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"Efficacy of a Structured Physical Education Curriculum on Bio-Motor Development among Preadolescent School Children: A Study on Balance and Coordination"

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ABSTRACT

Bio motor ability underlies the performance of a wide range of motor skills and serves as the criterion through which physical fitness is assessed. Dexterity denotes skill and grace in fine hand movement, while handedness reflects an individual's preferred use of the right or left hand for a given task. This study examined the impact of a model physical education curriculum on coordination and balance among dexterous preadolescents.

Forty right-hand-dominant students, aged 10-13 years, from Smart Mission High School, Anantnag, Jammu and Kashmir, India, were randomly divided into experimental and control groups (n=20 each). The experimental group underwent a 15-week curriculum (4 days/week, 45 minutes/session) comprising physical exercises (Part A), yogic asanas (Part B), and recreational activities (Part C), inclusive of warm-up and cool-down.

Hand-screwing coordination (Bennett Hand-Tool Dexterity Test) and hand steadiness (Whipple's Steadiness Tester) for both hands were measured before and after the intervention as dependent variables. Data were analyzed using ANCOVA, with an independent t-test applied to compare left- and right-hand performance, and percentage improvement calculated to assess dexterity gain.

The level of confidence was set at 0.05. Adjusted post-test means revealed that the physical training group outperformed the control group on all four measures: hand screwing coordination (right hand: 1.26 vs 1.35, F=55.10; left hand: 1.38 vs 1.46, F=38.61) and balance (right hand: 55.28 vs 50.75, F=97.50; left hand: 37.86 vs 26.91, F=169.07), all significant at the 0.05 level (df 1,37; table value 4.11). Independent t-test comparisons between right and left hand showed no significant difference in the magnitude of improvement for coordination (t=0.11) or balance (t=1.54).

However, percentage gain was consistently higher for the right hand than the left-hand coordination improved by 4.95% (R.H) versus 2.22% (L.H), and balance improved by 12.38% (R.H) versus 11.50% (L.H). These findings confirm that the model physical education curriculum significantly improved both coordination and balance in the experimental group compared to the control group, with the dominant (right) hand showing a marginally greater rate of improvement.

Keywords: Physical education curriculum, Dexterous coordination, and Balance.

INTRODUCTION

Curriculum serves as the vehicle through which the aims of education are realized aims that are not fixed but evolve alongside changing social needs. It encompasses every experience a child undergoes under the guidance of school authorities, representing the ongoing interaction among and between pupils **(Hamilton and David 2014)**. Physical education stands apart from other curricular domains because of its central emphasis on the body and physical experience, making it an indispensable part of a child's overall education no child's schooling can be considered complete without it.

The curriculum includes activities that build and refine skills such as running, catching, throwing, and striking, which carry over into sports like baseball, volleyball, or karate, while balance-related skills transfer to pursuits such as dance or gymnastics.Dexterity is generally understood as a function of motor control the coordination of muscle movement, typically synchronized with the eyes and can also be described as the quality of motor skill present in the hands and fingers **(Baum C, 1995)** and **(Clark, Czaja, & Weber, 1990)**. It refers specifically to the fine motor skills involved in hand use, entailing coordination among the small muscles of the hands and fingers in conjunction with visual input. The intricate level of manual dexterity seen inhumans reflects the nervous system's role in governing such tasks. Fine motor skill development, in turn, supports cognitive growth and continues to progress across the stages of human development.

The physiological system, including the neuromuscular system, adapts to physical training in direct proportion to the training stimulus applied. Hand-related abilities evolve gradually, beginning with rudimentary actions like grasping objects and advancing toward more precise, coordinated movements. Fine motor skills specifically involve the refined use of the small muscles that control the hand, fingers, and thumb. What matters is not simply whether a person is right- or left-handed, but the strength of their preference for one hand over the other. A more contested view holds that individuals are not strictly right or left-handed but rather strong-handed or mixed-handed **(Guiard, Y. 1987)**.

Balance refers to the capacity to keep the body upright and stable without losing footing, whether sitting, standing, walking, or running. It represents a foundational component of child development, as children must first acquire balance before advancing to more complex gross motor skills such as cycling, hopping, galloping, or skipping.Coordination denotes the capacity to perform a sequence of movements repeatedly, smoothly, and accurately, drawing on sensory input, muscular contraction, and joint movement alike.

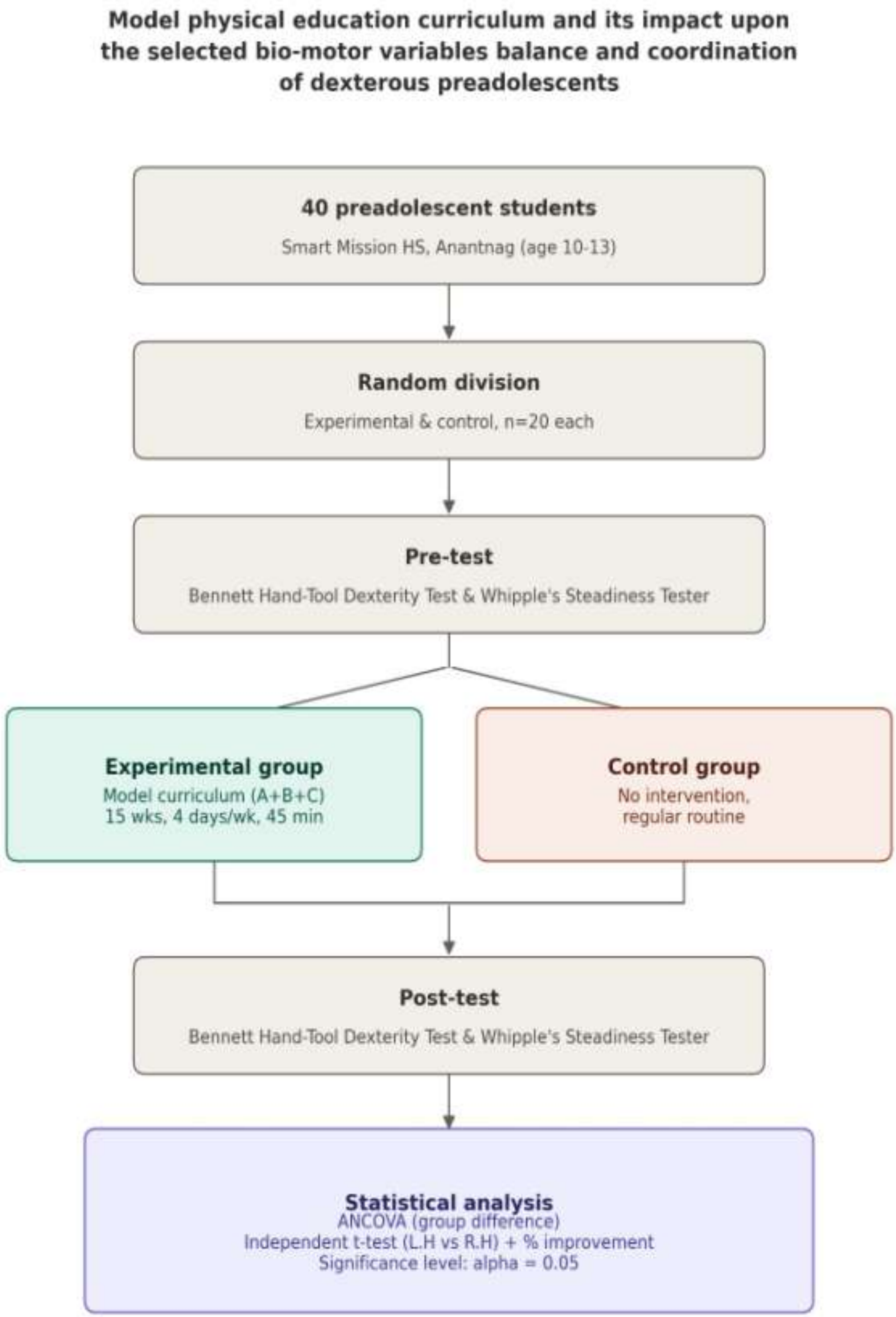
Virtually every physical activityfrom simple walking to complex athletic feats such as the pole vault depends on the ability to coordinate the limbs toward a successful outcome. All sports call for coordination between the eyes, hands, and/or feet, often alongside an implement or a ball. Racket sports such as tennis and squash, for instance, demand coordination of hand, eye, and racket to make contact with an incoming ball, together with correct body positioning to return it effectively **(Kasimatis, M. et al. 1996)**.

METERIAL AND METHODS

For this purpose, 40 preadolescent students with right-hand dominance were recruited as subjects from Smart Mission High School, Anantnag, Jammu and Kashmir, India, with ages spanning 10 to 13 years. Participants were split into two equal groups of 20 each, designated as the experimental and control groups. Only the experimental group received the model physical education curriculum, which was structured around three components: Part A, consisting of physical exercises; Part B, consisting of yogic postures; and Part C, a recreational segment.

The physical exercise component combined basic conditioning drills with specialized tasks such as alternating basketball bounces with the right and left hand, alternating wall-catch drills, two-handed ball juggling, and target-throwing practice for both hands. The yogic component drew on postures such as Dhanurasana, Bhujangasana, and Ananda Balasana, among others. The recreational segment was included to give students a break after the physical and yogic portions, allowing them to approach the curriculum as enjoyable rather than strenuous, while also readying them for subsequent sessions. To promote physiological adaptation in coordination and balance, the load and intensity of the exercises were raised by 5% every three weeks.

This curriculum ran for a total of 15 weeks, held four days per week for 45-minute sessions that included both warm-up and cool-down periods. Hand-screwing coordination and balance served as the study's criterion variables, assessed using the Bennett Hand-Tool Dexterity Test and Whipple's Steadiness Tester. Right- and left-hand performance on coordination and throwing accuracy were recorded for both groups and compared statistically through ANCOVA to test for significant differences. An independent t-test was additionally used to compare right-hand and left-hand performance, and percentage gains were computed to quantify the degree of improvement in dexterity. Statistical significance was evaluated at the 0.05 level of confidence**.**



FLOW CHART PRESENTS METHOD OF EXPERIMENTAL DESIGN

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Table no. 1: ANCOVA for Coordination and Balance. Adjusted posttest Mean

VARIABLE	Dexterous	Physical training group	Control group	SOV	Sum of squares	df	Mean square	F" ratio
Hand screwing coordination	R.H	1.26	1.35	B	0.072	1	0.072	55.10*
				W	0.048	37	0.001	
	L.H	1.38	1.46	B	0.056	1	0.056	38.61*
				W	0.054	37	0.001	
Balance	R.H	55.28	50.75	B	185.58	1	185.58	97.50*
				W	70.42	37	1.90	
	L.H	37.86	26.91	B	165.76	1	116.71	
				W	225.12	37	6.90	169.07*

R.H-right hand, L.H-left hand, SOV-source of variance, df-degree of freedom. Significance at .05 level of confidence. The table value required for significance at 0.05 level of confidence for 1 and 37 is 4.11.

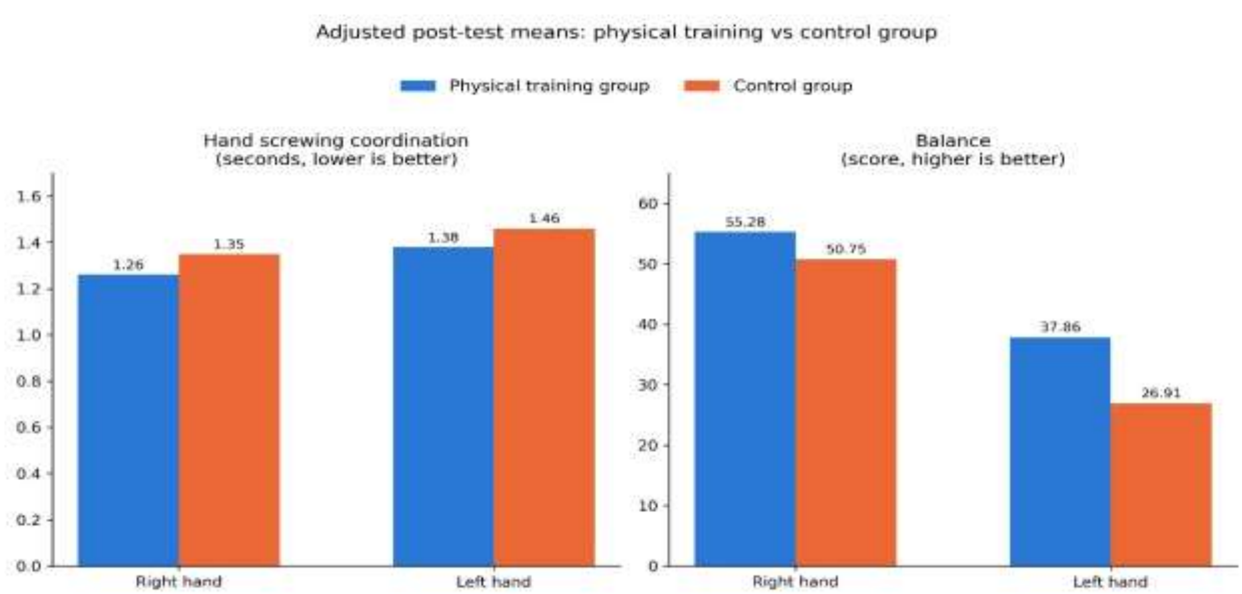
The table shows that there was significant difference between the adjusted post test mean of both physical training and control group on right- and left-hand balance and coordination. To find out the improvement on dexterous level independent "t" ratio was calculated with the magnitude of distance percentage.

Table no.2

Variable	DEXTEROUS	Mean	SD	"t"value	Magnitude of distance in%
Hand screwing coordination	R.H	0.12	0.08	0.11	4.95%
	L.H	0.11	0.15		2.22%
Balance	R.H	0.94	0.78	1.54	12.38%
	L.H	0.65	0.33		11.50%

Significance at .05
The table value required for signifance at 0.05 level of confidence for 38 is 2.03 respectively.

Bar graph shows posttest mean (adjusted) difference between training and control groups



RESULT, DISCUSSION, CONCLUSION

Result

The table indicates a significant difference between the adjusted post-test means of the physical training and control groups for both right- and left-hand balance and coordination. To assess the extent of improvement in dexterity, an independent t-ratio was computed alongside the percentage magnitude of change. The t-value results, however, reveal no significant difference between the right and left hand in terms of maximum strength.

Discussion

These findings affirm that the model physical education curriculumcomprising Part A (physical exercises), Part B (yogic asanas), and Part C (recreational activities)exerted a notable influence on strength, with the physical exercise and yogic components proving particularly effective. Together, these components positively influenced the body's neuromuscular system, thereby contributing to improved dexterity among preadolescent schoolboys. These outcomes align with findings reported by other researchers in the field.The present investigation demonstrated that coordination and balance related to dexterity can be enhanced through a model physical education curriculum. Its results underscore the significance of coordination and balance in dexterity development and highlight their relevance to both sport-related tasks and everyday activities. Coordination refers to the smooth integration of movements, while balance enables those movements to be executed accuratelytypically involving the simultaneous engagement of the upper and lower body. Together, coordination and balance constitute skill-related components of physical fitness.

Conclusion

The study concluded that a model physical education curriculum built around a structured set of exercises contributes to improved coordination and balance in dexterous hand function.Thedominant hand exhibited greater gains overall, while the non-dominant hand also showed measurable improvement in both bio-motor variables coordination and balance relative to baseline levels.

IMPLICATION

These findings shed light on how physical training delivered through a structured curriculum can enhance dexterity. Individuals with well-developed dexterity are better equipped to perform tasks using both hands simultaneously without experiencing fatigue. For physical educationists and coaches, these results offer practical value in strengthening the dexterity of athletes across various sports, enabling more effective use of both the dominant and non-dominant hand during physical activity. Ambidexterity, in particular, can offer athletes a distinct advantage during competitive play.

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