Gender equality in figure skating

ANNA ROMOLO[1], VERONIKA KRALJ-IGLIČ[1]
Correspondence: University of Ljubljana, Faculty of Health Sciences, Laboratory of Clinical Biophysics, Zdravstvena pot 5, 1000 Ljubljana; Veronika Kralj-Iglič
e-mail: veronika.kralj-iglic@fe.uni-lj.si
webpage: http://www.lkbf.si/biophysics-and-biomechanics

Abstract
We address the issue of gender equalities and differences in sport by pointing to the recent development in singles senior figure skating. In early time, men had primacy in the development of the technique. Also, present regulations that are imposed by the International Skating Union, favor men in scoring. We present an analysis of the score of 2022 Rostelecom Russian National Figure Skating Championships which shows that equal rules for both genders could render scores in women at the same level as in men. This poses a question whether in this sport women and men could in the future compete in the same category. Keywords: Figure skating; Gender equivalence in sport; Gender discrimination in sport; International Skating Union rules; Scoring in figure skating

Enakost spolov v umetnostnostnem drsanju

Povzetek
Vprašanje enakosti spolov in razlik v športu obravnavamo tako, da opozarjamo na nedavni razvoj v umetnostnem drsanju med starejšimi posamezniki. V zgodnjem času so imeli moški primat pri razvoju tehnike. Prav tako trenutni predpisi, ki jih nalaga Mednarodna drsalna zveza, dajejo prednost moškim pri točkovanju. Predstavljamo analizo rezultatov ruskega državnega prvenstva v umetnostnem drsanju Rostelecom 2022, ki kaže, da bi enaka pravila za oba spola lahko pri ženskah prinesla rezultate na enaki ravni kot pri moških. Pri tem se postavlja vprašanje, ali bi v tem športu ženske in moški lahko v prihodnosti tekmovali v isti kategoriji. Ključne besede: umetnostno drsanje; enakovrednost spolov v športu; spolna diskriminacija v športu; pravila Mednarodne kotalkarske zveze; točkovanje v umetnostnem drsanju

Male gender primacy in sports

In the history, sports developed mostly to the measure of men. The International Olympic Committee (IOC) founder Pierre de Coubertin described women's sports "impratical, uninteresting, unaesthetic, and incorrect" [1]. Women were discouraged to take part in more physically strenuous sports, argumented by concern over their physical strength and stamina. In some societies, they were prohibited from competing in sport [2].

However, there were distinguished women who understood importance of physical activity for both genders, and practiced sports. One of such pioneers was the Empress Elisabeth (Sissi) of Austria (1837-1898). Figure 1A and 1B show the portraits of her and her husband Franz Joseph in Belvedere Museum, Wienna and in the Hotel Imperial, Wienna, respectively, while Figure 1C shows her gym equipment in the Hofburg Imperial palace where she practiced regularly.

Figure 1. A: portraits of Empress Elisabeth of Austria and her husband Emperer Franz Joseph in Belvedere Museum, Wienna, B: portrait of Empress Elisabeth of Austria in the Hotel Imperial, Wienna, C: gym equipment of Empress Elisabeth of Austria in the Imperial palace Hoffburg, Wienna.

However, it was decided on the 6th IOC Congress in Paris 1914 that a woman's medal had formally the same weight as a man's in the official medal table. The decisions about women's participation were left to the individual international sports federations [3]. With such point of view, development of activities and rules within different sports disciplines was primarily made by the measure of male abilities. Although women followed with some shift in time, their results are in general lagging behind the men's results. This posed a presumption that being a male presents an advantage in sports. For that reason, female sex verification was introduced at some point in order to prevent participation of men in the female category [2]. A threshold testosterone level was considered as one of the possibilities to assess the gender in athletes, however later results indicated that testosterone levels of elite athletes overlap between the sexes [4]. Recent evidences in figure skating that are presented in this work however indicate that it is possible that men and women could compete on the same level.

Figure skating

The International Skating Union (ISU) formed in 1892 is the world governing body for speed skating, ice dancing, and figure skating [5]. The ISU is composed of the individual national associations which administer these sports at the national level while the international matters are under the sole jurisdiction and control of the ISU [6]. ISU organizes international competitions (including Olympic Winter Games) and exhibitions, and imposes the rules [7]. The ISU assumes the responsibility for the technical control and direction of the ISU sports including singles figure skating.

World championships in figure skating started in 1890s, olympic program for men, women, and pairs started in 1908 and in ice dancing in 1976.

Evaluation of the performances of skaters had undergone many changes during the history of competitive skating with important effect on the skills practiced by the skaters. This development was connected to the development of the equipment and the place of competition. The shape of skates and boots was crucial for allowing the performance of elements. Furthermore, competitions initially took place outdoors which implied lower temperatures and therefore respective clothing (Figure 2). Long skirts worn by women seem to be less comfortable for jumping and stretching than tights worn by men, however, they were tailored to allow for the liberty of leg motion (Figure 2).

Figure 2. Women and men wore different clothes which also affected the range of elements performed. From [8].

In early time, the largest portion of the score derived from the compulsory figures (Figure 2A) where the skaters placed turns or loops onto circles traced on the ice by gliding on the skate edges. Besides compulsory figures there were also a free skating program and special figures. By the time, free skating was gaining the importance, in particular because it was more attractive for the viewers, and in 1990, the compulsory figures were cancelled from ISU competitions.

The state of art rules of ISU impose that figure skaters compete in categories singles (women and men), pairs and ice dance. Further, the age of participants is taken into account. The word “senior” is used for participants with a minimum age entry requirement of fifteen (15) years, determined in each instance by the birthday of the skater that occurs before the July 1st that immediately precedes the relevant competition [5].

To address the gender issues, we focus on senior single skaters. The competition consists of short program with prescribed elements and free program where some more freedom is allowed in the composition of the program. Skaters should perform their programs to the music. According to the category, the length of the program is limited: short program of senior women and men should be within 10 seconds to 2 minutes and 40 seconds, free skating women and men should be within 10 seconds to 4 minutes. Men were formerly allowed to have longer programs (e.g. senior free skating 5 minutes with respect to women 4 minutes), however, the genders are now equal in these requirements.

The core of the competition score are the elements presented by the competitors, principally jumps (Figures 3,4) and spins (Figure 5). There are 6 basic jumps which differ with respect to the take off. Some of them are named after the skaters who performed them first. The jumps are (Axel Paulsen, Salchow, toe loop, Rittberger (or loop), flip and Lutz). After the take off the skater turns around the vertical body axis. In Axel Paulsen, the skater takes off facing the direction of the jump while in the other jumps, the

skater takes off in the backwards direction. The landing is on one foot, outside edge, backwards. Thus, a single Axel Paulsen requires 1 and ½ revolutions while the other jumps require 1 revolution. In double jumps, there is another revolution added thus yielding 2 ½ revolutions for double Axel Paulsen and 2 revolutions for other double jumps, in triple jumps there are 3 ½ revolutions for triple Axel Paulsen (Figure 4) and 3 revolutions for other triple jumps, in quadruple jumps there would be 4 ½ revolutions for quadruple Axel Paulsen (that was not yet performed in competition) and 4 revolutions for other quadruple jumps. The spins can be performed on any of both feet and on any of both skate edges. The principal positions are camel, layback and sit. However, skaters are employing the change of the body momentum to change the spinning speed (Figure 5).

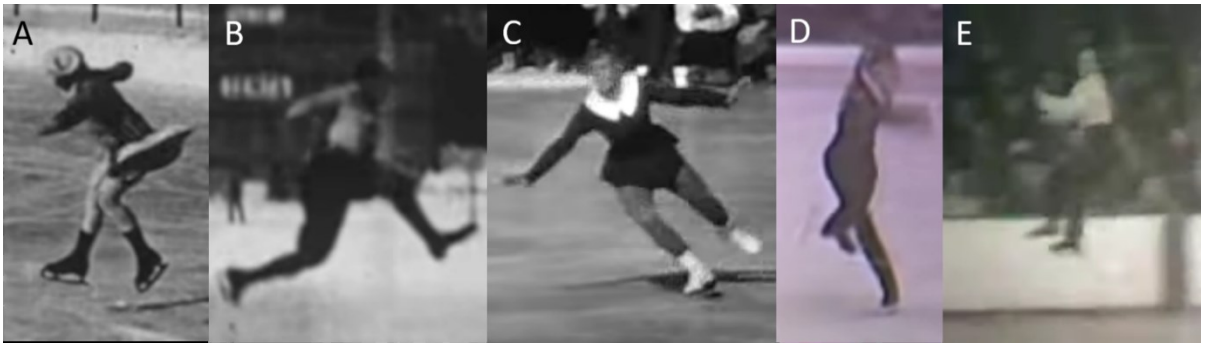

Figure 3. Jumps were early performed by women and by men. An Axel Paulsen type jump as performed by S. Henie (A) and W. Bockl (B) in 1924; landing of a double Axel Paulsen jump by S. Dijkstra in 1959, take off on the triple Lutz by D. Jackson in 1962 and a remarkable height of the jump performed by D. Button in sixties. Panels A and B from [8]. C from [9]. D and E: From [10].

Figure 4. Figure skating requires corrdination, explosiveness and automatism to execute triple and quadruple jumps in the time less than a second. Mao Asada performing the triple Axel Paulsen jump. From [11].

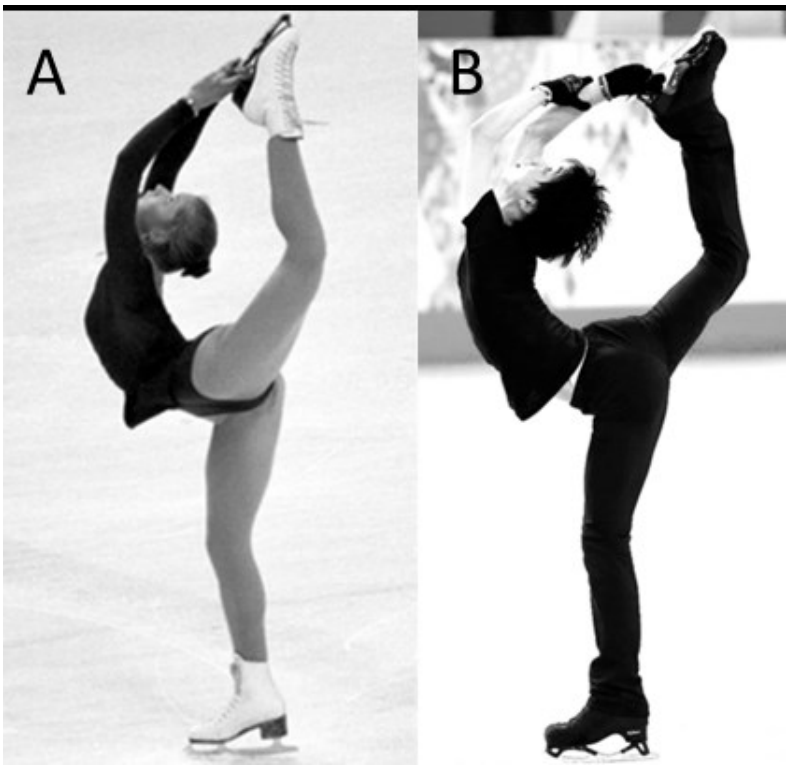

Figure 5. Stretching of the body can be performed by both men and women. Denise Biellmann (A) and Yuzuru Hanyu (B) executing the »Biellmann« spin. From [12] and [13], respectively.

The senior singles short program consists of seven required elements, in optional consecutive order. The program should be skated in harmony with the music where vocal music with lyrics is permitted. Some prescribed elements are the same for men and women: double or triple Axel Paulsen; flying spin; spin combination with only one change of foot and step sequence fully utilizing the ice surface. However, there are differences. In men: jump combination consisting of a double jump and a triple jump or two triple jumps or a quadruple jump and a double jump or a triple jump; triple or quadruple jump, camel spin or sit spin with only one change of foot. In women: jump combination consisting of a double jump and a triple jump or two triple jumps; a triple jump and a layback/sideways leaning spin or sit or camel spin without change of foot. Each of these elements has a numerical value which is the same regardless of the gender or senior/junior status of the skater. Quadruple jumps have higher values than triple jumps. A well-balanced free skating program for both men and women must contain: maximum of seven jump elements (one of which must be an Axel Paulsen type jump); maximum of three spins, one of which must be a spin combination: a flying spin or a spin with a flying entrance and a spin with only one position; maximum of one step sequence; maximum of one choreographic sequence.

The scoring

According to ISU rules [14] each element is given a technical base value (BV) score while the quality of the element is evaluated by the grade of execution (GOE) score. The element score is the sum of element BV and element GOE. The Total Element Score (TES) is the sum of BVs and GOEs of all elements. The judges also evaluate the overall presentation of the performance to give the Components Score (CS). The components score refers to skating skills, transitions, performance, composition, and interpretation of the music. Skating skills are defined by the overall cleanness and sureness, edge control and flow over the ice surface demonstrated by edges, steps, turns etc., the clarity of technique and the use of effortless power to accelerate and vary speed. Transitions refer to the variety, difficulty and use of footwork, positions, movements and holds that link all elements. Performance is defined as physical, emotional and intellectual involvement in delivering the intent of the music and composition (e.g. projection, carriage, variety, contrasts, personality, and projection). Composition is defined as an

intentionally developed and/or original arrangement of all types of movements according to the principles of musical phrase, space, pattern, and structure (e.g. idea, concept, vision, mood, pattern, multidimenstional use of space, phrasing, originality, design.) Interpretation of the music is defined as the personal, creative, and genuine translation of the rhythm, character and content of music to movement on ice.

Total Program Component Score (TPCS) is the sum of the Components Scores multiplied by a factor of 2 for men FS, by a factor 1.6 for women FS, by a factor 1 for men SP and by a factor 0.8 for women SP. The factor (weight) of the component score equilibrates the importance of component score with that of the technical score. The Total Segment Score (TSS) in the sum of TES and TPCS with added deductions (e.g. for falls) which have a negative value (DEDs).

It follows from these rules that women are not in a situation to obtain the same scores as men even if they were able to perform the same elements at the same quality. In the short program they are not allowed to perform quadruple jumps in the SP while men are allowed to. Hence, their TES is lower. Consequently, also the TPCS is lower for women as it is designed in such way as to level with TES. Furthermore, weight factor is lower for women in both, SP and FS.

Tables 1-3 show as an example scoring on a recent National Championships of Russia 2022 [15]. Besides the official scores for SP and FS (Tables 1 and 2, Columns 2-6) a projection is made by taking into account the same CS weights for men and women, respectively (Columns 7 and 8).

Table 1. Scoring of the Short Program for first 10 women and first 10 men in the National Championships of Russia 2022.

1	2	3	4	5	6	7	8
Name	BV SP	TES SP	CS SP	DEDs SP	TSS SP	Proj. CS SP	Proj. TSS SP
Kamila Valieva (F)	37.71	51.49	38.89	0.00	90.38	48.61	100.10
Alexandra Trusova (F)	37.11	39.61	35.60	-1.00	74.21	44.50	83.11
Anna Shcherbakova (F)	33.78	43.62	37.84	0.00	81.46	47.30	90.92
Adeliia Petrosian (F)	31.65	40.51	32.78	0.00	73.29	40.98	81.49
Sofia Samodelkina (F)	37.11	43.88	32.86	0.00	76.74	41.08	84.96
Sofia Muravieva (F)	37.51	47.74	34.13	-1.00	80.87	42.66	89.40
Elizaveta Tuktamysheva (F)	34.03	36.97	35.31	-1.00	71.28	44.14	80.11
Maiia Khromykh (F)	29.22	34.96	34.40	0.00	69.36	43.00	77.96
Kseniia Sinitsyna (F)	32.41	37.13	33.62	0.00	70.75	42.02	79.16
Veronika Yametova (F)	28.13	30.60	29.12	0.00	59.72	36.40	67.00
Mark Kondratiuk (M)	44.81	52.96	43.20	0.00	97.77	43.20	97.77
Mikhail Kolyada (M)	47.18	47.08	37.00	0.00	94.26	37.00	94.26
Andrei Mozalev (M)	44.11	47.87	43.26	-1.00	90.98	43.26	90.98
Evgeni Semenenko (M)	44.06	53.97	44.80	0.00	98.03	44.80	98.03
Petr Gumennik (M)	42.54	48.50	41.49	0.00	91.04	41.49	91.04
Alexander Samarin (M)	44.68	50.55	48.50	-1.00	94.23	48.50	94.23
Alexey Erokhov (M)	41.58	53.66	44.10	0.00	95.24	44.10	95.24
Gleb Lutfullin (M)	40.61	48.26	45.50	-2.00	86.87	45.50	86.87
Dmitri Aliev (M)	45.18	41.22	33.20	0.00	86.40	33.20	86.40
Makar Ignatov (M)	43.72	53.12	46.00	-1.00	95.84	46.00	95.84

BV: Technical Base Value Score, SP: Short Program, TES: Total Element Score, CS: Components Score, DEDs: Deductions, TSS: Total Segment Score, Proj. CS SP: Projected Components Score by taking the same weight factor for men and women, Proj. TSS SP: Projected Total Segment Score by taking the same weight factor for men and women. M: male, F: female gender.

Table 2. Scoring of the Free Skating for first 10 women and first 10 men in the National Championships of Russia 2022.

1	2	3	4	5	6	7	8
Name	BV FS	TES FS	CS FS	DEDs FS	TSS FS	Corr. CS FS	Corr. TSS FS
Kamila Valieva (F)	86.07	113.09	79.20	0.00	193.10	99.00	212.90
Alexandra Trusova (F)	90.81	101.34	74.10	-1.00	174.44	92.62	194.96
Anna Shcherbakova (F)	73.68	82.51	76.59	-1.00	158.10	95.74	179.25
Adeliia Petrosian (F)	75.05	93.20	67.48	0.00	160.68	84.35	177.55
Sofia Samodelkina (F)	76.81	88.19	68.16	0.00	156.35	85.20	173.39
Sofia Muravieva (F)	69.91	82.31	67.03	0.00	149.34	83.79	166.10
Elizaveta Tuktamysheva (F)	64.35	79.26	73.86	0.00	153.12	92.32	171.58
Maiia Khromykh (F)	75.33	80.26	68.56	-1.00	147.82	85.70	166.96
Kseniia Sinitsyna (F)	66.25	68.90	67.96	-3.00	133.86	84.95	156.85
Veronika Yametova (F)	61.34	71.47	60.18	0.00	131.65	75.22	146.70
Mark Kondratiuk (M)	76.26	93.68	92.92	0.00	186.60	92.92	186.60
Mikhail Kolyada (M)	76.22	93.86	95.58	0.00	189.44	95.58	189.44
Andrei Mozalev (M)	85.22	97.88	90.42	-1.00	187.30	90.42	187.30
Evgeni Semenenko (M)	76.18	86.39	90.86	-1.00	176.25	90.86	176.25
Petr Gumennik (M)	79.66	87.35	89.06	0.00	176.41	89.06	176.41
Alexander Samarin (M)	78.89	81.94	89.56	-1.00	170.50	89.56	170.50
Alexey Erokhov (M)	78.63	82.36	84.86	-1.00	166.22	84.86	166.22
Gleb Lutfullin (M)	73.23	83.58	81.08	0.00	164.66	81.08	164.66
Dmitri Aliev (M)	70.54	75.50	90.50	-1.00	165.00	90.50	165.00
Makar Ignatov (M)	71.60	70.15	84.78	0.00	154.93	84.78	154.93

BV: Technical Base Value Score, FS: Free Skating, TES: Total Element Score, CS: Components Score, DEDs: Deductions, TSS: Total Segment Score, Proj. CS SP: Projected Components Score by taking equal weight factors for men and women, Proj. TSS SP: Projected Total Segment Score by taking the same weight factor for men and women. M: male, F: female gender.

Table 3 shows integrated scores of women and men. Column 2 shows the official total score and Column 3 shows the first 10 places if both women and men were considered in the same category. It can be seen that with existing rules Kamila Valieva is the only woman placing within the first 10 persons. She would place third is spite of the uneven scoring system. Columns 4 and 5 show the projection by taking into account the same CS weights for men and women. It can be seen that in this case, three women would be placed within the first 10. However, women were limited by not being allowed to include quadruple jumps in their short programs, which affected the BVs of the SP and consequently also TES of SP. We therefore compared BVs of the FS (Table 3, Columns 6 and 7), which are least prone to subjective judgement as they evidence the level of elements performed (jumps, spins and sequences). It can be seen that 4 women and 6 men would be included in the list of first 10 places.

Table 3. Total segment scores/placing, projected scores/placing by taking equal weight factors for men and women and technical base value scores/placing for first 10 women and men in the National Championships of Russia 2022.

1	2	3	4	5	6	7
Name	TSS	Place TSS	Proj. TSS	Place Proj. TSS	BV FS	Place BV FS
Kamila Valieva (F)	283.48	3	313.00	1	86.07	2
Alexandra Trusova (F)	248.65		278.08	5	90.81	1
Anna Shcherbakova (F)	239.56		270.17	7	73.68	
Adeliia Petrosian (F)	233.97		259.04		75.05	10
Sofia Samodelkina (F)	233.09		258.35		76.81	7
Sofia Muravieva (F)	230.21		255.50		69.91	
Elizaveta Tuktamysheva (F)	224.40		251.69		64.35	
Maiia Khromykh (F)	217.18		244.92		75.33	
Kseniia Sinitsyna (F)	204.61		236.01		66.25	
Veronika Yametova (F)	191.37		213.70		61.34	
Mark Kondratiuk (M)	267.71	1	267.71	2	76.26	
Mikhail Kolyada (M)	264.34	2	264.34	3	76.22	8
Andrei Mozalev (M)	273.08	4	273.08	4	85.22	3
Evgeni Semenenko (M)	259.60	5	259.60	6	76.18	9
Petr Gumennik (M)	258.05	6	258.05	8	79.66	4
Alexander Samarin (M)	254.06	7	254.06	9	78.89	5
Alexey Erokhov (M)	255.23	8	255.23	10	78.63	6
Gleb Lutfullin (M)	243.68	9	243.68		73.23	
Dmitri Aliev (M)	231.44	10	231.44		70.54	
Makar Ignatov (M)	237.59		237.59		71.6	

TSS: Total Segment Score, Proj. TSS: Projected Total Segment Score by taking the same weight factor for men and women, BV: Technical Base Value Score. M: male, F: female gender.

Organization and rules are important for implementation of the sport within the society needs, however, the agens movens of the field is understanding of the technique. The human body is subjected to physical laws which are the same for both genders. Coaches have in this respect the greatest possibility to achieve the results. Gus Lussi (1898 – 1993) born in Switzerland and working in United States of America had contributed essentially to the development of the modern skating technique. In his own sport career he was a ski jumper, however, later he focused on figure skating, in particular in free skating [10]. He based his method on physics of spinning and taught his students to master the axis of rotation to spin effortlessly. Then he transferred this technique to jumping. In collaboration with his students (from which many had become olympic and world champions in the time interval 1948 – 1976) he implemented the flip jump, double and triple jumps (appearing as early as 1956) and flying spins. Skater S. Bonaly in the nineties contributed largely to the development of the technique of landing of triple and quadruple jumps and in introducing novelties in landing of backflips on one foot. While the former is largely used in modern skating technique, the backflip elements were banned by the ISU. Recently, a team in Russia (E. Tutberidze and S. Dudakov) had made a considerable step forward in understanding the physics of the quadruple jumps, in particular, in young girls. It is this team that contributed significantly to equalization of the technical performance of women and men. K. Valieva, A. Trusova, A. Schierbakova, A. Petrosian and M. Kromykh (Tables 1-3) have been trained by this team.

Figure 6. Women and men exhibiting excellence in elegance, style, esthetics of the body and fashion.

Optimally shaped body for jumps and spins is a narrow one with respect to the vertical axis in order to minimize the angular momentum in spinning. Yet there are requirements on the muscle forces to jump high enough – to stay in the air long enough – to perform multiple rotations. Decreasing the angular momentum requires also arm movement. The arms should be strong enough to stay close to the body while spinning. The overall condition of the athlete should be excellent to acquire the speed on the ice which requires already after some strokes the heart frequencies between 150 and 200 beats per minute while the concentration to successfully land triple and quadruple jumps should be supreme.
The technical input can be considered a founding stone of the figure skating performance, but it offers possibility to further up-gradation with artistry, esthetics and fashion. Some skaters have ingeniously added these qualities to the technical skills (Figure 6) which pleases the viewers and promotes this sport.

According to the ISU rules, at ISU championships, the Olympic Winter Games and international competitions, the clothing of the competitors must be modest, dignified and appropriate for athletic competition – not garish or theatrical in design. Clothing may, however, reflect the character of the music chosen. The clothing must not give the effect of excessive nudity inappropriate for the discipline. Men must wear full length trousers. In addition, in ice dance, women must wear a skirt. Accessories and props are not permitted. The decorations on costumes must be non-detachable. Clothing that does not adhere to these guidelines and part of the costume or decoration falling on the ice is penalized by a deduction.

CONCLUSION

Recent results in competitive figure skating indicate that performance of both men and women is equilibrated in technical, artistical and esthetic categories. It can be therefore expected that due to the commercial effects of the viewing, a question will be posed whether in the future the separation of the two genders in competition is reasonable.

REFERENCES

1. *Pierre de Coubertin. Les femmes aux Jeux Olympiques. Revue Olympique. 1912, 79: 109-111.*
2. *Mustar E, Trofenik D. Regulation of gender verification in sport and future sustainable development. In Proceedings of the 4th Socratic Lectures, Ljubljana. 2021, pp 195-200.*
3. *Krüüger A. Forgotten decisions. The IOC on the eve of World War I. Olympika 1997, 6: 85 – 98.*
4. *Healy ML, Gibney J, Pentecost C, et al. Endocrine profiles in 693 elite athletes in the postcompetition setting. Clinical Endocrinology. 2014, 81: 294–305. doi:10.1111/cen.12445*
5. *Britannica, The Editors of Encyclopaedia. Ice skating. Encyclopedia Britannica. 2019, https://www.britannica.com/sports/ice-skating. Accessed January 7, 2022.*
6. *International Skating Union special regulations & technical rules single & pair skating and ice dance 2021 as accepted by an online vote June 2021. Available at: https://www.isu.org/figure-skating/rules/fsk-communications. Accessed January 7, 2022.*
7. *International Skating Union constitution and general regulations 2014. Available at: http://hksu.org/en_US/about-skating/figure-skating/international-skating-union-figure-skating-technical-rules. Accessed January 7, 2022.*
8. *Floskate. 1913 World Ladies & Pairs Figure Skating Championships & Mens Nordic Games. Available at: https://www.youtube.com/watch?v=ggU8TcivI1I. Accessed January 7, 2022.*
9. *Floskate. Sjoukie Dijkstra – 1964 Olympics. Avaliable at: https://www.youtube.com/watch?v=6lS6tohTgds. Accessed January 7, 2022.*
10. *Gus Lussi Documentary. Available at: https://www.youtube.com/watch?v=3xZUNtBGLGs. Accessed January 7, 2022.*
11. *II. Technical rules single & pair skating / ice dance. Available at: https://www.isu.org/figure-skating/rules/fsk-judging-system. Accessed January 7, 2022.*
12. *Denise Biellmann, la petite amie de la Suisse. Le Temps, 2017. Available at: https://www.letemps.ch/sport/denise-biellmann-petite-amie-suisse#&gid=1&pid=1*
13. *Yuzuru Hanyu Edits. Available at: https://yuzuruhanyuedits.tumblr.com/post/151553167423/the-spectacular-spins-of-yuzuru-hanyu-the. Accessed January 22, 2022.*
14. *ISU Judging System. Available on: https://en.wikipedia.org/wiki/ISU_Judging_System. Accessed January 7, 2022.*
15. *Rostelecom Russian Nationals 2022 Results. Available at: https://fsrussia.ru/results/2122/rusnat2122/ENG/index.htm. Accessed January 22, 2022.*