COMPARATIVE ANALYSIS OF THE OLYMPIC GAMES DURING MEN'S ARTISTIC GYNASTICS BETWEEN 1988 AND 2000

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Abstract Material for analysis was derived from list of results obtained during six artistic gymnastics events for 142 Olympians between 1988-2000. The lowest scores were awarded for floor exercises, which indicates their difficult nature. ANOVA saw a growing trend in natural stratification of sports achievements among groups A, B, C as they were attaining different sporting levels. In the cluster analysis we have distinguished four patterns of six events results that were connected with the score in total of the all-round competition. Those best male athletes who had pattern of scoring No. 1 (characterized by value of the judges' verdicts) in the following order: floor exercises > pommel horse exercises > rings > horizontal bar exercises > parallel bars > vault.

Keywords: artistic gymnastics, men, scores

ANÁLISE COMPARATIVA DA GINÁSTICA ARTÍSTICA MASCULINA NOS JOGOS OLÍMPICOS ENTRE 1988 E 2000

Resumo O material para análise foi derivada de uma lista de resultados obtidos dos seis eventos de ginástica artística de 142 atletas olímpicos entre 1988 e 2000. As menores pontuações foram dadas para os exercícios de solo, o que indica sua dificuldade. A análise de variância demonstrou uma tendência de crescimento na estratificação das conquistas esportivas entre os grupos A, B e C ANOVA saw a growing trend in natural stratification of sports achievements between groups A, B, C, uma vez que eles foram atingidos por diferentes níveis esportivos. Na análise de Cluster nós distinguimos quatro padrões dos resultados de seis eventos que estavam relacionados com a pontuação no total da competição geral. Os melhores atletas masculinos que tiveram a classificação n. 1 (caracterizadas pelo valor das análises dos árbitros) na seguinte ordem: exercícios de solo > cavalo com alças > argolas > exercícios de barras horizontais > barra fixa > salto sobre o cavalo.

Palavras-chaves: ginástica artística, homens, pontuações.

Introduction

All ancient societies have been documented as having various aspect of gymnastics in their overall pattern of health and conditioning. In 700 BC the Athenians added gymnastics to Olympic competition. Television coverage of gymnastics in the modern Olympics, combined with the heightened interest in physical fitness in general, has led to a resurgence of interest in this sport (Weiker 1985) Contemporary men's artistic gymnastics is composed of six events: floor, pommel horse, rings, vault, parallel bar, horizontal bar (Events 2003, FIG 2003, WEST 2003).

Floor exercise. The floor measures 12x12 metres with an additional safety border of 1 metre and is covered with thick foam backed carpet. The gymnast's floor exercise should include movements which demonstrate strength, flexibility and balance. Each routine must combine movements such as somersaults, twists and leaps. Multiple saltos and twists are increasingly common. The whole floor area should be used and the routine should have a personal touch of expression and execution.

Pommel horse hight is 1.05 metre, whereas length at the top is reaching 1.60 metre. Distance between pommels 40-45 cm. The pommel horse routines should be a smooth continuous chain of circular and pendulum type swings, double leg circles, scissor movements and undercuts using all parts of the horse. The difficulty stems from two factors. First, the gymnast is performing moves that differ from the swinging and tumbling skills of the other five events. Second, he spends most of each routine on only one arm, as the free hand reaches for another part of the horse to begin the next skill. There are a long series of moves with the hands reaching behind the back, or when both hands are on a single pommel. The hand placements should be quick, quiet and rhythmic.

Rings height from the floor is 2.75 metres. Ring routines should include a variety of movements demonstrating strength, support and balance. The gymnast should perform a series of swings and holds and both forward and backward elements and the routine should finish with an acrobatic dismount. The rings are the least stable of the men's apparatus. Stillness is paramount, and those with the best command of the event will display extraordinary skill in arriving at all holds with absolute precision. The rings should not wobble or swing, the body should no sag or twist, and the arms should not waver or shake. The gymnast should move into his strength, move quickly, stop securely, and then move easily into the next part. It is important remaining the stretched body positions and straight handstands.

Vault. Height of the jumping table from the floor is 1.35 metres. The vault table is situated lengthways to the approach run of 25 metres. Each vault has a value according to its difficulty. The vault should demonstrate clean movements combining height and length with one or more rotations and finishing in a controlled landing. The height, distance of travel, overall acceleration into the vault, and sudden impact of no step, stuck landing creates an effect, or an impression.

Parallel bars has height 1.75 metres. Like the rings the parallel bars require a combination of swinging movements with strength or hold parts. The gymnast should travel along and work both above and below the bars. Although not a requirement, some of the better gymnasts move outside the two rails, performing handstands, presses, kips and hip circles on only one bar. When well executed, these movements mark a good performance The most difficult skills require the gymnasts to lose sight of the bars for a moment, as in front and back saltos. The more of these skills performed, in succession, the more challenging routine. The gymnast's routine ends in a dramatic dismount off the side or the end of the bars.

Horizontal bar has height 2.55 metres. The gymnast should perform continuous clean swinging movements and must not touch the bar with his body. He is required to demonstrate changes of grip, swinging movements both forwards and backwards, plus releases and re-grasps of the bar. The high bar is a showcase for both the gymnast's artistry and strength. The continuous flow, the lightning-quick changes in body position, and the wave of release moves and one-arm giants all enable the performer to test the upper limits of his skil and courage. There are interesting blind releases, in which the gymnast loses sight of the bar while executing a salto or twist. One arm giants are extremely difficult. If several are performed in succession as the gymnast changes directions, or if he performs a blind release out of one-arm giants, he has performed admirably. Dismounts

are an important part of the total routine and are usually acrobatic and spectacular. The high dismounts from the bar allows the gymnast to show his acrobatic talents and landing prowess.

The rules and regulations concerning the evaluation of male gymnasts' routines are prescribed by the FIG (Przepisy 2001). Plessner (1999) demonstrated that systematic biases in gymnastic judges decisions can be analyzed from a social cognition perspective. This approach might reveal a way to prove theoretical assumptions when applied to real-world settings, as well as to gain valuable insights into cognitive processes that might result in unfair evaluations, at least unintentional ones, of the athletes involved.

Some authors emphasized that empirical research is of capital practical importance for development of this discipline of sport. The published results concern different aspects of achievement (Perzyńska-Biskup et al. 2001). Seeking for factors which may bring about an improvement in the quality of executing sports technique and in consequence the awarding of higher scores by judges has been documented in many studies concerning exercises on rings (Sprigings et al. 1998, Yeadon and Brewin 2003), horizontal bar exercises (Reid and Kopp 2001, Takei and Dunn 1997, Arampatzis and Bruggemann 1998, 1999, Hiley and Yaedon 2003) and vaults (Ozguven and Berme 1988, Kerwin et al. 1993, Yeadon et al. 1998, King et al. 1999, Takei et al. 2000). Takei et al. (2000) stated that the scores awarded by judges for 122 vaults had fluctuated from 9.65 to 7.975 and correlated among others with characteristics of horizontal and vertical speed during take-offs from the springboard, whereas after a bounce from the horse - with the distance and height of flight and the angular velocity of the competitor's body. Biomechanical studies contribute to the optimising of the execution of particular technical elements in terms of the athlete's efficiency during competitions (Requejo 2003). Technical errors are conducive to sudden and/or gradual strains on the body, especially in the region of the ankle and knee joints during floor exercises at the moment of landing (Kirialanis et al. 2003). The enormous overloads during the cushioning of backward landings cause very strong eccentric contraction of the quadriceps of thighs, which given by far too low a value of this index of the strength of flexors in relation to the extensors of the knee joint led to ruptures of anterior cruciate ligaments of the competitors from the National Team (Russell et al. 1995). However, the rotation around the longitudinal body axis during jumps from gymnastic apparatuses contributed to serious injuries to knee joints at the moment of landing (Hunter and Torgan 1983). A considerable risk of injury also concerned wrist joints, which were frequently exposed to overloads by compressing and twisting forces causing pain during pommel horse exercises (Howse 1994). A relationship was found between traumatic injuries to the body sustained by competitors and their anxiety levels (Kolt and Kirby 1994). Some studies indicate that the period of maturation may lead to injuries. The interaction between adolescent growth spurt and intensive training causes greater susceptibility to injuries in gymnasts (Meusen and Borms 1992).

The psychic factor has an important role in their achievements. As it was demonstrated by Spink (1990), elite competitors were able to forget more quickly about their errors while executing exercises during competitions, they were more confident and trained more intensively than those who had not achieved such successes.

From the analysis of exercise patterns on five apparatuses during the World Championships in 1989, it appears, among other things, that the finalists evinced a distinct increase in the difficulty of technical elements (Barański et al. 1990). China has reached the advanced level of the world in free exercise and parallel bars. The ways for the Chinese gymnasts to get awarded points were by changing difficulties of the same sort of exercise, but those for the foreign gymnasts were by adopting more varieties and less amount of exercise that is beneficial to the future development (Cheng et al. 2000). The physiological profile of gymnasts has changed in recent years as well as their maximal anaerobic power has increased and, at present, it amounts to

14 Watts x kg-1 when measured with Wingate tests. The intensity of internal load has also increased during exercises. In 1970s of the last century, it ranged from 135 to 151 beats per minutes -1, while at present it reaches 190 beats per minutes- 1. The energy expenditure of gymnastic exercises has also risen (Jemni et al. 2001). On the grounds of analyses of the dynamic accumulation of lactic acid, Jemni et. al (2003) demonstrated a positive influence of active rest during breaks in between all-round gymnastic events on the speed of recovery processes and on the competitors' scores during simulated gymnastic events. Elite athletes compete in different parts of our globe. According to Reilly et. al (2001), it is necessary to monitor the indices of athlete's body condition, as these undoubtedly influence sports result. Both competitors and coaches as well as judges quickly relocate to different time zones, which causes disturbances in their circadian rhythms and fatigue after their trips due to the time difference, the so-called jet lag. This factor modifies among others the quality and length of sleep, reaction time, static strength of the hand and the muscular strength of lower extremities and that of the spine during the consecutive days of their stay in a new time-zone. Weariness has been known to trigger off technical errors, which lead to low scores awarded by judges (Kirialanis et al. 2003).

One ought to emphasise that rivalry and international competition stimulate coaches to seek new solutions for effective preparation of their competitors in order to come up to the ever-increasing requirements concerning the groups of difficult elements that are set forth by the International Federation of Gymnastics (FIG). The greatest appreciation in artistic gymnastics gain not achievements during individual events, but victories in all-round events.

Similarly to the preceding article concerning women (Sterkowicz 2003), the purpose of the present work have been:

- to define the repeatability in the scoring awarded to the leading competitors during The Olympic Games,

- to discover time trends and to conclude which event is the most difficult, and

- to compare average scores for individual all-round gymnastic events as awarded to elite gymnasts participating in the four Olympics 1988 –2000,

- to determine the scoring patterns and their relationship with the achievements during men's all-round gymnastic events.

MATERIAL AND METHOD

Material for analysis was derived from the official printouts of the results of the Olympic Games held in Seoul (1988), in Barcelona (1992), Atlanta (1996) and Sydney (2000). The International Federation of Gymnastics (FIG) published a list of results obtained during six artistic gymnastics events for men. Individual data of competitors were encoded and calculated by means of STAGRAPHICS 5.1.

The statistical calculations compared average scores awarded by judges to 142 competitors (36 gymnasts in three Olympics of 1988, 1992, 2000 and 34 ones in 1996) for six events (floor exercises, pommel horse exercises, rings exercises, vaults, exercises on parallel bars and on a horizontal bar) by means of analysis of variance (ANOVA) and Tukey's test. 48 gymnasts with higher achievements level were distinguished (i.e. competitors who occupied positions 1-12 during the consecutive Olympic Games) to form group A, group B consisted of 48 competitors with an average level of achievements (competitors who occupied places 13-24), and 46 competitors with a lower level of achievements were assigned to group C (competitors who occupied places 25-36).

During two-way ANOVA the factor of the level of sports achievements was taken into account (groups A, B, C) and the time factor (years 1988, 1992, 1996, 2000). We also considered interactions of the above-mentioned factors, which found expression in their mutual interaction on the scores of the competitors during their all-round gymnastic events. When effect of one factor hinged upon the level of other factor, the profiles of group results were not parallels, in other words an interaction occurred. Analysing individual results, their different arrangement in the men's six gymnastic events was observed. To arrange the data, a cluster analysis was used which allowed grouping the competitors with similar scoring patterns during all-round gymnastic events. In addition, the (average) results grouped in this manner were compared by means of the ANOVA.

RESULTS

The repeatability of individual results during the Olympic Games

In series of 142 results, the world leaders in all-round gymnastic events were identified as those who at least, twice entered for the Olympic Games. Between 1988 and 1992, that list included ten gymnasts, nine of them were present between 1992 and 1996, and six ones between 1996 and 2000. Mostly that group of brilliant competitors (eight out of ten) were observed to be experiencing a drop in scores between 1988 and 1992, whereas between 1992 and 1996 the same was true in seven cases out of nine. The 1996 and 2000 period saw however a reverse situation, because five out of six competitors of gymnastic elite occupied higher positions in 2000 than they had in the preceding ranking FIG (1996).

Average scores of 142 men represented different pattern of their sports results.

Pattern	Floor	Pommel horse	Rings	Vault	Parallel bars	Horizontal bar
1 (n = 30)	9.8221	9.8521	9.8483	9.7204	9.8075	9.8243
2 (n = 21)	9.5457	9.6916	9.5154	9.5642	9.6362	9.0048
3 (n = 41)	9.5982	9.6993	9.5985	9.5819	9.6618	9.6873
4 (n = 50)	9.1661	9.3758	9.4434	9.3453	9.3605	9.5483

Analysis of the scores during individual all-round gymnastic events

Figure 1 juxtaposes average scores (points) for individual all-round gymnastic events obtained by competitors during four Olympic Games.
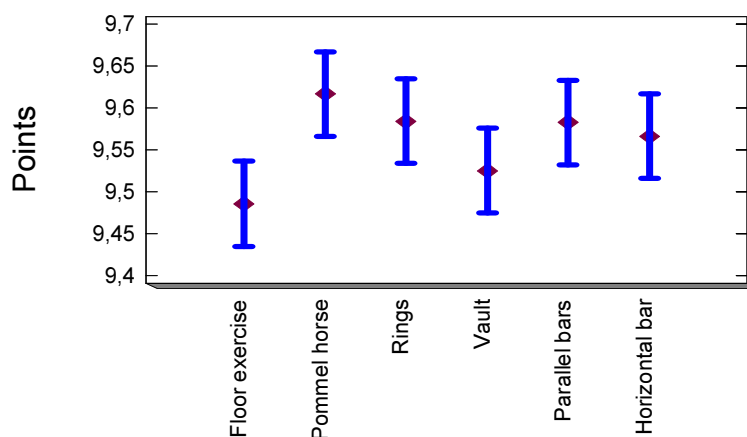

Figure 1. Average scores of men elite gymnasts in all-round individual gymnastic events (n = 852)

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The highest scores were obtained for pommel horse exercises. This event can therefore be regarded as the "easiest" one, because the competitors made the fewest mistakes. Floor exercises turned out to be the most "difficult" event, because the average of scores for them was the lowest. In the case of the remaining four competitions slight differences were observed in the average of results. It follows from the conducted ANOVA that there appeared statistically significant differences between the average results for six all-round gymnastic events (F = 3.53; p < 0.003). Tukey's repeated comparisons test has confirmed that statistically significant differences appeared between the average scores for floor exercises and pommel horse exercises. Those differences were slight (0.131 points), because they concerned world-class competitors.

The level of achievements vs. results for individual all-round events

a) The level of achievements vs. results for floor exercises

Figure 2 represents the results of the comparison of the average results for floor exercises with a due consideration for two factors: the year when the Olympics were held (between 1988 and 2000) and the level of achievements (groups A, B, C). Some differences can be noticed in the course of the lines that reflect the change in the awarding of points to competitors in the consecutive years. The competitors from group an experienced a slight drop in their scores after 1992. At the next competitions, the scores of group B competitors formed a smooth temporal trend, which was connected with a systematic decline in scores awarded to them in comparison with group A gymnasts. Group C was characterized, however, with a steep regress in the scores awarded between 1988 and 1992 as well as 1996 and 2000, while in the 1992-1996 period, there occurred an increase in sports results, which were similar to those in group B.
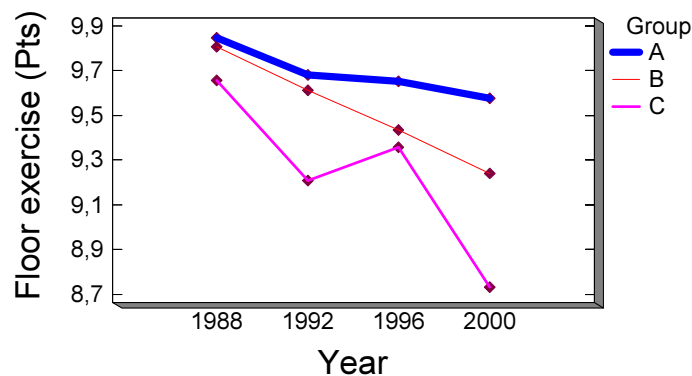

Figure 2 Average scores of men elite gymnasts for floor exercises (n = 142)

The ANOVA has verified the hypothesis that statistically significant differences appeared between the average scores for the execution of floor exercises by groups A, B, and C (F = 27.62; p < 0.001) during the following Olympic Games (F = 31.80; p < 0.001). Generally speaking, between 1988 and 2000 a fall can be observed in the average scores awarded to the competitors from the compared groups. During the Olympics in Seoul, the average scores for execution of floor exercises was very high and amounted to 9.77 points, whereas in Sydney they declined to 9.18 points. Although the fall in scores was characteristic both in group A, B and C, a growing tendency could be observed for them to be more and more diversified. In 1988, the results for floor exercises were the highest and they fluctuated from 9.68 to 9.86 points. In 2000, the lowest scores for floor exercises amounted to 9.09 points, while the best competitor in this ranking obtained 9.27 points for his floor exercises. All

three groups of those competitors were characterized by a decrease in scores for the execution of floor exercises during the consecutive Olympic Games. The average results during this event in Barcelona (1992) and in Atlanta (1996) can be regarded as homogeneous. The average results in events in 1988 and 1992, 1996 and 2000, 1988 and 2000 were significantly different in terms of statistics, however.

b) The level of achievements and results for pommel horse exercises

Figure 3 presents significant differences in the average scores for the execution of pommel horse exercises during the Olympic Games between 1988 - 2000 (F = 19.71; p < 0.001); these being broken down into three groups of competitors - A, B and C - during each of the competitions (F = 13.24; p < 0.001).
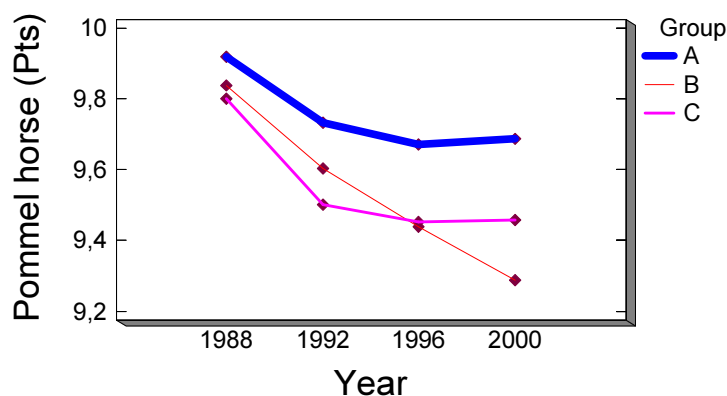

Figure 3. Average scores of men elite gymnasts for pommel horse exercises (n = 142)

In the case of pommel horse exercises, the results for this event have been found to be decreasing in the consecutive years, which can be seen in the position of means. In Seoul (1988), the average scores for pommel horse exercises were very high and amounted to 9.85 points, while the difference between the best and the weakest competitor in terms of their scores for this exercise amounted only to 0.15 points. During the next Olympics (1992 - 1996), the arithmetical means of the scores obtained by competitors from the three groups were diverging. In 2000, however, the average scores slightly increased by 0.04 points in the group with the highest level of achievements in relation to the preceding Olympics, wherein the results of the competitors, whose general score ranked them in the second twelve, were lower than those of the gymnasts from group C by 0.17 points. The average scores between 1992 and 2000 formed a homogeneous series and differed from the results obtained in 1988 significantly in terms of statistics.

c) The level of achievements vs. results during exercises on the rings

The judges' average scores for the execution of exercises on rings are illustrated in figure 4.

The best results (9.78 points) on this apparatus were attained by the competitors participating in the Seoul Olympics (1988). During the consecutive years, the scores were lower and amounted to 9.5 points in Barcelona (1992), 9.57 points in Atlanta (1996), and 9.45 points in Sydney (2000). The averaged results for exercises on rings formed a homogeneous series in the period between 1992 and 2000 and, in terms of statistics; they were significantly different from the results in 1988. The main effect of the time factor (F = 19.11; p < 0.001) and the level of achievements (F = 16.71; p < 0.001) were statistically significant.
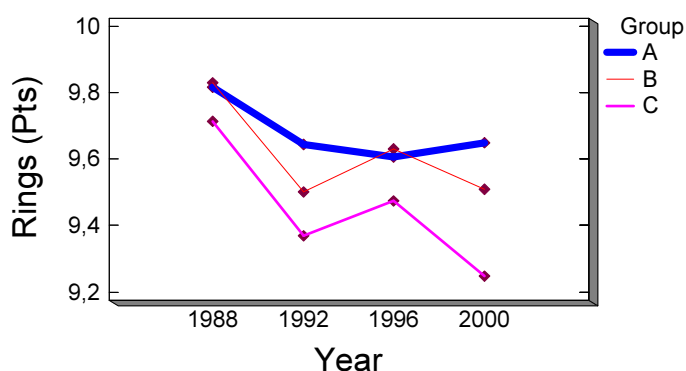
Figure 4. Average scores of men elite gymnasts for rings exercises (n = 142)

At the Olympic Games in Seoul and Atlanta, there appeared a slight superiority of group B over group A by 0.01 and 0.02 points respectively. At the Olympics in 1988, the results all of three groups were similar and fluctuated from 9.72 to 9.85 points. In 2000, the difference between the weakest group C and A - the best one - amounted by then to 0.4 points, wherein there was a noticeable improvement in the level of achievements for exercises on rings in group A as compared with the preceding year. Observing the results of groups B and C, we have noticed a rise in the average scores in 1996, with a simultaneous slight decrease in the results obtained by group A gymnasts. Figure 4 shows that the group profiles (A, B and C) are not parallel, which indicates that there was a certain interaction between the time factor and the level of sports achievements ($p = 0.137$).

d) The level of achievements vs. results for vaults

Figure 5 shows the average scores obtained by competitors for vault between 1988 and 2000. The ANOVA demonstrated that those results depended on the year when the Olympic Games were held ($F = 16.23$; $p < 0.001$).
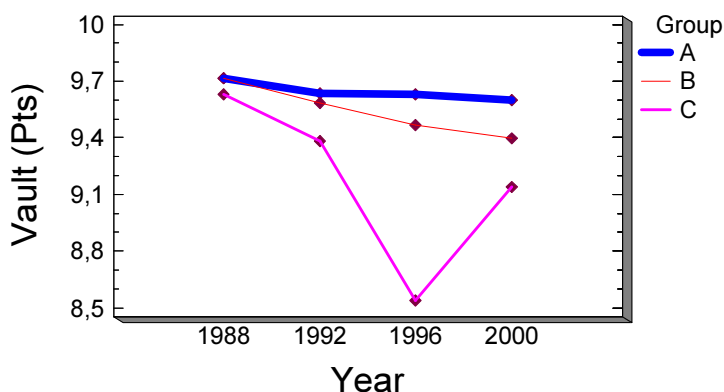

Figure 5. Average scores of men elite gymnasts for vaulting (n = 142)

The highest scores - 9.68 points - were given by judges in 1988 - and lowest ones- 9.38 points - in 2000. The effect of sports achievements factor also influenced the scores for vault in a significant way ($F = 21.95$; $p < 0.001$). Furthermore, we have shown a combined effect of these two factors on the scores for this event ($F = 2.25$; $p < 0.05$). While analysing the variance of the competitors' results caused by their sports achievements factor in the interaction with the time when the Olympic Games

were held, we have noticed high and stable results in group A, a systematic drop in scores in group B (time trend) as well as a sharp slump in the scores obtained by group C between 1988 and 1992 as well as between 1996 and 2000. Relatively slight inter-group differences present in 1988 tend to increase during the consecutive years of observation. The average scores for vaults in 2000 were significantly lower in terms of statistics than in the previous years, which was due to the lower scores of competitors from groups B and C.

e) The level of achievements vs. results for parallel bars exercises

The findings following from the ANOVA with the statistically significant impact of the time factor (F = 23.49; $p < 0.001$), group factor (F = 32.98; $p < 0.001$), as well as their interaction (F = 4.17; $p < 0.001$) in relation with the scores for parallel bars exercises. Tukey's test allowed diagnosing the results from 1988 as significantly higher than the remaining ones. Figure 6 presents a graph illustrating this interaction.
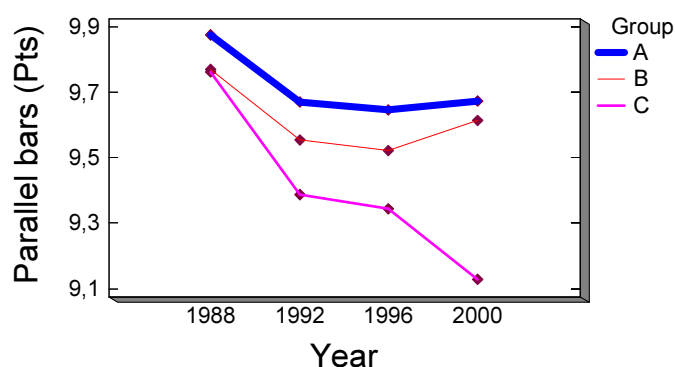

Figure 6. Average scores of men elite gymnasts for parallel bars exercises (n = 142)

The segments of lines connecting the points which reflect the positions of the averages for groups A, B, C are parallel between 1988 and 1996. They show that scores decline dramatically during the first period of 1988-1992 and they stand at the same in the second period between 1992 and -1996. This interaction is proved by these segments being not parallel for the third period of 1996-2000. Groups A and B indicate a slight increment in scores for parallel bars exercises, whereas group C shows significantly lower scores in 2000 (Tukey's test).

f) The level of achievements vs. results for horizontal bar exercises

Both the time factor (F = 5.70; $p < 0.01$) as well as the group factor (F = 18.56; $p < 0.001$), considerably influenced the results for horizontal bar exercises. Moreover, the interaction of the above-mentioned factors was also statistically significant (F = 2.39; $p < 0.05$). The interaction in question is shown in figure 7.
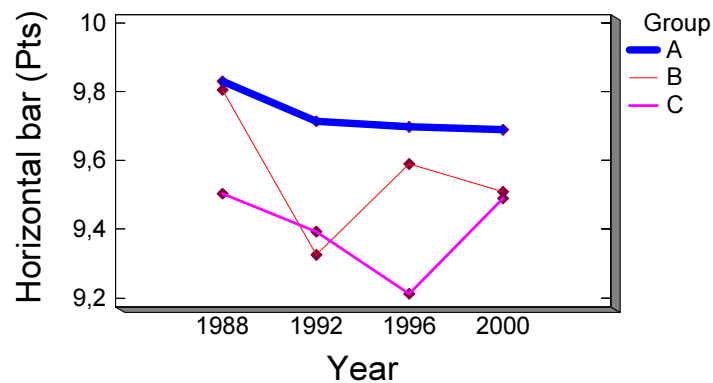
Figure 7. Average scores of men elite gymnasts for horizontal bar exercises (n = 142)

Our post-hoc comparisons have shown significantly lower scoring level for group C between 1988 and 1996 than in groups A and B. In 1992 and 2000, groups B and C did not differ in terms of awarded points. While analysing the differences in the scores for horizontal bar exercises, a significant drop in scores for group C has been revealed for the period of 1988-1996 along with a significant rise between 1996 and 2000. In the case of group B, the lowest scores appeared however in 1992 and they were significantly different from the average ones in 1988 and 1996.

The pattern in sports achievements during all-round gymnastic events for men during the Olympics of 1988-2000

Based on the cluster analysis applied to 852 individual results for all-round gymnastic events, we have distinguished 4 scoring patterns (table 1).

Competitors representing the first pattern of sports achievements (n = 30) were characterized with higher scores than the remaining groups in all six gymnastic events. The gymnasts won the majority of scores while they were exercising on the pommel horse and on rings. Their scores on horizontal bar and for floor exercises were at an average level, whereas they were lower for the execution of parallel bars exercises and vaults.

Also the scores for pommel horse exercises have been ranked in the first place in the second scoring pattern, while parallel bars exercises on the second position. This group of competitors (n = 21) obtained average scores for vaults and floor exercises. The scores for exercises on rings have found their place on the fifth position, whereas the points for horizontal bar exercise on the last one.

The third scoring pattern (n = 41), similarly to the preceding one, is dominated by scores for pommel horse exercises, while horizontal bar exercises are on the second position. If compared with other results in this group, the scores that were awarded for parallel bars exercises and exercises on rings oscillated at an average level. Those competitors obtained lower scores during floor exercises and for the execution of vaults.

The nature of the fourth scoring pattern consisted in the competitors (n = 50) being awarded with the highest scores for exercises on the horizontal bar and rings, and then for the evolutions they demonstrated on the pommel horse and parallel bars. Judges for the execution of their vaults and floor exercises granted the lowest scores in this cluster.

The total of points for all-round gymnastic events vs. the year when the Olympic Games were held. Taking into account the time factor in the two-way ANOVA, we have found that the scores for all-round gymnastic events in the consecutive years were different statistically in a significant way (F = 94.17; p < 0.001), and also that the level of achievements found its reflection in the total value of the scores awarded by judges (F = 108.58; p < 0.001).
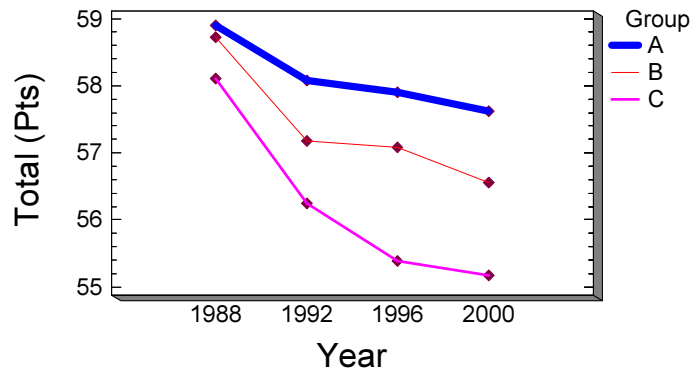

Figure 8. Total average scores of men elite gymnasts for all-round gymnastic events (n = 142)

The joint effect the time and group factors on the scores for all-round events was perceptible (F = 4.68; p < 0.001). This interaction as depicted in the graph in figure 8 indicates that the average scores (inter-group ones) were significantly different in terms of statistics between 1988 and 2000, although group A gymnasts' scoring results were of the greatest stability. The inter-group comparison (A, B, C) is indicative of growing differences during the consecutive years, especially between groups A and C. Statistically significant differences during the consecutive years have been demonstrated with Tukey's test.

The ANOVA has been conducted while seeking an answer to the key question, " how total scores for men's all-round gymnastic events depend on their scoring pattern? ". The differences between average scores for all-round gymnastic events were statistically significant for the groups isolated by the cluster analysis (F = 93.14; p < 0.001).
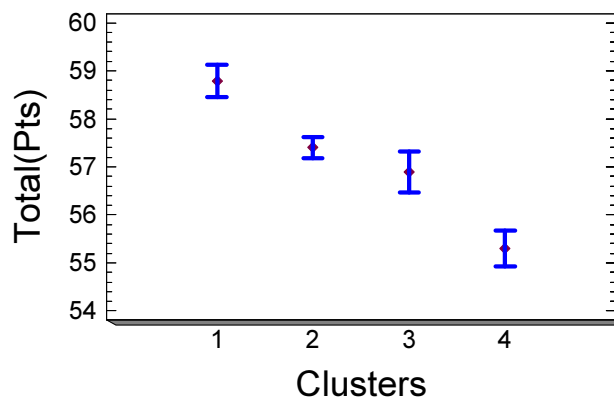

Figure 9. Average scores of men elite gymnasts for all-round gymnastic events with a consideration to the pattern of their sport results (n = 142)

Figure 9 exemplifies the average scores for all-round gymnastic event including the four scoring pattern found in the cluster analysis. Tukey's test has allowed to find significant differences between groups, which is illustrated by the position of 95% of confidence intervals round the average values.

RECAPITULATION

Practising of gymnastics commences very early and usually includes a phase of intensive growth and eventful changes connected with ontogenesis in boys. Only very few can cope with the requirements posed by training and competitions during this period. Our findings have shown that it is very was difficult to repeat the result during the phase of higher achievements in this sport. Only 17-27% of the same competitors participated during the consecutive Olympic Games. Repeating the same sports achievement during the six gymnastic events at the two consecutive Olympic Men's Gymnastics events is a very rare phenomenon.

In opinion of judges, the lowest scores were awarded for floor exercises, which indicates their difficult nature. Paradoxically, no special attention has been paid to floor exercises in scientific studies, which concentrate mostly on the evolutions executed on apparatuses (see the review of literature in the introduction to this article).

In general, the subsequent Olympics saw a growing trend in natural stratification of sports achievements between groups A, B, C as they were attaining different sporting levels. That phenomenon was manifestly present during floor exercises at the Olympic Games in Sydney (2000). A similar picture of changes during floor exercises was observed in vaults. There was a downward trend in the scores obtained during the events, especially during the Olympics Games of 1996 and 2000. This fact may indicate that those male athletes were not able to keep abreast with the ever-increasing requirements of the judges.

However, in the case of exercises on parallel bars, the differences between the average scores won by groups A and B were very small and clearly higher than average value for group C. Interestingly, groups B and C were fairly similar in their scores for horizontal bar exercises during the Olympic Games in Sydney. Following the trends in the temporal variability of scores for those events, we have also demonstrated a declining tendency in the awarding of points. There appears a high diversification in the scoring between the all-round individual competitions for male athletes. All the male athletes obtained the highest scores for floor exercises, while the lowest ones - for exercises on pommel horse, which indicates how difficult these exercises are. During the recently held Olympic Games, group C had higher scores than group B for pommel horse exercises, which being the easiest ones were awarded with the highest scores.

In the cluster analysis we have distinguished four patterns of six events results that were connected with the score in total of the all-round competition by male athletes. Those best male athletes had pattern of scoring No. 1 (characterised by value of the judges' verdicts) in the following order: pommel horse exercises > rings > horizontal bar exercises > floor exercises > parallel bars > vault. The worse gymnasts were characterized by pattern of scoring No.4 as follows: horizontal bar > rings > pommel horse > parallel bars > vault > floor exercises. So, the construction of the best athletes' all round results are different to the lower level athletes features. An improvement in the quality of exercises in the most difficult event (with the lowest scores) might leave some room for male contestants to obtain better scores during the four gymnastic events.

It will be interesting for us to observe the ways for the best gymnasts to get awarded points in the Olympic Games in Athens (2004).

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