The relationship between age and divisional rank in professional mixed martial arts

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Research article

THE RELATIONSHIP BETWEEN AGE AND DIVISIONAL RANK IN PROFESSIONAL MIXED MARTIAL ARTS

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Abstract. *Physiological changes brought about by a person's aging process are known to negatively affect elite sports performance, but this may be delayed by skill mastery brought about by continued training. The intersection of these two separate processes causes a potential 'peak performance window' in many sports. Within MMA it has been shown that older competitors are more likely to lose individual bouts, especially due to strikes, and when they win it is most likely to be via a judge's decision. It has not been determined whether age has a long-term effect on success in MMA. This study divided the top 100 competitors in each MMA weight division into 5 ranking groups (RG) and used Bayesian ANOVA (BF_{10}), 95% credible interval plots and Bayesian Kendall's Tau (BF_{10}) to determine if competitor rankings are affected by their age, and if each division displays a different age profile. The results found that whilst there is a general pattern of older participants being ranked higher, middleweight was the only division where this was statistically relevant. It was found, however, that the heavier the mass limit of the division, the older the participants are across each RG. These results suggest that skill mastery may be of more short-term importance to successful performance in MMA than physiological ability, particularly in the heavier divisions, but physiological decrements effect lighter competitors earlier in their chronological age. This is potentially due to differing performance requirements between the different divisions.*

Key words: *MMA; aging; peak performance; combat sports; competitive ranking*

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INTRODUCTION

Successful elite sports performance has traditionally been accepted to share an anecdotal relationship with chronological age, with a performer's competitive life-span deemed to be from their early 20's to their mid 30's, after which athletic performance and the level at which an athlete competes is seen to decline (Donato et al., 2003; Witnauer Rogers, & Saint Onge, 2007; Radek, 2014). This view is supported by the ages of record holders and champions in various sports and competitions (Rittweger, Prampero, Maffulli, & Narici, 2009; Elmenshawy, Machin, & Tanaka, 2015) and research has outlined the potential reasons behind these decrements in performance. Physiologically, there has been shown to be a significant reduction in both maximal isometric force and voluntary explosive force in the first 500ms of movement between men of 20 years old and men of 40 years old, as well as a significant reduction in squat jump and countermovement jump height between both groups (Izquierdo, Aguado, Gonzalez, Lopez, & Hakkinen, 1999), demonstrating that there is a reduction in a person's ability to produce fast, high impulse movements with increased age. This is compounded by the apparent reduction in ground reaction forces and type II muscle fibre area in older athletes in comparison to younger athletes (Korhonen et al., 2009), with recent research linking these reductions to changes in skeletal muscle activity at a cellular level (Kangas et al., 2017). Whilst the speed of decision making in response to a stimulus does not seem to significantly deteriorate with age (Ratcliff, McKoon, & Thapar, 2001), the degradation of neuromuscular junctions and the increased variability of motor unit action potential discharge rates does appear to inhibit neural drive and therefore overall reaction time, movement force and efficiency (Hunter, Pererira, & Keenan, 2016). These factors paired with a linear reduction in $\dot{V}o_2max$ related to age (Tanaka & Seals, 2003) mean that a reduction in successful athletic performance should be expected as athletes grow older.

Whilst rate of force development and speed are seen to peak in a person's early to mid 20's, the peak age for skill based sports performance tends to occur later in the athlete's life, generally in their late 20's to their early 30's (Allen & Hopkins, 2015), which could be attributed to the required skill mastery for professional or elite performance and the time this takes to attain, due to repeated, targeted coaching and training (Helsen, Starkes, & Hodges, 1998; Baker, Cote, & Abernethy, 2003; Bruce, Farrow, & Raynor, 2013). It has also been suggested that a person's ability to learn and master complex skills peaks during adulthood, after their physiological peak (Lukacs & Kemeny, 2014). This suggests that there is a 'peak performance window' for each athlete or sport, where the negative effects of chronological age and the positive effects of skill mastery intersect, allowing for optimal performance (Allen & Hopkins, 2015). It is difficult, however, to determine when this window occurs within a particular sport or event, and research in some sports indicates that this window can be highly dependent on position, skill acquisition rate and tactical approach (Bradbury, 2009; Tiruneh, 2010; Brander, Egan, & Yeung, 2014; Kovlachik, 2014).

Within mixed martial arts (MMA) it has been found that older competitors are more likely to lose individual bouts, with the average age difference between winners and losers in some weight divisions being as great as 3 years. It was also found that older competitors have a higher likelihood of losing due to strikes as opposed to submission or decision, and they are most likely to win by decision as opposed to strikes or submission (Kirk, 2016a). This could suggest that as MMA competitors age they lose muscular force and experience reduced reaction times and speed due to reduced neural drive and sarcopenia (Korhonen et al., 2009; Hunter, Pererira, & Keenan, 2016), making them more susceptible to strikes whilst impairing their own ability to deliver forceful strikes in return. There is also a suggestion that repeated, concussive strikes during years of training and competition could accelerate the aging process due to the collective impairment of the endocrine and neurological systems (De Beaumont et al., 2013; Richmond & Rogol, 2014). Due to their greater number of hours spent training and mastering the skills of the sport, however, older participants may well be able to make better use of tactics to guide their opponent and the bout towards movements and positions where velocity, force and reaction times are less important, providing them a greater chance of earning a win via decision. Even taking this possibility into account, it would be reasonable to expect to observe long term, negative effects of chronological age on success rates and achievements. Equally, due to the previously hypothesised force and velocity differences between competitors in the different weight divisions (Kirk, 2016a; Kirk 2016b), it may well be the case that competitors in the lighter divisions, where movement velocity may potentially be of more importance, could become less successful and drop down the rankings at an earlier age than observed in the heavier weight divisions.

With the aim of tracking long term success and achievement, global competitor rankings are often used, particularly in individual sports where league structures are not used to determine competition winners or champions (Kovalchik, 2014; Kovalchik, Bane, & Reid, 2017). Whilst the de facto MMA world championship organisation, the Ultimate Fighting Championship (UFC), do publish their own rankings, these are voted on by members of the media and only include competitors contracted to their organisation (UFC, 2018). As such, these rankings do not necessarily provide an unbiased, reliable ranking structure. Alternatively, Fightmatrix is an independent organisation which publishes algorithmically generated rankings for all professional MMA competitors worldwide, regardless of organisational affiliation. The rankings are based on each competitor's levels of success, and each of their opponent's comparable levels of success over time to compare and rank each currently active competitor in each division (Fightmatrix, 2018a). These rankings have been used previously in the literature (Kirk, 2016b) and due to the use of an objective algorithm, provide a more suitable tool for use in exploratory performance research (Fightmatrix, 2018b).

Based on the previous research into the effects of chronological age on sports performance in general and the effects of chronological age on the outcomes of individual MMA bouts, the following hypotheses were formed for this study: 1) there would be a statistical relationship between a competitor's chronological age and their divisional rank as determined by Fightmatrix; 2) each division would have a different age profile, with lighter divisions comprised of younger competitors than heavier divisions.

METHODS

The divisional rank and chronological age (yrs) of the top 100 competitors in each division included in the sample was taken from the Fightmatrix rankings on the 15th January 2018. Where Fightmatrix did not state a competitor age, the competitors were contacted directly via social media or email and asked to provide their age after a brief explanation of the study aims and the reasons for their age being required. The mass limits of each included division can be viewed in Table 1. The flyweight division was excluded as a high number of competitor ages could not be sourced, whilst the female divisions were excluded as there were fewer than 100 competitors ranked in each of these divisions. Each division was split into the following ranking groups (RG): RG1 = ranks 1 – 20; RG2 = ranks 21 – 40; RG3 = ranks 41 – 60; RG4 = ranks 61 – 80; RG5 = ranks 81 -100.

Bayesian one-way ANOVAs (BF_{10}) were calculated along with omega squared (ω^2) effect sizes (ES) for the whole cohort to: a) determine whether each division displayed different mean ages; b) determine whether each RG combined across all divisions displayed different mean ages; c) determine whether each RG split by division displayed different mean ages.

For each division in turn, Bayesian one-way ANOVAs (BF_{10}) were calculated along with ω^2 to determine whether each RG in each division had a different mean age. To determine whether age and rank share a relationship, Bayesian Kendall's Tau correlations (BF_{10}) were calculated between age and rank in each division. For each Bayesian ANOVA completed, post-hoc comparisons were calculated using a default t-test with a Cauchy prior, whilst plots displaying 95% credible intervals (95% CI) were also produced. The following thresholds were used for each of the BF_{10} related tests: 1-2.9 = anecdotal; 3-9.9 = moderate; 10-29.9 = strong; 30=99.9 = very strong; $\geq$ 100 = decisive (Wetzel and Wagenmakers, 2012). ES thresholds were set at: small $\omega^2 \geq 0.01$; mod $\omega^2 \geq 0.06$; large $\omega^2 \geq 0.14$ (Field, 2013). Correlation thresholds were set at: trivial $T \leq 0.0$; small $T \geq 0.1$; moderate $T \geq 0.3$; large $T \geq 0.5$; very large $T \geq 0.7$; nearly perfect $T \geq 0.9$; perfect $T \geq 1$ (Hopkins, 2002). Each of the named statistical tests were completed using JASP 0.8.5.1 (JASP Team, Amsterdam, Netherlands). All data was procured and analysed according to the principles set down in the Declaration of Helsinki.

Table 1 Divisions included in study with mass limits

Division	Mass Limit (kg)
Heavyweight (HW)	120.5
Light Heavyweight (LHW)	93.1
Middleweight (MW)	84
Welterweight (WW)	77.2
Lightweight(LW)	70.5
Featherweight (FW)	65.9
Bantamweight (BW)	61.3

RESULTS

The mean age of each division was found to be decisively different with a moderate ES according to Bayesian one-way ANOVA (BF_{10} = 7.211e+6, $\omega^2 = 0.07$) (Table 2 and Figure 1). Post-hoc comparisons found that these differences were caused by HW being decisively greater than BW (BF_{10} = 339333.7), HW being decisively greater than FW (BF_{10} = 8501.4), HW being decisively greater than LW (BF_{10} = 664.6) and HW being moderately greater than WW (BF_{10} = 9.6). LHW (BF_{10} = 200.1, decisive) and MW (BF_{10} = 236.8, decisive) respectively were found to be greater than BW. LHW (BF_{10} = 10.1, strong) and MW (BF_{10} = 11.8, strong) both were also greater than FW. WW was also found to have a greater age than BW (BF_{10} = 16.8, strong).

Table 2 Mean ± SD ages of whole cohort by division

Division	Age (yrs)
HW	32.8 ± 5.3
LHW	31.3 ± 4.4
MW	31.4 ± 4.4
WW	30.8 ± 4.1
LW	30.1 ± 3.4
FW	29.6 ± 3.9
BW	29 ± 4.1

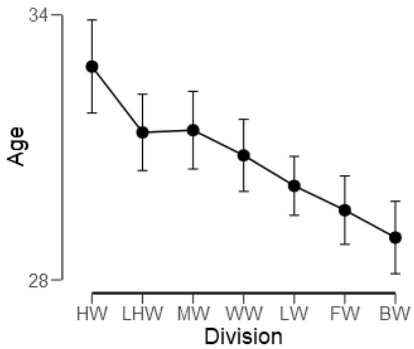

Fig. 1 95% CI plot of mean ages of whole cohort by division

When comparing combined RGs across the whole cohort, decisive differences with a small ES were found (BF_{10} = 324.8, ω^2 = 0.03) (Table 3 and Figure 2), which were due to RG1 being decisively greater than RG5 (BF_{10} = 1217) and RG1 being decisively greater than RG4 (BF_{10} = 697.3). There was also a very strong difference between RG1 and RG2 (BF_{10} = 71.2), and a strong difference between RG1 and RG3 (BF_{10} = 10.5).

Table 3 Mean ± SD ages of whole cohort by ranking group

Ranking Group	Age (yrs)
RG1	32.3 ± 4.4
RG2	30.5 ± 3.9
RG3	30.7 ± 4.5
RG4	30.1 ± 4.1
RG5	29.9 ± 4.7

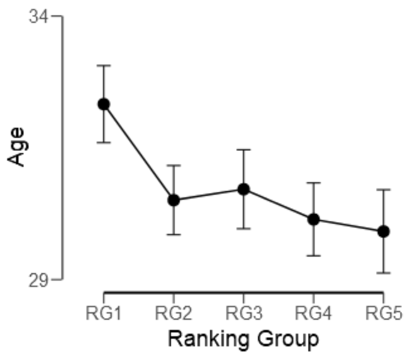

Fig. 2 95% CI plot of mean ages of whole cohort by ranking group

Within the combined RG1 between divisions, the mean age of each division was found to be decisively different with a large ES (BF_{10} = 805.4, ω^2 = 0.17) (Table 4, Figure 3). Post hoc comparisons found a decisive difference between HW and BW (BF_{10} = 194.3), a very strong difference between HW and FW (BF_{10} = 48.3), and a very strong difference between HW and LW (BF_{10} = 39.1). HW was also found to be moderately different to WW (BF_{10} = 5.9). MW was calculated to be greater than BW (BF_{10} = 41.9, strong), whilst also being moderately greater than FW (BF_{10} = 10) and LW (BF_{10} = 8.2), respectively.

Bayesian ANOVAs found no differences between divisions in RG2 (BF_{10} = 0.8, ω^2 = 0.05), RG3 (BF_{10} = 0.1, $\omega^2 < 0.01$) or RG4 (BF_{10} = 0.2, ω^2 = 0.02) (Table 4, Figures 4 – 6). In RG5 (Table 4, Figure 7), there was found to be only anecdotal differences between divisions with a moderate ES (BF_{10} = 2, ω^2 = 0.07), but HW was found to be moderately different to BW according to the post-hoc comparisons (BF_{10} = 3.4).

Table 4 Mean ± SD ages of each combined RG by division

Division	RG1 (yrs)	RG2 (yrs)	RG3 (yrs)	RG4 (yrs)	RG5 (yrs)
HW	35.8 ± 4.9	32.2 ± 4.5	32 ± 4.4	31.4 ± 5.6	32.8 ± 6.2
LHW	32.4 ± 4.5	31.1 ± 4.6	31.5 ± 4.5	31.1 ± 3.9	30.7 ± 4.6
MW	34.5 ± 4.2	31.7 ± 4	30.3 ± 3.8	31.3 ± 4.3	29.3 ± 4.4
WW	31.9 ± 3.8	30.8 ± 3.9	31.8 ± 4.6	29 ± 3.3	30.7 ± 4.5
LW	31 ± 3.2	29.9 ± 3.1	30.2 ± 3.6	30.1 ± 2.9	29.6 ± 4
FW	30.9 ± 3.1	29.1 ± 2.7	30.1 ± 5.3	29 ± 3.6	29 ± 4.1
BW	29.8 ± 3.8	28.9 ± 3.8	29.3 ± 4.8	29.3 ± 4.5	27.5 ± 3.6

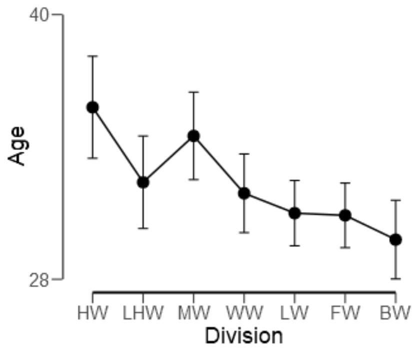

Fig. 3 95% CI plot of mean ages for RG1

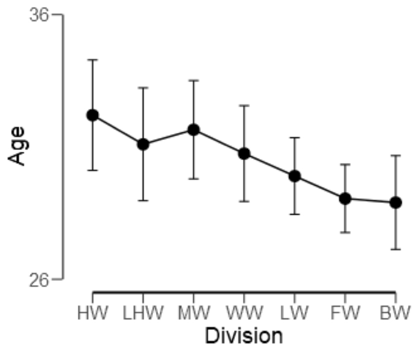

Fig. 4 95% CI plot of mean ages for RG2

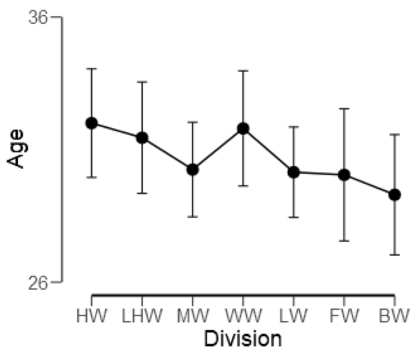

Fig. 5 95% CI plot of mean ages for RG3

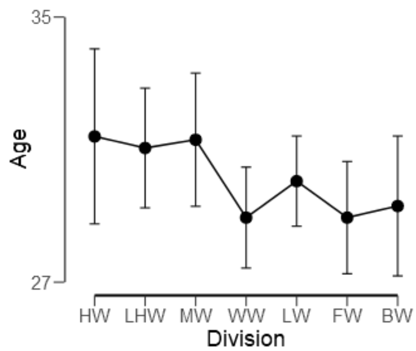

Fig. 6 95% CI plot of mean ages for RG4

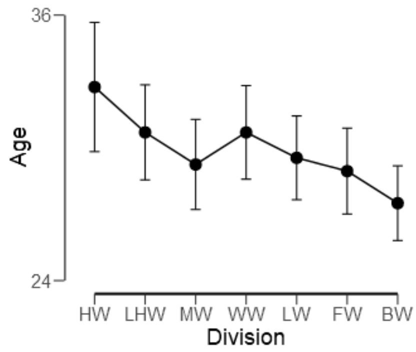

Fig. 7 95% CI plot of mean ages for RG5

The mean ± SD ages of each division between RGs can be viewed in Table 5. The only division which was found to have greater than anecdotal differences between each RG was MW, which displayed a strong BF_{10} with a moderate ES ($BF_{10} = 17.2$, $\omega^2 = 0.13$), which post-hoc comparisons found to be caused by RG1 being greater than RG5 ($BF_{10} = 64.1$, very strong) and RG3 ($BF_{10} = 18.4$, strong) (Figure 8). There were no differences greater than anecdotal found in HW ($BF_{10} = 0.7$, $\omega^2 = 0.05$), LHW ($BF_{10} = 0.1$, $\omega^2 < 0.01$), WW ($BF_{10} = 0.4$, $\omega^2 = 0.03$), LW ($BF_{10} = 0.07$, $\omega^2 < 0.01$), FW ($BF_{10} = 0.14$, $\omega^2 < 0.01$) or BW ($BF_{10} = 0.1$, $\omega^2 < 0.01$) (Figures 9 - 14).

Table 5 Mean ± SD ages of each division by ranking group

Ranking Group	HW (yrs)	LHW (yrs)	MW (yrs)	WW (yrs)	LW (yrs)	FW (yrs)	BW (yrs)
RG1	35.8 ± 4.9	32.4 ± 4.5	34.5 ± 4.2	31.9 ± 3.8	31.0 ± 3.2	30.9 ± 3.1	29.8 ± 3.8
RG2	32.2 ± 4.5	31.1 ± 4.6	31.7 ± 4.0	30.8 ± 3.9	29.9 ± 3.1	29.1 ± 2.7	28.9 ± 3.8
RG3	32.0 ± 4.4	31.5 ± 4.5	30.3 ± 3.8	31.8 ± 4.6	30.2 ± 3.6	30.1 ± 5.3	29.3 ± 4.8
RG4	31.4 ± 5.6	31.1 ± 3.9	31.3 ± 4.3	29.0 ± 3.3	30.1 ± 2.9	29.0 ± 3.6	29.3 ± 4.5
RG5	32.8 ± 6.2	30.7 ± 4.6	29.3 ± 4.4	30.7 ± 4.5	29.6 ± 4.0	29.0 ± 4.1	27.5 ± 3.6

In terms of correlations between age and rank, MW was the only division in which a better than anecdotal relationship was found. As can be viewed in Figure 15, this was calculated to be a small, negative but decisive correlation (T = -0.268, $BF_{10} = 300.6$). No other divisions were found to have better than anecdotal relationships between age and rank: HW (T = -0.152, $BF_{10} = 1.6$); LHW (T = -0.086, $BF_{10} = 0.3$); WW (T = -0.149, $BF_{10} = 0.4$); LW (T = t = -0.149, $BF_{10} = 0.3$); FW (T = -0.146, $BF_{10} = 0.4$); BW (T = -0.175, $BF_{10} = 0.6$).

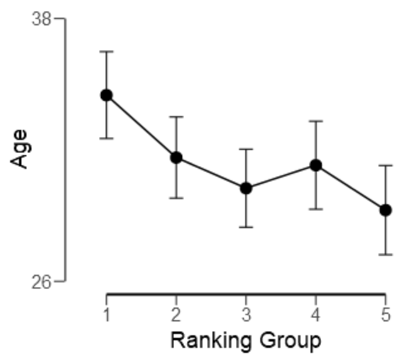

Fig. 8 95% CI plot of mean ages for MW by RG

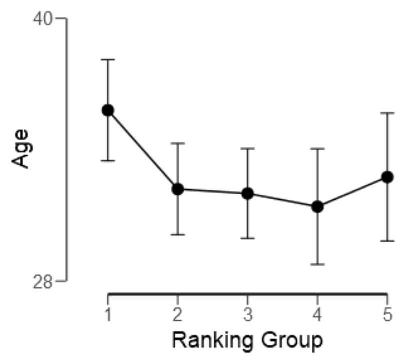

Fig. 9 95% CI plot of mean ages for HW by RG

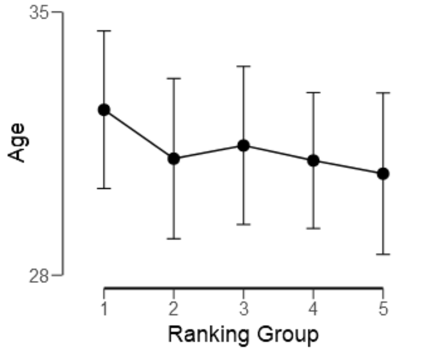

Fig. 10 95% CI plot of mean ages for LHW by RG

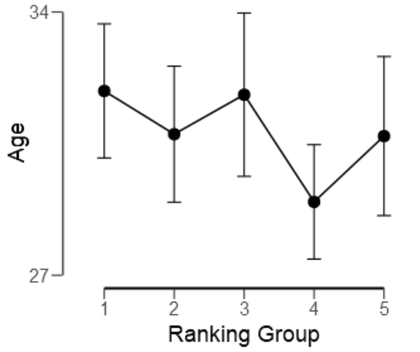

Fig. 11 95% CI plot of mean ages for WW by RG

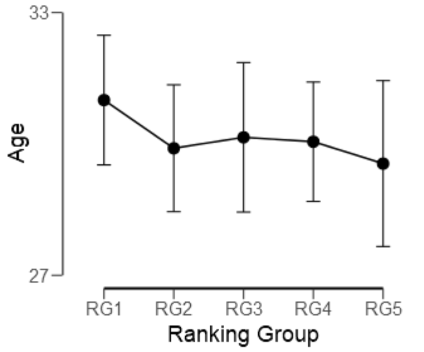

Fig. 12 95% CI plot of mean ages for LW by RG

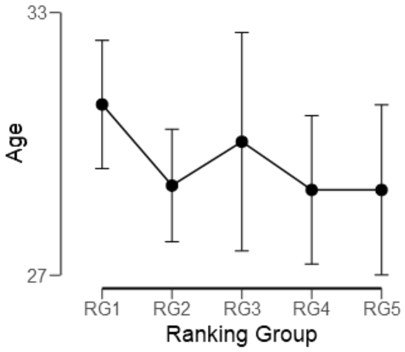

Fig. 13 95% CI plot of mean ages for FW by RG

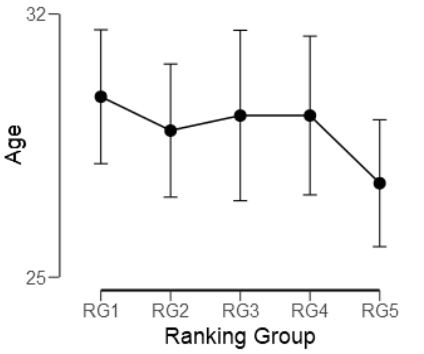

Fig. 14 95% CI plot of mean ages for BW by RG

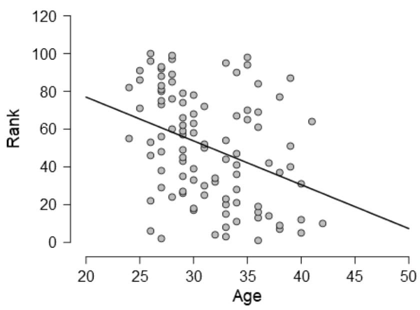

Fig. 15 Plot of Bayesian Kendall's Tau between age and rank in MW

DISCUSSION

This study was designed to determine whether chronological age has an effect on divisional ranking in professional MMA, and whether this effect was different for each division. When viewing the results, although HW was the only division that displayed a statistical age difference from the other divisions, it is clear that the lighter the mass limit a division has, the younger the average age of the competitors becomes, with only LHW and MW having a near matching age profile. This pattern continues when viewing the data of each RG split by division, where it was found that the heavier divisions in each RG are generally older, although only RG1 contained any statistical differences between divisions.

Based on the known physiological changes caused by aging, it was assumed that older competitors would generally be lower in the rankings. What has been observed, however, is that a combined RG1 across the whole cohort was statistically older than all the other ranking groups, by ~2 years. This demonstrates that the physiological effects of age are not necessarily the key variables to consider when assessing a competitor's potential performance, a finding which has recently been reflected in both team and combat sports (Wilson et al., 2017). As RG2 – RG5 across the whole cohort had very similar age profiles, this suggests that the increased skill mastery and experience that comes with age can outweigh the physiological decrements, at least in the short term, so older competitors are able to maintain a relatively high ranking once this level has been reached. This finding may have several explanations. Firstly, as an older competitor in RG1 begins to lose more often and their ranking begins to decline, they may well decide to retire rather than continue to allow their performance to deteriorate further. This would mean that the lower RGs would always have a younger age profile. This could also be explained by younger competitors needing time and experience to reach a certain skill threshold in order to win consistently enough against higher ranked opposition to enter RG1, a supposition which would also support RG 2-5 having a younger age profile than RG1.

When comparing between divisions, HW was generally found to have an older age profile than the other divisions across the whole cohort and within each RG. A similar pattern has also been documented in the heavier divisions of elite wrestling, where the average career length is longer, and the age of peak performance is older than the lighter divisions (Baic, Karnincic, & Sprem, 2014). An explanation for this in MMA may be found in the in-bout characteristics of each division, which have been shown to be differentiated. For example, bout winners and bout losers at HW are primarily distinguished by strikes, whilst in the lighter divisions such as FW and BW, takedowns along with strikes are key distinguishing factors (Kirk, 2018). The named study proposed that these effects were due to mass and velocity differences between the divisions altering the risk-reward ratio of each technique, causing the competitors to favour certain techniques over others, or to have more success with certain techniques. It was suggested that smaller competitors can make more use of velocity dependent techniques such as takedowns and scrambles with less risk than heavier competitors, however, once a competitor starts to lose speed and velocity of movement due to aging, they become less able to successfully utilise these movements, which may explain why the average age of the more elite performers is lower in the lighter divisions. As the heavier divisions are more dependent on strikes for success, and these movements are potentially less affected by velocity decrements, then older competitors can remain in the rankings for longer, whereas in the lighter divisions, it becomes more difficult to maintain a top 100 ranking with increasing age. In support of this proposition, it has previously been noted that LHW and MW share similar anthropometrical characteristics, much more so than the other divisions (Kirk, 2016b), as well as similar patterns in their technique use (Kirk, 2018). The similarities in physical make up and performance characteristics between these two divisions could explain similar changes in ranking due to aging, although only MW demonstrated a correlation between the two variables.

When looking at the ages of each RG in each division, whilst the general pattern of RG1 being older remains, the statistical differences largely disappear. Indeed, only MW displays statistical differences between the RGs, with RG1 being statistically older than RG3 and RG5. The lack of differences is particularly apparent in the lightest divisions of LW, FW and BW where there is little or no practical difference in age between the RGs at all, showing that the age effect only exists between divisions and not within divisions. What must be concluded here is that MW is the only division in which age is related to performance, either positively or negatively. Indeed, at MW, as a competitor ages, they move up the rankings, although it cannot currently be determined whether this is due to skill learning or physiological peaking. In this instance it could be more informative to understand at which age the participants enter and leave each RG, and how much movement there is between the RGs in each division. This may allow a more nuanced description of whether there is a peak performance window or not, as the current data does not allow any inference of whether the competitor's rank is improving or declining in each division. For instance, RG2 and RG4 in MW share almost identical age profiles: could it be that the competitors in RG4 have lower skill levels than those in RG2? Or have they been more affected by the physiological aging process than RG2 competitors? In order to answer this question, it must first be determined what specific effects aging and skill learning has on MMA performance, as issue which has not yet been addressed by researchers.

To this end, the first hypothesis of whether there is a relationship between age and divisional rank in MMA must be rejected, as only MW displayed such an effect. The second hypothesis that each division would contain different age profiles can, however, be accepted, with these differences potentially being caused by differing physical, anthropometrical and performance profiles between each division.

CONCLUSION

Whilst it can be stated that there is an effect of age on rank between divisions, this effect does not consistently appear within divisions. Whilst there is a general pattern of older participants being ranked higher, this is more pronounced in some divisions than others and non-existent in some. What is clear is that the lighter weight divisions are statistically younger on average than the heavier divisions. Why this pattern exists cannot be fully explained by these results, however, its cause is potentially a combination of the positive effects of skill learning and mastery brought on by years of targeted training, which offsets the decrements of aging more in the heavier divisions than the lighter divisions, potentially due to less reliance on high impulse movements on the part of the heavier competitors (Allen and Hopkins, 2015; Kirk, 2016a; Kirk 2016b). Equally, the natural competitive lifespan of an athlete may cause the participants to retire before they lose their competitive abilities enough to drop out of RG1.

The main issue which cannot be explained and requires much further research is the specific physiological decrements which aging causes amongst this population and how this alters in-competition performance in comparison to skills and ability increments brought on by training. A key barrier to this is that the physiological and training characteristics of MMA competitors has not yet been sufficiently established in the literature, so judging how aging affects these elements cannot yet be elucidated. Further research which may also be of interest is determining whether there is a peak age where most MMA competitors attain their highest career rank or not. This could enable researchers and practitioners to begin to specify the peak performance window for professional MMA competition and tailor their practice more appropriately.

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ODNOS IZMEĐU GODINA STAROSTI I OSVOJENOG MESTA U MMA

Fiziološke promene koje donosi proces starenja poznato je da negativno utiču na učinak vrhunskih sportista, ali njihov uticaj može biti odložen savladavanjem veština kontinuiranim treniranjem. Presek ova dva odvojena procesa dovodi do potencijalnog "prostora za vrhunski učinak" u mnogim sportovima. U okviru MMA pokazano je da su veće šanse da stariji učesnici izgube pojedinačne napade, posebno zbog udaraca, a kada ih dobiju, to je najverovatnije zbog odluke sudije. Nije utvrđeno da li starost ima dugoročni uticaj na uspeh u MMA. U ovom istraživanju podelili smo 100 vrhunskih takmičara u svakoj MMA težinskoj kategorili u 5 rangiranih grupa (RG) i koristilli Bajesovu ANOVA (BF10), 95% interval pouzdanosti i Bajesov Kendall, Tau (BF10) da bismo utvrdili da li na takmičare različitih rangova utiču godine starosti, i da li svakoj kategoriji odgovara različiti starosni profil. Rezultati su ukazali da postoji opšti obrazac prema kome su stariji učesnici bolje rangirani, a srednje-teška kategorija bila je jedina u kojoj su rezultati bili statistički značajni. Utvrđeno je, međutim, da što je teža kategorija, to su stariji učesnici svake RG. Ovi rezultati ukazuju na to da savladavanje veština može više biti od kratkoročnog značaja za uspešan nastup u MMA, za razliku od fiziološke sposobnosti, posebno u težim kategorijama, ali negativan uticaj fizioloških promena dovodi do manje težine takmičara ranije u hronološkoj starosti. Ovo potencijalno može biti posledica različitih zahteva koje postavlja svaka težinska kategorjia.

Ključne reči: *MMA; starenje; vrhunski učinak; borilački sportovi; rangiranje*