CHAPTER IV

RESULTS AND DISCUSSIONS

This chapter deals with the statistical analysis of the data collected from the subjects. For the newly constructed electronic device, scientific authenticity should be established. Hence, an attempt has been made in this study to establish reliability, validity and objectivity separately for each chosen variables and which have been described below.

4.1 COMPUTATION OF DESCRIPTIVE STATISTICS

The descriptive statistics on reaction time, 20m split timings at different five phases and speed performance of 100m sprinters are presented in Table IV.

TABLE IV

MEAN AND STANDARD DEVIATION ON REACTION TIME, 20m SPLIT TIME AT DIFFERENT FIVE PHASES AND SPEED (Sec.) PERFORMANCE OF 100m SPRINTERS

Testing Period	Mode of Assessment	Mean & SD	Reaction Time	20m Split Time					Speed Performance
				Starting Point to 20m	20m to 40m	40m to 60m	60m To 80m	80m to 100m	
1	New Device	Mean	0.27	3.24	2.31	2.23	2.43	3.05	13.33
		SD	0.04	0.12	0.29	0.24	0.22	0.47	0.75
	Stop Watches	Mean	---	3.26	2.32	2.72	2.36	3.17	13.39
		SD	---	0.13	0.30	0.20	0.84	0.93	0.73
2	New Device	Mean	0.29	3.23	2.30	2.28	2.42	3.09	13.3
		SD	0.05	0.11	0.28	0.24	0.20	0.53	0.77
3	New Device	Mean	0.24	3.26	2.32	2.26	2.40	3.02	13.26
		SD	0.03	0.11	0.29	0.22	0.20	0.44	0.76
4	New Device	Mean	0.25	3.25	2.33	2.25	2.39	3.08	13.31
		SD	0.05	0.13	0.28	0.23	0.29	0.51	0.74

Table IV shows the mean values of subjects in reaction time, 20m split time at different five phases and speed performance of 100m sprinters. The mean values of the subjects' in reaction times during testing periods, 1 to 4 are 0.27, 0.29, 0.24 and 0.25 with standard deviations of ± 0.04, 0.05, 0.03 and 0.05 respectively. The mean values of the subjects' 20m split timings between, staring point to 20m during testing periods 1 to 4 are 3.24, 3.26, 3.23, 3.26 and 3.25 with standard deviations of ± 0.12, 0.12, 0.11, 0.11 and 0.13 respectively. The mean values of the subjects' split timings between 20m to 40m during testing periods 1 to 4 are 2.31, 2.32, 2.30, 2.32 and 2.33, with standard deviations of ± 0.29, 0.30, 0.28, 0.29 and 0.28 respectively. The mean values of the subjects' split timings between 40m to 60m during testing periods 1 to 4 are 2.23, 2.72, 2.28, 2.26 and 2.25 with standard deviations of ± 0.24, 0.20, 0.24, 0.22 and 0.23 respectively. The mean values of the subjects' split timings between 60m to 80m during testing periods 1 to 4 are 2.43, 2.36, 2.42, 2.40 and 2.39 with standard deviations of ± 0.22, 0.84, 0.20, 0.20 and 0.29 respectively. The mean values of the subjects' split timings between 80m to 100m during testing periods 1 to 4 are 3.05, 3.17, 3.09, 3.02 and 3.08 with standard deviations of ± 0.47, 0.93, 0.53, 0.44 and 0.51 respectively. The mean values of the subject's speed performance during testing periods 1 to 4 are 13.33, 13.39, 13.30, 13.26 and 13.31 with standard deviations of 0.75, 0.73, 0.77, 0.76 and 0.74 respectively.

4.2 ESTABLISHING THE RELIABILITY

In this study, test re-test method was used to establish reliability. Analysis of Variance with repeated measures and intraclass correlation(R) were computed. This method was used to obtain the reliability co efficient.

4.2.1 RELIABILITY OF REACTION TIME

To analyze the reliability of reaction time, Analysis of Variance with repeated measures and intraclass correlation(R) were computed. The summary of ANOVA for reliability estimation of reaction time is presented in table V.

TABLE V

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR REACTION TIME (sec.)

Source	SS	df	MS	F
Subjects	0.555	119	0.005	
Trials	0.001	1	0.001	**3.59**
Residual	0.018	119	0.0002	

The table value required for significance at 0.01 level of confidence with degrees of freedom1&119 is 4.78.

Table V indicates that the obtained F ratio 3.59 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference between the tests and re-test scorers and also indicate that the process of testing of reaction time is perfect and consistent.

The test performance should be consistent from one trial to the next and that any trial – to – trial variance should be attributed simply to measurement error **(Thomas & Nelson 1996).**

The formula used to calculate the intraclass correlation (R) is

$$R = (MS_S - MS_E) / MS_S$$

In which MS_s = Mean Squares for subjects, MS_E = Mean Squares for error,

$$MS_E = \frac{(\text{SS for trials} + \text{SS for residual})}{(\text{df for trials} + \text{df for residual})}$$

The intraclass correlation for reaction time is given in table Va.

TABLE Va

INTRACLASS CORRELATION FOR REACTION TIME (sec.)

Source	SS	df	MS_E	R
Subjects	0.555	119	0.002	0.96
Trials	0.001	1		
Residual	0.018	119		

The table value required for significance at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table Va indicates that the obtained intraclass (R) value 0.96 is higher than the table value 0.234 required at 0.01 level of significance. It denotes that the reaction time recorded by the device during testing and re-testing periods are significantly related.

The above results proved that the newly constructed electronic device is reliable to assess the reaction time of sprinters on the track from starting position simultaneously for eight athletes.

4.2.2 RELIABILITY OF SPLIT TIME FROM STARTING POINT TO 20m

The summary of ANOVA for reliability estimation of starting point to 20m is presented in table VI.

TABLE VI

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR SPLIT TIME FROM STARTING POINT TO 20 m (sec.)

Source	SS	df	MS	F
Subjects	2.747	119	0.023	
Trials	0.004	1	0.004	**0.90**
Residual	0.310	119	0.0026	

The table value required for significance at 0.01 level of confidence with degrees of freedom 1& 119 is 4.78.

Table VI indicates that the obtained F ratio 0.90 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference between the test and re-test scorers indicating that the process of testing of the split time from starting point to 20m is perfect and consistent.

The results of intraclass correlation are given in table VIa.

TABLE VIa

INTRACLASS CORRELATION FOR SPLIT TIME FROM STARTING POINT TO 20m (sec.)

Source	SS	df	MS_E	R
Subjects	2.747	119	0.003	0.0.87
Trials	0.004	1		
Residual	0.310	119		

The table value required for significance at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table VIa indicates that the obtained intraclass correlation (R) value 0.87 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split timings from starting point to 20 m recorded by the device during testing and re-testing periods are significantly related.

The above results proves that the newly constructed electronic device is reliable to assess the split timings from starting point to 20m of sprinters on the track simultaneously for eight athletes.

4.2.3 RELIABILITY OF SPLIT TIME FROM 20m to 40m

The summary of ANOVA for reliability estimation of the split time from 20m to 40m is presented in table VII.

TABLE VII

ANALYSIS OF VARIANCE WITH REPEATED MEASURES FOR SPLIT TIME FROM 20 m TO 40m (sec.)

Source	SS	df	MS	F
Subjects	18.533	119	0.156	0.89
Trials	0.006	1	0.006	
Residual	0.840	119	0.007	

The table value required for significance at 0.01 level of confidence with degrees of freedom 1& 119 is 4.78.

Table VII indicates that the obtained F ratio 0.89 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference between the test and re-test scorers indicating that the process of testing of split time from 20m to 40m is perfect and consistent.

The result of intraclass correlation is given in table VIIa.

TABLE VIIa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 20m TO 40m (sec.)

Source	SS	df	MS_E	R
Subjects	18.533	119	0.007	0.96
Trials	0.006	1		
Residual	0.840	119		

The table value required for significance at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table VIIa indicates that the obtained intraclass correlation (R) value 0.96 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split timings from 20m to 40m recorded by the device during testing and re-testing periods are significantly related.

The above results proved that the newly constructed electronic device is reliable to assess the split timings from 20m to 40m of sprinters on the track simultaneously for eight athletes.

4.2.4 RELIABILITY OF SPLIT TIME FROM 40m to 60m

The summary of ANOVA for reliability estimation of split time from 40m to 60m is presented in table VIII.

TABLE VIII

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR SPLIT TIME FROM 40 m TO 60m (sec.)

Source	SS	df	MS	F
Subjects	12.440	119	0.104	0.74
Trials	O.OO7	1	0.007	
Residual	1.152	119	0.O10	

The table value required for significance at 0.01 level of confidence with degrees of freedom 1& 119 is 4.78.

Table VIII indicates that the obtained F ratio 0.74 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no

significant difference between the test and re-test scorers indicating that the process of testing of the split time from 40m to 60m is perfect and consistent.

The results of intraclass correlation is given in table VIIIa

TABLE VIIIa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 40m TO 60m (sec.)

Source	SS	df	MS_E	R
Subjects	12.440	119	0.010	0.98
Trials	O.OO7	1		
Residual	1.152	119		

The table value required for significance at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table VIIIa indicates that the obtained intraclass (R) value 0.98 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split timings from 40m to 60m recorded by the device during testing and re-testing periods are significantly related.

The above results proved that the newly constructed electronic device is reliable to assess the split timings from 40m to 60m of sprinters on the track simultaneously for eight athletes.

4.2.5 RELIABILITY OF SPLIT TIME FROM 60m to 80m

The summary of ANOVA for reliability estimation of split time from 60m to 80m is presented in table IX.

TABLE IX

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR SPLIT TIME FROM 60m TO 80m (sec.)

Source	SS	df	MS	F
Subjects	9.66	119	0.081	1.39
Trials	0.011	1	0.011	
Residual	0.914	119	0.008	

The table value required for significance at 0.01 level of confidence with degrees of freedom 1& 119 is 4.78.

Table IX indicates that the obtained F ratio 1.39 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference between the test and re-test scorers indicating that the process of testing of the split time from 60m to 80m is perfect and consistent.

The results of intraclass correlation is given in table IXa.

TABLE IXa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 60m TO 80m (sec.)

Source	SS	df	MS_E	R
Subjects	9.66	119	0.008	0.90
Trials	0.011	1		
Residual	0.914	119		

The table value required for significance at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table IXa indicates that the obtained intraclass (R) value 0.90 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split timings from 60m to 80m recorded by the device during testing and re-testing periods are significantly related.

The above results proved that the newly constructed electronic device is reliable to assess the split timings from 60m to 80m of sprinters on the track simultaneously for eight athletes.

4.2.6 RELIABILITY OF SPLIT TIME FROM 80m to 100m

The summary of ANOVA for reliability estimation of split time from 80m to 100m is presented in table X.

TABLE X

ANALYSIS OF VARIANCE WITH REPEATED MEASURES FOR SPLIT TIME FROM 80m TO 100m (sec.)

Source	SS	df	MS	F
Subjects	49.00	119	0.412	0.65
Trials	0.059	1	0.059	
Residual	10.86	119	0.091	

The table value required for significance at 0.01 level of confidence with degrees of freedom 1& 119 is 4.78.

Table X indicates that the obtained F ratio 0.65 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference between the test and re-test scorers indicating that the process of testing of the split time from 80m to 100m is perfect and consistent.

The result of intraclass correlation is given in table Xa.

TABLE Xa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 80m TO 100m (sec.)

Source	SS	df	MS_E	R
Subjects	49.00	119	0.091	0.78
Trials	0.059	1		
Residual	10.86	119		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table Xa indicates that the obtained intraclass (R) value 0.78 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split timings from 80m to 100m recorded by the device during testing and re-testing periods are significantly related.

The above results proved that the newly constructed electronic device is reliable to assess the split timings from 80m to 100m of sprinters on the track simultaneously for eight athletes.

4.2.7 RELIABILITY OF 100m SPEED PERFORMANCE

The summary of ANOVA for reliability estimation of 100m speed is presented in table XI.

TABLE XI

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR 100m (sec.) SPRINT PERFORMANCE

Source	SS	df	MS	F
Subjects	127.86	119	1.074	0.05
Trials	0.0048	1	0.004	
Residual	10.155	119	0.085	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1& 119 is 4.78.

Table XI indicates that the obtained F ratio 0.05 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no

significant difference between the test and re-test scorers indicating that the process of testing of the 100m sprint is perfect and consistent.

The result of intraclass correlation for 100m sprint performance is given in table XIa.

TABLE XIa

INTRACLASS CORRELATION FOR 100m (sec.) SPRINT PERFORMANCE

Source	SS	df	MS_E	R
Subjects	127.86	119	0.85	0.93
Trials	0.0048	1		
Residual	10.155	119		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XIa indicates that the obtained intraclass (R) value 0.93 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the 100m sprint assessed by the device during the test and re-testing periods are significantly related.

The above results proved that the newly constructed electronic device is reliable to assess the 100m sprint performance of sprinters on the track simultaneously for eight athletes.

4.3 ESTABLISHING THE VALIDITY

In this study, to establish validity, tests were conducted by using the newly constructed electronic device and stopwatches simultaniously. The collected data were treated by calculating Pearson Product Moment correlation.

The reaction time of sprinters from starting position on the track could not assess by using other than newly devised equipment. Hence, validity was unable to establish for reaction time.

4.3.1 VALIDITY OF SPLIT TIME FROM STARTING POINT TO 20m

The summary of Pearson Product Moment correlation of split time from starting point to 20m is presented in table XII.

TABLE XII

PEARSON PRODUCT MOMENT CORRELATION FOR SPLIT TIME FROM STARTING POINT TO 20m (sec.)

Mode of Assessment	Mean	SD	r
New Device	3.24	0.12	0.98
Stopwatch	3.26	0.12	

The table value required for 2 & 118 degrees of freedom at 0.01 level of significant is 0.236

Table XII indicates that the obtained correlation value 0.98 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split

timings from starting point to 20m by using the newly constructed electronic device and stopwatches simultaniously are significantly related.

The above results proved that the newly constructed electronic device is valid in assessing the split timings from starting point to 20 m of sprinters on the track simultaneously for eight athletes.

4.3.2 VALIDITY OF SPLIT TIME FROM 20m TO 40m

The summary of Pearson Product Moment correlation of split time from 20m to 40m is presented in table XIII.

TABLE XIII

PEARSON PRODUCT MOMENT CORRELATION FOR

SPLIT TIME FROM 20m TO 40m (sec.)

Mode of Assessment	Mean	SD	r
New Device	2.31	0.29	0.93
Stopwatch	2.32	0.30	

The table value required for 2 & 118 degrees of freedom at 0.01 level of significant is 0.236

Table XIII indicates that the obtained correlation value 0.93 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split timings from 20m to 40m using the newly constructed electronic device and stopwatches simultaniously are significantly related.

The above results proved that the newly constructed electronic device is valid in assessing the split timings from 20m to 40m of sprinters on the track simultaneously for eight athletes.

4.3.3 VALIDITY OF SPLIT TIME FROM 40m TO 60m

The summary of Pearson Product Moment correlation of split time from 40m to 60m is presented in table XIV.

TABLE XIV

PEARSON PRODUCT MOMENT CORRELATION FOR

SPLIT TIME FROM 40m TO 60m (sec.)

Mode of Assessment	Mean	SD	r
New Device	2.23	0.24	0.70
Stopwatch	2.72	0.20	

The table value required for 2 & 118 degrees of freedom at 0.01 level of significant is 0.236

Table XIV indicates that the obtained correlation value 0.70 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split timings from 40m to 60m using the newly constructed electronic device and stopwatches simultaniously are significantly related.

The above results proved that the newly constructed electronic device is valid in assessing the split timings from 40m to 60m of sprinters on the track simultaneously for eight athletes.

4.3.4 VALIDITY OF SPLIT TIME FROM 60m TO 80m

The summary of Pearson Product Moment correlation of split time from 60m to 80m is presented in table XV.

TABLE XV

PEARSON PRODUCT MOMENT CORRELATION FOR

SPLIT TIME FROM 60m TO 80m (sec.)

Mode of Assessment	Mean	SD	r
New Device	2.43	0.22	0.74
Stopwatch	2.36	0.84	

The table value required for 2 & 118 degrees of freedom at 0.01 level of significant is 0.236

Table XV indicates that the obtained correlation value 0.74 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split timings from 60m to 80m using the newly constructed electronic device and stop watches simultaniously are significantly related.

The above results proved that the newly constructed electronic device is valid in assessing the split timings from 60m to 80m of sprinters on the track simultaneously for eight athletes.

4.3.5 VALIDITY OF SPLIT TIME FROM 80m TO 100m

The summary of Pearson Product Moment correlation of split time from 80m to 100m is presented in table XVI.

TABLE XVI

PEARSON PRODUCT MOMENT CORRELATION FOR

SPLIT TIME FROM 80m TO 100m (sec.)

Mode of Assessment	Mean	SD	r
New Device	3.05	0.47	0.91
Stopwatch	3.17	0.93	

The table value required for 2 & 118 degrees of freedom at 0.01 level of significant is 0.236

Table XVI indicates that the obtained correlation value 0.91 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the split timings from 80m to 100m using the newly constructed electronic device and stopwatches simultaniously are significantly related.

The above results proved that the newly constructed electronic device is valid in assessing the split timings from 80m to 100m of sprinters on the track simultaneously for eight athletes.

4.3.6 VALIDITY OF 100m SPEED PERFORMANCE

The summary of Pearson Product Moment correlation of 100m speed performance is presented in table XVII.

TABLE XVII

PEARSON PRODUCT MOMENT CORRELATION FOR

100m (sec.) SPEED PERFORMANCE

Mode of Assessment	Mean	SD	r
New Device	13.33	0.75	0.98
Stopwatch	13.39	0.73	

The table value required for 2 & 118 degrees of freedom at 0.01 level of significant is 0.236

Table XVII indicates that the obtained correlation value 0.98 is higher than the table value 0.236 required at 0.01 level of significant. It denotes that the 100m speed performance using the newly constructed electronic device and stopwatches simultaniously are significantly related.

The above results proved that the newly constructed electronic device is valid in assessing the 100m speed performance of sprinters on the track simultaneously for eight athletes.

4.4 ESTABLISHING THE OBJECTIVITY

In this study to establish objectivity, three testers were used to assess the variables by using the newly constructed electronic device at three different periods. ANOVA and intraclass correlation (R) were computed. This method was used to obtain the reliability coefficient.

4.4.1 OBJECTIVITY OF REACTION TIME

To analyze the objectivity of reaction time, Analysis of variance with repeated measures and intraclass correlation (R) were computed.

The summary of ANOVA for objectivity estimation of reaction time is presented in table XVIII.

TABLE XVIII

ANALYSIS OF VARIANCE WITH REPEATED MEASURES FOR REACTION TIME (sec.)

Source	SS	df	MS	F
Subjects	0.990	119	0.0084	
Trials	0.001	2	0.0007	**3.82**
Residual	0.050	238	0.0002	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XVIII indicates that the obtained F ratio 3.82 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers using the newly constructed electronic device at three different periods and also indicate that the process of establishing objectivity for reaction time is perfect and consistent.

The test performance should be consistent from one trial to the next and that any trial – to – trial variance should be attributed simply to measurement error **(Thomas & Nelson 1996).**

The formula used to calculate the intraclass correlation (R) is

$$R = (MS_S - MS_E) / MS_S$$

In which MS_s = Mean Squares for subjects,

MS_E = Mean Squares for error,

$$MS_E = \frac{(\text{SS for trials} + \text{SS for residual})}{(\text{df for trials} + \text{df for residual})}$$

The intraclass correlation for reaction time is given in table XVIIIa

TABLE XVIIIa

INTRACLASS CORRELATION FOR REACTION TIME (sec.)

Source	SS	df	MS_E	R
Subjects	0.990	119	0.0002	0.98
Trials	0.001	2		
Residual	0.050	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XVIIIa indicates that the obtained intraclass (R) value 0.98 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the reaction time recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the newly constructed electronic device possess objectivity to assess the reaction time of sprinters from starting position on the track simultaneously for eight athletes.

4.4.2 OBJECTIVITY OF SPLIT TIME FROM STARTING POINT TO 20m

The summary of ANOVA for inter tester reliability estimation of split time from starting point to 20m is presented in table XIX.

TABLE XIX

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR SPLIT TIME FROM STARTING POINT TO 20m (sec.)

Source	SS	df	MS	F
Subjects	2.57	119	0.021	**2.03**
Trials	0.30	2	0.16	
Residual	1.82	238	0.008	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XIX indicates that the obtained F ratio 2.03 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that, the process of testing the split time from starting point to 20m is perfect and consistent.

The results of the intraclass correlation is given in table XIXa

TABLE XIXa

INTRACLASS CORRELATION FOR SPLIT TIME FROM STARTING POINT TO 20m (sec.)

Source	SS	df	MS_E	R
Subjects	2.57	119	0.009	0.64
Trials	0.30	2		
Residual	1.82	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XIXa indicates that the obtained intraclass (R) value 0.64 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split time from starting point to 20m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the the newly constructed electronic device possess objectivity to assess the split time from starting point to 20m of sprinters on the track simultaneously for eight athletes.

4.4.3 OBJECTIVITY OF SPLIT TIME FROM 20m TO 40m

The summary of ANOVA for inter tester reliability estimation of split time from 20m to 40m is presented in table XX.

TABLE XX

ANALYSIS OF VARIANCE WITH REPEATED MEASURES FOR SPLIT TIME FROM 20m to 40m (sec.)

Source	SS	df	MS	F
Subjects	30.66	119	0.26	**0.96**
Trials	0.007	2	0.003	
Residual	2.703	238	0.011	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XX indicates that the obtained F ratio 0.96 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there are no significant differences among three different testers. It reveals that the process of testing the split time from 20m to 40m is perfect and consistent.

The results of intraclass correlation is given in table XXa.

TABLE XXa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 20m TO 40m (sec.)

Source	SS	df	MS_E	R
Subjects	30.66	119	0.011	0.96
Trials	0.007	2		
Residual	2.703	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XXa indicates that the obtained intraclass (R) value 0.64 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split time from 20m to 40m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the newly constructed electronic device possess objectivity to assess the split time from 20m to 40m of sprinters on the track simultaneously for eight athletes.

4.4.4 OBJECTIVITY OF SPLIT TIME FROM 40m TO 60m

The summary of ANOVA for inter tester reliability estimation of split time from 40m to 60m is presented in table XXI.

TABLE XXI

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR SPLIT TIME FROM 40m to 60m (sec.)

Source	SS	df	MS	F
Subjects	16.58	119	0.139	1.45
Trials	0.034	2	0.017	
Residual	2.819	238	0.012	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XXI indicates that the obtained F ratio 1.45 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that the process of testing the split time from 40m to 60m is perfect and consistent.

The result of intraclass correlation is given in table XXIa

TABLE XXIa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 40m TO 60m (Sec.)

Source	SS	df	MS_E	R
Subjects	16.58	119	0.012	0.92
Trials	0.034	2		
Residual	2.819	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XXIa indicates that the obtained intraclass (R) value 0.92 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split time from 40m to 60m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the newly constructed electronic device possess objectivity to assess the split time from 40m to 60m of sprinters on the track simultaneously for eight athletes.

4.4.5 OBJECTIVITY OF SPLIT TIME FROM 60m TO 80m

The summary of ANOVA for inter tester reliability estimation of split time from 60m to 80m is presented in table XXII.

TABLE XXII

ANALYSIS OF VARIANCE WITH REPEATED MEASURES FOR SPLIT TIME FROM 60m to 80m (sec.)

Source	SS	df	MS	F
Subjects	13.08	119	0.11	**3.75**
Trials	0.070	2	0.035	
Residual	2.224	238	0.009	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XXII indicates that the obtained F ratio 3.75 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that the process of testing the split time from 60m to 80m is perfect and consistent.

The results of intraclass correlation is given in table XXIIa

TABLE XXIIa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 60m TO 80m (sec.)

Source	SS	df	MS_E	R
Subjects	13.08	119	0.01	0.91
Trials	0.070	2		
Residual	2.224	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XXIIa indicates that the obtained intraclass (R) value 0.91 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split time from 60m to 80m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the newly constructed electronic device possess objectivity to assess the split time from 60m to 80m of sprinters on the track simultaneously for eight athletes.

4.4.6 OBJECTIVITY OF SPLIT TIME FROM 80m TO 100m

The summary of ANOVA for inter tester reliability estimation of split time from 80m to 100m is presented in table XXIII.

TABLE XXIII

ANALYSIS OF VARIANCE WITH REPEATED MEASURES

FOR SPLIT TIME FROM 80m to 100m (sec.)

Source	SS	df	MS	F
Subjects	60.59	119	0.51	**1.45**
Trials	0.277	2	0.14	
Residual	22.67	238	0.095	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XXIII indicates that the obtained F ratio 1.45 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that the process of testing the split time from 80m to 100m is perfect and consistent.

The results of intraclass correlation is given in table XXIIIa

TABLE XXIIIa

INTRACLASS CORRELATION FOR SPLIT TIME FROM 80m TO 100m (Sec.)

Source	SS	df	MS_E	R
Subjects	60.59	119	0.096	0.81
Trials	0.277	2		
Residual	22.67	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XXIIIa indicates that the obtained intraclass (R) value 0.81 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the split time from 80m to100m recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the newly constructed electronic device possess objectivity to assess the split time from 80m to 100m of sprinters on the track simultaneously for eight athletes.

4.4.7 OBJECTIVITY OF 100m SPEED PERFORMANCE

The summary of ANOVA for inter tester reliability estimation of 100m speed performance is presented in table XXIV.

TABLE XXIV

ANALYSIS OF VARIANCE WITH REPEATED MEASURES FOR 100m (sec.) SPEED PERFORMANCE

Source	SS	df	MS	F
Subjects	187.22	119	1.57	**2.24**
Trials	0.378	2	0.19	
Residual	20.07	238	0.08	

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 4.78.

Table XXIV indicates that the obtained F ratio 2.24 is less than the table value of 4.78 required at 0.01 level of significant. This proved that there is no significant difference among three different testers. It reveals that the process of testing the 100m speed performance is perfect and consistent.

The results of intraclass correlation is given in table XXIVa.

TABLE XXIVa

INTRACLASS CORRELATION FOR 100m (sec.) SPEED PERFORMANCE

Source	SS	df	MS_E	R
Subjects	187.22	119	0.09	0.94
Trials	0.378	2		
Residual	20.07	238		

The table value required for significant at 0.01 level of confidence with degrees of freedom 1&119 is 0.234.

Table XXIVa indicates that the obtained intraclass (R) value 0.94 is higher than the table value 0.234 required at 0.01 level of significant. It denotes that the 100m speed performance recorded by the three testers using the newly constructed electronic device at three different periods are significantly related.

The above results strongly proved that the newly constructed electronic device possess objectivity to assess the 100m speed performance of sprinters on the track simultaneously for eight athletes.

4.5 ADMINISTRATIVE FEACIBILITY OF THE NEW DEVICE

To record the 20m split time at different five phases of 100m sprinting event for eight athletes, 40 timers and stopwatches are required. While a single newly constructed device is able to record the split timings very accurately for eight sprinters simultaneously. It leads to economy of finance and time. Further the new device is easy for administration, scoring and interpretation. Thus, the device is possessing administrative feasibility.

4.6 EDUCATIONAL AND RESEARCH APPLICATIONS OF THE NEW DEVICE

It is not possible to assess the reaction time of sprinters on the track from starting position by using stopwatches, while the new device assess the same accurately and simultaneously for eight sprinters. Further, the coaches, judges and athletes can use this device for the accurate assessment of 20m split time of 100m sprinting event at five different phases and speed performance of 100m sprinters. Hence, this device is possessing educational applications.

The newly constructed electronic device possesses the scientific authenticity such as reliability, validity, objectivity, administrative feasibility, and educational applications. Hence, the new device can be used to collect the data for research purposes in addition to training, testing and officiating. Hence, this device is possessing research applications too.

4.7 DISCUSSION ON FINDINGS

4.7.1 DISCUSSION ON REACTION TIME

The results of the present study reveals that, the newly constructed electronic device is reliable, valid and objective to assess the reaction time of sprinters on the track from starting position simultaneously for eight athletes.

The results of reliability and validity are in conformity with the findings of the studies undertaken by DoAramaci et. al. ; Jose et. al.; Cesar Augusto & Otero Vaghetti et. al.

At the global level, the developed countries are using such a sophisticated electronic device to record and use the reaction time of sprinters on the track in starting position.

4.7.2 DISCUSSION ON 20m SPLIT TIME AT DIFFERENT FIVE PHASES

It is observed in the present study that the newly constructed electronic device is reliable, valid and objective to assess the 20m split time at various phases of a) from starting point to 20m, b) 20m to 40m, c) 40m to 60m, d) 60 to 80m, and 80m to 100m simultaneously for eight athletes.

The results of the study especially of reliability and validity are in line with the findings of the research work done by Gregor Kuntze et. al; Maulder et. al. and Miller, et. al.

The developed countries are giving much importance for sports technology to attain excellence in sports performance. They are much interested to record the split time of sprinters, which are helpful to predict the future performance of the sprinters.

4.7.3 DISCUSSION ON SPEED PERFORMANCE

The finding of this study is that, the newly constructed electronic device is reliable, valid and objective to assess the speed performance of 100m sprinters, simultaneously for eight athletes.

The results of reliability and validity are in conformity with the findings of Albertville, Andrew Davidhazy and Havriluk.

The experts in sports technology are showing much concentration to construct innovative latest equipment to assess the speed of sprinters, when compare to devising electronic equipment to record the reaction time and split time of sprinters.

It is observed from the review of related literature that the sports technology experts are making several attempts to establish reliability and validity for the electronic equipment devised by them. While very rarely they are showing interest to establish objectivity. It is observed that only scarce studies are available with regard to objectivity.

However, by understanding the present scenario the investigator is motivated to establish objectivity in addition to reliability and validity for the newly devised electronic equipment.

The special features are that, the new device is also possessing administrative feasibility and educational applications.

4.8 DISCUSSION ON HYPOTHESES

In the present study It was hypothesized that the newly designed computer oriented electronic device would be accurate, reliable, valid and objective in assessing the reaction time of 100m sprinters, from starting position on the track.

In this study it is found that the newly designed computer oriented electronic device is reliable, valid and objective to assess the reaction time of sprinters on the track from starting position simultaneously for eight athletes. Hence, the hypothesis is true.

It was also hypothesized that the newly constructed electronic device would be accurate, reliable, valid and objective in recording the 20m split time at different five phases.

It is found in this study that, the newly designed computer oriented electronic device is accurate, reliable, valid and objective, to assess the 20m split time at different five phase's of1 00m sprinters simultaneously for eight athletes. Therefore, the hypothesis is accepted.

In this study it is found that the newly designed computer oriented electronic device is reliable, valid and objective to assess the speed performance of 100m sprinters, simultaneously for eight athletes. Hence, the hypothesis is valid. Therefore, all the three hypotheses formulated are true and accepted.

The summary, conclusions and recommendations have been presented in next chapter.