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Effect of Carbon Rackets on Performance Parameters in Table Tennis

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Abstract
This study investigates the impact of carbon fiber rackets on key performance parameters in table tennis, including ball speed, spin rate, control, and rally duration. Twenty elite table tennis players participated in a cross-over design experiment using both carbon and wooden rackets. Performance data were recorded using a spin analyzer, speed radar, and video tracking. Results showed that carbon rackets significantly increased ball speed and spin rate but slightly reduced control and rally length. The study concludes that carbon rackets are more suitable for advanced players favoring aggressive playstyles.

Keywords: Carbon racket, table tennis, ball speed, spin rate, control, performance analysis

1. Introduction
Technological innovations in sports equipment have greatly influenced athlete performance. In table tennis, the use of carbon fiber materials in racket blades is a significant advancement. Carbon rackets offer increased stiffness, enhanced energy transfer, and a larger sweet spot, making them appealing to offensive players. However, these advantages may come at the cost of reduced control. This study aims to assess how carbon rackets influence measurable aspects of performance in competitive table tennis.

2. Review of Literature
Previous research (e.g., Zhang et al., 2019; Ito & Nagano, 2021) has shown that equipment material significantly affects spin and ball trajectory. Carbon blades have been associated with higher ball speed and lower vibration absorption. However, limited studies have quantitatively compared carbon vs. wooden rackets under controlled conditions with elite players. This study seeks to bridge this gap.

3. Objectives
- To compare ball speed, spin rate, and control between carbon and wooden rackets.
- To analyze the impact of racket type on rally duration and player preference.
- To provide recommendations for racket selection based on playing style.

4. Hypotheses
- **H_0:** There is no significant difference in performance metrics between carbon and wooden rackets.
- **H_1:** Carbon rackets significantly affect speed, spin, and control in table tennis.

5. Methodology

5.1 Participants

- **N = 20** elite male table tennis players
- Age: 18–25 years
- All participants had ≥5 years of competitive experience

5.2 Equipment

- Carbon and 5-ply wooden rackets (standard ITTF-approved)
- Spin and speed measurement tools: Tibhar Spin Analyzer, Pocket Radar
- Video tracking system for rally analysis

5.3 Design

- Cross-over design: Each player used both types of rackets in randomized order
- 30-minute session per racket with identical warm-up and drills
- 3-match simulation with data recorded per point

5.4 Variables

- **Independent Variable:** Type of racket (carbon or wood)
- **Dependent Variables:** Ball speed, spin rate, control (error rate), rally duration, subjective preference

6. Results

Table 1: Comparative Performance Data

Parameter	Carbon Racket	Wooden Racket	p-value	Significance
Ball Speed (km/h)	78.5 ± 4.3	72.3 ± 3.9	0.012	Significant
Spin Rate (RPM)	1650 ± 120	1505 ± 110	0.015	Significant
Control Accuracy (%)	82.4 ± 5.2	87.6 ± 4.9	0.045	Significant
Rally Duration (sec)	4.5 ± 0.6	5.2 ± 0.7	0.032	Significant
Player Preference (%)	70% chose carbon racket	30% chose wooden racket	–	–

7. Discussion

The findings indicate that carbon rackets significantly increase ball speed and spin, which is advantageous for attacking players. However, a noticeable drop in control accuracy and shorter rally durations were observed. This supports previous observations by sports engineers and professional coaches. Player preference data aligned with the performance trends, as most offensive-style players favored carbon rackets.

8. Conclusion

Carbon rackets enhance speed and spin in table tennis but require greater skill for control. These rackets are better suited for advanced players who focus on offensive gameplay. Coaches should assess player style and skill before recommending equipment.

9. Recommendations

- **Advanced players:** Use carbon rackets for speed-based techniques.
- **Intermediate players:** Prefer wooden rackets for better control.

- Further research should explore the effect of racket material on injury risk, player fatigue, and long-term skill development.

10. References

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