

Research Article

Effects of 360° Titanium Core Strength Exercise® on Swing Speed and Driving Distance in Novice Golfers

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Abstract

The 360° Titanium Core Strength Exercise® comprises a series of 12 exercises aimed at strengthening the body's core. This study aims to examine the effectiveness of 360° Titanium Core Strength Exercise® on Swing Speed and Driving Distance in Novice Golfers. Participants were 40 students aged 18-22 from Linyi Golf Academy, Shandong Province, China, selected through purposive sampling. They were randomly assigned to two groups: an intervention group and a control group. All participants completed a pre-test using PRGR golf rangefinder equipment before a 12-week intervention program. The intervention group underwent training and coaching in the 360° Titanium Core Strength Exercise® prior to the training, while the control group only participated in warm-up exercises. Post-testing was conducted using PRGR devices after the 12-week intervention program. Statistical analysis using independent sample t-tests demonstrated significant effects, with the intervention group showing significantly higher Swing Speed in the post test compared to the control group (Intervention group post-test: $M=78.65$, $SD=16.37$; control group post-test: $M=64.00$, $SD=19.77$; $t(38) = 4.504$, $p < 0.05$). Similarly, the intervention group exhibited significantly greater Driving Distances in the post-test compared to the Control group (Intervention group post-test: $M=80.30$, $SD=14.63$; Control group post-test: $M=64.00$, $SD=19.77$; $t(37) = 2.553$, $p < 0.05$). There was a significant difference in Swing Speed between pre-test ($M=60.20$, $SD=9.87$) and post-test ($M=78.65$, $SD=16.37$) in the Intervention group ($t(19) = -7.074$, $p < 0.05$). Similarly, there was a significant difference in Driving Distance between pre-test ($M=55.80$, $SD=18.49$) and post-test ($M=80.30$, $SD=14.63$) in the Intervention group ($t(19) = -6.309$, $p < 0.05$). In contrast, the Control group did not show significant differences in Swing Speed (pre-test: $M=43.00$, $SD=13.10$; post-test: $M=46.55$, $SD=9.29$; $t(19) = -1.976$, $p > 0.05$) and Driving Distance (pre-test: $M=56.60$, $SD=22.53$; post-test: $M=64.00$, $SD=19.77$; $t(19) = -1.864$, $p > 0.05$). This study demonstrates that the Intervention group exhibited significantly higher Swing Speed and further Driving Distances compared to the Control group, indicating the effectiveness of 360° Titanium Core Strength Exercise® in enhancing these aspects of golf performance. The findings emphasize the potential benefits of core strength improvement in enhancing technical stability, increasing on-course performance.

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Keywords

360 °Titanium Core Strength Exercise®1, Golf Performance2, Swing Speed3, Driving Distance4

1. Introduction

30 Years of Golf Development in China: Review and Prospect.

It describes the development process of golf in China, starting from a period of slow growth (1984-2000). There were less than 100 golf courses, entering a stage of rapid expansion (2001-2008) [19].

The number of venues exceeded 500, entering a stable development period (2009-2014). Golf made its debut as a sport in the 2016 Olympic Games. With the popularity of golf, more and more people have begun to pay attention to the core strength and skills of golf [14]. With the development of technology and the integration and innovation of traditional core strength [12] with modern core technologies [11], how to incorporate modern core technologies into golf techniques has become a constant pursuit for golf enthusiasts and researchers [1], and the research on core strength training is of great significance [2]. Empirical data show that core strength training significantly improves technical proficiency [15], course proficiency and performance [16]. This not only enhances our comprehensive understanding of golf skills, but also helps athletes achieve outstanding performance on the course [9]. Furthermore, such research is very helpful for us to understand the universal principles that govern sports and human behavior.

2. Equations

$$\text{Cohen's } d = \frac{\mu_1 - \mu_2}{s}$$

Cohen's d is a statistical measure used to assess the effect size between two groups [4], commonly employed when comparing the difference in means between two groups. Its formula is as follows: μ_1 and μ_2 are the means of the two groups (typically the experimental group and the control group).

s is the pooled standard deviation of the two groups, which can be calculated using different formulas depending on the situation. For instance, when the sample sizes [8].

n_1 and n_2 are unequal and the population standard deviations are unknown, the pooled standard deviation s_{ss} is calculated using the following formula s :

$$s = \frac{\sqrt{(n_1-1) \cdot s_1^2 + (n_2-1) \cdot s_2^2}}{n_1 + n_2 - 2}$$

Here, s_1 and s_2 are the sample standard deviations of the two groups, and n_1 and n_2 are the sample sizes of the two groups.

2.1. Figures

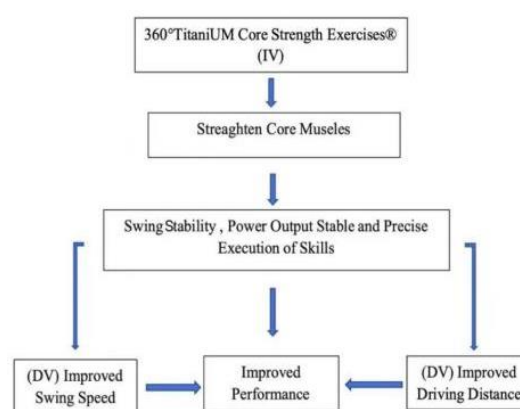


Figure 1. Conceptual Framework.

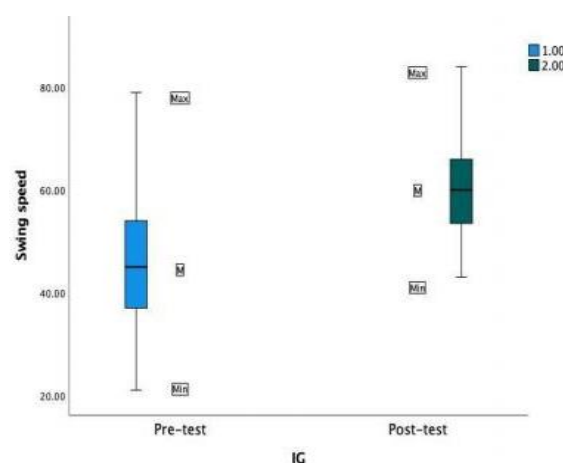


Figure 2. Pre-Test and Post-Test of Intervention Group Boxplot Swing Speed.

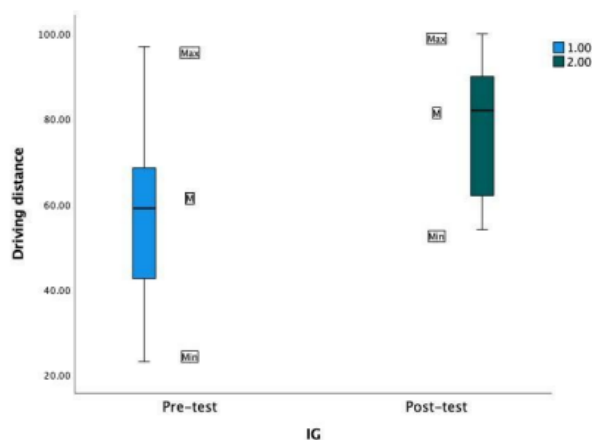


Figure 3. Pre-test and Post-test of Intervention Group Boxplot Driving Distance.

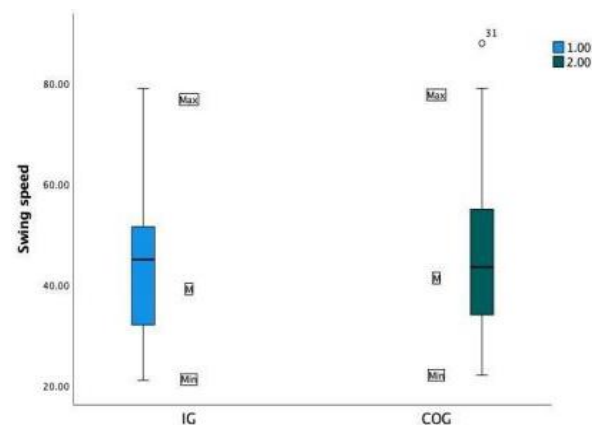


Figure 6. Intervention group and Control group Difference of Pre-test Boxplot Swing Speed.

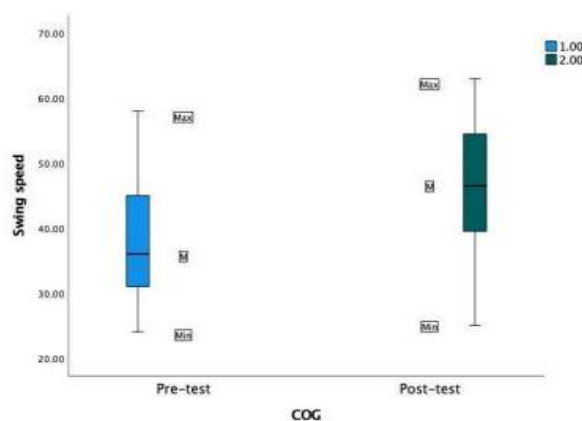


Figure 4. Pre-test and Post-test of Control Group Boxplot Swing Speed.

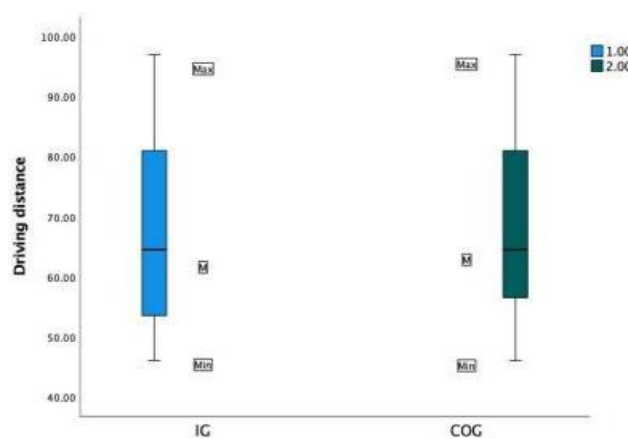


Figure 7. Intervention Group and Control Group Difference of Pre-test Boxplot Driving Distance.

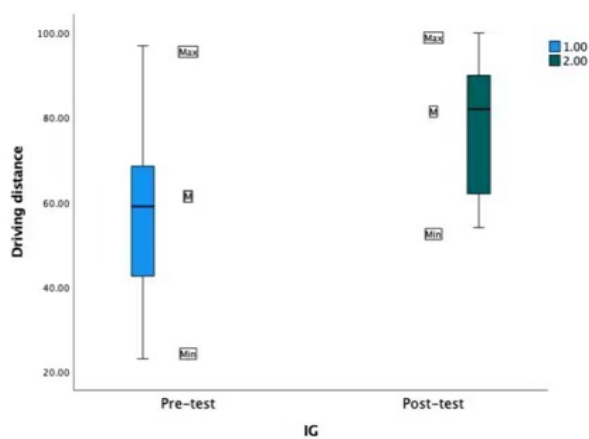


Figure 5. Pre-test and Post-test of Control Group Boxplot Driving Distance.

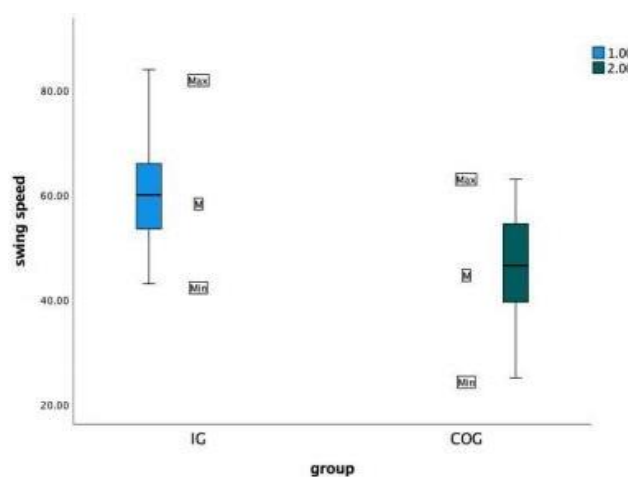


Figure 8. Post-tests of Intervention Group and Control Group Boxplot Swing Speed.

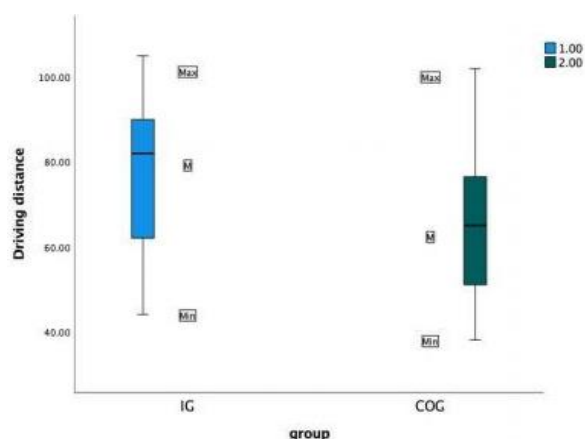


Figure 9. Post-test of Intervention Group and Control Group Box-plot Driving Distance.

2.2. Tables

Table 1. Intervention Program.

Group	IOG	COG
Frequent	3/week	3/week
Duration	12-weeks	12-weeks
Training	Normal training (15 minutes)	Normal training (15 minutes)
Intervention	360 °TitanUM Core Strength Exercises®	N/A
Set	3set/sessions	N/A
Duration/Set	20s/set	N/A
Total	36/sessions	N/A

Table 2. Intervention Group Swing Speed with Pre-test and Post-test.

Test	Mean	N	Std. Deviation
Pre-Swing Speed	60.20	20	9.87
Post-Swing Speed	78.65	20	16.37

Table 3. Intervention Group Swing Speed with Pre-test and Post-test.

Paired Samples Test					
Test	Paired Differences		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
pre-swing speed - post-swing speed	-18.45000	11.66405	-7.074	19	.001

Table 4. Intervention group of Driving Distance with Pre-test and Post-test Descriptive Statistics.

Test	Mean	N	Std. Deviation
Pre-Driving Distance	55.80	20	18.49
Post-Driving Distance	80.30	20	14.63

Table 5. Control Group of Swing Speed with Pre-test and Post-test Descriptive Statistics.

Test	Mean	N	Std. Deviation
Pre-Post tests	43.00	20	13.10
Swing Speed	46.55	20	9.29

Table 6. Control Group of Swing Speed with Pre-test and Post-test.

	Paired Differences Std.		t	df	Sig. (2- tailed)
	Mean	Deviation			
Pre-Post tests Swing Speed	-3.55000	8.03594	-1.976	19	.063
	Paired Differences Std.		t	df	Sig. (2- tailed)
	Mean	Deviation			
Pre-Post tests Swing Speed	-3.55000	8.03594	-1.976	19	.063

Table 7. Control Group of Driving Distance with Pre-test and Post-test Descriptive Statistics.

Test	Mean	N	Std. Deviation
Pre-Driving Distance	56.60	20	22.53
Post-Driving Distance	64.00	20	19.77

Table 8. Control Group of Driving Distance with Pre-test and Post-test.

Test	Paired Differences Std.		t	df	Sg.(2- tailed)
	Mean	Deviation			
Pre-Post tests Driving Distance	-7.40000	17.75387	-1.864	19	.078

Table 9. Intervention group and Control group Difference of Pre-test Swing Speed.

Group Statistics				
Test	Group	N	Mean	Std. Deviation
Pre-test	IG	20	41.30	10.20
Swing Speed	COG	20	41.20	9.91

Table 10. Intervention Group and Control Group Difference of Pre-test Driving Distance Group Statistics.

Test	Group	N	Mean	Std. Deviation
Pre-Driving Distance	IG	20	55.55	18.79
	COG	20	52.95	19.38

Table 11. Intervention Group and Control Group Difference of Post-test Swing Speed Group Statistics.

Test	Group	N	Mean	Std. Deviation
Post-test	IG	20	60.2	9.87
Swing Speed	COG	20	46.55	9.29

Table 12. Intervention Group and Control Group Difference Levene's Test of Post-test Swing Speed Independent Samples Test.

	Levene's Test for Equality of Variances	F	Sig.	t	t-test for Equality of Means	Sig. (2-tailed)	Mean Difference
Post-test	.002	.962		4.504	38	13.65	.001
Swing Speed				4.504	38	13.65	.001

Table 13. Intervention Group and Control Group Difference of Post-test Driving Distance Group Statistics.

	Group	N	Mean	Std. Deviation
Post-test	IG	20	78.65	16.37
Driving Distance	COG	20	64.00	19.77

Table 14. Intervention Group and Control Group Difference of Post-test Driving Distance.

Independent Samples Test						
Post-test	Levene's Test for Equality of Variances		t-test for Equality of Means			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Driving Distance	.007	.932	2.553	38	.015	14.65
			2.553	37	.015	14.65

3. Materials and Methods

This study consists of two research parts: Study 1 (preliminary study) was designed to investigate the reliability and effectiveness of portable Launch Monitor (PRGR) golf rangefinders for measuring swing speed and driving distance [3]. Including the pre-test of the experimental study and the pilot post-test one week later, a data was obtained and the reliability and validity [17] data were obtained by using SPSS for analysis and sorting [5]. Study 2 mainly investigated the effects of 360° Titanium core strength Exercise® on swing speed and driving distance for novice golfers [10]. The aim of this study was to assess the impact of 360° Titanium strength training® on the overall performance of novice golfers by comparing post-intervention outcomes in the intervention and control groups [11]. For 12 weeks, the experimental group performed 360° TitaniUM Core Strength Exercise® three times per week for a total of 36 workouts over 12 weeks. Refer to the training table of the study process for the detailed training plan [6].

4. Results

Based on the research results and data analysis, as well as a series of repeated measures paired T-Tests and independent samples T-Tests, the effects of 360° TitaniUM Core Strength Exercises® on swing speed and driving distance for novice golfers was evaluated [13], with significant statistical differences observed before and after the intervention [9].

After 12 weeks, the intervention group showed a significant difference in swing speed between pre- and post-test ($t(19) = -7.074$, $p < 0.001$), with a mean difference of -18.45. Similarly, the 360° TitaniUM Core Strength Exercises® intervention group exhibited a significant difference in driving distance between pre- and post-test ($t(19) = -6.3$, $p < 0.001$), with a mean difference of -24.50 [7]. In comparison:

The control group showed no significant difference in swing speed between pre- and post-test ($t(19) = -1.9$, $p = 0.063 > 0.05$), with a mean difference of -3.55. Likewise, there was no significant difference in driving distance between pre- and post-test for the control group ($t(19) = -1.8$, $p = 0.078 > 0.05$), with a mean difference of -7.40 [16].

Comparisons of swing speed before the intervention between the intervention group and the control group showed no significant difference ($t(df) = 38$, $p = 0.554 > 0.05$), indicating the rigor of the experiment and facilitating future comparative studies. Similarly, there was no significant difference in driving distance before the intervention between the intervention group and the control group ($t(df) = 38$, $p = 0.425 > 0.05$), further confirming the robustness of the experimental design. Finally, post-test comparisons of driving distance between the intervention group and the control group showed

a statistically significant difference ($t(df) = 38$, $p < 0.005$), indicating the success of the intervention experiment [8].

In summary, these analyses clearly demonstrate the significant impact of 360° TitaniUM Core Strength Exercises® on swing speed and driving distance for novice golfers, while highlighting the reliability and effectiveness of the experiment [4].

5. Discussion

By exploring the research hypotheses, research purposes and the characteristics of novice golfers [18], the significant improvements in swing speed and driving distance observed among novice golf participants before and after testing. Specifically, statistical analyses revealed that the intervention group exhibited substantial increases in swing speed and driving distance (swing speed $t(19) = -7.07$, $p < 0.01$; driving distance: $t(19) = -4.11$, $p < 0.01$). Similarly, the control group also demonstrated significant improvements in these metrics (swing speed: $t(19) = -7.07$, $p < 0.01$; shot distance: $t(19) = -4.11$, $p < 0.01$). Furthermore, comparisons between the intervention and control groups at post-test indicated significant differences, highlighting superior performance in swing speed and shot distance among the intervention group [20].

Further analysis revealed significant contrasts between the intervention and control groups in swing speed ($t(38) = 4.50$, $p < 0.05$) and driving distance ($t(38) = 2.56$, $p < 0.05$) comparisons. Examination of inter-group differences confirmed significant disparities in post-test results for swing speed and shot distance, conclusively establishing superior outcomes in the intervention group over the control group [13]. These findings underscore the impactful influence of 360° Titanium Core Strength Training® on enhancing swing speed and shot distance for novice golfers, validating its efficacy and potential in improving athletic performance [14].

6. Conclusions

In conclusion, this study provides robust data through rigorous statistical analyses, emphasizing the positive role of 360° Titanium Core Strength Training® in golfing performance. It serves as a critical theoretical foundation and practical guide for designing and implementing future training programs in the field of golf.

Abbreviations

COG	Control Group
IV	Intervention Group
CHS	Club Head Speed
ISA	Instantaneous Spiral Axis

PRGR Portable Launch Monitor

Acknowledgments

The authors would like to thank all of the participants for their time.

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

The data supporting the outcome of this research work has been reported in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

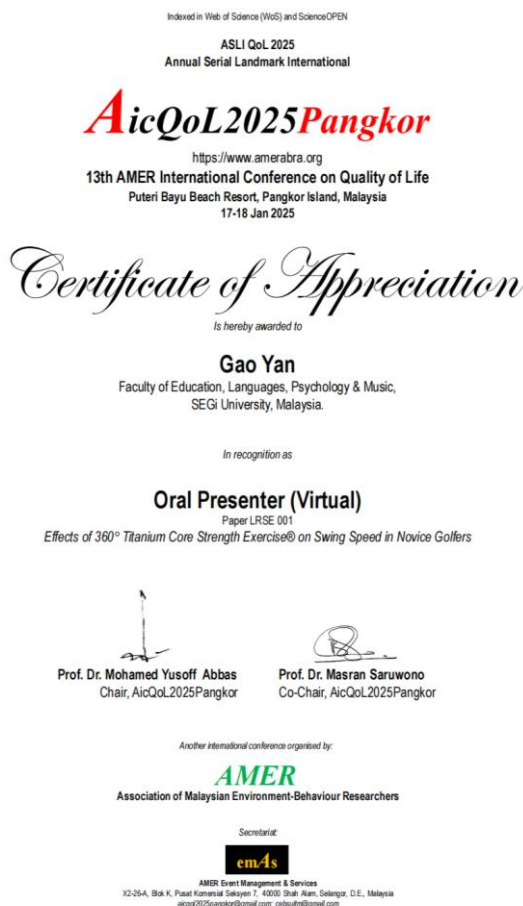


Figure A1. Published Paper

Research Title:

Effects of 360° Titanium Core Strength Exercises® on Swing Speed and Driving Distance in Novice Golfers.

Researcher's Name:

GAO YAN

Dr. Lim Boon Hooi

have read the information in the Participant Information Sheet including information regarding the risk in this study.

have been given time to think about it and all of my questions have been answered to my satisfaction.

have been explained the research and its details to me.

understand that my child may freely choose to withdraw from this study at anytime without reason and without repercussion.

understand that my child's anonymity will be ensured in the write-up.

I will be given a copy of the informed consent form with my signature and the researcher's.

(Signature)

Gao Yan

Name:

Gao Yan

29/Mar/2024

(Date)

Figure A2. Informed Consent Form

Content Validation Criteria of PRGR Golf Instrument

Title of study : Effects of 360° Titanium Core Strength Exercise® on Swing Speed and Driving Distance in Novice Golfers

I would like to ask for your opinion on the effectiveness of the Golf Portable Launch Monitor (PRGR) device as a measuring instrument. It measures the accuracy of swing speed, driving distance, and its sensitivity during use, as well as its overall performance feel on the course.

Content Verification:
Please tick (✓) the appropriate ratings for this form

	1.Poor	2.Below Average	3.Average	4.Good	5.Excellent
No					
1					✓
2					✓
3					✓
4					✓
5					✓

Verified by: ZHANG MAO QING

Name: ZHANG MAO QING

Designation : Professional golf coach in China, champion of the China Tour

Date: 30.03.2024

Signature :

ZHANG MAO QING

Figure A3. Content Validation Criteria of PRGR Golf Instrument

Content Validation Criteria of PRGR Golf Instrument

Title of study :Effects of 360° TitaniUM Core Strength Exercise@ on Swing Speed and Driving Distance in Novice Golfers

I would like to ask for your opinion on the effectiveness of the Golf Portable Launch Monitor (PRGR) device as a measuring instrument. It measures the accuracy of swing speed, driving distance, and its sensitivity during use, as well as its overall performance feel on the course.

Content Verification:
Please tick(✓)the appropriate ratings for this form

	1.Poor	2.Below Average	3.Average	4.Good	5.Excellent
No					
1 This device can be used as a measurement tool for golf swing speed.					✓
2 This device can be used as a measurement tool for golf driving distance.					✓
3 The device is applicable for this study					✓
4 The device is relevant to the components mentioned in this study					✓
5 The device measurement is reliable and valid					✓

Verified by: Padraig Harrington

Name: Padraig Harrington

Designation : A famous Irish golfer. By the time he won the Portuguese Masters in October 2016, he had won 15 European Tour titles, six PGA Tour titles and four Asian Tour titles.

Figure A4. Content Validation Criteria of PRGR Golf Instrument

Content Validation Criteria of PRGR Golf Instrument

Title of study :Effects of 360° TitaniUM Core Strength Exercise@ on Swing Speed and Driving Distance in Novice Golfers

I would like to ask for your opinion on the effectiveness of the Golf Portable Launch Monitor (PRGR) device as a measuring instrument. It measures the accuracy of swing speed, driving distance, and its sensitivity during use, as well as its overall performance feel on the course.

Content Verification:
Please tick(✓)the appropriate ratings for this form

	1.Poor	2.Below Average	3.Average	4.Good	5.Excellent
No					
1 This device can be used as a measurement tool for golf swing speed.					✓
2 This device can be used as a measurement tool for golf driving distance.					✓
3 The device is applicable for this study					✓
4 The device is relevant to the components mentioned in this study					✓
5 The device measurement is reliable and valid					✓

Verified by: YANG LI YONG

Name: YANG LI YONG

Designation : China's famous sports professor

Data:28/3/2024

signature: 

Figure A5. Content Validation Criteria of PRGR Golf Instrument



Figure A6. The Instrument is Called a Golf Rangefinder (PRGR)



Figure A6. Brand Endorsers and Experts(Chris Wood)



Figure A8. Brand Endorsers and Experts (Padraing Harrington)





SEGi
University

SEGi Research Ethics Committee

Ethics Approval Letter

Ethics Approval Number: SEGiEC/SR/FOELPM/153/2024-2025 Date: 26/6/2024

To,

Gao Yan

FOELPM

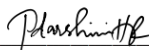
Dear Gao Yan,

The SEGi Research Ethics Committee reviewed your application on 24/6/2024 to conduct the research project titled "Effects of 360° Titani UM Core Strength Exercises® on Swing Speed and Driving Distance in Novice Golfers". Approval is granted for a period of 12 months from June 2024 to May 2025.

The approval has been granted based on reviews by the Committee on the following core principles:

• Appropriate procedures to protect confidentiality and anonymity of participants	☒
• Appropriate method of securing data and information collected	☒
• Appropriate and sufficient information to obtain informed consent of participants	☒
• No indication of inducements for participation or penalty for not taking part	NA
• Appropriate procedures to prevent or minimise potential risk/ harms to participants	NA
• Appropriate procedures to allow participants to withdraw from the research at any time	NA
• Benefits of the research outweigh the risk of harm	NA
• Declaration of any actual or potential conflicts of interest	NA

The SREC wishes you every success in your research.



Professor Dr. Priyadarshini HR

Chairperson,

SEGi Research Ethics Committee

The REC members present at the meeting:

	Member	Name
1.	Cluster Rep from Healthcare & Life Sciences cluster	A/P Dr.Saravana Sampathkumar
2.	Cluster Rep from Engineering & Technology	Dr. Nurulazina
3.	Rep Social Sciences & Humanities	Prof Dr.Geetha Subramaniam
4.	Pharmacist	Ms.Rini Dinesh Sanggaran
5.	Philosopher/Ethicist	Dr.Elise Monerasinghe

Please quote Project Title and Ethical Approval Number in all correspondence to RIMC

Figure A9. Ethics Committee

12 week training schedule form					
time/week	frequency /weeks	intensity/time	Normal warm-up	content	
				Intervention	Control
1	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
2	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
3	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
4	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
5	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
6	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
7	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
8	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
9	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
10	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
11	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills
12	3	30s	✓	360°TitaniUM Core Strength Exercises®+golf skills	golf skills

Figure A10. Week Training Schedule Form



a. Record data



b. A Picture of the PRGR Golf Rangefinder Used In Measurement

Figure A11. Data Collection





Figure A12. Data Collection of Intervention group (360° TitaniUM Core Strength Exercises®).

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