EVALUATION OF DIFFICULTY IN WOMEN'S AEROBIC GYMNASTICS COMPETITIONS

AVALIAÇÃO DA DIFICULDADE EM COMPETIÇÕES DE GINÁSTICA AERÓBICA FEMININA

EVALUACIÓN DE LA DIFICULTAD EN COMPETICIONES DE GIMNASIA AERÓBICA FEMENINA

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ABSTRACT

Introduction: Feminine aerobic gymnastics is a highly artistic competition, and analyzing its difficulties is fundamental. Objective: This work analyzes the difficulty of the movements of feminine aerobic gymnastics. This study aims to explore the choreographic characteristics of the difficulty of the movements and evaluate their difficulties. Methods: Several female aerobics athletes are selected as volunteers for the research. The women's aerobic gymnastics video points are classified, grouped, scored, and their actions combined, recorded, and organized. Mathematical statistics are used to analyze the difficulty of aerobics movements. Results: The difficulty factor is the best quantitative scoring criterion to judge the competition results. The highest frequency in Group B was the right-angle split leg combination to support the 720° twist. The highest frequency in Group C was the 180° scissor transformation. The highest frequency in Group D was the unsupported vertical split. The five-person project difficulty score choice tended to be stable and high. Conclusion: The transition types of difficulty action space in the competition of the women's aerobics team are B-C-B, B-C-A, B, A. The difficulty score of the women's aerobics team competition was significantly correlated with the final score. ***Level of evidence II; Therapeutic studies - investigating treatment outcomes.***

Keywords: Gymnastics; Sports; Competitive Behavior; Female; Athletes.

RESUMO

*Introdução: A ginástica aeróbica feminina é uma competição altamente artística e a análise de suas dificuldades é fundamental. Objetivo: Este trabalho analisa a dificuldade dos movimentos da ginástica aeróbica feminina. Este estudo visa explorar as características coreográficas da dificuldade dos movimentos e avaliar as suas dificuldades. Métodos: Várias atletas de aeróbica feminina são selecionadas como voluntárias para a pesquisa. Os pontos de vídeo da ginástica aeróbica feminina são classificados, agrupados, pontuados, tem suas ações combinadas, gravadas e organizadas. São utilizadas estatísticas matemáticas para analisar a dificuldade dos movimentos da aeróbica. Resultados: O fator de dificuldade é o melhor critério de pontuação quantitativa para julgar os resultados da competição. A maior frequência no Grupo B foi a combinação de perna dividida em ângulo reto para suportar o giro de 720°. A mais alta frequência no Grupo C foi a transformação em tesoura de 180°. A mais alta frequência no Grupo D foi a divisão vertical sem suporte. A escolha da pontuação da dificuldade do projeto de cinco pessoas tende a ser estável e alta. Conclusão: Os tipos de transição do espaço de ação de dificuldade na competição da equipe de aeróbica feminina são B-C-B, B-C-A, B, A. A pontuação da dificuldade da competição da equipe de aeróbica feminina foi significativamente correlacionada com a pontuação final. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Ginástica; Esportes; Comportamento competitivo; Feminino; Atletas.*

RESUMEN

*Introducción: La gimnasia aeróbica femenina es una competición altamente artística y el análisis de sus dificultades es fundamental. Objetivo: Este trabajo analiza la dificultad de los movimientos de la gimnasia aeróbica femenina. Este estudio pretende explorar las características coreográficas de la dificultad de los movimientos y evaluar sus dificultades. Métodos: Se seleccionan varias atletas de aeróbic como voluntarias para la investigación. Los puntos de vídeo de la gimnasia aeróbica femenina se clasifican, se agrupan, se puntúan, se combinan sus acciones, se graban y se organizan. Se utilizan estadísticas matemáticas para analizar la dificultad de los movimientos aeróbicos. Resultados: El factor de dificultad es el mejor criterio de puntuación cuantitativa para juzgar los resultados del concurso. La frecuencia más alta en el Grupo B fue la combinación de pierna dividida en ángulo recto para soportar el giro de 720°. La mayor frecuencia en el Grupo C fue la transformación en tijera de 180º. La frecuencia más alta en el Grupo D fue la división vertical sin apoyo. La elección de la puntuación de dificultad del proyecto de cinco personas tendió a ser estable y alta. Conclusión: Los tipos de transición del espacio de acción de dificultad en la competición del equipo de aeróbic femenino son B-C-B, B-C-A, B, A. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Gimnasia; Deportes; Conducta Competitiva; Femenino; Atletas.*

INTRODUCTION

Difficulty moves are the skeleton of a complete set of competitive aerobics movements. It reflects the critical factor of competitive aerobics, the problematic and beautiful characteristics. Its technical level is also the mainstream direction of developing competitive aerobics.[1] Competitive aerobics is judged in three dimensions: difficulty score, completion score, and artistic score. The selection of complicated movements, the quality of completion, and the choreography performance will affect the three points. It is directly related to the final score. There is still a lack of comprehensive and in-depth discussion on the winning factors of complicated moves. It is a new topic that needs to be studied and excavated urgently.

METHOD

Research objects

This paper studies the complex movements of the five-person event in the team competition.[2] This paper records and organizes the ranking, group, score, combination action, and difficulty action space conversion of the top 8 complete sets of complicated movements in the team competition final through video recordings. This provides detailed data support for this study.

Mathematical Statistics

This study used Excel 2003 data processing software to analyze the recorded and organized data.[3] This yields the relevant data needed for the study.

Design of an automatic scoring system for aerobics difficulty based on an action recognition algorithm

The difficulty automatic scoring system belongs to the standard distance measurement method for time series similarity estimation. In this paper, the two symbol sequences are set to be rt_x, rt_y. Their lower bound distances are:

$$E_{lower}(rt_x, rt_y) = \sqrt{\frac{n_a + n_b}{2 \times j}} \sqrt{\sum_{j=1}^{j} \varphi(a_j, b_j)^2} \tag{1}$$

The length of the aerobics action data a, b is n_a, n_b. The dimension of the aerobics action data is j. $\varphi(a_j, b_j)$. It is the Euclidean distance of the j dimension aerobics action data a_j, b_j.

$$\varphi(a_j, b_j) = C_{\max(a_j, b_j)} - C_{\min(a_j, b_j)} \tag{2}$$

$C_{max(aj, bj)}$, $C_{min(aj, bj)}$ is the maximum and minimum values of the breakpoints of the j aerobics movement data a_j, b_j, respectively. Measure similarity of matching a_j, b_j using Euclidean distance

$$E(i, j) = \sqrt{\sum_{j=1}^{j} (a_j - b_j)^2} \tag{3}$$

Aerobics action data points belong to three-dimensional data at each moment. We can choose a matching mode or mode in each dimension according to the relationship between the different dimensions.[4] Aerobics action features are G_a and G_b, G_a respectively. The perception of aerobics movements is more significant. Algorithms Re*liefF* randomly select a sample Z in the aerobics action dataset. The algorithm obtains k nearest neighbor samples in the same type. Then calculate the weight $ZG(\omega_j)$ of the aerobics action feature of the nearest neighbor:

$$ZG(\omega_j) = \omega(G_j) - \sum_{j=1}^{k} \frac{gg(G_j, Z, T_j)}{nk} + \sum \frac{[(q(D)/(1-q(Z)))\sum_{j=1}^{k} gg(G_j, Z, N_j(D))]}{nk} \tag{4}$$

In the formula, $gg(G_j, Z, T_j)$ is the candidate feature function of the j nearest neighbor sampling of aerobics action sample Z. gg is the characteristic function.

There is no need for a code of ethics for this type of study.

RESULTS

Analysis of the final results of the team competition

From Table 1, we know that Team A ranks first in difficulty score. 1st overall score. Team B, C, and D tied for 3rd in difficulty score.[5] The overall score ranking is 2nd, 3rd, and 4th. Team F's difficulty score ranked 2nd. The difficulty is the most quantifiable scoring factor in the judging process of competition results. Complex action is the core factor in winning the game, and it is also a symbol of the athletes' athletic ability. The difficulty score plays a crucial role in the final score of the set.

Analysis of Difficulty Actions in Team Competition

Sorting of Difficult Actions

The top 8 teams in the team competition finals will choose Group D's difficulty at the start and end of the set. The athlete begins with a standing swivel of Group D - a 1080° swivel on one foot. It ended with Group D's flexible-unsupported Yilu Xincheng vertical split. The difficulty of Group C is evenly distributed among the sets. The difficulty of support in Group B is mainly distributed in the first half of the set. The difficulty of group A is mainly in the form of connecting movements. Judging from the difficulty combination selected by the participating teams, the complex combination of Team A and Team C is performed once.[6] Actions are arranged in the first half of the set. Team H difficulty combined action one time. Actions are arranged in the second half of the set; Team B, Team D, Team E, Team F, Team G difficulty combination moves two times. The movements are arranged in the front and back half sets. Team A simultaneously selects two different groups of complex moves in the first half of the set and simultaneously selects two complex moves of the same group but with different fundamental groups in the second half. Team E chose two different sets of difficulty moves simultaneously in the first half of the set. In the first half of the set, Team G chose two complex moves of the same group but with different root groups.

Selection of Difficulty Action Scores

The Difficulty Score is calculated by adding all the Difficulty Action Scores and Connection Bonus points in the set and dividing by a factor. The difficulty coefficient of the collective events participated by male athletes is 2.0, and the difficulty coefficient of collective events participated by female athletes is 1.8. The top 8 teams in the team competition finals should choose between 0.5 and 0.8 points. Difficulty with a score of 0.7 was selected most frequently.[7] The difficulty score of Team A is

Table 1. The top 8 results of the team finals.

Ranking	NO	Difficulty score	Art score	Completion points	Total score
1	Team A	3.833	8.15	8.85	21.833
2	Team B	3.333	8	8.65	21.083
3	Team C	3.333	8.8	8.65	20.883
4	Team D	3.333	8.8	8.35	20.783
5	Team E	2.833	8.85	8.6	20.383
6	Team F	3.5	8.65	8.325	20.375
7	Team G	3.055	8.8	8.35	20.305
8	Team H	3.15	8.85	8.35	20.35

0.321 points higher than the average. The difficulty scores of the 2nd to 8th place sets are slightly different from the average. Its value ranges from 0.154 to 0.179 points. Team A has chosen difficulty with a high score of 1.0. This reflects the super athletic skill level of Team A athletes. This choice enhances the artistic value of the set.

Selection of Difficulty Combination Actions

C+A, supplemented by C+C, will connect the top 8 teams in the finals of the team competition. The highest frequency of C+A is the 360° flexion of the body and the split-leg jump (jump) into a push-up connection to raise the hips and rise into Vincent. Athlete turns one week after completion. The highest frequency of C+C is the scissor transformation jumping body 180°, connecting the turning body 180° bending body jump, and then turning 180° into a push-up. After completion, the athlete rotates for one and a half weeks.[8] The C+A difficulty connection highlights the athlete's upper body strength, and the C+C difficulty connection highlights the athlete's lower body strength.

Arrangement of Difficult Action Space Transformation

In the top 8 sets in the team competition final, Team A's difficulty action space is reasonably used and balanced. One athlete uses B space, and four athletes use B-C-B space. This reflects the diversity and artistry of complicated action choreography. Team B's difficulty action B-C-B space use appears three times in a row, and team C's difficulty action B space and B-C-B space appears two times row. Team E, Team F, Team GB-C-B space, and B-C-A space use appear two times. The above teams reuse the same type of space consecutively.[9] This leads to a single transformation of the difficulty action space and reduces the artistry of the difficulty arrangement. At the same time, there is an imbalance in the space usage of this action.

From Table 2, it can be known that the top 8 sets of difficulty in the finals of the team competition are B-C-B, B-C-A, B, A, A-C-A, and B-A. The complete set's B-A category space for the medium-difficulty actions can be used 0 times. Class B-C-B spaces are used three times. Class B-C-A spaces are used 2 to 3 times. Class A-C-A spaces are used 1 or 2 times. This kind of space difficulty movement mainly reflects the physical quality of the athlete's organic combination of dynamic strength and explosive power. This requires high comprehensive physical fitness and the ability of athletes.

DISCUSSION

The top 8 complete sets of complex movements in the team finals, the most frequent group A is Cheng Wensen, who raises his hips and rises. The highest frequency in Group B is the right-angle split-leg combination to support the swivel 720°. The highest frequency in Group C is the 180° scissor transformation. The highest frequency in Group D

Table 2. The number of action spaces used by the top eight difficulty levels in the team finals.

Ranking	NO.	A	B	A-C-A	B-C-B	B-C-A	B-A
1	Team A	1	3	2	3	2	0
2	Team B	1	2	1	3	3	0
3	Team C	1	2	1	3	3	0
4	Team D	1	2	2	3	3	0
5	Team E	2	2	1	3	3	0
6	Team F	2	2	1	3	3	0
7	Team G	2	2	1	3	2	0
8	Team H	1	2	2	3	2	0

was the vertical split of Yiliuxincheng without support. Coaches should encourage high-level athletes to create sets of complicated combinations of both connection types simultaneously.

Therefore, the coaches should create personalized and innovative difficulty combinations based on the competition rules and the individual characteristics of the athletes. In this way, the ability of the athlete is perfectly displayed. The training and arrangement of complicated movements should reflect the trend of technological development. Coaches need to strengthen the physical fitness training of female aerobics athletes. This can improve the ability of female aerobics athletes to complete complicated movements.

CONCLUSION

For the start and end of the team competition, choose Group D. The difficulty of Group C is evenly distributed among the sets. The difficulty of support in Group B is primarily distributed in the first half of the set. The difficulty of group A is mainly in the form of connecting movements. Difficulty action groups are dominated by C and D, supplemented by A and B. Athletes showed the structural characteristics of 2:1:5:2 according to the four groups of A, B, C, and D. The difficulty combination of the team competition is mainly C+A, supplemented by C+C. The highest frequency of C+A is the 360° flexion of the body and the split-leg jump (jump) into a push-up connection to raise the hips and rise into Vincent. One week after the athlete completes the rotation. The highest frequency of C+C is the scissor transformation jumping body 180°, connecting the turning body 180° bending body jump, and then turning 180° into a push-up. The athlete completes the rotation for 1 1/2 weeks. The type of action space conversion of the difficulty of the team competition is B-C-B, B-C-A, B, A, A-C-A, B-A. Of the top 3 teams, only Team A is used two times in the A-C-A category space.

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REFERENCES

1. De Vries NM, Darweesh SK, Bloem BR. Citius, Fortius, Altius—Understanding Which Components Drive Exercise Benefits in Parkinson Disease. JAMA Neurol. 2021;78(12):1443-5.

2. La Touche R, Fernández Pérez JJ, Martínez García S, Cuenca-Martínez F, López-de-Uralde-Villanueva I, Suso-Martí L. Hypoalgesic effects of aerobic and isometric motor imagery and action observation exercises on asymptomatic participants: a randomized controlled pilot trial. Pain Med. 2020;21(10):2186-99.

3. Nho JH, Kim EJ. Health promoting behaviors in low-income overweight and obese women in Korea: an exploratory qualitative study. Korean J Women Health Nurs. 2021;27(4):348-57.

4. Akgül MŞ, Baydil B. Thyroid hormone responses to acute aerobic exercise. Physical Education of Students. 2021;25(6):359-63.

5. Marlatt KL, Pitynski-Miller DR, Gavin KM, Moreau KL, Melanson EL, Santoro N, et al. Body composition and cardiometabolic health across the menopause transition. Obesity. 2022;30(1):14-27.

6. Lee CF, Lin YH, Chi LK, Lin HM, Huang JP. The Evidence Base in Exercise Knowledge of Pregnant Women: A Latent Class Analysis. Worldviews Evid Based Nurs. 2020;17(6):437-47.

7. Krysiak R, Kowalcze K, Okopień B. The impact of metformin on hypothalamic–pituitary–thyroid axis activity in postmenopausal women with untreated non-autoimmune subclinical hypothyroidism. Clin Exp Pharmacol Physiol. 2021;48(11):1469-76.

8. Amiri-Farahani L, Parvizy S, Mohammadi E, Asadi-Lari M, Taghizadeh Z, Pezaro S. Development, implementation and evaluation of the 'BELIEVE'program for improving physical activity among women: a mixed method action research study. BMC Sports Sci Med Rehabilitation. 2021;13(1):1-13.

9. Schwartz H, Har-Nir I, Wenhoda T, Halperin I. Staying physically active during the COVID-19 quarantine: exploring the feasibility of live, online, group training sessions among older adults. Transl Behav Med. 2021;11(2):314-22.