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Cadet and Junior Performance Is Associated With Senior's World Championship and Olympics Achievement in Judo

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ABSTRACT

Purpose: We determined whether cadet and junior Judo World Championship participation and medal achievement would predict senior performance at World Championship (WC) and Olympic Games (OG).

Methods: We analyzed retrospectively a total of 7780 athletes who competed at the OG and WC in the cadet, junior, and senior between 2009 and 2021. **Results:** There was an increase in the probability of winning a medal in the senior category (WC and OG, and only WC) ranged from 4.3 to 4.5 for medal-winning cadets compared to non-medalists and this probability remained around 3.3–3.8 for medalists in the male and 5.3–5.4 for the female medalists in cadet WC. Moreover, the chance of winning a medal in the senior category (WC and OG) was 8.1–8.5 times greater for medalists when compared to non-medalists in the junior WC. In turn, the probability of winning a medal in the senior (WC) was 1.5–1.7 times greater for athletes who did not compete in the junior WC. In the OG, the probability of winning a medal was 3.5 greater times for medalists when compared to non-medalists at cadet and junior WC.

Conclusion: Thus, being a cadet or junior WC medalist increases the probability of winning a senior WC or an Olympic medal.

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Athlete development; combat sports; grappling; sport specialization

In Ancient Greece, Olympic Games were the most important event, which demanded a frequent and great investment of each City-State in their athletes (Poliakoff, 1987). Boys competition was part of the Ancient Olympic Games, and at that time as nowadays, there were also worries regarding the effect of early achievements on future performances. Aristotle, in its *Politics* (Aristotle, 2009), established that “The evil of excessive training in early years is strikingly proved by the example of the Olympic victors; for not more than two or three of them have gained a prize both as boys and as men; their early training and severe gymnastic exercises exhausted their constitutions.” Currently, nations interested in a good position in the international level competition, especially at the Olympic Games, try to optimize their limited resources to achieve outstanding results. Sport science-based approaches have been reported to be effective, and the successful experience of Great Britain regarding talent development has been reported (Rees et al., 2016). Indeed, systems developed to improve the efficiency of the work executed by coaches and sports scientists have provided scientific evidence to increase sports skills at different ages (Balagué et al., 2017).

Therefore, determining the factors that may contribute to success in these sports can be relevant for decision-making processes regarding resource application. An initial and relevant approach to obtaining this information is to verify whether early success in a given sport may predict future success. Some authors reported no predictive power of early competitive success on senior career performance in power- (Boccia et al., 2021, 2021) and sprint-related (Boccia et al., 2021) track and field events or even a negative relationship

between junior and senior performances (Barreiros & Fonseca, 2012; Güllich & Emrich, 2014). Conversely, some investigations reported low-to-moderate correlations between junior and peak senior performance (Brustio et al., 2021), and others have observed and proposed that early performance is relevant for senior success, specifically in tennis, swimming (Post et al., 2020; Yustres et al., 2019), cycling (Gallo et al., 2022; Mostaert et al., 2022) and track-and-field events (Fulton et al., 2022; Hollings & Hume, 2010; Reid et al., 2007, 2009). However, a study with sprint swimmers demonstrated that early-success athletes presented a performance stagnation around 16 to 18 years for females and 19 to 20 years for males, while later-success swimmers presented 1–2% annual performance increase up to 20 to 24 years (Brustio et al., 2022). Thus, these authors suggested that using solely early performance for talent identification instead of rate of progression may have limited contribution to this end.

Combat sports have a relevant contribution to the total medals disputed in multi-sport events, with special reference to the Olympic Games, where nearly 25% of the total medals come from these sports (Franchini & Gutiérrez-García, 2018). Moreover, Olympic combat sports have specific characteristics, such as athletes’ division in weight categories, and demanding several physiological and psychological traits to be successful (Bridge et al., 2014; Chaabene et al., 2017; Chaabène et al., 2012, 2015; Franchini et al., 2011). However, few studies investigated the relationship between cadet and junior performance in these sports and senior or Olympic success (Julio et al., 2011; Li et al., 2018). Li et al. (2018) reported that 61.4% of

the junior medal winners in international competitions and 90.4% of those who competed as seniors when they were still junior—early achievers in the definition of the authors—went on to win international events at a senior age. Among these early achievers, 92.2% of the taekwondo athletes, 68.4% of the wrestlers, and 37.9% of the boxers could be reliably predicted to achieve international senior success (i.e., to win a medal). However, this study did not include two other combat sports, judo, and fencing. Specifically, with judo athletes, Julio et al. (2011) reported that nearly 93% of the athletes did not repeat their initial competitive results at the state-level competition, independently of age or sex. It is important to consider, however, that this study considered state-level performance, included athletes from 9–10 years-old, 11–12 year-old, 13–14 years-old, 15–16 years-old, 17 to 19 years-old, and 20+ years-old, and was conducted before a series of changes were implemented in international judo competitions—specifically the judo world tour and its ranking system in 2009. Indeed, since 2009 cadet judo athletes take part in World Championships and judo is part of the Youth Olympic Games since 2010. Junior Judo World Championship has a long tradition. Additionally, in 2009 the International Judo Federation adopted the world ranking list used for senior athletes for both cadet and junior athletes (Franchini & Julio, 2015; Velloso Breviglieri et al., 2018). Evidence demonstrated that Olympic-level judo athletes typically start to practice before they are 9 years old and compete before they are 10–11 years old (Franchini & Takito, 2014). However, little is known regarding the relationship between judo performance in top-level international competition during the cadet and junior years, and athletes' achievement in senior competitions.

Therefore, the objective of the present study was to determine whether cadet and junior Judo World Championship participation and medal achievement would predict senior performance at World Championship and/or Olympic Games. The main hypothesis of this study was that judo athletes medaling at cadet and/or junior Judo World Championship would more likely be able to win a medal at senior World Championship and/or Olympic Games.

Methods

Procedures

A total of 7780 athletes (4714 male and 3066 female) competed at Olympic Games and World Championships in the Cadet (2845), Junior (3512), and Senior (3132) between 2009 and 2021. Specifically, the 2009–2021 period was considered for the senior age group, whereas the 2009–2019 period was considered for the cadet and junior age groups. Thus, this insertion considered the possibility of cadets competing in the junior age group, and junior competing in the senior age group in the period analyzed. Considering only athletes that competed in World Championships we analyzed 7718 (4670 male and 3048 female), with 3073 competing in the senior category. For Olympic Games, 651 athletes were considered.

All data were collected and compiled from the official International Judo Federation database website (www.judobase.org), and missing information was obtained by accessing supplementary websites (www.judoinside.com and www.ijf.org). These archive data are from open-access, and no ethical issues were involved in the analysis and interpretation of these data as they were obtained in secondary form and not generated by experimentation, and athletes' details were not presented.

Statistical analysis

Logistic regression was used to measure the magnitude of association between winning a medal in the Olympic Games and/or the World Championships. This analysis was performed considering the dependent variables, winning a medal in the Olympic Games and/or World Championship or not, and the independent variables World Championships participation in the cadet and junior classes, as medalists, non-medallists, and no participation. The models were presented overall and separately for each sex. Results were reported as odds ratio (OR), and 95% confidence interval (CI). The level of significance was 5%. All the analyses were performed with Statistical Package Social Science (SPSS, Version 17.0).

Results

Table 1 presents analyses for considering the participation in the cadet World Championships. When data were analyzed altogether (males and females), the chance of winning a medal in the senior category (World Championships and/or Olympic Games, and only World Championships) ranged from 4.3 to 4.5 for medal-winning cadets compared to non-medalists (**Table 1**). Regarding sex, it is noted that this chance remained around 3.3–3.8 for medalists in the male and 5.3–5.4 for the female medalists in cadet World Championships. Conversely, there was no significant association ($p > .05$) between medalists in the senior competitions and athletes who did not compete in the cadet World Championships.

Table 2 analyses for considering the participation in the junior World Championships. When the data were analyzed altogether (males and females), the odds of winning a medal in the senior category (World Championships and/or Olympic Games) were 8.1–8.5 times greater for medalists when compared to non-medalists in the junior World Championships ($p < .001$). For males, the odds of winning a medal in the senior category were 6.9–7.8 times greater for medalists in the junior World Championships when compared to non-medalists. For females, the odds ratio of winning a medal in the senior category was 9.4–10.6 times greater for medalists concerning non-medalists in the junior World Championships ($p < .001$). Moreover, the odds ratio of winning a medal in the senior (including World Championships) was 1.5–1.7 times greater for athletes who did not compete in the junior World Championships ($p < .05$). However, there was no significant association between male athletes who did not compete and

Table 1. Distribution of winning a medal in the senior category (World Championships and/or Olympic Games, and only World Championships) by results at cadet World Championships.

Cadet WC	Senior category (WC and/or OG)						Senior World Championships					
	Win a medal			Total			Win a medal			Total		
Grouped	n	%	n	OR	95% CI	p	n	%	n	OR	95% CI	p
No medal	20	8.8	226	1			18	8	225	1		
Medal	26	30.2	86	4.46	2.33–8.55	<0.001	23	27.1	85	4.26	2.16–8.14	<0.001
No participation	373	13.2	2820	1.57	0.98–2.52	0.061	296	10.7	2763	1.38	0.84–2.27	0.204
Males												
No medal	12	9.2	131	1			11	8.4	131	1		
Medal	11	27.5	40	3.76	1.51–9.38	0.004	9	23.1	39	3.27	1.24–8.61	0.016
No participation	204	11.8	1735	1.32	0.72–2.44	0.372	158	9.3	1698	1.20	0.59–2.12	0.730
Females												
No medal	8	8.4	95	1			7	7.4	94	1		
Medal	15	32.6	46	5.26	2.03–13.62	0.001	14	30.4	46	5.44	2.01–14.69	0.001
No participation	169	15.6	1085	2.01	0.96–4.22	0.066	138	13	1065	1.85	0.84–4.08	0.127

Note: 95%CI = confidence interval at 95%.

Table 2. Distribution of winning a medal in the Senior category by competition (World Championships and/or Olympic Games, and only World Championships) by results at Junior World Championships.

Junior WC	Senior category (WC and/or OG)						Senior World Championships					
	Win a medal			Total			Win a medal			Total		
Grouped	n	%	n	OR	95% CI	P	n	%	n	OR	95% CI	p
No medal	43	7.4	581	1			38	6.5	583	1		
Medal	93	40.4	230	8.49	5.65–12.76	<0.001	84	36.2	232	8.14	5.33–12.44	<0.001
No participation	283	12.2	2321	1.74	1.24–2.43	0.001	215	9.5	2258	1.51	1.06–2.16	0.024
Males												
No medal	27	7.7	352	1			26	7.3	356	1		
Medal	43	39.4	109	7.84	4.53–13.58	<0.001	39	35.1	111	6.88	3.94–12.01	<0.001
No participation	157	10.9	1445	1.47	0.96–2.25	0.078	113	8.1	1401	1.11	0.72–1.73	0.634
Females												
No medal	16	7.0	229	1			12	5.3	227	1		
Medal	50	41.3	121	9.38	5.02–17.49	<0.001	45	37.2	121	10.61	5.33–21.12	<0.001
No participation	126	14.4	876	2.24	1.30–3.85	0.004	102	11.9	857	2.42	1.31–4.49	0.005

Note: 95%CI = confidence interval at 95%.

Table 3. Distribution of winning a medal in the Olympic Games by results at Cadet and Junior World Championships (WC).

Cadet WC	Olympic Games					
	Win a medal			Total		
Grouped	n	%	n	OR	95% CI	p
No medal	6	11.5	52	1		
Medal	12	33.3	36	3.83	1.28–11.48	0.016
No participation	88	15.6	563	1.42	0.59–3.43	0.435
Junior WC						
No medal	16	12.9	124	1		
Medal	38	33.9	112	3.47	1.80–6.67	<0.001
No participation	52	12.5	415	0.97	0.53–1.76	0.913

Note: 95%CI = confidence interval at 95%.

non-medalists in the junior World Championships and winning a medal in the Senior category ($p > .05$). Moreover, the odds ratio of winning a medal in the senior category was 2.2–2.4 greater for athletes who participated when compared to non-medalists in the junior World Championships ($p = .005$).

Considering only the Olympic Games (Table 3), the odds of winning a medal-winning was 3.5 greater times for medalists when compared to non-medalists at cadet ($p = .016$) and junior World Championships ($p < .001$). However, there was no significant association between athletes who won a medal in Olympic Games but did not compete in the cadet ($p = .435$) or junior World Championships ($p = .913$).

Discussion

The main finding of the present study was that being a medal winner at cadet or junior World Championships increased the odds ratio of winning a senior World Championship or an Olympic medal, confirming our hypothesis. Another relevant finding was that just competing but not getting a medal at cadet World Championships did not affect the chance of getting a medal at senior World Championship or Olympics compared with those who did not take part in these specific-age competitions. For female junior athletes, however, a higher odds ratio of winning medals in the senior World Championships was found when they did not participate in the junior World

Championships compared to those who took part but did not win medals.

Other authors have also reported that junior performance was relevant for senior success in tennis (Kovalchik et al., 2017; Reid et al., 2007, 2009), swimming (Post et al., 2020; Yustres et al., 2019), cycling (Gallo et al., 2022; Mostaert et al., 2022) and track-and-field events (Barreiros & Fonseca, 2012; Boccia et al., 2021; Brustio et al., 2021; Chaabène et al., 2012; Güllich & Emrich, 2014). When the ranking trajectories of the elite female tennis talents were analyzed, Kovalchik et al. (2017) showed that female tennis players with the highest career peak ranking were youngest when first ranked, top 10 players were first ranked at age 15.5 years, 1.2 years earlier than top 51–100 players. Moreover, early success under 18 (U-18) is not a good predictor of becoming an elite senior athlete in sprint events (100-, 200- and 400-m races; Boccia et al., 2021) and jump disciplines (i.e., high jump, long jump, triple jump and pole vault; Boccia et al., 2021). Indeed, when analyzing sprint swimmers, Brustio et al. (2021) indicated that the sole use of early performance for talent identification had limited value compared with the rate of progression. However, for combat sports, performance-related variables are more difficult to identify as no single parameter is related to performance (Kons et al., 2018, 2020).

Specifically, regarding combat sports, we found only two studies that addressed early-career and senior performances (Julio et al., 2011; Li et al., 2018). Julio et al. (2011) observed that approximately 93% of judo athletes did not repeat their initial state-level competitive results, independently of age or sex. However, this study was conducted before a series of rule changes in judo (i.e., the creation of a world ranking list for senior, cadet, and junior athletes by IJF), included athletes as young as 9–10 years-old, and no information was reported regarding whether some of these athletes did not achieve the same competitive level due to competing in higher levels, and not taking part in state-level competitions anymore. Li et al. (2018) investigated wrestlers, boxers, and taekwondo athletes and reported that 61.4% of the junior medal winners in international competitions and 90.4% of those who competed as senior when they were still junior—early achievers in the definition authors—won international events at a senior age. Among these early achievers, 92.2% of the taekwondo athletes, 68.4% of the wrestlers, and 37.9% of the boxers could be reliably predicted to achieve international senior success (i.e., to win a medal). Indeed, in our study around 40% of junior and 30% of cadet World Championship medal winners were able to repeat their achievements at the senior World Championship or the Olympic Games. In turn, Barreiros and Fonseca (2012), analyzing soccer, volleyball, swimming, and judo Portuguese athletes, observed that it was possible to win a medal at senior age without taking part in junior competitions. However, they indicated that especially for the individual sports analyzed (i.e., swimming and judo) those athletes who did not achieve relevant results in younger categories presented difficulty presenting similar results as those who had gained medals when younger.

Different from our study that analyzed only World Championships and Olympic Games, however, Li et al. (2018) considered several international competitions. Therefore, when compared to the only two studies (Julio et al., 2011; Li et al., 2018) addressing this issue with combat sports athletes, our study found similar results, adding information specifically regarding judo and including cadet competitions as predictive events. A limitation of our study was that we did not consider whether junior athletes were already performing well at the senior level, as investigated by Li et al. (2018).

The increased odds ratio of winning medals in the senior World Championships for females who did not take part in the junior World Championships compared to those who took part in it but did not win medals can be explained by lower scrutiny of the technical and tactical approaches of these athletes by their opponents or a preserved confidence for those not taking part in such event. Interestingly female judo athletes reach the world level at younger ages than their male counterparts (Franchini et al., 2020). It seems that for this specific group, an early exposition may result in being studied by the opponents, which can create specific strategies to deal with specific actions. Additionally, unsuccessful participation may create a negative carry-over effect for the senior event, a fact not experienced by those not taking part in the junior World Championships. Moreover, elite performance needs many hours of training and exposure to numerous competitions, and the longer the career the greater the possibility to reach a high-performance level (Boccia et al., 2019).

Another limitation of the present study was that we did not analyze the different weight categories, which may be a factor influencing these results. However, such an approach would decrease the statistical power of our results. Over the years, this analysis considering the weight categories will likely be possible to execute, as more athletes will compose the sample. Additionally, future studies should investigate which variables (e.g., technical, physical and psychological abilities) are related to performance in different age groups, and which variables development during cadet or junior ages may predict future performance in senior competitions.

Conclusion

Therefore, our study indicated that cadet World Championship medal winners have an increased odds ratio of winning a senior World Championship or an Olympic medal. Thus, it seems that in judo, directing the training program to allow athletes to achieve this level of performance at early age (i.e., cadet) can be a good strategy when focusing on later performances. However, it is important to consider that not taking part in cadet World Championships did not affect the likelihood of winning a medal at top-level senior competitions (i.e., World Championship or Olympics) compared with those who just took part in the World Championships—and not got a medal—at these specific-age competitions. However, for female athletes aiming to win a medal at the senior World Championships, it is better not to take part in the junior World Championships compared to those who took part but

did not win medals. Together, our results may be utilized by athletes, coaches, and sports managers in setting goals and assessing athletes' development for judo athletes helping to play a role in the long-term athlete's development process.

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References

- Aristotle. (2009). *The politics*. A&D Publishing.
- Balagué, N., Torrents, C., Hristovski, R., & Kelso, J. A. S. (2017). Sport science integration: An evolutionary synthesis. *European Journal of Sport Science*, 17(1), 51–62. <https://doi.org/10.1080/17461391.2016.1198422>
- Barreiros, A. N., & Fonseca, A. M. (2012). A retrospective analysis of Portuguese elite athletes' involvement in international competitions. *International Journal of Sports Science & Coaching*, 7(3), 593–600. <https://doi.org/10.1260/1747-9541.7.3.593>
- Boccia, G., Brustio, P. R., Moisè, P., Franceschi, A., La Torre, A., Schena, F., Rainoldi, A., & Cardinale, M. (2019). Elite national athletes reach their peak performance later than non-elite in sprints and throwing events. *Journal of Science and Medicine in Sport*, 22(3), 342–347. <https://doi.org/10.1016/j.jsams.2018.08.011>
- Boccia, G., Cardinale, M., & Brustio, P. R. (2021). Elite junior throwers unlikely to remain at the top level in the senior category. *International Journal of Sports Physiology and Performance*, 16(9), 1281–1287. <https://doi.org/10.1123/ijsspp.2020-0699>
- Boccia, G., Cardinale, M., & Brustio, P. R. (2021). Performance progression of elite jumpers: Early performances do not predict later success. *Scandinavian Journal of Medicine & Science in Sports*, 31(1), 132–139. <https://doi.org/10.1111/sms.13819>
- Boccia, G., Cardinale, M., & Brustio, P. R. (2021). World-class sprinters' careers: Early success does not guarantee success at adult age. *International Journal of Sports Physiology and Performance*, 16(3), 367–374. <https://doi.org/10.1123/ijsspp.2020-0090>
- Bridge, C. A., Ferreira da Silva Santos, J., Chaabène, H., Pieter, W., & Franchini, E. (2014). Physical and physiological profiles of taekwondo Athletes. *Sports Medicine*, 44(6), 713–733. <https://doi.org/10.1007/s40279-014-0159-9>
- Brustio, P. R., Cardinale, M., Lupo, C., & Boccia, G. (2022). Don't throw the baby out with the bathwater: Talent in swimming sprinting events might be hidden at early age. *International Journal of Sports Physiology and Performance*, 17(11), 1–8. <https://doi.org/10.1123/ijsspp.2021-0530>
- Brustio, P. R., Cardinale, M., Lupo, C., Varalda, M., De Pasquale, P., & Boccia, G. (2021). Being a top swimmer during the early career is not a prerequisite for success: A study on sprinter strokes. *Journal of Science and Medicine in Sport*, 24(12), 1272–1277. <https://doi.org/10.1016/j.jsams.2021.05.015>
- Chaabène, H., Hachana, Y., Franchini, E., Mkaouer, B., & Chamari, K. (2012). Physical and physiological profile of elite Karate athletes. *Sports Medicine*, 42(10), 829–843. <https://doi.org/10.1007/BF03262297>
- Chaabene, H., Negra, Y., Bouguezzi, R., Mkaouer, B., Franchini, E., Julio, U., & Hachana, Y. (2017). Physical and physiological attributes of wrestlers: An update. *Journal of Strength and Conditioning Research*, 31(5), 1411–1442. <https://doi.org/10.1519/JSC.0000000000001738>
- Chaabène, H., Tabben, M., Mkaouer, B., Franchini, E., Negra, Y., Hammami, M., Amara, S., Chaabène, R. B., & Hachana, Y. (2015). Amateur boxing: Physical and physiological attributes. *Sports Medicine*, 45(3), 337–352. <https://doi.org/10.1007/s40279-014-0274-7>
- Franchini, E., Del Vecchio, F. B., Matsushigue, K. A., & Artioli, G. G. (2011). Physiological profiles of elite judo athletes. *Sports Medicine*, 41(2), 147–166. <https://doi.org/10.2165/11538580-00000000-00000>
- Franchini, E., Fukuda, D. H., & Lopes-Silva, J. P. (2020). Tracking 25 years of judo results from the world championships and Olympic games: Age and competitive achievement. *Journal of Sports Sciences*, 38(13), 1531–1538. <https://doi.org/10.1080/02640414.2020.1747265>
- Franchini, E., & Gutiérrez-García, C. (2018). Olympic combat sports research output in the web of science: A sport sciences centered analysis. *Ido Mov Culture*, 18(3), 21–27. <https://doi.org/10.14589/ido.18.3.4>
- Franchini, E., & Julio, U. F. (2015). The judo world ranking list and the performances in the 2012 London Olympics. *Asian Journal of Sports Medicine*, 6(3). <https://doi.org/10.5812/asjm.24045>
- Franchini, E., & Takito, M. Y. (2014). Olympic preparation in Brazilian judo athletes. *Journal of Strength and Conditioning Research*, 28(6), 1606–1612. <https://doi.org/10.1519/JSC.0000000000000300>
- Fulton, T. J., Baranauskas, M. N., & Chapman, R. F. (2022). World championship and Olympic games experience influences future medal performance in track-and-field athletes. *International Journal of Sports Physiology and Performance*, 17(1), 111–114. <https://doi.org/10.1123/ijsspp.2021-0027>
- Gallo, G., Mostaert, M., Faelli, E., Ruggeri, P., Delbarba, S., Codella, R., Vansteenkiste, P., & Filipas, L. (2022). Do race results in youth competitions predict future success as a road cyclist? A retrospective study in the Italian cycling federation. *International Journal of Sports Physiology and Performance*, 17(4), 621–626. <https://doi.org/10.1123/ijsspp.2021-0297>
- Güllich, A., & Emrich, E. (2014). Considering long-term sustainability in the development of world class success. *European Journal of Sport Science*, 14(sup1), S383–397. <https://doi.org/10.1080/17461391.2012.706320>
- Hollings, S. C., & Hume, P. A. (2010). Is success at the world junior athletics championships a prerequisite for success at world senior championships or Olympic games? – Prospective and retrospective analyses. *New Studies in Athletics*, 25(2), 65–77.
- Julio, U. F., Takito, M. Y., Mazzei, L., Miarka, B., Sterkowicz, S., & Franchini, E. (2011). Tracking 10-year competitive winning performance of judo athletes across age groups. *Perceptual and Motor Skills*, 113(1), 139–149. <https://doi.org/10.2466/05.10.11.pms.113.4.139-149>
- Kons, R. L., Dal Pupo, J., Ache Dias, J., & Detanico, D. (2018). Female judo athletes' physical test performances are unrelated to technical-Tactical competition skills. *Perceptual and Motor Skills*, 125(4), 802–816. <https://doi.org/10.1177/0031512518777586>
- Kons, R. L., da Silva Athayde, M. S., da Silva Junior, J. N., Katcipis, L. F. G., & Detanico, D. (2020). Predictors of judo-specific tasks from neuromuscular performance in young athletes aged 11–16 years. *International Journal of Sports Physical Therapy*, 15(3), 365–373. <https://doi.org/10.26603/ijsppt20200365>
- Kovalchik, S. A., Bane, M. K., & Reid, M. (2017). Getting to the top: An analysis of 25 years of career rankings trajectories for professional women's tennis. *Journal of Sports Sciences*, 35(19), 1904–1910. <https://doi.org/10.1080/02640414.2016.1241419>
- Li, P., De Bosscher, V., Pion, J., Weissensteiner, J. R., & Vertonghen, J. (2018). Is international junior success a reliable predictor for international senior success in elite combat sports? *European Journal of Sport Science*, 18(4), 550–559. <https://doi.org/10.1080/17461391.2018.1439104>
- Mostaert, M., Vansteenkiste, P., Pion, J., Deconinck, F. J. A., & Lenoir, M. (2022). The importance of performance in youth competitions as an indicator of future success in cycling. *European Journal of Sport Science*, 22(4), 481–490. <https://doi.org/10.1080/17461391.2021.1877359>
- Poliakoff, M. (1987). *Combat sports in the ancient world: Competition, violence, and culture*. Yale University.
- Post, A. K., Koning, R. H., Visscher, C., & Elferink-gemser, M. T. (2020). Multigenerational performance development of male and female top-

- elite swimmers—a global study of the 100 m freestyle event. *Scandinavian Journal of Medicine & Science in Sports*, 30(3), 564–571. <https://doi.org/10.1111/sms.13599>
- Rees, T., Hardy, L., Güllich, A., Abernethy, B., Côté, J., Woodman, T., Montgomery, H., Laing, S., & Warr, C. (2016). The great British medalists project: A review of current knowledge on the development of the world's best sporting talent. *Sports Medicine*, 46(8), 1041–1058. <https://doi.org/10.1007/s40279-016-0476-2>
- Reid, M., Crespo, M., & Santilli, L. (2009). Importance of the ITF junior girls' circuit in the development of women professional tennis players. *Journal of Sports Sciences*, 27(13), 1443–1448. <https://doi.org/10.1080/02640410903037714>
- Reid, M., Crespo, M., Santilli, L., Miley, D., & Dimmock, J. (2007). The importance of the International Tennis Federation's junior boys' circuit in the development of professional tennis players. *Journal of Sports Sciences*, 25(6), 667–672. <https://doi.org/10.1080/02640410600811932>
- Velloso Breviglieri, P., Emilia Soares Possa, M., Moura Campos, V., Humberstone, C., & Franchini, E. (2018). Judo world ranking lists and performance during cadet, junior and senior world championships. *Ido Mov Culture*, 18(2), 48–53. <https://doi.org/10.14589/ido.18.2.7>
- Yustres, I., Santos Del Cerro, J., González-Mohino, F., Peyrebrune, M., & González-Ravé, J. M. (2019). Comparing the pathway to success in European Countries competing in the swimming world championships. *Frontiers in Psychology*, 10, Article 10. <https://doi.org/10.3389/fpsyg.2019.01437>