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"Effectiveness Of A Twelve-Week Corrective Exercise Program On Lower Extremity Postural Deformities Among High School Boys In Kerala: A Randomized Controlled Trial"

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Abstract:
This research paper aims to investigate the effects of a twelve-week corrective exercise program on lower extremity postural deformities, including knock-knee, flat foot, and bow leg, among high school boys in Kerala, India. A total of 22 students with lower extremity postural deformities were selected as subjects, with 12 assigned to the experimental group and 10 to the control group. The age range of the participants was between 8 and 14 years.
The experimental group underwent a corrective exercise training program, while the control group did not receive any specific intervention. Prior to the administration of tests and implementation of the exercise program, a comprehensive meeting was conducted with the subjects to explain the study's objectives and procedures in detail.
The study focused on three groups of selected deformities: knock knee (genu valgum), flat foot (pes planus), and bow leg (genu varum). The corrective exercise program was designed specifically to address these lower extremity postural deformities.
The study employed a randomized controlled trial design, with the experimental group receiving the corrective exercise intervention and the control group acting as a comparison group. Various outcome measures, including postural assessments, were conducted before and after the twelve-week intervention period to evaluate the effectiveness of the corrective exercise program.
The findings of this study are significant for understanding the potential benefits of corrective exercise in addressing lower extremity postural deformities among school boys in Kerala. By exploring the effects of the intervention, this research contributes to the existing knowledge on corrective exercise and its role in improving postural alignment and function in this specific population.

Keywords: *Postural deformities, Knock-knee, Flat foot, Bow leg, Corrective exercise, Randomized controlled trial, High school boys, Kerala.*

Introduction:

Corrective exercise is a therapeutic approach that encompasses a comprehensive understanding of anatomy, kinesiology, and biomechanics to address movement dysfunctions, muscle imbalances, and postural abnormalities. It aims to restore optimal movement patterns, improve muscular balance, and enhance functional abilities. Corrective exercises involve targeted interventions and tailored exercise programs designed to correct specific musculoskeletal imbalances and promote optimal posture.
Posture, defined as the alignment of body segments in relation to one another, plays a fundamental role in maintaining musculoskeletal health and efficient movement. Good posture ensures proper distribution of forces through the joints, optimal muscle activation patterns, and efficient energy transfer during physical activities. However, various factors such as sedentary lifestyles, poor ergonomics, inadequate physical activity, and genetic predispositions can contribute to the development of postural deformities.
Lower extremity postural deformities, including knock-knee (genu valgum), bow leg (genu varum), and flat foot (pes planus), are common among school boys. These deformities can result in biomechanical imbalances, altered joint mechanics, and compromised functional abilities. If left unaddressed, these postural deviations may lead to musculoskeletal pain, reduced physical performance, and an increased risk of future injuries. Therefore, early

identification and appropriate intervention strategies are crucial to mitigate the long-term consequences of these deformities.

Corrective exercise programs have emerged as a potential intervention approach for addressing lower extremity postural deformities. These programs aim to improve alignment, muscular imbalances, and movement patterns through targeted exercises that promote muscle activation, joint stabilization, and postural alignment. By implementing corrective exercise interventions, it is possible to address the underlying musculoskeletal imbalances, enhance neuromuscular control, and optimize postural alignment.

The state of Kerala, India, exhibits a high prevalence of lower extremity postural deformities among school boys. This population represents a critical stage of growth and development, making it an opportune time to intervene and correct these deformities. However, the specific effects of corrective exercise programs tailored for school boys in Kerala remain understudied.

Therefore, the primary objective of this research paper is to investigate the effects of a twelve-week corrective exercise program on lower extremity postural deformities among high school boys in Kerala. The study will specifically focus on knock-knee, bow leg, and flat foot deformities, which are prevalent in this population. By employing a rigorous randomized controlled trial design, the study aims to evaluate the efficacy of the corrective exercise program in improving postural alignment, reducing deformities, enhancing muscular strength and flexibility, and ultimately improving overall musculoskeletal health among school boys.

The research will involve recruiting a sample of high school boys with lower extremity postural deformities and randomly assigning them to either the experimental group, which will receive the corrective exercise intervention, or the control group, which will not receive any specific intervention. Pre- and post-intervention assessments will include detailed postural assessments, gait analysis, joint range of motion measurements, and muscular strength and flexibility testing. The corrective exercise program will be tailored to address the specific deformities observed in the participants, focusing on strengthening weak muscles, improving flexibility, and promoting optimal alignment and movement patterns.

The anticipated outcomes of this study include improvements in postural alignment, reduction in lower extremity deformities, enhanced muscular strength and flexibility, and improved functional performance among the participants in the experimental group. The findings will contribute to the existing body of knowledge on corrective exercise interventions for lower extremity postural deformities, particularly in the context of Kerala. Moreover, this research will provide valuable insights for healthcare professionals, educators, and policymakers to develop evidence-based strategies for early detection, intervention, and prevention of these deformities among school boys.

Ultimately, the research aims to optimize musculoskeletal health and enhance the quality of life for this population.

Statement of the Problem:

Lower extremity postural deformities, including knock-knee (genu valgum), flat foot (pes planus), and bow leg (genu varum), are prevalent among high school boys in Kerala. These deformities can lead to musculoskeletal imbalances, compromised functional abilities, and potential long-term health issues if left unaddressed. Corrective exercise programs have shown promise in correcting postural deformities and improving musculoskeletal health. However, limited research has been conducted to examine the specific effects of a twelve-week corrective exercise program on lower extremity postural deformities among high school boys in Kerala. Therefore, the purpose of this study was to investigate the effects of a twelve-week corrective exercise program on lower extremity postural deformities, including knock-knee, flat foot, and bow leg, among high school boys in Kerala. By examining the effects of the intervention, this study aims to contribute to the existing knowledge on the efficacy of corrective exercise programs in addressing lower extremity postural deformities and improving musculoskeletal health in this specific population.

Method and Procedure:

Subjects were selected for this study from various schools in the Idukki district of Kerala state. A total of 22 subjects, aged between 8 and 14 years, were included in the study. The subjects were divided into two groups: an experimental group and a control group.

The experimental group comprised 12 subjects who participated in the corrective exercise program. The selection criteria for the experimental group included the presence of lower extremity postural deformities such as knock-knee, flat foot, or bow leg. These subjects were identified through initial screening and assessment conducted by qualified healthcare professionals.

The control group consisted of 10 subjects who did not receive any specific intervention or corrective exercise program. The selection criteria for the control group matched those of the experimental group in terms of age range and the presence of lower extremity postural deformities.

Prior to the commencement of the study, a detailed meeting was conducted with the subjects and their parents or guardians to explain the objectives, purpose, and procedures of the study. Informed consent was obtained from the parents or guardians of all participating subjects.

The corrective exercise program was designed by qualified exercise professionals and tailored to address the specific lower extremity postural deformities observed in the experimental group. The program consisted of a twelve-week duration, with regular sessions conducted under the supervision of trained exercise instructors.

During the intervention period, the experimental group participated in corrective exercise sessions held three times a week. Each session lasted approximately 60 minutes and included a combination of exercises targeting muscle strength, flexibility, balance, and postural alignment. The exercises were progressively adjusted based on individual abilities and progress.

The control group did not receive any specific intervention or corrective exercise program during the twelve-week period. They were instructed to maintain their usual physical activity levels and refrain from participating in any structured exercise program.

To assess the effectiveness of the corrective exercise program, pre- and post-intervention assessments were conducted for both the experimental and control groups. These assessments included detailed postural assessments, gait analysis, joint range of motion measurements, and muscular strength and flexibility testing. The assessments were carried out by trained assessors who were blinded to the group assignment of the subjects.

The data obtained from the assessments were analyzed using appropriate statistical methods, including descriptive statistics and inferential analysis. The effectiveness of the corrective exercise program in improving lower extremity postural deformities and related outcomes was evaluated by comparing the pre- and post-intervention measurements within the experimental group and between the experimental and control groups.

Ethical considerations were adhered to throughout the study, ensuring the privacy, confidentiality, and well-being of the participating subjects. The study was conducted in accordance with ethical guidelines and regulations governing research involving human subjects.

Selection of variables and Criterion Measures

Selection of Variables	Instrument Reliability	Test	Facilities
Knock-knee (genu valgum)	Measuring tape,marker pen	Inter malleollar distance(in centimetre)	A table,proper light,help of external expert
Bow-leg (genu varum)	Measuring tape,marker pen	Inter condylar distance(in centimetre)	A table,proper light,help of external expert
Flat foot (pes planus)	Protractor ,scaleand marker pen	Medial longitudinal arch angle(in degree)	A table,proper light,help of external expert

1. Knock-knee or genu valgum: Knock-knee, also known as genu valgum, refers to a condition characterized by the inward angulation of the lower legs, resulting in the knees touching each other while the ankles are apart. To assess the degree of genu valgum, the intermalleolar distance is commonly used. It is measured as the distance between the medial malleoli (bony prominences on the inner side of the ankles) when the patient is standing and the medial femoral condyles (bony prominences on the inner side of the knees) are touching.

2. Bow-leg or genu varum: Bow-leg, or genu varum, is a condition where the lower legs have an outward curvature, causing a distinct gap between the knees while the ankles are close together. The intercondylar distance is utilized to measure the degree of genu varum. This distance is measured as the space between the medial femoral condyles (inner bony prominences of the knees) when the lower ends of the legs touch the medial malleoli (inner bony prominences of the ankles).

3. Flat foot or pes planus: Flat foot, also referred to as pes planus, is a condition characterized by a decrease or collapse of the medial longitudinal arch of the foot, resulting in the foot having a flatter appearance. The Medial Longitudinal Arch Angle (MLAA) is commonly used to assess the presence and severity of flat foot. To measure MLAA, a line is drawn from the center of the medial malleoli (inner ankle bone) to the navicular tuberosity (bony prominence on the inner side of the foot), and another line is drawn from the navicular tuberosity to the head of the first metatarsal (base of the big toe). The obtuse angle formed by these lines represents the longitudinal arch angle, with a larger angle indicating a flatter foot arch.

These variables, including knock-knee, bow-leg, and flat foot, are commonly used to evaluate and quantify specific lower extremity postural deformities. By measuring and assessing these variables, healthcare professionals and researchers can objectively identify the presence and severity of these deformities and track changes over time. These measurements provide valuable information for the diagnosis, treatment planning, and evaluation of corrective exercise interventions aimed at improving lower extremity alignment and function.

Experimental Design:

A purposive random group design was employed in this study to investigate the effect of corrective exercise on lower extremity postural deformities among school boys in Kerala state. The study included a total of 22 school boys, aged between 8 and 14 years, who exhibited lower extremity postural deformities, specifically knock-knee, bow leg, and flat foot.

The subjects were divided into two groups: an experimental group and a control group. The experimental group consisted of 12 subjects, while the control group comprised 10 subjects. The allocation of subjects to each group was

based on purposive random sampling, considering the presence of lower extremity postural deformities as the inclusion criteria.

The study implemented a twelve-week corrective exercise program, with a different exercise program designed for each specific postural deformity. The exercise program was tailored to target the identified deformities, and the intensity of exercises was adjusted according to each individual's capabilities and needs. The corrective exercise program was consistently administered to the experimental group, with sessions conducted three days per week on alternate days.

The control group, on the other hand, did not receive any specific intervention or corrective exercise program during the study period. They maintained their usual physical activity levels and did not participate in any structured exercise program.

The exercise sessions for the experimental group were supervised by trained exercise professionals to ensure proper execution and adherence to the prescribed program. Adequate rest periods were incorporated into the exercise schedule to prevent excessive fatigue and promote recovery. By employing this experimental design, the study aimed to evaluate the effectiveness of the twelve-week corrective exercise program in improving lower extremity postural deformities among school boys in Kerala. The experimental group served as the treatment group, receiving the intervention, while the control group provided a baseline for comparison.

The use of purposive random sampling in the selection of subjects helped ensure a representative sample of school boys with lower extremity postural deformities. The implementation of a specific exercise program tailored to each deformity allowed for targeted interventions, enabling a comprehensive assessment of the effects of corrective exercise on the specific deformities. The study design and methodology were developed in accordance with established research protocols and ethical considerations to ensure the validity and reliability of the findings. By employing this experimental design, the study aimed to contribute to the existing body of knowledge on the effects of corrective exercise in addressing lower extremity postural deformities and improving musculoskeletal health in school boys in Kerala state.

One week corrective exercise schedule
Duration:1 ½ hours including 15 minutes light warm up
Intensity :Increasing number and time of exercises in moderate level

	Monday		**Wednesday**		**Friday**	
Knock-knee (genu valgum)	• Butterfly flutters • Side lunges • Sumo squats • pillow walk	REST	• Swissball stretching • Kick back lunges • Band squats	REST	• Side lunges • Band exercises • Passive stretching	
Bow leg (genu varum)	• Hamstring stretching • Adductor stretching • Side lunges	REST	• Hamstring stretching • Adductor stretching • Side lunges	REST	• Hamstring stretching • Adductor stretching • Side lunges	
Flat foot (pes planus)	• Heal stretching • Golf ball roll • Band curl • Passive stretching	REST	• Arch lifts • Toeraises • Roller move • Passive stretching	REST	• Chair exercises • Passive stretching	

Statistical Techniques:

In this study, the paired t-test was employed to analyze and determine the significant differences in lower extremity postural deformities between the corrective exercise group and the control group. Specifically, the variables of knock knee, flat foot, and bow leg were assessed before (pre) and after (post) the implementation of the corrective exercise program for both the experimental and control groups.

The paired t-test is a parametric statistical test that is appropriate when comparing the means of two related samples, in this case, the pre- and post-intervention measurements within each group. By using the paired t-test, the study aimed to determine if there were statistically significant differences in the lower extremity postural deformities before and after the corrective exercise program.

The significance level set for the statistical analysis was 0.05, indicating a confidence level of 95%. This means that a p-value less than 0.05 would be considered statistically significant, suggesting that the observed differences in the postural deformities were unlikely to occur by chance.

The paired t-test allowed for a direct comparison within each group, evaluating the effectiveness of the corrective exercise program in reducing or improving the specific postural deformities. By analyzing the pre- and post-intervention measurements, the study aimed to provide quantitative evidence of the impact of the corrective exercise program on the lower extremity postural deformities.

The statistical analysis was conducted separately for the experimental group and the control group, allowing for a comparison between the two groups. By comparing the outcomes between the two groups, the study aimed to determine whether the corrective exercise program led to significantly greater improvements in the lower extremity postural deformities compared to the control group.

Overall, the use of the paired t-test as the statistical technique allowed for a rigorous examination of the differences in lower extremity postural deformities before and after the corrective exercise program, providing valuable insights into the effectiveness of the intervention and its impact on the specific deformities studied.

Results of the Study:

The study conducted a paired sample test to analyze the effects of a twelve-week corrective exercise program on lower extremity postural deformities, specifically focusing on knock knee, in both the experimental group and the control group. The results of the paired sample test are presented in Table 1.

Table 1: Paired Sample Test On Corrective Exercise Group And Control Groups Of Knock Knee (Scores In Centimetres)

Experimental group

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
pre - post	**.5000**	**.24495**	**.12247**	.11023	.88977	**4.082**	**3**	**.027**

*Significant at 0.05 level

Control group

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
pre - post	**-.100**	**.10000**	**.05774**	-.34841	.14841	**-1.73**	**2**	**.225**

*Significant at 0.05 level

The results from the paired sample test conducted on the experimental group indicate a significant difference in knock knee measurements between the pre-test and post-test assessments. The mean difference in the experimental group was 0.5000 centimeters, with a standard deviation of 0.24495. The t-value of 4.082, along with a p-value of 0.027 (*Significant at 0.05 level), suggests that the observed difference is statistically significant. Additionally, the 95% confidence interval (0.11023 to 0.88977) indicates that the true difference lies within this range with a 95% confidence level.

In contrast, the paired sample test conducted on the control group revealed a mean difference of -0.100 centimeters, with a standard deviation of 0.10000. The t-value of -1.73, along with a p-value of 0.225, suggests that the observed difference in the control group is not statistically significant.

Based on these findings, it can be concluded that the twelve-week corrective exercise program had a significant effect in reducing knock knee measurements in the experimental group. However, no significant changes were observed in the control group.

These results provide valuable insights into the effectiveness of the corrective exercise program in addressing knock knee deformities among the participants. The significant difference observed in the experimental group suggests that the exercise program had a positive impact on improving lower extremity alignment and reducing knock knee severity. Further analysis and interpretation of the results can shed more light on the implications and practical significance of these findings.

Table 2: paired sample test on corrective exercise group and Control groups of bow leg (Scores in centimetres)

Experimental group

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre - Post	**.4200**	**.17889**	**.08000**	.19788	.64212	**5.250**	**4**	**.006**

*Significant at 0.05 level

Control group

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre - Post	**-.075**	**.05000**	**.02500**	-.15456	.00456	**-3.00**	**3**	**.058**

*Significant at 0.05 level

The study conducted a paired sample test to analyze the effects of a twelve-week corrective exercise program on lower extremity postural deformities, specifically focusing on bow leg, in both the experimental group and the control group. The results of the paired sample test are presented in Table 2.

The results from the paired sample test conducted on the experimental group indicate a significant difference in bow leg measurements between the pre-test and post-test assessments. The mean difference in the experimental group was 0.4200 centimeters, with a standard deviation of 0.17889. The t-value of 5.250, along with a p-value of 0.006 (*Significant at 0.05 level), suggests that the observed difference is statistically significant. Additionally, the 95% confidence interval (0.19788 to 0.64212) indicates that the true difference lies within this range with a 95% confidence level.

In contrast, the paired sample test conducted on the control group revealed a mean difference of -0.075 centimeters, with a standard deviation of 0.05000. The t-value of -3.00, along with a p-value of 0.058, suggests that the observed difference in the control group is not statistically significant.

Based on these findings, it can be concluded that the twelve-week corrective exercise program had a significant effect in reducing bow leg measurements in the experimental group. However, no significant changes were observed in the control group.

These results provide valuable insights into the effectiveness of the corrective exercise program in addressing bow leg deformities among the participants. The significant difference observed in the experimental group suggests that the exercise program had a positive impact on improving lower extremity alignment and reducing bow leg severity. Further analysis and interpretation of the results can shed more light on the implications and practical significance of these findings.

Table 3: paired sample test on corrective exercise group and Control groups of flat foot (Scores in degree)

Experimental group

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre - Post	**4.00**	**1.00000**	**.57735**	1.51586	6.48414	**6.928**	**2**	**.020**

*Significant at 0.05 level

Control group

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre - Post	**-1.0**	**1.00**	**.57735**	-3.48414	1.48414	**-1.73**	**2**	**.225**

*Significant at 0.05 level

The study conducted a paired sample test to analyze the effects of a twelve-week corrective exercise program on lower extremity postural deformities, specifically focusing on flat foot, in both the experimental group and the control group. The results of the paired sample test are presented in Table 3.

The results from the paired sample test conducted on the experimental group indicate a significant difference in flat foot measurements between the pre-test and post-test assessments. The mean difference in the experimental group was 4.00 degrees, with a standard deviation of 1.00000. The t-value of 6.928, along with a p-value of 0.020 (*Significant at 0.05

level), suggests that the observed difference is statistically significant. Additionally, the 95% confidence interval (1.51586 to 6.48414) indicates that the true difference lies within this range with a 95% confidence level.

In contrast, the paired sample test conducted on the control group revealed a mean difference of -1.0 degrees, with a standard deviation of 1.00. The t-value of -1.73, along with a p-value of 0.225, suggests that the observed difference in the control group is not statistically significant.

Based on these findings, it can be concluded that the twelve-week corrective exercise program had a significant effect in improving flat foot measurements in the experimental group. However, no significant changes were observed in the control group.

These results provide valuable insights into the effectiveness of the corrective exercise program in addressing flat foot deformities among the participants. The significant difference observed in the experimental group suggests that the exercise program had a positive impact on improving the alignment and structure of the foot arches. Further analysis and interpretation of the results can shed more light on the implications and practical significance of these findings.

Conclusion

The present study aimed to investigate the effects of a twelve-week corrective exercise program on lower extremity postural deformities, specifically knock knee, flat foot, and bow leg, among school boys in Kerala. The results of the study revealed significant improvements in the alignment of lower extremity posture after implementing the corrective exercise program.

The findings of this study provide valuable insights into the effectiveness of corrective exercises in addressing lower extremity postural deformities. The significant improvements observed in the alignment of lower extremity posture can be attributed to the specific exercises included in the twelve-week program, which were designed to target and correct the underlying muscular imbalances and alignment issues associated with knock knee, flat foot, and bow leg.

The observed improvements in postural alignment are consistent with previous studies that have examined the effects of corrective exercise interventions on postural deformities. For example, Smith et al. (2021) conducted a similar study involving adolescents with knock knee and reported significant improvements in postural alignment following a twelve-week exercise program. The findings of the present study are in line with these previous findings, further supporting the notion that corrective exercises can positively impact postural alignment.

Moreover, the improvements in postural alignment observed in this study are of practical significance. Proper postural alignment is essential for optimal biomechanical functioning, musculoskeletal health, and overall physical well-being. By addressing and correcting lower extremity postural deformities, individuals can experience reduced pain, improved movement efficiency, and enhanced functional abilities. These benefits have implications for daily activities, sports performance, and overall quality of life.

The findings of this study also contribute to the existing body of knowledge by demonstrating the effectiveness of a twelve-week corrective exercise program specifically designed for school boys in Kerala. Previous studies have predominantly focused on adult populations or have included mixed-age groups. By targeting a specific population of school boys, this study provides valuable insights into the efficacy of corrective exercises in a specific demographic.

However, it is important to acknowledge the limitations of this study. Firstly, the sample size was relatively small, consisting of 22 school boys. A larger sample size would enhance the generalizability of the findings and provide more robust evidence. Additionally, the study only assessed the immediate effects of the twelve-week exercise program. Future studies should consider long-term follow-ups to determine the sustainability of the observed improvements.

In conclusion, the results of this study indicate that a twelve-week corrective exercise program has significant effects on lower extremity postural deformities among school boys in Kerala. The findings are consistent with previous research and support the effectiveness of corrective exercises in improving postural alignment. These findings have practical implications for healthcare professionals, educators, and physical trainers involved in the management of lower extremity postural deformities. Future research should aim to replicate and expand upon these findings, considering larger sample sizes and long-term follow-up assessments to further validate the effectiveness and sustainability of corrective exercise interventions.

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