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Effect Of Reactive Agility Drills Using Fitlight System On Selected Motor Fitness And Psychological Variables Among Students With Hearing Impairment

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Abstract:

Background: Agility training is crucial for enhancing physical and psychological well-being, particularly among individuals with disabilities such as hearing impairment. TheFITLIGHT system offers a novel approach to agility training, utilizing visual cues to improve reactive agility skills.

Objective: This study aimed to investigate the effects of reactive agility drills using the FITLIGHT system on selected motor fitness (agility,balance, coordination) and psychological variables (attention and working memory) among students with hearing impairment.

Methods: Repeated measures of designemployed with a sample of 30 students (mean age [14] years) diagnosed with varying degrees of hearing impairment. Participants underwent a structured agility training program using the FITLIGHT system over 6 weeks, with sessions conducted 3 times weekly. Motor fitness variables were assessed using standardized agility tests(Illinois Agility Test), balance (stork balance test), coordination (alternate hand wall toss) Psychological variablesattention and working memory (trail making test A and B). Data were analysed using Normality Test (Shapiro-Wilk Test), Homogeneity of Variance (Mauchly's Test) For comparing mean score of dependent variables within subject (one-way repeated measures of ANOVA) was used.

Results: Summarize key findings related to motor fitness and psychological variables. Significant improvements were observed in motor fitness variables post-intervention, including agility ($p < 0.05$), speed ($p < 0.05$), and balance ($p < 0.05$). Psychological assessments revealed enhanced attention and working memory ($p < 0.05$) among participants following the agility training program.

Conclusion: The findings suggest that reactive agility drills using the FITLIGHT system can effectively enhance both motor fitness and psychological variables among students with hearing impairment. Incorporating such technology-driven interventions into physical education and rehabilitation programs may contribute positively to the overall well-being and functional capabilities of individuals with sensory disabilities.

INTRODUCTION:

It is necessary to introduce fitness interventions that coincide with the population in tailor-made manner to aid in the overall wellness of the students having hearing impairment. A confluence of reactive agility drills with FITLIGHT training could provide an effective approach to improve motor fitness as well as psychological variables. The present study was designed to test the effectiveness of this approach, and how it can be used to the advantage of people with hearing impairment.

A common tool used to improve some of the physical attributes and motor abilities of athletes is called FITLIGHT. The equipment is simple to install at the location or building where training is given. To use a variety of workouts and exercises, lights can be mounted on walls, floors, tennis courts, balls, baskets, hockey pitches, and football pitches. One tool that is widely utilized in sports around the world is called FITLIGHT, and it has the potential to significantly improve young basketball players' physical, skill, and visual performance levels (FITLIGHT®SYSTEM, 2022) Players benefit from FITLIGHT by developing their physical, consensual, and visual capabilities as well as their basic skills and overall performance in many sports. As a result, a notable increase in responsiveness, agility, and compatibility is produced, which contributes to the development of an advanced and well-rounded athlete (Wisnu et al., 2022). Additionally, it tries to increase awareness among experts and instructors regarding the significance of FITLIGHT reactive agility training. The study also emphasizes how important FITLIGHT is in helping players to enhance their sports performance. There is also discussion of the significance of training in accordance with a person's talents. It is very much important to discover the requirements of different sports players to capacitate them to use reactive agility training in line with their skill and physical abilities.

It is speed and cognitive training system which act as a blue print to transform the way of exercise, training system and the way which we measure the individual or team performance. In this training is magnify instead of its replacement. That is why this product will always enhance the training regime not matter what it is. FITLIGHT uses patented wireless light sensors and proprietary training program to challenge users with engaging powerful tasks

Hearing is one of the most important perceptions for communication between people. Hearing impairment is defined as an insufficient ability to perceive sounds (Uysal S. et al., 2010). Language and vocabulary are abilities that contribute to the formation of a child's personality (Gkouvatzi AN et al., 2010). Hearing, vision, touch, and other senses are responsible for providing inputs that result in motor responses. Impaired sensations might have an impact on motor skill development (Stevens G et al., 2013). According to

Department of Education and Skills (DES) circulars, hearing impairment is defined as a hearing disability that significantly impairs students' ability to hear and understand human speech, preventing them from fully participating in classroom interactions and benefiting adequately from school instruction. It is also noted that most of these pupils have been prescribed hearing aids and/or cochlear implants and will benefit from the Visiting Teacher Service (Helsel, 1987).

Causes of hearing loss include HI sensory losses, can be caused by environmental or hereditary factors. Prolonged exposure to high-intensity sound can negatively impact auditory function and reduce hearing thresholds. A sudden loud noise can cause acoustic trauma, resulting in temporary or permanent hearing loss. Various environmental conditions, including viral infections, neonatal anoxia, and hyperbilirubinemia, can cause permanent HI. Long-term use of ototoxic medicines like aminoglycoside and gentamicin antibiotics can harm the auditory system and cause hearing abnormalities (Yorgason et al., 2006). Environmental factors, unlike genetics, can be mitigated or prevented by raising awareness and implementing appropriate protective measures.

Hearing abnormalities can be caused by genetic damages, creating additional obstacles. Hearing loss's clinical heterogeneity is defined by common classifications based on a variety of factors, including onset, severity, and the existence of clinical manifestations other than deafness. Prelingual deafness refers to hearing loss that occurs before speech acquisition and can be congenital or arise after birth. A hearing loss that develops early in life can have a significant impact on language learning. Age-related hearing loss (ARHL) is common among the elderly and is impacted by genetic and environmental variables (Cruickshanks et al., 1998).

Reactive Agility Training (RAT) is a kind of exercise that is frequently used to try to increase speed and agility. According to (Holmberg, 2009), using RAT can help athletes read and respond to stimuli better, which can improve their agility performance by enhancing their anticipatory and/or decision-making responses to movement (Sheppard et al., 2006). Therefore, might be defined as anticipating events and/or making choices quickly and changing direction or pace in reaction to them (Oliver and Meyers, 2009). With the support of the lateral mirror drill and sprint mirror drill exercise models, RAT can be utilized to increase agility (Holmberg, 2009). The capacity to maintain and regulate one's body's position when quickly changing directions is known as agility (Sporis et al., 2010). Additionally, an athlete's agility should be flexible, efficient, and repeatable to change directions, halt quickly, and perform fast movements (Sporis et al., 2010). Further, agility is the ability to keep one's body in control when making rapid direction changes during a sequence of movements (Bal et al., 2011).

Speed, flexibility, and balance are necessary components of good agility (Bompa, 2015). The result of a complicated interaction of power, speed, coordination, and flexibility is agility. The result of a complicated interaction of strength, flexibility, speed, and coordination is agility. It is possible to view agility as the result of a complicated interplay between strength, speed, coordination, and flexibility. The capacity to alter one’s body posture and direction of movement rapidly and precisely while maintaining balance is known as agility. The skills of speed, flexibility, and balance are closely related to agility. Someone cannot move with good agility if these three factors are not supported. A muscle or a group of muscles' speed is its capacity to react to stimuli as quickly or as efficiently as feasible. The capacity to move continuously in the same direction in the least amount of time is known as velocity or speed (Bompa, 2015). Therefore, speed can be defined as the capacity to complete a series of comparable movements in the shortest amount of time or the capacity to cover a distance in the shortest amount of time.

The brain system known as working memory oversees temporally keeping and manipulating the data required for learning, reasoning, and language comprehension—all of which are basic cognitive functions (Baddeley, 1992, 2010). Working memory can only store a limited quantity of information, such as countable items or abstract concepts (Cowan, 2014). Adults' working memory capacity has been estimated to be within three and four things (Cowan, 2001; Luck & Vogel, 1998; also, Cowan 2016). According to (Cowan, Nugent, Elliott, Ponomarev, & Saults, 1999; Cowan, Elliott et al., 2005; Riggs, McTaggart, Simpson, & Freeman, 2006; Simmering, 2012; see Cowan 2016) preschoolers and early primary school students can retain two or three objects in their working memory.

Short-term memory is used to store information for a brief period (e.g., remembering a phone number), whereas working memory is used to handle information during a complex cognitive process (e.g., remembering numbers while reading a paragraph). Working memory and short-term memory are different memory systems that represent different cognitive functions (Aben et al., 2012). In addition, the number of components that make up working memory—the central executive, the phonological loop, the episodic buffer, and the visuospatial sketchpad—distinguishes it from short-term memory (Goldstein, 2015).

METHODOLOGY

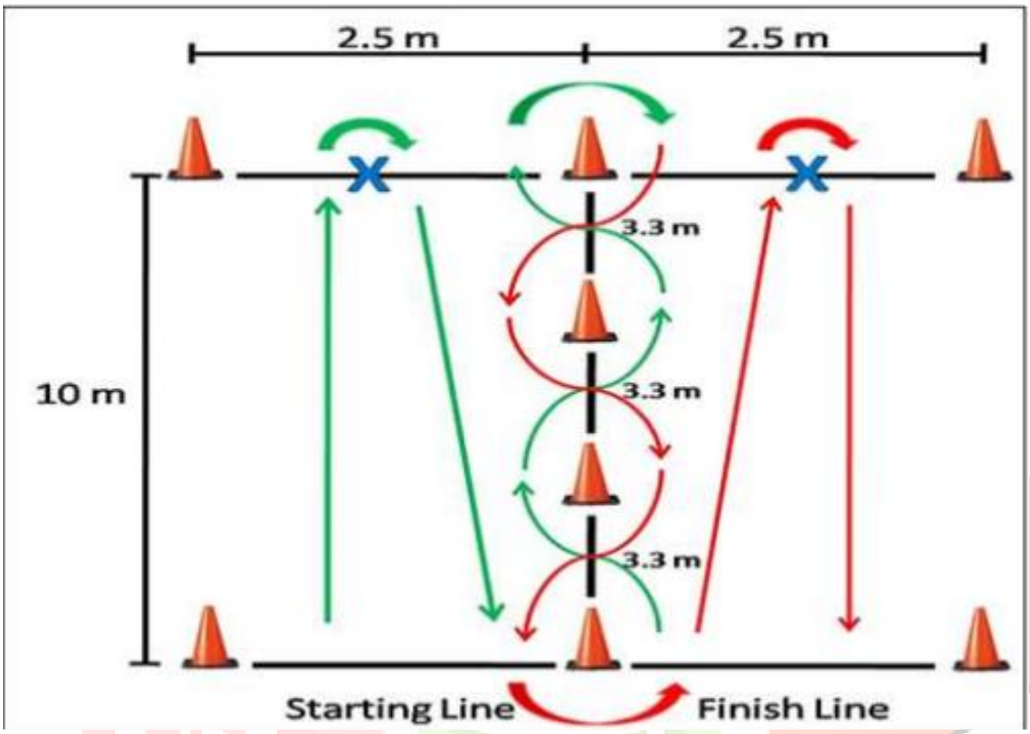
Materials: FITLIGHT, Stopwatch, Tennis Ball, Ladders, Cones, pen Trail making sheet (A and B)

Study Design: Repeated measures design (within subject) has been used to determine the effect of treatment on dependent variables (agility, balance, coordination, attention and working memory) at different time interval. The subjects have been tested for different interval times as follows.Pre data was taken from all the 30 subjects(18 males and 12 females)of age group 13-15 years (Hearing impairment students).Pre data was collected before giving any kind of training after that 3 weeks of training was given to them and mid data was collected and again 3 more weeks of training was given and post data was collected from all the 30 subjects

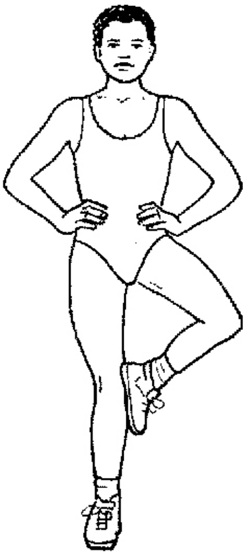
Selection of subjects: Total 30 subjects with special need (hearing impaired), were randomly selected for the present study from Mahant Gurbanta Das school, Bathinda. Based on the available literature in the library of central university of Punjab pertaining to motor fitness and psychological variable following variables were selected for this study:Independent Variables(Reactive agility drills using FITLIGHT training)Dependent Variables (Agility,Balance,Coordination,Attention and Working Memory)

DATA COLLECTION:

Agility: The Illinois Agility Test (IAT) assesses agility by having participants navigate a course marked with cones. Originally 30 feet but standardized to 10 meters for practicality, the course includes four center cones spaced 3.3 meters apart and four corner cones 2.5 meters from the center cones. Starting prone behind a line, participants rise at the command "go," sprint to touch the first tape mark, weave through the center cones, return to the start, sprint to touch the second tape mark, and finish by crossing the line. Time in seconds for each trial is recorded, with disqualification for deviations, failure to touch marks, incomplete runs, or cone displacement (adapted from Michele A. Raya et al., 2013). Each subject will get single chance to complete the test and the time will be recorded in seconds. Norms of the test are as follows.



Balance: The Stork Balance Stand Test is designed to assess an individual's balance. To perform this test, the participant removes their shoes, places their hands on their hips, and positions the non-supporting foot against the inside knee of the supporting leg. The goal is to balance on the ball of the supporting foot, lifting the heel off the ground, with the stopwatch starting at this point. The participant has one minute to achieve a stable balance. The test concludes if the hands leave the hips, the supporting foot swivels or hops, the non-supporting foot loses contact with the knee, or the supporting heel touches the floor. The total time in seconds is recorded. The score is the best of three attempts. Norms of the test are given in the next page.



Rating	Score (seconds)
Excellent	>50
Good	40-50
Average	25-39
Fair	10-24
Poor	<10

Coordination: The Alternate-Hand Wall-Toss Test is designed to assess hand-eye coordination. In this test, participants throw a ball underarm against a wall from behind a line, which is positioned a set distance away (e.g., 2 meters or 3 feet). The ball must be caught with the opposite hand before being thrown back and caught with the initial hand. This sequence continues either for an unlimited number of attempts or within a fixed duration, such as 30 seconds, to introduce the element of performing under time pressure. Performance is scored based on the number of successful catches within the given time, with general ratings provided to interpret the results.

Rating	Score (in 30 seconds)
Excellent	>35
Good	30 – 35
Average	20- 29
Fair	15 – 19
Poor	< 15

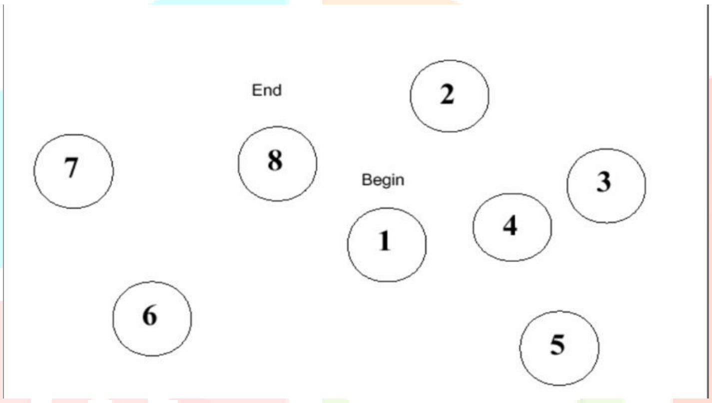
All aspects of this test can be altered to achieve the desired results: the size, weight, and shape of the object, the distance from the wall, the number of attempts, and the time can all be changed. The process and results should be documented and kept consistent for future testing with the same individuals.

Attention and working memory : The Trail Making Test (TMT) is used to evaluate attention and working memory. It has two parts, A and B, and requires the participant to use a pencil. Timing begins for each part as soon as the instructions are given and the participant starts. Timing continues without interruption until the participant finishes the task or reaches the discontinuation points

Administration of Part A:

Trails A Sample

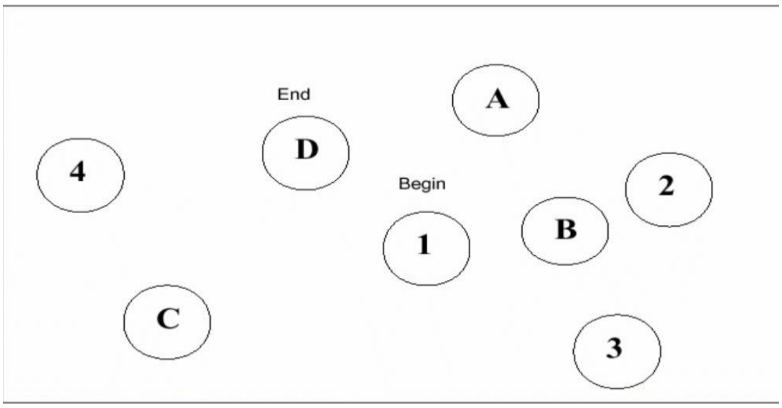
Say to the participant, "On this page are some numbers (place the Trails A form sample side up in front of the participant and point to the numbers in the sample box). Begin at number 1 (point) and draw a line from 1 to 2 (pointing), 2 to 3 (pointing), 3 to 4 and so on, in order, until you reach the end (point to the circle marked 'end'). Begin here (point to number 1) and draw your line as fast as you can. Ready! Go!"



Administration of Part B:

Trails B Sample

Say to the participant, "On this page are some numbers and letters. (Place Trails B in front of the participant and point to the sample box) Begin at 1 (point) and draw a line from 1 to A (point) from A to 2 (point), from 2 to B (point), from B to 3 (point) from 3 to C and so on in order until you reach the end (point). Remember, first you have a number then a letter, then a number then a letter and so on. Draw your lines as fast as you can. (If the participant still seems a little confused add again Remember number-letter, number-letter). Begin here (Point to 1). Ready. Go!"



❖ **SCORING:**

TRAIL-MAKING TEST A AND B

Hand used (check one): ☐ dominent ☐ non- dominent

Trail-making test part A- time to completion: __________seconds.

Trail-making test part B- time to completion:___________seconds.

Trail Making Test Part A	
Time (seconds)	
Number of errors	

Trail Making Test Part B	
Time (seconds)	
Number of errors	

Statistical Analysis: To assess the normality of the dependent variables (agility, balance, coordination, memory, and attention) within the experimental group, Shapiro-Wilk tests were employed. Homogeneity of variance across these dependent variables was examined using Mauchly's test of sphericity. Mean scores of the dependent variables within subjectswere compared using one-way repeated measures ANOVA at a significance level of 0.05. These statistical tests were chosen to ensure the robustness and validity of the analyses conducted in the study

Results

Table No. 4.3- Descriptive Statistics

	Mean	Std. Deviation	N
IAT(Pre)	22.29	2.36	30
IAT(Mid)	20.48	1.52	30
IAT(Post)	19.57	1.25	30
WTT(Pre)	14.87	3.07	30
WTT(Mid)	19.37	3.08	30
WTT(Post)	21.83	2.96	30
SBT(Pre)	3.67	1.95	30
SBT(Mid)	4.37	2.09	30
SBT(Post)	6.10	2.09	30
TMT(A)(Pre)	69.77	28.66	30
TMT(A)(Mid)	53.40	17.34	30
TMT(A)(Post)	49.13	15.60	30
TMT(B)(Pre)	144.37	37.90	30
TMT(B)(Mid)	109.97	35.87	30
TMT(B)(Post)	97.47	30.82	30

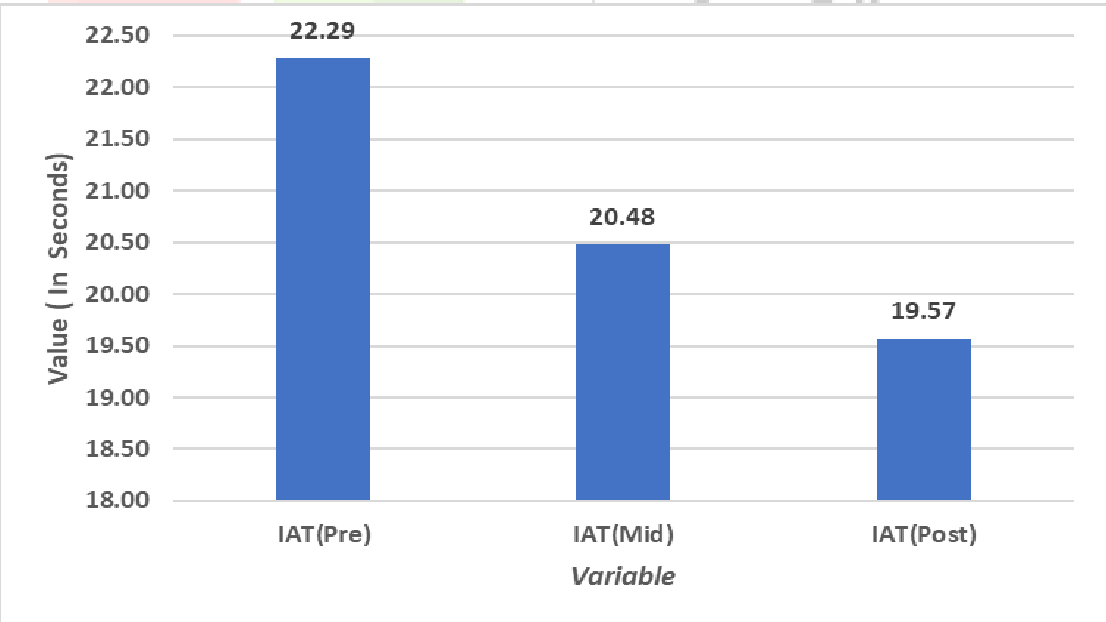


Figure 4.1 Mean value of pre, mid and post data of agility.

As figure 4.1 represents that the mean value of IAT (pre, mid and post) is 22.29(2.36,30), 20.48(1.52,30) and 19.57(1.25,30) respectively shows significant decrease with respect of time.

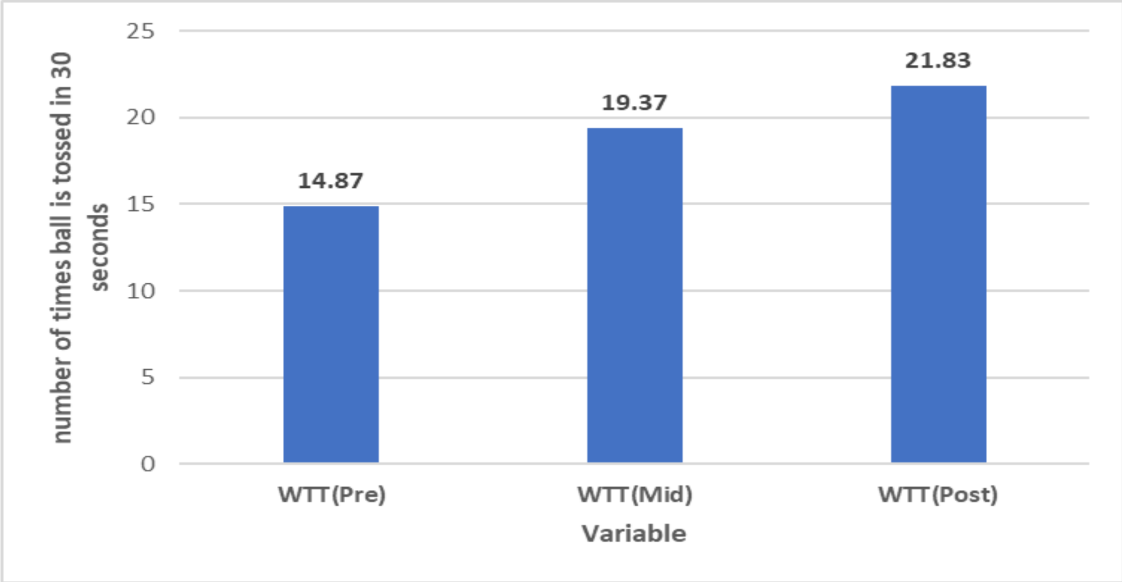


Figure 4.2 Mean value of pre, mid and post data of coordination

As figure 4.2 represent that the mean value of WTT (pre, mid and post) is 14.87(3.07,30), 19,37(3.08,30) and 21.83(2.96,30) respectively which shows significant increase in number of times of ball tossed.

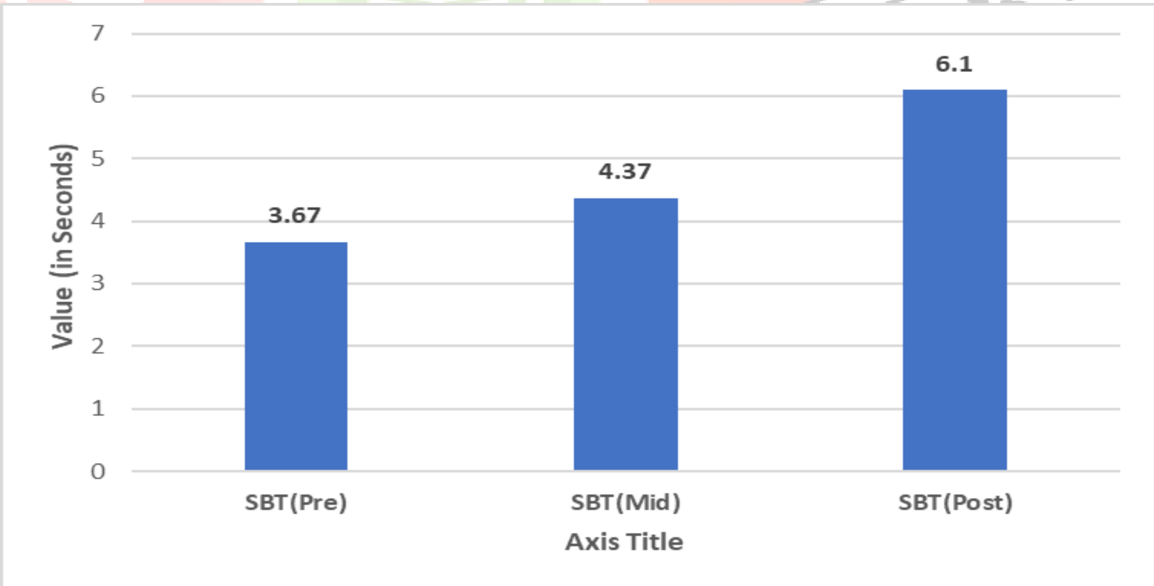


Figure 4.3 Mean value of pre, mid and post data of balance

As figure 4.3 represent that the mean value of SBT (pre, mid and post) is 3.67(1.95,30), 4.37(2.09,30) and 6.1(2.09,30) respectively which shows that significant increase in duration of time.

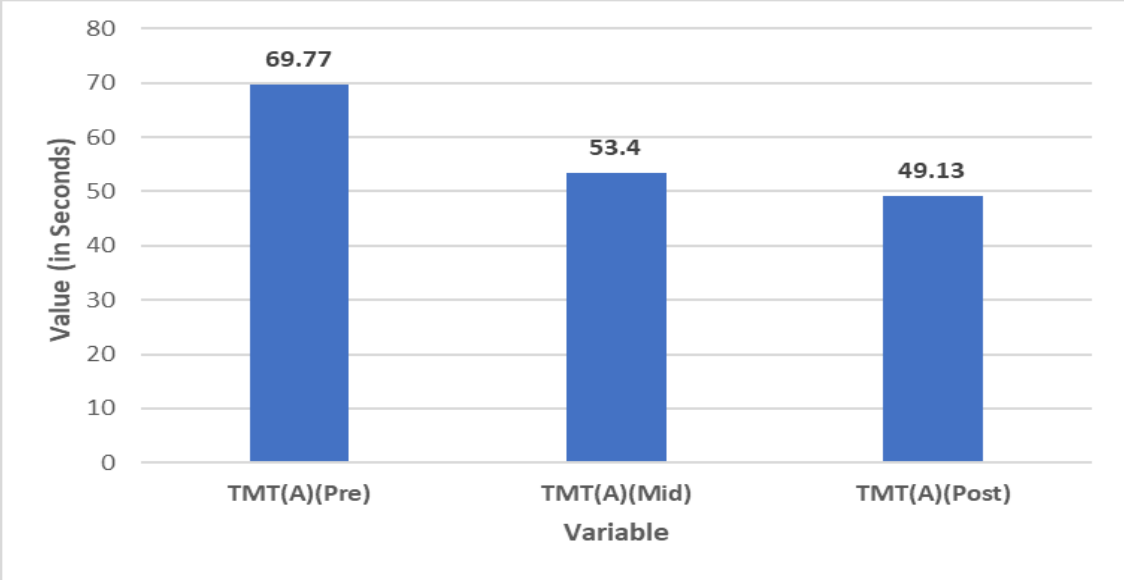


Figure 4.4 mean value of pre, mid and post data of attention and working memory

As figure 4.4 represent that the mean value of TMT(A) (pre, mid and post) is 69.77(28.66,30), 53.4(17.34,30) and 49.13(15.06,30) respectively which shows that significant decrease in duration of time in completing the test.

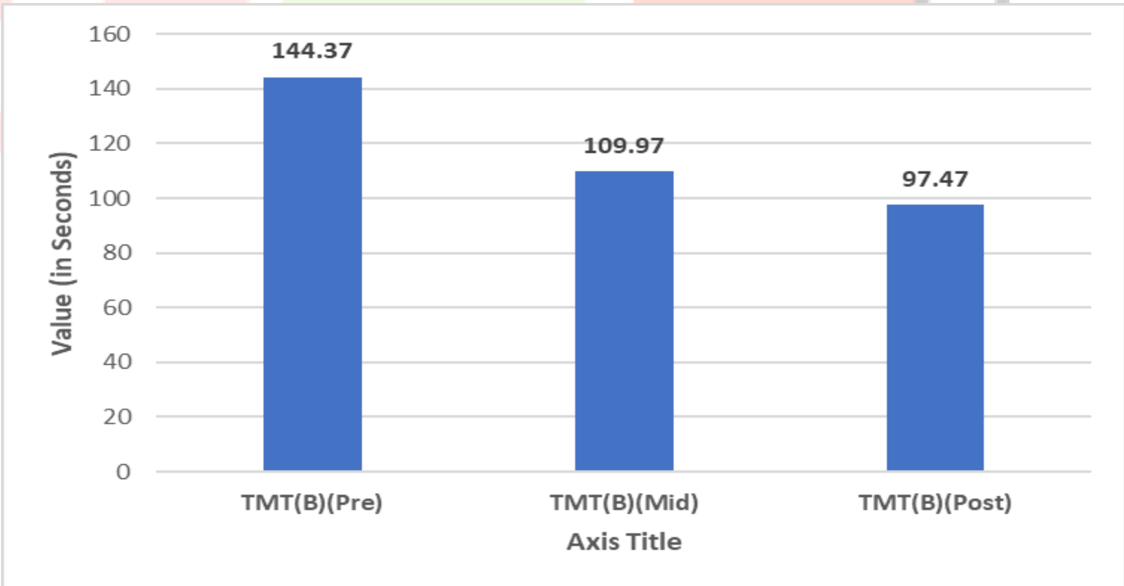


Figure 4.5 mean value of pre, mid and post data of attention and working memory

As figure 4.4 represent that the mean value of TMT(B) (pre, mid and post) is 144.37(37.90,30), 109.97(35.87,30) and 97.47(30.82,30) respectively which shows that significant decrease in duration of time in completing the test.

Table No. 4.4- Test of Within- Subject Effect (ANOVA)

Source			Type III Sum of Squares	d.f.	Mean Square	F	Sig.	Partial Eta Squared
factor 1	IAT	Sphericity Assumed	115.256	2	57.628	60.846	0.000	0.677
		Greenhouse-Geisser	115.256	1.080	106.739	60.846	0.000	0.677
	WTT	Sphericity Assumed	748.689	2	374.344	176.075	0.000	0.859
		Greenhouse-Geisser	748.689	1.259	594.796	176.075	0.000	0.859
	SBT	Sphericity Assumed	94.156	2	47.078	60.439	0.000	0.676
		Greenhouse-Geisser	94.156	1.273	73.958	60.439	0.000	0.676
	TMT (A)	Sphericity Assumed	7118.067	2	3559.033	34.131	0.000	0.541
		Greenhouse-Geisser	7118.067	1.031	6906.183	34.131	0.000	0.541
	TMT (B)	Sphericity Assumed	35392.200	2	17696.100	57.890	0.000	0.666
		Greenhouse-Geisser	35392.200	1.268	27914.432	57.890	0.000	0.666

*Significant at 0.05

Interpretation: For IAT

Mauchly's Test of Sphericity indicated that the assumption of sphericity was violated for IAT ($p<0.05$). Therefore, we used the Greenhouse-Geisser correction to interpret the within-subjects' effects. The ANOVA showed a significant effect of the factor on IAT (F (1.080,) =60.846, $p<0.000$), indicating significant differences between the pre, mid, and post-test scores. Pairwise comparisons revealed that all comparisons (Pre-Mid, Pre-Post, and Mid-Post) were significant ($p<0.05$). Specifically, the mean IAT score increased significantly from Pre to Mid, Mid to Post, and Pre to Post, suggesting that participants took lesser time to complete the test at each subsequent time point.

For WTT

The assumption of sphericity was violated for WTT ($p<0.05$), and we used the Greenhouse-Geisser correction. The ANOVA showed a significant effect of the factor on WTT (F (1.259) =176.075, $p<0.05$). Pairwise comparisons indicated significant differences between all pairs of time points ($p<0.05$). Specifically, the number of tosses significantly increased from Pre to Mid, Mid to Post, and Pre to Post, suggesting that participants tossed the ball more times at each subsequent time point.

For SBT

The assumption of sphericity was violated for SBT ($p<0.05$), and we used the Greenhouse-Geisser correction. The ANOVA showed a significant effect of the factor on WTT (F (1.273) =60.439, $p<0.05$). Pairwise comparisons indicated significant differences between all pairs of time points ($p<0.05$). Specifically, the number of seconds significantly increased from Pre to Mid, Mid to Post, and Pre to Post, suggesting that participants stand on ball of the foot for longer duration of times at each subsequent time point.

For TMT (A)

The assumption of sphericity was violated for TMT(A) ($p<0.05$), and we used the Greenhouse-Geisser correction. The ANOVA showed a significant effect of the factor on TMT(A)- (F (1.031) =34.131, $p<0.05$). Pairwise comparisons indicated significant differences between all pairs of time points ($p<0.05$). Specifically, the number of seconds significantly decreased from Pre to Mid, Mid to Post, and Pre to Post, suggesting that participants completed the test battery in lesser duration of times at each subsequent time point.

For TMT(B)

The assumption of sphericity was violated for TMTB ($p<0.05$), and we used the Greenhouse-Geisser correction. The ANOVA showed a significant effect of the factor on TMT(B)- ($F(1.268) = 57.890$, $p<0.05$). Pairwise comparisons indicated significant differences between all pairs of time points ($p<0.05$). Specifically, the number of seconds significantly decreased from Pre to Mid, Mid to Post, and Pre to Post, suggesting that participants completed the test battery in lesser duration of times at each subsequent time point.

For all variables **IAT, WTT, SBT, TMT(A) AND TMT(B)** Sig. value<0.05, there is significant difference between the pre, mid and post values of these variables. Now to the cause of difference in pairwise comparison.

Discussion:

The hypotheses posited that there would be a notable disparity in mean scores of agility, balance, coordination, and attention/working memory among students with hearing impairment across different time intervals. Statistical analyses confirmed significant effects for each variable, with p-values below the 0.05 threshold, thereby failing to reject the directional hypotheses. Specifically, significant differences were observed in agility, balance, coordination, and attention/working memory over time intervals, substantiating the initial hypotheses that changes would occur in these skills among students with hearing impairment

Conclusion:

Based on the study and analysis conducted, the following conclusions are drawn: Firstly, the study assessed the dependent variable of agility (referred to as IAT) across three stages, showing performance improvements of 8.8% from IAT pre (22.29) to IAT mid (20.48), 4.64% from IAT mid (20.48) to IAT post (19.57), and 13.89% from IAT pre (22.29) to IAT post (19.57). Secondly, balance (SBT) exhibited increases of 19.07% from SBT pre (3.67) to SBT mid (4.37), 39.59% from SBT mid (4.37) to SBT post (6.10), and 66.21% from SBT pre (3.67) to SBT post (6.10). Thirdly, coordination (WTT) showed improvements of 30.26% from WTT pre (14.87) to WTT mid (19.37), 12.70% from WTT mid (19.37) to WTT post (21.83), and 46.82% from WTT pre (14.87) to WTT post (21.83). Additionally, attention and working memory (TMT) were divided into TMT(A) and TMT(B), with TMT(A) improving by 30.65% from TMT(A) pre (69.77) to TMT(A) mid (53.40), 8.69% from TMT(A) mid (53.40) to TMT(A) post (49.13), and 42% from TMT(A) pre (69.77) to TMT(A) post (49.13). Similarly, TMT(B) improved by 31.28% from TMT(B) pre (144.37) to TMT(B) mid (109.97), 12.82% from TMT(B) mid (109.97) to TMT(B) post (97.47), and 48.12% from TMT(B) pre (144.37) to TMT(B) post (97.47). The mean differences for each variable across stages (IAT: 1.812, 0.911, 2.713; SBT: -0.700, -1.733, -2.433; WTT: -4.500, -2.467, -6.967; TMT(A): 16.367, 4.267, 20.633; TMT(B): 34.400, 12.500, 46.900) indicate significant performance improvements, validated through pairwise comparisons using Post Hoc tests. In summary, the study concludes that the reactive agility training program significantly enhanced the agility, balance, coordination, attention, and working memory of hearing-impaired students, underscoring its effectiveness in improving both physical and mental skills among participants.

Future perspectives:

A comparable investigation could be undertaken involving a broader cohort of participants characterized by identical variables. Implementing reactive agility training programs is advised to promote the physical and mental well-being of students with hearing impairments. Further studies could explore the efficacy of such training programs for various student demographics, each with unique requirements and capabilities. Additionally, examining the applicability of this study to enhance performance among Olympic and Paralympic athletes is warranted. This research could encompass diverse motor and psychological variables to expand our understanding in these areas.

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