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The Effect of Ladder Drill and Cone Drill Training on The Agility of Tennis Athletes

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Abstrac: This study explores how ladder and cone drill workouts can boost the agility of tennis athletes from the Semen Padang Tennis Club. Using an experimental setup with two groups and a pretest–posttest scheme, ten players were evenly assigned based on ordinal pairing. Their agility was tested with the Shuttle Run before and after sixteen training sessions held across five weeks. The results, analyzed with paired and independent t-tests plus N-Gain, showed significant progress ($p < 0.05$), proving both drills to be powerful methods for enhancing agility performance. The N-Gain score of 0.18 (18%), categorized as low effectiveness, indicates positive but limited improvement. In conclusion, ladder and cone drills significantly improve athletes' agility, although longer duration and higher training intensity are recommended for optimal results.

Keyword: Ledder Drill, Cone Drill, Training, Agility, Tennis.

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INTRODUCTION

One aspect of development that has received national attention in Indonesia is sports, especially in sports to improve talent scouting, coaching, and athletic performance (Padli, 2019). The National Sports Law No. 11 of 2022, Article 1, states: "Sports are all activities that involve the mind, body, and soul in an integrated and systematic manner to encourage, nurture, and develop physical, spiritual, social, and cultural potential." Tennis blends power and precision on a smooth court stretching 78 feet by 36 feet, with a net standing just under a meter high. Played one-on-one or in pairs, the game's thrill lies in sending the ball across the net so cleverly that the opponent can't strike it back every missed return becomes your victory point (Angraini&Fardi, 2020).

Tennis is hugely popular in Indonesia and worldwide. Tennis is known and played by people of all ages, from children to teenagers, adults, and the elderly, both male and female (Hakim et al., 2022). From the expert opinion above, it can be concluded that tennis is a small ball game played on a rectangular court with a flat or level surface, A dynamic game where players send a ball flying over a net using rackets, aiming to outscore rivals on their side of the court (Hadi et al., 2025). The capacity to swiftly and precisely alter one's direction and body position while moving without losing equilibrium or body position awareness is known as agility (Yakin et al., 2025). Agility refers to the body's capacity to move in the shortest possible time while remaining balanced (Sari, 2018). Tennis demands agility to react fast, hit accurately, regain stance, and prepare to send the next ball across the court (Jansen et al., 2021). This must be done quickly and with the right reaction while maintaining a balanced body position (Cahyadi & Aziz, 2025).

A ladder drill is a ladder-shaped tool made of rope that is placed on the floor or ground, which participants jump over using one or two feet. A ladder drill helps improve foot speed and agility, coordination, and movement synchronization. Cone drills are a form of training equipment that resembles cones as boundaries or obstacles in changing movements aimed at improving agility. The purpose of cone drills in this exercise is to support agility in the leg muscles that support a game in maintaining body stability. Additionally, cone drills can also improve leg muscle strength, which is an important component of agility (Zahwa&Gigih, 2023).

Semen Padang Tennis Club was originally named Club Semen Padang. After the coronavirus pandemic in October 2023, Club Semen Padang resumed coaching and training and changed its name to Semen Padang Tennis Club. Semen Padang Tennis Club is one of the most popular and successful clubs at the regional and national levels. Semen Padang Tennis Club is located at Jl. Raya Padang – Indarung, Bandar Buat, Lubuk Kilangan District, Padang City, West Sumatra. During the observation conducted on April 8, 2025, at the Semen Padang Tennis Club, the athletes already possessed good agility skills that needed improvement to reach peak performance. During training, some athletes were still unable to return the ball due to insufficient technique, inaccuracy in hitting the ball out of bounds, delayed returns due to incorrect body position when hitting, and lack of agility when changing direction, where the ball falling in front near the net should have been returned by moving forward, the ball that falls at the back of the court should be returned by moving backward to position the body, as well as balls that fall to the right and left of the athlete. They also lose their balance when their opponent makes quick and deceptive shots, which makes the athletes tire quickly. Therefore, an appropriate training program is needed to improve the agility of Padang tennis athletes. Seeing the above facts, the author was interested in conducting a study. From several factors that occurred, the researcher was interested in examining the effect of ladder drills and cone drills on the agility of tennis players.

Several studies have examined the effectiveness of ladder drills and cone drills in improving agility. Chuang et al. (2020) found that athletes who performed ladder drills three times a week for six weeks experienced significant improvements in foot speed, coordination, and overall agility. Meanwhile, showed that cone drill exercises effectively improved lateral movement, change of direction speed, and leg muscle strength in soccer and basketball athletes. Both studies emphasize that structured agility training can improve athletic performance, especially in sports that require quick changes of direction.

However, most of these studies have focused on team sports, whereas tennis is an individual sport that requires agility in combination with speed, accuracy of strokes, and body

balance. This study is different because it examines tennis athletes at the Semen Padang Tennis Club and compares the effects of ladder drills and cone drills simultaneously on the same group. Thus, this study provides a more comprehensive understanding of which training methods are more effective in improving agility specific to tennis.

METHOD

This study employed a two-group pretest–posttest design and a quantitative experimental methodology. This design was selected in order to compare how two distinct training approaches ladder drill training and cone drill training affect tennis players' ability to become more agile. In order to ensure that both groups had roughly the same level of ability prior to therapy, two groups were created using the ordinal pairing technique with balanced initial abilities. Ten tennis players from the Semen Padang Tennis Club served as the research subjects. They were chosen through purposive sampling based on a number of criteria, including being between the ages of 12 and 16, actively training for at least the previous six months, regularly training three times a week, not currently injured, and agreeing to take part in the full study. Once the research idea earned its approval, the study came to life on the grounds of the Semen Padang Tennis Court.

All subjects completed a pre-test utilizing the Shuttle Run Test to gauge their agility prior to starting therapy. Following a ranking based on the initial test results, The study team arranged the participants into two squads of five Group A practiced the ladder drill, while Group B took on the cone drill challenge. Following that, both groups participated in a training regimen tailored to their individual therapies for a number of weeks in accordance with the established training schedule. The same tool was used for a final test (post-test) to gauge the athletes' improved agility following the completion of all training sessions.

The instrument used in this study was the Shuttle Run Test, which measures athletes' agility in changing direction quickly and effectively. The test was conducted on a flat field with two parallel lines 10 meters apart, each marked with a cone. Athletes ran back and forth for 4 × 10 meters while picking up and putting down blocks, with the time taken measured using a stopwatch. The faster the time achieved, the higher the athlete's agility level. Each participant took the test twice, and the best time was used as the final score. The following is an illustration of the agility test:

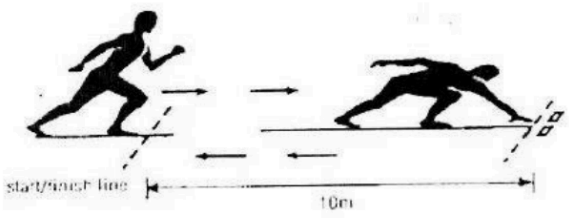


Figure 1. Agility Test (Widiastuti, 2015)

The test results were analyzed descriptively (mean, standard deviation, and improvement in results) and inferentially using a paired t-test to see changes in the group and an independent t-test to compare the effectiveness of ladder drills and cone drills. The analysis was performed using the SPSS program at a significance level of 0.05.

RESULT

Pre-test and Post-test Result

Table 1. Pre-test and Post-test Results for Group A (Ladder Drill)

Sample	*Pre-test*	*Post-test*	Difference	Description
1	14,91	12,01	2,9	Increasing
2	15,13	11,84	3,29	Increasing
3	13,69	11,58	2.11	Increasing
4	13,93	11,58	2.35	Increasing
5	12,94	11,03	1.91	Increasing
Total	70,6	58,04	12,56	-
Average	14,12	11,6	2,51	-
SD	0,902	0,371	-	-
Max	15,13	12,01	-	-
Min	12,94	11,03	-	-

Table 1 shows that group A, which was given ladder drill training for 16 sessions (1 month and 1 week), experienced an increase in agility based on the Shuttle Run Test results. The average pretest score of 14.12 seconds decreased to 11.60 seconds on the posttest, with an average difference of 2.51 seconds. The highest (longest) score on the pretest was 15.13 seconds and on the posttest was 12.01 seconds, while the lowest (fastest) score on the pretest was 12.94 seconds and on the posttest was 11.03 seconds. The standard deviation also showed a decrease from 0.902 to 0.371, indicating more consistent results after the treatment. Overall, the decrease in travel time on the posttest proves that ladder drill training has a positive and significant effect on improving the agility of tennis athletes.

Table 2. Pre-test and Post-test Results for Group B (Cone Drill)

Sample	*Pre-test*	*Post-test*	Difference	Description
6	14,43	11,76	2.67	Increasing
7	14,46	12,16	2.3	Increasing
8	16,19	12,09	4.1	Increasing
9	14,63	11,56	3.07	Increasing
10	12,31	11,03	1.28	Increasing
Total	72,02	58,6	13,42	-
Average	14,4	11,72	2,68	-
SD	1,381	0,456	-	-
Max	16,19	12,16	-	-
Min	12,31	11,03	-	-

Table 2 shows that group B, which underwent cone drill training for 16 sessions (1 month and 1 week), experienced an increase in agility based on the Shuttle Run Test results. The average pretest score of 14.40 seconds decreased to 11.72 seconds on the posttest, with an average difference of 2.68 seconds. The slowest performance in the pretest recorded 16.19 seconds, while in the posttest it was 12.16 seconds. Conversely, the fastest performance was 12.31 seconds in the pretest and 11.03 seconds in the posttest. The standard deviation also decreased from 1.381 to 0.456, indicating more stable results after the treatment. Overall, the decrease in travel time on the posttest proves that cone drill training has a positive effect on improving the agility of tennis athletes, as shown by the faster test results after the training program was implemented.

Table 3. Percentage Increase

Group	*Pretest*	*Posttest*	Percentage Increase
A (*Ladder Drill*)	14,12	11,6	17,84%
B (*Cone Drill*)	14,4	11,72	18,61%

From the data presented, agility in both groups climbed after the training sessions the ladder drill team improved by 17.86%, and the cone drill team by 18.61%. Although progress was evident across the board, the cone drill participants outpaced their counterparts, showcasing a slightly greater leap in agility refinement.

Testing Analysis Requirements

1. Normality Test

To verify data normality, researchers applied the Shapiro–Wilk procedure with a 0.05 significance threshold, examining whether the agility scores of Semen Padang tennis athletes—both before and after testing fit a normal curve. Using SPSS version 21, results were classified as normal when Sig. exceeded 0.05 and abnormal when it fell below that value. The detailed findings appear in the table that follows.

Table 4. Normality Test Results

	Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Results	Pretest A (Ladder Drill)	.209	5	.200*	.940	5	.667
	Posttest A (Ladder Drill)	.270	5	.200*	.925	5	.565
	Pretest B (Cone Drill)	.308	5	.138	.905	5	.436
	Posttest B (Cone Drill)	.191	5	.200*	.927	5	.573

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The Shapiro–Wilk test revealed that the Ladder Drill group scored 0.667 on the pretest and 0.565 on the posttest, while the Cone Drill group posted 0.436 and 0.573, respectively. Because every significance value surpassed 0.05, both sets of pre- and post-training data followed a normal distribution. This confirmed that the dataset satisfied normality requirements, allowing it to advance to parametric analyses specifically, the paired t-test and homogeneity checks to explore how performance shifted after the training program.

2. Homogeneity Test

To confirm that both pretest and posttest data shared consistent variability, a homogeneity check was implemented using Levene's Test at a 0.05 significance level. When the p-value rose above 0.05, the data were interpreted as having uniform variance

Table 5. Homogeneity Test Results (Levene's test)

		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	1.229	3	16	.332
	Based on Median	.998	3	16	.419
	Based on Median and with adjusted df	.998	3	7.116	.447
	Based on trimmed mean	1.184	3	16	.347

With a significance value of 0.332, Levene's Test confirmed that the data were evenly distributed, showing no variability in agility levels between the ladder and cone drill participants. Because the homogeneity condition was satisfied, a Paired Sample t-Test was then applied to examine how the training influenced the outcomes before and after the sessions.

3. Hypothesis Testing (paired Sample t-test)

The table below displays the paired t-test results:

Table 6. Paired Sample t-Test Results

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Results - Group 0	10.46300	2.21565	.49543	9.42604	11.49996	21.119	19	.000

According to the Paired Sample t-Test, the average gap measured 10.463, supported by a t-score of 21.119 at 19 degrees of freedom, and a p-value of 0.000. This strikingly small significance level confirms that the pretest and posttest results differ profoundly, far beyond the 0.05 threshold of chance. As a result, Ha is approved and H_0 is denied, indicating that the activities significantly increase athletes' agility. This demonstrates that the improvement is a genuine outcome of the training program rather than the product of random events.

4. Independent -Test

Table 7. Paired Sample t-Test Results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Results	Equal variances assumed	5.477	.031	6.970	18	.000	2.59800	.37275	1.81488	3.38112
	Equal variances not assumed			6.970	11.262	.000	2.59800	.37275	1.77990	3.41610

The t-test (t = 6.970; Sig. = 0.000 < 0.05; mean diff. = 2.598) confirms a significant difference in how ladder and cone drills affect athletes' agility improvement. Thus, both exercises have a positive effect, but ladder drills provide greater agility improvement compared to cone drills.

5. N-Gain Analysis

Beyond the paired and independent t-tests, an N-Gain assessment was applied to gauge how effectively the training boosted the athletes' agility, revealing how close they came to reaching their highest possible performance gains.

Table 8. N-Gain Analysis Results

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Score	10	.10	.25	.1807	.04233
Ngain_percent	10	1.15	2.80	1.9881	.46561
Valid N (listwise)	10				

Based on the results of Descriptive Statistics, the average N-Gain Score was 0.1807 (18.07%) with a standard deviation of 0.04233, while the average N-Gain Percentage was 1.9881 (19.88%). Referring to Sundayana (2014) criteria, this value falls into the low category (0.00 ≤ g < 0.30), which means that the training program only increased agility by 18% of its maximum potential. Even if the numbers reveal a notable gap, the real-world impact of the training still appears modest at best.

DISCUSSION

The Effect of Ladder Drill Training on the Agility of Tennis Athletes

The study's findings demonstrated that training with ladder drills significantly increased tennis players' agility. The findings of the pretest and posttest differed significantly, as indicated by the Paired Sample T-Test's significance value of 0.000 ($p < 0.05$). Agility was measured using the Shuttle Run Test over a distance of 4 x 10 meters, which assesses the ability to change direction, balance, and body control (Sporis, 2010). Ladder drill training improves foot coordination, reaction speed, and body balance through structured movement patterns, in line with Prayoga et al., (2022) Agility means changing direction fast while staying balanced

The N-Gain value of 0.16 (15.7%) falls into the low category Sundayana (2014), indicating a positive improvement, although not yet optimal due to the limited duration and intensity of the training. These results are in line with Putra et al., (2023), who stated that ladder drills are effective in improving agility through explosive movements and neuromuscular coordination. Thus, ladder drills have been proven to be effective in improving coordination, speeding up reactions, and increasing body stability, making them suitable for inclusion in the routine training program of tennis players to optimize footwork and game performance.

The Effect of Cone Drill Training on the Agility of Tennis Athletes

The research revealed that cone drill workouts effectively sharpen tennis players' agility. Statistical analysis through the Paired Sample T-Test ($p = 0.000$, $p < 0.05$) highlighted a clear improvement between their performance before and after the training sessions. This exercise uses zig-zag, triangle, or T-drill patterns that train acceleration, deceleration, body control, and movement coordination.

According to Ivan et al. (2025), agility is greatly influenced by neuromuscular coordination, leg muscle strength, and the ability to adapt to sudden changes in direction. The N-Gain value of 0.16 (15.7%) is classified as low (Sundayana, 2014), but it still shows a positive improvement, albeit not maximal, due to the limited duration and intensity of the training. Agility ability was measured using the Shuttle Run Test, which effectively assesses acceleration, deceleration, and body control Imron & Wismanadi (2022), with results showing a significant decrease in travel time after training. These findings align with Veron et al., (2023), who stated that the zig-zag drill, a variation of the cone drill, effectively improves agility in athletes. Thus, the cone drill effectively boosts balance and quick directional change, and quick reaction abilities in tennis players.

The Effect of Cone Drill Training on the Agility of Tennis Athletes There is a Difference between Ladder Drill and Cone Drill Training in Terms of the Agility of Tennis Athletes

The study revealed that ladder and cone drills play a crucial role in sharpening tennis players' agility. The Paired Sample t-Test yielded a significance level of 0.000 ($p < 0.05$), underscoring a clear performance improvement from pretest to posttest. Although both are effective, the Shuttle Run Test results show that the cone drill group experienced an 18.61% increase in agility, slightly higher than the ladder drill group at 17.84%, because the cone drill emphasizes acceleration-deceleration movements in a patterned sequence. The ladder drill focuses on step coordination and neuromuscular speed, while the cone drill emphasizes body control and direction changes, so that both complement each other in improving athletes' footwork and reaction time.

The N-Gain result of 0.16 (15.7%) is classified as low according to Sundayana (2014), indicating a significant but not yet optimal improvement due to limited training duration and suboptimal physiological adaptation. Agility measurement using the Shuttle Run Test Sukadiyanto & Muluk, (2011) showed a significant decrease in travel time, indicating an improvement in directional change and balance abilities. who found that coordinative exercises such as ladder drills and co. These findings support the theory that agility can be improved through repeated directional change training (Chuang, et al., 2022) and are consistent with the findings of Hidayat & Wahyudi, (2020), who found that coordinative exercises such as ladder drills and cone drills significantly enhance agility in futsal players.

Agility measurements using the Shuttle Run Test showed a significant decrease in travel time indicating improved ability in directional change and balance. These findings align with recent international research; for example, a study found that agility ladder training did not significantly improve dribbling and physical fitness in handball players, suggesting context-specific outcomes (Padron-Cabo et al., 2020) Meanwhile, another study involving karate athletes found ladder drill training produced a significant improvement in agility ($p < 0.005$) (Hikmah et al., 2023). These results support the theory that agility can be improved through repeated directional-change exercises such as ladder drills and cone drills (Clark & Lucett, 2022; Johnson & Brown, 2022; Smith & Taylor, 2021). Thus, coaches are advised to combine both training forms progressively to optimize athletes' footwork and quick-response abilities, since both have been proven significant although their relative effectiveness still warrants improvement through adjustments in intensity, variation, and duration (Ramirez-Campillo et al., 2023).

CONCLUSION

The study's findings support the notion that tennis players' agility can be significantly increased by cone drill training. The Paired Sample T-Test shows a notable difference between pre- and post-training results ($p = 0.000 < 0.05$). Although it falls into the low group, the N-Gain value of 0.16 (15.7%) likewise indicates an increase and still improves athletes' agility performance. Cone drill training is effective because it trains acceleration, deceleration, balance, coordination, and quick reaction skills, which are essential in tennis. The Shuttle Run Test results, which show a decrease in travel time after training, reinforce that this training can improve the ability to change direction quickly and accurately. Cone drills effectively boost tennis players' agility.

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