Age and Anthropometric Variables and Success in Mixed Martial Arts

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Abstract

Anthropometry and chronological age has been demonstrated to have an effect on individual performance in competitive sport, with the relationship between stature and wingspan being found to be selective criteria in many sports, although evidence for this in MMA is negligible. In this study, n = 278 professional MMA bouts were analysed with the winners and losers being compared in terms of chronological age, stature, wingspan, stature-to-wingspan ratio (S:W) and method of win/loss using paired samples t tests, Wilcoxon signed-rank tests, one way ANOVAs, Kruskal-Wallis tests (all $\leq .05$) and Bayes Factor (BF_{10}). The results showed that for the most part anthropometric differences have no effect on who wins the bout, but taller bout losers are most likely to lose via strikes. Across the full cohort and several competitive divisions, it was found that older participants are significantly more likely to lose, and are also significantly more likely to lose via strikes. Participants who won via decision were found to be significantly older than those who won via strikes or submission.

Key words: MMA; combat sports; ape ratio; stature; wingspan; aging

Introduction

Anthropometry and its effect on an individual's chances of success within high level competition has been studied and documented in several sports (Gabbett, 2000; Mladenovic, 2005; Young et al, 2005; Pieter, 2008) and in many cases has been shown to be a key factor in success, equating to longer careers, greater earning potential and improved chances of selection at an elite level, particularly in sports with specialised skills sets or specific physical requirements (Norton and Olds, 2001). To this end, anthropometry has been used as a tool in talent identification and development across several levels of performance (Gabbett, 2005; Pieter, 2008; Mohamed et al., 2009; Gabbett et al., 2011). Body composition in terms of fat and muscle mass distribution has been more commonly reported in the literature (Alburquerque et al., 2005; Duthie et al, 2006; Adhikari and McNeely, 2015) but generalised whole body measurements are not always found to be indicators of elite performance (Knechtle et al., 2009; Wheeler et al., 2012). Since the 1990's there has been a trend towards researching more detailed anthropometrical measurements such as body segment length and differential growth rates with the aim of finding more reliable performance predictors (Norton and Olds, 1996; Mirwald et al, 2002; Caruso et al, 2009; Stratton and Oliver, 2014).

One particular measurement that has been identified is the so called 'ape index' – a measure of the ratio of an individual's wingspan relative to their stature (Perciavalle et al, 2014). Whilst the average human population is generally perceived to have an 'ape index' of 1:1 (Harbour, 2015), an athlete having a wingspan greater than their stature has been demonstrated to be an advantage and indeed a prerequisite for success in some sports. This is especially the case within basketball, where National Basketball Association (NBA) players are found to have an average stature-to-wingspan ratio of 1:1.064 (Epstein, 2014), whilst elite water polo players have shown significant increases in wingspan length between 1980 and 2008 (Lozovina et al., 2012). The influence of the size of a person's wingspan has also been shown to be selective criteria in the choice of sports amongst Brazilian adolescents, where those who chose basketball, handball and volleyball had significantly greater wingspans than those who chose football (Silva et al., 2013). Whilst these results indicate that wingspan length has contributed to a form of natural talent selection in each of these sports, this measurement has also been found to have no effect in sport climbing (Mermier et al., 2000) or cricket bowling (Stuelcken et al., 2007; Wormgoor et al., 2010) and is also inferior to other anthropometrical measurements in predicting swimming performance (Perciavalle et al., 2014).

Within mixed martial arts (MMA), Kuhn and Crigger (2013) demonstrated that Ultimate Fighting Championship (UFC) world champions at the time of publication had greater heights and wingspans than their competitive division's mean and in some cases, greater than the mean of some higher competitive divisions. This was used to argue that having greater anthropometrical measurements is related to success within MMA due to potential technical advantages it provides in striking and grappling movements. This hypothesis has been tested through an analysis of MMA competitor's anthropometric measurements in relation to their competitive ranking, which found that there was little influence of these measurements on success, with the few statistically significant findings being negligible and isolated to single divisions (Kirk, 2015). This study did not, however, illicit any information of the effect of anthropometry on the outcome of single bouts or whether a particular body size or proportion provided more or less chance of winning. An area which has not yet been studied in terms of effecting performance in MMA is chronological age. The aging of athletes has been shown to decrease strength, power, reaction times and therefore performance (Nessel, 2004; Vingren et al., 2010). It is not currently known whether or not this has a significant impact on the outcome of individual MMA bouts. In summary, this study was conducted to quantify any anthropometric or chronological age differences between the winners and losers of professional MMA bouts,

Methods

Data Collection

The following data collection and analysis was given ethical clearance by the University of Central Lancashire's Research Ethics Sub-Committee in keeping with the Declaration of Helsinki. A total of n = 278 professional, televised MMA bouts were analysed. The following participant data were recorded from each bout, using the 'Tale of the Tape' measurements reported by event promoters during televised broadcasts: winner's age (yrs); winner's mass (kg); winner's stature (cm); winner's wingspan length (cm); loser's age (yrs); loser's mass (kg); loser's stature (cm); loser's wingspan length (cm). Each participant's stature and wingspan was used to calculate their 'ape ratio' (S:W) using the following formula:

$$S:W = \text{wingspan} / \text{stature}.$$

The resulting number is the ratio of the participant's wingspan to their stature (stature always = 1).

The following variables were also calculated for each bout: AgeDiff (the difference between the bout winner's age and the bout loser's age in yrs); StatDiff (the difference between the bout winner's stature and the bout loser's statue in cm); WingDiff (the difference between the bout winner's wingspan and the bout loser's wingspan length in cm); S:WDiff (the difference between the bout winner's S:W and the bout loser's S:W). The mean ± SD for each variable was calculated for the whole cohort and each competitive division.

The method of win/loss was also recorded using the following categories: strikes (the bout winner was declared victorious due knockout or technical knockout, either in a standing or a grounded position); submission (the bout winner was declared victorious due to their opponent giving in to a joint lock or choke manoeuvre); decision (the bout lasted the full duration and judges ruled on which participant deserved to win). Draws, disqualifications and no contests were excluded from the sample.

Statistical Analysis

The following statistical procedures were conducted for the whole cohort and each competitive division respectively. Normality of data was tested using a Shapiro-Wilk test ($p \geq .05$). Where data was found to be parametric, paired samples t tests ($p \leq .05$) with Cohen's delta (*d*) effect size (ES) were used to determine any differences between the winners and losers of each bout in terms of age, stature, wingspan length and S:W. Thresholds for *d* were set to: small $d \geq 0.2$; moderate $d \geq 0.5$; large $d \geq 0.8$.Where data was non-parametric, these variables were compared using a Wilcoxon signed-ranks test

($p \leq .05$) with r being calculated as the ES. Thresholds for r were set to: small $r \geq 0.1$; moderate $r \geq 0.3$; large $r \geq 0.5$.

To discover whether or not age or anthropometry has any influence on how a bout is concluded, each of the participant data were grouped using method of win/loss as a grouping variable. Where the data was parametric, one-way ANOVA was calculated (using omega squared (ω2) as the ES, with small $\omega^2 \geq 0.01$; moderate $\omega^2 \geq 0.06$; large $\omega^2 \geq 0.14$) with Gabriel post hoc treatments ($p \leq .05$), using r as the post hoc ES. In cases where the data was non-parametric, a Kruskal-Wallis test (using eta squared (η^2) as the ES with small $\eta^2 \geq 0.01$; moderate $\eta^2 \geq 0.06$; large $\eta^2 \geq 0.14$) with Wilcoxon signed-ranks test post hoc treatment ($p \leq .05$) being used, again with r being calculated as the post hoc ES. Each of these procedures were completed using SPSS 22.0 (IBM, New York, USA).

For each significant result yielded, a Bayes factor (BF_{10}) was calculated, using a Jeffrey-Zellner-Siow prior and a scale r on effect size = 0.707. The following thresholds were used for categorising each BF_{10}: 1-2.9 = anecdotal; 3-9.9 = substantial; 10-29.9 = strong; 30=99.9 = very strong; ≥ 100 = decisive. Each resulting BF_{10} was then used to determine a Bayes factor likelihood (BF%). These two procedures were carried out to determine by what magnitude the effect was greater than the null hypothesis, and what the likelihood of this effect being observed in the future is.

Results

Full Cohort

When analysing the whole cohort, bout winners (29.79 ± 4.29 yrs) were significantly younger than bout losers (30.79 ± 4.29 yrs) according to Wilcoxon signed-rank test, with a small ES but a strong BF_{10} ($z = - 3.418$, $p = .001$, $r = 0.21$, $BF_{10} = 11.72$, BF% = 0.92).

According to the Kruskal-Wallis test ($H_{(2)} = 8.490$, $p = .014$, $\eta^2 = 0.02$) there were significant differences between the methods of win/loss dependent on the bout winner's age. Post hoc Wilcoxon signed-rank tests found that older participants were significantly more likely to win by strikes (30.59 ± 4.8 yrs) than submission (28.44 ± 3.4 yrs) with a small ES but substantial BF_{10} ($z = -2.756$, $p = .006$, $r = 0.22$, $BF_{10} = 3.64$, BF% = 0.78), and older participants were also more likely to win by decision (29.68 ± 4 yrs) than submission, also with a small ES and an anecdotal BF_{10} (z = -2.058, p = .040, *r* = 0.15, BF_{10} = 2.04, BF% = 0.67). There was no difference between strikes and decision.

Kruskall-Wallis testing also found that there were significant differences between the three methods of win/loss for bout winners dependent on winner's stature ($H_{(2)}$ = 14.466, p = .001, η^2 = 0.4), with post hoc Wilcoxon signed-rank testing finding that taller participants were more likely to win by strikes (181.4 ± 9 cm) than submission (177.3 ± 8.3 cm) with a small ES and an anecdotal BF_{10} (z = -2.683, p = .007, *r* = 0.22, BF_{10} = 2.49, BF% = 0.71). Taller participants were also more likely to win by strikes rather than decision (177.1 ± 8.6 cm) also with a small ES but a decisive BF_{10} (z = -3.582, p < .001, *r* = 0.24, BF_{10} = 48.89, BF% = 0.98). There was no difference between submission and decision.

It was also found that there were significant differences between the three methods of win/loss for bout losers dependent on loser's age according to Kruskall-Wallis tests ($H_{(2)}$ = 14.025, p = .001, η^2 = 0.04). Post hoc Wilcoxon signed-rank tests revealed that older participants were more likely to lose via strikes (31.8 ± 4.4 yrs) than submission (29.19 ± 4.1 yrs) (z = -3.451, p = .001, *r* = 0.28, BF_{10} = 23.86, BF% = 0.96) and also more likely to lose via strikes than decision (30.6 ± 4.1 yrs) with an anecdotal BF_{10} (z = -2.580, p = .010, *r* = 0.17, BF_{10} = 1.19, BF% = 0.54). There was no difference between the ages of participants who lost via submission or decision.

It was also revealed that there were significant differences between the three methods of win/loss dependent on the bout loser's stature ($H_{(2)}$ = 13.721, p = .001, η^2 = 0.04). Bout losers who lost via strikes (180.7 ± 8.2 cm) were significantly taller than participants who lost via submission (176.9 ± 8.5 cm) with an anecdotal BF_{10} (z = -2.401, p = .016, *r* = 0.20, BF_{10} = 2.23, BF% = 0.69) and those who lost via decision (176.5 ± 9.1 cm), with a moderate ES but a very strong BF_{10} (z = -3.570, p < .001, *r* = 0.24, BF_{10} = 32.14, BF% = 0.97), where as there were no differences in the statures of those who lost by submission or decision.

Finally, Kruskall-Wallis tests determined there were significant differences between the three methods of win/loss dependent on the bout loser's wingspan ($H_{(2)}$ = 11.318, p = .003, η^2 = 0.3), where participants with greater wingspans were more likely to lose via strikes (185.2 ± 9.8 cm) rather than decision (180.5 ± 11.1 cm) with a small ES and a strong BF_{10} (z = -3.336, p = .001, *r* = 0.22, BF_{10} = 16.22, BF% = 0.94).

Discussion

This study was designed to determine if chronological age or anthropometry has any effect on the outcome of individual professional MMA bouts. Based on the results presented in this paper, it can be stated that the anthropometrical differences between opponents have little to no effect on determining the winner of a professional MMA bout for either males or females. This conclusion is based on the fact that the only division that demonstrated a significant difference between winners and losers was in WW where the bout winners were taller. This result was found to be anecdotal, however, with only a 57% likelihood of occurring in the future, meaning any use of this finding in predicting a bout winner should be done with extreme caution, if at all. The complete lack of evidence for stature or wingspan having an effect on which participant wins the bout seems on the surface to be counter-intuitive, as it would be assumed that being able to reach, and therefore strike, the opponent without being struck in return would give a competitive advantage (Ljubisavljevic et al., 2015). This is not the case, however, and this is most likely due to MMA competitors spending relatively large amounts of time engaged in grappling movements or in a clinch, and that it is these phases of combat that most contribute to a winning performance (Del Vecchio et al., 2011; Kirk et al., 2015). This seems to negate any advantage that a competitor with a longer wingspan would have, as a smaller opponent can engage their opponent in a clinch or a grapple, making any differences in wingspan and/or S:W largely meaningless. This outcome has been mirrored in the grappling sport of wrestling, where the length of the competitor's limbs also had no effect on bout winners (Demirkan et al., 2015).

Whilst anthropometry does not have any effect on deciding the winner/loser of a bout, it does seem to have an effect on how the bout is won or lost. When analysed as a whole cohort, if the taller participant won, they were more likely to win by strikes than either submission or decision. This is a similar result to when the losing participant is taller, in that they are also more likely to *lose* via strikes rather than submission or decision. One potential explanation for this occurrence could be that taller participants assume they have a natural advantage in striking, so are going to be more inclined to maintain distance from their opponent and avoid engaging in grappling or clinching. This naturally increases the likelihood of the bout ending due to strikes rather than submission or decision, as the more time a participant spends exchanging strikes with their opponent, the more chance they have of being struck in turn. This could also explain why losing participants with greater wingspans were most likely to lose by strikes, as they may assume having a long reach provides them an advantage that does not actually exist, so they utilise tactics that put them more at risk of being defeated by strikes. Tellingly, the evidence in favour of the taller participants winning by strikes was found to be anecdotal, whereas the BF_{10} for taller participants losing to strikes was very strong, suggesting the risk of losing to strikes is actually higher than the potential of them winning in this scenario.

In contrast, the age of the participants was found to have a more pronounced effect. Generally speaking, the younger participants were more likely to win the bouts, and in several divisions, when the older the losing participant, it was more likely it was due to strikes rather than submission or decision. When considering the cohort as a whole, however, bout winners via strikes were more likely to be older than winners via either of the other methods of win/loss; however, the evidence for winners via strikes being older is classed as anecdotal, whereas the evidence for losers via strikes being older is classed as substantial. This leads to an interesting discussion regarding the relative importance of the physiological benefits of youth (Nessel, 2004; Vingren et al., 2010) versus the increased skill and tactical knowledge brought about by age and experience (Rosalie and Muller, 2012).

Conclusion

Whilst it has been widely assumed that anthropometric differences give one competitor an advantage over another in MMA, this study demonstrates that this is not the case. Taller competitors and those with greater wingspans are actually at a disadvantage in striking and are at a greater risk of losing via strikes and potentially submission. A more telling predictor of performance is age, where older competitors are more likely to lose the bouts, with losing via strikes having the highest likelihood. This information should be used by competitors and coaches to plan tactics for competition and inform training focus.

Limitations

As the data used in this study was those reported by the promoters during televised MMA events, it is not known how or when these measurements were taken. This could lead to some inaccuracies in the measurements; however, given the conclusive nature of these results, it is argued that any alterations to some of the recorded measurements would have little impact on the overall picture that has emerged.

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