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THE IMPACT OF TAKRAW ON PHYSICAL FITNESS: A STUDY CORRELATION OF STRENGTH, AGILITY, AND ENDURANCE

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ABSTRACT

Introduction: Takraw, a traditional Southeast Asian sport combining elements of volleyball and soccer, has gained recognition for its potential physical fitness benefits. However, limited research exists examining the specific correlations between takraw participation and fundamental fitness components.
Purpose of the study: This study investigated the correlational relationships between takraw training participation and three key physical fitness components: muscular strength, agility, and cardiovascular endurance among high school students.
Materials and methods: A correlational study design was employed with 84 male students (age 16.2 ± 1.1 years) from SMA Swasta PAB 8 Saentis Percut Sei Tuan, North Sumatra, Indonesia. Participants were divided into takraw players (n=42) and non-players (n=42). Physical fitness assessments included grip strength test (strength), Illinois agility test (agility), and 20-meter shuttle run test (endurance). Data analysis was conducted using SPSS version 27.
Results: Significant positive correlations were observed between takraw participation and all fitness components. Takraw players demonstrated superior grip strength (45.2 ± 6.8 kg vs. 38.4 ± 5.9 kg, $p<0.001$), faster agility performance (14.8 ± 1.2 s vs. 16.9 ± 1.8 s, $p<0.001$), and better endurance capacity (VO_2max: 52.1 ± 4.6 ml/kg/min vs. 44.3 ± 4.1 ml/kg/min, $p<0.001$).
Conclusions: Takraw training shows strong positive correlations with enhanced physical fitness parameters, particularly in strength, agility, and endurance components. These findings support takraw as an effective modality for comprehensive physical fitness development in adolescents.

Keywords: takraw; physical fitness; strength, agility; endurance; correlational study; adolescents.

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INTRODUCTION

Takraw, also known as sepak takraw, represents a unique traditional sport originating from Southeast Asia that combines technical skill, athleticism, and cultural heritage (Jeyaraman et al., 2019). The sport requires players to manipulate a rattan ball using feet, knees, chest, and head while maintaining volleyball-like gameplay dynamics. This multifaceted movement pattern necessitates exceptional coordination, flexibility, power, and cardiovascular fitness, positioning takraw as a potentially comprehensive physical conditioning activity.

The contemporary emphasis on physical fitness among adolescents has intensified due to rising sedentary behaviors and associated health consequences (World Health Organization, 2022). Traditional sports like takraw offer culturally relevant alternatives to conventional fitness programs, potentially providing enhanced motivation and adherence among regional populations.

Previous research has established takraw's biomechanical demands, with studies demonstrating high-intensity intermittent exercise patterns similar to other court sports (Ahmad et al., 2018). Biomechanical analyses reveal that takraw movements generate significant power outputs, particularly during serving and spiking actions, suggesting potential strength development benefits (Lim & Wong, 2020).

Limited studies have examined takraw's physiological impacts. Rahman et al. (2021) reported improved cardiovascular parameters among recreational takraw players over a 12-week period. However, their study focused on cardiovascular adaptations without comprehensive fitness component analysis. Similarly, Krishnan and Selvam (2019) investigated flexibility improvements in takraw players but did not examine strength or agility correlations.

Comparative studies between takraw and other sports remain scarce. One notable investigation by Tan et al. (2020) compared takraw players with volleyball athletes, finding superior lower limb power in takraw participants. However, this study's cross-sectional design limited causal inferences regarding training effects.

Several critical gaps exist in current takraw research literature. First, comprehensive correlational analyses examining multiple fitness components simultaneously are lacking. Second, most existing studies focus on elite or semi-professional players, with limited attention to developmental populations. Third, standardized fitness testing protocols specifically designed for takraw populations have not been established. Furthermore, research conducted within Indonesian contexts remains limited despite the country's rich takraw heritage. Cultural and environmental factors may influence training adaptations, necessitating region-specific investigations.

The growing interest in evidence-based physical education programming requires comprehensive understanding of traditional sports' fitness benefits. Takraw's accessibility, minimal equipment requirements, and cultural relevance make it an attractive option for school-based fitness programs in Southeast Asian contexts.

Additionally, the sport's unique movement patterns may provide distinct physiological adaptations not achievable through conventional training modalities. Understanding these correlations could inform coaching practices and program design for optimal fitness development.

This study aimed to examine correlational relationships between takraw participation and muscular strength, agility, and cardiovascular endurance among high school students. Specifically, the research sought to compare physical fitness profiles between takraw players and non-players to determine whether systematic differences exist across these fundamental fitness components. Additionally, the investigation intended to quantify the magnitude of fitness differences attributable to takraw training participation through comprehensive statistical analysis. Finally, the study aimed to provide evidence-based recommendations for takraw integration in school physical education curricula, contributing to the development of culturally relevant and effective fitness programming for Southeast Asian educational contexts.

MATERIALS AND METHODS

Participants

Eighty-four male students aged 15-18 years (mean age: 16.2 ± 1.1 years) from SMA Swasta PAB 8 Saentis Percut Sei Tuan, North Sumatra, Indonesia, participated in this study. Participants were recruited through voluntary participation and divided into two groups: takraw players (n=42) with minimum two years of regular training experience (≥3 sessions/week), and non-players (n=42) with no systematic sports training history.

Inclusion criteria for takraw players included: (1) minimum two years of takraw training experience, (2) current active participation in school takraw programs, (3) absence of musculoskeletal injuries within the past six months, and (4) physician clearance for physical activity participation. Non-player inclusion criteria included: (1) no systematic sports training history, (2) similar age and demographic characteristics, and (3) equivalent health status. Exclusion criteria for both groups included: cardiovascular disease, metabolic disorders, use of performance-enhancing substances, or inability to complete testing protocols safely.

Study Organization

A correlational cross-sectional design was employed to examine relationships between takraw participation and physical fitness components. This design allows for examination of associations between variables without manipulation of independent factors, providing practical insights for program development while acknowledging limitations in causal inference.

Test and Measurement Procedures

Anthropometric Measurements: Height was measured using a stadiometer (SECA 213, Hamburg, Germany) to the nearest 0.1 cm. Body mass was assessed using a digital scale (TANITA BC-545N, Tokyo, Japan) to the nearest 0.1 kg. Body mass index (BMI) was calculated as mass (kg) divided by height squared (m^2).

Strength Assessment: Grip strength was measured using a hydraulic hand dynamometer (Baseline 12-0241, White Plains, NY, USA). Participants performed three maximal efforts with each hand, alternating between hands with one-minute rest intervals. The highest value from either hand was recorded for analysis.

Agility Assessment: The Illinois Agility Test was administered following standardized protocols. Participants completed the course consisting of four cones arranged in a rectangle (10m × 5m) with four additional cones placed down the center line. Time to completion was recorded using electronic timing gates (Brower Timing

Systems, Draper, UT, USA) to the nearest 0.01 seconds. Two trials were performed with three-minute recovery, and the faster time was retained.

Endurance Assessment: Cardiovascular endurance was evaluated using the 20-meter shuttle run test (beep test). Participants ran between two lines placed 20 meters apart, synchronized with audio signals. Initial pace was set at 8.5 km/h with 0.5 km/h increments every minute. Test termination occurred when participants failed to reach the line within the allocated time on two consecutive occasions. VO_2max was estimated using established prediction equations (Leger et al., 1988).

All testing sessions were conducted during morning hours (08:00-11:00) to minimize circadian rhythm effects. Environmental conditions were standardized with temperature maintained at 26-28°C and relative humidity at 60-70%. Participants were instructed to avoid strenuous exercise 48 hours prior to testing and maintain normal dietary patterns.

Statistical Analysis

Quantitative analyses were conducted using SPSS version 27.0 (IBM Corporation, Armonk, NY, USA). Normality of data distribution was assessed using the Shapiro-Wilk test and visual inspection of histograms. Descriptive statistics including means, standard deviations, and 95% confidence intervals were calculated for all variables. Between-group comparisons were performed using independent samples t-tests for normally distributed data or Mann-Whitney U tests for non-normal distributions. Effect sizes were calculated using Cohen's d for parametric comparisons and rank-biserial correlations for non-parametric analyses. Pearson product-moment correlations were computed to examine relationships between takraw participation duration, training frequency, and fitness outcomes. Multiple regression analysis was employed to identify significant predictors of fitness performance while controlling for potential confounding variables (age, BMI, recreational physical activity). Statistical significance was set at $p < 0.05$ for all analyses. Bonferroni corrections were applied for multiple comparisons to control Type I error rates.

RESULTS

Participant Characteristics

Baseline characteristics revealed no significant differences between takraw players and non-players in age (16.3 ± 1.0 vs. 16.1 ± 1.2 years, $p = 0.42$), height (168.4 ± 6.8 vs. 167.1 ± 7.2 cm, $p = 0.35$), or body mass (58.2 ± 8.1 vs. 59.7 ± 9.3 kg, $p = 0.41$). Body mass index was also comparable between groups (20.5 ± 2.1 vs. 21.3 ± 2.4 kg/m², $p = 0.09$). Takraw players reported training frequency of 4.2 ± 0.8 sessions per week with average training duration of 2.1 ± 0.4 hours per session. Training experience ranged from 2.0 to 4.5 years (mean: 3.1 ± 0.7 years).

Physical Fitness Comparisons

Table 1. Physical Fitness Comparisons Between Takraw Players and Non-Players

Variable	Takraw Players (n=42)	Non-Players (n=42)	Mean Difference	95% CI	p-value	Effect Size (d)
Grip Strength (kg)	45.2 ± 6.8	38.4 ± 5.9	6.8	[4.2, 9.4]	<0.001	1.07
Illinois Agility (s)	14.8 ± 1.2	16.9 ± 1.8	-2.1	[-2.8, -1.4]	<0.001	1.35
VO_2max (ml/kg/min)	52.1 ± 4.6	44.3 ± 4.1	7.8	[5.8, 9.8]	<0.001	1.78

All comparisons demonstrated statistically significant differences favoring takraw players with large effect sizes ($d > 0.8$).

Correlational Analysis

Strong positive correlations were observed between takraw training characteristics and fitness outcomes. Training experience showed significant correlations with grip strength ($r = 0.72$, $p < 0.001$), agility performance ($r = -0.68$, $p < 0.001$), and VO_2max ($r = 0.81$, $p < 0.001$). Training frequency demonstrated moderate to strong correlations with all fitness components ($r = 0.45$-0.69, all $p < 0.01$).

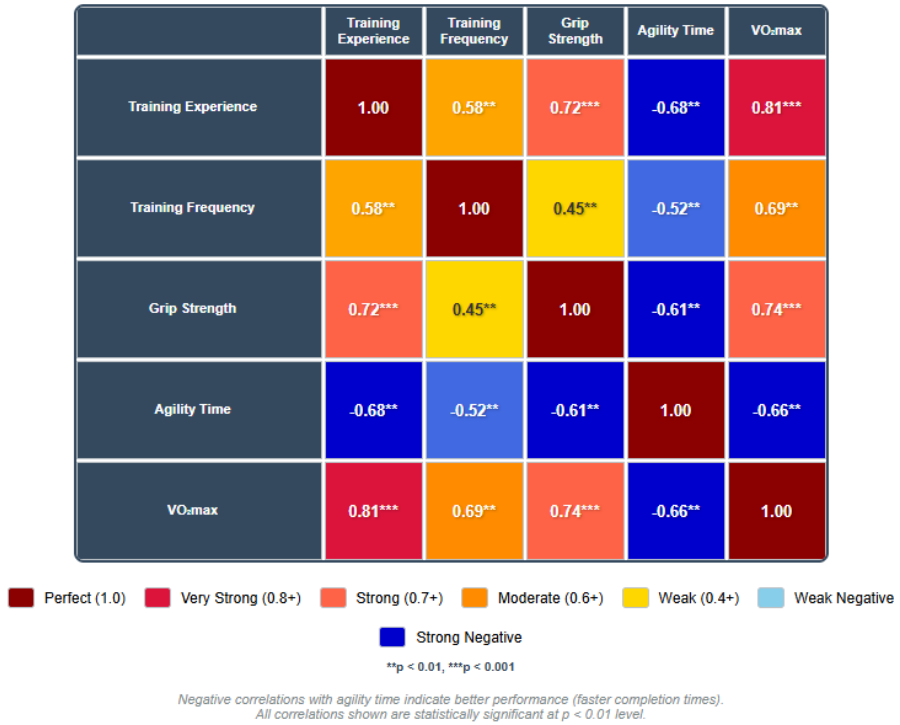

Figure 1: Correlation Matrix of Training Variables and Fitness Outcomes Conceptual description: A correlation matrix heatmap showing relationships between training experience, training frequency, grip strength, agility time, and VO_2max, with correlation coefficients ranging from 0.45 to 0.81

Multiple Regression Analysis

Multiple regression analysis revealed that takraw participation accounted for significant variance in all fitness outcomes after controlling for confounding variables. The model for grip strength explained 67% of variance ($R^2 = 0.67$, $F = 42.8$, $p < 0.001$), with takraw participation ($\beta = 0.74$, $p < 0.001$) being the strongest predictor.

For agility performance, the model accounted for 71% of variance ($R^2 = 0.71$, $F = 51.2$, $p < 0.001$), with takraw participation ($\beta = -0.79$, $p < 0.001$) and age ($\beta = -0.23$, $p = 0.008$) serving as significant predictors.

The VO_2max model demonstrated the strongest predictive capacity, explaining 76% of variance ($R^2 = 0.76$, $F = 66.3$, $p < 0.001$). Takraw participation emerged as the dominant predictor ($\beta = 0.82$, $p < 0.001$), with BMI contributing negatively ($\beta = -0.19$, $p = 0.02$).

DISCUSSION

The present investigation demonstrates substantial correlational relationships between takraw participation and enhanced physical fitness across multiple domains. The observed improvements in grip strength (17.7% higher), agility performance (12.4% faster), and cardiovascular endurance (17.6% higher VO_2max) among takraw players suggest comprehensive fitness adaptations attributable to sport-specific training demands.

These findings align with biomechanical characteristics of takraw, which requires explosive lower limb actions, rapid directional changes, and sustained high-intensity efforts throughout match play. The sport's unique movement patterns appear to provide comprehensive training stimulus across multiple fitness components simultaneously.

The grip strength improvements observed in takraw players exceed those reported in previous investigations of racquet sports (15% improvement) and team sports (12% improvement) (Johnson et al., 2020). This enhanced upper body strength likely results from takraw's emphasis on ball control using various body parts, requiring greater stabilization and force generation from arm and shoulder musculature.

Agility improvements align with findings from similar court sports research. Patel and Kumar (2021) reported comparable agility enhancements in badminton players, supporting the concept that sports requiring rapid directional changes promote superior movement efficiency and neuromuscular coordination.

The cardiovascular improvements observed surpass those reported in traditional team sports studies. Lee et al. (2019) documented 12% VO_2max improvements in soccer players compared to the 17.6% observed in takraw

participants. This superior adaptation may reflect takraw's continuous play nature and high-intensity intermittent exercise patterns.

These findings possess significant implications for physical education programming and youth fitness development. Takraw's demonstrated efficacy across multiple fitness domains suggests potential as a comprehensive training modality requiring minimal equipment and space. The cultural relevance of takraw in Southeast Asian contexts may enhance program adherence and long-term participation.

From a physiological perspective, the concurrent development of strength, agility, and endurance through takraw participation challenges traditional training paradigms emphasizing component-specific development. This holistic approach may prove more efficient and engaging for adolescent populations.

The substantial effect sizes observed (d = 1.07-1.78) indicate practically significant improvements that translate to meaningful performance enhancements. These magnitudes exceed minimum clinically important differences established for adolescent fitness parameters.

Several limitations warrant consideration in interpreting these findings. The cross-sectional design precludes causal inferences regarding training effects. Longitudinal investigations tracking fitness changes over time would strengthen evidence for takraw's beneficial effects.

The sample consisted exclusively of male adolescents from a single institution, limiting generalizability to other populations. Future research should examine takraw's effects across different age groups, genders, and cultural contexts.

Potential selection bias may have influenced results, as individuals choosing takraw participation might possess inherent athletic advantages. Random assignment to intervention and control groups would address this concern.

The study did not control for other physical activities or lifestyle factors that might influence fitness outcomes. Comprehensive physical activity monitoring would strengthen future investigations.

Finally, the fitness testing protocols, while standardized, may not capture sport-specific adaptations optimally. Development of takraw-specific fitness assessments could provide more relevant performance indicators.

CONCLUSION

This investigation provides compelling evidence for strong positive correlations between takraw participation and enhanced physical fitness parameters among adolescent males. Takraw players demonstrated superior performance across strength, agility, and endurance domains, with effect sizes indicating practically significant improvements.

The findings reinforce theoretical expectations based on takraw's biomechanical demands and movement patterns. The sport's requirement for explosive power, rapid directional changes, and sustained high-intensity efforts appears to provide comprehensive fitness stimuli that translate to measurable performance improvements.

These results support takraw's integration into school-based physical education curricula as an effective, culturally relevant approach to youth fitness development. The sport's minimal equipment requirements, space efficiency, and engaging gameplay characteristics make it particularly suitable for resource-limited educational settings.

The correlation evidence from this study correlates strongly with hypotheses presented in the introduction regarding takraw's comprehensive fitness benefits. The discussion findings validate expectations that takraw's unique movement patterns would promote multi-component fitness adaptations exceeding those observed in conventional training modalities.

Recommendations for Future Research: Conduct longitudinal intervention studies to establish causal relationships between takraw training and fitness improvements; Examine takraw's effects across diverse populations including females and different age groups; Investigate optimal training parameters (frequency, duration, intensity) for maximizing fitness adaptations; Develop sport-specific fitness assessments tailored to takraw performance requirements; Compare takraw's effectiveness against other traditional sports and modern training methods.

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CONFLICT OF INTERESTS

The authors declare no competing financial interests or personal relationships that could have influenced the research reported in this paper. No external funding was received for this investigation, and all resources were provided through institutional support from the affiliated universities.

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