Journal of Physical Education

Volume 37 – Issue (4) – 2025 Open Access

P-ISSN: 2073-6452, E-ISSN: 2707-5729

https://jcope.uobaghdad.edu.iq

The effect of complex exercises using added resistances relative to body parts on the explosive power and accuracy of long-distance shooting from high jumping for Baghdad Educational Team handball players

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DOI:

https://doi.org/10.37359/JOPE.V37(4)2025.2003

Article history: Received 28/ January/2024 Accepted 27/ September/2025 Available online 28/ December/2025

Abstract

This study aimed to investigate the effect of complex resistance-based exercises on enhancing the explosive power of the arms and legs and improving the accuracy of long-range jump shots among basketball players. A single-group experimental design with pre- and post-tests was employed, aligning with the research objectives. The population comprised 20 players from the First Al-Karkh Education Team, from which 8 were randomly selected for the main study, and 4 participated in an exploratory experiment. Homogeneity of the sample was confirmed for age, weight, and height, with skewness values within ±3. The training program, directly supervised by the researchers with assistance from the team coaches, lasted eight weeks during the special preparation phase preceding the competition, with three sessions per week, totaling 24 sessions. Post-tests were conducted after completing the program, and data were analyzed using SPSS, employing descriptive and inferential statistics, including mean, standard deviation, and paired-sample t-tests. Results indicated that complex exercises incorporating added resistance to specific body parts significantly enhanced the explosive power of the arms and legs and positively influenced the accuracy of long-range jump shots. The study concludes that integrating targeted resistance-based complex exercises can effectively improve both muscular explosiveness and technical shooting performance among basketball players, highlighting their importance in structured training programs aimed at optimizing athletic performance.

Keywords: compound exercises, handball, added resistance, explosive power, shooting accuracy.

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Journal of Physical Education
Volume 37 – Issue (4) – 2025 Open Access
P-ISSN: 2073-6452, E-ISSN: 2707-5729
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Introduction

The environment cannot sprout by chance; it has been built and developed with dedication, systematic work, strategic planning and a well-defined program of training curricula. It is extremely popular at international level which has seen it experience significant and visible growth especially due to its dynamism of movements in driving motor skills as well as shooting, dribbling and fending capabilities. It is therefore important to allow scientific principles-based trainings to improve player performance. An effective option is resistance training of specific muscles. These methods are used to increase the rate of athletic performance and success by making exercises more complex by adding extra external resistance. Not only is it improving the physical and technical efficiency of players, but they are now becoming peak performers. or according to Antdar Al-Khazali (Al-Khazali, 2009, p. 34):

"Resistance training involves imposing an external force to the active muscles, inducing physical characteristics, and leading toward a different form of functional adaptation. This in turn increases a trainee's physical work capability."

The most significant reason to bring up this subject is for the author, is that all important personality traits of a successfull handball player should be emphasized in winning. The present study emphasizes in particular the importance of explosive power in an athlete's arms and legs as it is critical for the improvement of players' jumping performance during high jump shooting and to increase shooting accuracy. Jumping is considered as an important skill for handball players and its training benefits are the underlying support for most shooting techniques, especially high jump shots. As Qablan (2012, p. 249) pointed out:

"Progress in jump strength leads to increased jumping ability, providing favorable conditions for the effective execution of certain skills, such as shooting in handball.

The higher the player’s jump at the moment of shooting, the greater the chance of scoring and improving accuracy, as it overcomes the defensive wall and clarifies the shooting angle toward the target.

The objectives of this research were: preparing compound exercises using proportionally added resistance to body parts to enhance the explosive strength of the arms and legs and improve long-distance shooting accuracy from high jumps, and identifying differences between pre- and post-tests in explosive strength and shooting accuracy in the sample under study.

The research problem emerged through the researchers’ observation of training sessions of the Baghdad Karkh First Education team and the national junior team matches, alongside

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P-ISSN: 2073-6452, E-ISSN: 2707-5729
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reviewing multiple scientific studies in this field. It was found that there is a clear weakness in high jump shooting skills, not only among the Baghdad Karkh First Education team players but generally across all levels. This may result from reduced physical capabilities, particularly explosive strength, which directly affects the production of high jumps and subsequent shooting. This can be attributed to several factors, including the lack of suitable training methods to develop these capabilities, or the insufficiency of existing methods to achieve the required adaptation for enhancing the muscles responsible for the primary skill of shooting. Most previous studies employed bodyweight exercises or weight training (Multi Gym) to develop the explosive strength of the arms and legs in handball.

The distinct feature of this study is the preparation of compound exercises using proportionally added resistance to body parts, employing weighted vests and cuffs placed on the wrists and ankle joints, with the weight proportioned according to each body part as per the Bernstein table (Mohammed, 2021, p. 34). The progression in resistance ranged from 7% to 10% during the training curriculum. The primary aim of these compound exercises is to integrate strength training with the training of high jump long-distance shooting accuracy to maintain the motor pathways of the skill. As Abbas (2005) emphasized:

"The design and orchestration of the specific training programs, should not be isolated, but rather they should be tailored with the features of the specialized sport activity. "The use of different methods and instruments must be maintained to the extent of the sport (in order) to have a positive incidence on the performance, favoring excellence and creativity.

Several previous studies support the significance of this approach:

Mohammed Mahmoud Kazem (2015) studied the effect of training with elastic ropes on exerciser muscle in emergency strength of legs and arms, also on special biochemical indicators in goal keepers handball teams 13 –14 years old. Using one experimental group, significant p re- and post-test explosive strength improvements were observed with beneficial biochemical responses.

Saif Hamed Ali, (2017) The correlation between the explosive strength of the arms and legs with performing fast shooting skills on some players of the Army Club handball team. Explosive strength was significantly correlated to Accuracy of shooting indicated by the result of this study.

Nizar Faeq Saleh (2021) has a study carried out to determine the influence of technique resistance training on depth strength and motor speed in young tennis players aged 14 – 16 years.

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Through an experimental, control group research design the study found significant gains in both constructs for the experimental group.

Sadiq Dreyoul Khalaf (2021) explored the effect of weighted exercises on defensive movement and offensive skill speed in advanced futsal players, concluding improvements in both defensive and offensive performance.

Ahmed Abdulaziz Faraj (2021) studied the impact of different types of resistance training (sand/resistance) exercises on specific strength in 17- to 19-year-old football players. There were significant gains in explosive strength, a speed-specific strength and strength endurance.

Hassanein Hashim Ismail (2021) analyzed the effect of weighted compound movements on skill related performance abilities of 17-19 years old soccer players. Results also indicated that modifiers adding weight to compound exercises resulted in better outcomes than modifiers not adding weight.

Methodology

The authors used an experimental design with one-group pre-and post-test, which meant that the research procedures were consistent. The study sample was chosen purposively from Education Teams of Baghdad Governorate, including 20 handball players who are playing in the first education team of Baghdad Karkh. A random selection was applied to select 8 riders from the sample in a lottery format. A pilot study sample of 4 players was also set. Sample homogeneity was confirmed on age, weight and height data with the computation of the skewness coefficient (+- 3). The researchers collected data by observation, personal interviews and collection of online materials.

The equipment and tools used in the study included:

- 8 weighted vests
- 16 weighted arm cuffs
- 16 weighted leg cuffs
- 1 HP Chinese-made laptop
- 2 Chinese-made stopwatches
- 1 Chinese-made electronic scale
- 1 measuring tape (15 meters)

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- 2 Fox whistles
- 4 custom-designed barriers with different heights
- 10 markers of different colors
- 10 handballs (size 2)
- 2 wooden benches
- 2 wooden boxes
- 4 iron squares (40x40 cm)

Following a thorough analysis and review of several scientific references and sources, the researchers identified the specific tests for the research variables. The selected tests were:

- Medicine Ball Throw (3 kg) from a seated position (Al-Badiri, 2011)
- Vertical Jump Test (Sargent) (Al-Badiri, 2011)
- Accuracy of High Jump Shooting (Al-Badiri, 2011)

After determining the key physical capabilities and their respective tests, the researchers conducted the first pilot experiment on 28/2/2023 with a sample of 4 players randomly chosen from the research population. With the help of the assistant team, the pilot experiment was carried out, aiming to achieve the following objectives:

- Verify the suitability of the tests for the sample individuals and their ease of application
- Determine the time needed to perform the tests
- Identify any obstacles that may arise during the tests and prevent errors and overlaps in work

A second pilot experiment for the current study took place on 02-03-23; the aim was to be able to carry out some of the planned exercises and examine their suitability with this target group. With the cooperation of coaches in the Baghdad Karkh First Education team, the research sample were trained before starting the main study. The objective of this session was to:

- Determine the appropriate percentage of added resistance
- Identify the number of exercises per training session

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- Assess the players' ability to comprehend and adapt to the prepared exercises using resistance

Research sample's pre-tests It was carried out on Sunday, 12 March 2023 with eight players. The tests' parameters (time, place, tools, method of execution and the team of assistants) were rigorously recorded to be the same in the post-tests. The training was then carried out on weekdays between Tuesday, March 14, 2023 and Sunday, May 14, as directed by the academics with help from the team's coach. This phase was conducted over the 8-week period prior to competition, which served as a preparation stage, and included three training sessions per week (Saturday, Tuesday, and Thursday) for a total of 24 training sessions over the entire program.

The scientists advised in increasing the loads gradually by small percentages of the body weight to the trunk, arms and legs during the course of training applying a loading principle based on Bernstein's table (Mohammed, 2021, p. 34). The load increased from 7% to10% of relative body weigh throughout the course of the program. Post-tests were carried out on 16/5/2023 under the same conditions and procedure as the pretreatment tests by the same group of assistants.

Statistical analysis of the data was conducted using the SPSS program, with the following statistical methods: mean, standard deviation, and the paired T-test.

Results

Table 1. *The Mean and Standard Deviations for the Pre-Test and Post-Test*

Variable	Unit	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	Development Percentage
Explosive Strength of Arms	Meter	4.927 ± 0.309	5.893 ± 0.254	9.60%
Explosive Strength of Legs	Centimeter	33.500 ± 2.329	41.000 ± 2.267	22.38%
Accuracy of High Jump Shooting	Points	4.500 ± 0.534	6.500 ± 0.925	44.44%

Table 2. *Difference in Means, Standard Deviations, and T-Value for Pre-Test and Post-Test*

Variable	Difference in Means	Difference in S.D.	T-Value	P-Value
Explosive Strength of Arms	0.96625	0.075210	12.847	0.00
Explosive Strength of Legs	7.50000	0.327330	22.913	0.00
Accuracy of High Jump Shooting	2	0.188980	10.583	0.00

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Discussion

As seen in Tables (1 and 2), which show the findings of the research sample in the pre-test and post-test, there was a remarkable increase in all study variables by the post-test. According to the researchers, this improvement could be due to the exercises specifically developed with an added resistance for certain body parts, that were well-accepted by the sample. The subjects in the study also showed an increased explosive strength of hands and legs as well as improvement of accuracy while taking shot for high jump. The training units and the park provided exercise opportunities in different locations, which had a strong impact on the mean differences of scores of the study variables. Al-Madamgah & Al-Sudani (2013, p. 218) affirmed this by claiming "Variation of using different exercises to develop strength of the same muscle group will involve in significant augment in the strength." Furthermore, the intensities and volumes of the exercises implemented in training programmes developed by these authors were similar to or higher than those applied during skill execution, with corresponding improvements in player performance. This was based on a very precise determination of the work periods and breaks between repetitions and sets, as well as a slow increase in intensity of the training units. This approach is emphasized by Jassim (2014, p. 101) who posited "systematic and programmed sports training with prescribed intensities in training and optimal use of rest between repetitions are associated with better performance results." Furthermore, the introduction of modern training ideas based on the principle of phased increase of physical load, except as suggested by the experiments, were essential. Training Principle Faraj (2021) attests "the principle of progressive overload is one of the fundamental principles in the training process not only for physical preparation, but also everything related to the training. According to al-Jubouri (2011, 214), This progressive increase in exercise difficulty allows the body to adapt and improve physical and skillful conditioning resulting in performance improvement. Properly therefore progressive training in exercises leads to a permanent physical adaptation and performance fitness.

Points out, the above significant between-group differences in sample can largely be attributed to performance of the exercises within training protocol based on scientific foundation. These exercises largely promoted the explosive power of upper and lower limbs, and accuracy of high jump shot. The addition of specific loads to certain body parts (proportioned according to scientifically-determinated percentage in terms of the weight of each body segment) and sinthetic movements patterns, conductive on stimolating the closerly a simulating possible of the appealed atletic skill made difference in this improvement. This is in agreement with (Mohamed and Hassan, 2008, p. 102) who posit that: "Training with extra loads is efficient and results in excellent performance for developing various forms of the strength especially explosive force." (Al-Aidhi ,2011, p. 139) reinforces this argument when he states that 'It is impossible to achieve the desired

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level of strength development from exercises only in the performance activities during the development phase and will require adding external weights as effective strengthening tools'. Resistance training is one of the core pillars in developing the capacities that underpin skill acquisition, with resistance training playing a fundamental and impactful part in this development (Saleh, 2021).

Moreover, exercises according to the training theories with different intensities and repetition in a dynamic manner through the training program would have improved study variables of sample. This corresponds with Al-Haddad (2015, p. 37) who described that, 'Continuous and intensive training repetition can contribute to improving the coordination between the arms and legs' movement as well as an increase in strength of those muscles groups involved in a skilled performance.' The authors attribute the greater accuracy of high jump type shooting to improvements in both upper and lower limb explosive strength. As Jamaluddin and Jowied (2007, p. 97) have claimed "The better physical conditioning, the more enhanced performance is skillful to get increased levels of achievement". Gorstiaga (2005, p. 106) argues "there are crucial skills in preparation for shooting, such as strength, coordination and accuracy". Similarly, Al-Sheikhly (2005, p. 95) stresses that "Physical abilities constitute the base on which other constituents are incorporated, and high-performance level is highly related to physical ability," and therefore must be considered in developing a periodized training program for athletes.

Thus, explosive force should play a major role in time invested to develop muscular strength due to high correlation with accuracy of high jump shooting. In addition, Ali (2016) and as cited by Abdul-Fattah stated that "Explosive power is a direct contributor to the precision of execution skill. Preparation for players, combined with the application of the balance principle during formation of a physical provision in shooting skills, allows both balanced and harmonious development. This method was also conducive to the degree of high jump shooting accuracy were found in the research sample, in line with how an organism adapts to training and increasing load, intra complex exercises; consideration for individual differences, as well as adequate warm-up/cool-down procedures. The novel feature of training players with tasks that replicate natural movement when executing the skill clearly produced the greatest change in vertical jump and translated into enhanced shot accuracy. Qassem and Khamis (2011, p.107 – 108) further supports this by arguing that skuddop hopp "allows the shooter to bypass interference from defending players and offers enough time to assess the goalkeeper's re action before shooting at an opportune area of the goal."

Abbas (2005, p. 140) concludes, "The design and coordination of specific programs should not be done arbitrarily but must align with the characteristics of the specialized sport activity. The use of diverse methods and tools must continue in accordance with the specifications of the sport

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to achieve a positive impact on performance, leading to excellence and creativity." The researchers also attribute the improvements in the accuracy of high jump shooting to the increased difficulty of the playing conditions during the application of the high jump shooting exercises. These included added weights relative to the body parts' weight and interaction between players during the shooting process, as well as the accuracy markers on the target.

Conclusions

In light of the statistical analyses of the test results, which were presented, analyzed, and discussed, the researchers reached the following conclusions: The application of specific exercises had a positive effect on developing the explosive strength of the arms and legs. Additionally, the compound exercises using added resistance had a positive effect on improving the accuracy of high jump shooting.

Recommendations

Based on the conclusions reached by the researchers, it is recommended to use the training method with added resistance relative to body parts, combined with exercises, to develop certain types of strength in handball and improve the accuracy of high jump shooting. Additionally, it is recommended to use the method of training with added resistance relative to body parts along with exercises to develop other skills in handball.

Appendix (1)
Training Unit

Workplace: Sports Activity Hall
Week: Second
Unit: Fifth

Sample Size: 8 Players
Training Unit Duration: 88 Minutes
Total Intensity: 90%

Training Goal: Developing explosive strength for the arms and legs, and improving accuracy in long-distance shooting from a high jump.

Week: Fifth Unit: First Date: April 11, 2023, Tuesday Sample Size: 8 Players Resistance Percentage: 10%	Application of Exercises During Training Units	Workplace: Sports and School Activity Hall in Baghdad's Karakh First Education Directorate Exercise Duration: 41.47 minutes Total Intensity: 89.66% Total Intensity for Exercises: 88-93%
Training Unit Goal: Developing explosive strength for the arms and legs and improving accuracy in high jump shooting.		

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Training Unit Sections	Exercises	Performance Time	Repetitions	Exercise Intensity	Rest Between Repetitions	Sets	Rest Between Sets	Total Work Time	Total Rest Time	Total Training Time
Main Section	(2)	8 sec	6	88%	20 sec	4	40 sec	2.24 min	9.20 min	11.44 min
	(1)	16 sec	5	91%	35 sec	3	60 sec	4 min	10 min	14 min
	(3)	12 sec	6	90%	30 sec	4	45 sec	4.48 min	12.15 min	16.3 min

Exercise (1)

Exercise Goal: Developing explosive strength for the arms and legs, and improving accuracy in high jump shooting.

Tools Used: Medicine balls weighing 1 kg, barriers with different heights, colored markers, handballs size 2, whistle, stopwatch, iron squares measuring 40x40 cm (4 pieces).

Method of Performance:

The players are divided into two groups, with each group consisting of four players. Each player from both groups will throw a 1 kg medicine ball at a marker located 10 meters away, then run to reach three barriers of different heights. The first barrier is 30 cm high, the second is 40 cm, and the third is 50 cm, over which the player must jump with both feet. After jumping, they will sprint towards the next marker, receive the ball from the coach, take three steps, and then shoot from the high jump position between the markers. The shot should be directed at one of the squares located at the corners of the upper goal, as shown in figure No. (1).

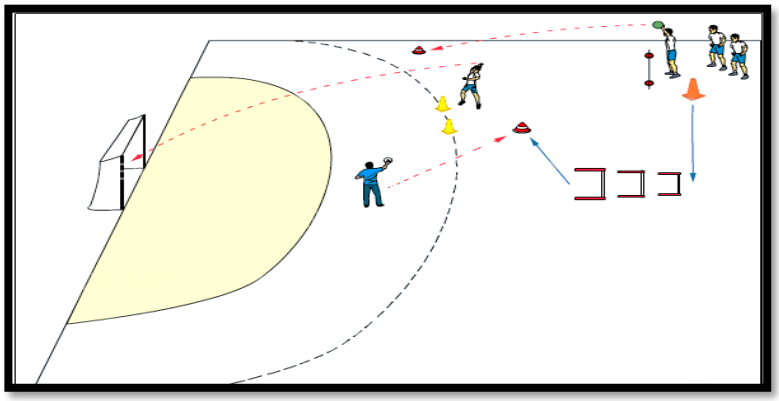

figure (1): Shows how to perform the exercise

Exercise (2)

Exercise Goal: Developing explosive strength for the arms and legs, and improving accuracy in high jump shooting.

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Tools Used: 3 barriers, each 30 cm high, colored markers, wooden bench, handballs size 2, whistle, stopwatch, iron squares measuring 40x40 cm (4 pieces).

Method of Performance:
The players are divided into two groups, with each group consisting of four players. Each player from both groups will run towards the three barriers, each 30 cm high, with a 1-meter distance between each barrier. The player will jump over the barriers with both feet, then sprint towards the next marker to receive the ball from the coach, take three steps, and then shoot from above the wooden bench. The shot should be aimed at one of the squares located at the corners of the upper goal, as shown in figure No. (2).

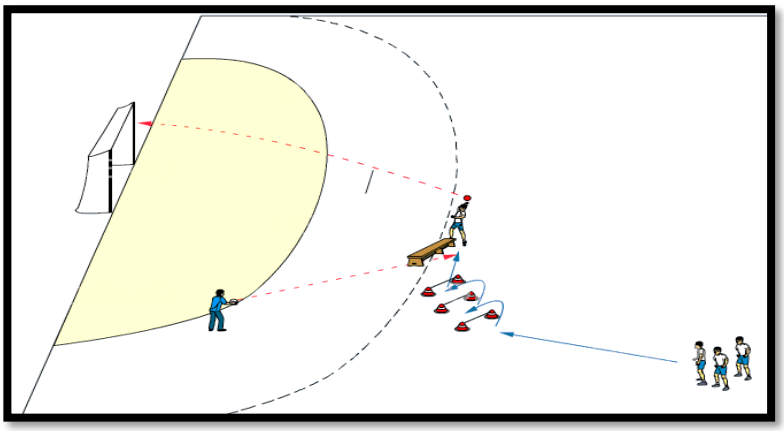

figure (2): Shows how to perform the exercise

Exercise (3)
Exercise Goal: Developing explosive strength for the arms and legs, and improving accuracy in high jump shooting.
Tools Used: 1 kg medicine balls, 30 cm high barriers, colored markers, wooden bench, handballs size 2, whistle, stopwatch, iron squares measuring 40x40 cm (4 pieces).

Method of Performance:
The players are divided into two groups, with each group consisting of four players. Each player from both groups will throw a 1 kg medicine ball at a marker located 10 meters away, then sprint towards the marker. The player will then jump over the three barriers (30 cm high) with both feet. Upon reaching the marker, the player will sprint towards the wooden bench, receive the ball from the coach, take three steps, and then shoot from above the bench. The shot should be aimed at one of the squares located at the corners of the upper goal, as shown in figure No. (3).

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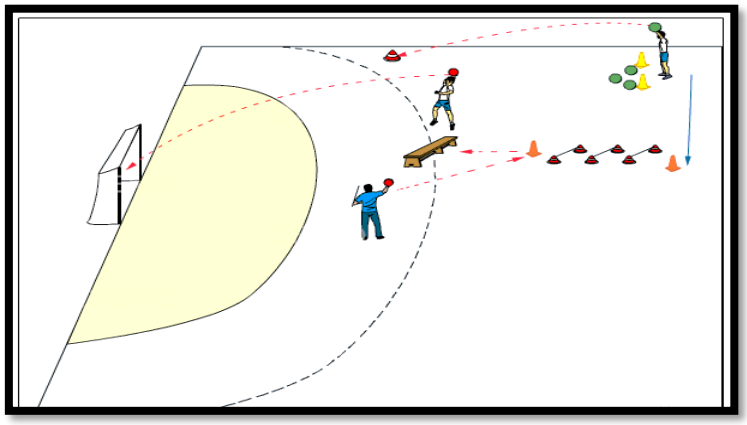

figure (3): Shows how to perform the exercise

Appendix (2)

The Relative Weights of Human Body Parts

Body Part	Fischer's Opinion	Men	Women	Rounded Values
Head	7.06%	6.72%	6.12%	7%
Trunk	42.7%	46.30%	43.9%	43%
Thigh	11.58%	12.21%	12.89%	12%
Shank	1.79%	4.65%	4.34%	5%
Foot	3.36%	1.46%	1.29%	2%
Upper Arm	2.28%	2.65%	2.60%	3%
Forearm	0.84%	1.82%	1.82%	2%
Hand	0.48%	0.70%	0.55%	1%

Appendix (3)

Shows the Gradual Increase in Weight During the Exercise Period

Week	Training Week	Percentage of Added Weight
1	Week 1	7%
2	Week 2	8%
3	Week 3	9%
4	Week 4	10%
5	Week 5	10%
6	Week 6	10%
7	Week 7	10%
8	Week 8	10%

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P-ISSN: 2073-6452, E-ISSN: 2707-5729

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