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SPECIAL ISSUE ARTICLE

The Effect of Skill Exercises Using Equipment on Some Functional Abilities and Learning the Handstand in Artistic Gymnastics for Students

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Abstract

This research aims to determine the effect of skill exercises using equipment on some functional abilities and skill performance, specifically the handstand skill in artistic gymnastics for students at the College of Physical Education and Sports Sciences, University of Diyala. The study also aimed to determine the effect of skill-based exercises using equipment on certain functional variables within the research sample. The researcher hypothesized that skill-based exercises using equipment have a statistically significant impact on some anaerobic functional abilities in learning the handstand gymnastics skill for students. The research population and sample consisted of (12) students representing the college's team, with the research sample limited to (9) of them. The researcher used the experimental method, as it was suitable for the nature of the research. Functional tests of the students' body systems and handstand gymnastics skills were used. The training sessions were conducted over two months, with three training sessions per week. By obtaining the research data through statistical analysis, the study concluded that the calculated t-value (6.821) was higher than the tabulated values (2.87), indicating statistically significant differences. The study concluded that there is an effective impact of equipment-based exercises on the students' anaerobic functional abilities and heart rate after physical exertion, and directly on the development of functional and physical abilities related to the handstand skill. These tools increase speed-strength in the arm and shoulder muscles, enhance dynamic balance, and improve neuromuscular coordination. They also help prepare the body to cope with a high center of gravity. The study recommended that using assistive exercises leads to improved physical abilities, increased ability to maintain balance in handstands, and better control of equilibrium through functional strength of the working muscles, and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education).

Keywords: Skill exercises with equipment, Functional abilities, Handstand skill

1. Introduction

Gymnastics is a sport that requires a high degree of physical fitness, motor skills, and extensive training. It can be practiced by men, women, and children of all ages. There are several forms of gymnastics to choose from, including artistic, rhythmic, jumping, floor, and aerial gymnastics, among others. This sport can be practiced simply for enjoyment and to reap its numerous benefits, or to participate in the competitive events held annually. It is essential to learn and adhere to all the rules. Gymnastics is an enjoyable physical activity that forms the basis

for almost all sports. It teaches participants how to move, jump, twist, swing, and perform other flexible body movements. This sport uniquely contributes to improving overall physical fitness, coordination, strength, balance, agility, and speed. It can be practiced by people of all ages [Alcock et al. \(2024\)](#). Most sports clubs now include gymnastics, practiced either as a competitive sport or to improve strength and flexibility. The handstand, which involves supporting the body in an inverted vertical position by balancing on the hands, requires upper body strength and good balance. This skill is used in sports such as gymnastics and yoga, and includes Students. Strengthening

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the shoulder, core, and arm muscles. This can be learned gradually through wall-supported exercises such as wall walking to build the strength and control needed to transition to free standing. Andersson, H. Å., and Randers, M. B. argue that equipment training enhances specific muscle strength in the shoulders, arms, and upper back—the muscles responsible for supporting the entire body weight in inversions—improving balance and increasing neuromuscular coordination, thus ensuring better equilibrium and more precise body alignment. Ishida et al. (2022) indicate that skills should be practiced in various ways to align with optimal performance. This depends on rapidly changing the rhythm of nerve signals transmitted to the muscles, effectively engaging the nerve centers. Equipment training strengthens the abdominal and back muscles, preventing curvature of the spine and maintaining a straight posture. Parpa and Michaelides (2025) further emphasize the importance of equipment training in gymnastics, highlighting its significant impact on the body's physiological variables. It helps increase muscle strength and flexibility, improves balance and coordination, and enhances cardiovascular performance. The vascular and respiratory systems are enhanced, contributing to improved gymnastic performance. Equipment helps guide movements and ensure their correct execution, especially for beginners. It also provides a safety element during training and raises the heart rate, strengthening the cardiovascular and respiratory systems. This is essential for overall fitness and the ability to withstand strenuous physical exertion in gymnastics. Exercises increase oxygen transport efficiency, requiring the heart and lungs to work more efficiently to meet the body's oxygen needs Charlton et al. (2022). The research problem lies in the effect of equipment exercises on physiological variables in gymnastics. Exercises using equipment in gymnastics effectively contribute to the development of specific functional and physical abilities, such as explosive power, strength endurance, and neuromuscular coordination. These exercises enhance flexibility, balance, and working muscle strength, improving motor skill performance. This leads to physiological adaptations that are reflected in the functional efficiency of internal body systems, which in turn directly impacts the skill performance level of the handstand in gymnastics. This was observed during the researcher's monitoring of the training sessions. The instructor noted a lack of attention to functional abilities and their impact on learning the handstand skill. The research objectives are:

1. To develop skill exercises using equipment for the handstand in gymnastics for students.

2. To identify some values of functional variables among the research sample at the College of Physical Education and Sports Sciences, University of Bilad Al-Rafidain.
3. To determine the effect of skill exercises using equipment on some functional variables among the research sample.

The research hypothesis is that there are statistically significant differences between skill exercises using equipment and some anaerobic lactic functional abilities and learning the handstand in gymnastics among the research sample of students at the College of Physical Education and Sports Sciences, University of Bilad Al-Rafidain, in the college's halls and fields from February 3, 2026, to March 3, 2026.

The research terms are:

1. Physiological Functional Abilities: Physiological functional abilities refer to the body's ability to perform its vital functions such as movement, breathing, digestion, and thinking. These abilities depend on diverse biological and chemical processes occurring within living cells and organs. They are influenced by multiple factors such as age, physical fitness, exercise, and environmental factors, and are essential for the body's health and its ability to adapt to life's demands. Karwowska and Kononiuk (2020)
2. Handstand Skill: The student begins by placing their hands slightly wider than shoulder-width apart, then sweeps their legs up while forcefully pushing off the ground with their hands to extend their arms. They tighten their core and gluteal muscles to maintain a straight posture, then focus their gaze on the ground between their hands to aid balance.

2. Research procedures

2.1. Methodology used

The researcher used the single-group experimental method, given its suitability to the nature of the problem. The experimental method is considered one of the most precise, effective, and appropriate methods for obtaining accurate and reliable results, as it deals with influencing phenomena and their causes (Abdul Haq et al., 2012).

2.2. Research population and sample

The research population consisted of all students of the College of Physical Education and Sports Sciences at the University of Bilad Al-Rafidain for the academic year 2025–2026, totaling (100) students. The sample

Table 1. Shows that the skewness coefficient values are less than ± 3 , indicating a homogeneous sample.

Variables			Skewness Coefficient
: Height	186.11 cm	30.40 cm	1.82
Weight	76 kg	5.83 kg	2.67
, Age	21.77	0.97 kg	1.45

was selected purposively from the artistic gymnastics team of the College of Physical Education and Sports Sciences at the University of Bilad Al-Rafidain, totaling (12) students.

The research sample is defined as the part representing the original population or model upon which the researcher's work is based (Abdul Hamid, 2000). Nine students were selected from a total of twelve, representing 75% of the sample.

2.3. Sample homogeneity

Table 1 shows the sample homogeneity in terms of height, weight, and age.

2.4. Data collection methods and tools used in the research

Arabic and Foreign Sources, Testing and Measurement, Medical Scale for Mass Measurement, Heart Rate Monitor, Manual Calculator 6- Stopwatch, Wooden box 40cm high, Gymnastics hall, Metal measuring tape, Adhesive tape 5cm wide.

2.5. Tests used in the research

2.5.1. Functional (physiological) tests

1- 60-second step test (Muhammad Nasr al-Din Radwan, 1998, p. 162).

- 1- Test objective: To measure anaerobic lactic functional capacity
- 2- Equipment: Step bench or box (40cm high), stopwatch, medical scale
- 3- Procedures: Weighing the participant before the performance.
 - Calculating the length of the steps performed.
 - Calculating the total time.
 - Calculating the score using the following formula: (Number of steps per minute * Height of the stepper in meters (0.4) * (Body weight in kg) = Effort exerted).

2- Measuring the pulse rate immediately after the effort:

The pulse is measured immediately after the effort for (60 seconds) using an electronic device designed to measure the pulse rate.

2.6. Skill tests

2.6.1. Handstand gymnastics tests

Method of evaluating the skill performance: The score for the technical skill performance under study was divided by a panel of (5) accredited gymnastics instructors from the College of Physical Education and Sports Sciences, University of Mesopotamia. The evaluation was conducted according to the judging rules. The highest score was discarded, and the arithmetic mean of the remaining scores was taken and divided by the number of judges after the discards.

2.7. Pilot test

The pilot test was conducted on Saturday. On March 15, 2025, a study was conducted with (5) students from outside the research sample. The objectives of this experiment were to determine the following:

1. To identify obstacles that might accompany the testing process in order to overcome them.
2. To determine the time required to conduct the tests.
3. To assess the suitability of the equipment and tools used in the research.
4. To evaluate the efficiency of the support team and their understanding of the tests.

2.8. Skill exercises with equipment for the handstand in gymnastics

The researcher implemented skill exercises with gymnastics equipment for the students to assess their impact. This involved demonstrating the handstand skill through explanation and model performance by the instructor or the course teacher. The students observed the model using a computer, monitoring its accuracy and ensuring correct execution or the teacher's application. The study focused on understanding the technical points (body alignment, leg extension, body extension using arms, and maintaining balance and a straight handstand) for the research group during the practical gymnastics lesson on the skill, with three sessions per week for two months.

2.9. Post-tests

The following tests were conducted Post-tests of the research group, conducted by the researcher, assessed the handstand gymnastics skill used in the research on a sample of first-year students on Wednesday,

Table 2. Shows the arithmetic means and standard deviations for the functional and skill tests of the research sample.

Physiological and Skill Variables	Unit of Measurement	Arithmetic Mean	Standard Deviation
Anaerobic Functional Capacity	(seconds)	954	13.54
Heart Rate	(beats/minute)	80.0	68.0
Handstand Gymnastics	Skill Score	5.800	1.398

Table 3. Shows the values of the arithmetic means, standard deviations, calculated t-value, and significance of differences for the research sample.

Skills	Unit of Measurement	Tests		S P	S P	Sig	Calculated (t)	Significance of Difference
		S -	+ S					
Anoxygenetic Lactic Functional	sec	954	13.54	2.700	1.201	0.001	6.821	Significant
Pulse Rate After Exertion	bpm	80.0	68.0			0.000		
Handstandskill in Gymnastics	Score	5.800	1.398			0.000		

February 25, 2025, in the gymnastics hall at the College of Physical Education, Al-Rafidain University. The sample consisted of nine (9) students, and data were collected for statistical analysis.

2.10. Statistical methods

The researcher used the Statistical Package for the Social Sciences (SPSS) to process the data.

2.10.1. Presentation, analysis, and discussion of results

1- Function To identify the functional tests of the research sample, the arithmetic mean and standard deviation were calculated for each test for the purpose of analysis.

From Table 2, it is clear that the anaerobic functional capacity of the research sample achieved an arithmetic mean of (954) and a standard deviation of (13.54), and the heart rate after exertion achieved an arithmetic mean of (80.0) and a standard deviation of (3.52). This indicates that the handstand gymnastics skill of the research sample achieved an arithmetic mean of (5.800) and a standard deviation of (1.39).

2- Arithmetic Means for the Skill and Functional Abilities Tests of the Research Sample

Significant at a significance level of (0.05) and a tabulated value of (2.87).

We note from Table 3 that the significance of the arithmetic mean for the functional abilities test (954) and the standard deviation (13.54) and the students' handstand skill in gymnastics. The arithmetic mean was (5.800) and the standard deviation was (1.398) and the significance of the differences for the arithmetic means was (2.700) and also the significance of the differences for the standard deviations was (1.201) and the calculated value (6.821) compared to the tabulated value (2.87) is greater than the calculated value and this indicates the significance of the tests and

it has a positive effect on the students' anaerobic functional abilities on the handstand skill in artistic gymnastics. Through the table above, all variables showed statistical differences at the significance level of (0.05) and high values of (t) with a low (0.001sig =) which indicates the strength of the effect of the applied exercises. Also, the results of the (t) test for the samples associated with the variables of functional abilities of the body showed statistically significant differences at the significance level of (0.05). The t-value for the functional abilities test was 6.821 with a significance level of 0.001, and the t-value for the handstand test was also 6.821 with a significance level of 0.00. This indicates a real effect of the independent variable, equipment exercises, on the two dependent variables: functional abilities and handstand skills in gymnastics. The high t-value, coupled with a low significance level, suggests that the magnitude of the differences between the pre- and post-tests is not random but reflects a real and effective effect resulting from the exercises. This is reinforced by what Hoffman (2002) indicated: that training combining functional movements and resistance develops motor skills, particularly those related to balance and rapid motor response to movement (Logue et al., 2020). Furthermore, achieving statistical significance for each Test for the Research Sample:

3. Perform push-ups and handstands against a wall to strengthen the shoulders.
4. Use a Swiss ball for abdominal and back exercises to ensure proper body alignment (stretching the body as a single unit) and avoid lower back curvature.
5. Increase explosive power in the arms, balance, neuromuscular coordination, and trunk control.
6. Regulate training loads according to energy systems, as this is crucial for developing students' physiological capabilities and physical fitness.
7. Incorporate anaerobic exercises into students' training sessions.

8. Instructors must be aware of the importance of anaerobic exercises in their training sessions, given their specific characteristics and the nature of the handstand in gymnastics.

Author's declaration

Conflicts of interest

None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical-clearance

This manuscript approved by the Scientific Committee of the College of Physical Education and Sports Sciences, University of Bilad Alrafidain, Iraq.

Author's contributions

All contributions to this study were carried out by the researcher **Osama Abdul-Khaliq Kamel**.

All contributions to this study were made by the researcher who conducted the study procedures, collected and organized the data, participated in the implementation of the pilot program, contributed to drafting the report, developed the research idea, designed the study, supervised the research procedures, interpreted the results, reviewed the draft, and finalized it with the assistance of Dr. Walid Attallah, who contributed to the statistical applications, advisory office for languages and translations in Translation.

Facilitating the task

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Roles of each researcher in the research

Researcher: Osama Abdel-Khaleq is responsible for participating in the study procedures, data collection and organization, implementation of the pilot program, contributing to the interpretation of results, and drafting the report.

He is also responsible for developing the theoretical framework for the research idea, designing the study, reviewing the literature, supervising data collection and experimental procedures, interpreting results, reviewing the draft, and final revision.

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This research has not received any external funding.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Appendix (1) Model learning unit

First: Preparatory Section: The task in this section is:

1. Assume the position to perform the handstand skill with arms raised high and angled, then take a suitable step forward with one leg and lean the torso slightly forward.
2. During the handstand, place your hands on the ground with fingers open and pointing outwards to increase the support area and reduce forward pressure. The hands should be slightly angled at the wrists, the distance between them equal to the distance between the shoulders, and a distance of (50-60 cm) from the standing foot. The shoulders should be behind the handstand position.
3. Look at the ground a short distance from the handstand position or look at your hands.

Second: Main section

1. The main task in this section is to maintain a straight torso, arms, and legs throughout the exercise, avoiding angles that could lead to loss of balance and muscle strength.
2. The swinging force of the leading leg and the pushing force of the rising leg should be appropriate for moving the body over the perimeter of the support base. Excessive force causes the body's center of gravity to shift away from the support base, resulting in a forward fall. Insufficient force prevents the body from reaching the support base, causing a backward fall.
3. Maintaining muscle tension in all muscle groups, especially the large hip muscles, back muscles, and abdominal muscles.
4. Stopping (braking) the leg swing the moment the legs reach the support base to maintain balance.
5. Keeping the shoulders above hand level and avoiding forward thrusts. The angle between the arms and torso should be 180 degrees, and the angle between the torso and legs should also be 180 degrees.

Third: Final section

Maintaining body position and balance for a short period, or having the torso assume different positions, or a starting position for a new movement.

Model learning unit

Week 1	Exercises	Time	Repetitions	Rest	Sets	Rest	Notes
		Distance					
	. Wall Exercises Handstand facing the wall (Spider-Man) Stand with your back to the wall, place your hands on the floor, then place one foot on the wall. Support your other foot against the wall and move your hands closer to it until your stomach is flat against the wall. Hold this position, trying to increase the duration of the hold, then slowly lower yourself	2		1.0 min		2 min	
	Exercises Using a Box or Bench Box-Facing Handstand Place your feet on a box or bench. Slide your hands towards the box until your hips are over your hands. This exercise helps improve hip alignment and practice lifting one leg at a time to find balance	2		1.0min		2min	
	Parallel Bar Exercises Bike Pull-Up: Place your hands on the edge of a block or bar, then pull your legs up the block or bar until you are in a bike position over it. If you are on a bar, you will pull your legs to touch the bar.	2		1.0 min		2 min	Increasing Duration: After each exercise, try to gradually increase the duration of the hold to develop the strength and endurance needed for freestanding. Photography: Take a photo of yourself from the side so you can review your form and correct any mistakes.
	Plank on Parallel Bars: From a plank position, lift your feet onto the lower bar. Move your hands in and out while trying to maintain the plank position to perform a handstand	5m*2		30sec		10min	Strengthening muscles Plank exercises using parallel bars are excellent for strengthening the arm and abdominal muscles, and are essential for handstands. After the

تأثير تمرينات مهارية باستخدام الأدوات على بعض القدرات الوظيفية وتعلم الوقوف على اليدين بالجمناستك الفني للطلاب

اسامة عبد الخالق كامل

جامعة ديالى / كلية التربية الاساسية – قسم التربية البدنية وعلوم الرياضة / العراق

ملخص البحث:

يهدف هذا البحث إلى تحديد أثر تمارين المهارات باستخدام المعدات على بعض القدرات الوظيفية وأداء المهارات، وتحديدًا مهارة الوقوف على اليدين في الجمباز الفني، لدى طلاب كلية التربية البدنية وعلوم الرياضة بجامعة ديالى. كما هدفت الدراسة إلى تحديد أثر تمارين المهارات باستخدام المعدات على بعض المتغيرات الوظيفية ضمن عينة البحث. افترض الباحث أن تمارين المهارات باستخدام المعدات لها تأثير ذو دلالة إحصائية على بعض القدرات الوظيفية اللاهوائية في تعلم مهارة الوقوف على اليدين في الجمباز لدى الطلاب. تكون مجتمع البحث وعينته من 12 طالبًا يمثلون فريق الكلية، واقتصرت عينة البحث على 9 منهم. استخدم الباحث المنهج التجريبي لملاءمته لطبيعة البحث. استخدمت اختبارات وظيفية لأجهزة الجسم ومهارات الوقوف على اليدين لدى الطلاب. أجريت الدورات التدريبية على مدار شهرين، بمعدل ثلاث دورات تدريبية أسبوعيًا. من خلال تحليل البيانات البحثية إحصائيًا، خلصت الدراسة إلى أن قيمة t المحسوبة (6.821) كانت أعلى من القيم الجدولية (2.87)، مما يشير إلى وجود فروق ذات دلالة إحصائية. وخلصت الدراسة إلى وجود تأثير فعال للتمارين القائمة على استخدام الأجهزة على القدرات الوظيفية اللاهوائية للطلاب ومعدل ضربات القلب بعد بذل الجهد البدني، وعلى تنمية القدرات الوظيفية والبدنية المتعلقة بمهارة الوقوف على اليدين. تزيد هذه الأدوات من سرعة وقوة عضلات الذراع والكتف، وتعزز التوازن الديناميكي، وتحسن التناسق العصبي العضلي. كما أنها تساعد في تهيئة الجسم للتعامل مع مركز ثقل مرتفع. أوصت الدراسة بأن استخدام التمارين المساعدة يؤدي إلى تحسين القدرات البدنية، وزيادة القدرة على الحفاظ على التوازن في وضعية الوقوف على اليدين، وتحسين التحكم في التوازن من خلال القوة الوظيفية للعضلات العاملة، وهذا يحقق أحد أهداف التنمية المستدامة للأمم المتحدة في العراق، وهو (التعليم الجيد).

الكلمات المفتاحية: تمارين مهارية بالأدوات , القدرات الوظيفية , مهارة الوقوف على اليدين