SYSTEMATIC SKILL PRACTICE IN WOMEN'S FLOOR EXERCISE

PRÁTICA SISTEMÁTICA DE HABILIDADES NO EXERCÍCIO DE SOLO FEMININO

PRÁCTICA SISTEMÁTICA DE HABILIDADES EN EL EJERCICIO DE SUELO FEMENINO

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ABSTRACT

Introduction: Ground exercise is a high-level event of Chinese women's gymnastics. Maintaining the dominant strength of women's floor exercise in China has become one of the issues that coaches, athletes and gymnastics researchers should actively discuss. A research analysis on athletes' competition in the National Games can better reflect and illustrate the fundamental level of athletes and their overall developmental status. Objective: To verify the relationship between women's floor exercise skills and competition performance. Methods: The analysis and study of 65 female athletes participating in floor exercises at the National Games was carried out. In this paper, the on-the-spot statistical method is used to perform statistics on the skills and the athletes' completion in the four games. Movement training and choreography experts were consulted. Results: The performance of women's floor drills in the National Games was discussed from three aspects: the difficulty and arrangement of movements, the initial score and bonus points, and the completion of movements. Conclusion: Most athletes can adapt to the changes in the new rules and master many complex movements. This also gets them a higher score. However, the choreography of the athletes' complete movements is relatively simple and lacks features. Strength training in the lower limbs should be the key to improving the athletes' ability in floor exercise. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Athletes; Gymnastics; Physical Fitness; Athletic Performance.

RESUMO

*Introdução: O exercício no solo é um evento de alto nível da ginástica feminina chinesa. Manter a força dominante do exercício físico feminino na China tornou-se uma das questões que treinadores, atletas e pesquisadores de ginástica devem discutir ativamente. Uma análise de pesquisa sobre a competição dos atletas nos Jogos Nacionais pode refletir e ilustrar melhor o nível fundamental dos atletas e seu status geral de desenvolvimento. Objetivo: Verificar a relação entre as habilidades de exercício do solo feminino e o desempenho na competição. Métodos: Foi efetuada a análise e estudo de 65 atletas femininas que participam de exercícios de solo nos Jogos Nacionais. Neste trabalho, o método estatístico no local é utilizado para realizar estatísticas sobre as habilidades e a conclusão dos atletas nos quatro jogos. Foram consultados especialistas em treino de movimento e coreografia. Resultados: Discutiu-se o desempenho dos exercícios de piso feminino nos Jogos Nacionais a partir de três aspectos: a dificuldade e a disposição dos movimentos, a pontuação inicial e os pontos de bônus, e a conclusão dos movimentos. Conclusão: A maioria dos atletas pode se adaptar às mudanças nas novas regras e dominar muitos movimentos complexos. Isto também obtém uma pontuação mais alta. Entretanto, a coreografia dos movimentos completos dos atletas é relativamente simples e carece de características. O treinamento da força nos membros inferiores deve ser a chave para melhorar a habilidade das atletas no exercício do solo. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Atleta; Ginástica; Aptidão Física; Desempenho Atlético.*

RESUMEN

Introducción: El ejercicio en el suelo es una prueba de alto nivel de la gimnasia femenina china. Mantener la fuerza dominante del ejercicio de suelo femenino en China se ha convertido en una de las cuestiones que entrenadores, atletas e investigadores de la gimnasia deben debatir activamente. Un análisis de la investigación sobre la competición de los atletas en los Juegos Nacionales puede reflejar e ilustrar mejor el nivel fundamental de los atletas y su estado de desarrollo general. Objetivo: Verificar la relación entre las habilidades del ejercicio de suelo de las mujeres y el rendimiento en la competición. Métodos: Se llevó a cabo el análisis y estudio de 65 atletas femeninas que participaron en ejercicios de suelo en los Juegos Nacionales. En este trabajo se utiliza el método estadístico in situ para realizar estadísticas sobre las habilidades y la realización de los atletas en los cuatro partidos. Se consultó a expertos en formación del movimiento y coreografía. Resultados: El rendimiento de los ejercicios de suelo de las mujeres en los Juegos Nacionales se analizó desde tres aspectos: la dificultad y la disposición de los movimientos, la puntuación inicial y los puntos de bonificación, y la finalización de los movimientos. Conclusión: La mayoría de los atletas pueden adaptarse a los cambios de las nuevas reglas y dominar muchos movimientos complejos. Esto también obtiene una

mayor puntuación. Sin embargo, la coreografía de los movimientos completos de los atletas es relativamente simple y carece de características. El entrenamiento de la fuerza en los miembros inferiores debe ser la clave para mejorar la capacidad de los atletas en el ejercicio de suelo. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: *Atletas; Gimnasia; Aptitud Física; Rendimiento Atlético.*

INTRODUCTION

Floor exercise is the strength of Chinese women's gymnastics. Maintaining the dominant strength of women's floor exercise in China has become one of the issues that gymnastics coaches, athletes, and researchers should actively discuss. Gymnastics is one of the critical events of the National Games. The sport is a high-level event. Sixty-five athletes participate in the women's floor exercise in the qualifying competition, accounting for 64.4% of the participants. Twenty-four athletes participated in the team finals. Twenty-two athletes are participating in the individual all-around competition. Eight athletes are participating in the individual finals.[1] The National Games is the largest sporting event in China. Its importance is no less than the Olympic Games for the participating athletes. Therefore, the National Games is also the competition that best reflects the training level of athletes in China. In addition, the new international gymnastics scoring rules were adopted in this competition. The formulation of new rules will pose severe challenges to participating athletes. Therefore, our analysis and research on the athletes' competition in the National Games can best reflect and illustrate the athletes' fundamental level and overall development status.

METHOD

Research objects

This paper analyzes and studies 65 female athletes participating in floor exercises in the National Games.[2] In this paper, the on-the-spot statistical method is used to carry out statistics on the skills and completion of the athletes in the four games. This paper surveyed experts on movement difficulty, movement choreography, and training.

Athlete's aerial tossing and turning attitude control

The human body's air tossing, tilting, and turning movements are movements around the above three coordinate axes.[3] The direction cosine matrix of the outer azimuth angle under the rotational motion with attitude angles φ, θ and ψ is expressed as follows

$$T_{fi} = \begin{bmatrix} c\theta \cdot c\psi & -c\theta \cdot s\psi & s\theta \\ c\varphi \cdot s\psi + s\psi \cdot c\psi & c\varphi \cdot c\psi - s\varphi \cdot s\theta \cdot s\psi & -s\varphi \cdot c\theta \\ s\varphi \cdot s\psi - c\varphi \cdot s\theta \cdot c\psi & s\varphi \cdot c\psi + c\varphi \cdot s\theta \cdot s\psi & c\varphi \cdot c\theta \end{bmatrix} \quad (1)$$

Where $s\varphi = \sin \varphi$, $c\varphi = \cos\varphi$. In this paper, the position quantity x_i in the relative coordinate system can be converted into the position quantity x_f in the reference coordinate system through the above matrix.

$$x_f = x_c + T_{fi}x_i \quad (2)$$

Where x_c is the position of the origin of the relative coordinate system f in the reference coordinate system. The Canadian angle coordinates were used in this study to determine the azimuth angle between the left upper arm and the torso.[4] Its direction cosine matrix is:

$$T_{cu} = \begin{bmatrix} c\beta \cdot c\gamma & -c\beta \cdot s\gamma & s\beta \\ s\alpha \cdot s\beta \cdot c\gamma + c\alpha \cdot s\gamma & -s\alpha \cdot s\beta \cdot s\gamma + c\alpha \cdot c\beta & -s\alpha \cdot c\beta \\ -c\alpha \cdot s\beta \cdot c\gamma + s\alpha \cdot s\gamma & c\alpha \cdot s\beta \cdot s\gamma + s\alpha \cdot c\gamma & c\alpha \cdot c\beta \end{bmatrix} \quad (3)$$

Where α, β and γ are the coordinates of the Cardan angle. The angular velocity of the link in Cardan angle coordinates is:

$$\begin{pmatrix} \omega_x \\ \omega_y \\ \omega_z \end{pmatrix} = \begin{bmatrix} c\beta c\gamma & s\gamma & 0 \\ -c\beta s\gamma & c\gamma & 0 \\ s\beta & 0 & 1 \end{bmatrix} \begin{pmatrix} \dot{\alpha} \\ \dot{\beta} \\ \dot{\gamma} \end{pmatrix} \quad (4)$$

Where $\dot{\alpha}, \dot{\beta}$ and $\dot{\gamma}$ are the angular velocities in Cardan angular coordinates.

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

RESULTS

This article will discuss the performance of women's floor exercises in the National Games from three aspects: the difficulty and arrangement of movements, the starting score and bonus points, and the completion of the movements.

Action Difficulty and Arrangement

The value of a set is in its difficulty. The novelty of the sets is the choreography. Therefore, the difficulty and choreography of the movements are the core of a complete set of movements.[5] This paper firstly made statistics on the movement difficulty and arrangement of the athlete's complete sets of movements (Table 1).

It can be seen from Table 1 that quite a few athletes have mastered the intricate movements in groups C, D, and E. Group D's difficulty movements have the highest number of movements completed by athletes in the four competitions. Followed by the E group of complex moves.[6] The problematic moves in Group E appeared only three times in the four competitions. Because the new rules stipulate that the movements of the floor exercise skill string cannot be repeated, most athletes add the more difficult Group D somersaults in the arrangement of the floor exercise skill string. The content includes a 900° straight backflip, a two-week straight backflip, a quick 900° straight back, and a 360° front turn. From the choreography perspective, there is no novel feature in the structure and choreography of the athletes' complete set of movements.[7] Most athletes mainly use side flips or back jump body type B or C group actions to satisfy a structural group. The choreography of the complete set of actions is rather monotonous.

Onwards scoring and bonus points

The higher the starting score, the higher the athlete's starting point. If an athlete has an advantage in scoring, the chance of defeating an opponent is much greater. The minimum score for gymnastics is 10 points. For an athlete to earn a starting score of 10, he must work on

Table 1. Athletes in 4 kinds of competitions completed the number of complicated movements above group C.

Difficulty group	Qualifying	Team final	All-around final	Single final
Super E	3	3	2	0
Group E	66	25	25	10
Group D	230	107	103	33
Group C	48	18	17	6

the bonus points. The new rules dictate a set of actions or bonus points earned.[8] An athlete can only score 10 points if he has a difficulty bonus of 1.2. This study calculated the starting and final scores of athletes in the National Games qualifying and finals (Tables 2 and 3).

Only nine people can evaluate the whole set of 10 points. It accounted for 13.8% of the total number of participants. Of the 24 people who participated in the team finals, ten athletes reached a 10-point rating. It accounted for 41.7% of the total number of participants. Among the athletes in the all-around final and the individual finals, 7 of them each achieved a 10-point assessment. No athlete scored more than 9.8 points from the final scoring results. Only one person in the top eight finals representing the elite floor gymnastics has a score of 9.9. Everyone else is rated out of 10. The final score was 9.5 to 9.757, and there were only three people. 9.35 ~ 9.45 points, there are four people. 9.20 to 9.30 minutes per person. The highest score in the individual finals was 9.55 points. This shows that although the athletes have mastered the more serious difficulty, the quality of the completed movements is not high.

Action completion

Action completion indicates the quality of the athlete's action completion. Points will be deducted if the athlete does not have the ability or quality to complete a set of movements, even if the starting score is high. For this reason, this paper makes statistics on the completion of the athletes' movements in 4 games. (Table 4)

Most mistakes of athletes in floor exercises are out of bounds and sitting on the ground. There were 12 out-of-bounds in the qualifying match while completing the action. Four players each went out of bounds in the team finals and the all-around finals. There is one person in the single final, and most of the moves out of bounds occur when doing trick strings. A trick string is a concatenation of two or more flips. When the quality of the athlete's action is poor, and the height of the flip is not enough, it will inevitably affect the

Table 2. The distribution of the scores of the athletes in the National Games Qualification and Finals.

	Qualifying		Single final	
10	**9**	**13.80%**	**7**	**87.50%**
9.9	5	7.60%	1	12.50%
9.8	4	6.20%	0	0.00%
9.7	7	10.80%	0	0.00%
9.6	8	12.30%	0	0.00%
9.5	10	15.40%	0	0.00%
9.4	4	6.20%	0	0.00%
9.3	3	4.60%	0	0.00%
9.2	4	6.20%	0	0.00%
9.1	5	7.60%	0	0.00%
9 points or less	6	9.20%	0	0.00%

Table 3. Distribution of final scores of athletes in National Games Qualification and Finals.

	Qualifying		Single final	
9.8 and above	0	0.00%	0	0.00%
9.75-9.6	2	3.10%	0	0.00%
9.575-9.5	6	9.20%	3	37.50%
9.45-9.35	6	9.20%	4	50%
9.30-9.2	8	12.30%	1	12.50%
9.15-8.95	14	21.50%	0	0.00%
8.9-8.5	15	23.10%	0	0.00%
Below 8.5	14	21.50%	0	0.00%

Table 4. Statistics of athletes going out of bounds, sitting on the ground, and overtime in 4 games.

	Out of bounds		Sit down		Time out	
Qualifying	12	18.51%	11	16.91%	1	1.50%
Team competition	4	16.71%	2	8.31%	0	0%
All-around final	4	18.21%	1	4.51%	0	0%
Single final	1	12.51%	1	1%	0	0%

completion of the next flip. 0.1 point is deducted for an athlete who goes out of bounds due to a technical error extending the distance. In addition, the more severe deduction is the failure of the action to sit on the ground. Eleven people have deducted 0.5 points for sitting on the ground in the qualifying rounds. Athletes' mistakes mainly occurred when they completed the somersaults of Groups D and E and the connection of skill strings. The height of somersaults in the floor exercise and the landing of skill strings are the keys to obtaining high scores for the whole set of movements. This is also a measure of the quality of the action. The main reason for the failure of the movement is the poor ability of the athlete to master the technical movement. When there is a technical problem in completing the movement, it is reluctant to connect to the next flip, resulting in a failure and sitting on the ground. Some athletes fail due to incorrect landing techniques or poor control. Gymnastics rules emphasize that athletes should perform technical movements according to their abilities. The high-level competition first requires athletes to complete their movements steadily. The study found that the floor flip is the weak link of Chinese athletes.

DISCUSSION

Floor exercise is a sport that pays special attention to body art. It has strict requirements on the athlete's physique and body posture. Every movement or a complete set of movements completed by an athlete is highly demanding to be accurate, significant in range, and substantial in rhythm. Athletes cannot perform actions such as waning, shaking, and dividing. Individual actions must meet a specific skill score. Athletes use muscle sense to control various joints in the body. They hold their heads high to show their physical charm and interest in their gestures. Athletes form a whole body from top to bottom, and the interconnection affects the ability to coordinate performance. Judging from the connection of skills and movements, foreign elite athletes mainly perform "straight backflips at 900° and straight front flips". It shows professional skills and superb control and is highly ornamental. They may continue to develop a 360° connected frontal inversion like the floor exercise. This allows for more difficulty and connection bonus points. However, Chinese athletes mostly use "quick backflip second-hand flip followed by straight backflip body 900°" and single action.

CONCLUSION

Most athletes can adapt to the changes in the new rules and master a lot of complex movements. This also gets a higher score. However, the choreography of the athletes' complete movements is relatively simple and lacks characteristics. In the floor exercise competition, there is a common problem that the basic skills of the athletes are not too strong. This has caused some athletes to be unable to adapt to the development of movement difficulty. The problem of weak physical fitness of athletes is also more apparent. Later, athletes need the training to strengthen their legs. Leg strength training should be the key to improving athletes' unique ability in the floor exercise.

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