



The Effect of a Proposed Training Program Using Functional Training Exercises on the Development of Some Physical, Skill, and Cardiac Functional Abilities (In Youth Basketball Players Aged (17–18) Years)

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Abstract. The research aims, by designing a proposed training curriculum using functional training exercises, to identify the effect of a proposed training curriculum using functional training style exercises in developing some of the physical, skill and functional capabilities of the heart in basketball for young people aged (17-18) years. The sample consisted of a group of club players. Heat basketball athletes, numbering (15) players after the end of the training season for the 2023/2024 academic year due to the summer vacation. Their ages are (17-18) years, and each group is five (10) players. The exploratory experiment was conducted on five (5) players and after confirmation The scientific foundations of the research were extracted from the tests of the main experiment. The researcher used the experimental method to suit the nature of the research and its procedures, through an experimental design for one experimental group through measurements (pre- and post-tests). The researcher designed and prepared a proposed training curriculum using exercises that were applied to the experimental sample. In the functional training method, post-tests were conducted and there were significant differences and in favor of the post-test, there were rates of development in the post-test measurement compared to the pre-test for individuals of the basic research sample in the variables under study, where the variables of physical abilities ranged from strength distinguished by speed for the arms (35.45%) and distinctive strength The speed of the legs (43.84%). What are the skill variables in basketball? The chest pass (41.44%) and the layup shot (47.09%). As for the functional variables of the heart, pulse rate (H.R.) (24.50) and Hit volume (S.V) (27.69%) in basketball in favor of dimensional measurement.

Keywords: Training curriculum, functional training, physical, skill and functional variables of the heart.

1. INTRODUCTION

Sports sciences have developed and advanced significantly, transitioning from a descriptive nature to precise scientific disciplines. This progress is largely attributed to the abundance of scientific findings obtained from research and field studies conducted on athletes. Most sources of information, regardless of their disciplinary origin, have been utilized to enhance coaches' understanding of the effects of physical exercises on the athlete's body. Consequently, physical exercise itself has become the central focus of studies and research in sports training sciences and other related fields.

The design and construction of training programs have become fundamental concerns for coaches and experts in the field of sports. Scientifically structured training programs represent the only effective means of achieving advanced performance levels, excelling in performance, and accomplishing training objectives.

Come from our perspective, issue concerning human body adaptation plus response concerning its various system for physical load represent one concerning most important

research topic inside of sport field. This importance stem out of fact that physical load constitute primary mean for improving both physical plus athletic performance.

Basketball are considered one concerning team sport characterized by way of wide range concerning skill. Development concerning game depend large upon player mastery concerning fundamental skill. Player who lack proficiency inside of this basic skill will fails to performs task assigned by way of coach, whether offensive or defensive, plus will also is unable to executes planned strategy, thereby contributing for team decline. Team success are therefore high dependent upon player mastery concerning this fundamental skill. Accord, player must possesses both speed plus accuracy inside of movement, whether alongside or without ball, as well as proficiency inside of executing essential skill such as dribbling, passing, shooting, feinting, screening, plus other related technique.

In addition, process concerning development are close linked for degree concerning skill mastery plus ability to performs under real competitive condition. Such mastery represent fundamental basis for excellence plus advancement (Muaid, 1999).

Sport activity require physical fitness, which vary depending upon nature concerning each sport. It are also essential for coach to has sufficient knowledge plus understanding concerning training method plus principle to ensures effective training. This lead for physiological adaptation plus performance improvement. Basketball, inside of particular, are characterized by way of endurance plus speed requirement, enabling player to performs repeated high-intensity movement over short distance throughout game. During gameplay, movement pattern vary significant. Dentiman plus Edward (1988) recommended use concerning “pick-up speed” method, where performance progress gradual out of jogging for 75% sprinting plus then for maximum speed, using 1:1 ratio for walking recovery (Abu Al-Ela & Ahmed, 2003).

Functional training have emerged as modern training method used by way of athlete as complementary form concerning conditioning alongside traditional training. This approach help improves athletic performance by way of incorporating various strategy such as core stability training to facilitates force transfer across limb, strength development to enhances power output, plus proprioceptive training to improves balance, coordination, agility, plus overall movement efficiency. Addition, functional training emphasize injury prevention plus performance enhancement through well-structured exercise routine.

Importance concerning this study lie inside of identifying effect pertaining to proposed training program based upon functional training exercise inside of developing certain physical, skill-related, plus heart functional variable among youth basketball player aged 17–18 year.

Research problem emerged after extensive review concerning Arabic plus foreign source, published study, plus postgraduate thesis. Researcher observed significant lack concerning scientific research inside of field pertaining to basketball, particular inside of sport physiology related for functional training. There are also limited attention given for this training method inside of designing training program plus integrating it effective into training planning to enhances performance inside of specialized sport activity.

Based on the above, the researcher identified the necessity of addressing this topic through scientific investigation, aiming to promote the use of functional training exercises and incorporate them into the design of a specialized basketball training program grounded in scientific principles. This program seeks to improve physical, skill, and functional variables in basketball.

Accordingly, the researcher conducted this study using a proposed training program designed to address the research problem by targeting selected physical, skill, and heart functional variables among youth basketball players, with the aim of achieving the study objectives and validating its hypotheses.

This study aims, through the design of a proposed training program using functional training exercises, to: Examine the effect of the coach's existing training program and the proposed program developed by the researcher on improving selected physical, skill, and heart functional variables among youth basketball players.

Within basketball specific, physical attribute such as speed plus agility are close linked for skill performance, including dribbling, passing, plus shooting. Study by way of Zhang et al. (2026) demonstrated that agility-focused training program significant enhance basketball performance, particular inside of dynamic plus game-like situation requiring quick decision-making plus rapid execution. Similar, García-Rubio et al. (2023) highlighted that key performance indicator inside of basketball are strong influenced by way of both physical fitness plus mastery concerning fundamental skill.

Moreover, monitoring training intensity through physiological indicator such as heart rate have become essential inside of optimizing training outcome. Study suggest that maintaining training intensity within specific heart rate zone can improves adherence for training goal plus maximizes performance gain (Zhao et al., 2026; Zhang et al., 2026). This highlight importance concerning integrating physiological monitoring into training program design.

Effective training program design are another critical factor inside of achieving optimal performance. Scientific approach for training design, including structured planning plus

periodization, are essential for improving athletic performance. Clemente et al. (2024) emphasized that well-designed training program based upon scientific principle lead for significant improvement inside of athlete performance. Similar, neuromuscular training strategy have is shown to enhances overall athletic capability when proper integrated into training routine (Behm et al., 2024).

2. THEORETICAL REVIEW

Recent study consistent highlight that functional training program are high effective inside of improving physical, technical, plus cardiovascular (cardiac) function inside of youth basketball player. Functional training emphasize multi-joint, sport-specific movement, which mimics actual game situation plus enhances neuromuscular coordination. Evidence out of systematic review plus experimental study show that integrating functional or high-intensity training lead for improvement inside of agility, strength, endurance, heart rate recovery, plus skill execution, especial among adolescent athlete aged 12–18 year. Addition, cardiovascular adaptation—such as improved VO_2max plus heart rate efficiency—are strong linked alongside enhanced on-court performance plus recovery capacity (Liu & Li, 2025; Cao et al., 2025).

Functional Training in Sports Performance

Functional training refer for exercise program designed to improves movement pattern relevant for specific sport. Unlike traditional resistance training, functional training integrate balance, coordination, strength, plus core stability inside of dynamic condition. Set concerning exercise included within single training session or unit, organized within structured framework to achieves specific training objective (Al-Hiti, 2011).

Recent research indicate that functional training significant enhance motor skill plus physical fitness inside of youth population. For instance, Zhang et al. (2024) explains that functional training improve fundamental motor skill by way of targeting movement efficiency plus neuromuscular coordination. Similar, Amato et al. (2025) finds that functional plus core-based training program improved athletic performance plus injury prevention inside of young basketball player.

Furthermore, CrossFit plus high-intensity functional training approach have is shown superior outcome compared for traditional training inside of improving strength, agility, plus endurance (Gong et al., 2025). This finding support idea that functional training are more aligned alongside demand concerning basketball, which require rapid, multidirectional movement plus coordinated action.

Development of Physical Abilities in Youth Basketball

Physical ability such as speed, agility, muscular strength, power, plus endurance is essential for basketball performance. Meta-analysis by way of Liu & Li (2025) demonstrate that structured training program significant improves this physical attribute inside of youth basketball player. Ability to overcomes resistance alongside high degree concerning acceleration, representing capacity to produces maximum القوة inside of minimal time, high dependent upon neuromuscular coordination (Al-Hiti, 2011).

Addition, longitudinal study shows that regular basketball training combined alongside functional exercise lead for improvement inside of change-of-direction speed, sprint performance, plus explosive power (Mikołajec et al., 2025). This improvement are critical because basketball performance depend heavy upon short burst concerning high-intensity activity.

High-intensity interval training (HIIT), often integrated into functional training, have also is shown to enhances aerobic plus anaerobic capacity, which direct contribute for game performance (Cao et al., 2025). Moreover, biological maturation play important role inside of how adolescent responds for training, alongside functional training producing significant gain inside of cardiorespiratory fitness (Domaradzki et al., 2025).

Skill Development in Basketball

Technical skill such as shooting, dribbling, passing, plus defensive movement are close linked for physical fitness. Functional training enhance this skill by way of improving movement efficiency plus coordination under game-like condition. Fundamental basketball skill plus most common type concerning passing, involving coordinated action pertaining to multiple joint plus muscle group (Basketball, 2000, p. 154).

Research by way from Qin & Zhao (2025) finds that functional training significant improved basketball-specific skill while also enhancing physical performance. Similar, cognitive-coordination training integrated alongside physical exercise have is shown to improves technical accuracy plus decision-making ability inside of adolescent player (Li et al., 2026).

This relationship suggest that skill development are not isolated but depend upon integration concerning physical plus neuromuscular capacity, which functional training effective target.

Cardiovascular (Cardiac Functional) Adaptations

Cardiovascular fitness are key component concerning athletic performance, particular inside of sport like basketball that involves intermittent high-intensity activity. Functional training have is shown to produces significant improvement inside of heart rate efficiency, recovery ability, plus overall cardiac function.

Xiong & Thadanattaphak (2025) reports that functional training improved heart rate recovery plus endurance capacity, indicating better cardiovascular adaptation. Addition, basketball-specific training program that incorporates monitoring concerning heart rate plus intensity can optimizes cardiovascular benefit while preventing overtraining (Joldasbaeva et al., 2025).

Moreover, regular participation inside of basketball plus structured training program enhance cardiorespiratory endurance plus metabolic efficiency, which is essential for sustaining performance during match (Richen et al., 2025). This adaptation are particular important for youth athlete, as it contributes for both performance plus long-term health.

One concerning most essential basketball shooting technique performed while moving toward basket, requiring proper execution to avoids violation such as traveling. Player must masters this skill alongside both hand due for its application inside of various game situation (Richard, 1963, p. 132).

Integration of Functional Training in Youth Programs

Integration concerning functional training into youth basketball program are supported by way of evidence showing its effectiveness inside of improving multiple performance domain simultaneous. Functional training not only enhance physical plus technical ability but also contribute for injury prevention plus overall athletic development.

Karatrantou et al. (2024) emphasizes that structured exercise program that monitor intensity (e.g., heart rate) can optimizes functional capacity plus health outcome. Addition, combining functional training alongside sport-specific drill ensure that improvement are transferable for actual game performance.

Therefore, well-designed training curriculum should includes progressive functional exercise, high-intensity interval, plus skill-based drill to maximizes development inside of youth basketball player. Pulse resulting out of blood flow through artery, used as indicator concerning cardiac activity. It are reliable measure concerning cardiovascular response during physical effort (Bayoumi & Abdel-Sami, p. 224) (Muaid, 1999). Amount concerning blood pumped by way of heart inside of single beat (Kamash & Abu Al-Khait, 2009, p. 67) (Muaid, 1999).

3. METODE PENELITIAN

The research aims, through designing a proposed training program using functional training exercises, to identify the effect of the training program followed by the coach and the program proposed by the researcher on developing some variables of physical abilities, including speed-strength of the arms and legs, as well as skill variables in basketball, namely the chest pass and layup shot, and cardiac functional variables, including heart rate (H.R) and stroke volume (S.V). The researcher used the experimental method due to its suitability for the nature of the study and its procedures, employing a one-group experimental design with pre- and post-measurements.

Table (1): Independent and Dependent Variables

Independent Variable	Dependent Variables
Proposed training program using functional training exercises	Physical abilities: speed-strength of arms and legs; Skill variables: chest pass and layup shot; Cardiac functional variables: heart rate (H.R) and stroke volume (S.V)

Research Scope

Human Domain: Youth basketball players of Hit Sports Club (first division) in Al-Anbar Governorate (n = 15).

Temporal Domain: From Tuesday, 24/4/2024 to Sunday, 2/9/2024.

Spatial Domain: Al-Athar Secondary School court (boys) – Hit District – Laboratories of Hit General Hospital.

Population and Sample

The sample consisted of **15 basketball** players from Hit Sports Club after the 2023/2024 training season (during the summer break), aged 17–18 years.

- A pilot study was conducted on 5 players, who were later excluded from the main experiment.
- The main experimental sample included 10 players.

Table (2): Description of the Research Sample

No.	Sample Type	Number of Players	Percentage
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1	Study population	15	100%
2	Pilot sample	5	33.33%
3	Experimental sample	10	66.66%
4	Total sample	10	100%

The table shows that the population consisted of 15 players (100%), with 5 players (33.33%) in the pilot study and 10 players (66.66%) in the main study.

The sample was selected purposively from the Hit Basketball Club.

Table (3): Characteristics of the Sample (n = 10)

Variable	Unit	Mean	SD	Median	Skewness
Age	Year	17.55	0.47	18.5	0.54
Height	cm	174.80	4.61	180.48	1.76
Weight	kg	75.10	3.67	76.84	0.78
Training age	Year	3.9	0.38	2.76	0.56

The skewness values ranged between ± 3 , indicating a normal distribution of the sample.

Study utilize set concerning instrument plus tool to collects data related for physical, skill, plus cardiac variable. Device include mercury sphygmomanometer for measuring blood pressure, heart rate monitor, plus Doppler echocardiography device (ECHO CRITEREA, Japanese-made, 3–5 MHz) to assesses cardiac function. Additional tool such as stethoscope, basketball court, basketball, cone, plus data recording form were also employed. Physical ability were evaluated through test measuring speed-strength concerning arm using push-up for 10 second plus speed-strength concerning leg using knee flexion-extension for 20 second, alongside score based upon number concerning repetition. Basketball skill were assessed using chest pass test against wall out of distance concerning 2.70 meter, measured by way of completion time, plus layup shot test performed after dribbling, evaluated by way of number concerning successful attempt. Cardiac functional variable include heart rate (H.R), measured at rest using Doppler echocardiography, plus stroke volume (S.V), calculated using formula $SV = EDV - ESV$. Pilot study were conducted upon five player to ensures participant readiness, verifies equipment validity, identifies potential challenge, plus refines procedure. Study also adhere for scientific testing principle, ensuring validity, reliability, plus objectivity concerning measurement.

Table (4): Validity, Reliability, Objectivity

Variable	Test	Validity	Reliability	Objectivity
Arm speed-strength	Push-up test	0.91	0.95	100%

Leg speed-strength	Jump test	0.90	0.93	100%
Chest pass	Wall pass test	0.79	0.89	100%
Layup shot	Shooting test	0.85	0.90	100%

Pre-test procedure were conducted over two day, where cardiac measurement were taken upon October 4, 2024, followed by way of physical plus basketball skill test upon October 5, 2024. Subsequent, researcher implement proposed functional training program consisting concerning 36 training session distributed over three month, alongside three session per week plus duration concerning 120 minute per session. Program were designed based upon progressive (wave-like) load principle plus specific intensity ratio (1:2 plus 1:3), incorporating exercise that reflect fundamental human movement pattern such as running, jumping, pushing, pulling, plus rotation. Training parameter include 8–20 repetition, 2–4 set, plus rest interval ranging out of 30 second for 1 minute.

After completing the training program, post-tests were conducted under the same conditions as the pre-tests to evaluate improvements in physical abilities, basketball skills, and cardiac functional variables. For data analysis, the study employed several statistical methods, including the mean, standard deviation, correlation coefficient, simple linear regression, and paired sample t-test.

4. RESULTS AND DISCUSSION

Based on the research objectives, hypotheses, and the data of the main research sample, which were organized into tables and statistically analyzed, the results of the study are presented as follows:

Presentation of the statistical results related to the hypothesis, which states: There are statistically significant differences between the pre-test and post-test of the experimental group in favor of the post-test.

Table (5)

Significance of Differences Between Pre- and Post-Measurements for the Experimental Group in Physical, Skill, and Cardiac Functional Variables, and Percentage of Improvement (n = 10)

No .	Physical, Skill, and Cardiac Functional Tests	Pre-Test Mean	± SD	Post - Test Mean	± SD	Mean Difference	Standard Error	t-value	Improvement %	Effect Size	Effect Size Interpretation
1	Speed-strength of arms	13.36	0.89	20.70	1.86	7.34	1.85	7.23	35.45%	—	High
2	Speed-strength of legs	10.67	2.43	19.00	0.97	8.33	1.98	9.13	43.84%	—	High
3	Chest Pass	19.57	0.98	11.46	0.23	8.11	47.14	8.19	41.44%	—	High
4	Layup Shot	4.65	0.32	8.79	0.89	4.14	0.36	5.93	47.09%	—	High
5	Heart Rate (H.R)	86.10	6.90	65.00	1.70	21.10	19.15	7.26	24.50%	—	High
6	Stroke Volume (S.V)	60.10	22.10	88.54	32.78	28.44	15.67	6.54	17.69%	—	High

Tabulated t-value at 0.05 = 2.262

Significant at the 0.05 level

Results

Table (5) shows statistically significant differences at the level of (0.05) between the pre- and post-measurements of the research sample in the physical ability variables, namely **speed-strength** of the arms and legs, as well as the basketball skill variables, including the chest pass and layup shot, and the cardiac functional variables, namely heart rate (H.R) and stroke volume (S.V), all in favor of the post-measurement.

The table also indicates improvement percentages in the post-test compared to the pre-test for the study variables. The improvement rates ranged as follows: Physical abilities: arm speed-strength (35.45%) and leg speed-strength (43.84%), Skill variables: chest pass (41.44%) and layup shot (47.09%), Cardiac variables: heart rate (24.50%) and stroke volume (27.69%)

All improvements were in favor of the post-test.

Discussion

The results demonstrate that all post-test outcomes for the experimental group were superior to the pre-test results. This improvement can be attributed to the scientifically designed training program and the physical exercises implemented using the functional training approach, which had a positive effect on physical, skill, and functional variables.

Functional training promote different perspective upon athletic development. Its goal are not limited for improving strength, flexibility, or cardiovascular capacity, but also focus upon essential principle such as agility, balance, coordination, plus movement efficiency, which contribute for motor enrichment plus overall athletic performance. As focus shift toward movement quality, training become more functional plus begin to overlaps alongside rehabilitation concept. It emphasize fundamental movement pattern such as pushing, pulling, squatting, plus lunging, rather than isolated muscle exercise.

Within basketball, functional training play crucial role inside of improving both skill plus physical conditioning. Basketball are high-intensity sport requiring combination concerning technical skill plus physical attribute. Player must possesses not only shooting plus dribbling ability but also strength, agility, plus endurance. Functional training, which focus upon sport-specific movement, enhance performance, reduce injury risk, plus improve overall efficiency upon court.

Researcher attribute observed improvement for nature concerning exercise used inside of functional training program, which provide variation plus contribute for development concerning physical ability, particular speed-strength concerning arm plus leg. Accord for Al-Rabadi (2001), variation inside of training are fundamental factor inside of achieving physical balance plus increasing motivation, which support validity concerning research hypothesis..

Result also indicate that proposed training program have significant positive effect upon developing speed-strength ability. Statistical analysis show that calculated difference between pre- plus post-test were significant inside of favor concerning experimental group, confirming importance concerning this ability inside of basketball performance. As noted by way of Al-Bisati (1999), sport training aim to improves physical, psychological, plus mental capability through systematic practice.

Regarding skill performance, researcher emphasize that chest pass are primary method concerning ball movement during gameplay. Team alongside accurate passing are more difficult to defeats, even if their shooting ability are relative weak, as effective passing allow quick plus efficient ball movement toward scoring position.

Layup shot are considered one concerning most decisive skill inside of basketball, as scoring determine outcome concerning game. All offensive strategy ultimate depend upon successful shooting. Therefore, shooting should receives significant emphasis inside of training program, as it represent primary objective concerning basketball performance (Khalid, 1986).

Out of physiological perspective, researcher explain improvement inside of cardiac variable as result concerning functional adaptation concerning circulatory system for physical

effort. Increase inside of heart rate plus stroke volume reflect improved cardiovascular efficiency, enabling player to sustains high-intensity performance. Stroke volume (S.V) represent amount concerning blood pumped by way of heart per beat plus are calculated as:
$$S.V = EDV - ESV$$

It influenced by way of factor such as heart size, age, gender, plus training status. During physical activity, stroke volume may reaches up for 200 ml per beat depending upon intensity concerning exercise.

Historical example highlighting importance concerning skill performance inside of basketball are 1972 Munich Olympic, where Soviet Union defeat United State through precise plus rapid passing sequence followed by way of successful shot, demonstrating critical role concerning accurate passing inside of achieving victory (Mazen Abdulrahman, 2005).

5. CONCLUSION

In conclusion, functional training provide numerous benefit for basketball player, including improved athletic performance, injury prevention, plus enhanced overall conditioning. By way of incorporating sport-specific movement pattern, player can develops their skill while minimizing injury risk. Implementing functional training require consideration concerning individual need plus focus upon skill transfer for real-game situation. Therefore, whether for beginner or professional athlete, functional training should is essential component concerning basketball training program.

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