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# Comparative Effectiveness of Straight Set and Superset Training on Forearm Strength in Handball Athletes

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## Abstract

Handball demands that athletes must develop their forearm muscles to succeed at throwing and catching and defending their positions. The research study aimed to assess and compare two weight training methods which included straight sets and supersets to determine their effects on Semarang handball players' forearm strength. The research used a quasi-experimental design which included a control group that participated in pretests and posttests with 25 athletes as study subjects. The subjects were made to undergo a program lasting 6 weeks in which they performed all their exercises on the principle of alternation between straight sets and supersets. The participants were divided into two groups with 12 members in the first group and 13 members in the second group. The researchers used a hand grip dynamometer to measure strength levels because it provided measurement data in kilograms which they obtained before the study and after the study. The statistical analysis used paired and independent sample t-tests at a significance level of $\alpha = 0.05$ to show that both training methods produced significant strength gains. The data showed that superset training produced greater improvements than straight set training according to the results. Coaches who want to help their athletes develop forearm muscles should use both methods because both techniques provide value but superset training delivers better results.

## How to Cite

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## INTRODUCTION

Handball is a sports category where rapid growth along with popularity have been experienced currently in Indonesia. People show growing interest in this sport although it remains less popular than football and futsal and basketball. Handball demands that players combine their speed abilities with their agility skills and their muscular strength capabilities and their endurance for extended combat. Athletes need to establish their physical fitness level because every match requires them to engage in violent contact (Caccese et al., 2021). Furthermore, the amount of strength displayed in this exercise is dependent upon the wrist muscles. Forearm muscle strength functions as an essential element for success in this sport. Handball requires players to depend on this body region for executing basic skills like throwing and catching and shooting at goal and defending and blocking. Athletes who possess optimal forearm strength can perform three actions better because they can make faster and more precise throws and they can maintain possession when their opponents try to steal the ball and they can catch the ball more effectively. Research shows that specialized forearm muscle training improves throwing ability.

The study by Kusumawati et al. (2022) proved that male handball players who performed six weeks of forearm resistance band training experienced substantial increases in their throwing speed, which proves that dedicated forearm strength training must become a standard component of handball conditioning programs. Handball athletes must develop grip strength because it serves as the most important performance indicator that distinguishes them from their rivals. The study by (Karadenizli et al., 2026) showed that elite handball players achieved superior handgrip strength results when compared to football players and athletes from other team sports which demonstrated the need for handball players to undergo specialized training for their forearm muscle development. Athletes need to include forearm strength training as a fundamental requirement which coaches must implement through their training programs. Building muscle mass and strength, endurance through time has been considered the most effective way to achieve your goals (Hadjisavvas et al., 2024). Coaches and fitness practitioners use different methods for their work. The two most common methods which practitioners use include straight sets and supersets. The two methods both work to build muscle strength but they exhibit different features and bodily processes that enable their operation.

Press straight sets need a person to undertake one set of exercises at a time with a pause time of between 30-90 seconds before approaching another exercise set. The recovery pattern which follows this schedule enables athletes to continue their session with heavier weights because their phosphagen system (ATP-PC) system needs less time to recover. The superset method requires athletes to complete two exercises which they must execute without taking any breaks between their two workouts (Haruna et al., 2023). Supersets can be classified into two types: compound supersets, which involve two different muscle groups, and antagonistic supersets, which target opposing muscles such as wrist curls and reverse wrist curls. Rios et al. (2025) conducted their research to demonstrate that upper body strength directly affects throwing ability through their findings which showed that external rotation peak torque linked to both standing throw and jump throw performance at $r = 0.760$ and $r = 0.568$ respectively. The research findings show that handball conditioning programs need specialized forearm strength training because forearm and upper arm muscles function as essential elements for achieving throwing speed and precision. Researchers have extensively documented the advantages which superset training brings to training programs. Supersets provide time efficiency because they reduce the duration of necessary rest periods (Andersen et al., 2021). Handball requires specialized research because forearm muscles have distinct anatomical and functional characteristics which researchers need to investigate before proving the theoretical benefits of these methods.

The city of Semarang is one of the handball development centers in Central Java and has produced a number of talented athletes. There is a work report I looked at and found some big issues. However, my independent study about the complexity of information search has been reported. The forearm strength scores of Semarang handball athletes demonstrated low performance results across two assessment periods which were compared to their other physical attributes. Being below the threshold of what is recommended for provincial-level competitors has rendered the grip strength values of athletes of this skill group. The current training programs need to reach their highest level of development because current training programs fail to develop sport-specific forearm strength training. Coaches have used traditional straight set training methods for their training programs because they have not conducted tests to evaluate how these methods perform compared to supersets. Modern

periodized training requires method changes to maintain peak performance because constant training methods lead to performance decline.

The study aims to assess which resistance training method between straight set and superset better enhances forearm strength in handball players from Semarang. The research investigates which training method produces higher strength improvements while it also measures the strength improvement effects. The study investigates various training methods by examining their physiological foundations to establish a connection between theoretical sport coaching knowledge and its practical application. The results will give coaches evidence-based guidelines to create better forearm strength training programs which will also help the scientific community understand how overhead athletes should choose upper body strengthening methods.

## METHOD

The researchers used experimental research to study the impact of straight set and superset resistance training methods on handball players' forearm strength development. The study used a pretest-posttest two-group research design. The researchers conducted their investigation at a training facility located in Semarang City during a six-week period that consisted of 16 scheduled training sessions. The researchers selected a six-week training period because their earlier studies showed that this time frame would bring visible improvements in both forearm strength and handball throwing skills (Fredriksen & van den Tillaar, 2025). The research process includes three main stages which include initial data collection through pretest and intervention implementation and final data collection through posttest. The study involved all handball players who competed in Semarang City. The researchers used purposive sampling to select 25 athletes who met three inclusion requirements which included being between 18 to 25 years old and having at least one year of competitive experience and having similar starting physical fitness levels. Before the participants participated in the study, the researchers took time and carefully explained all procedures and took written consent from the participants.

The scores of initial wrist strength from the pretests are the classifications of the subjects according to them. The highest-ranked athlete received assignment to the straight set group through ordinal pairing while the second-highest athlete went to the superset group and the third-highest athlete joined the straight set group and the process continued. The procedure established identical average starting scores for both groups. The allocation process was conducted by an independent researcher who did not take part in the training intervention to achieve selection bias reduction. The straight set group had 12 athletes while the superset group had 13 athletes. The two groups executed four forearm-specific exercises which included wrist curl reverse wrist curl wrist twist and farmer's walk. The program used three mesocycles which included weeks 1–2 and 3–4 and 5–6 to increase intensity and volume throughout its duration.

Exercises were executed in consecutive sets with complete rest between sets. The participants performed three sets of 12 to 15 repetitions at 60 percent of their one-repetition maximum which included wrist curl reverse wrist curl and wrist twist exercises together with three sets of 20 to 30 meter farmer's walk. The participants took rest breaks that lasted between 60 and 90 seconds after each set. The program required participants to increase their intensity level to 70% 1-RM during the period between weeks 3 and 4 (sessions 5 through 10). Wrist curl and reverse wrist curl were performed for three sets of 10–12 repetitions; wrist twist and farmer's walk were increased to four sets of 10–12 repetitions and 30–40 meters, respectively. Rest periods were reduced to 60 seconds. The intensity scale increased to 75 to 80% 1-RM from the 5th to the 6th weeks. All exercises were performed for four sets: wrist curl, reverse wrist curl, and wrist twist at 8–10 repetitions, and farmer's walk at 40–50 meters. Rest intervals were set at 45–60 seconds.

Exercises were paired into two combinations: (1) wrist curl immediately followed by reverse wrist curl, and (2) wrist twist immediately followed by farmer's walk. No rest was given between exercises within a superset, followed by a designated rest period before the next superset. During weeks 1–2 (sessions 1–4), each participant did three super-sets per couple, each one at 60% of their 1-RM. The first pair required 12–15 repetitions per exercise; the second pair required 12–15 repetitions for wrist twist followed by 20–30 meters for farmer's walk. Rest between supersets was 60 seconds. An intensity of 70% 1-15 of 1-RM was involved during weeks 3 and 4 (sessions 5 to 10). The first pair was performed for three sets of 10–12 repetitions; the second pair was increased to four sets of 10–12 repetitions and 30–40 meters. Rest between supersets was reduced to 45–60 seconds. Weight was increased in weeks 5 and 6 at 75-80% max.% of the pretraining max%(1-RM). Both pairs were performed for four sets. The first pair required 8–10

repetitions per exercise; the second pair required 8–10 repetitions for wrist twist followed by 40–50 meters for farmer's walk. Rest between supersets was shortened to 30–45 seconds.

The researchers conducted initial one-repetition maximum strength assessments before starting the training program and executed follow-up tests every two weeks to track their strength development. The training program maintained relative intensity throughout each mesocycle by implementing absolute load changes which corresponded to each athlete's strength improvements. All strength training sessions received oversight from certified strength and conditioning coaches who verified that athletes executed their exercises with correct techniques while following their scheduled break times and using appropriate weight limits.

The researchers measured forearm strength through grip strength testing by using a digital hand grip dynamometer which operated in the measurement range from 5 to 90 kilograms with an accuracy of 0.5 kilograms (Camry, Model EH101, China). The device required calibration before each session of data collection. The participants conducted two maximum tests while standing with their arms straight; the research team documented their highest performance. The instrument has demonstrated high test-retest reliability (ICC = 0.92–0.96) and good concurrent validity (r = 0.85–0.91) in previous studies involving Indonesian adolescent and athletic populations. The selection of a hand-held dynamometer in this particular study is in line with the common trends in Indonesia related to sports research. Raharja and Abdulaziz (2025) used a push-pull dynamometer to test arm muscle strength in volleyball players which shows that this device can be used to evaluate upper body strength in racket ball sports.

The researchers used SPSS version 25 software to conduct their data analysis. The researchers used the Kolmogorov-Smirnov test to determine if the data set followed a normal distribution. The paired sample t-test measured the differences between pretest and posttest scores for each group. The researchers used an independent sample t-test to assess training method effectiveness by comparing the average score differences between the two group. The researchers established a significance level of $\alpha = 0.05$ for their study.

## RESULTS AND DISCUSSION

The study aimed to examine how well straight set training methods and superset training methods improved forearm strength of handball players from Semarang City. The main findings are presented in **Table 1**, **Table 2**, **Table 3**, and **Figure 1**.

**Table 1.** Descriptive Statistics of Pretest and Posttest Forearm Strength

| Group | n | Pretest (kg) | Posttest (kg) | Gain (Δ) (kg) |
|---|---|---|---|---|
| Straight Set | 12 | 28.75 ± 3.99 | 32.35 ± 3.91 | 3.59 ± 0.83 |
| Superset | 13 | 30.15 ± 4.36 | 35.14 ± 4.81 | 4.98 ± 0.83 |

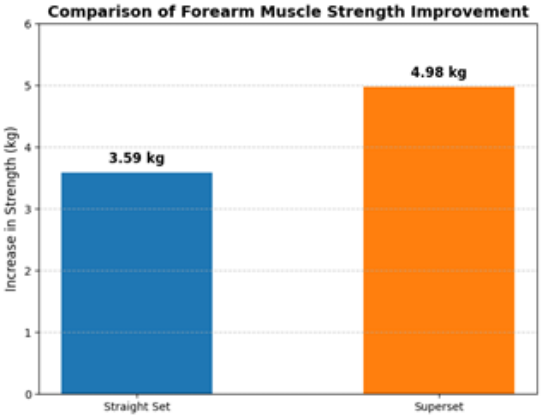


**Figure 1.** Comparison of mean pretest, posttest, and gain (Δ) forearm strength between straight set (n=12) and superset (n=13) groups.

Six weeks of training would lead to a significant increase in forearm strength in both groups, although it was the superset group that exhibited greater strength improvement. **Figure 1** displays the second part of this distance. We assessed the data for parametric analysis requirements before testing our hypothesis. The results of the normality and homogeneity tests are shown in **Table 2**.

**Table 2.** Normality and Homogeneity Test Results

| Test | Group | Statistic | p-value | Decision |
|---|---|---|---|---|
| Normality* (Shapiro–Wilk) | Straight Set (Δ) | 0.923 | 0.312 | Normal |
| | Superset (Δ) | 0.901 | 0.128 | Normal |
| Homogeneity** (Levene) | Gain (Δ) | 0.042 | 0.839 | Homogeneous |

*Normality criterion: $p > 0.05$

**Homogeneity criterion: $p > 0.05$

As formulated in **Table 2**, both groups showed normally distributed gain scores and equal variances. As a result, the independent two-sample t-test could be deployed.

**Table 3.** Independent t-Test Results

| Group | n | Mean Δ ± SD (kg) | t | df | p | 95% CI | Cohen's d |
|---|---|---|---|---|---|---|---|
| Straight Set | 12 | 3.59 ± 0.83 | | | | | |
| Superset | 13 | 4.98 ± 0.83 | | | | | |
| Comparison | | | -4.18 | 23 | <0.001 | -2.04 to -0.74 | 1.67 |

Note: Δ = posttest – pretest difference; SD = standard deviation; CI = confidence interval; d = Cohen's effect size (0.2 = small, 0.5 = medium, 0.8 = large).

The **Table 1** displays results which show both training methods produced substantial forearm strength increases after six weeks of training. The superset group achieved greater strength development with their training method than the straight set group who achieved lesser strength gains. The researchers executed normality and homogeneity of variance tests before they began their hypothesis testing because these tests allowed them to conduct parametric analysis. The independent t-test revealed a statistically significant difference between the two groups ($p < 0.001$) with a large effect size (Cohen's $d = 1.67$) which the study presented in **Table 3**. From the study Benjamin showed the forearm strength benefit extended from a straight set group to superset group.

The observed superiority of the superset method can be explained through several physiological mechanisms. The back-to-back execution of exercises with minimal rest periods creates training density which leads to higher metabolic stress and athletes accumulate metabolites that include lactate and hydrogen ions which serve as essential factors for muscular development and growth (Miranda et al., 2020; Poon et al., 2020). Athletes who take short rest breaks during their training sessions can maintain their growth hormone levels at peak levels which leads to better strength and endurance development (Andersen et al., 2021; Francia et al., 2023). The combination of wrist curls and reverse wrist curls creates an agonist-antagonist muscle pairing which activates additional motor units while producing cross-education advantages that enhance neuromuscular performance (Miranda et al., 2020). The factors together produce a stronger training effect which exists in every training session. The straight set method requires athletes to fully recover their ATP-PC system which allows them to lift heavier weights but this approach results in smaller strength improvements. The forearm training methods used in handball show that metabolic stress and total training volume have a greater impact than complete phosphagen recovery. The findings confirm previous research which shows that high-density training leads to fast strength gains and they match systematic evidence which demonstrates that resistance training improves handball throwing performance (Hadjisavvas et al., 2024).

The practical benefits that the results of the study produce by far outweigh all basic strength gains. Handball players depend on forearm strength because it enables them to execute vital game functions which consist of throwing and catching and defending. The superset group developed their grip strength better than all other groups which produced better throwing results and faster ball release and improved their defensive performance. The study conducted by Karadenizli et al. (2026) established grip strength as an accurate assessment tool because elite handball players showed better grip strength compared to athletes from other team sports. Successful attacking strategies require passing accuracy which depends on players controlling their forearms with precise movement skills. Korte and Lames (2019) used network analysis to demonstrate that passing functioned as the primary method through which teams could create optimal throwing positions while backcourt players designed their team interactions as primary orchestrators. The research conducted by Kusumawati et al. (2022) and Fredriksen and van den Tillaar. (2025) proved that handball players can improve their throwing speed through specific forearm training programs. The research conducted by Dhurgham et al. (2024) discovered that wrist angular velocity functioned as a crucial biomechanical element which determined shooting performance. The coaches should use superset training methods during their general preparation phase to achieve better results for their specific sports performance. The research results apply to sports that need athletes to demonstrate grip strength while performing overhead movements, which includes basketball, badminton, rock climbing, and softball.

Multiple study limitations must be evaluated, despite the positive outcomes. The findings of the study face limits because the sample size was only 25 participants. The study permitted external factors to function without any restrictions because nutritional intake and stress levels were among the factors that created individual participant differences. The study results were probably affected because the participants continued their regular handball training throughout the entire research period. The researchers applied ordinal pairing methods together with their continuous monitoring systems to minimize the effects of these confounding variables. Future studies will require larger participant groups from various

backgrounds to examine human stress and fatigue biomarkers while controlling their dietary intake.

The study establishes its two main contributions through its two main findings. The existing literature receives theoretical advancement from this study which establishes that training density together with metabolic stress are vital elements for developing strength in smaller muscle groups that include the forearm which researchers have not studied in comparative studie (Andersen et al., 2021; Poon et al., 2020). The research provides coaches with scientific evidence which they can use to create strength training programs that target specific strength deficiencies found in Semarang City handball players during their routine strength tests. The implementation of superset training gives practitioners a time-efficient training method that enables them to enhance their forearm muscle strength which results in improved match performance.

## CONCLUSION

The straight set and superset resistance training methods both demonstrate their ability to enhance forearm strength in handball athletes. The superset technique suggests better results, as it is a more effective way to isolate the muscle group. The research findings show that training density together with metabolic stress impacts neuromuscular development because these elements determine how small muscles develop through training. The study results offer coaches evidence-based techniques to help athletes who require strength training for their specific sports needs. The study establishes a basis for upcoming research which will examine broader participant groups while implementing dietary monitoring and biomarker studies to better understand the biological processes that make superset training successful.

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