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The Effect of Mixed Method Training Circuit Training Ladder Drill on Agility and Speed Run

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ABSTRACT

Objectives: *The ladder drill training method to increase agility and speed (speed run) has not been combined in much research. This research tries to combine them in order to improve the quality of professional futsal athletes.* ***Method:*** *The research approach used in this research is a quantitative approach. This type of research uses a quasi experiment. This research design uses a matching only design research design. This research variable consists of 1 independent variable (circuit training ladder drill) and 2 dependent variables (agility and speed). The population is 100 professional futsal athletes in Madiun City, and the sample is 30 people. This research is only specifically for male samples aged between 18-20 years. The sample was divided into 2 groups, namely the circuit training ladder drill experimental group and the control group. The research instrument used a hexagonal obstacle test and a 30 meter acceleration test. Data collection techniques were carried out first by carrying out normality tests and homogeneity tests. Data analysis techniques were carried out using the formula mean , standard deviation , variance , percentage increase, paired sample t test , one way anova test , and post hoc comparison.* ***Results:*** *There was a difference in agility before and after giving the mixed method training circuit training ladder drill. The difference in agility is shown from the results of parametric statistical analysis using a paired sample t test with the significance value in the sig column showing sig 0.000 < a 0.05.* ***Novelty****: The novelty in this research is combining the ladder drill training method to increase agility and speed run aimed at professional futsal athletes.*

INTRODUCTION

In terms of scope, sports are divided into 3 scopes, namely educational sports, community sports and achievement sports (Undang-Undang (UU) Nomor 11 Tahun 2022 Tentang Keolahragaan, 2022). Achievement sports are sports that are also in great demand among Indonesian people. The Great Design of National Sports emphasizes the development of national sports in various spheres, including achievement sports, based on Science and Technology (Chaeroni et al., 2023). Achievement sports are more focused on the limits or achievements that must be achieved by the sports players. Athletes' achievement goals significantly predict their sportspersonship orientations (Barkoukis & Mouratidou, 2015). Performance sports performers are also called athletes (Blair, 2022; Conceison, 2023). In the scope of performance sports, there are many sports components that underlie it, such as strength (K.-H. Lee et al., 2020), speed, power, agility (Sukamti & Saputra, 2020), balance (Ardoino et al., 2021; A. C. Lee et al., 2022; Pau et al., 2014), coordination (Glazier, 2017; Rawlley-Singh, 2022), and so on. Agility or *agility* is a person's ability to change body position with fast movements and without losing body balance (Sheppard & Young, 2006). Speed is defined as a person's ability to carry out continuous movements and with the same form of movement in the shortest possible time (Akbar et al., 2015). The speed in question is running speed. In this research, researchers want to improve the agility component known as *agility* , and the speed

component known as *speed run.* Individualization is one of the main requirements of contemporary training (Bompa & Haff, 2017).

According to Gabbard, LeBlanc and Lowy agility is a condition where the human body is able to change body direction very quickly and can maintain the body's condition until the *end* of the movement without falling or being out of control (Budiwanto, 2012). In the world of sports science, previous researchers have also conducted a lot of research, one of which is according to Scholich in (Comyns, n.d.) with the book title *Circuit Training Development of Strength and Conditioning* , stating that: "*Circuit training is a method of fitness training that is designed to develop general, all-round physical and cardiovascular fitness.*" Which means *circuit training* is a training method to improve general fitness, both all physical components and cardiovascular fitness. *Ladder drills* also include methods for training leg agility, strength, explosive power, aerobic capacity and speed which are important for games such as football and basketball (Manimaran & Ramesh, 2017).

According to research conducted by (Padrón-Cabo et al., 2020) the use of the ladder drill training method was able to increase *running speed* at a distance of 10 meters, even at a distance of 20 meters. Shown by calculating the probability value or *(p value)* < the error limit value, namely *alpha* 0.05. This means that the *ladder drill training method* has been scientifically proven to increase the biomotor component of running speed. Therefore, researchers want to combine two training methods, namely the *circuit training method with the ladder drill* training method to increase *agility* and *speed run*.

RESEARCH METHOD

The research approach used in this research is a quantitative approach, namely a research approach that is based on numbers and interpretive thinking (Maksum, 2012). This type of research uses a quasi experiment. This research design uses a *matching only design research design* . This research variable consists of 1 independent variable *(circuit training ladder drill)* and 2 dependent variables (*agility* and *speed*). The population is 100 professional futsal athletes in Madiun City , and the sample is 30 people. This research is only specifically for male samples aged between 18-20 years. The sample was divided into 2 groups, namely the *circuit training ladder drill experimental group* and the control group. The research instrument used *the hexagonal obstacle test* and *the 30 meter acceleration test* by (Mackenzie, 2015). Data collection techniques were carried out first by carrying out normality tests and homogeneity tests. Data analysis techniques were carried out using the formula *mean* , *standard deviation* , *variance* , percentage increase, *paired sample t test , one way anova* test , and *post hoc comparison* (Maksum, 2012). All the tests above were carried out by analysis using IBM SPSS computer software.

RESULTS AND DISCUSSION

The results and discussion of this research will be presented in the form of data which will then be narrated according to the data displayed in tabular form.

Results

Descriptive Variable Agility

Circuit Training Ladder Drill (CTLD) Group

Table 1. Descriptive Statistics CTLD Agility Variable

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistics	Statistics	Statistics	Statistics	Std. Error	Statistics	Statistics
PreTest _ Agility_ *CTLD*	15	11.03	14.53	12.7513	.24261	.93962	.883
PostTest _ Agility_ *CTLD*	15	10.80	12.77	11.6353	.15984	.61906	.383
Valid N (listwise)	15						

It can be seen that in the *circuit training ladder drill experimental group* , the *pre-test* showed a *mean value* of 12.7 with a standard deviation of 0.93. The fastest time (minimum value) was 11.03 seconds and the longest time (maximum value) was 14.53 seconds. This value uses time units. So, the less time, the better the level of agility.

Then the *post-test* showed a *mean value* of 11.63 with a standard deviation of 0.61. The fastest time (minimum value) is 10.80 seconds and the longest time (maximum value) is 12.77 seconds. This value uses time units. So, the less time, the better the level of agility.

Meanwhile, to find out the difference in average increase, it can be calculated using the following formula:

$$P = \frac{M_d}{M_{post}} \times 100\%$$

$$P = \frac{M_{pre-post}}{M_{post}} \times 100\%$$

$$P = \frac{12.75 - 11.63}{11.63} \times 100\%$$

$$P = \frac{1.12}{11.63} \times 100\%$$

$$P = 9.63\ \%$$

The percentage calculation is reversed (*mean* of *pre-test* – *mean* of *post-test*), because the lowest value indicates the fastest time, while the highest value indicates the longest time. So the difference in the average increase in agility in the *circuit training ladder drill treatment group* was 9.63%.

To make it easier to read the results above, the results will be displayed clearly in the form of a bar chart as shown in the following image:

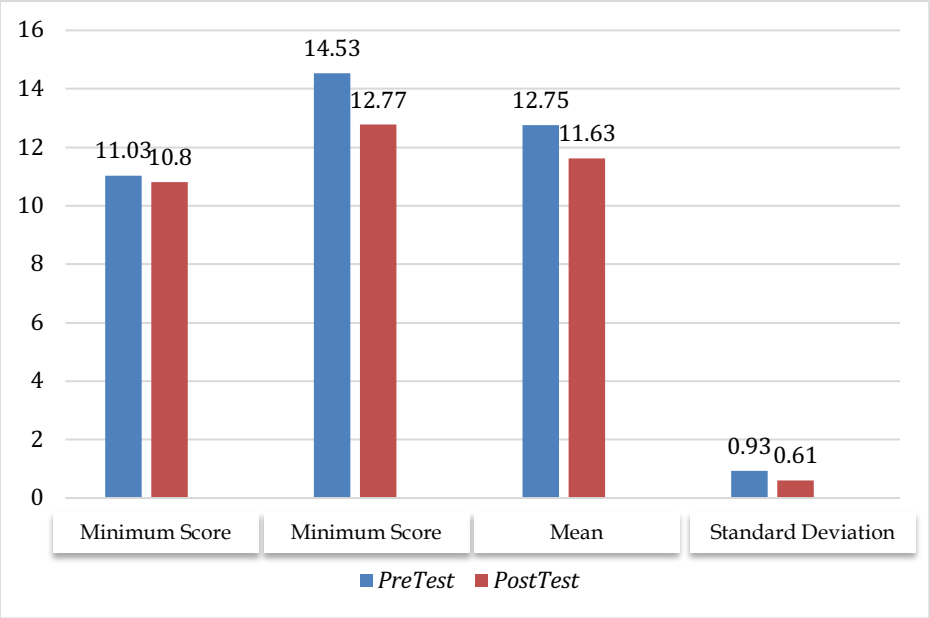

Figure 1. Descriptive Statistical Diagram of *Agility Variables CTLD* (In Seconds).

The percentage calculation will also be displayed in tabular form, so that it is easy to understand, the percentage calculation will be explained in detail, so that the origin of the percentage obtained and verification of the percentage calculation above can be carried out and proven. The percentage calculation will appear in the following table:

Table 2. Descriptive Statistical of *Agility Variables CTLD*

Mean	Percentage Calculation	Percentage Yield	Percentage Calculation	Percentage Increase
Pre:Pre	12.75 : 12.75 x 100%	100%	109.6% - 100%	**9.6%**
Pre:Post	12.75 : 11.63 x 100%	109.6%		

After the percentage calculations were displayed in table form, the researcher also displayed an overview of the percentages in bar chart form. The percentage bar chart is intended to facilitate quick understanding. The diagram will look as follows:

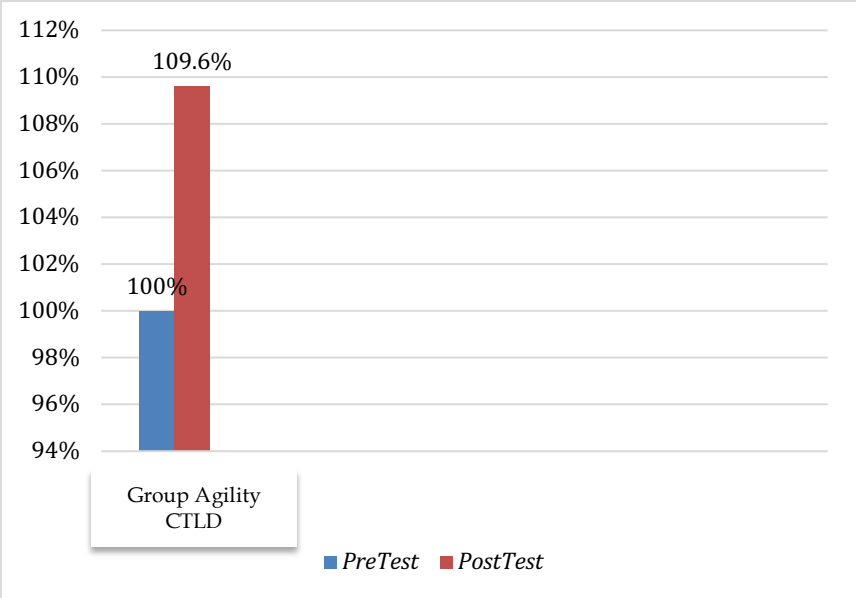

Figure 2. Pre-test and Post-test Percentage

The pre-test average and the post-test average. So the conclusion is, the increase in agility in the *circuit training ladder drill treatment group* was 9.63%.

Control Group

Table 3. Descriptive Statistics Control Group Agility Variable

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistics	Statistics	Statistics	Statistic	Std. Error	Statistics	Statistics
PreTest _ Agility_Control	15	11.71	13.87	12.8580	.15245	.59043	.349
PostTest _ Agility_Control	15	11.70	13.82	12.8320	.14977	.58005	.336
Valid N (listwise)	15						

It can be seen that in the control group, the *pre-test* showed a *mean value* of 12.85 with a standard deviation of 0.59. The fastest time (minimum value) was 11.71 seconds and the longest time (maximum value) was 13.87 seconds. This value uses time units. So, the less time, the better the level of agility.

Then the *post-test* showed a *mean value* of 12.83 with a standard deviation of 0.58. The fastest time (minimum value) was 11.70 seconds and the longest time (maximum value) was 13.82 seconds. This value uses time units. So, the less time, the better the level of agility.

Meanwhile, to find out the difference in average increase, it can be calculated using the following formula:

Meanwhile, to find out the difference in average increase, it can be calculated using the following formula:

$$P = \frac{M_d}{M_{pre}} \times 100\%$$

$$P = \frac{M_{pre-post}}{M_{post}} \times 100\%$$

$$P = \frac{12.85 - 12.83}{12.83} \times 100\%$$

$$P = \frac{0.02}{12.83} \times 100\%$$

$$P = 0.15\ \%$$

The percentage calculation is reversed (*mean* of *pre-test* – *mean* of *post-test*), because the lowest value indicates the fastest time, while the highest value indicates the longest time. So the difference in average increase in agility in the control group was 0.15%.

To make it easier to read the results above, the results will be displayed clearly in the form of a bar chart as shown in the following image:

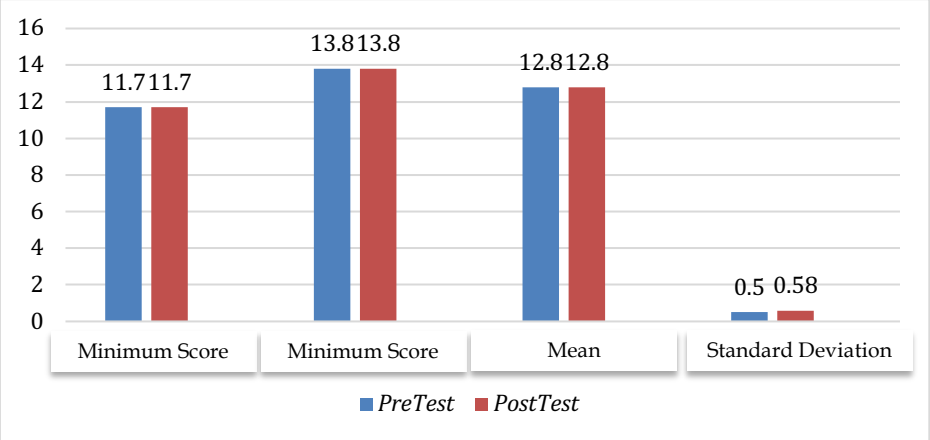

Figure 3. Descriptive Statistical Diagram of Control Group *Agility Variables (In Seconds)*

The percentage calculation will also be displayed in tabular form, so that it is easy to understand, the percentage calculation will be explained in detail, so that the origin of the percentage obtained and verification of the percentage calculation above can be carried out and proven. The percentage calculation will appear in the following table:

Table 4. Descriptive Statistical of Control Group *Agility Variables (In Seconds)*

Mean	Percentage Calculation	Percentage Yield	Percentage Calculation	Percentage Increase
Pre:Pre	12.85 : 12.85 x 100%	100%	100.15% - 100%	**0.15%**
Pre:Post	12.85 : 12.83 x 100%	101.7%		

After the percentage calculations were displayed in table form, the researcher also displayed an overview of the percentages in bar chart form. The percentage bar chart is intended to facilitate quick understanding. The diagram will look as follows:

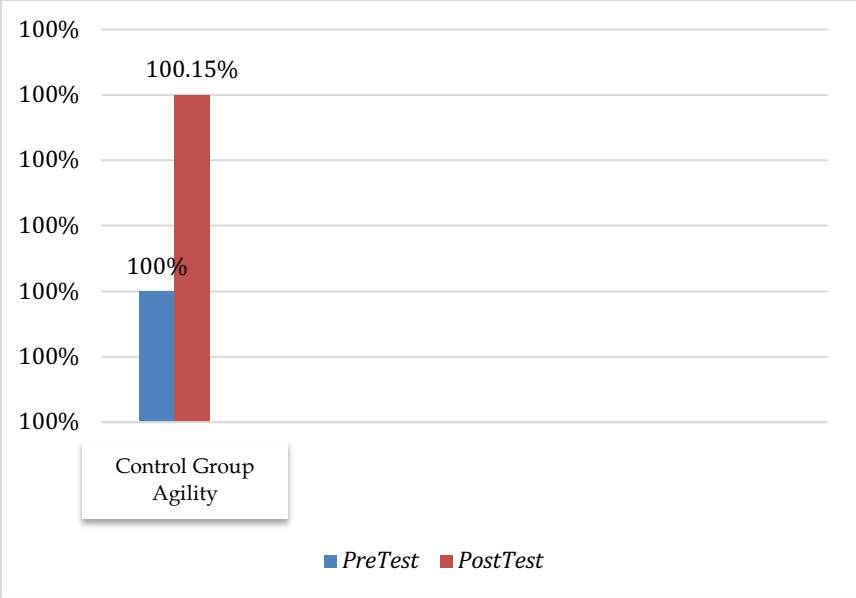

Figure 4. *PreTest* and *PostTest* Percentage

The pre-test average and the *post-test* average. So the conclusion is, the increase in agility in the control group was 0.15%.

Descriptive Variable Speed

Circuit Training Ladder Drill (CTLD) Group

Table 5. *Descriptive Statistics CTLD* Variable *Speed Run*

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistics	Statistics	Statistics	Statistics	Std. Error	Statistics	Statistics
PreTest _ Speed_ *CTLD*	15	5.06	6.21	5.6893	.10239	.39655	.157
PostTest _ Speed_ *CTLD*	15	4.32	5.98	5.1153	.12385	.47969	.230
Valid N (listwise)	15						

It can be seen that in the *circuit training ladder drill experimental group* , the *pre-test* showed a *mean value* of 5.68 with a standard deviation of 0.39. The fastest time (minimum value) was 5.06 seconds and the longest time (maximum value) was 6.21 seconds. This value uses time units. So, the less time, the better the speed level.

Then the *post-test* showed a *mean value* of 5.11 with a standard deviation of 0.47. The fastest time (minimum value) was 4.32 seconds and the longest time (maximum value) was 5.98 seconds. This value uses time units. So, the less time, the better the speed level.

Meanwhile, to find out the difference in average increase, it can be calculated using the following formula:

$$P = \frac{M_d}{M_{pre}} \times 100\%$$

$$P = \frac{M_{pre-post}}{M_{post}} \times 100\%$$

$$P = \frac{5.68 - 5.11}{5.11} \times 100\%$$

$$P = \frac{0.57}{5.11} \times 100\%$$

$$P = 11.1\ \%$$

The percentage calculation is reversed (*mean* of *pre-test* – *mean* of *post-test*), because the lowest value indicates the fastest time, while the highest value indicates the longest time. So the difference in the average increase in speed in the *circuit training ladder drill treatment group* was 11.1%.

To make it easier to read the results above, the results will be displayed clearly in the form of a bar chart as shown in the following image:

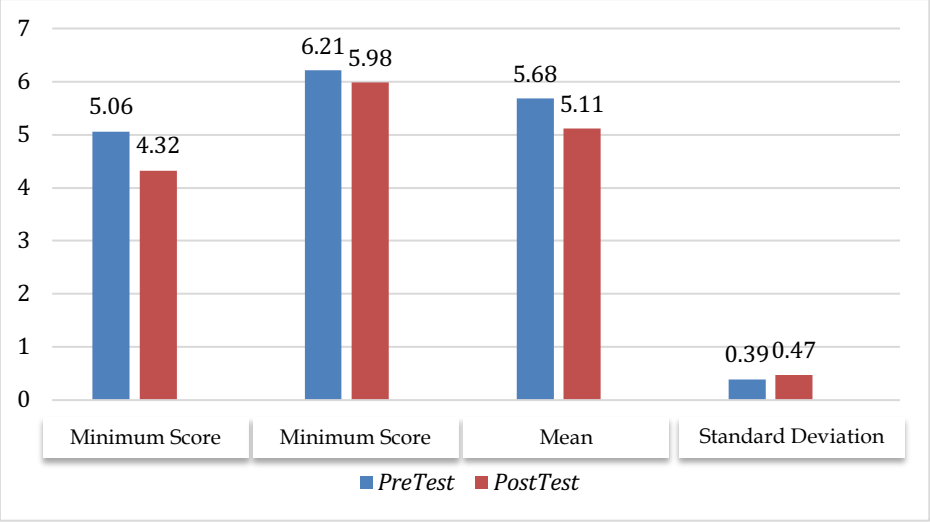

Figure 5. Descriptive Diagram of *CTLD Speed Run Variable Statistics* (In Seconds)

The percentage calculation will also be displayed in tabular form, so that it is easy to understand, the percentage calculation will be explained in detail, so that the origin of the percentage obtained and verification of the percentage calculation above can be carried out and proven. The percentage calculation will appear in the following table:

Table 6. Descriptive Diagram of *CTLD Speed Run Variable Statistics* (In Seconds)

Mean	Percentage Calculation	Percentage Yield	Percentage Calculation	Percentage Increase
Pre:Pre	5.68 : 5.68 x 100%	100%	111.1% - 100%	**11.1%**
Pre:Post	5.68 : 5.11 x 100%	111.1%		

After the percentage calculations were displayed in table form, the researcher also displayed an overview of the percentages in bar chart form. The percentage bar chart is intended to facilitate quick understanding. The diagram will look as follows:

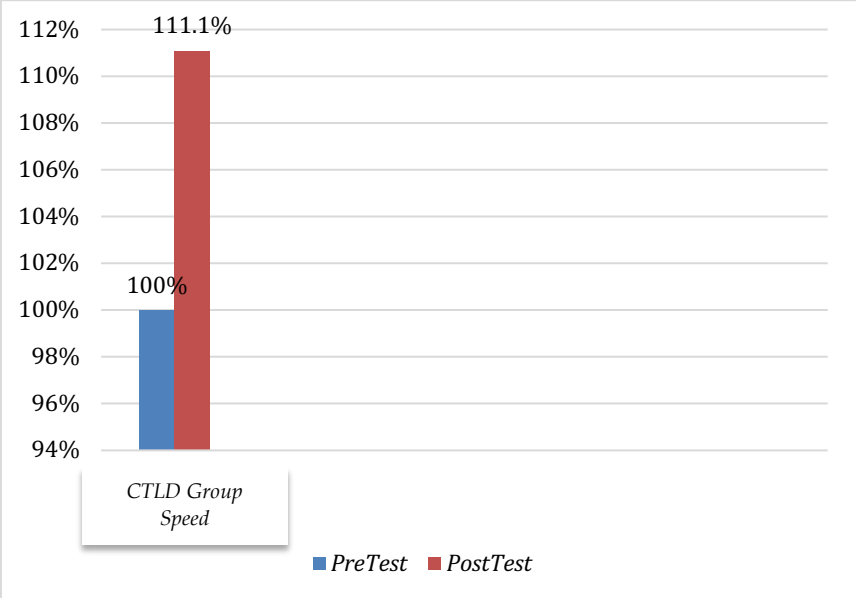

Figure 6. *PreTest* and *PostTest* Percentage

The pre-test average and the *post-test* average . So the conclusion is, the increase in speed in the *circuit training ladder drill treatment group* was 11.1%.

Control Group

Table 7. *Descriptive Statistics* Control Group Variable *Speed Run*

	N Statistics	Minimum Statistics	Maximum Statistics	Mean Statistics	Mean Std. Error	Std. Deviation Statistics	Variance Statistics
PreTest _ Speed_ Control	15	4.97	6.75	5.6167	.14297	.55374	.307

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistics	Statistics	Statistics	Statistics	Std. Error	Statistics	Statistics
PostTest _ Speed_ Control	15	4.95	6.73	5.5913	.14356	.55600	.309
Valid N (listwise)	15						

It can be seen that in the *circuit training ladder drill experimental group* , the *pre-test* showed a *mean value* of 5.61 with a standard deviation of 0.55. The fastest time (minimum value) was 4.97 seconds and the longest time (maximum value) was 6.75 seconds. This value uses time units. So, the less time, the better the speed level.

Then the *post-test* showed a *mean value* of 5.59 with a standard deviation of 0.55. The fastest time (minimum value) is 4.95 seconds and the longest time (maximum value) is 6.73 seconds. This value uses time units. So, the less time, the better the speed level.

Meanwhile, to find out the difference in average increase, it can be calculated using the following formula:

$$P = \frac{M_d}{M_{pre}} \times 100\%$$

$$P = \frac{M_{pre-post}}{M_{post}} \times 100\%$$

$$P = \frac{5.61 - 5.59}{5.59} \times 100\%$$

$$P = \frac{0.02}{5.59} \times 100\%$$

$$P = 0.35\ \%$$

The percentage calculation is reversed (*mean* of *pre-test* – *mean* of *post-test*), because the lowest value indicates the fastest time, while the highest value indicates the longest time. So the difference in the average increase in speed in the control group was 0.35%.

To make it easier to read the results above, the results will be displayed clearly in the form of a bar chart as shown in the following image:

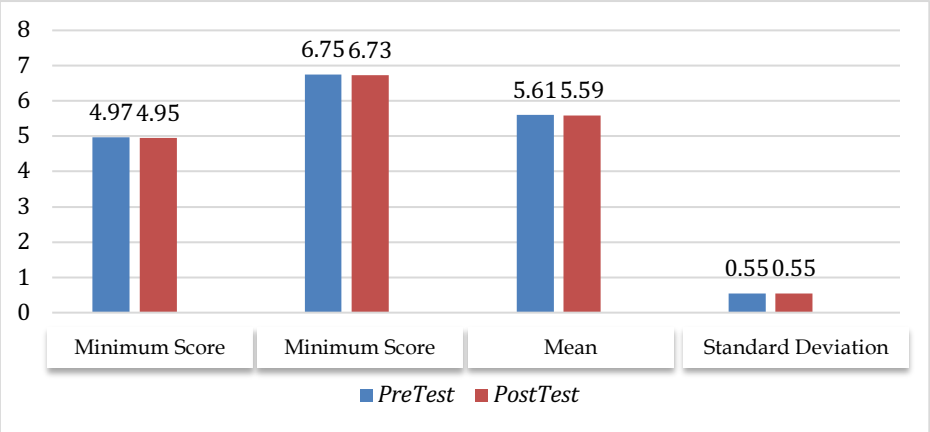

Figure 7. *Speed Run* Variable Statistics (In Seconds)

The percentage calculation will also be displayed in tabular form, so that it is easy to understand, the percentage calculation will be explained in detail, so that the origin of the percentage obtained and verification of the percentage calculation above can be carried out and proven. The percentage calculation will appear in the following table:

Table 8. The percentage calculation of *Speed Run* Variable Statistics (In Seconds)

Mean	Percentage Calculation	Percentage Yield	Percentage Calculation	Percentage Increase
Pre:Pre	5.61 : 5.61 x 100%	100%	100.35% - 100%	**0.35%**
Pre:Post	5.61 : 5.59 x 100%	100.35%		

After the percentage calculations were displayed in table form, the researcher also displayed an overview of the percentages in bar chart form. The percentage bar chart is intended to facilitate quick understanding. The diagram will look as follows:

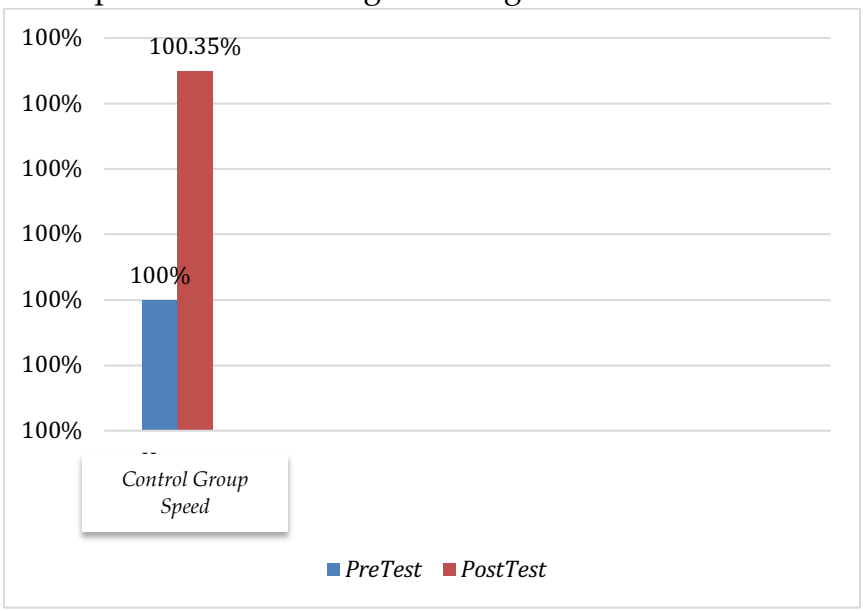

Figure 8. *PreTest* and *PostTest* Percentage of Control Group Speed

The pre-test average and the *post-test* average . So the conclusion is, the increase in speed in the control group was 0.35%.

Hypothesis Test

Paired Sample T Test Agility Variable

Tabel 9. Paired Samples Agility Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	*Pre_CTLD - Post_CTLD*	1.11600	.43380	.11201	.87577	1.35623	9.964	14	.000
Pair 2	*Pre* _Control - *Post* _Control	.02600	.02131	.00550	.01420	.03780	4.724	14	.000

The circuit training ladder drill (CTLD) group line based on the data above states that the significance value in the sig column shows 0.000 < α 0.05. What can be concluded is that there is a difference in *agility before and after the mixed method circuit training ladder drill* treatment .

Meanwhile, decision making in the control group row based on the data above states that the significance value in the sig column shows 0.000 < α 0.05. What can be concluded is that there is a difference in *agility* without any treatment.

Paired Sample T Test Variable Speed Run

Tabel 10. Paired Samples Test (Speed Run)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	*Pre_CTLD - Post_CTLD*	.57400	.17872	.04614	.47503	.67297	12,439	14	.000
Pair 3	*Pre* _Control - *Post* _Control	.02533	.01356	.00350	.01783	.03284	7,237	14	.000

The circuit training ladder drill (CTLD) group line based on the data above states that the significance value in the sig column shows 0.000 < α 0.05. What can be concluded is that there is a difference *in running speed* before and after giving the *mixed method circuit training ladder drill treatment* .

Meanwhile, decision making in the control group row based on the data above states that the significance value in the sig column shows 0.0 00 < α 0.05. What can be concluded is that there is a difference in *running speed* without any treatment.

One Way Anova Test

Table 11. *One Way Anova* Test

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Agility	*Between Groups*	10.763	2	5.381	15.631	.000
	Within Groups	14.460	42	.344		
	Total	25.223	44			
Speed Run	*Between Groups*	2.648	2	1.324	5.571	.007
	Within Groups	9.982	42	.238		
	Total	12.630	44			

From the results of the analysis in the table above, the *agility variable* shows an F value of 15.631 at a significance of 0.000. Then the *speed run variable* shows an F value of 5.571 at a significance of 0.000. The basis for decision making is, if the significance value is > 0.05 then H_0 is accepted and H_1 is rejected, but if the significance value is < 0.05 then H_0 is rejected and H_1 is accepted. Thus, from the data in the table above, a decision can be made that the two variables show a significance of 0.000 < 0.05, which means that H_0 is rejected and H_1 is accepted, in other words and it can be concluded that there are significant differences between groups.

Post Hoc Multiple Comparison

Table 12. Post Hoc Multiple Comparison

Multiple Comparisons Scheffe							
						95% Confidence Interval	
Dependent Variable	**(I) Exercise Method**	**(J) Training Method**	**Mean Difference (IJ)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Agility	CTLD	Control	-1.19667 *	.21425	.000	-1.7404	-.6530
	Control	CTLD	1.19667 *	.21425	.000	.6530	1.7404
Speed Run	CTLD	Control	-.47600 *	.17802	.037	-.9278	-.0242
	Control	CTLD	.47600 *	.17802	.037	.0242	.9278

*. The mean difference is significant at the 0.05 level.

From the table above, the author will make several statements regarding the *post hoc multiple comparisons test*. *Agility* Variable: 1) The comparison test between the CTLD group vs the control group resulted in *p value* = 0.000 < *a* = 0.05; 2) The comparison test between the control group vs the CTLD group produced *p value* = 0.000 < *a* = 0.05.

Regarding the agility variable, from the two *statements* above, it can be concluded that in the first point, there is a difference between the CTLD group and the control group, in the second point, there is a difference between the control group and the CTLD group. Variable *Speed Run*: 1) The comparison test between the CTLD group vs the control group resulted in *p value* = 0.037 < *a* = 0.05; 2) The comparison test of the control group vs the CTLD group produced *p value* = 0.037 < *a* = 0.05.

Regarding the speed variable, from the three statements above, it can be concluded that in the first point, there is a difference between the CTLD group and the control group, in the second point, there is a difference between the control group and the CTLD group.

Discussion

Based on all the results of the presentation above which have been analyzed systematically, the *mixed method circuit training ladder drill* is a very suitable combination of training methods that can be used to improve several biomotor components, in this case the *agility* and *speed run components* . There are still many training methods that can be combined, so the term *mixed method training emerged* . This training method is a new training method created by the author. With this method, it turns out that the increase is significant, in accordance with the data presented by the author.

So this research is also in line with the opinion of experts, as written in (Ireland, 2001) which states that exercise using the *circuit training method* can be designed to increase fitness components, including cardiovascular endurance, muscle endurance, *power* , and anaerobic endurance.

This research is also in line with previous research conducted by (Rizkiyanto et al., 2018) with the research title " *The Effect of Exercise and Agility on Speed Dribbling Football Extracurricular*" with the following research results, there are differences in the influence between participants who have high and low agility in *dribbling speed* where the significance value (0.00) < α (0.05) and F_{count} (55.8) > F_{table} (4.04), then Ha_{reads} : "There is a difference in the influence between high and low agility on *dribbling speed* in extracurricular participants.

The results of this research are also supported by research from (Mahesh, 2022) with the title " *Effects Of Ladder And Plyometric Training On Agility Among Cricket Players* " with research results showing that the F value for the significance level is set at a confidence level of 0.05 for 14 degrees of freedom. So In conclusion, this research does not differ from the results of research conducted by previous experts.

CONCLUSION

Fundamental Findings: There is a difference in *agility* before and after giving *the mixed method training circuit training ladder drill.* There is a difference in *speed run* before and after giving *the mixed method training circuit training ladder drill.* **Implications:** The *mixed method circuit training ladder drill* is an appropriate training method to use to improve biomotor *agility abilities* and *speed run biomotor abilities*. **Limitation:** This research is limited to

professional athletes in the city of Madiun, one of the cities in Indonesia. **Future Research:** In the future, this research can be applied to more cities, provinces and national levels throughout Indonesia.

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