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How new intervention "CSSSD" Shows Effects as against conventional methods On Selected Physiological Parameters, Psychosocial Aspects and Academic Stress in Adolescents At Risk of Metabolic Syndrome?

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Abstract

Metabolic Syndrome has emerged as a major early indicator of future non-communicable diseases among children and adolescents. Global evidence from the World Health Organization suggests that prolonged sedentary habits in young populations are linked to excess body fat, reduced cardiometabolic fitness, behavioral difficulties, and compromised sleep patterns. Recognizing the growing health risks in school-aged children, the present pilot study evaluated the effectiveness of a combined lifestyle-based approach, Cycling, Surya Namaskar, and habitual lifestyle modification referred to as the CSSSD intervention. This randomized controlled pilot study was carried out in selected schools in Wardha, Maharashtra. Twenty-four adolescents who met the inclusion criteria for elevated BMI (overweight: 23.0–24.9 kg/m²; obesity: ≥25 kg/m²) were enrolled and randomly assigned to an intervention group (n=12) and a control group (n=12), with equal representation of boys and girls. Physiological parameters, including height, weight, BMI, waist circumference, blood pressure, and fasting blood glucose, were assessed at baseline, at 6 weeks, and after 3 months. Psychosocial status was evaluated using the Pediatric Symptom Checklist, Youth Report (Y-PSC), while academic stress was measured using the Students' Academic Stress Scale (SASS). The intervention group practiced Surya Namaskar and Cycling along with structured behaviour modification related to diet, sleep routines, and screen exposure. The control group engaged in Cycling and habit modification only, for 50–60 minutes per session, at least five days weekly over three months. Data were analyzed using descriptive and inferential statistics, with ANOVA and Chi-square tests (α=0.05). While BMI and waist circumference did not show statistically significant changes, clinically meaningful reductions were observed in both measures. Psychosocial outcomes improved significantly (Y-PSC $p=0.035$), and academic stress declined markedly (SASS $p<0.01$). Blood pressure and glucose levels remained within normal ranges. Overall, the CSSSD approach demonstrated promising benefits for psychosocial wellbeing and academic stress, with clinically relevant improvements in anthropometric measures. This low-cost, easily adoptable combination of activities offers a feasible lifestyle strategy for adolescents at risk of metabolic syndrome.

Keywords: Surya Namaskar, Cycling, Lifestyle Modification, Adolescents, Metabolic Risk, Psychosocial Health, Academic Stress

Introduction

Prevalence of metabolic syndrome and obesity rates are increasing collaterally in children and adolescents (Ogden et al., 2016) According to World Health Organization (WHO) In children and adolescents, higher amounts of sedentary behaviour are associated with the following poor health outcomes: increased adiposity; poorer cardiometabolic health, fitness, behavioural conduct/pro-social behaviour; and reduced sleep duration (WHO, 2020). WHO stated more than 1 billion people worldwide are obese – 650 million adults, 340 million adolescents and 39 million children (aged 5-19 yrs.). WHO estimates that by 2025, approximately 167 million people – adults and children – will become less healthy due to this. With 14.4 million obese children, India has the second-highest number of obese children in the world, next to china (WHO, 2020). The prevalence of overweight and obesity in children in India is 15% (Kassi et al., 2011).

Obesity results from interactions between genetic and environmental factors (Flegal et al., 2012; Kohut et al., 2019; Yang et al., 2020). Effect of activities inside and outside of school are interrelated to reduced activity which might be adding in pediatric obesity in school going children (Garver, 2011; Von Hippel et al., 2007; Smith et al., 2009). Hippel et al. (2007) Concluded that non-school environments are supporting factors which results in extreme increasing of weight in childhood (Smith et al., 2009). As per a study conducted by rashmi et al out of 545 (28.2%) children who were overweight or obese the overall prevalence of metabolic syndrome (ms) in these children was 21.8% (Mangaraj et al., 2021). The International Diabetic Federation task force given metabolic syndrome criteria for children and adolescents in 2007. Criteria of International Diabetes Federation for at-risk group and the metabolic syndrome in children and adolescents (2007) (Zimmet et al., 2007).

The criteria summarized in Table 1 outline age-appropriate thresholds used to identify key components of metabolic syndrome, recognizing the physiological differences that exist across childhood, adolescence, and adulthood. For children aged 6 to <10 years, the emphasis is placed primarily on abdominal obesity, defined as a waist circumference at or above the 90th percentile for age and sex. At this stage, other metabolic parameters are monitored cautiously, reflecting the evolving metabolic profile during early childhood (Table 1).

In the 10 to <16 years age group, the diagnostic framework becomes more comprehensive. Central obesity remains a core criterion, identified by a waist circumference ≥90th percentile or the adult cut-off, whichever is lower. Additional metabolic abnormalities are clearly defined, including elevated triglycerides (≥150 mg/dl), low HDL-cholesterol (<40 mg/dl), raised blood pressure (systolic ≥130 mmHg or diastolic ≥85 mmHg), and impaired fasting plasma glucose (≥100 mg/dl) or known type 2 diabetes mellitus. These thresholds help capture early cardiometabolic risk during adolescence, a critical period for prevention (Table 1).

For individuals aged 16 years and above, adult diagnostic criteria are applied with ethnicity-specific adjustments. Abdominal obesity is defined using Asian-specific waist circumference cut-offs (≥90 cm in males and ≥80 cm in females). Lipid abnormalities, hypertension, and dysglycemia follow standard adult thresholds, including treatment status for previously diagnosed conditions. The inclusion of treatment criteria acknowledges ongoing clinical management rather than relying solely on measured values (Table 1).

Table 1. Age-specific diagnostic thresholds for components of metabolic syndrome in children, adolescents, and adults.

Age group (yr)	Obesity (WC)	Triglycerides	Hdl-c	Blood pressure	Plasma glucose
6–<10*	≥90th percentile				

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10–<16	≥90th percentile or adult cut-off if lower	≥1.7 mmol/l (≥150 mg/dl)	<1.03mmol/l (<40 mg/dl)	Systolic BP ≥130 or diastolic BP ≥85 mmhg	FPG ≥100 mg/dl or known T2DM
16+ (adult criteria)	Wc ≥90 cm for Asian males and ≥80 cm for Asian females, with ethnic-specific values for other groups†)	≥1.7 mmol/l (≥150 mg/dl) or specific treatment for high Triglycerides	<1.03mmol/l (<40 mg/dl) in males and <1.29mmol/l (<50 mg/dl) in females, or specific treatment for low HDL	Systolic BP ≥130 or diastolic BP ≥85 mmhg or treatment of previously diagnosed hypertension	FPG ≥100 mg/dl or known T2DM

Defining criteria will be Central obesity plus at least 2 out of 4 criteria Adolescents with metabolic syndrome often exhibit reduced cognitive abilities, including decreased math skills, poor spelling, inattention, and emotional instability. Furthermore, excessive body weight is linked to lower academic achievement, as reflected in lower grades. This population also tends to experience more school-related problems, absenteeism, and poor attendance, affecting both adolescents (12-17 years) and children (6-11 years) (Von Hippel et al., 2007).

Research shows that metabolic syndrome increases the risk of developing type 2 diabetes by five times and doubles the likelihood of cardiovascular disease (Smith et al., 2009). To prevent obesity and metabolic syndrome, the first step is to adopt lifestyle changes and achieve weight loss. Effective management of metabolic syndrome requires proactive treatment of cardiac risk factors.

Aim of the study

This study is aimed to assess how CSSSD shows effects as against conventional methods on selected physiological parameters, Pychosocial aspects and academic stress in adolescents with risk of metabolic syndrome.

Materials and Methods

The pilot study was conducted in selected schools of Wardha (Maharashtra). Interventional analytical approach was used with a Randomized Control Trial Research design. 24 adolescents i.e. 12 interventional & 12 control (6 girls & 6 boys each) were selected after screening who were having BMI with overweight (23.0 –24.9 kg/m^2) and obese (≥25 kg/m^2). As obesity is the essential component of Metabolic Syndrome risk criteria.

Data collection was done with assessment of Physiological parameters; Height (as metres), Body weight (as kg), BMI,Waist circumference, Blood Pressure (BP), fasting Blood glucose assessed initially and at the end of 3 month. Assessment of Psychosocial aspects done initially, at 1.5 month & at the end of 3 months with Pediatric symptom checklist youth report (y-psc), academic stress was assessed with Students' academic stress scale (SASS). Study participants included Experimental & control group. Intervention comprised of CSSSD which includes Bicycle riding, Surya Namaskaar, sleeping & screening time management, Dietary management whereas conventional measures comprised of Bicycle riding, sleeping & screening time management, Dietary management. Experimental group was intervening with CSSSD whereas Control Group was provided with conventional measures. Bicycle riding 30 min. moderate to vigorous intensity @ 8-10 mph. Surya

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Namaskaar 20 times (approximately 30 minutes) which will Start with 5 times then gradually to 20 times by 4th day which was guided by Physical training teacher and investigator. Habit modification composed of Diet modification which includes home based food only. Outside food allowed only once in a week in small amount. Sleeping time Approximately 8-9 hrs per day and Screening time less than 2 hours in a day was kept. The intervention Duration was 50-60 minutes per session at least 5 days per week for 3 months.

Statistical Analysis

The assessment of various parameters across different timelines and treatment groups. Control group having 12 samples and experimental group with 12 samples. The variables include Body Mass Index, Waist Circumference, Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Blood Glucose levels. These variables were measured at three different time points: baseline, 1st assessment, and 2nd assessment. Each time point has data for both a control group and an experimental group.

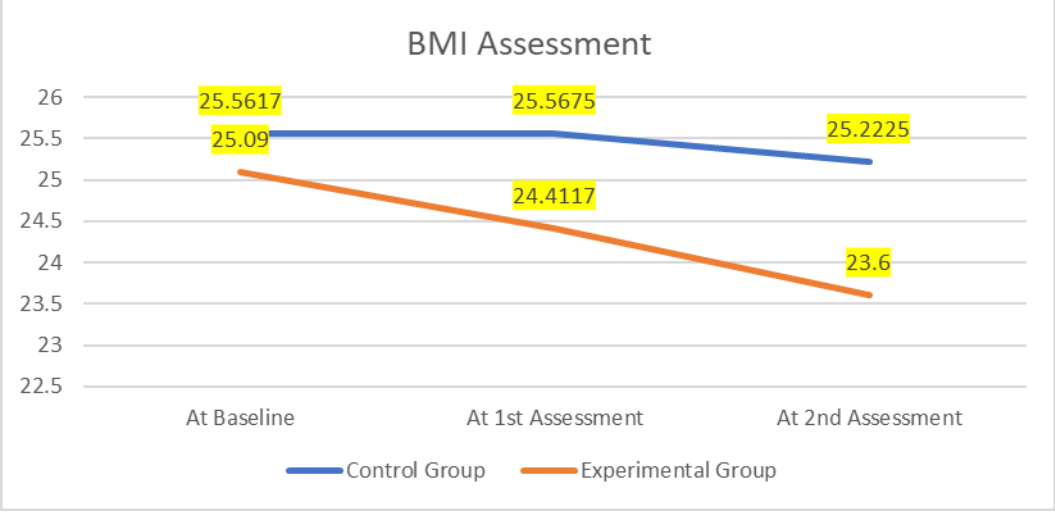
At baseline, BMI was similar between groups with no significant difference ($p = 0.636$), indicating group comparability. By the 1st assessment, the experimental group showed a modest BMI decrease, while the control group remained stable ($p = 0.241$). At the 2nd assessment, the experimental group's BMI dropped further, with a near-significant difference ($p = 0.095$).

The pattern presented in Figure 1 highlights notable differences in BMI trajectories between the control and experimental groups across the three assessment points. At baseline, the mean BMI values were comparable for both groups, confirming homogeneity prior to intervention. Over time, the experimental group exhibited a steady decline in BMI from baseline to the first assessment and further to the second assessment, whereas the control group showed only a minimal reduction. Statistical analysis indicated that the change in BMI between groups did not reach statistical significance ($p > 0.05$). However, the magnitude and consistency of reduction observed in the experimental group reflect clinically meaningful improvement.

Specifically, the experimental group demonstrated a greater absolute decrease in BMI compared to the control group, suggesting a beneficial effect of the combined intervention despite the limited sample size. The lack of statistical significance can be attributed to the pilot nature of the study and small group numbers, which may have reduced statistical power. Nevertheless, the downward trend in BMI in the experimental group contrasts clearly with the relatively stable pattern in the control group, reinforcing the practical relevance of the intervention.

Overall, the findings illustrated in Figure 1 suggest that while BMI changes were not statistically significant, the intervention produced favorable clinical outcomes, supporting its potential role in managing weight-related risk among adolescents.

Figure 1. Graphical representation of comparative evaluation of BMI assessment Control Group Vs Experimental Group.



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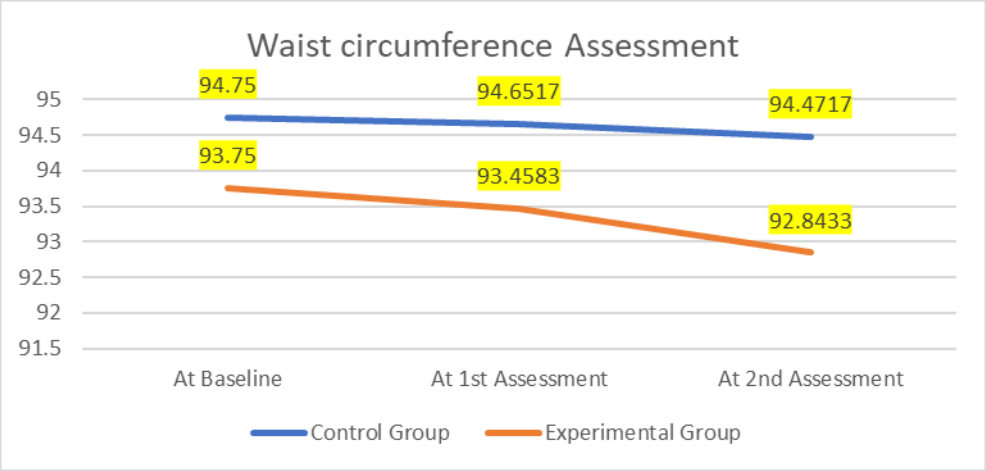
The pattern shown in Figure 2 highlights measurable changes in waist circumference for both groups across the assessment periods. At baseline, the mean waist circumference was 94.75 cm in the control group and 93.75 cm in the experimental group, indicating comparable central adiposity at the start of the study. By the first assessment, a slight reduction was observed in both groups, with values decreasing to 94.65 cm in the control group and 93.46 cm in the experimental group. At the second assessment, the control group showed a marginal decline to 94.47 cm, whereas the experimental group demonstrated a more substantial reduction to 92.84 cm (Figure 2).

Statistical analysis revealed that the difference in waist circumference changes between the two groups was not statistically significant ($p > 0.05$). However, the experimental group exhibited a greater absolute reduction of approximately 0.91 cm, compared to a reduction of about 0.28 cm in the control group. This consistent downward trend suggests a clinically relevant improvement in central adiposity among adolescents receiving the combined intervention.

Overall, the findings presented in Figure 2 indicate that although statistical significance was not achieved—likely due to the pilot sample size the intervention was effective in producing meaningful reductions in waist circumference, underscoring its potential role in mitigating metabolic risk in adolescents.

Figure 2. Graphical representation of comparative evaluation of Waist circumference assessment Control Group Vs Experimental Group.



The trends illustrated in Figure 3 present changes in systolic blood pressure (SBP) for both the control and experimental groups across the three assessment points. At baseline, the control group recorded a higher mean SBP of 108.5 mmHg, whereas the experimental group showed a lower baseline value of 103.7 mmHg, indicating initial variation between groups. At the first assessment, SBP in the control group declined noticeably to 104.0 mmHg, while the experimental group exhibited a modest increase to 105.8 mmHg. By the second assessment, SBP values in both groups converged, measuring 105.0 mmHg in the control group and 104.8 mmHg in the experimental group (Figure 3). Inferential statistical analysis indicated that the changes in SBP across time and between groups were not statistically significant ($p > 0.05$). Despite this, all recorded values remained within the normal physiological range for adolescents throughout the study period. The initial reduction observed in the control group and the stabilization seen in the experimental group suggest that both interventions contributed to maintaining healthy blood pressure levels. Overall, the findings shown in Figure 3 indicate that while no statistically significant differences were detected, the intervention helped sustain normal SBP values, reflecting a favorable cardiovascular profile and supporting the role of regular physical activity and lifestyle modification in adolescent health management.

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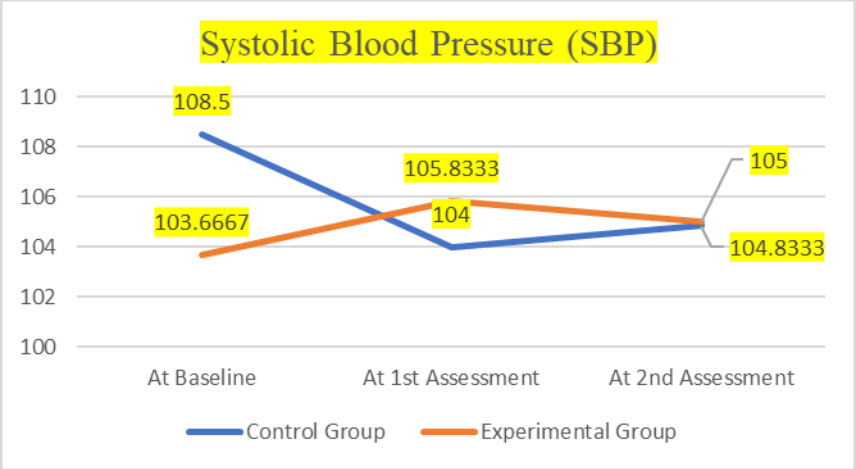
Figure 3. Graphical representation of comparative evaluation of systolic blood pressure (SBP)Control Group Vs Experimental Group.



The pattern displayed in Figure 4 illustrates the variation in diastolic blood pressure (DBP) across the three assessment periods for both study groups. At baseline, the mean DBP in the control group was 72.5 mmHg, while the experimental group recorded a slightly lower value of 71.4 mmHg, indicating comparable cardiovascular status at the outset. During the first assessment, DBP in the control group decreased to 71.5 mmHg, whereas the experimental group showed a temporary rise to 72.9 mmHg. By the second assessment, DBP values in both groups declined, reaching 71.4 mmHg in the control group and 72.2 mmHg in the experimental group (Figure 4). Statistical testing demonstrated that the observed changes in DBP between the groups and across time points were not statistically significant ($p > 0.05$). Importantly, all DBP values remained within the normal physiological range for adolescents throughout the intervention period. The slight fluctuations noted in the experimental group may reflect short-term physiological adaptation to increased physical activity rather than adverse effects.

Overall, the findings presented in Figure 4 suggest that the intervention had a stabilizing influence on diastolic blood pressure. Although no statistically significant differences were detected, the maintenance of normal DBP levels supports the cardiovascular safety and potential protective benefit of the implemented lifestyle-based intervention.

The trend illustrated in Figure 5 depicts changes in fasting blood glucose levels for both the control and experimental groups across the three assessment points. At baseline, the mean blood glucose level in the control group was 101.33 mg/dl, while the experimental group recorded a slightly lower value of 100.50 mg/dl, indicating comparable glycemic status at the start of the study. At the first assessment, glucose levels in the control group declined to 99.83 mg/dl, whereas the experimental group showed a marginal increase to 101.17 mg/dl. By the second assessment, a notable reduction was observed in the control group, with levels decreasing further to 96.92 mg/dl, while the experimental group demonstrated a stable reading of 100.92 mg/dl (Figure 5).

Statistical analysis revealed that the changes in blood glucose levels between the groups and over time were not statistically significant ($p > 0.05$). Despite this, all measured values remained within the normal fasting range throughout the intervention period, suggesting effective metabolic regulation in both groups. The greater reduction observed in the control group may be attributed to physiological adaptation to regular physical activity, while the stability noted in the experimental group reflects maintained glycemic control. Overall, the findings presented in Figure 5 indicate that the intervention did not adversely affect glucose metabolism. Although statistical significance was not achieved, the maintenance of normal blood glucose levels supports the metabolic safety of the intervention and highlights its potential role in preventing early glycemic dysregulation among adolescents at risk of metabolic syndrome.

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Figure 4. Graphical representation of comparative evaluation of diastolic blood pressure (SBP) Control Group Vs Experimental Group.

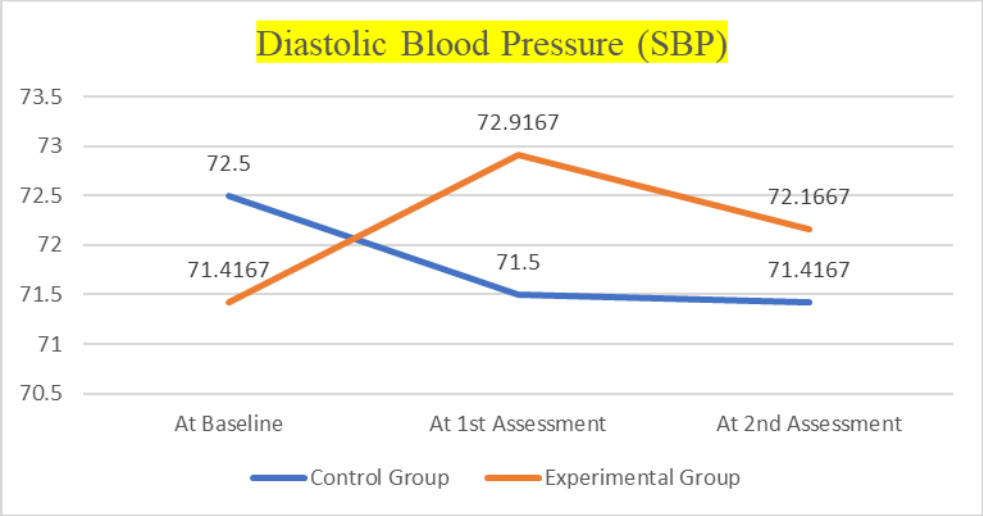
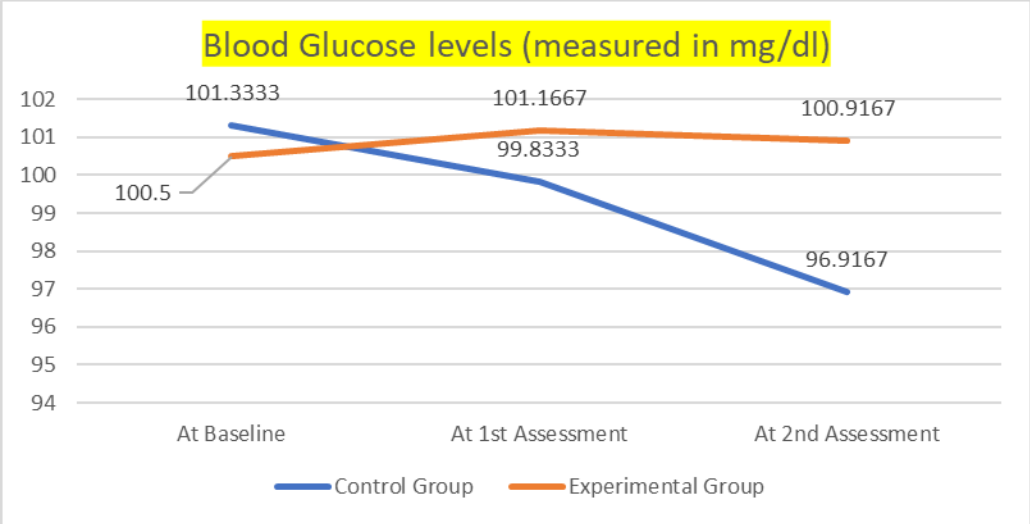


Figure 5. Graphical representation of comparative evaluation of blood glucose level Control Group Vs Experimental Group.



Effect of the Intervention on Academic Stress Levels among Adolescents

The distribution of academic stress levels across the control and experimental groups at three assessment points is presented in Table 2, offering clear insight into the progressive impact of the intervention over time. At baseline, both groups demonstrated comparable stress profiles, indicating an equivalent starting point before the intervention. Specifically, 66.7% (n=8) of the control group and 58.3% (n=7) of the experimental group were classified under high academic stress, while moderate stress was reported by 33.3% (n=4) and 41.7% (n=5) of participants, respectively. The Chi-square analysis at baseline showed $\chi^2 = 0.178$ with $p = 0.673$, confirming the absence of a statistically significant difference between groups at the outset (Table 2).

At the first assessment, a marked shift in academic stress distribution was observed, particularly within the experimental group. The proportion of adolescents experiencing moderate stress increased substantially to 91.7% (n=11) in the experimental group, compared to 33.3% (n=4) in the control group. Conversely, high stress levels declined sharply in the experimental

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group to 8.3% (n=1), while remaining unchanged at 66.7% (n=8) in the control group. This divergence between groups was statistically significant, with a Chi-square value of $\chi^2 = 8.711$ and $p = 0.003$, indicating a strong association between the intervention and reduced academic stress by the first follow-up (Table 2).

By the second assessment, the contrast between groups became even more pronounced. The experimental group demonstrated further improvement, with 33.3% (n=4) of adolescents reporting low stress, 66.7% (n=8) reporting moderate stress, and 0% remaining in the high stress category. In stark contrast, the control group showed a worsening trend, with 75.0% (n=9) of participants classified under high stress and only 25.0% (n=3) under moderate stress. Notably, none of the control group participants achieved the low stress category at this stage. The Chi-square result at the second assessment ($\chi^2 = 15.273$, $p < 0.01$) indicates a highly statistically significant difference between the two groups.

The progressive reduction in academic stress observed in the experimental group across assessments highlights both statistical and practical relevance. While the baseline data confirmed group comparability, subsequent findings demonstrate that the intervention was effective in not only reducing high stress levels but also facilitating a transition toward moderate and low stress category. The emergence of low academic stress exclusively in the experimental group by the second assessment underscores the cumulative benefit of the structured intervention approach. In contrast, the persistence and escalation of high stress levels within the control group suggest that routine activities without structured, holistic support may be insufficient to address academic stress in adolescents. The statistically significant Chi-square values at both follow-up points reinforce the robustness of these findings and minimize the likelihood that the observed differences occurred by chance.

Overall, the results summarized in Table 2 provide compelling evidence that the intervention had a positive and sustained impact on academic stress among adolescents. The gradual shift from high to moderate and low stress categories in the experimental group, combined with strong statistical support, indicates that such integrated lifestyle-based interventions can play a crucial role in improving academic and psychological well-being during adolescence.

Table 2. Comparative evaluation of Academic stress levels Control vs experimental group at baseline, 1st Assessment and 2nd Assessment.

Academic stress levels			Group		Total	Chi Sq	P-value
			Control	Experimental			
At Baseline	Moderate Stress	Frequency	4	5	9	0.178	0.673
		%	33.3%	41.7%	37.5%		
	High Stress	Frequency	8	7	15		
		%	66.7%	58.3%	62.5%		
Total		Frequency	12	12	24		
		%	100.0%	100.0%	100.0%		
At 1st Assessment	Moderate Stress	Frequency	4	11	15	8.711	0.003
		%	33.3%	91.7%	62.5%		

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	High Stress	Frequency	8	1	9		
		%	66.7%	8.3%	37.5%		
Total		Frequency	12	12	24		
		%	100.0%	100.0%	100.0%		
At 2nd Assessment	Low Stress	Frequency	0	4	4	15.273	<0.01
		%	0.0%	33.3%	16.7%		
	Moderate Stress	Frequency	3	8	11		
		%	25.0%	66.7%	45.8%		
	High Stress	Frequency	9	0	9		
		%	75.0%	0.0%	37.5%		
Total		Frequency	12	12	24		
		%	100.0%	100.0%	100.0%		

Impact of the Intervention on Academic Stress Distribution among Adolescents

The comparative pattern illustrated in Figure 6 clearly demonstrates changes in academic stress levels between the control and experimental groups across the three assessment stages. At baseline, both groups showed a similar stress distribution, confirming baseline comparability. In the control group, 66.7% of participants experienced high academic stress, while 33.3% reported moderate stress. Similarly, the experimental group recorded 58.3% high stress and 41.7% moderate stress, with 0% participants in the low-stress category in both groups (Figure 6). These findings indicate that participants began the study with comparable academic stress burdens.

At the first assessment, notable divergence emerged between the groups. The experimental group showed a substantial shift toward reduced stress, with 91.7% of adolescents reporting moderate stress and only 8.3% remaining in the high-stress category. In contrast, the control group exhibited no improvement, maintaining 66.7% high stress and 33.3% moderate stress. This difference aligns with the statistically significant Chi-square result reported earlier ($p = 0.003$), suggesting a meaningful effect of the intervention on stress reduction (Figure 6). By the second assessment, the contrast became more pronounced. The experimental group demonstrated further improvement, with 33.3% of participants achieving low stress and 66.7% reporting moderate stress, while 0% remained highly stressed. Conversely, the control group showed a deterioration, with 75.0% of adolescents experiencing high stress and only 25.0% reporting moderate stress. The absence of low-stress cases in the control group and the emergence of low stress exclusively in the experimental group reflect a strong intervention effect, supported by a highly significant statistical outcome ($p < 0.01$). Overall, Figure 6 visually reinforces the statistical findings, highlighting the effectiveness of the intervention in progressively reducing academic stress levels among adolescents. The transition from high to moderate and low stress in the experimental group underscores the practical and psychological relevance of the intervention, while the persistent high stress in the control group emphasizes the need for structured stress-management strategies in academic settings.

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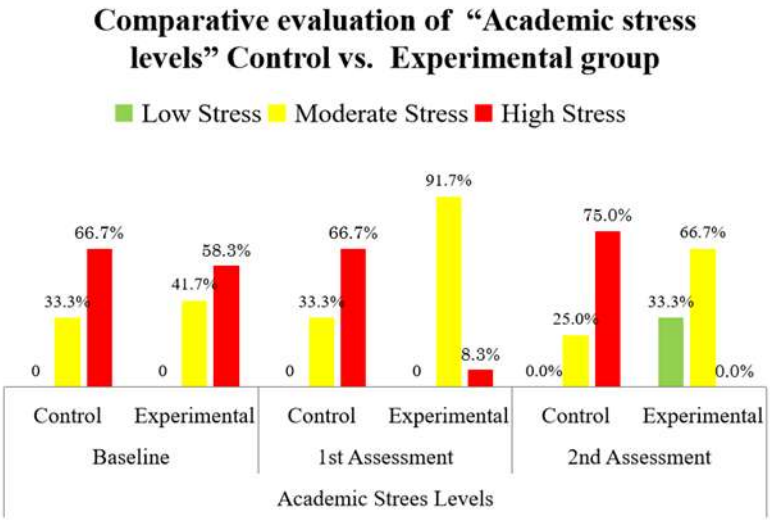
Figure 6. Comparative changes in academic stress levels among control and experimental groups across baseline, first assessment, and second assessment.



Effect of the Intervention on Psychosocial Wellbeing among Adolescents

The comparative distribution of psychosocial status between the control and experimental groups across assessment points is depicted in Figure 7, using Pediatric Symptom Checklist–Youth Report (Y-PSC) scores. At baseline, both groups demonstrated a high prevalence of psychosocial impairment (scores ≥30), indicating comparable initial vulnerability. In the control group, 66.7% of adolescents scored ≥30, while 33.3% scored <30. Similarly, the experimental group showed 75.0% psychosocial impairment and 25.0% without impairment, confirming baseline equivalence between groups (Figure 7). At the first assessment, divergent trends became evident. The control group showed minimal improvement, with 66.7% of participants still exhibiting psychosocial impairment and only 33.3% scoring below the threshold. In contrast, the experimental group demonstrated a notable positive shift, where the proportion of adolescents without psychosocial impairment increased to 58.3%, while those with impairment declined to 41.7%. This improvement aligns with inferential analysis, which indicated a statistically significant difference between groups ($p = 0.035$), highlighting the beneficial effect of the intervention (Figure 7).

By the second assessment, the gap between groups widened further. The control group continued to show persistent psychosocial challenges, with 58.3% of participants remaining in the impaired category and 41.7% without impairment. Conversely, the experimental group exhibited substantial improvement, with 83.3% of adolescents scoring <30 (no psychosocial impairment) and only 16.7% remaining in the impaired range. This marked transition underscores both statistical and clinical relevance, demonstrating sustained psychosocial gains in the intervention group (Figure 7). Overall, the findings illustrated in Figure 7 confirm that the intervention had a significant and progressive positive impact on adolescents' psychosocial wellbeing. While the control group showed limited change over time, the experimental group transitioned steadily from high psychosocial impairment to predominantly healthy psychosocial functioning. These results emphasize the effectiveness of structured physical activity combined with lifestyle modification in enhancing mental and emotional health during adolescence.

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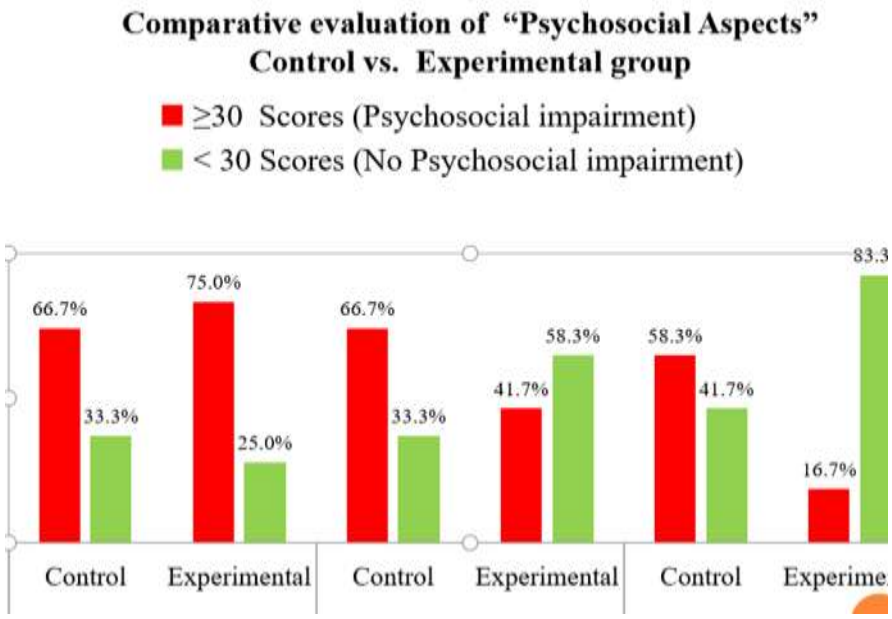
Figure 7. Comparison of psychosocial status (Y-PSC scores) between control and experimental groups at baseline and follow-up assessments.



Effect of the Intervention on Psychosocial Status (Y-PSC Scores) among Adolescents

The distribution of psychosocial status across the control and experimental groups at baseline and follow-up assessments is presented in Table 3, providing a clear picture of how the intervention influenced psychosocial wellbeing over time. At baseline, both groups demonstrated a high prevalence of psychosocial impairment, defined by Pediatric Symptom Checklist–Youth Report (Y-PSC) scores of 30 or above. Specifically, 66.7% (n = 8) of adolescents in the control group and 75.0% (n = 9) in the experimental group fell into this impaired category, while only 33.3% (n = 4) and 25.0% (n = 3), respectively, scored below 30. The Chi-square analysis at baseline ($\chi^2 = 0.202$, p = 0.653) confirmed that there was no statistically significant difference between the two groups, indicating comparable psychosocial status prior to the intervention (Table 3). At the first assessment, changes in psychosocial outcomes began to emerge, particularly within the experimental group. The proportion of adolescents with scores ≥30 remained unchanged in the control group at 66.7% (n = 8), while it declined to 41.7% (n = 5) in the experimental group. Correspondingly, the percentage of participants scoring <30 increased to 58.3% (n = 7) in the experimental group, compared with 33.3% (n = 4) in the control group. Although this shift suggested an improving trend associated with the intervention, the Chi-square value ($\chi^2 = 1.51$, p = 0.219) indicated that the difference was not yet statistically significant (Table 3).

By the second assessment, a substantial and statistically meaningful divergence between groups was evident. In the experimental group, only 16.7% (n = 2) of adolescents continued to exhibit psychosocial impairment, while a striking 83.3% (n = 10) achieved scores below 30, indicating the absence of psychosocial impairment. In contrast, the control group showed comparatively limited improvement, with 58.3% (n = 7) still scoring ≥30 and 41.7% (n = 5) scoring <30. The Chi-square analysis at this stage yielded $\chi^2 = 4.444$ with p = 0.035, demonstrating a statistically significant difference between the control and experimental groups.

The progressive improvement observed in the experimental group highlights both statistical and clinical relevance. While baseline equivalence ensured a fair comparison, the sustained reduction in psychosocial impairment over successive assessments suggests that the intervention had a cumulative positive effect on adolescents' emotional and behavioral functioning. The emergence of a large majority of participants with healthy psychosocial scores (<30) exclusively in the experimental group by the second assessment further strengthens this

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interpretation. Conversely, the relatively modest changes observed in the control group imply that routine activities alone were insufficient to produce meaningful psychosocial benefits. The persistence of impairment in more than half of the control participants underscores the need for structured and holistic interventions to address psychosocial challenges during adolescence. Overall, the findings summarized in Table 3 provide compelling evidence that the intervention significantly improved psychosocial outcomes over time. The statistically significant improvement at the second assessment, supported by clear shifts in score distribution, confirms the effectiveness of the intervention in enhancing psychosocial wellbeing among adolescents at risk.

Table 3. Comparative evaluation of "Psychosocial Aspects" Control vs experimental group at Baseline, 1st assessment and 2nd Assessment.

PSYCHOSOCIAL ASPECTS			Group		Total	Chi Sq	P-value
			Control	Experimental			
At Baseline	30 or > Scores	Frequency	8	9	17	0.202	0.653
		%	66.7%	75.0%	70.8%		
	< 30 Scores	Frequency	4	3	7		
		%	33.3%	25.0%	29.2%		
Total		Frequency	12	12	24		
		%	100.0%	100.0%	100.0%		
At 1st Assessment	30 or > Scores	Frequency	8	5	13	1.51	0.219
		%	66.7%	41.7%	54.2%		
	< 30 Scores	Frequency	4	7	11		
		%	33.3%	58.3%	45.8%		
Total		Frequency	12	12	24		
		%	100.0%	100.0%	100.0%		
At 2nd Assessment	30 or > Scores	Frequency	7	2	9	4.444	0.035015
		%	58.3%	16.7%	37.5%		
	< 30 Scores	Frequency	5	10	15		
		%	41.7%	83.3%	62.5%		
Total		Frequency	12	12	24		
		%	100.0%	100.0%	100.0%		

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