KMANPUB Health Nexus Vol. 3 No. 2 (2025): 139-144

Article history:
Received 02 January 2025
Revised 01 March 2025
Accepted 07 March 2025
Published online 01 April 2025

The Effect of Prior Learning on Table Tennis Instruction in Young Women with Disabilities in Tehran

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A r t i c l e I n f o

Article type:
Original Research

How to cite this article:
Jalilbal, Z., Taghiyar, P., Soltani, M., & Hasanlo, S. (2025). The Effect of Prior Learning on Table Tennis Instruction in Young Women with Disabilities in Tehran. *Health Nexus, 3*(2), 139-144.
https://doi.org/10.61838/kman.hn.3.2.16

A B S T R A C T

The present study was conducted to examine the effect of prior learning on table tennis instruction in young women with disabilities in the city of Tehran. This research employed a quasi-experimental method with a pretest-posttest design including experimental and control groups. The statistical population consisted of female athletes with physical disabilities from Hazrat Abolfazl Sports Club in District 15 of Tehran in the year 2022. The research sample included 20 participants who were divided into two groups of 10 (experimental and control) using a group homogenization method. The research instrument was a researcher-made checklist on table tennis techniques. Data analysis was conducted using multivariate analysis of covariance (MANCOVA). The findings indicated that there was a statistically significant difference in the scores for forehand push serve, backhand push serve, forehand chop, and backhand chop. A significant difference was observed at the 0.01 error level in the posttest stage between the experimental and control groups. It can be concluded that the prior learning intervention was effective in improving table tennis instruction for young women with disabilities in Tehran.

Keywords: *Prior learning intervention, table tennis, disability.*

1. Introduction

Physical activity is defined as “any bodily movement produced by skeletal muscles that requires energy expenditure” (1). The link between physical activity and health benefits for women—regardless of disability—has been extensively documented (2). Disability is a condition that restricts an individual’s functional capabilities and participation in various activities (3, 4). Despite the proven health advantages of engaging in physical activity, women with physical disabilities often lead sedentary lifestyles (5).

Physical inactivity and sedentary behavior result in deconditioning, particularly among children with physical disabilities, who tend to exhibit reduced levels of cardiorespiratory fitness. This decline leads to a further decrease in physical activity, contributing to physical deterioration and increased difficulty in managing daily life tasks (6). Moreover, physical immobility can contribute to social isolation and depression. Therefore, it is essential to promote increased levels of physical activity among women with physical impairments. Sports that are enjoyable, engaging, and easily accessible tend to have higher

adherence rates. Table tennis, a globally popular sport with over 300 million participants, meets these criteria (7).

Table tennis requires sophisticated visuospatial perception and motor coordination, including balance control. Research indicates that table tennis players have faster visual reaction times, enhanced executive functioning, and improved visuospatial working memory compared to healthy individuals (8). Furthermore, playing table tennis has been shown to improve motor skills and executive functioning in children with Attention Deficit Hyperactivity Disorder (ADHD) or Autism Spectrum Disorder (ASD), as well as visuospatial perception and executive function in children with mild intellectual disabilities (9). Among older adults, recreational table tennis has been associated with better bone health, improved physical function, increased muscle strength, and positive cognitive outcomes (10).

For physical fitness programs tailored to table tennis players, it is essential to include components such as strength, coordination, and sprint speed, as these factors are directly linked to athletic performance (11). Muscular strength and coordination are especially correlated with a player's rank; those with better strength and coordination tend to execute strokes with greater quality (12). Common movements in table tennis—such as swinging, sprinting, and rotating—require a high level of coordination to integrate various motor elements (13). Thus, comprehensive training programs that incorporate all elements of physical fitness can positively affect table tennis performance (14).

Nevertheless, fitness regimens adopted by table tennis athletes often focus on singular aspects—such as strength or speed—while neglecting comprehensive physical development (15). It is not uncommon to find training programs that emphasize strength and sprinting with little effort to simultaneously enhance coordination or endurance. This points to the need for more efficient training models capable of improving multiple facets of physical fitness in a relatively short time, particularly for professional table tennis players (16). One such emerging method is integrated neuromuscular training, which combines strength, speed, endurance, and balance exercises with standard functional drills (17). This type of training has demonstrated benefits across various sports, including basketball and football, enhancing strength, balance, and speed (18). However, to date, no study has assessed its effectiveness in professional table tennis players who face unique physical demands (19).

A key factor that enhances future performance is variability in training experiences. Theories of motor skill acquisition support the notion that variability improves learning outcomes. In table tennis, consistent and high-quality practice is the foundation of skill development, and one effective approach to enhancing training quality is through contextual interference (20). Contextual interference refers to the phenomenon in which interference during skill acquisition may reduce immediate performance but improves long-term learning, as demonstrated by retention tests.

Despite the promising potential of table tennis as a training modality, to the best of our knowledge, no research has yet examined the impact of table tennis instruction on young women with physical disabilities. The present preliminary study aims to investigate whether prior learning can significantly enhance table tennis instruction in this population in the city of Tehran.

2. Methods and Materials

The present study utilized a quasi-experimental method with a pretest-posttest design including experimental and control groups. The statistical population consisted of female athletes with physical disabilities who were members of Hazrat Abolfazl Sports Club in District 15 of Tehran in 2022. The sample included 20 participants who were divided into two groups of 10 (experimental and control) using a group homogenization method. The inclusion criteria were: age between 25 and 35 years and having one of the following types of disabilities—seated physical-motor disability, standing physical-motor disability, or hearing impairment.

The research procedure involved selecting the participants and designating the testing and training location, which was the Hazrat Abolfazl Sports Club. The experimental group in this study received, over a period of two months and for two hours per week, first incorrect instruction followed by correct instruction on table tennis techniques. These techniques included forehand push serve, backhand push serve, forehand chop, and backhand chop. The control group, in contrast, had no prior training and only received correct instruction in these same four table tennis techniques over the course of two months.

Health Nexus
E-ISSN: 2981-2569

The data collection tool was a researcher-made checklist for table tennis techniques. This checklist was used to qualitatively assess the athletes' performance. The checklist was developed based on consultation and collaboration with table tennis coaches at Hazrat Abolfazl Sports Club. The four fundamental techniques of the sport—forehand push serve, backhand push serve, forehand chop, and backhand chop—were selected and approved for inclusion in the checklist.

Scoring of the exercises was performed on a five-level scale. The lowest level, "very poor," was assigned a score of 1; "poor" received a score of 2; "moderate" was given a score of 3; "good" received a score of 4; and "excellent" received the full score of 5. After scoring the exercises, the scores were categorized for analysis and evaluated using multivariate analysis of covariance (MANCOVA).

3. Findings and Results

Table 1 presents the descriptive statistics of the groups in table tennis skill variables.

Table 1

The Results of Descriptive Statistics

Group	Variable	Stage	N	Mean	Std. Deviation	Min Score	Max Score	Kurtosis	Skewness
Experimental	Forehand Push Serve	Pretest	10	2.30	0.632	1	3	0.132	0.179
		Posttest	10	2.50	0.738	3	5	0.166	-0.734
	Backhand Push Serve	Pretest	10	2.10	0.738	1	3	0.166	-0.734
		Posttest	10	2.30	0.667	3	5	0.001	0.080
	Forehand Chop	Pretest	10	2.20	0.738	1	3	0.166	-0.734
		Posttest	10	1.80	0.738	3	5	0.166	0.734
	Backhand Chop	Pretest	10	2.20	0.738	1	3	0.166	0.734
		Posttest	10	2.30	1.033	2	5	0.272	0.896
Control	Forehand Push Serve	Pretest	10	2.20	0.675	1	3	0.434	0.283
		Posttest	10	4.10	0.527	2	3	0.001	2.571
	Backhand Push Serve	Pretest	10	2.10	0.876	1	3	0.223	1.734
		Posttest	10	4.00	0.675	1	3	0.434	0.283
	Forehand Chop	Pretest	10	1.90	0.632	1	3	0.132	0.179
		Posttest	10	4.10	0.789	1	3	0.407	1.074
	Backhand Chop	Pretest	10	2.10	0.789	1	3	0.407	1.074
		Posttest	10	3.80	0.483	2	3	1.035	1.224

Table 1 shows the descriptive statistics of scores across the table tennis skill variables. It can be observed that the mean score of the experimental group in the forehand push serve variable at the pretest stage was 2.30, while at the posttest stage it increased to 2.50. In the control group, the mean score for forehand push serve at the pretest stage was 2.20, and it significantly increased to 4.10 at the posttest stage. Based on Table 1, it can be concluded that the performance of the components in the posttest stage demonstrated a noticeable improvement compared to the pretest stage.

Table 2

Results of Multivariate Analysis of Covariance (MANCOVA) on Table Tennis Skill Scores

Test Name	Value	F	Significance Level	Eta Squared
Pillai's Trace	0.871	18.596	0.001	0.871
Wilks' Lambda	0.129	18.596	0.001	0.871
Hotelling's Trace	6.762	18.596	0.001	0.871
Roy's Largest Root	6.762	18.596	0.001	0.871

This set of multivariate significance tests (Table 2) determines whether there are statistically significant differences between the groups regarding the linear combination of the dependent variables. There are several

Health Nexus
E-ISSN: 2981-2569

test statistics available, one of the most commonly reported being Wilks' Lambda. The results in the table show that there is a statistically significant difference between the experimental and control groups in terms of the combined dependent variables (table tennis skills), as indicated by Wilks' Lambda = 0.129, $F(1,18) = 18.596$, $p < 0.001$. Since the multivariate test results were significant, it is appropriate to examine the individual variables, as presented in Table 3, which reports the results of univariate ANCOVA for the table tennis skill variables in the experimental group.

Table 3

Results of Univariate Analysis of Covariance for Table Tennis Skill Variables

Source	Variable	Sum of Squares	df	Mean Square	F	Significance	Effect Size
Group	Forehand Push Serve	10.873	1	10.873	24.524	0.001	0.637
	Backhand Push Serve	11.538	1	11.538	24.523	0.001	0.637
	Forehand Chop	24.495	1	24.495	33.179	0.001	0.703
	Backhand Chop	12.630	1	12.630	22.830	0.001	0.620
Error	Forehand Push Serve	6.207	14	0.443			
	Backhand Push Serve	6.587	14	0.470			
	Forehand Chop	10.336	14	0.738			
	Backhand Chop	7.745	14	0.553			
Total	Forehand Push Serve	238.000	20				
	Backhand Push Serve	221.000	20				
	Forehand Chop	211.000	20				
	Backhand Chop	209.000	20				

As shown in Table 3, when the dependent variables were examined individually, the F values for forehand push serve, backhand push serve, forehand chop, and backhand chop indicated statistically significant differences. These differences were significant at the 0.01 level of error in the posttest stage between the experimental and control groups. Therefore, it can be concluded that prior learning had a significant effect on table tennis instruction in young women with disabilities in Tehran.

4. Discussion and Conclusion

The present study was conducted with the aim of examining the effect of prior learning on table tennis instruction in young women with disabilities in the city of Tehran. The findings revealed a statistically significant difference between the experimental and control groups in the posttest phase. The control group, which received two months of correct instruction, scored higher compared to the experimental group, which first received two months of incorrect instruction followed by two months of correct table tennis training. These results indicate that prior learning played a significant role in table tennis instruction for young women with disabilities in Tehran.

This finding can be interpreted as evidence that incorrect instruction at the beginning of training may negatively impact subsequent learning and hinder the acquisition of correct techniques. Overall, the women with physical disabilities in this study demonstrated that their prior learning affected their table tennis training outcomes. It diminished their awareness of adaptive sports and the benefits of learning, and did not foster motivation or enthusiasm to participate in sport. This finding is inconsistent with prior studies, such as Coates (2016), which affirmed that sport activities and instruction have a positive impact on increasing physical activity participation and improving disability awareness in children with disabilities (21).

We also aimed to influence some of the behavioral beliefs held by participants regarding physical activity—such as awareness of the benefits of regular exercise and sport activities specifically designed for individuals with disabilities—in order to enhance their mastery of the four table tennis skills. However, within the two-month period, women with disabilities were unable to fully acquire the targeted skills (22).

Prior learning in table tennis instruction for individuals with physical disabilities is considered an emerging instructional method that integrates various components of education. Depending on the specific goal, a prior learning protocol for table tennis may include strength training,

Health Nexus
E-ISSN: 2981-2569

agility drills, dynamic balance, and coordination exercises tailored to individuals with motor impairments. Compared to traditional training methods—which often focus on one or a few limited aspects of physical fitness—prior learning-based table tennis training incorporates key exercise elements while simultaneously emphasizing dynamic balance, coordination, and proprioception.

However, when incorrect instruction is delivered to individuals with disabilities, the process of correcting these embedded mental patterns takes a significantly longer time due to motor impairments and a slower learning curve. Considerable effort must be invested to overwrite incorrect patterns and replace them with accurate training experiences (23).

It appears that prior learning interference occurs when there is similarity between the target skill and intervening activities. This similarity is likely dependent on comparable contexts and conditions. Most previous studies using prior learning in table tennis instruction have focused on young or non-professional athletes. In contrast, the present study sought to assess the effectiveness of prior learning-based instruction in women with physical, motor, and hearing impairments.

Given the results and the fact that the research hypotheses were confirmed, the findings are promising. Despite the low baseline physical fitness levels among the participants, the designed prior learning protocol in table tennis instruction led to a noticeable improvement in learning outcomes for women with disabilities. Our study confirms that prior learning in table tennis instruction can also be useful for training even elite professional athletes.

Nevertheless, how improvements in physical fitness resulting from prior learning in table tennis translate into athletic or occupational performance remains unknown and warrants further investigation (24).

There are limitations associated with this study. First, it is well established that upper limb musculature is essential for racket sports such as tennis and table tennis. Therefore, information on how the training intervention may have influenced upper limb strength and muscular power would be informative for those engaged in such sports. The absence of specific measurements to assess the effects of prior learning on the upper limbs is one of the limitations of the present study and should be addressed in future research.

Additionally, the present study did not assess whether prior learning could be used as a preventive strategy against injury, nor did it evaluate whether the benefits of prior learning might translate into improved long-term health outcomes in athletes. Longitudinal studies with these specific objectives are needed.

Authors' Contributions

All authors equally contribute to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki. Ethical considerations included obtaining informed consent, ensuring confidentiality and anonymity, and avoiding any harm to participants.

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Health Nexus
E-ISSN: 2981-2569

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Health Nexus
E-ISSN: 2981-2569