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Effects of Upper-Body Resistance Exercises and Anxiety Levels on Free-Throw Performance in Basketball Players

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Abstrac: This study examined the effects of Medicine Ball Throw One Hand and Overhead Tricep Extension Resistance Band training on free throw performance, anxiety level, and their interaction among male high school basketball players. A 2×2 factorial design was employed involving 24 male athletes from SMAK Gloria 1 Surabaya. Anxiety was measured using the Competitive State Anxiety Inventory-2 (CSAI-2), with group assignment via Matched-Subject Ordinal Pairing (MSOP). Two-Way ANOVA was applied at α = 0.05. Results showed: (1) both training methods significantly improved free throw performance, with Overhead Tricep Extension Resistance Band being more effective (F = 18.615; p = 0.000); (2) anxiety level did not significantly affect free throw performance (F = 1.385; p = 0.253); (3) no significant interaction existed between training method and anxiety level (F = 0.000; p = 1.000). Overhead Tricep Extension Resistance Band training is recommended for improving free throw ability regardless of anxiety level.

Keyword: Anxiety, Basketball, Free Throw, Medicine Ball, Resistance Band

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INTRODUCTION

Basketball is a team sport that demands the integration of technical skills, physical conditioning, and psychological readiness. A team's success in competition is greatly influenced by each player's ability to execute fundamental skills effectively. One of the most important fundamental skills for scoring points is shooting (Kosasih, 2008). Shooting is the primary skill in basketball as it serves as the main means for players to score points and determine match outcomes (Wissel, 2011). Therefore, the ability of shooting is an important factor in enhancing both individual and team performance (Wang & Li, 2024).

One form of shooting that offers a high opportunity to score is free throw. Free throw is a free shot awarded to a player following certain violations committed by the opposing player. The ability to perform free throw accurately is considered an important performance indicator for basketball players (Irawan et al., 2021). Failure in executing free throw can be caused by various factors, including technical, physical, and psychological aspects (Hidayat, 2018).

From a biomechanical perspective, the shooting movement in basketball involves a sequence of actions beginning with the preparation, execution, through to follow through (Irawan et al., 2021). During the execution phase, elbow extension plays a key role in propelling the ball toward the basket. Biomechanical research has shown that arm muscle activation, particularly the triceps brachii muscle, plays a critical role in determining the success of the free throw because this muscle acts as the primary mover during elbow extension at ball release (Pakosz et al., 2021).

Statistical data from the DBL Play application in 2024 show that the male basketball team of SMAK Gloria 1 Surabaya converted only 3 of 8 free throw attempts (37.5%) in the regional semifinal against SMA 5 Surabaya. DBL 2025 data show that free throw accuracy was only 6 of 14 attempts (42.9%) against SMA Vita Surabaya. These figures highlight that improving free throw performance requires not only technical development, but also improvement of relevant muscular strength and effective management of athletes' psychological conditions.

The Medicine Ball throw one hand and Overhead Tricep Extension Resistance Band training methods were selected because both have the characteristics of resistance training that is functional in nature, simulating sport-specific movement patterns (Bompa & Buzzichelli, 2019). Medicine Ball throw one hand training drills a one-hand push movement resembling the shooting motion, while Overhead Tricep Extension Resistance Band training specifically targets the triceps muscle involved in elbow extension during ball release. Sport specific resistance training provides more optimal performance transfer in young game-sport athletes.

In addition to physical and technical factors, psychological aspects also play an important role in free throw success. Competitive anxiety is an emotional state characterized by tension, worry, and increased physiological arousal that can affect athletic performance. Research shows that competitive anxiety can influence an athlete's concentration and motor control when performing sport-specific skills (Feng & Zhuang, 2025). Furthermore, (Büttner et al., 2024) confirmed that psychological pressure can reduce athlete performance in free throw situations due to disruptions in concentration and movement coordination.

Several studies have investigated resistance training interventions in basketball players. (Suntharalingam et al., 2022) demonstrated that medicine ball training improved physical performance variables in basketball athletes. Makaruk et al., (2024) concluded that resistance training enhances sport-specific performance among elite athletes. In addition, Maeo et al. (2023) reported that overhead elbow extension exercises induce greater triceps hypertrophy, which may contribute to movements requiring explosive elbow extension. Meanwhile, studies in sport psychology have shown that competitive anxiety can influence concentration and motor performance during precision tasks such as free throws (Büttner et al., 2024; Goldschmied et al., 2022).

Despite the growing body of literature on basketball training interventions, several research gaps remain. First, most prior studies examining resistance training for basketball players have focused on general strength outcomes rather than sport-specific skill performance such as free throw accuracy (Makaruk et al., 2024). Second, although competitive anxiety has been widely studied in sport psychology, its moderating role in the relationship between

resistance training and free throw performance has not been simultaneously investigated in adolescent athletes (Goldschmied et al., 2022; Büttner et al., 2024). Third, the comparative effectiveness of Medicine Ball Throw One Hand versus Overhead Tricep Extension Resistance Band training modalities specifically for free throw improvement in high school players has not been empirically tested under a factorial design. The novelty of this study lies in three aspects. First, this study compares two upper-body resistance training modalities that specifically target free throw mechanics. Second, it examines competitive anxiety as a moderating variable within a 2×2 factorial experimental design. Third, this study focuses on adolescent high school basketball athletes, a population that has been underrepresented in previous studies examining the relationship between resistance training, anxiety, and free throw performance. Therefore, this study aimed to: (1) examine the effect of Medicine Ball Throw One Hand and Overhead Tricep Extension Resistance Band training on free throw performance; (2) examine the effect of anxiety level on free throw performance; and (3) examine the interaction between training method and anxiety level on free throw performance in a male high school basketball team.

METHOD

Research Design

This study used a quantitative approach with an experimental method and a 2×2 factorial design (Sugiyono, 2019). The factorial design was chosen because it allows for simultaneous testing of the main effects of two independent variables and their interaction on the dependent variable (Montgomery, 2019). The independent variable was training method (Medicine Ball Throw One Hand and Overhead Tricep Extension Resistance Band), the moderating variable was anxiety level (high and low), and the dependent variable was free throw performance. Competitive anxiety was measured using the Competitive State Anxiety Inventory-2 (CSAI-2) distributed via Google Form. Participants were categorized into high-anxiety and low-anxiety groups using the median score as the cut-off point. Group assignment used the Matched-Subject Ordinal Pairing (MSOP) method with an A–B–B–A pattern, producing four groups: A1B1 (Medicine Ball + High Anxiety, n=6), A1B2 (Medicine Ball + Low Anxiety, n=6), A2B1 (Resistance Band + High Anxiety, n=6), and A2B2 (Resistance Band + Low Anxiety, n=6).

Table 1. 2×2 Factorial Design

Anxiety Level	TRAINING METHOD	
	Exercise Medicine Ball Throw One Hand (A1)	Exercise Overhead Triceps Extension Resistance Band (A2)
High (B1)	A1B1	A2B1
Low (B2)	A1B2	A2B2

Note. A1B1: Medicine Ball + High Anxiety; A1B2: Medicine Ball + Low Anxiety; A2B1: Resistance Band + High Anxiety; A2B2: Resistance Band + Low Anxiety.

Participant

The research subjects were 24 male athletes from the SMAK Gloria 1 Surabaya basketball team in 2026, selected through purposive sampling from 30 initial candidates based on the following criteria: (a) active male basketball players registered on the SMAK Gloria 1 Surabaya team for the 2025/2026 season, (b) aged 15–18 years, (c) had a minimum of one year of competitive experience, (d) free from musculoskeletal injury at the time of the study, and (e) willing to participate in all training sessions and measurement procedures. Six candidates were excluded due to injury (n=3) or failure to meet the minimum experience requirement (n=3). Anxiety level was measured using the Competitive State Anxiety Inventory-2 (CSAI-2) distributed via Google Form. Group assignment was conducted using the Matched-Subject Ordinal Pairing (MSOP) technique with an A–B–B–A pattern, producing four groups: A1B1 (Medicine Ball + High Anxiety, n=6), A1B2 (Medicine Ball + Low Anxiety, n=6), A2B1 (Resistance Band + High Anxiety, n=6), and A2B2 (Resistance Band + Low Anxiety, n=6).

Instrument

Data were analyzed using descriptive and inferential statistics. Prerequisite tests included the Shapiro-Wilk normality test and Levene's Test homogeneity test. Hypothesis testing used Two-Way Analysis of Variance (Two-Way ANOVA) at a significance level of $\alpha = 0.05$, followed by effect size calculation through Partial Eta Squared. All analyses were performed using SPSS version 23. Free throw performance was assessed using the free throw shooting test from (Johnson & Nelson, 1986), in which each athlete performed 10 shot attempts with 5 seconds per attempt in accordance with FIBA (2023) regulations. The final score was the number of successful shots from 10 attempts. Ecological validity was enhanced by simulating competitive conditions through the presence of spectators, supporter sounds, and a team selection scenario.

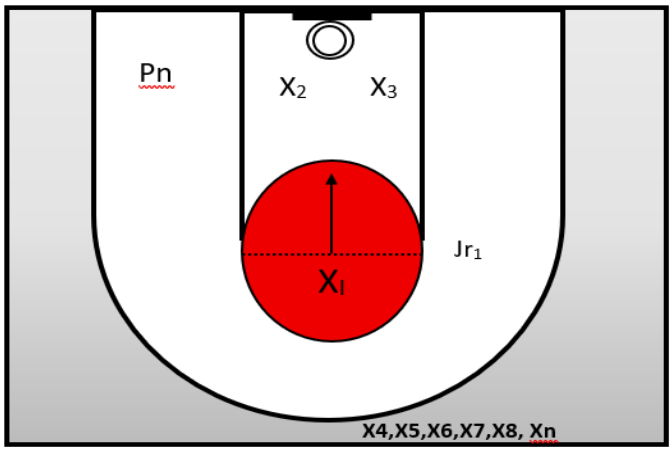

Figure 1. Battery Test from AAHPERD Basket Ball Test Manual

Note. X1; throws the ball 10 times, X2; returns the ball to X1 after the throw, X3; catches the ball thrown by X1, Jr1; supervises the free-throw shooter, The scorekeeper (Pn); records how many shots the shooter successfully makes into the basket. X4-Xn moves to X3's position, and so on.

Research Procedure

The training program was conducted for 6 weeks with a frequency of 3 times per week (18 total sessions) at the SMAK Gloria 1 Surabaya court and Training Zone Indonesia in April 2026. The training program was structured using the progressive overload principle with intensity increasing from 50–60% (Weeks 1–2), 60–70% (Weeks 3–4), to 70–80% (Weeks 5–6). Training volume for the Medicine Ball group used balls weighing 2–3 kg, while the Resistance Band used resistance band (black, 16–32 kg).

Table 2. Medicine Ball Throw One Hand Training Program

Week	Exercise Material	Dosage
1–2	**Foundation phase** a. One-hand push with 2 kg medicine ball from chest level b. One-hand medicine ball throw at wall target (standing) c. One-hand catch and throw alternately Application: building basic throwing pattern, activating triceps and shoulder muscles	a–c. 10–12 reps, Sets 3–4 • Intensity: 50–60% 1RM • Rest: 60 seconds between sets • Duration: 60–75 minutes
3–4	**Strength development phase** a. One-hand medicine ball throw (2–3 kg) from shooting position b. One-hand overhead throw aiming at basket height c. Seated one-hand throw with core stabilization Application: increasing power and neuromuscular specificity of throwing movement	a–c. 8–10 reps, Sets 4–5 • Intensity: 60–70% 1RM • Rest: 60–75 seconds between sets • Duration: 60–90 minutes
5–6	**Functional and specificity phase**	a–c. 6–8 reps, Sets 4–5 • Intensity: 70–80% 1RM

	a. One-hand medicine ball throw (3 kg) simulating free throw motion b. One-hand rapid throw to partner (explosive) c. One-hand throw with lateral footwork drill Application: integrating strength and technique for sport-specific transfer	• Rest: 75–90 seconds between sets • Duration: 75–90 minutes

Table 3. Overhead Tricep Extension Resistance Band Training Program

Week	Exercise Material	Dosage
1–2	**Familiarization phase** a. Overhead tricep extension with resistance band (standing, black band 16–32 kg) b. Two-arm overhead extension (controlled tempo) c. Alternating arm overhead extension Application: triceps brachii activation in elongated position, elbow stabilization	a–c. 12–15 reps, Sets 3–4 • Intensity: 50–60% effort • Rest: 45–60 seconds between sets • Duration: 60–75 minutes
3–4	**Hypertrophy and strength phase** a. Single-arm overhead tricep extension (band anchored overhead) b. Overhead extension with elbow flare control c. Overhead extension with isometric hold at top position (2 sec) Application: maximizing stretch-induced hypertrophy of long head of triceps brachii	a–c. 10–12 reps, Sets 4–5 • Intensity: 60–70% effort • Rest: 60 seconds between sets • Duration: 60–90 minutes
5–6	**Power and sport-specific phase** a. Explosive overhead tricep extension (rapid concentric phase) b. Overhead extension in shooting stance (mimicking free throw position) c. Overhead extension combined with wrist flexion follow-through Application: transferring triceps strength into sport-specific free throw mechanics	a–c. 8–10 reps, Sets 4–5 • Intensity: 70–80% effort • Rest: 60–75 seconds between sets • Duration: 75–90 minutes

Data Analysis

The data were analyzed using both descriptive and inferential statistics. Descriptive statistics were calculated to summarize the participants' free throw performance by reporting the mean and standard deviation for each experimental group in the pretest and posttest measurements.

Prior to hypothesis testing, the assumptions required for parametric analysis were examined. Data normality was assessed using the Shapiro–Wilk test, while the homogeneity of variance across groups was evaluated using Levene's test. Data were considered normally distributed and homogeneous when the significance value exceeded 0.05. Following confirmation that all statistical assumptions were satisfied, hypothesis testing was performed using a Two-Way Analysis of Variance (Two-Way ANOVA) with a 2 × 2 factorial design to examine: (1) the main effect of training method (Medicine Ball Throw One Hand versus Overhead Tricep Extension Resistance Band), (2) the main effect of anxiety level (high versus low), and (3) the interaction effect between training method and anxiety level on free throw performance. Statistical significance was established at $\alpha = 0.05$.

To complement the significance testing, Partial Eta Squared (η^2p) was calculated to determine the magnitude of the effects. The interpretation of effect size followed Cohen (1988), where values of approximately 0.01, 0.06, and 0.14 represent small, medium, and large effects, respectively. All statistical analyses were performed using IBM SPSS Statistics version 26.

RESULT

Descriptive Analysis

The CSAI-2 measurement produced 12 athletes classified as high-anxiety and 12 as low-anxiety. Through the MSOP A–B–B–A technique, each group consisted of 6 subjects with relatively homogeneous characteristics. The descriptive analysis of pretest-posttest results is presented in Table 4.

Table 4. Descriptive Analysis Results of Pretest-Posttest Free Throw Performance

Training Method	Group	Pretest (M±SD)	Posttest (M±SD)
Medicine Ball Throw One Hand	A1B1 (High Anxiety)	5,00 ± 1,414	6,17 ± 0,753
	A1B2 (Low Anxiety)	4,67 ± 1,506	5,67 ± 1,211
Overhead Tricep Extension Resistance Band	A2B1 (High Anxiety)	5,17 ± 0,753	8,00 ± 1,095
	A2B2 (Low Anxiety)	5,50 ± 1,225	7,50 ± 1,049

Based on Table 4, the Overhead Tricep Extension Resistance Band group showed greater improvement in free throw scores compared to the Medicine Ball Throw One Hand group. In the A2B1 group (high anxiety), the mean score increased from 5,17 to 8,00, while in the A1B1 group (high anxiety) it only increased from 5,00 to 6,17. A similar improvement pattern was observed in the low anxiety groups.

Normality Tests

Before hypothesis testing, the Shapiro-Wilk normality test and Levene's Test homogeneity test were conducted.

Table 5. Normality Shapiro – Wilk Test Results

Group	Statistic	df	Sig.	Description
Pretest_Medicine Ball	0,944	12	0,547	Normal
Posttest_Medicine Ball	0,877	12	0,080	Normal
Pretest_Resistance Band	0,877	12	0,080	Normal
Posttest_Resistance Band	0,872	12	0,069	Normal

The normality test showed all data groups were normally distributed with significance values ranging from 0.069 to 0.547 ($p > 0.05$).

Homogeneity Tests

The homogeneity test confirmed homogeneous variances with $p = 0.563$ for *pretest* and $p = 0.592$ for *posttest* ($p > 0.05$).

Table 6. Homogeneity Test Results

Group	Levene Statistic	df1	df2	Sig.	Description
Pretest_Freethrow_MB_RB	0,700	3	20	0,563	homogeneous
Posttest_Freethrow_MB_RB	0,650	3	20	0,592	homogeneous

All parametric assumptions were therefore satisfied, allowing analysis to proceed to Two-Way ANOVA. Given that the assumptions of normality, and homogeneity of variance, the Two-Way ANOVA provided a valid framework for evaluating the individual and combined effects of the independent variables on the outcome measure.

Hypothesis Testing: Two-Way ANOVA

Table 7. Two-Way ANOVA Results (Tests of Between-Subjects Effects)

Source	Type III SS	df	Mean Square	F	Sig.	Partial η^2
Corrected Model	21.667	3	7.222	6.667	.003	.500
Training Method	20.167	1	20,167	18.615	.000	.482
Anxiety	1.500	1	1,500	1.385	.253	.065
Method × Anxiety	,000	1	,000	,000	1,000	,000
Error	21,667	20	1.083			
Total	1164.000	24				
R^2 = .500 (Adjusted R^2 = .425)						

Based on Table 8, the training method factor yielded F = 18.615 with significance 0.000 ($p < 0.05$), thus H_0 was rejected. The partial eta squared value of 0.482 indicates that the training method factor accounted for 48.2% of the variance in free throw scores, classified as a large effect size (Cohen, 1988). For the anxiety factor, F = 1.385 with p = 0.253 ($p > 0.05$), thus H_0 was accepted. No significant interaction was found between training method and anxiety (F = 0.000; p = 1.000).

DISCUSSION

Effect of Training Method on Free Throw Performance

The results of this study confirmed a significant difference in the effect of Medicine Ball Throw One Hand and Overhead Tricep Extension Resistance Band training methods on free throw performance (F = 18.615; p = 0.000). Overhead Tricep Extension Resistance Band training proved more effective with a mean improvement of 2.83 points (high anxiety) and 2.00 points (low anxiety), compared to Medicine Ball Throw One Hand which improved by only 1.17 and 1.00 points respectively. The superiority of Overhead Tricep Extension Resistance Band training can be explained through specific neuromuscular mechanisms. (Maeo et al., 2023) published that elbow extension training performed in the overhead position produces substantially greater hypertrophy of the triceps brachii compared to training in a neutral arm position, because the overhead position places the muscle in a stretched condition that generates a stronger adaptive stimulus. Furthermore, Pakosz et al., (2021) confirmed that the activation timing of the triceps brachii muscle is significantly correlated with free throw effectiveness in basketball.

These findings are consistent with the principle of training specificity. According, Santoso et al., (2025), sport specific resistance training provides more optimal performance transfer in young game-sport athletes. Makaruk et al., (2024) demonstrated through a systematic review that sport-specific strength training consistently improves sport-specific performance more than general strength training. Furthermore, Haugen et al., (2023) found that resistance equipment mimicking functional movement patterns, including resistance band, produced maximal strength gains comparable to free-weight training.

Although Medicine Ball Throw One Hand training also showed significant improvement, the magnitude was smaller. Suntharalingam et al., (2022) reported in an 8-week study using medicine ball training among basketball players that this modality positively contributes to general physical performance, but its effectiveness in improving shooting accuracy that is technical in nature is more heavily influenced by neuromuscular coordination aspects.

Effect of Anxiety Level on Free Throw Performance

The second hypothesis test showed that anxiety level did not significantly affect free throw performance (F = 1.385; p = 0.253). The partial eta squared value of 0.065 indicates that anxiety accounted for only approximately 6.5% of the score variation, classified as a small effect size. This finding can be understood through the Inverted-U Hypothesis theory in sport

psychology, which posits that the relationship between anxiety and athletic performance follows an inverted-U curve Weinberg & Gould. (2019). It is possible that anxiety levels categorized as "high" in this study had not yet reached the threshold capable of meaningfully disrupting performance, as the subjects were trained athletes accustomed to competitive environments.

Goldschmied et al. (2022) reviewed free throw performance under pressure and concluded that the relationship between psychological pressure and free throw is heavily modified by individual factors such as experience, emotion regulation strategies, and pre-shot routines. Maher et al. (2020) found in research with basketball players that pressure management during free throw is greatly influenced by athletes' subjective perception of the competitive situation, not solely by objectively measured anxiety levels.

Feng & Zhuang. (2025) emphasized that pre-competition anxiety is dynamic and may shift during a training program, meaning the initial anxiety categorization may not remain consistent throughout the intervention period. Büttnser et al. (2024) affirmed that although psychological pressure can affect motor coordination and free throw accuracy, this primarily occurs under authentic competitive conditions with real audience pressure and live match scores.

Interaction between Training Method and Anxiety Level

The third hypothesis test revealed no significant interaction between training method and anxiety level on free throw performance ($F = 0.000$; $p = 1.000$; partial $\eta^2 = 0.000$). This finding indicates that the effect of training method on free throw performance was consistent and did not depend on the athlete's anxiety level. The absence of an interaction effect aligns with the perspective of modern coaching science, which emphasizes that physiological adaptations to strength training are largely independent of short-term psychological states Cuthbert et al. (2021). Roberts et al. (2023) explained that muscle hypertrophy mechanisms resulting from mechanical overload are physiological in nature and not substantially influenced by emotional conditions during a structured training period. From a practical standpoint, coaches do not need to adjust training methods based on athletes' individual anxiety profiles, as the superiority of Overhead Tricep Extension Resistance Band training applies universally regardless of athletes' anxiety levels.

CONCLUSION

This study addressed three research questions regarding the effects of training method, anxiety level, and their interaction on free throw performance among male high school basketball athletes. First, with respect to the effect of training method on free throw performance, the findings confirm that Overhead Tricep Extension Resistance Band training is significantly more effective than Medicine Ball Throw One Hand training in improving free throw accuracy, demonstrating a large practical effect. This superiority is attributed to the muscle-length-specific hypertrophic stimulus of overhead elbow extension and its direct neuromuscular correspondence to the free throw release mechanics. Second, regarding the effect of anxiety level, the study found that athletes' pre-categorized anxiety level did not produce a meaningful difference in free throw outcomes, suggesting that experienced athletes may possess sufficient emotional regulation skills to maintain performance under moderate anxiety conditions. Third, concerning the interaction between training method and anxiety level, the absence of a significant interaction indicates that the advantage of Overhead Tricep Extension Resistance Band training is consistent across both high- and low-anxiety athletes. Coaches are therefore recommended to prioritize Overhead Tricep Extension Resistance Band training in their free throw development programs without the need to differentiate based on individual anxiety profiles.

Future research is recommended to involve larger samples and longer training durations. Additionally, exploring the combination of Overhead Tricep Extension Resistance Band training with psychological interventions such as imagery training or relaxation techniques is also

recommended to examine the synergistic effects of physical and mental strengthening on free throw performance more holistically.

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REFERENCES

Bompa, T. O., & Buzzichelli, C. (2019). *Periodization-: theory and methodology of training*. Human kinetics.

Büttner, C. M., Kenntemich, C., & Williams, K. D. (2024). The power of human touch: Physical contact improves performance in basketball free throws. *Psychology of Sport and Exercise*, *72*, 102610. https://doi.org/10.1016/j.psychsport.2024.102610

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd Editio). Lawrence Erlbaum Associates.

Cuthbert, M., Haff, G. G., Arent, S. M., Ripley, N., McMahon, J. J., Evans, M., & Comfort, P. (2021). Effects of Variations in Resistance Training Frequency on Strength Development in Well-Trained Populations and Implications for In-Season Athlete Training: A Systematic Review and Meta-analysis. *Sports Medicine*, *51*(9), 1967–1982. https://doi.org/10.1007/s40279-021-01460-7

Feng, H., & Zhuang, L. (2025). Research on the Interactive Relationship between Pre-competition State Anxiety and Peer Support of College Athletes: A Case Study of Zhaoqing University. *Frontiers in Sustainable Development*, *5*(10), 93–99. https://doi.org/10.54691/gxstca90

Goldschmied, N., Raphaeli, M., Moothart, S., & Furley, P. (2022). Free throw shooting performance under pressure: a social psychology critical review of research. *International Journal of Sport and Exercise Psychology*, *20*(5), 1397–1415. https://doi.org/10.1080/1612197X.2021.1979073

Haugen, M. E., Vårvik, F. T., Larsen, S., Haugen, A. S., van den Tillaar, R., & Bjørnsen, T. (2023). Effect of free-weight vs. machine-based strength training on maximal strength, hypertrophy and jump performance – a systematic review and meta-analysis. *BMC Sports Science, Medicine and Rehabilitation*, *15*(1), 103. https://doi.org/10.1186/s13102-023-00713-4

Hidayat, S. (2018). *Profil Kondisi Fisik Atlet Cabang Olahraga Hoki Kabupaten Kendal Tahun 2018*.

Irawan, F. A., Raharja, W. K., Billah, T. R., & Ma'dum, M. A. (2021). Analisis biomekanika free throw basket sesuai kaidah Dave Hopla. *Jurnal Keolahragaan*, *9*(2), 210–219. https://doi.org/10.21831/jk.v9i2.40360

Johnson, B. L., & Nelson, J. K. (1986). *Practical Measurements for Evaluation in Physical Education*. Burgess Pub. https://books.google.co.id/books?id=T9rtAAAAMAAJ

Kosasih, D. (2008). *Fundamental basketball* (Pertama). Karangturi media.

Maeo, S., Wu, Y., Huang, M., Sakurai, H., Kusagawa, Y., Sugiyama, T., Kanehisa, H., & Isaka, T. (2023). Triceps brachii hypertrophy is substantially greater after elbow extension training performed in the overhead versus neutral arm position. *European Journal of Sport Science*, *23*(7), 1240–1250. https://doi.org/10.1080/17461391.2022.2100279

Maher, R., Marchant, D., Morris, T., & Fazel, F. (2020). Managing pressure at the free-throw line: Perceptions of elite basketball players. *International Journal of Sport and Exercise Psychology*, *18*(4), 420–436. https://doi.org/10.1080/1612197X.2018.1536159

Makaruk, H., Starzak, M., Tarkowski, P., Sadowski, J., & Winchester, J. (2024). The Effects of Resistance Training on Sport-Specific Performance of Elite Athletes: A Systematic Review with Meta-Analysis. *Journal of Human Kinetics*. https://doi.org/10.5114/jhk/185877

Montgomery, D. C. (2019). *Design and Analysis of Experiments* (10th ed.). Wiley.

Pakosz, P., Domaszewski, P., Konieczny, M., & Bączkowicz, D. (2021). Muscle activation time and free-throw effectiveness in basketball. *Scientific Reports*, *11*(1), 7489. https://doi.org/10.1038/s41598-021-87001-8

Roberts, M. D., McCarthy, J. J., Hornberger, T. A., Phillips, S. M., Mackey, A. L., Nader, G. A., Boppart, M. D., Kavazis, A. N., Reidy, P. T., Ogasawara, R., Libardi, C. A., Ugrinowitsch, C., Booth, F. W., & Esser, K. A. (2023). Mechanisms of mechanical overload-induced skeletal muscle hypertrophy: current understanding and future directions. *Physiological Reviews*, *103*(4), 2679–2757. https://doi.org/10.1152/physrev.00039.2022

Santoso, B., Robaeni, R. S., Langit, M. S., & Nursantiko, D. R. (2025). Resistance Training Dan Combined Strength Training Untuk Pemain Muda Olahraga Permainan: A Literature Review. *Jurnal Kepelatihan Olahraga*, *17*(2). https://doi.org/10.17509/jko-upi.v17i2.85780

Sugiyono. (2019). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.

Suntharalingam, T., Jawis, N., Malik, A., & Sivanesan, S. (2022). *Effects of 8-week medicine ball training on physical performance among basketball players*. *6*, 1307–1319.

Wang, J., & Li, W. (2024). Research on teaching basketball free throw action process based on motion vector field transformation. *Applied Mathematics and Nonlinear Sciences*, *9*. https://doi.org/10.2478/amns-2024-2298

Weinberg, R. S., & Gould, D. (2019). *Foundations of Sport and Exercise Psychology*. Human Kinetics.

Wissel, H. (2011). *Basketball 3rd Edition: Steps to Success*. Human Kinetics. https://books.google.co.id/books?id=M4WvvQEACAAJ