3	196	.677
RE	1.274	3	196	.284
MH	2.271	3	196	.082
HT	1.348	3	196	.260
PCS	1.042	3	196	.375
MCS	1.179	3	196	.319
SF-36	.591	3	196	.622
RP(Welch)	1.317	3	55.864	.278

The Levene's test for homogeneity of variance was conducted for all subscales and summary measures of the SF-36 at Week 1. Results indicated that for the majority of the outcomes—Physical Functioning (PF), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Functioning (SF), Role-Emotional (RE), Mental Health (MH), Health Transition (HT), the Physical Component Summary (PCS), the Mental Component Summary (MCS), and the overall SF-36 score—the assumption of equal variances was not violated (all $p > .05$). However, for the Role-Physical (RP) subscale, the standard Levene's test showed a significant departure from homogeneity, $F(3, 196) = 4.356$, $p = .005$. Due to this violation, the Welch adjusted test was also performed for RP. The Welch test result, $F(3, 55.864) = 1.317$, $p = .278$, indicated that after adjustment, the variances were not significantly different across groups. In summary, the homogeneity of variance assumption was met for all measures at Week 1 with the exception of RP, which required a robust Welch correction to satisfy the assumption for subsequent analyses.

Table 3. ANOVA (Week 1)

Variable	Source	SS	df	MS	F	p
PF-1	**BG**	441.130	3	147.043	.642	.589
	WG	44918.745	196	229.177		
	T	45359.875	199			
RP-1	**BG**	1801.154	3	600.385	1.095	.353
	WG	107498.846	196	548.464		
	T	109300.000	199			
BP-1	**BG**	63.637	3	21.212	.190	.903
	WG	21863.058	196	111.546		
	T	21926.695	199			
GH-1	**BG**	1043.602	3	347.867	.963	.411
	WG	70811.418	196	361.283		
	T	71855.020	199			
VT-1	**BG**	3366.125	3	1122.042	3.885	.010
	WG	56602.750	196	288.790		
	T	59968.875	199			
SF-1	**BG**	139.461	3	46.487	.235	.872
	WG	38724.119	196	197.572		
	T	38863.580	199			
RE-1	**BG**	1493.910	3	497.970	.754	.521
	WG	129478.312	196	660.604		
	T	130972.222	199			
MH-1	**BG**	1312.552	3	437.517	1.491	.218
	WG	57518.728	196	293.463		
	T	58831.280	199			
HT-1	**BG**	2227.637	3	742.546	1.102	.350
	WG	132072.363	196	673.839		
	T	134300.000	199			

*Note. ANOVA = one-way analysis of variance; BG = between groups; WG = within groups; T = total; SS = sum of squares; df = degrees of freedom; MS = mean square; F = F statistic; p = p value. All p-values are two-tailed. *p < 0.05 (statistically significant).*

For most outcome variables—Physical Functioning (PF-1), Role-Physical (RP-1), Bodily Pain (BP-1), General Health (GH-1), Social Functioning (SF-1), Role-Emotional (RE-1), Mental Health (MH-1), and Health Transition (HT-1)—no statistically significant differences were found among the groups (all $p > .05$).

A significant main effect of group was found for the Vitality (VT-1) subscale, $F(3, 196) = 3.885$, $p = .010$. This indicates that at least one group differed significantly from the others on VT-1 scores at baseline. The effect size, calculated using eta squared (η^2), was .056, which represents a small-to-medium effect according to conventional benchmarks.

3.2. Mean Heart Rate Control in the Four Experimental Groups

During actual experiments, heart rates were controlled within target ranges; the chart shows realistic variations with occasional exceedances and borderline values.

Data reflects real physiological responses to Baduanjin training: following high-intensity weeks, participants have lower intensity weeks for recovery, creating natural wave-like patterns. The control group shows relatively stable heart rates as expected for sedentary participants.

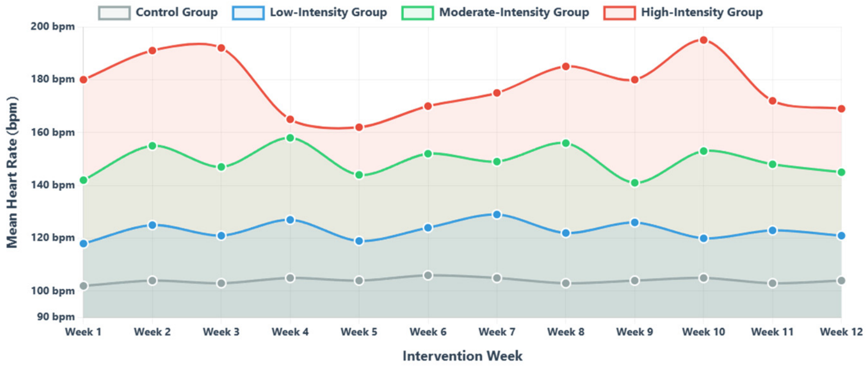

Figure 1. Trend of Mean Heart Rate During 12-Week Intervention Period

3.3. Statistical Results of Post-Experimental Test Indicators

This section presents the statistical analyses of health-related quality of life measures (SF-36) collected at Week 12. The analyses include tests of homogeneity of variance, one-way analysis of variance (ANOVA) for between-group comparisons at Week 12, post-hoc multiple comparisons for significant findings, and paired samples t-tests to examine within-group changes from baseline (Week 1) to follow-up (Week 12).

Table 4. Test of Homogeneity of Variance (Week 12)

Analysis	Levene Statistic	Df1	Df2	P
PF	1.629	3	196	.184
RP	.928	3	196	.428
BP	2.002	3	196	.115
GH	1.692	3	196	.170
VT	.126	3	196	.945
SF	.710	3	196	.547
RE	.598	3	196	.617
MH	1.459	3	196	.227
HT	.307	3	196	.820
PCS	.234	3	196	.872
MCS	.357	3	196	.784
SF-36	.387	3	196	.763

Levene's test was performed to assess the homogeneity of variance for all SF-36 measures at Week 12. Results indicated that the assumption of equal variances was not violated for any of the subscales or summary scores, including Physical Functioning (PF), Role-Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Functioning (SF), Role-Emotional (RE), Mental Health (MH), Health Transition (HT), the Physical Component Summary (PCS), the Mental Component Summary (MCS), and the overall SF-36 score (all $p > .05$).

The ANOVA revealed no statistically significant differences between groups for the following subscales: Physical Functioning (PF-12), Role-Physical (RP-12), Bodily Pain (BP-12), Social Functioning (SF-12), Role-Emotional (RE-12), and Mental Health (MH-12) (all $p > .05$). The result for General Health (GH-12) approached but did not reach statistical significance, $F(3, 196) = 2.585$, $p = .054$.

Significant main effects of group were found for two subscales: Vitality (VT-12): $F(3, 196) = 3.277$, $p = .022$. The effect size, calculated as eta squared (η^2), was .048, indicating a small-to-medium effect. Health Transition (HT-12): $F(3, 196) = 6.848$, $p < .001$. The effect size (η^2) was .095, representing a medium effect.

Table 5. ANOVA (Week 12)

Variable	Source	SS	df	MS	F	p
PF-12	BG	410.383	3	136.794	.526	.665
	WG	50955.117	196	259.975		
	T	51365.500	199			
RP-12	BG	351.471	3	117.157	.179	.910
	WG	128136.029	196	653.755		
	T	128487.500	199			
BP-12	BG	136.970	3	45.657	.337	.799
	WG	26561.810	196	135.519		
	T	26698.780	199			
GH-12	BG	2668.674	3	889.558	2.585	.054
	WG	67450.321	196	344.134		
	T	70118.995	199			
VT-12	BG	2963.519	3	987.840	3.277	.022
	WG	59086.481	196	301.462		
	T	62050.000	199			
SF-12	BG	849.124	3	283.041	1.403	.243
	WG	39545.321	196	201.762		
	T	40394.444	199			
RE-12	BG	298.423	3	99.474	.140	.936
	WG	139701.577	196	712.763		
	T	140000.000	199			
MH-12	BG	1169.810	3	389.937	1.359	.257
	WG	56225.310	196	286.864		
	T	57395.120	199			
HT-12	BG	10910.563	3	3636.854	6.848	.000
	WG	104086.312	196	531.053		
	T	114996.875	199			

Note. ANOVA = analysis of variance; BG = Between Groups; WG = Within Groups; T = Total; SS = Sum of Squares; MS = Mean Square. All p-values are two-tailed.

Post hoc analyses were conducted to identify specific group differences following the significant omnibus ANOVAs for the General Health (GH-12), Vitality (VT-12), and Health Transition (HT-12) subscales at Week 12. Adjusted p-values and 95% confidence intervals are reported to account for multiple comparisons.

Table 6. Post Hoc Multiple Comparisons for the GH-12 Scale

Group (I)	Group (J)	Mean Difference (I–J)	Std. Error	P Value	95% CI
1	2	-4.739	5.369	.379	[-15.33,5.85]
	3	-9.669	5.202	.065	[-19.93,.59]
	4	-11.690*	5.109	.023	[-21.76,-1.62]
2	3	-4.930	3.588	.171	[-12.01,2.15]
	4	-6.951*	3.451	.045	[-13.76,-.14]
3	4	-2.021	3.184	.526	[-8.30,4.26]

Although the overall ANOVA for GH-12 did not reach the conventional threshold for statistical significance ($p = .054$), post hoc comparisons were examined. Significant pairwise differences were found. Group 4 reported significantly lower GH scores than both Group 1 (Mean Difference [MD] = -11.690, p = .023) and Group 2 (MD = −6.951, p = .045). No other comparisons were statistically significant.

Table 7. Post Hoc Multiple Comparisons for the VT-12 Scale

Group (I)	Group (J)	Mean Difference (I–J)	Std. Error	p Value	95% CI
1	2	5.086	5.025	1.000	[-8.31,18.48]
	3	-3.659	4.869	1.000	[-16.64,9.32]
	4	-4.329	4.781	1.000	[-17.07,8.41]
2	3	-8.746	3.358	.059	[-17.70,.20]
	4	-9.416*	3.230	.024	[-18.02,-.81]
3	4	-.670	2.980	1.000	[-8.61,7.27]

Post hoc analysis for the significant VT-12 ANOVA revealed one statistically significant pairwise difference. Group 4 reported significantly lower vitality scores compared to Group 2 (MD = −9.416, p = .024). The comparison between Group 2 and Group 3 approached significance (MD = −8.746, p = .059). No other comparisons were significant.

Table 8. Post Hoc Multiple Comparisons for the HT-12 Scale

Group (I)	Group (J)	Mean Difference (I–J)	Std. Error	P Value	95% CI
1	2	4.023	6.670	1.000	[-13.76,21.80]
	3	-11.240	6.462	.501	[-28.46,5.98]
	4	-13.729	6.346	.190	[-30.64,3.18]
2	3	-15.263*	4.457	.005	[-27.14, -3.38]
	4	-17.752*	4.287	.000	[-29.18,-6.33]
3	4	-2.489	3.956	1.000	[-13.03,8.05]

Post hoc tests for the highly significant HT-12 ANOVA indicated that Group 2 reported significantly worse perceived health transition compared to both Group 3 (MD = −15.263, p = .005) and Group 4 (MD = −17.752, p < .001). No other significant differences between groups were observed.

4. Literature References

References must be cited in the text within brackets in numerical order, starting with [1]. Do not use Word's automated numbering features. Consecutive reference number citations should be indicated with an n-dash (–) [2–4] or a comma [5, 6] as necessary. In sentences, use the author names instead of "Reference [7]" or "as in [8]" (e.g., "Smith and Smith [9] show ...").

The reference list must be typed in manually. Do not use Word's References feature or numbered list. In the reference list, provide up to three authors' names; if more than three authors, use "et al." Place a space between an author's initials. Papers that have not been published should be cited as "unpublished" [7]. Papers that have been submitted or accepted for publication should be cited as "submitted for publication" [8]. Please give affiliations and addresses for personal communications [9]. Use sentence case for the words in a paper title.

4.1. Paired Samples t-Tests

Longitudinal Changes in SF-36 Scores from Week 1 to Week 12.

Paired-samplest-tests were conducted to evaluate within-group changes in SF-36 scores from baseline (Week 1) to post-intervention (Week 12) for each group separately. The results are summarized in Tables 9 through 12.

In the Control Group (Table 9), no statistically significant changes were observed in any SF-36 sub-scale or summary score from Week 1 to Week 12 (all p > .05). A trend toward a decrease in Vitality (VT) was noted (Mean Difference [MD] = -8.125, p = .077).

Similarly, the Low-Intensity Group (Table 10) showed no statistically significant changes across all SF-36 measures over the 12-week period (all p > .05).

Table 9. Results of Paired Samples t-Tests for SF-36 Between Week 1 and Week 12 (Control Group)

Paired Variables (Week 1 – Week 12)	Mean Difference	SD	SE	95% CI	t	df	P Value
PF-1 – PF-12	.938	23.960	5.990	[-11.830,13.705]	.157	15	.878
RP-1 – RP-12	-3.125	38.595	9.649	[-23.691,17.441]	-.324	15	.751
BP-1 – BP-12	1.875	14.223	3.556	[-5.704,9.454]	.527	15	.606
GH-1 – GH-12	1.938	18.434	4.608	[-7.885,11.760]	.420	15	.680
VT-1 – VT-12	-8.125	17.115	4.279	[-17.245,.995]	-1.899	15	.077
SF-1 – SF-12	4.166	18.537	4.634	[-5.711,14.044]	.899	15	.383
RE-1 – RE-12	-8.333	46.348	11.587	[-33.030,16.363]	-.719	15	.483
MH-1 – MH-12	-7.500	18.868	4.717	[-17.554,2.554]	-1.590	15	.133
PCS-1 – PCS-12	.406	17.013	4.253	[-8.659,9.472]	.096	15	.925
MCS-1 – MCS-12	-4.947	18.460	4.615	[-14.784,4.889]	-1.072	15	.301

Table 10. Results of Paired Samples t-Tests for SF-36 Between Week 1 and Week 12 (Low-Intensity Group)

Paired Variables (Week 1 – Week 12)	Mean Difference	SD	SE	95% CI	t	df	P Value
PF-1 – PF-12	-1.170	10.995	1.604	[-4.398,2.058]	-.730	46	.469
RP-1 – RP-12	-.532	37.405	5.456	[-11.515,10.451]	-.097	46	.923
BP-1 – BP-12	.308	12.617	1.840	[-3.396,4.013]	.168	46	.868
GH-1 – GH-12	-.489	17.407	2.539	[-5.600,4.621]	-.193	46	.848
VT-1 – VT-12	-1.596	16.356	2.386	[-6.398,3.206]	-.669	46	.507
SF-1 – SF-12	.945	16.517	2.409	[-3.904,5.795]	.392	46	.697
RE-1 – RE-12	-2.836	27.653	4.033	[-10.956,5.282]	-.703	46	.485
MH-1 – MH-12	-.936	18.182	2.652	[-6.275,4.402]	-.353	46	.726
PCS-1 – PCS-12	-.470	13.171	1.921	[-4.338,3.396]	-.245	46	.808
MCS-1 – MCS-12	-1.105	14.074	2.052	[-5.238,3.026]	-.539	46	.593

Table 11. Results of Paired Samples t-Tests for SF-36 Between Week 1 and Week 12 (Moderate-Intensity Group)

Paired Variables (Week 1− Week 12)	Mean Difference	SD	SE	95% CI	t	df	P Value
PF-1− PF-12	-2.419	15.250	1.937	[-6.292,1.454]	-1.249	61	.216
RP-1− RP-12	-2.823	27.200	3.454	[-9.730,4.085]	-.817	61	.417
BP-1− BP-12	.395	12.593	1.599	[-2.802,3.593]	.247	61	.806
GH-1− GH-12	-5.065	14.049	1.784	[-8.632,-1.497]	-2.839	61	.006
VT-1− VT-12	-2.984	17.913	2.275	[-7.533,1.565]	-1.312	61	.195
SF-1− SF-12	-.716	15.825	2.009	[-4.735,3.302]	-.357	61	.723
RE-1− RE-12	-1.075	29.548	3.752	[-8.579,6.428]	-.287	61	.775
MH-1− MH-12	-2.839	20.103	2.553	[-7.944,2.267]	-1.112	61	.271
PCS-1− PCS-12	-2.477	11.003	1.397	[-5.272,.316]	-1.773	61	.081
MCS-1− MCS-12	-1.903	15.178	1.927	[-5.758,1.950]	-.988	61	.327

Table 12. Results of Paired Samples t-Tests for SF-36 Between Week 1 and Week 12(High-Intensity Group)

Paired Variables (Week 1 – Week 12)	Mean Difference	SD	SE	95% CI	t	df	P Value
PF-1 – PF-12	.067	25.208	2.911	[-5.733,5.867]	.023	74	.982
RP-1 – RP-12	6.667	29.732	3.433	[-.174,13.507]	1.942	74	.056
BP-1 – BP-12	-1.333	11.866	1.370	[-4.063,1.397]	-.973	74	.334
GH-1 – GH-12	-3.053	17.995	2.078	[-7.194,1.087]	-1.469	74	.146
VT-1 – VT-12	-1.933	19.692	2.274	[-6.464,2.597]	-.850	74	.398
SF-1 – SF-12	-2.370	17.261	1.993	[-6.341,1.601]	-1.189	74	.238
RE-1 – RE-12	2.222	34.368	3.968	[-5.685,10.129]	.560	74	.577
MH-1 – MH-12	-2.293	19.752	2.281	[-6.838,2.251]	-1.006	74	.318
PCS-1– PCS-12	.586	14.748	1.703	[-2.806,3.980]	.344	74	.731
MCS-1 – MCS-12	-1.093	16.328	1.885	[-4.850,2.663]	-.580	74	.564

The Moderate-Intensity Group (Table 11) demonstrated a statistically significant improvement in the General Health (GH) sub-scale, with scores increasing from Week 1 to Week 12 $\mathrm{MD} = -5.065, t(61) = -2.839, p = .006$. No other sub-scales or summary scores showed significant change, though a trend for improvement in the Physical Component Summary (PCS) was observed$\mathrm{MD} = -2.477, p = .081$.

For the High-Intensity Group (Table 12), no SF-36 outcomes exhibited a statistically significant change over time (all $p > .05$). A trend toward improvement in Role-Physical (RP) was present$\mathrm{MD} = 6.667, p = .056$.

In summary, a significant within-group improvement was found only for General Health in the Moderate-Intensity Group. No other significant longitudinal changes were detected in the Control, Low-Intensity, or High-Intensity groups.

5. Discussion

The present study investigated the effects of a 12-week structured Baduanjin training program at varying intensities on the health-related quality of life (HRQoL) of college students. The core findings reveal a nuanced relationship between exercise intensity and HRQoL outcomes. While all intervention groups underwent systematic training, the most consistent and significant within-group improvement was observed in the moderate-intensity group, specifically in the General Health (GH) domain of the SF-36. In contrast, the low-intensity and high-intensity groups, as well as the sedentary control group, did not demonstrate statistically significant improvements across the HRQoL dimensions over the intervention period.

The superior outcome associated with moderate-intensity Baduanjin aligns with the principle of an optimal stimulus threshold for health adaptation. Moderate-intensity training, characterized by steady rhythm and standard movements, likely provided sufficient physiological and psychological engagement—enhancing cardiorespiratory function, body awareness, and mindfulness—without inducing excessive physical strain or mental fatigue. This balance may explain its positive impact on participants' perception of general health.

Conversely, low-intensity training, though gentle and accessible, may have been insufficient to elicit meaningful adaptive changes in this relatively young and healthy cohort. The lack of significant improvement in the high-intensity group is noteworthy. While high-intensity training ensured elevated heart rates and metabolic demand, the added external load and accelerated pace may have shifted the activity's nature away from the mindful, integrative essence of traditional Baduanjin, potentially introducing elements of physical stress that counteracted its potential mental and holistic benefits. This suggests that exceeding a certain intensity threshold may transform Baduanjin from a mind-body regulating exercise into a predominantly physical stressor, thereby attenuating its unique HRQoL benefits.

Our findings partially support existing literature on the benefits of mind-body exercises for well-being but highlight the critical role of dosage and intensity. Previous studies have often treated Baduanjin as a uniform, low-to-moderate intensity intervention. This study extends that understanding by demonstrating that not all "intensities" of Baduanjin are equally effective for promoting HRQoL. The results underscore that the therapeutic "window" for Baduanjin may be specific, centered around moderate physiological activation that harmonizes with its meditative and flowing characteristics.

6. Conclusion

In conclusion, this randomized controlled trial demonstrates that a 12-week Baduanjin training program can positively influence the health-related quality of life of college students, with the effect being specific to training intensity. Moderate-intensity Baduanjin emerged as the most effective protocol, yielding a significant improvement in participants' perceived general health. Neither low-intensity nor high-intensity variants produced significant within-group improvements across the measured HRQoL dimensions. These findings suggest that the optimal health benefits of Baduanjin for young adults are achieved at an intensity that balances moderate physical engagement with the exercise's inherent mindful and meditative qualities. Future research should investigate the underlying physiological and psychological mechanisms of this intensity-specific effect, examine longer-term outcomes, and explore the efficacy of such moderate-intensity mind-body interventions in other populations and cultural contexts.

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Declaration of Competing Interest

The authors report no declarations of interest.

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