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POLISH JOURNAL OF PHYSIOTHERAPY

OFICJALNE PISMO POLSKIEGO TOWARZYSTWA FIZJOTERAPII

THE OFFICIAL JOURNAL OF THE POLISH SOCIETY OF PHYSIOTHERAPY

NR 1/2024 (24) KWARTALNIK ISSN 1642-0136

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Innovative circuit training for children 10-12 years old to improve forehand and backhand drive skills

Innowacyjny trening obwodowy dla dzieci w wieku 10-12 lat mający na celu poprawę umiejętności forehandu i backhandu

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Abstract

Mastery of forehand and backhand drive skills is crucial for the foundational development of table tennis athletes. This study aims to introduce an engaging training methodology for children aged 10-12 to enhance their table tennis abilities. Utilizing a mixed-methods approach, data were collected through the Delphi technique and repeated measures. Participants included three academic experts, four professional table tennis coaches, and nine young table tennis players. The research employed a questionnaire featuring a rating scale from one to four (very relevant, relevant, somewhat relevant, not relevant) for content validity and a one to three scale for assessing the practicality of the instruments. Data analysis was conducted using Aiken's formula.

Results. The innovation in training methodology using the circuit approach to enhance beginner-level forehand and backhand drives in table tennis demonstrated significant effectiveness. The first aspect, alignment of the training concept with objectives, received a validation score of $V = 0.952$. Similarly, the training movements' relevance to objectives and the modifications introduced both scored $V = 0.952$. The suitability of the training procedures received a slightly lower score of $V = 0.857$. A practicality assessment of all components yielded scores exceeding 80%.

Conclusion. The circuit training methodology designed for children aged 10-12 significantly improves forehand and backhand drive skills, demonstrating high content validity and practicality. Consequently, this study's findings endorse the circuit training approach as an effective means to enhance table tennis skills among young athletes.

Keywords

circuit training, forehand drive, backhand drive, table tennis, children

Streszczenie

Opanowanie umiejętności forehandu i backhandu jest kluczowe dla podstawowego rozwoju młodych tenisistów stołowych. Niniejsze badanie ma na celu wprowadzenie atrakcyjnej metodyki treningowej dla dzieci w wieku 10-12 lat, mającej na celu poprawę ich zdolności tenisowych. Wykorzystując podejście mieszane, dane zostały zebrane za pomocą techniki Delphi oraz powtarzalnych pomiarów. Uczestnikami badania byli trzej eksperci akademicki, czterech profesjonalnych trenerów tenisa stołowego oraz dziewięciu młodych graczy w tenisa stołowego. Badanie wykorzystało kwestionariusz z czterostopniową skalą ocen (bardzo istotne, istotne, umiarkowanie istotne, nieistotne) dla walidacji treści oraz skalę od jednego do trzech do oceny praktyczności narzędzi. Analizę danych przeprowadzono, korzystając z formuły Aikena.

Wyniki. Innowacja w metodologii treningowej, wykorzystująca podejście obwodowe do poprawy umiejętności forehandu i backhandu na poziomie początkującym w tenisie stołowym, wykazała znaczącą skuteczność. Pierwszy aspekt, zgodność koncepcji treningowej z celami, otrzymał wynik walidacji $V = 0.952$. Podobnie, trafność ruchów treningowych do celów oraz wprowadzone modyfikacje również uzyskały wynik $V = 0.952$. Zgodność procedur treningowych otrzymała nieco niższy wynik $V = 0.857$. Ocena praktyczności wszystkich komponentów przyniosła wyniki przekraczające 80%.

Wnioski. Metodologia treningu obwodowego zaprojektowana dla dzieci w wieku 10-12 lat znacząco poprawia umiejętności forehandu i backhandu, wykazując wysoką walidację treści i praktyczność. W konsekwencji, wyniki tego badania popierają podejście treningu obwodowego jako skutecznego środka do poprawy umiejętności tenisa stołowego wśród młodych sportowców.

Słowa kluczowe

trening obwodowy, forehand, backhand, tenis stołowy, dzieci

Introduction

Achievement coaching is a long process that requires effective and efficient training methods to create a structured program [1]. Childhood is a critical period for preparing achievement coaching programs, aligning with the principles of multilateral development [2]. The development of an accurate training program for early age group children can be a tool to find potential athletes [3]. The coaching process is gradual, requiring time, systematization, and sustainability. As Faber et al., [4] said the development of elite young table tennis players is a complex and multidimensional stage. Table tennis is considered a sport that requires coaching for young athletes (< 10 years old) to reach their best potential [5]. Therefore, the development of training programs in early childhood requires more attention. As explained by Myer et al., [6] without proper calculation the risk of injury is greater at this age. So far adjustments such as volume and frequency have been taken into consideration in the early specialization stages of individual sports such as skating, gymnastics, tennis, and table tennis [7]. Many studies have tried to develop training programs for early-age athletes in table tennis. However, it is not yet known whether the training program carried out has been adjusted to the characteristics of the sport, whether the methods used have considered the age classification of athletes, and whether the program has clear development goals, between technical and tactical.

Previous studies have already explored the concept of designing and planning exercise programs for children [8]. Children's training should primarily focus on recognizing and mastering the fundamental technical skills of a sport to develop overall physical abilities [9]. The training program should have a game concept and be done in a fun way and avoid the specialization stage, this stage is intended for elite athletes [10], [11], because training for elite athletes will impact the growth, development of the child's body, and the risk of injury [10].

Some previous studies explain the importance of play methods for children, model games can explore both qualitatively and quantitatively, the design designed by the coach encourages children to have positive social interactions, have a sense of community, to foster a sense of brotherhood, and positive interactions for children [12]. Games have a meaning that can cultivate conscious and responsible attitudes, have significant pedagogical strengths, games also develop moral traits such as line discipline, fairness and patience [13]. The game-based training model contributes to overall development, and the competitive nature of the game encourages children to realize their full capabilities [14]. As also explained by Myer et al., [6] during the formation of early athletes it is necessary to conduct a needs analysis on early specialization between physiological and biomechanical demands, training programs are holistic, and provide opportunities for children to explore movements that are rarely performed.

The explanation of the basic concepts of training children is a reference for researchers to explore the potential problems in it also the problem is that the ability of forehand drive techniques is still in the low category, following data on several studies that the effectiveness of hitting techniques for male

athletes is 18% and women 13%. Analysis data found statistically the need for forehand drive during the game has a percentage of forehand spin 54.792%, and other techniques such as backhand chop 20.979%, backhand block 13.200%, flick 9.041%, and smash 0.904% [15]. It can be interpreted that the need for forehand drive and backhand drive in the game is greater. The maturity of basic skills such as forehand drive and backhand drive reflects the full potential in the development of table tennis athletes toward the elite level. Full study and identification in the problem of developing an effective and efficient training program for the basic skills of forehand drive and backhand drive is a challenge. Especially in the early age stage to achieve good development, the training program takes into account the psychological field [16]. In recent years many training concepts for young athletes have been developed, such as the German and Dutch table tennis associations that have developed perceptual-motor items for young athletes (7-10) [17]. It is based on the child's world that the development of technical skills and tactical strategies is adapted to perception with active movements that are fun but in accordance with the characteristics of the game. So far, the closest to these needs is the circuit training method [18] where physical, technical, and tactical requirements can be manipulated with adjustments to the characteristics of the sport.

Based on the background of these problems, researchers tried to develop a training model in the form of circuit games to train forehand drive and backhand drive techniques. The circuit game form of training was chosen to avoid any negative impacts on children while engaging in the activity. In addition, complex motor tasks such as agility, motor coordination, concentration, and balance found in table tennis can be combined with circuit training methods [19]. Also said by Strelnikowa & Polevoy [20] Performing repetitive movements over many different types of exercises stimulates the automatization of technical movements. Thus, this approach can serve as a foundation for addressing specific needs, including those in early childhood. Therefore, this study aims to develop a circuit training program for children aged 10-12 years to improve forehand drive and backhand drive skills.

Research methods

The research design used in this study is a mixed-method approach combining qualitative and quantitative methods. There are five stages in this research, as follows: The first stage is a qualitative approach with a literature study method of articles, journals, and textbooks [21]. The second stage is to test the content validity of the exercise types to improve existing table tennis skills, to develop conceptual and operational definitions of exercise types to improve forehand and backhand drives of novice table tennis athletes. The third stage involves testing the content validity of the exercise type, collecting data using the Delphi technique [22]–[24]. In the Delphi technique, experts do not meet in person but provide their judgments remotely to assess the design of innovative exercise types, gradually and repetitively refining opinions on a particular matter [25]. The third stage continued with qualitative analysis, namely input from expert judgment, then the results were analyzed for revision until the exercise type was accepted without further im-

provement [26] by giving a score. The fourth stage of statistical analysis The data analysis technique used in this research is quantitative analysis. Quantitative data were analyzed using the Aiken formulation. The Vaiken value range is 0 to 1. The

V value is in the medium category, if the V value > 0.8 is in the high category [27]. The fifth stage is to test the practicality of the training innovation. Here is the Aiken V formula as shown in Figure 1.

$$V = \frac{\sum(r_i - l_o)}{n(c-1)}$$

$S = r - l_o$
 L_o = lowest rating score
 C = highest rating score
 R = number given by rater

Figure 1. Rumus Aiken V

Results

The results of the Literature Review of Training Types to

Improve Athletes' Skill Abilities found research results that are worthy of research as shown in Table 1 below.

Table 1. Characteristics of articles

Author	Title	Method	Result
J. López, L.Coy, J.Caviativa, Y.Guzman, A.Gutierrez [28]	The Video Game As Practice For Developing Virtual Reality Sports Jumping Skills in Children 5 Years. Case Study of Innovative Practices in Educational Institutions of Bogotá, Colombia	Quasi-experimental design with pre-test, post-test, and a control group	The study found that the motivation generated by sports training, after incorporating the use of virtual reality video games with repetition exercises with body lengthening and elongation movements, influenced locomotor jumping patterns in 5-year-old children. This allows the expansion of the capacity of sports training as part of the body building and sports process in state educational institutions.
Widha Srianto, Siswantoyo, Rumpis Agus Sudarko, Muhammad Wahyu Arga, Yuyun Farida, Susanto [8]	Circuit game development mawashigeri based on CGFU-PM 515 for children aged 10-12 years in karate sports	The research design used in this research is research and development (RnD)	In this study it was concluded that the product in the form of a mawashigeri circuit game model based on CGFU PM 515 for children aged 10-12 years in karate sports had a high level of validation and practicality value with a very practical category. The developed product consists of 5 stations, namely station 1 for lightning kicks, station 2 for alying bottles, station 3 for crossing mountains, station 4 for delivering boxes, station 5 for alying cones.
Muhammad Ishak, Moch. Asmawi, James Tangkudung, Firmasyah Dlis, Sahabuddin [29]	Smash Training Model in Badminton Game in College Students of the Faculty of Sports Science, Makassar State University	The research design used in this research is research and development (RnD)	Based on the results of the development it can be concluded that: (1) Smash training models for badminton games for beginners can be developed and applied in practice, and (2) The smash training model in badminton games for beginners has been developed, obtained data on the effectiveness and results of the development of smash training models in beginner badminton games.

From the results of the literature review analysis, the definition of forehand drive and backhand drive skills for beginner table tennis athletes is obtained. Forehand drive and backhand drive skills are basic skill abilities that are important for beginners in achieving elite players. Forehand drive and backhand drive are very important for athletes because in

mastering skill techniques so that athletes can improve their abilities to peak performance [30]. In addition, a type of training with the circuit method has been produced to improve the forehand drive and backhand drive skills of novice table tennis athletes. The type of exercise with the circuit method can be seen in table 2.

Table 1. Characteristics of articles

Exercise type	Exercise type description	Exercise type objective
Hitting the balloon with the blade	Children bounce a balloon using a blade with a forehand surface.	The purpose of this type of exercise is that when hitting the balloon using the forehand surface, the child aims to feel the forehand hitting.
	Children bounce a balloon using a blade with a backhand surface.	The purpose of this type of exercise is that when hitting the balloon using the backhand surface, the child aims to feel in hitting the backhand.
Hitting the balloon with friends	Children bounce a balloon using a blade with a forehand/backhand surface with a friend without touching the ground.	The purpose of this type of exercise is to hit a balloon with a friend with a forehand/backhand movement so that children can feel each other's forehand and backhand movements when using a balloon.
Hitting the ball over the goal	Children perform movements such as forehand/backhand with friends with the target passing the goal placed on the table.	The purpose of this type of exercise is to foster children's concentration and forehand/backhand movement.
Hitting the ball with a table barrier	Children do forehand/backhand movements to hit the ball after it touches the floor, this movement is done with friends	The purpose of this type of exercise is that the forehand and backhand techniques of children can understand and feel the feeling with friends when doing movements
Hold the ball and carry the balloon	Children move through the obstacle course and hold with the forehand surface and one hand holding the balloon.	The purpose of this type of exercise is to improve children's concentration and coordination, just as a forehand drive requires concentration.
	Children move through the obstacle course and hold with the backhand surface and one hand holding the balloon.	The purpose of this type of exercise is to improve children's concentration and coordination, just as a backhand drive requires concentration.

Table 3. Results of Aiken's analysis

	Score evaluator							Score evaluator							ΣS	V
Aspect 1	4	3	4	4	4	4	4	3	2	3	3	3	3	3	20	0.952
Aspect 2	4	3	4	4	4	4	4	3	2	3	3	3	3	2	20	0.952
Aspect 3	4	3	4	4	4	4	4	3	2	3	3	3	3	3	20	0.952
Aspect 4	4	3	4	3	3	4	4	3	2	3	2	2	3	3	18	0.857

The results showed that all aspects received a V score. The first aspect is the suitability of the concept relevant to the training objectives V = 0.952. The second aspect is the training motion is relevant to the training objectives V = 0.952.

The third aspect of modification is relevant V = 0.952. The fourth aspect of the suitability of the training procedure V = 0.857. The next step was to analyze the practicality of the exercise.

Table 4. Practicality test results

No.	Assessment item	Percentage	Criteria
1	Is the developed product easy to implement	88.8%	Practical
2	Are the exercise materials used in the developed product fun	96.2%	Practical
3	Is the exercise procedure of the developed product clear	96.2%	Practical
4	Whether the developed product has safety value	92.5%	Practical

The results showed that all aspects received scores of 88.8% for ease of implementation, 96.2% for enjoyment of exercise

materials, 96.2% for clarity of exercise procedure, and 92.5% for safety value.

Discussion

This study focuses solely on the game innovation stage, where coaches develop a game model while considering key elements of forehand and backhand drive techniques. The critical point in question is to develop a game model that is adapted to the movement patterns of the forehand and backhand drive techniques. The training model is made with a circuit game model that has 7 game stations. The use of the circuit game model has been effective in enhancing athletes' fitness [31].

After the training model is made, the next step is to test it with a validity test and a practicality test. The results of the quantitative content validity test with the Aiken formula show that all items from seven assessors of the circuit training type design to improve the forehand and backhand drives of novice table tennis athletes show a V value above 0.76. Because the minimum standard of Aiken's V coefficient value for this study is 0.76 [32], then it is said that all aspects are very valid. Therefore, the circuit training type for improving forehand and backhand drives possesses high validity. Content validity is conducted to ascertain whether the content of the training circuit design is appropriate and relevant to the training objectives. Content validity indicates that the content reflects the overall attributes being studied and is usually conducted by experts [27]. An estimate of content validity is obtained by thoroughly and systematically assessing items to determine the extent to which they do and do not reflect the content domain [33].

The practicality test produced index data of $> 80\%$ in the very practical category, namely the circuit game model is easy to do, fun, easy to understand, and can train forehand and backhand drive techniques. Based on the above results, the type of exercise with the circuit method has high validity and good practicality, so it can be used for children aged 10-12 th in practicing to improve forehand and backhand drive skills.

Conclusion

Based on the above of the research results above, the results of this study can be concluded that the innovation of exercise types with circuit methods to improve forehand and backhand drive skills aged 10-12th are as follows: (1) the exercises used have high content validity, and (2) the exercises used have good practicality. In other words, the exercise innovation can be used for coaches to apply in improving the forehand and backhand drive skills of 10-12th age table tennis athletes.

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