ZAGAZIG JOURNAL OF SPORTS SCIENCES

VOLUME 1, ISSUE 1, July, 2025, Pp.70-82

ZJSS-2501-1008

Enhancing Footwork and Its Effect on Squash Match Performance

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Abstract:

This research aims to explore the impact of competitive footwork training on match performance among squash players. The experimental method was employed, utilizing a pre-and post-measurement design with experimental and control groups to suit the nature of the study. Participants included young squash players under the age of 15 from squash clubs in Cairo Governorate, all registered with the Egyptian Squash Federation during the 2023/2024 training season. The sample was intentionally selected to represent this population.

The findings revealed that competitive footwork training programs significantly improve players' ability to move efficiently and swiftly on the squash court. These enhancements result in better positioning, improved shot execution, and superior overall game performance. The results align with international research emphasizing the pivotal role of footwork in racket sports.

Furthermore, tailored training programs focusing on footwork were found to enhance critical physical abilities, including agility, reaction speed, muscular strength, flexibility, and balance. These components are integral to developing effective movement patterns in squash, as corroborated by studies in high-performance sports.

The study underscores the importance of implementing scientifically designed footwork training programs for young squash players. Such programs not only meet the physical and technical demands of competitive squash but also contribute to sustainable athletic development and long-term performance consistency.

Keywords: competitive footwork training, Squash, physical abilities.

Introduction and research problem

In squash, the ability to move swiftly and accurately within the confines of a small court is paramount. Despite the limited playing area, the sport demands a level of intensity and variety in movement that surpasses many other racket sports. To perform effectively, players must demonstrate fluidity, agility, and efficiency in their movements, which helps conserve energy throughout a tournament. Furthermore, proper movement is fundamental for attaining the ideal position required for precise stroke execution. Maintaining this positioning ensures balance both before and after striking the ball, enabling players to quickly recover their central court position and sustain tactical control.

Philip Yarrow (2010) emphasized that a player's ability to execute basic strokes proficiently or maintain excellent physical fitness is not enough to guarantee competitive success. Achieving a high degree of expertise in footwork movements is crucial to excel in the competitive arena.

Riham Mahmoud (2008) Inefficient footwork, she pointed out, can cause players to lose vital points in a match, while precise and well-executed movements help them dictate the pace and flow of the game. She also emphasized the critical role of implementing structured footwork training programs as a core component of player development.

According to (Spont Y. Cross (2007), the majority of technical errors in squash, approximately 80%, are linked to deterioration in footwork quality rather than mistakes in shot technique or motor execution. This underscores the fact that achieving precision and

effectiveness in a shot depends on the player being correctly positioned and well-timed to meet the ball.

The research problem can be summarized in two key aspects:

- Random Court Movements: Young squash players often lack knowledge of proper footwork techniques, and there are no scientifically validated programs for developing precise and efficient foot movements. Existing approaches rely more on experience than on evidence-based methods, leading to inconsistencies in player development.
- Deficient Physical Abilities: Young players often lack the specific physical capacities required for effective footwork. This is due to an overemphasis on other aspects of training while neglecting the critical importance of footwork. As a result, players struggle to maintain correct movements throughout a game.

By analyzing matches from the perspectives of both a coach and a referee, the researcher identified several key problems. Players often displayed uncoordinated and ineffective footwork, which hindered their ability to reach the ball quickly and maintain stability. This led to early fatigue and a noticeable decline in performance due to insufficient physical preparation for the demands of movement. Additionally, players frequently made mistakes, such as executing improper returns and failing to follow correct movement techniques, resulting in penalties and lost points.

To address these issues, the researcher proposed designing a scientifically structured training program focused on enhancing footwork efficiency in young athletes and evaluating its impact on their squash performance.

Research objectives:

The research's aims to examine the impact of competitive footwork training on match performance in squash players.

Research hypotheses:

1. Statistically significant differences at the 0.05 level were observed between the pre- and post-measurements of the experimental group in the physical abilities related to footwork and match performance, with the post-measurement showing superior results.
2. There were notable differences between the post-measurements of the experimental and control groups in footwork patterns and match outcomes, favoring the experimental group's post-measurement.

3. A strong correlation was identified between the enhancement of footwork patterns and the improvement in match performance among squash players in the experimental group.

Research procedures:

- **Research method:**

To align with the goals and characteristics of this research, the researchers opted for the experimental method. This approach involved implementing a design that incorporated both pre- and post-assessments for the experimental and control groups.

- **Research people and sample:**

The research population consists of junior squash players under 15 years old from squash clubs in Alexandria Governorate, registered with the Egyptian Squash Federation for the 2023/2024 training season. The researcher selected the study sample through a purposive sampling method, consisting of 5 junior players from Smouha Sporting Club as the experimental group and 5 players from Sporting Sporting Club as the control group. Additionally, a sample of 10 junior players from Al Ahly Sporting Club was included for the exploratory studies. Thus, the total sample size comprises 20 junior players.

- **Homogeneity of the research sample:**

The researcher computed the skewness coefficient in function of arithmetic mean, median and standard deviation of the research sample in variables of growth, tests of physical abilities and footwork movement patterns under investigation as illustrated in Table (1).

Table (1) The study calculated the mean, median, standard deviation, and skewness for age, height, weight, and training experience in the research sample.

Variables	Measuring unit	Ẍ	M	SD	Kurtosis	Skewness coefficient
Age	Year	14.31	14.40	0.33	-0.57	-0.70
Height	cm	166.20	166.50	1.55	0.63	-0.86
Weight	kg	59.90	60.00	2.13	0.07	-0.61
Training age	Year	6.10	6.00	0.74	-0.73	-0.17

Data in Table (2) show that values of skewness coefficients fall between (-0.86 and -0.17) i.e. between (0 and +3) in variables of (age, height, weight, training age) indicating that the research sample individuals in such variables were homogeneous.

- **Survey studies:**
- **First Survey study:**

The study was carried out from December 2 to 6, 2023, to train assistants, identify weaknesses, prevent errors, and determine the time required for tests and measurements.

- **Second Survey study:**

From December 10 to 14, 2023, the researcher calculated the scientific coefficients, including validity and reliability, for the tests, as shown in Tables (2 & 3), covering footwork movement patterns and match results.

- **The validity of tests**

Table (2) Significance of Differences Between Distinguished and Non-Distinguished Groups in the Physical Tests Under Study (n1=n2=10)

Test	Unit of Measurement	Distinguished Group		Non-Distinguished Group		t-value
		SD	Mean	SD	Mean	
First	cm	43.60	1.66	39.10	1.60	3.19*
Second	sec	58.10	1.41	60.65	1.30	2.25*
Third	sec	24.16	1.62	26.10	1.25	3.29*
Fourth	cm	159.71	1.89	155.11	1.72	4.67*
Fifth	sec	1.96	1.19	2.10	1.28	3.79*
Sixth	count	16.05	1.15	14.57	1.10	3.26*
Seventh	sec	74.10	1.32	76.21	1.23	3.39*

Table t-value at 0.05 significance level and 18 degrees of freedom = 1.734

Table (2) demonstrates statistically significant differences in the physical tests under investigation between the distinguished and non-distinguished groups, favoring the distinguished group, which directly indicates the validity of these tests.

Table (3) Stability Coefficient Between First and Second Applications of Footwork Movement Tests in the Pilot Sample N=10

Tests	Unit of Measurement	1st application		2nd application		*r*
		$\bar{x}$	SD	$\bar{x}$	SD	
1st	cm	43.60	1.66	44.10	1.51	0.867*
2nd	Sec.	58.10	1.41	57.65	1.26	0.865*
3rd	Sec.	24.16	1.62	24.10	1.39	0.759*
4th	cm	159.71	1.89	160.11	1.56	0.726*
5th	Sec.	1.96	1.19	1.90	1.14	0.679*
6th	No.	16.05	1.15	16.85	1.10	0.897*
7th	Sec.	74.10	1.32	73.90	2.14	0.967*

Table "r" value at 0.05 significance level and 8 degrees of freedom = 0.632

As seen in Table (3), there is a significant correlation at the 0.05 level (8 degrees of freedom) between the initial and retest scores, confirming the stability of the physical tests.

- **Training Program:**

The training program was structured to progressively increase in intensity, matching the age and fitness levels of the young players. Spanning 8 weeks with 3 sessions per week, each lasting 60 to 95 minutes, it included a 15-minute warm-up and a 5-minute cool-down.

The program combined low and high interval training, with weekly loads alternating between medium and high intensities. Initially, the ratio was 1:2, shifting to 1:3 from week four. Training duration increased progressively: starting at 200 minutes in week one, rising to 240 minutes by week three, and fluctuating between 220–260 minutes through the program, peaking at 260 minutes in week seven, and returning to 220 minutes in week eight.

In total, the training program lasted for 1,855 minutes. Of this, 941 minutes (60%) were dedicated to the physical aspect of footwork movement patterns, 675 minutes (30%) focused on skill development, and 239 minutes (10%) were allocated to improving the planning performance level through both quick and slow interval training methods.

The field application of the research took place on the squash court at Tala'ea El-Geish Sports Club in Nasr City, during the 2023-2024 training season. After selecting the research sample and determining the necessary tests, measurements, and tools, the researchers followed several essential steps to ensure the experiment proceeded in a scientifically accurate and proper manner. These steps were designed to support the successful execution of the research.

- **Pre-measurement:**

The researchers conducted the pre-measurements on the research sample, applying the physical tests under study on Monday, December 18, 2023. Following this, a friendly experimental tournament was held on December 19, 20, and 21, 2023.

- **Implementation of the proposed training program:**

After confirming the homogeneity of the sample, the researchers implemented the training program over a period of two months during both the general and special

preparation phases. The program ran from Saturday, December 23, 2023, to Wednesday, February 14, 2024, covering a total of 8 weeks. The participants underwent three training sessions each week, held on Saturdays, Mondays, and Wednesdays.

- **Post-measurement:**

The post-measurement of the research sample was conducted under the same conditions, instructions, and specifications as the pre-measurement, immediately after the completion of the program application period on Monday, February 19, 2024. A friendly experimental tournament was then held on February 20, 21, and 22, 2024.

Results Presentation and Analysis:

- **Results Overview:**

1- Results for the First Hypothesis:

Table (4) Significance of Differences in Pre- and Post-Measurements of the Experimental Group and Effect Size Using Bilateral Correlation and Eta Squared (Η²) for Footwork Movement Pattern Results N=5

Tests	Negative ranks			Positive ranks			Z		The size of effect	
	No.	Rank x⁻	Total ranks	No.	Rank x⁻	Total ranks			(r prb)	(Η²)
1st	0	0.00	0.00	5	3.00	15.00	2.12	Sig	1.55	0.95
2nd	5	3.00	15.00	0	0.00	0.00	2.06	Sig.	0.80	0.92
3rd	5	3.00	15.00	0	0.00	0.00	2.02	Sig	0.80	0.91
4th	0	0.00	0.00	5	3.00	15.00	2.06	Sig.	1.55	0.92
5th	5	3.00	15.00	0	0.00	0.00	2.06	Sig	0.80	0.92
6th	0	0.00	0.00	5	3.00	15.00	2.03	Sig.	1.55	0.90
7th	5	3.00	15.00	0	0.00	0.00	2.02	Sig	0.80	0.90
Results of games	0	0.00	0.00	5	3.00	15.00	2.12	Sig.	1.55	0.95

Table (4) shows that the computed (Z) value exceeds the tabulated value, indicating a statistically significant result from Wilcoxon's test. The effect size (r prb) ranges from 0.80 to 1.55, indicating a strong to very strong effect, while the Eta squared (Η²) value ranges from 0.90 to 0.95, indicating a large effect size.

2- Results for the Second Hypothesis

Table (5) Significance of Differences in Post-Measurements Between Experimental and Control Groups and Effect Size Using Bilateral Correlation and Eta Squared (Ƞ²) for Footwork Movement Patterns n1=n2=5

Tests	Experimental group		Control group		U	Z		Effect size	
	Rank x⁻	Total ranks	Rank x⁻	Total ranks				(r prb)	(Ƞ²)
1st	7.90	39.50	3.10	15.50	.500	2.52	Sig.	0.96	0.79
2nd	3.60	18.00	7.40	37.00	3.00	2.01	Sig.	0.76	0.63
3rd	3.20	16.00	7.80	39.00	1.00	2.41	Sig.	0.92	0.76
4th	7.60	38.00	3.40	17.00	2.00	2.19	Sig	0.84	0.69
5th	3.00	15.00	8.00	40.00	0.00	2.63	Sig.	1.00	0.83
6th	8.00	40.00	3.00	15.00	0.00	2.68	Sig	1.00	0.85
7th	3.00	15.00	8.00	40.00	0.00	2.67	Sig.	1.00	0.84
Skill	8.00	40.00	3.00	15.00	0.00	2.64	Sig	1.00	0.83

Table (5) shows that the computed (Z) value exceeds the tabulated value (1.96), indicating a significant result from Mann Whitney's test. The effect size (r prb) ranges from 0.76 to 1.00, signifying a strong to very strong effect, while the Eta squared (Ƞ²) ranges from 0.63 to 0.84, indicating a large effect size.

3- Results for the Third Hypothesis

Table (6) Correlation Results and Effect Size (r²) Between Game Outcomes and Footwork Movement Patterns in the Experimental Group n=5

Correlation coefficient (*r*)				Effect size (r^2)
Physical tests		Results of games	Significance	
1st	cm	0.88	Sig.	0.77
2nd	sec.	-0.92	Sig.	0.85
3rd	sec.	-0.89	Sig.	0.79
4th	cm	0.88	Sig	0.78
5th	sec.	-0.94	Sig.	0.88
6th	No.	0.90	Sig	0.81
7th	sec.	-0.95	Sig.	0.90

Tabulated (r) (0.05) = 0.878

Table (6) shows that the computed (r) exceeds the tabulated value at the 0.05 significance level, indicating a significant correlation. The effect size (r²) ranges from 0.77 to 0.90, indicating a large effect.

- **Analysis of Results:**

1-Discussion of results of the First Hypothesis:

According to the first hypothesis, significant differences were expected at the 0.05 level between pre- and post-measurements in footwork abilities and game results, with improvements observed in the post-measurements. Table (4) validates this hypothesis, showing significant differences in both footwork patterns and game outcomes, as confirmed by the Wilcoxon test. The computed (Z) value surpassed the tabulated value, and the effect size ranged from 0.80 to 1.55, indicating a very strong effect. Additionally, the (η^2) value fell between 0.905 and 0.949, reflecting a large effect size. The game performance results were also statistically significant, with an effect size (rprb) of 1.55 and (η^2) of 0.949, further emphasizing the large and strong effect.

The researcher linked the improvement in game results within the experimental group to the enhancement of footwork-specific physical abilities. This progress resulted from the proposed training program, which included targeted exercises to improve flexibility, leg strength, agility, speed endurance, reaction time, and balance. Designed using scientific principles, these exercises closely mimicked squash movements, motivating players to engage emotionally and strive for optimal performance.

These findings are consistent with Mamdouh Mohammed's (2007) study, which showed that a footwork-focused training program improved motor abilities, resulting in better speed and balance on the court, thus enhancing performance. Mohammed emphasized integrating footwork with technical and tactical exercises, noting that successful coaches worldwide recognize its critical role.

The study also aligns with Spont Y. Cros's (2007) research, which found that about 80% of technical faults in squash are due to poor footwork, not shot technique errors. Cros highlighted that precise shots require proper positioning at the right time.

Furthermore, Basem Al-Maligi (2008) stressed the importance of footwork in executing shots, with players relying on it to position themselves effectively, ensuring proper contact with the ball. This reinforces the notion that efficient footwork is key to overall success in squash.

2-Discussion of the Second Hypothesis:

The second hypothesis suggested that significant differences would exist between the post-measurements of the experimental and control groups, with the experimental group showing better results. Table (6) supports this, revealing clear differences in favor of the experimental group in both footwork patterns and game performance.

The enhanced performance of the experimental group is attributed to the scientifically-designed training program. Based on extensive research, the program included targeted exercises to improve physical abilities crucial for footwork, aligning with game-related movements. This strategic approach motivated the players to achieve peak performance.

These results echo the work of Ali Jihad (2014), who highlighted the importance of structured training in conditioning, footwork, and skill development for consistent performance. Similarly, Shawkat Jaber (2005) emphasized that footwork is key to improving players' physical and technical abilities, which directly impacts their performance.

Ultimately, the experimental group's success stemmed from the effective application of the training program, which significantly enhanced both their footwork and overall game results.

3-Discussion of the Third Hypothesis:

The third hypothesis suggested a link between footwork movement pattern development and improved squash game performance in the experimental group. As shown in Table (7), the data confirm a significant correlation between these two factors, highlighting a strong connection between quality footwork and better overall performance in squash.

This correlation is attributed to the intentional development of footwork-specific physical abilities through a scientifically-based approach. The training program included exercises designed to replicate the movement patterns required during actual games, ensuring comprehensive coverage of the court. This focus on footwork directly contributed to the improvement in game results.

These results support the findings of Riham Mahmoud (2008), who emphasized the importance of footwork in squash, particularly the difficulty of moving to the left side of

the court, where errors often lead to lost points. Similarly, Hamdy Aliwa (2010) highlighted the value of training specific footwork-related physical abilities like reaction time, strength, flexibility, and endurance, suggesting that such training enhances a player's ability to control the game and win points.

Overall, the study's results reinforce the significant role footwork development plays in improving performance, especially for young players in squash.

Findings and Recommendations:

- **Findings:**

– Competitive footwork training programs significantly enhance players' ability to move efficiently and quickly on the squash court. This improvement contributes to better positioning, shot execution, and overall game performance, aligning with findings from international studies emphasizing the critical role of footwork in racket sports.

– Tailored training programs focusing on footwork improve specific physical abilities such as agility, reaction speed, muscular strength, flexibility, and balance. These physical components are essential for effective movement patterns in squash, as supported by research in high-performance sports.

– The optimization of footwork movement patterns directly correlates with improved match outcomes. Studies in racket sports consistently show that players with refined movement patterns exhibit better control of the court, superior shot accuracy, and higher endurance throughout matches.

– Effective footwork training reduces the occurrence of technical faults during gameplay. International research highlights that a majority of errors in squash stem from improper positioning rather than deficiencies in stroke technique, emphasizing the importance of precise footwork.

– Implementing scientifically designed footwork training programs for young squash players promotes their athletic development. Such programs prepare players to meet the demands of competitive squash and foster long-term performance consistency.

– Successful footwork training should integrate physical conditioning with skill and tactical exercises. Global best practices in sports training emphasize the synergy between these elements to achieve holistic player development.

- Structured and goal-oriented training programs enhance players' confidence and competitive mindset. Research indicates that players with strong movement capabilities feel more in control during matches, which positively affects their mental resilience and performance.
- Coaches can use these findings to design and implement more effective training regimens that prioritize footwork. This aligns with international methodologies that advocate for movement-focused training as a cornerstone of elite player preparation.

- **Recommendations:**

- Coaches and trainers should prioritize incorporating structured and scientifically designed footwork training into regular practice sessions for squash players to enhance performance and match outcomes.
- Develop and implement age-appropriate footwork training programs, particularly for young players, to build a strong foundation in movement patterns early in their athletic careers.
- Integrate footwork exercises with technical and tactical training to ensure that physical abilities are directly applied to gameplay scenarios, fostering a holistic approach to player development.
- Design exercises that mimic real match situations and court movements to enhance the transfer of training benefits to competitive performance, as emphasized in international research.
- Implement regular assessments of players' physical abilities and movement efficiency to track progress and make data-driven adjustments to training programs.
- Employ motion analysis tools and wearable technology to provide players with feedback on their footwork, enabling precise corrections and fostering continuous improvement.
- Include mental conditioning alongside footwork drills to build players' confidence in their movements, which research shows is crucial for peak performance under pressure.
- Train players to maintain optimal footwork throughout entire matches by focusing on speed endurance and recovery techniques, preventing performance decline due to fatigue.

– Provide squash coaches with access to workshops and certifications that focus on advanced footwork training techniques and the latest scientific findings in racket sports.

– Customize training programs based on the competitive level of players, ensuring that elite athletes receive advanced, high-intensity drills while beginners focus on mastering fundamentals.

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