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MODERNIZATION OF SPORTS EQUIPMENT AS A FACTOR OF INCREASING OF DIFFICULTY SCORE OF COMPETITIVE ROUTINES IN TRAMPOLINE GYMNASTICS

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Author contribution:

A – study concept and design; B – data collection; C – data analysis and interpretation; D – paper writing; E – paper editing; F – paper final adoption

Abstract

Introduction. Trampolining is a modern sport included in the program of the Games of Olympiads since 2000. Constant improvement of sporting equipment, changes and innovations to international competition rules provide continuous development of the sport and worldwide popularity of trampolining.

The *aim* is to substantiate interrelation between sporting equipment modernization and increasing the complexity of competitive exercises for trampolinists.

Material and methods: theoretical analysis of research and methodological literature, retrospective analysis of result cards from international events, video analysis, methods of mathematical statistics.

Results. The conducted research gave an opportunity to determine the main equipment designs used at international events in trampolining in different periods of time. By means of video analysis the basic elements building competitive exercises for athletes in 1964–1972; the retrospective analysis of result cards from international events makes it possible for us to calculate medium, maximal and minimal complexity of competitive exercises completed by the prominent trampolinists at the world championships and World cups during 1972–2020, and find interrelation between equipment design modernization and increasing the complexity of performed competitive exercises for athletes in different times of the sport's history.

Conclusions. The conducted research proved interrelation between the increasing of the number of complex elements and increasing of complexity of performed competitive exercises and sporting equipment modernization in trampolining. Based on the results of the research the average complexity of competitive exercises for qualified athletes after implementing each new trampoline model was increasing from 0.2 to 0.5 points and the maximal complexity resulted in 0.1 to 0.7 points.

Key words: trampolining, equipment modernization, World Championships, World Cups.

Introduction. Trampolining is one of the sports with high coordination complexity developing under the aegis of International Gymnastics Federation (further mentioned as FIG). The analysis of the recent researches and publications give reason to state that the development of gymnastic disciplines is influenced by technical progress and sporting equipment modernization. The national and international specialists studied the changes of sporting equipment in women's and men's gymnastics [3, 6, 13] and items in rhythmic gymnastics [11, 20]. Yet, the influence of sporting equipment modernization in trampolining on the complexity of competitive exercises for the athletes remains a relevant question of scientific researches.

The **aim of the research** is to substantiate the influence of sporting equipment modernization on the complexity of competitive exercises for trampolinists.

Material and methods of the research.

Contingent – highly qualified athletes filling 1-24 places by the results of the previous program at World

Championships and World Cups in trampolining.

Methods of the research: theoretical analysis of research and methodological literature, retrospective analysis of result cards from international events, video analysis, methods of mathematical statistics.

Organization of the research – 34 World Championships and 16 stages of World Cups in trampolining during the years 1964–2020 were analyzed to calculate medium, maximal and minimal complexity of competitive exercises for the athletes and determine interrelation of these indicators to sporting equipment design.

Results of the research and discussion. The history of the development of trampolining is related to the name of an American gymnast George Nissen having invented the first trampoline in 1934, in Cedar Rapids, Linn County, Iowa. In 1945, George Nisse patented the equipment sized 4.1 x 2.15 m with bed sizes 3.6 x 1.8 m (patent US 2.370.990) and began trampoline mass production [2, 14] (fig. 1).

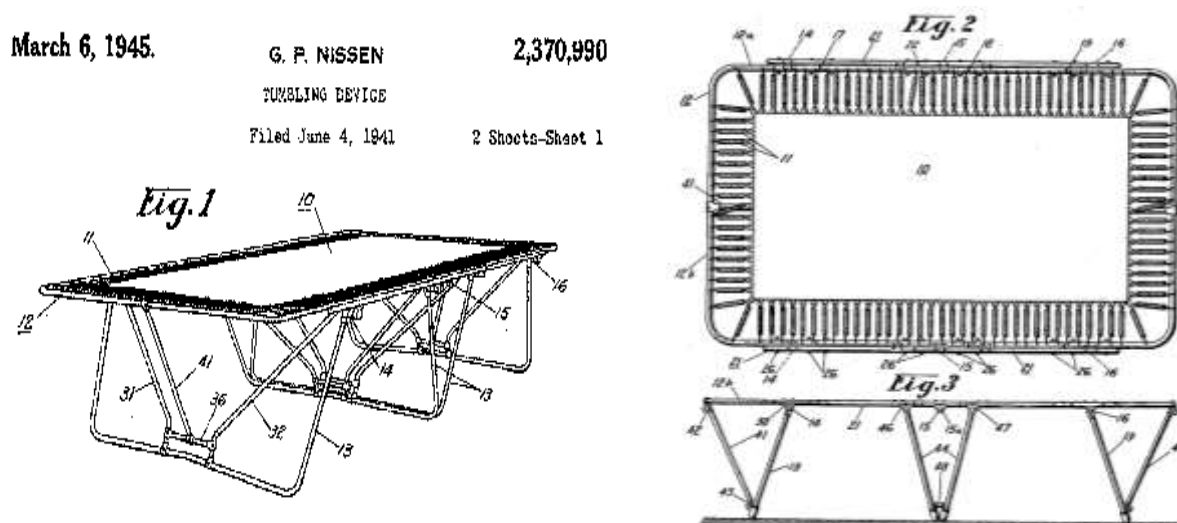


Figure 1. Patent for the first trampoline model invented by George Nissen (March, 1945)



The analysis of research and methodological literature and Internet data approved that by virtue of equipment spreading across the territory of the USA trampolining had become a part of PE lessons where it gained popularity among school youth. Beginning from 1948, the National Gymnastics Federation of the USA organized the first Championships in trampolining [2, 4, 21].

At the same time, specialists note that the development of this sport in the countries of the Western Europe started in late 1950s when the federations were created in Switzerland, Great Britain, Germany, and the first events were held on national levels. As late as March, 4, 1964, in Frankfurt-on-Main the representatives of 40 states create International Trampoline Federation and select a Swiss Rene Scherer as a president. The newly created organization take a decision on holding the first World Championship in trampolining March, 21, 1964, in Royal Albert Hall in London [15, 21].

In 1964–1968, the World Championships in trampolining are held annually, in 1968–1988, they are held once in two years, however, after including trampolining into Olympic program the World Championships go back to annual holding except the year of holding the Games of Olympiads [2, 15].

As at 2020, the FIG Technical Committee on Trampolining takes care of all aspects of development of trampolining, and also approves international competition rules and demands to sporting equipment [10, 15].

The conducted research found that in 1964–1972, the Griswold-Nissen Trampoline & Tumbling Company had been the main manufacturer of sporting equipment founded by George Nissen and Larry Griswold in 1942. At the same time, the analysis of technical regulations approved that the peculiarity of trampolines in this period was lack of safety covering (the springs were left open) and end-decks [1, 4, 14] (fig. 2).



Figure 2. Using the «Nissen Trampoline» model without safety covering and end-decks at the first World Championship in trampolining (London, 1964)

However, regardless of the lack of safety end-decks and covering, the video analysis of the athletes' performances approved that in 1964, during the first World Championship in trampolining in London the athletes were completing various forward and backward somersaults, the ones with and without half or full turns, and double back somersaults tucked [12].

It is worth noting that it was as late as the fourth World Championship in 1967, when the athletes had first completed double full back somersaults, double front full and a half tucked, double back stomach drop piked with travel double full, etc. [4, 14]. Also, in the course of the research the 1966 and 1970 World Championships' results cards were analyzed having shown that the average complexity of the competitive exercises performed by the athletes consisted in 7.0 points in 1966 and 7.6 points in 1970, respectively, and the maximal complexity of competitive exercises did not exceed 9.8 points.

However, in the early 1970s, in the Griswold-Nissen Trampoline & Tumbling Company emerged financial

difficulties because of a range of legal claims related to the traumas sustained while operating the trampolines, so George Nissen taken a decision on selling the company [5, 21]. Therefore, from the year 1972, the main manufacturer of the equipment for most international events like World Championships, European Championships, World Cups, and from the year 2000, also the Olympic Games (except the Games of XXX Olympiads in London) became the German company Eurotramp [7, 9 12].

The main model of the trampoline used at the most international events in 1972–1998, becomes Eurotramp Grand Master. Compared to the Nissen's edit the new model of the trampoline had bigger sizes of the frame $5.20 \times 3.05 \times 1.08$ m, and bed – 4.26×2.13 m, with the nylon bands' width of 13 mm, and higher demands to the athletes' safety. Thus, in 1974, during the Eighth World Championship in trampolining, the covering for the springs as well as the end-decks appear (fig. 3).

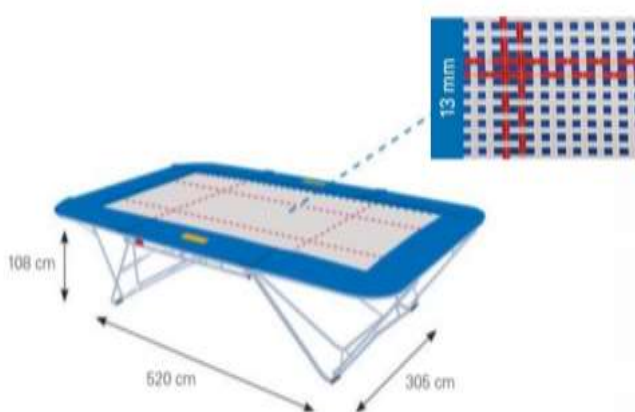


Figure 3. The Eurotramp Grand Master trampoline model with coverings, safety end-decks and detailed picture of the bed (above). The eighth World Championship in trampolining (Johannesburg, South African Republic, 1974)



The analysis of the performances' program of the athletes makes it possible for us to state that together with the trampoline model improvement the athletes started to do new elements with higher coefficient of complexity. Thus, the video analysis of 1974–1998 World Championships approved that after introducing the new model of the equipment the following elements were completed for the first time: 1 and 3/4 front somersault piked, full in piked, triple back stomach drop tucked, triple front half twist tucked, etc.

Additionally, the analysis of the event result cards gave an opportunity to reveal that the average complexity of the competitive exercises completed by the athletes at the 1972–1998 World Championships when using the Eurotramp Grand Master trampoline model consisted in 7.5 to 12.6 points. At the same time, the maximal complexity of competitive exercises did not exceed 14.2 points for the whole period of using this trampoline model (fig. 4).

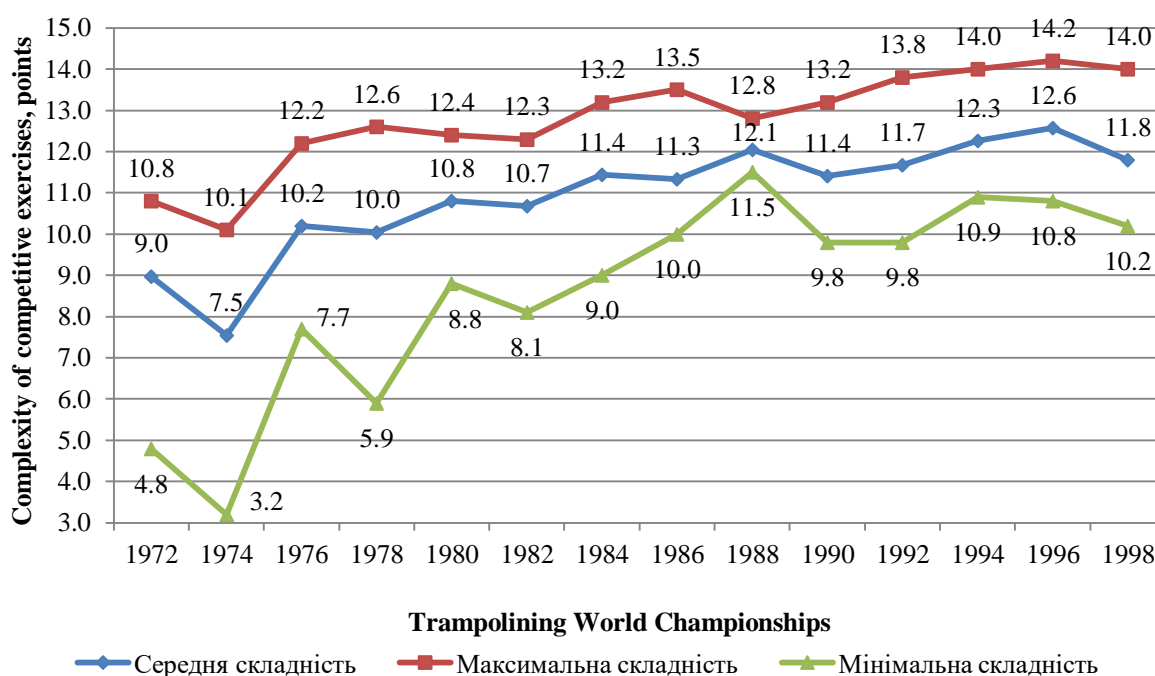


Figure 4. Complexity of the athletes' competitive exercises at the 1972–1998 World Championships in trampolining

We can state that increasing the diversity and complexity of the elements having been completed during the period of 1972 to 1998, was directly related to the modernization of the sporting equipment and increasing the safety of its usage by the athletes.

On the current stage of trampolining development, namely, after having included it into the program of the Games of Olympiads

and the sport's promotion by FIG, the main model used for holding international events was Eurotramp Grand Master Exclusive. The notable difference of this model with the previous was the increased height of the equipment by 7 cm, as well as the changed width of the bed's nylon bands from 13 mm to 4×6 mm (fig. 5) [7, 9, 22].

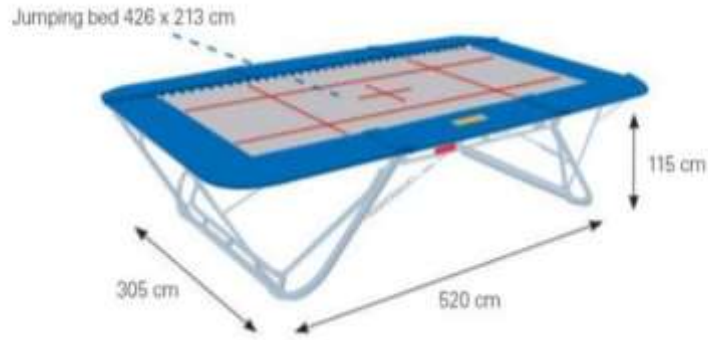


Figure 5. The Eurotramp Grand Master Exclusive trampoline model

First of all, the reasons for changing the height of the equipment were the complexity and height of the performed competitive exercises which were growing. Over a matter of imperfection of the bed, the athletes were touching the ground which was likely to cause injury, so the introduction of the new Eurotramp Grand Master Exclusive trampoline model in 1999 with the improved frame height and bed characteristics had a positive impact on increasing the complexity of the athletes' competitive exercises. Thus, at the 1999 World Championship, in Sun City (South African Republic) the average complexity of the combinations being completed by the prominent athletes increased from 11.8 to 13.3 points

compared to the previous World Championship 1998. This trampoline model had been used until the year 2007. The analysis of the result cards of the World Championships and World Cup stages 2001–2007 showed that the average complexity of the competitive exercises being completed consisted in approximately 15.4 points, and the minimal one increased to 15.3 points (fig. 6).

The sharp increase of complexity at the 2003 and 2007 World Championships compared to the previous events can be explained by the fact that these World championships were qualifying for taking part in the 2004 and 2008 Olympic Games, respectively.

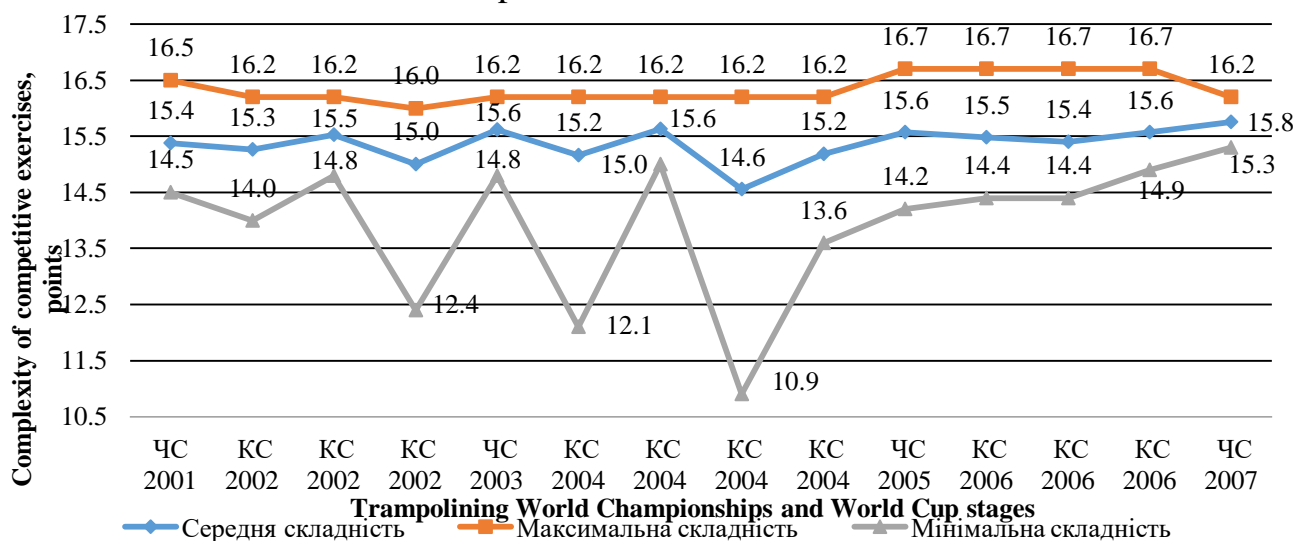


Figure 6. Complexity of the athletes' competitive exercises at the 2001–2007 World Championships and World Cups in trampolining



Yet we have to note that the complexity of the competitive exercises of the most prominent trampolinists completed at the 1964–1999 World Championships will not be compared to the complexity of the competitive exercises in 2001–2020, as in 2001, the technical committee of the trampolining FIG have reviewed the calculation of the elements' complexity and introduced the system of bonuses for completing complex jumps [15]. Therefore, comparing the complexity of the competitive exercises completed by

the athletes before and after 2001 is inappropriate.

The next trampoline model created by the Eurotramp Company specifically for the Games of XXIX Olympiads on Beijing (People's Republic of China) became Eurotramp Grand Master Exclusive Premium. This model of the equipment was distinguished by increasing the number of legs of the trampoline's base having increased the steadiness of the equipment, and by the changing of the bed's configuration, namely – the width of the nylon bands having become 6×4 mm [7, 10] (fig. 7).

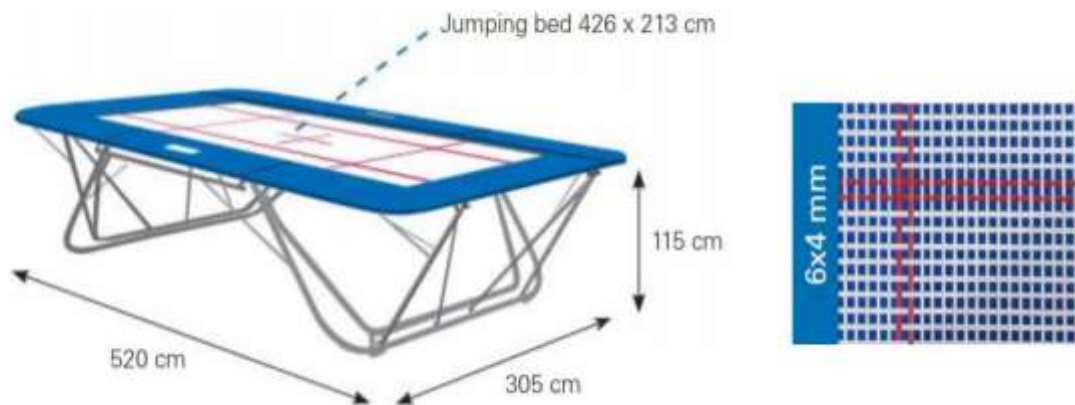


Figure 7. The Eurotramp Grand Master Exclusive Premium trampoline model with detailed image of the bed 6×4 mm (on the right)

According to the FIG international competition rules, in the year of introducing and implementation of this trampoline model no World Championships were held, so to analyze the complexity of the athletes' competitive exercises completed the result cards of six World Cup stages and the Olympic Games were used.

Figure 8 shows that after the implementation of the new trampoline model the average complexity of competitive exercises remained stable at a level 15.8 points, and also there was a notable slight increase of the maximal complexity to 16.8 points and decline of the minimal one to 13.8 points.

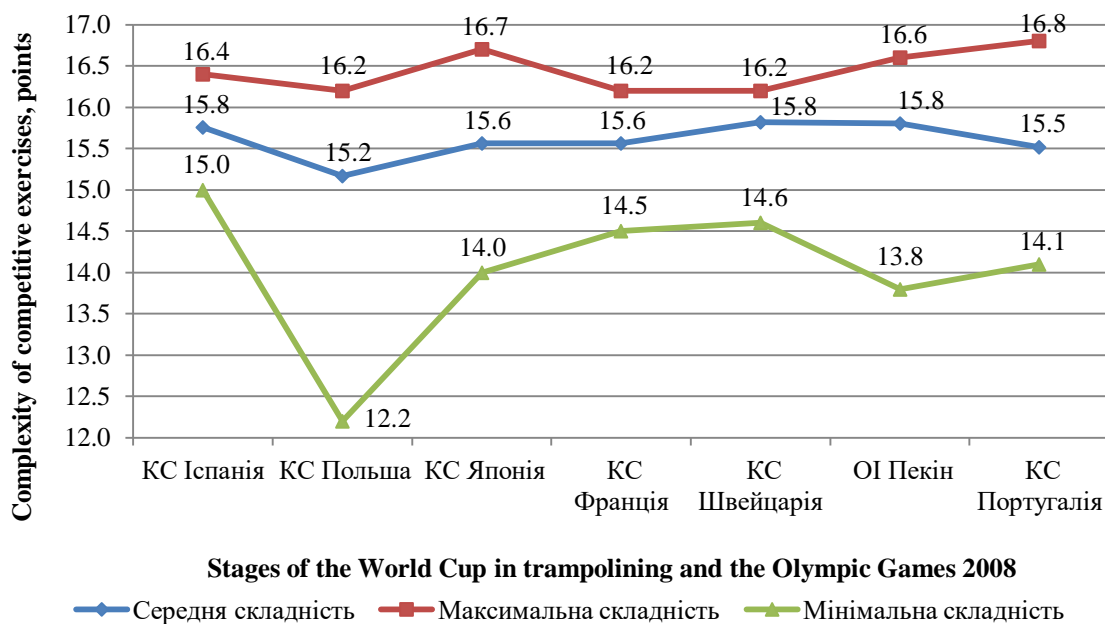


Figure 8. Complexity of the athletes' competitive exercises on the stages of the World Cup in trampolining 2008 and the Games of XXIX Olympiad

However, the research had shown that in 2009, the Eurotramp Company introduced the new trampoline model Eurotramp Premium, which compared to the previous model had the same sizes of the frame and bed, but differed

by the parameters – the width of longitudinal and cross nylon bands of the bed became equal 4×4 mm. According to the company's data, it has increased the capacity of the bed [7, 17, 18] (fig. 9).



Figure 9. The Eurotramp Premium trampoline model with detailed image of the bed 4×4 mm (on the right)

The analysis of the 24 best performances' results at three championships in trampolining during 2009 to 2011 and the Games of Olympiads 2012 has approved that after

the start of using the Eurotramp Premium trampoline model at the official events, the average complexity of the free program increased from 16.2 to 16.7 points.

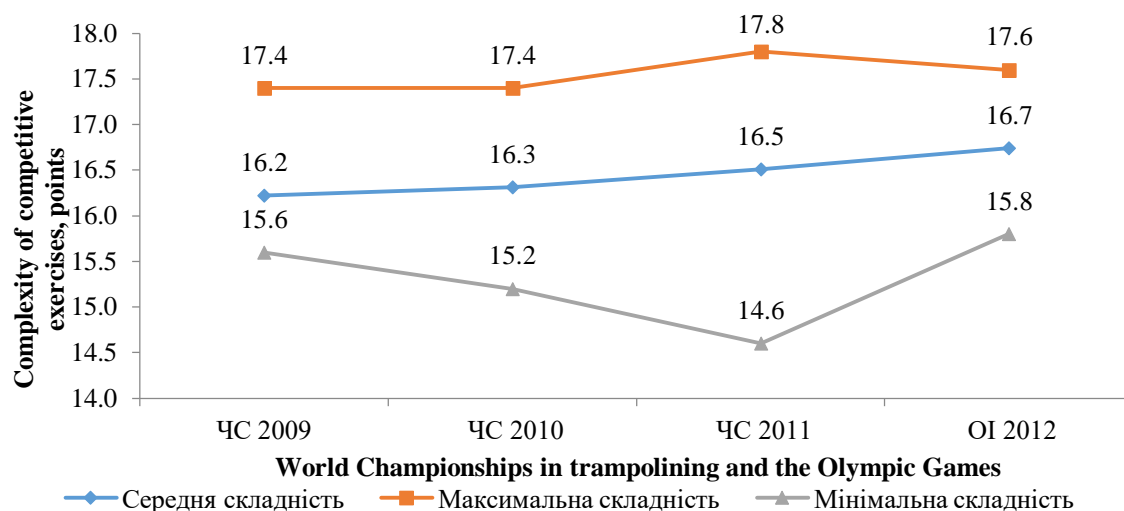


Figure 10. Complexity of competitive exercises of the athletes at the World Championships in trampolining during 2009–2011 and the Olympic Games 2012

Compared to the indicators of free program complexity presented by the athletes until 2009, the indicator of complexity in men's events grew by 0.9–1.4 points. The figures 6, 8, and 10 show that after the start of using the new trampoline model the maximal complexity of the completed competitive exercises grew from 16.2 to 17.8 points.

The following step in modernizing the equipment in trampolining was introducing the new trampoline model Eurotramp Ultimate by the Eurotramp Company in 2013. This model of equipment got higher safety and stability indicators. According to the

manufacturer company's data the Eurotramp Ultimate model has 200% higher tension in the section of the trampoline's legs having increased the stability of the frame, while the sizes and parameters remained the same as in the previous model – 4,26×2,13 m with the width of the nylon bands 4×4 mm, yet the cooperation with the Rebound Products Company founded by Dave Ross and producing the new type of strings Ultimate (fig.11) created the conditions for dynamic increase of complexity of competitive exercises and performing new elements in trampolining [8, 10, 22].



Figure 9. The «Eurotramp Ultimate» trampoline model with detailed image of the strings (on the right)



The analysis of the result cards from six World Championships in trampolining has approved a sharp growth of complexity of competitive exercises completed by the prominent trampolinists (fig. 12).

The conducted research approve that after the start of using the new trampoline model Eurotramp Ultimate

at the official events the average complexity of the second free exercise among 24 best athletes began to be from 16.4 to 17.0 points. Namely, if we compare it to the previous model, the average complexity of competitive exercises increased by 0.3-0.8 points, the maximal one – by 0.2-0.6 points, and the minimal one remained the same.

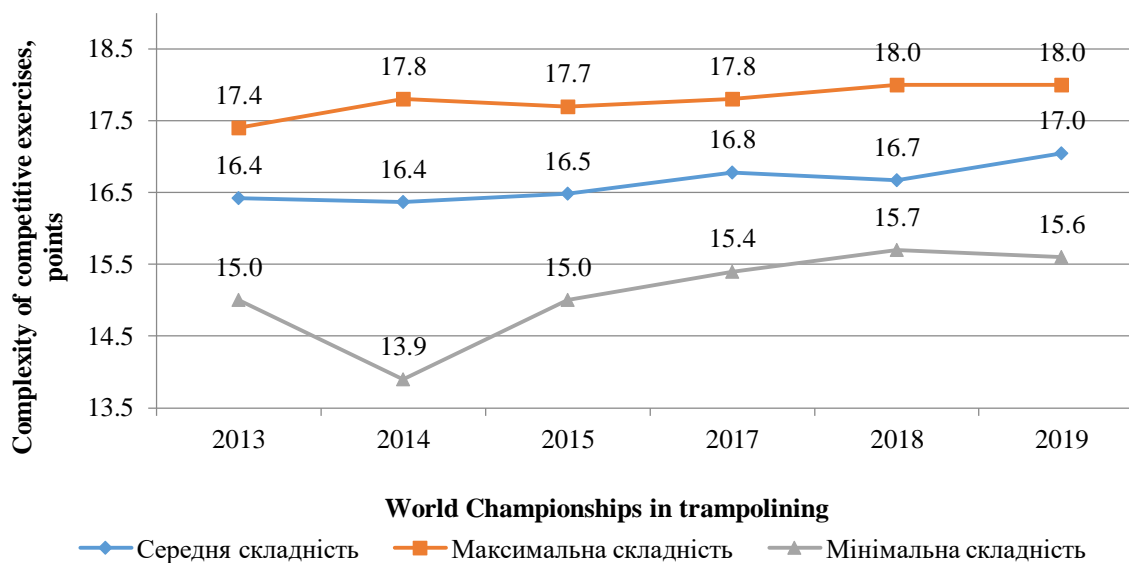


Figure 12. Complexity of competitive exercises of the athletes at the World Championships in trampolining during 2013–2019

Conclusions.

Trampolining is quite a young sport included in the program of the Olympic Games. Its dynamic development is directly related to technical progress and modernization of sporting equipment. Thus, the conducted research has proved the interrelation between the increase of the number of complex elements and the increase of complexity of the competitive exercises completed by the athletes as well as modernization of sporting equipment in trampolining.

By the results of the research, we can claim that implementing every new trampoline model caused the average complexity of highly qualified athletes' to grow from 0.2 to 0.5 points, and the maximal one from 0.1 to 0.7 points.

Prospects for further research consist in determining the impact of different equipment models on the height of completing competitive exercises and creating recommendations on how to increase the indicators of complexity and height of the qualifying exercises for the athletes specialized in trampolining.



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