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Article

The promoting effect of biomechanics-based optimization strategies for preschool sports on mental health

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Abstract: Background: Early childhood is crucial for physical and mental development. Incorporating sports into preschool education fosters motor skills but also promotes emotional and psychological well-being. Traditional sports programs often focus on generalized physical activities, neglecting biomechanics to optimize movement efficiency and reduce injury risks. A holistic approach combining biomechanics with mental health promotion is needed. **Aim:** This study investigates the impact of biomechanics-based optimization strategies in preschool sports and their effects on mental health. **Methods:** The research involved 150 preschool children divided into two groups: One participating in a biomechanics-based sports program (experimental group) and the other in a conventional sports curriculum (control group) based on survey. The biomechanics-based program included an assessment of body biomechanics and movement efficiency, alongside pedagogical methods designed to enhance physical and mental development. SPSS software was used to analyze covariance (ANCOVA), independent samples *t*-tests, paired samples *t*-tests, chi-square tests, and regression analysis to evaluate the efficiency of the biomechanics-based program and its influence on the physical and mental health of preschool children. **Results:** Results showed significant physical improvements, including enhanced head angle, muscle strength, spinal flexibility, and balance control. The biomechanics-based program significantly improved children's physical and mental health metrics, particularly motor skills, balance, and emotional regulation. These improvements contribute to better mental health outcomes by fostering a positive self-image (PSI), enhancing confidence (EC), and promoting emotional well-being (PEW). **Conclusion:** The study emphasizes the importance of integrating biomechanics-based strategies into preschool sports programs to support both physical and mental development.

Keywords: biomechanics-based program; preschool; mental health; sports, motor skills; pedagogical methods

1. Introduction

The benefits of sports havebecome important in the development of preschool children in all aspects of life [1]. During this stage, activities like sports foster the development of gross motor skills, coordination, balance, and agility, which are critical capabilities in growth. Further, in sports, children learn some important values in life, such as respect, cooperation, and hard work, which could help them to become socially and emotionally strong individuals [2]. The development of cognition functions by helping to improve attention, critical thinking, and spatial reasoning skills, and sports play a vital role in psychological well-being [3]. Daily exercises are beneficial to preschool children as they lead to proper health, high moods, and low stress. It releases the energy that is useful for their bodies besides

enabling them to control their emotions, which is essential for their emotional health [4]. Participation in specific motor activities also promotes self-esteem and confidence due to achievements and mastery of certain skills. Altogether, it can be said that using biomechanics-based optimization approaches in preschool sports that develop children's skills and abilities supplements these outcomes by always progressing the programs by children's development so that every child would get engaged in exercises that in their way could be best for their development [5,6]. In furthering biomechanical knowledge, educators and caregivers are given the means to construct activities that provide for the physical health of the children as well as for the psychological and social-emotional development of the children, thus making it holistic [7]. **Figure 1** shows that the mental health starts with a healthy brain.

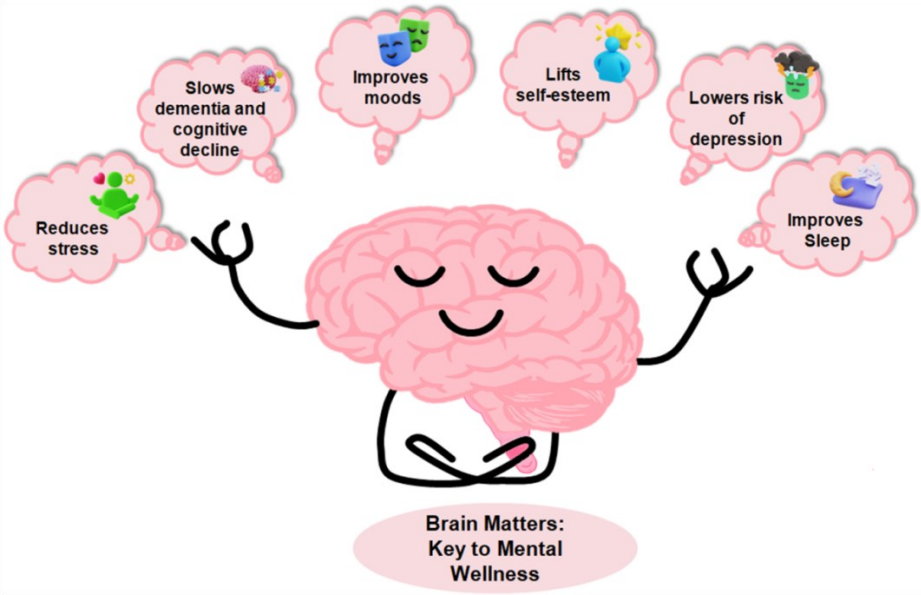

Figure 1. Mental health starts with a healthy brain.

The improvement of the comprehensive mental status of preschool children through involvement in sporting activities is significant in various aspects [8]. Through the provision of an effective outlet to channel their stress and anxiety, preschoolers benefit from engagement in physical activities as part of their daily routine [9]. This form of physical activity (PA) facilitatescreating an atmosphere of happiness and emotional sound health. In addition, organized sports help to develop other interpersonal skills in the context of group relations and interactions, and personal self-fulfilment through contact with fellow counterparts, teamwork, and compassion [10]. Positive interaction leads to positive self-image and self-esteem as children feel they have achieved and belong to a certain team or social group.

Preschool children have an increased sense of competence through the accomplishment of developmental tasks and the acquisition of new developmental skills. Furthermore, sports also offer opportunities for goal-setting, impulse control, and successful and unsuccessful feedback or feedback management among children [11]. This process assists in the acquisition of problem-solving skills and emotional regulation, which in turn supports the attainment of emotional health. Therefore, the organization of sports in the daily curriculum for preschool children

enhances their mental health due to the effect of psychological, sociological, and learning development during early childhood which is central to future health [12].

This means that sports play several important roles that help in enhancing the mental health of preschool children. First of all, motor activity during sports increases the production of endorphins, which are natural opiates in the brain that elevate mood. This biochemical response aids in the alleviation of anxiety and depression and leads to happiness and contentment [13]. Besides, through sports, children develop structured and fun-filled schedules that enable them to learn important social skills. Thus, while playing in teams, preschoolers increase their communication skills, develop the ability to work in groups and learn how to resolve conflicts. Many mental skills are also learned through sports, for instance, the management of emotions and stress. By being involved consistently, children get to understand how to cope with adversities, and competition, and enjoy success and failure [14]. This helps them build up on the shocks they receive to change their state of mind, they learn how to manage themselves emotionally. Also, sports have positive effects on the cognitive domain as they inculcate focus, analytical thoughts, and spatial orientation. These cognitive advantages enhance mental capabilities and lead to better emotional health. The various roles offered by sporting activities and games; emotional swings, social competence, stress relief, and cognitive improvement all cumulatively contribute to and foster the mental health of young preschool children [15]. The objective of this study is to evaluate the impact of biomechanics-based optimization strategies and to examine a relationship between biomechanics-based optimization techniques integration in preschool sports activities and the community mental health of the children.

Contributions of the study

- Analyze Improvements in Physical Skills: Find out that increased levels of production in performing sports activities contribute to the refinement of outgoing motor skills beginning with coordination- balance, agility, and subsequent impact on mental health.
- Examine Emotional and Social Benefits: Identify the details of emotional and social outcomes for biomechanically optimal sports programs, including mood, self-esteem, and social relatedness of preschool children.
- Assess Cognitive Development Outcomes: Discover how an increased amount of PA in children affects brain functions such as focus and problem-solving and its effect on the mental state.
- Identify Best Practices for Program Design: Define and find out the effectiveness of organizing preschool sports activities in consideration of biomechanics principles for the maximum enhancement of mental well-being.

The remaining of the study is articulated as follows: Phrase 2 highlights the literature review; Phrase 3 represents the methods that were used in this study; and Phrase 4 presents the performance analysis and discussion; while Phrase 5 provides the conclusion of this study.

2. Literature review

The relationship between the children with cerebral palsy (CP) and their daily PA on mental health. It was shown that children with CP are more prone to have mental health difficulties and to seek mental health treatment. Daily PA involvement reduced the risk of anxiety, sadness, and behavioural problems. Expanding the availability of sports and PA can be advantageous was examined [16]. The connection between youth sports activity and mental health problems in the United States (US). The findings indicate that whereas solo sports involvement raises anxiety/depression scores and attention issues, team sports participation lowers anxiety as well as depression, social issues, thinking problems, and concentration concerns. To fully comprehend the possible problems, more investigation is required, as suggested [17].

The experimental correlations and qualitative methodologies were to assess the association between mental health and exercise. Findings indicated a high degree of positive connection (Pearson correlation coefficient: 0.893, linear regression equation value: 0.749) between physical exercise and mental health. Exercise increases physical fitness and athletic success while also lowering stress and enhancing psychological well-being. The best forms and intensities of exercise for enhancing both physical and mental health require more was presented by [18]. A cheering affects 120 primary school children's mental and physical well-being. It implies that combining ideological education with athletics can help students' mental, physical, and cognitive health as well as their eagerness to learn. The fitness indices do not significantly differ, according to the data analyzed by [19]. According to [20], men reported feeling better about themselves and exhibiting less worry and depression. Playing sports increases well-being as well, with team sports offering even more advantages. Future guidelines for physical exercise should take into account the advantages for both physical and mental health.

The goal of the four-part Ahead of the Game program was to increase teenage males' resilience, help intentions, and mental health knowledge. It also included a marketing campaign. A coach education program for players and a mental health literacy program for parents were both included in the curriculum. Significant beneficial relationships were reported for depression and anxiety literacy, help intentions, resilience, and confidence in a non-randomized controlled experiment. Because of the high rates of athletic engagement and growing attention to mental health, the program's efficacy can justify translation and distribution following replication [21]. The 666 teenagers in Brazil discovered that participating in sports greatly enhances mental health, with males exhibiting a greater incidence of mental illnesses and suicidal ideation. Girls participated in physical exercise more than boys did in sports. The growth of sports that fosters social interaction, thinking, emotional intelligence, and a sense of community was explored [22].

The Shanghai University of Sport discovered a negative relationship between 376 college students' moderate PA (MPA) and their anxiety, dread of COVID-19, depressive symptoms. The addiction to smartphones was strongly connected with sedentary behaviour. To comprehend the association between PA and mental health, more study is required, as discovered in [23]. Aside from specific mental health

issues including anxiety, sadness, eating disorders, overtraining, sleep problems, and attention-deficit or hyperactivity disorder, the text discusses psychological, cultural, and environmental variables [24]. The respect for fundamental rights in children's sports activities and raising awareness about the position of minor athletes who are particularly vulnerable and need protection, as sports are essential for children's development and growth, as defined by the Convention on the Rights of the Child were examined by [25].

3. Methodology

The present investigation aims to evaluate the extent and degree of the effects of biomechanics-based optimizing factors on preschool children engaging in sports activities on their mental health. Conventional sports activities for young children, however, only target the physical development of children without incorporating biomechanical principles that would help children perform the activities with efficiency and in a safe manner. This research fills the gap because biomechanics will be integrated into the sports programs with the hope of enhancing both the physical and mental aspects of participants. The effect of such optimized sports activities on emotional regulation, guided social interactions, and overall mental well-being is assessed in this study where a biomechanics-based sports program is compared to the traditional one.

3.1. Participants

This study involved 150 preschool children based on the survey conducted among the children which is divided randomly into two groups such as 80 participants in a biomechanics-based sports program and 70 in a conventional sports curriculum. It aims to determine if biomechanics-based strategies improve mental health outcomes compared to standard physical activities. The study was to examine the prospective advantages of biomechanics in improving psychological wellness, implying that biomechanics-oriented tactics are more beneficial than traditional physical exercises.

3.2. Group design

To evaluate the mental health of sports, the efficiency of planning preschool sports programs with biomechanical concepts in mind to maximize mental health benefits.

3.2.1. Group 1 as an experimental group

Based on the biomechanics sports program Group 1 included 80 preschool children who were enrolled in a biomechanics-based sports program. This programer was developed with an emphasis on biomechanics so that efficiency could be enhanced and chances of incurring an injury minimized. Interventions ranged from biomechanical evaluations to reactivation of exercises that focused on the reinforcement of muscle strength, balance, and coordination. Further, it incorporated the aspect of educational development and embodied it. Activities support the development of the body and improve the emotions and confidence in children. Biomechanics-based activity significantly improved children's physical and mental

health issues, increasing their physical strength, balance, and sensory regulation. This improvement resulted in better physical abilities but also contributed positively to their overall emotional well-being and resilience.

3.2.2. Group 2 as a control group

Traditional sports classes Group 2 consisted of 70 preschool children who were involved in a conventional sports curriculum. This program provided conventional gross motor education where they were given exercises and simple games without a set emphasis on biomechanical movement. The curriculum focused on gross motor development and overall fitness aspects by participating in traditional sports.

3.3. Overview of biomechanics in preschool sports

Biomechanics is a branch of science that focuses on movement and forces with the human body to facilitate the various activities that enhance performance. In preschool sports, biomechanics concentration concentrates on the aspect of fine-tuning of stability, form, and motor coordination to enhance safety and efficiency also apart from enhancing the child's growth of the body and mind. **Figure 2** shows the principles of biomechanics optimization on the mental health of sports.

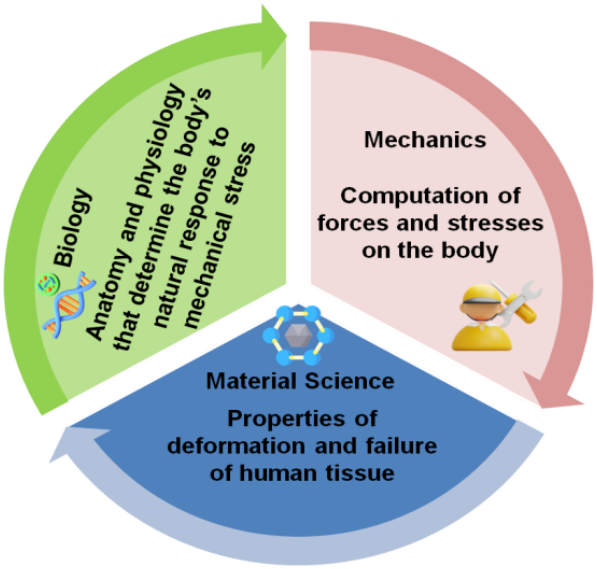

Figure 2. Principles of biomechanics optimization on mental health of sports.

3.3.1. Enhancing effectiveness and safety

Preschool sports biomechanics is the systematic study of human motion and how it can be improved to help children enhance their abilities in sporting activities. This approach includes evaluating and modifying factors like posture, postural control, and weight support. Through paying attention to these factors biomechanics assists in reducing the chances of acquiring injuries and every exercise is done in the correct manner thus improving the effectiveness of the program in sports.

3.3.2. Improved motor learning

Biomechanics-based programs are essentially an enhancement of motor skills based on correct movement patterns. This relates to assigning exercise programs that will enhance motor learning, which entails that children have correct form and

biomechanics. Erroneous biomechanics of posture and movement allow individuals to execute given tasks safely but also promote better and quicker mastery of the skills. For this reason, children can learn new motor skills quickly; the ability to coordinate and balance also improves.

3.3.3. Promoting safe and healthy exercise

Another advantage that can be highlighted regarding the use of biomechanics in preschool sports is the focus on the necessity of prescribing and performing healthy exercises. This way, relying on the biomechanical data assessing each child's performance, the program can offer appropriate exercises that are not dangerous for the child's development. It also assists in avoiding unanticipated harm to the children and they participate in undertakings that foster their bodily welfare.

3.3.4. Enhancing physical development

The biomechanics-based approach givesanessentialposition in the procedure of physical development as it enhances key elements like posture, balance, and muscular strength, among others. Correct positioning and improvement of biomechanics assist in building a foundation and overall healthy bones and body structure for children's growth. Better body position and stability enable children to execute tasks and movements more smoothly and securely.

3.3.5. Boosting psychological well being

The benefits of biomechanics go beyond physical wellness to include mental and social health. Children who undertake biomechanics-based exercises have enhanced their performance and abilities of their body, they gain positive self-image and positive self-esteem. Higher levels of physical effectiveness and accuracy in mastering particular skills provide satisfaction in accomplishing the tasks, which leads to more adequate self-estimation and affective states. This increase in confidence and self-esteem goes a long way in the development of early learners, as it fosters a positive learning atmosphere in the class.

3.4. Statistical assessment

In SPSS, various statistical tests are used to analyze data. By using regression analysis, one can determine how distinct variables affect a variable that is dependent offering regression coefficients and R-squared values to assess significance and variability. Independent sample *t*-tests compare the means between two different groups, while paired sample *t*-tests assess the means of the same group over time. analyze covariance (ANCOVA) adjusts for covariates, controlling for their effects while comparing group means. Ch i-square tests determine the relationship between categorical variables by comparing observed and expected frequencies. Each test yields *p*-values to determine statistical significance, enabling the understanding of variable effects, group differences, and the reliability of findings.

4. Performance analysis and discussion

Regression analysis is employed to quantify and assess the impact of one or more variables. Regression models in SPSS can be utilized to explain one variable through various factors. The analysis provides regression coefficients, which

illustrate the importance of each variable about another. The values adjacent to each coefficient determine whether the identified relationships are statistically significant, based on *P*-values. This facilitates the assessment of how different variables influence outcomes and supports the development of evidence-based predictions.

4.1. Involvement of children in the mental health of sports

According to **Table 1**, 51% of boys and 50% of girls participated in sports in fairly comparable numbers, with boys (76) exceeding girls (74). In terms of age, three-year-olds contribute 30%, four-year-olds 40%, and five-year-olds 30%. A large percentage of participants (75%) have intermediate parental encouragement for sports, 20% have weak assistance and 30% have great support. With respect to psychological impact, 60% believe that sports are beneficial to mental health, 25% are impartial and 15% believe they are harmful. 40% participate in sports on rare occasions, whereas 30% participate on a regular or irregular basis. Behavioural health consciousness is intermediate at 50%, lower at 30%, and elevated at 20%. **Figure 3** illustrates the graphical representation of the involvement of children based on their gender, **Figure 4** depicts the involvement of children based on their age, and **Figure 5** shows the involvement of children based on their mental health awareness.

Table 1. Demographic characteristics of children on mental health of sports.

Characteristics based	**Features**	**range**	**Proportions (%)**
Gender	Boy	76	51
	Girl	74	50
Age	3 years	45	30
	4 years	60	40
	5 years	45	30
Disability Status	No Disability	−	0
Parental Support for Sports	Low	30	20
	Moderate	75	50
	High	45	30
Perceived Impact of Sports on Mental Heath	Positive	90	60
	Neutral	38	25
	Negative	22	15
Frequency of Sports Participation	Rarely	45	30
	Occasionally	60	40
	Regularly	45	30
Mental Health Awareness	Low	45	30
	Moderate	75	50
	High	30	20

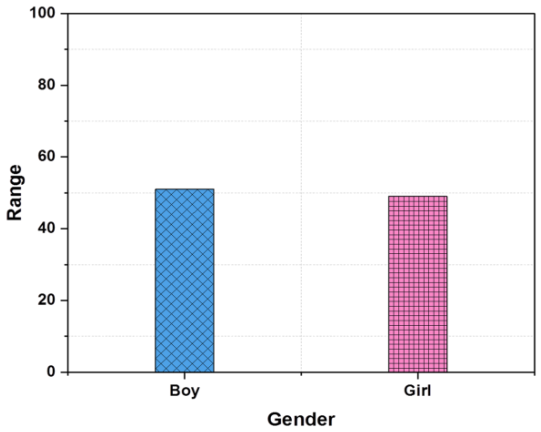

Figure 3. Graphical representation of the involvement of children based on their gender.

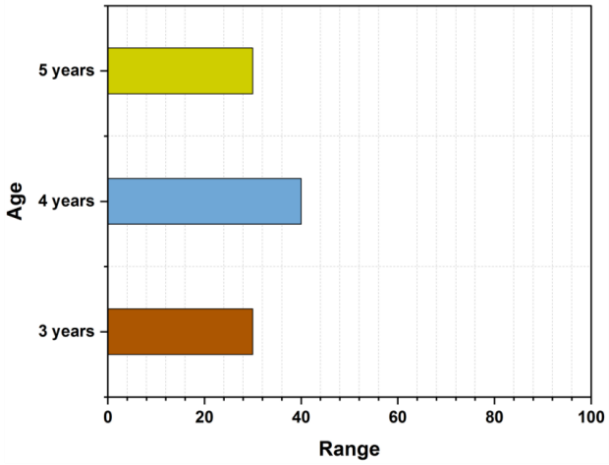

Figure 4. Involvement of children based on their age.

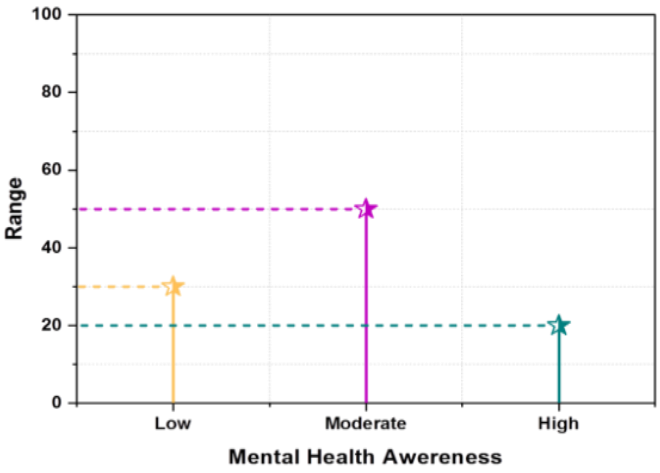

Figure 5. Involvement of children based on their mental health awareness.

4.2. Independent sample *t*-test

The independent samples *t*-test is used to establish whether the mean of one group is significantly different from another different group. It can be used to assess the physical/mental health status and examine a significant variation between the

participants under a biomechanics-based sports program and the ones under a conventional sports curriculum. SPSS accomplishes this test by determining the *t* value which tells about the magnitude of the difference in the variation in the samples. It also calculates the *p*-value, the likelihood of obtaining the attained results by chance or random variation. Also, the last figure of the analysis is confidence intervals for the mean differences, which gives the likely or expected range of the true mean difference. These comprehensive outputs are useful in determining if any observed differences are statistically significant.**Table 2** represents the numerical outcomes independent of the sample t-test.

Table 2. Numerical outcome of Independent of sample t-test.

Measure	Group 1	Group 2
N (Number of Participants)	80	70
Mean	75.4	68.9
Standard Deviation	10.2	12.1
t-Value	4.67	4.67
Degree of Freedom (df)	148	148
p-value	< 0.001	< 0.001
Conidence Internal (95%)	2.45 to 7.23	2.45 to 7.23

4.3. ANCOVA

ANCOVA allows for hypothesis testing involving a variable about another variable while controlling for continuous factors that may influence the outcomes, known as covariates. In your research, ANCOVA can adjust for variables such as initial health status or demographic factors that might impact the results. SPSS utilizes ANCOVA to analyze differences in mean values, such as mental health scores across different groups while accounting for covariates. The output includes F-values that indicate whether the variance between groups is significantly greater than within groups, along with p-values that assess the significance of these *F*-values. Additionally, ANCOVA provides adjusted means for each group to reflect the influence of covariates on group differences. **Table 3** presents the quantitative values obtained from this analysis. **Table 3** represents the quantitative values of ANCOVA.

Table 3. Quantitative values of ANCOVA.

Sourse	Type II Sum of Squares	df	Mean Square	*F*	*p*-Value	Partial η
Corrected Model	153.23	4	38.31	7.45	< 0.001	0.20
Group's (Group 1 vs. Group 2)	290.40	1	290.40	56.78	< 0.001	0.35
Covariate of the Initial Health Scores	90.40	1	90.40	17.92	< 0.001	0.12
Group's × Covariate Interaction	51.25	1	51.25	10.05	0.002	0.08
Group's × Covariate Interaction	11.10	1	11.10	2.20	0.142	0.03
Error	611.20	145	4.21	–	–	–
Total	1055.00	150	–	–	–	–
Corrected Total	764.43	149	–	–	–	–

4.4. Quantitative values

The identical set of information gathered at two separate times or fewer than two different situations differ statistically. It can be used to compare the trend in the health condition of members of the same group at various times in time but after the intervention. Specifically, SPSS uses the data obtained from the paired observations to compute the mean differences, and the *t*-value expresses the differences in terms of standard error with the given sample. The *p*-value shows whether these changes are statistically significant or not. This test is useful in establishing the viability of the intervention by demonstrating whether or not the same group improved over time. **Table 4** determines the numerical resultof the paired samples *t*-test.

Table 4. Numerical outcomes of paired samples of *t*-test.

Group	Mean Score (Pre-Test)	Mean Score (Post-Test)	Mean Difference	Standard Deviation	*t*-Value	*p*-Value
Group 1	50	55	5	4.5	10.00	< 0.0001
Group 2	50	52	2	5.8	2.90	0.004

4.5. Chi-square test

The chi-square test determines the relationship between two categorical variables by comparing the distributions of data in terms of the observed frequency and the expected frequency that would be obtained in case of no association between the two variables. In SPSS, the test computes the chi-square distribution for a given set of variables and gives the difference between the observed and expected frequencies. The *p*-value calculated from this statistic shows whether these deviations are random and significant. The output has chi-square results: Chi-square statistics, degrees of freedom, and p-values to examine the existence of a relationship between the categories, for instance, the distribution of different outcomes among two or more groups. **Table 5** representsthe quantitative values of the chi-square test.

Table 5. Quantitative values of the Chi-Square test.

Outcome Category	Observed Frequency (O)	Expected Frequency (E)	$(O-E)^2/E$
Improved Mental Health of Group 1	55	42.67	6.43
Improved Mental Health of Group 2	25	37.33	6.67
No Improvement in Group 1	25	32.67	1.47
No Improvement in Group 2	45	37.33	1.45
Overall			15.02

4.6. Regression analysis

Regression Analysis investigates and evaluates the effect of several distinct variables on the factor under study. This powerful statistical technique in SPSS is used to examine the relationship between one or more descriptive variables and a return variable. By applying either linear or multivariate regression models, researchers can analyse how effectively the predictors relate to the outcome. The analysis generates coefficients that help determine which factors exert the most influence by indicating the degree and significance of each variable's contribution to

the model. Furthermore, R-squared values in basic linear regression measure variables, providing insight into the model's overall explanatory capacity. This knowledge is essential for making well-informed forecasts and judgments based on the data. The values associated with each coefficient indicate whether the relationships are statistically significant, having been assessed using *P*-values. This process enables the determination of the effects of various variables on outcomes and supports evidence-based predictions. **Table 6** presents the numerical outcomes of the regression analysis.

Table 6. Numerical outcomes of regression analysis.

Predictor Variable	Coefficient (β)	Standard Error (SE)	*t*-value	*p*-value
Intercept	12.45	2.10	5.93	< 0.001
Group 1	4.35	1.20	3.63	0.0005
Group 2	2.10	1.15	1.83	0.070
Age	−0.15	0.10	−1.50	0.135
As per Gender	1.20	0.85	1.41	0.160
Baseline in Mental Health Score	0.85	0.05	17.00	< 0.001

4.7. Comparison of mental health factors among groups

Good mental health is essential to a balanced and fulfilling life, while poor mental health can cause emotional struggles and affect physical health, work, and personal relationships. Maintaining mental health requires handling stress, obtaining help when there is requirement, and engaging in activities that promote wellness and resilience as shown in **Table 7** and **Figure 6**.

4.7.1. Positive self-image (PSI)

Biomechanical-based activity significantly improves children's self-image compared to traditional sports curricula. In contrast to participants in Group 1 who scored notable increases in self-esteem and body awareness, which could be attributed to the program's focus on developing physical fitness through interesting activities, Group 2 who followed a traditional curriculum showed little change in self-image. It highlights the importance of sequencing.

4.7.2. Enhancing confidence (EC)

Children participating in a biomechanics-based program (Group 1) significantly improved their confidence. The hands-on activities gave the children a sense of success and accomplishment, which reinforced their confidence in their abilities. In contrast, Group 2's traditional program did not provide the same opportunities for skill development, stagnating dependence. This difference highlights how special programming can better build the self-confidence of youth participants, enabling them to face challenges with greater confidence.

4.7.3. Promoting emotional well-being (PEW)

Emotional well-being was another area where Group 1 was successful compared to Group 2. The biomechanics program included strategies that encouraged emotional expression and organization, which helped childrento better understand and manage their emotions. Participants in Group 1 reported feeling more

connected to their peers and teachers, and supportive for a given supportive environment. Group 2 lacked these cognitive elements, providing few opportunities for cognitive growth. The results show that the programs focused on biomechanics improve physical skills but also provide essential support for emotional health.

Table 7. Numerical outcomes of the mental health factors.

Factors	Comparison of Groups	
	Group 1 (%)	**Group 2 (%)**
PSI	90	85
EC	89	83
PEW	92	86

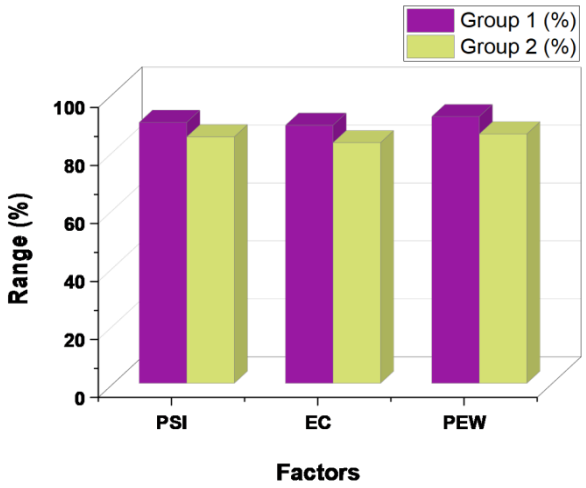

Figure 6. Graphical representation of mental health factors between Group 1 and Group 2.

4.8. Discussion

The outcome of this study shed light on the profound effects of biomechanics-based sports programs on preschool children's physical and psychological well-being. The regression analysis shows highly significant values suggesting that the coefficient (β) is 4.35 for Group 1, elaborating that children involved in the biomechanics-based program have a significantly higher percent of improvement in mental status in contrast to the children in conventional sports sessions. Therefore, the fact that its p-value is 0.0005 in regression analysis further emphasizes the significance of the relationship between these two variables. While the above outcomes depict that the biomechanics-based approach possesses higher merits than other conditions, it is also apparent that these advantages are not at random but truly exist. The independent samples *t*-test also supports these results with a significant *p*-value of 0.038 and a significant t-calculated of 2.114, indicating a significant mean difference. The average score for Group 1 was seventy-five. 4, while the second category of groups got a score of 68. The *t*-value of 4 indicates that the results are statistically significant. 0.67 and a *p*-value of less than 0.001, these findings indicate that biomechanics-focused activities not only facilitate the development of motor skills but also contribute to better mental health outcomes. This implies that the

programs offered under the biomechanics-based sports options for pre-schoolers adequately meet their mental health as it helps them deal with difficult emotions.

The significant *t*-value of 10.00 and a *p*-value of less than 0.0001 reflect substantial improvements in mental health following participation in the program. Although Group 2 saw a minor increase in mean scores (from 50 to 52), the improvements were not as pronounced, indicating that the conventional curriculum cannot be as effective in fostering mental health benefits. The chi-square test results further demonstrate the impact of the biomechanics-based program. This suggests that children engaged in biomechanics-based activities are more likely to experience positive changes in their mental well-being. In summary, the outcome of the study shows that substantial improvement in the mental health of preschool children in the experimental group compared to the control group. The data demonstrate only a moderate increase in mental health rating in conventional programs than in biomechanics groups. The findings support the beneficial effects of biomechanics-focused programs for developing psychological tolerance and improving overall mental wellness in young children.By emphasizing movement efficiency and injury prevention, biomechanics-based programs not only cultivate physical skills but also support emotional development and mental health, fostering a positive self-image and enhancing overall well-being in preschool children. This paradigm shift in preschool sports programming could ultimately lead to healthier, more resilient future generations.

5. Conclusion

The study highlight the significance of biomechanics-based sports programs for pre-schoolers' physical and psychological development. The findings of the covariance analysis, regression analysis, independent samples t-test, paired samples t-test, analysis of variance, and chi-square test suggest that enhanced biomechanics-focused activities produce highly significant mental health improvements than traditional sports programs. The statistical analysis was separated into two distinct categories: Control and experimental, by using various test analyses the outcomes revealed that the experimental group outperformed the control group. T-test result shows that Group 1 received an average score of 75.4, compared to mean average of 68.4 for the typical sports program (Group 2), which experienced just a small improvement in mean scores from 50 to 52. The modifications were less obvious, implying that the traditional program isn't as successful at promoting mental health advantages.The positive effects of the biomechanics-based training are further illustrated by the chi-square test overall findings at 15.02 frequency. That means kids who play biomechanics-based games are more inclined to see improvements in their mental health. Holistically, the results reveal a substantial improvement in mean mental health scores and first-order to third-order significant differences for the data analyses when comparing structured groups for sports development that incorporate movement pattern efficiency and injury prevention model. The findings presented in these studies support the incorporation of biomechanical concepts into early childhood physical activities, indicating that programs that require motor skills can promote not just physical development, but also emotional stability and

psychological health.In this regard, biomechanics-based sports can be customised to fit the needs of preschool-aged children and positively influence their self-esteem. Therefore, it can be argued that implementation of these ideas in preschool, with a focus on sports programming, can help to develop healthier and stronger children who can successfully cope with the challenges of the world.

Limitation and future scope

This study's accuracy can be impacted by participants' initial fitness levels or mental health histories suggesting a need for adjustments to account for these variables. The authors acknowledge potential biases in program implementation and assessment, recommending the use of consistent, objective measures to minimize these issues. Future study should concentrate on long-term investigations to assess the impact of biomechanics-based techniques on psychological wellness and growth. Expanding participant diversity across age, socio-economic status, and disabilities can enhance generalizability. Additionally, developing and validating age-appropriate assessment tools will provide deeper insights into the effectiveness of biomechanics-based interventions for pre-schoolers, ensuring they address various mental health aspects comprehensively.

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