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ORIGINAL PAPER

Life Expectancy of Olympic Wrestling Champions in Comparison to the General Population

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Abstract

Although it was presumed that moderate exercise is a healthy practice but long term high intensity exercise is not, studies observed a life expectancy benefit for both high-intensity endurance and fast power sports athlets, but the data for contact sports are conflicting. Therefore, the author aimed to investigate the life expectancy of Olympic wrestling champions in comparison to the general population. Characteristics, vital status and life-span of the male Olympic wrestling champions was collected (1896–2016). The life expectancy of Olympic champions was compared with matched individuals of the general population (by country, age, and year of birth) obtained from the human mortality database (http://www.mortality.org). Overall, 341 male Olympic wrestling champions with median age of 25 (IQR 24–28) years at their Olympic victory were included in this analysis. In total, 142 (41.6%) came of rich countries. The survival was not affected by weight class and country of origin. A significant life expectancy benefit for Olympic champions in comparison to the general population was observed. Male Olympic wrestling champions lived in mean 19.1 ± 19.1 years longer than the matched individuals of the general population (respectively of their country of origin). A substantially lower mortality in male Olympic wrestling champions, compared with the general male population was observed. However, the results do not allow us to draw conclusions about the causes of this survival benefit.

Keywords Olympic champion · Wrestling · Life expectancy · Wrestler · Olympia

Abbreviations

IQR Interquartile range

Introduction

The Olympic Summer Games are the world's largest and most important sports event. At the Olympic games in Rio de Janeiro in the year 2016 more than 11,000 participants from more than 200 countries competed for Olympic sports glory. The Olympic summer games of the modern era have been held every 4 years since 1896 except during the two World Wars. The Olympic wrestling events were part of the Olympic Summer Games since the beginning in the year 1896.

The benefit of regular moderate physical activity is well established and moderate sport activity has been recommended for both primary and secondary prevention of cardiovascular diseases since several years [1, 5, 11, 12]. Although, it has been presumed that moderate exercise is a healthy practice but long term high intensity exercise is not, studies observed a life expectancy benefit for both high-intensity endurance [7, 11, 14, 16] as well as fast power sports athlets [7, 15]. The data for contact sports are conflicting [2, 15, 20]. To the best of our knowledge, there are sparse study results about contact sports athletes such as

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Olympic wrestling. The focus was on Olympic wrestling as the oldest Olympic fighting sports.

Thus, the aim of this study was to investigate the life expectancy of Olympic wrestling champions in comparison to the general population.

Methods

Data on Olympic wrestling champions, for the modern Olympic era between 1896 and 2016, were collected by internet research especially from two official Websites (http://www.unitedworldwrestling.org, http://www.olympic.org) and complemented with two other sources (http://www.wikipedia.org, http://www.google.com/).

The internet research comprised dates of birth and death of all Olympic wrestling champions (Freestyle and Greco-Roman style). The cutoff day for this information was the the 31 December 2016. The life-span in years with the survival interval since the date of birth up to the date of death or to the 31 December 2016 was calculated for each Olympic champion. In addition, for each athlete the year of his Olympic victory, the weight class, the wrestling style (Freestyle and Greco-Roman style), the age of the Olympic champions at their first Olympic wrestling victory, the number of Olympic victories (single vs. multiple) and the country of origin was assessed.

In wrestlers with more than one Olympic wrestling victories, only the first Olympic victory was included in the analysis.

Overall, 391 Olympic men wrestling champion titels were awarded to 341 athlets. In the year 1912 in the semi-heavyweight class of Greco-Roman tournament no Olympic title was awarded, because no winner could be established out of the final fight. In total, 50 Olympic titels were won by wrestlers, who had already at least one Olympic title. As mentioned above, only the first Olympic victory was taken into account for this analysis.

The Olympic champions came of more than 25 countries. Olympic wrestling champions were compared with matched cohorts in the general population (by country, age, sex, and year of birth). The average age of death of the male general population in the countries of origin was calculated from data obtained from the human mortality database (http://www.mortality.org). For the countries Turkey, Cuba, Iran, South and North Korea, Romania, Yugoslavia, Greece and Egypt no average age of death of the male general population was available. Therefore, the Olympic champions of these countries (n = 70) were included for other analyses, but their data were not used for life expectancy comparison between Olympic wrestling champions and the general population.

While the human mortality database (http://www.mortality.org) provides for some countries an average age of death for the male general population dating back to birth years in the mid or late nineteenth century, for other countries these data were only available since the mid twentieth century. Therefore, life expectancy comparison between Olympic wrestling champions and the general population was calculated only for Olympic wrestling champions, in whom data about matched individuals from the general population in the human mortality database are precisely available. To expand the number of matched individuals between the general population in the different countries and the assessed Olympic champions, the stated average age of death for the male general population from the human mortality database was interpolated by transferring the first available average age of death of the male general population to all of the previous years of birth. Taken into account that the worldwide life expectancy is growing [3], it cannot be expected, that individuals with previous years of birth would have significantly higher life expectancies but on the contrary it could presumed that individuals with previous years of birth would have significantly lower life expectancies. Therefore, this interpolation should overestimate the life expectancy of the general population.

Ethical Aspects

The requirement for informed consent was waived as we used only publicly accessible data collected in official websides. Studies in Germany involving an analysis of publicly accessible data do not require an ethics statement (Landesdatenschutzgesetz des Landes Rheinland-Pfalz (Germany) § 12 Absatz 4 Unterpunkt 9).

Statistical Analysis

This is a case-control study. Characteristics of subjects were described as means ± SD, proportions (%), median, and inter-quartile ranges (IQR) when appropriate.

The overall mortality (from Olympic champions between 1896 and 2016) were compared with matched cohorts in the general population (by country, age, sex, and year of birth).

The follow-up for each athlete was defined as his life-span in years with the survival interval since the date of birth up to the date of death or to the 31th December 2016. The average age of death of the matched male individuals of the general population in the countries was calculated from data obtained from the human mortality database (http://www.mortality.org).

In the already died Olympic wrestling champions, these chmapions, who died younger than the matched individual in the relevant general population of the country of origin with those, who died older than the matched individual in

the relevant general population for the following parameters were compared: Wrestling style (Freestyle vs. Greco-Roma), weight class, Olympic victory befor 1960 or ≥ 1960, age at Olympic victory, body weight, Olympic champions with single vs. multiple Olympic victories, country of origin [Rich countries (western Europe, USA, Kanada, Japan, South Korea) vs. poorer countries (other countries)]. For statistical comparison of these categorical variables the Fisher's exact or Chi^2 test was used, as appropriate.

Spearman correlation model was calculated to investigate the correlation between these mentioned parameters and an early death in Olympic wrestling champions (dead was before the average estimated average life expectancy of the matched individual in the relevant general population). In addition, crude binary logistic regression models were computed to identify associations between an early death in Olympic wrestling champions (dead was before the average estimated average life expectancy of the matched individual in the relevant general population) and the parameters above.

The average life-time of the Olympic champions in comparison to the general population was calculated. The difference was represented as a relative survival benefit.

All analysis were done for the cohorts with and without interpolation of life-expectancy in the controlls, as described above.

Statistical analysis was performed with SPSS (Chicago, IL, USA) software for Windows (version 22.0). The alpha level for statistical significance was set at $p < .05$ (two-sided).

Results

Overall, 341 male Olympic wrestling champions were included in this analysis. Among them 50 won more than one Olympic title. The athlets were in median 25 (IQR 24–28) years old at their first Olympic wrestling victory. Slightly more of the Olympic champions were freestyle than Roman-Greco wrestler [171 (51.9%) vs. 164 (48.1%)]. More than 1/3 of the Olympic wrestling victories were before the year 1960 [119 (34.9%)]. In total, 142 (41.6%) of the Olympic champions came out of rich countries (western Europe, USA, Kanada, Japan, South Korea).

Among the 341 Olympic champions, 70 Olympic champions were excluded from life expectancy comparison, because no valid data about the general population life expectancies (by country, age, sex, and year of birth) were available.

While without interpolation 69 Olympic champions and their matched counterparts in the general population remained in life expectancies comparison, with interpolation by transferring the first available average age of death of the male general population to all of the previous years of birth 171 Olympic champions and their matched counterparts in the general population were incoporated in life expectancies comparison.

Among these included subjects, 11 (15.9%) Olympic champions without interpolation died before having reached the mean life expectancy in their relevant countries, whereas with interpolation 29 (17.0%) Olympic champions died before the mean life expectancy in their relevant countries.

Male Olympic wrestling champions, who died before their matched counterparts in the general population in their countries of origin did not differ regarding body weight, weight class, age at the Olympic victory and the economic status of their country of origin (Table 1). The crude binary regression models (Table 2) and the Spearman correlation models (Table S1 in the supplementary material) confirmed Olympic wrestling champions' survival was not affected by their weight class at competition and unexpectingly, socioeconomic conditions in their countries of origin. Also the Kaplan Meier curves for Olympic champions survival stratified for the weight-classes (Fig. 1) showed no significant difference (log-rank test: $P = .203$) for Olympic champions between these with higher versus those with lower weights.

A distinct life expectancy benefit for Olympic wrestling champions in comparison to the general population in their countries of origin was detected. Male Olympic wrestling champions lived without interpolation in mean 19.1 ± 19.1 years and with interpolation 13.0 ± 18.4 years longer than the matched individuals of the general population.

Discussion

The main findings of this study can be summarized as follows: (i) male Olympic wrestling champions revealed a substantially higher life expectancy compared with the general male population; (ii) the survival benefit was not affected by body weight and not influenced by the year of the Olympic victory (before 1960 vs. 1960 and after).

Over several decades the body of knowledge grew (among the general population and health professionals) that moderate exercise is a healthy practice, but long term high intensity exercise might not [13]. But the real intensity and specific amount of physical activity necessary for good health were widely unclear [13]. While in this context the benefit of regular moderate physical activity was increasingly established for both primary and secondary prevention of cardiovascular diseases [1, 5, 11, 12], longevity studies of elite athletes were relatively sparse and the results conflicting [13].

However, in the recent years, studies revealed a life expectancy benefit also for high-intensity exercise sportsmen [7, 11, 14–16]. Unexpectingly, this benefit was not limited to endurance athlets only [7, 11, 14, 16], but was suprisingly

Table 1 Olympic wresling champions, who died after or survived the mean life expectancy in their relevant countries in comparison to those Olympic wrestling champions, who died before having reached the mean life expectancy in their countries of origin

	Without interpolation (n = 69)			With interpolation (n = 171)		
	Olympic wrestling champions, who died before having reached the mean life expectancy in their relevant countries N = 11	Olympic wresling champions, who died after or survived the mean life expectancy in their relevant countries N = 58	P-value	Olympic wrestling champions, who died before having reached the mean life expectancy in their relevant countries N = 28	Olympic wresling champions, who died after or survived the mean life expectancy in their relevant countries N = 143	P-value
Wrestling category (Freestyle vs. Greco-Roma): Freestyle = refernece category	3 (27.3%)	32 (55.2%)	.110	10 (35.7%)	75 (52.4%)	.147
Weight classes welterweight and above	6 (54.5%)	36 (62.1%)	.740	13 (46.4%)	77 (53.8%)	.537
Olympic victory befor 1960	6 (54.5%)	44 (75.9%)	.161	13 (46.4%)	90 (62.9%)	.139
Age at Olympic victory < 26 years	3 (27.3%)	20 (34.5%)	.740	16 (57.1%)	59 (41.3%)	.146
Body weight < 75 kg at Olympic victory	5 (45.5%)	30 (51.7%)	.752	17 (60.7%)	82 (57.3%)	.836
Athlets with more than 1 Olympic victory	2 (18.2%)	9 (15.5%)	1.000	4 (14.3%)	18 (12.6%)	.762
Rich countries (western Europe, USA, Kanada, Japan, South Korea)	5 (45.5%)	33 (56.9%)	.525	10 (35.7%)	61 (42.7%)	.536

Table 2 Crude binary logistic regression models for relation between early death in Olympic wresling champions (date of death before having reached the mean life expectancy in their countries of origin) and several paramters

	Without interpolation		With interpolation	
	Olympic wrestling champions, who died before having reached the mean life expectancy in their relevant countries 11 (15.9%) of n = 69		Olympic wrestling champions, who died before having reached the mean life expectancy in their relevant countries 28 (16.4%) of n = 171	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Wrestling category (Freestyle vs. Greco-Roma): Freestyle = refernece category	0.3 (0.1–1.2)	.102	0.5 (0.2–1.2)	.109
Weight classes welterweight and above	1.3 (0.4-5.0)	.640	1.3 (0.6-3.0)	.473
Olympic victory befor 1960	2.6 (0.7–9.9)	.156	2.0 (0.9–4.4)	.106
Age at Olympic victory < 26 years	1.4 (0.3–5.9)	.643	0.5 (0.2–1.2)	.125
Body weight < 75 kg at Olympic victory	1.3 (0.4–4.7)	.703	0.9 (0.3–2.0)	.771
Athlets with more than 1 Olympic victory	0.8 (0.2–4.5)	.825	0.9 (0.3–2.8)	.806
Rich countries (western Europe, USA, Kanada, Japan, South Korea)	1.6 (0.4–5.8)	.487	1.3 (0.6–3.1)	.496

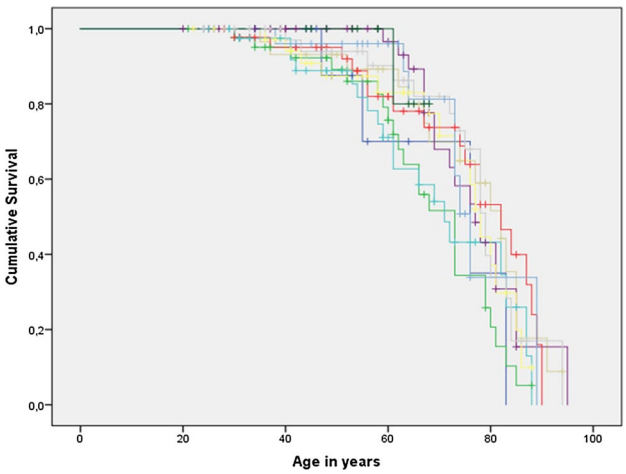

Fig. 1 Kaplan–Meier curves for the male Olympic wrestling champions' cumulative survival stratified for weight-classes. The navy blue line respresents the super-heavyweight athlets, the light green line the heavyweight athlets, the brown line the semi-heavyweight champions, the violet line the middleweight sportsmen, the yellow line the welterweight athlets, the red line the lightweight champions, the cyan line the bantamweight sportsmen, the grey line the featherweight athlets, the light blue line flyweight athlets and the dark green line represents the strawweight athlets. The difference between the curves was not statistically significant (log-rank-test: P = .203). (Color figure online)

as well observed in fast power sports athletes [7, 15], but the data about contact sports are conflicting [2, 15, 20]. To the best of the author's knowledge, there are only sparse study results about the oldest Olympic fighting sport in the modern era: the Olympic wrestling.

The key finding of this study is that a distinct survival benefit in male Olympic wrestling champions in comparison to the male controls of the respective male general population born in the same year and in the same country of origin was identified. The olympic champions lived in mean more than 13 years longer than the matched controls of the general population.

This life expectancy benefit in male Olympic wrestling champions detected in this study was distincly higher than in other studies [4, 7]. Kettunen et al. [7] reported that elite athletes had a 5–6 years increased life expectancy when compared to men who were healthy as young adults [7]. In addition, Clarke et al. [4] showed a 2.8 years longer life-span in Olympic medalists in comparison to the general population in the respect country of origin [4].

There are different explanations for the survival benefit of high-performance athlets and especially Olympic champions including genetic factors, physical activity, healthy lifestyle, and the wealth and status that come with international sporting glory [4].

Firstly, it could be hypothysed that we have to be aware that a preselection BIAS regarding a survival of the fittest in the Olympic champions may be present. With a few exceptions, only the healthiest, tough and resistant sportsmen will find their way to Olympic glory. Especially in Olympic wrestling it seems particularly hard to prevail even under worse conditions in countries with fewer resources and the physical selection might be particularly high.

The higher life expectancy benefit in this study compared to other previously published studies [4, 7] may be driven by a large number of Olympic champions born in poor countries of origin (approximately 60% of the included olympic champions). Most other studies focused on sports with athletes born in richer countries (for example: French participants in the Tour de France [11]) [11, 13, 14]. These study results suggest that benefits gained by Olympic glory might have a large impact on the life conditions and especially,

the athletes, who were born in poor countries, benefit from sports glory with better living conditions on their way to Olympic glory and also after their Olympic victory. The fact that the survival between the Olympic champions of the different countries did not differ significantly, contributes to this hypothesis of distinctly improved living conditions and priviliges for the Olympic champions of poor countries of origin, leading to comparable living condition levels of the Olympic champions in poor and rich countries.

Other reasons may be the selection of investigated athlets, the homogenity of the investigated athlet group, a sport-specific exception regarding the countries of origin of the majority of the Olympic wrestling champions and different assessment methods to compare the life expectancies of the athlets with the general population. In addition, it has to be assumed that the male Olympic wrestling champions did not have to go to war in contrast to most of the male counterparts of the general population, especially of the poorer countries. This may be also an explanation for the larger life expectancy benefit in this study focusing on male Olympic champions, in contrast to other studies including male and female athlets [20].

Other causes for the differences in life expectancy benefit were recruiting and methodical reasons: some studies did not focus on one sport, but have included athletes of different sports. Kettunen et al. [7] included in their study former Finnish male endurance, team and power sports athletes, who had not all the same high sports performance than Olympic champions [7]. Kettunen et al. [7] as well as Clark et al. [4] investigated athletes of different sports and disciplines [4, 7]. Moreover, some studies compared the survival between the athlets and the general population at a defined time point, such as 30 years after winning the Olympic medal [4] or comparing the groups regarding the age at which 50% of the general population died [13]; therefore these studies include not the whole life-span in the comparison, which may lead to lower survival differences between the general population and the athlets. However, the most important difference between the studies is the high rate of male Olympic wrestling champions out of the former Soviet union and the successor states and the countries of the former Eastern block. Overall, 174 male Olympic wrestling champions (51.0%) came out of this association of countries.

Although the increase of doping with anabolic steroids started in the late 1950s and grow since then and especially athlets of power sports were affected by this doping methods in order to increase strength, speed and power level [8, 17, 18], the survival benefit was also not influenced by the year of the Olympic victory (before 1960 vs. 1960 and after).

As expected, the survival was not influenced by athlets' body weight. Although it is well known that obesity is a major risk factor for cardiovascular diseases such as coronary artery disease and myocardial infarction [6, 9, 10, 19], the body weight of the male Olympic wrestling champions is primarily attributable to strong physique and muscle mass accompanied by a strong fitness and therefore without relevant effect on the survival of the athlets.

Additionally, study results showed that life expectancy benefit of athlets was specific for the type of sports exercise [7, 14, 15]. Median life expectancy was higher especially in endurance and team sports athletes compared to power sports athlets and controls (general population) [4, 7, 14, 15] driven by lower cardiovascular mortality [7, 14, 15]. Power sport athlets showed in some, but not in all studies survival benefits compared to the general population [4, 7, 14, 15]. Lower mortality for cardiovascular disease was partly due to lower rates of smoking, as the tobacco-related cancer mortality was particularly low [7]. In addition, dementia mortality had an increased risk in power sports athletes, particularly boxers, compared to the general population [7]. Bianco et al. [2] reported that boxers had in comparison to athlets of other types of sport the lowest life expectancy, whereby the difference was non-significant [2]. In contrast, Zwiers et al. [20] reported in their study about 9889 Olympians that an engagement in disciplines with high intensity exercise did not brought a survival benefit compared with disciplines with low intensity exercise, an increased mortality was seen among athletes from disciplines with a high risk of bodily collision and high levels of physical contact [20]. Olympic wrestling seems to be (in contrast to boxing) in the majority of fighters a contact sport without relevant long-term damage of the brain.

Conclusions

The benefits of physically active life-style on health were clearly higher than the adverse effects. Male Olympic wrestling champions live longer than the general population, irrespective of country, body weight and participating in the Olympic games before or after the begin of the anabolic steroids doping era. This study was not designed to explain this effect, but some possible explanations are genetic factors, the physical activity, a healthy lifestyle, and the wealth and status affecting athletes' life conditions attributed to international sporting glory.

Limitations

This study has some important limitations. The dates of birth and death were assessed by an internet recherche and had no additional information about the life circumstances of the Olympic wrestling champions. It remains unclear, if the athlets lived a healthy life or not and especially the cause of death was not tacken into account of this analysis.

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Compliance with Ethical Standards

Conflict of interest The author declares no conflict of interest.

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