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# STUDY ON IMPROVING EXPLOSIVE UPPER BODY STRENGHT IN PROFESSIONAL HANDBALL PLAYERS SPECIALISED AS WINGS

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**Abstract**

The aim of this study is to verify whether a strength and injury prevention program proposed by us succeeds in improving explosive strength in the upper body and, implicitly, the throwing force of the ball in professional handball players specialized in the wing position. We chose to carry out the research with athletes who compete at the highest level of handball in Romania, specifically the seven players specialized in the wing position at Dinamo Bucharest, athletes participating in the Champions League. To track whether there are significant increases in the throwing force following the implemented program, we tested the athletes in three different throwing trials: a three-step running throw, a standing throw with the arm raised, and a standing throw with the arm from the side. Measurements were taken using the Polar Pure equipment – Pro radar, and results were expressed in km/h. The final results showed a significant improvement statistically ($p<0.05$) in throwing force: three-step running throw 99.86±9.75; 106.87±7.27 – standing throw with the arm raised 95.86±9.03; 105±5.48 – standing throw with the arm from the side 94.71±13.72; 105±10.13, and also zero injuries throughout the research. We believe that the study achieved its goal and the tested program is significantly effective.

## Introduction

Handball is a highly popular Olympic sport due to its dynamic nature, which involves many actions performed at high speed and encompasses a wide range of movements and technical skills. It has constantly evolved both in terms of athlete training and the regulations designed to increase its spectacle. This rapid development has led to handball being studied in depth, enabling those involved in the sport to adapt the training process according to current research [6] [14].

To perform at the highest level, athletes must have excellent overall physical fitness and, in particular, a high level of speed-strength [9], which positively influences acceleration, deceleration, and change of direction in the lower body [4] [10], while in the upper body, a direct relationship with ball throwing has been proven [3] [4] [11] . Some authors claim that one of the most important elements of the game of handball is throwing for goal [8]. In addition, [16] considers that this is

the most relevant aspect of the completion of the attack, and [13] concludes that the ability to throw the ball forcefully and accurately is essential to winning a match.

Also, analysts of the International Handball Federation (IHF) observed, following the 2021 World Men's Handball Championship, held in Egypt, a significant increase in the efficiency of the teams in attack, from 48.1% in 2012 to 58.6%. The same upward trend was also noted in women's handball, where the rate of successes in attack increased by 5.5%, from 46.1% (China 2009) to 51.6% (Japan 2019) [17] . According to the IHF, this improvement in offensive efficiency is due to the growing role of players specializing in pivot and wing positions in modern handball.

Therefore, it is essential to find training methods that help increase upper body strength for wing players, who specialize in the position where scoring efficiency is the highest [12]. This aims to improve their throwing power, taking into account the research [15] which analyzed 1,049 shots on goal and found that in 95% of cases, the shots were executed with maximum possible power. Moreover, as demonstrated by previous studies [1] [5] [7], strength capacity is a key factor in injury prevention. So we consider that improving this aspect of handball players' training, especially for wings, contributes to a team's overall performance not only through enhanced scoring efficiency but also by reducing injury risks. This ensures that players remain physically fit for more official matches, allowing them to contribute consistently to the team's results.

Strength training must be tailored to the specific demands of each playing position to maximize player efficiency and performance on the court. While some players focus on developing strength for sprints and throws, others need to build resilience for physical contact and strength for intense duels. Personalizing strength training based on the requirements of each position is essential for a team's success and for injury prevention. For wing players, in particular, it is necessary to focus on enhancing explosive strength, endurance strength, and agility-related strength.

Therefore, this study aims to verify whether a training program tailored to the specific explosive upper body strength requirements of wing players will improve their strength capacity and reduce the risk of injuries during a season.

## Material- Method

### *Participants*

Seven athletes specialized as wing players, members of CS Dinamo Bucharest during the 2021-2022 competitive season, participated in this experiment. The inclusion criteria were: to be male, to be wing, good health status, to activate at the highest performance level. Participants gave their consent to use these personal data for scientific purpose.

***Measurements and tests***

To assess the explosive upper body strength, we evaluated each participant's throwing power by measuring the ball's speed after executing three types of shots on goal: a standing overhead throw, a standing sidearm throw, and a three-step run-up throw. The measurements were conducted using the equipment from the Human Performance Research Center (CCPU) within the Doctoral School of Sports Science and Physical Education at the University of Pitești, specifically the **POLAR PURE – SPEED RADAR PRO.** Each athlete was given three attempts for each throwing variation, and the best result was recorded for both the initial and final testing. All athletes completed the test during the same testing session under identical conditions to ensure that external factors (such as weather or the state of the playing surface) did not influence the results.

***Data analyses***

For the statistical analysis, we used mean—X, standard deviation—SD and coefficient of variability. To determine the degree of achievement of the proposed objectives, we used the **"t" test**, which indicates whether there are statistically significant differences between the initial and final test results. The calculated values are presented in **Table 3.**

**Findings**

The results obtained during the initial testing for the control trials measuring the handball throwing speed are presented in **Table 1**. The data show an **arithmetic mean** of **95.86 km/h** for the **standing overhead throw**, with a **standard deviation** of **±9.03 km/h** and a **coefficient of variation** of **0.09%,** indicating a **high level of homogeneity** within the group. For the **standing sidearm throw**, the arithmetic mean was **94.71 km/h,** with a **standard deviation** of **±13.72 km/h** and a **coefficient of variation** of **0.14%,** reflecting a **moderate level of homogeneity** among the participants. In the **three-step run-up throw** trial, the arithmetic mean reached **99.86 km/h**, with a **standard deviation** of **±9.75 km/h** and a **coefficient of variation** of **0.1%,** again indicating a **high level of group homogeneity**.

As shown in Table 2, all three control trials recorded notable progress, both in terms of the group's homogeneity—reflected by a decrease in the coefficient of variation by 4.2%, 4.84%, and 2.97%, respectively—and in the measured values themselves. Significant improvements were observed in the minimum values, with an increase of 16 km/h for both the standing overhead throw and the standing sidearm throw, and 15 km/h for the three-step run-up throw. Similarly, the maximum values increased by 9 km/h for the overhead and sidearm throws and by 7 km/h for the three-step run-up throw.

It is worth noting that the youngest athletes in the experimental group, S. A**.** and P. V., recorded the lowest values in all three trials during both the initial and

final testing sessions. However, they also showed the greatest improvement: S. A. increased his results by 16 km/h in the first two trials and by 15 km/h in the third. P. V**.** improved by 12 km/h, 15 km/h, and 6 km/h, respectively.

**Table nr. 1. Throwing speed – initial results**

| **Name** | **Standing overhead throw** (km/h) | **Standing sidearm throw** (km/h) | **Three-step run-up throw** (km/h) |
|---|---|---|---|
| S. A. | 82 | 73 | 80 |
| P. V. | 87 | 81 | 95 |
| G. V. | 103 | 105 | 102 |
| N. N. | 104 | 108 | 108 |
| P. A. | 91 | 89 | 102 |
| M. R. | 101 | 103 | 107 |
| G. R. | 103 | 104 | 105 |
| **X** | 95.86 | 94.71 | 99.86 |
| **SD** | 9.03 | 13.72 | 9.75 |
| **CV** | 9.42% | 14.49% | 9.77% |
| **MIN.** | 82 | 73 | 80 |
| **MAX.** | 104 | 108 | 108 |

**Table nr. 2. Throwing speed – final results**

| **Name** | **Standing overhead throw** (km/h) | **Standing sidearm throw** (km/h) | **Three-step run-up throw** (km/h) |
|---|---|---|---|
| S. A. | 98 | 89 | 95 |
| P. V. | 99 | 96 | 101 |
| G. V. | 107 | 110 | 105 |
| N. N. | 113 | 117 | 115 |
| P. A. | 102 | 100 | 108 |
| M. R. | 108 | 112 | 115 |
| G. R. | 108 | 111 | 109 |
| **X** | 105,00 | 105.00 | 106.86 |
| **SD** | 5.48 | 10.13 | 7.27 |
| **CV** | 5.22% | 9.65% | 6.80% |
| **MIN.** | 98 | 89 | 95 |
| **MAX.** | 113 | 117 | 115 |

The **"t" test** value for all three control trials exceeded **3.71,** the critical value from **Fisher's table** corresponding to **n-1 = 6** cases at a **0.01 significance level**. This indicates, with **99% certainty**, that the implemented program was **effective** in increasing **explosive upper body strength**.

**Table. 3. independent "t" test results**

| Variation | Initial | Final | "t" test |
|---|---|---|---|
| **Standing overhead throw** | 95,86±9.03 | 105±5.48 | 5.73 *p<0.01* |
| **Standing sidearm throw** | 94.71±13.72 | 105±10.13 | 6.75 *p<0.01* |
| **Three-step run-up throw** | 99.86±9.75 | 106.87±7.27 | 4.73 *p<0.01* |

## Conclusions

The ball throwing speed confirms the trend of achieving improved results following the experimental intervention. The handball throwing speed using the three techniques showed significant increases during the final testing:

- **Standing overhead throw** – higher values ranging between **4–16 km/h**
- **Standing sidearm throw** – improvements between **5–16 km/h**
- **Three-step run-up throw** – increases between **3–15 km/h**

The **"t" test** values confirm that all results are statistically significant at a $p<0.05$ significance level.

Taking into account that throughout the entire study period, the research subjects did not suffer any injuries, not even minor ones, we can conclude that the proposed program for improving strength capacity and injury prevention in professional handball players specialized in the wing position has proven to be effective to a sufficient degree to be considered by practitioners in the field for the individualization of team training.

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