
Journal: Asian Journal of Sports Medicine**Section:** General**Manuscript Type:** Research Article**Manuscript Full Title:** Technique utilisation and success in competitive Brazilian Jiu-Jitsu matches at white and blue-belt; **Revision:** 0**Abstract** [Required]:

Despite its increasing popularity, little is known about the techniques utilised in Brazilian Jiu-Jitsu competition and their relative success. This work aims to answer questions around the most used and successful takedowns, guardpasses, guard sweeps and submissions to allow development of coaching methods towards enhancing performance at lower belt levels. 140 tournament fights were analysed. The most common takedown was guardpull with 94% success. Significantly more single leg takedowns were attempted for blue belts, compared to white belts ($p = .013$). However, there was no significant difference in success ($p = .150$). White belts used 3 main types of guardpasses with 93% covering knee slice, knee pin and bullfighter pass. A greater variety of passes was observed at blue belt with 71% coming from these three passes. The four most commonly attempted guard sweeps were scissor sweep, back take, X-guard sweep and SitUp sweep all experiencing varying levels of success: 55% for the scissor sweep, 60% back take, 63% X-guard sweep and 38% for the sit up sweep. Of all the submissions attempted 34% were for arm bar, 21% triangle, 12% cross collar choke but there is almost an inverse relationship between use and success with the least used having higher success rates. Brazilian Jiu-Jitsu competition at this level was dominated by guard pull takedowns and submission attempts from guard illustrating the early focus on developing a competition strategy around this position. This information will aid coaches in development of techniques and tactics in order to better prepare players for competition.

Keywords: combat sport,performance analysis,scoring frequency,martial arts**Submitted by**

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1 **Background**

2 Brazilian Jiu-Jitsu (BJJ) has its foundation as a self-defence art but has rapidly grown into a
3 widely practiced competitive sport. As such, competitive contests are primarily decided by
4 submission from joint locks or chokes or failing this by accumulated points decided based on
5 superior positions or positional transitions (1). The success of BJJ in the early days of the
6 Ultimate Fighting Championship firmly cemented its place in the martial arts offering since
7 1993. Since that early introduction it has grown to become one of the most popular martial
8 arts currently studied (1).

9 The presence of scientific articles on BJJ are limited, with the focus being injury profiling
10 (2,3,4), athlete profiling (5,6) or understanding the physiological demands (7,8,9). Whilst
11 these endeavours could contribute to the understanding of the demands of the sport and
12 therefore potentially aid in coaching development, competitive performance analysis is
13 lacking. Performance analysis has been used successfully in many sports including those with
14 similarities to BJJ (10,11) to objectively measure tactics. Such information is invaluable to
15 the technical and tactical development of such sports. To date similar approaches have not
16 been applied to BJJ.

17 Competitive BJJ allows participants to employ a large variety of techniques with the aim to
18 outscore or submit the opponent. Multiple takedowns, pins, joint locks and chokes can be
19 combined to provide a victorious outcome and to date no attempt to compare the
20 effectiveness of different techniques has been undertaken. At its core, competitive points are
21 accumulated from throwing an opponent or pinning them whilst on the ground, whilst a
22 successful submission will award victory to the practitioner regardless of the score. For this
23 reason, it is important that a deeper understanding of technique success is developed to aid in
24 the identification of the technical and tactical aspects most likely to be successful in

25 competition. Such an understanding will aid in the development of coaching education.
26 Therefore, the aim of this study was to analyse beginner BJJ matches to better understand the
27 nature of the techniques and their successes.

28

29 **Methods**

30 Using performance analysis to assess the fights required the establishment of objective
31 definitions for the techniques. A pilot review of BJJ contests by two authors was used to
32 establish the usability of a series of definitions for observable events. A tagging panel was
33 created using these definitions in Dartfish (v8).

34

35 *Sample*

36 With institutional ethical approval, the sample consisted of 140 fights and were obtained from
37 video footage of BJJ tournament fights from a publically accessible website. All personal
38 data were excluded from the final results. The inclusion criteria for contests were the whole
39 contest needed to be available, fighters were of white or blue belt rank, Gi or kimono fights
40 only, male (due to lack of available quantity of female fights) and all weight classes were
41 permitted. The use of Dartfish (v8) for the data collection allowed each athlete to be coded
42 with the time when the specific event occurred, the technique used (examples of which
43 include takedown attempt, guard pass, submission attempt etc). In addition, whether such an
44 attempt was successful or not. Briefly success was defined as scoring takedown, successful
45 position reversal (from bottom to top), full guard pass (not to half guard) or submission. The
46 option to code an event as 'other' was available for collective analysis of techniques not
47 recognised.

48 All data were collected by the same researcher, with over 9 years of experience in BJJ, to
49 provide consistency of interpretation for techniques. Completed data collection resulted in
50 each contest being represented by a coded matrix of events which was stored for later
51 analysis. Collective matrices were analysed using MatLab (R2017b) where bespoke
52 algorithms were developed to identify descriptive and analytical statistics relating to specific
53 techniques and their outcome.

54

55 *Analysis*

56 The resulting data were analysed and presented as attempts, success rates and percentages.
57 Each variable is considered independent for the analysis and breakdown into belt colour was
58 completed. Where possible chi-squared testing on the frequency data was completed to
59 investigate differences between blue belt (BB) and white belt (WB).

60 Success was defined according to Miller and colleagues (12) as:

61 % of successful techniques = (No. of successful techniques / total number of attempted
62 techniques) *100

63

64 **Results**

65 *Takedowns*

66 A total of 247 takedown attempts were recorded, from the 140 fights. The most common
67 takedown attempted was 'guardpull' which had an attempt frequency almost 3 times that of
68 the next most common. Guardpull was identified as 50% of all takedown attempts. 94% of
69 guardpull attempts were determined as successful and it was the most success of all

70 takedowns. Footsweeps and backwards takedowns also achieved high success rates (86%).

71 Other frequencies and successes are evident in figure (1).

72

73 “Insert Figure 1 here”

74 The belt split demonstrated a similar breakdown for white and blue belts, where 46% of all
75 takedowns were classified as guardpull for WB and 53% for BB with a common success rate
76 of 94%. There were a similar number of attempts of double leg takedowns across the belts,
77 whereas there was a significantly greater number of single leg takedowns attempts for BB
78 (18%, n=24) compared to WB (7%, n=8); $\chi^2 (1, N = 247) = 6.13, p = .013$. However, there
79 was no significant difference in success $\chi^2 (1, N = 247) = 2.06, p = .150$, (figure 2).

80

81 “Insert Figure 2 here”

82 The most frequently attempted takedowns (guardpull, single leg and double leg) resulted in a
83 mixed array of ground positions. Guardpull resulted in guard or half guard (bottom) 93% of
84 the time. Double leg takedown resulted in side control 31% of the time, however it also had a
85 high prevalence of resulting in guard (top) and turtle (bottom) 28% and 19% respectively.
86 Single leg takedown resulted in similar resulting positions, side control (top) 30%, guard
87 (top) 27% and turtle (bottom) 17% of the time.

88 The belt split illustrates that the double leg takedown by WB resulted in guard (top) 47% of
89 the time in contrast to just 11% for BB. Similarly, the double leg takedown resulted in side
90 control (top) 47% in contrast to WB where just 12% of double leg takedowns resulted in side
91 control (top). Furthermore, WB double leg takedowns resulted in guard (bottom) 18% in
92 contrast to 0% at BB.

93

94 ***Guard passes***

95 A total of 107 guard passes were recorded. The most common guard pass attempt was knee
96 pin and knee slice, closely followed by the bullfighter pass. Success rates identified
97 bullfighter pass as most successful with similar success rates for the sao paulo and knee pin
98 pass.

99

100 “Insert Figure 3 here”

101 Passes at WB concentrated three passes, knee slice, knee pin and bullfighter pass accounting
102 for 93% of pass attempts. A greater variety of passes was witnessed at BB with 71% coming
103 from these three passes. Double under and leg drag passes accounted for a further 19% of
104 passes at BB compared to 0% at WB. The BB, WB split showed similar attempts of knee
105 slice and bullfighter passes. Knee pin was attempted more at blue belt but this was not
106 significantly different $\chi^2(1, N = 141) = 0, p = .995$.

107 Of the three common WB passes knee pin was 100% successful, with 81% and 82% success
108 rates for knee slice and bullfighter respectively. At BB bullfighter pass was most successful
109 of these three passes (89%) with 69% and 70% success for knee slice and knee pin
110 respectively. A particularly low success rate was noted for the double under pass at BB
111 (29%).

112

113 ***Guard sweeps***

114 A total of 56 guard sweeps were observed. The four most commonly attempted guard sweeps
115 were scissor sweep, back take, X-guard sweep and SitUp sweep. Various levels of success

116 were noted for these sweeps; 55% for the scissor sweep, 60% back take, 63% X-guard sweep
117 and 38% for the sit up sweep. The belt split shows that WB attempted a scissor sweep on 10
118 occasions compared to just once for BB. DeLaRiva was attempted 5 times more often at blue
119 belt as was backtake (twice as often). In contrast Situp sweep was three times more common
120 at white belt as was spiderguard sweep.

121 *Submissions*

122 173 submission attempts were observed. Of all the submissions attempted 34% were for arm
123 bar, 21% Triangle, 12% cross collar choke, 8% kimura and 7% rear choke. All other
124 submissions had an attempt frequency of less than 5%. The success for these top five
125 submissions were best for the rear choke (75%) falling to triangle at just 22% (figure 4).

126

127 “Insert Figure 4 here”

128 The belt split illustrates a similar pattern of attempts at white belt (figure 5) for arm bar,
129 triangle, kimura and cross collar choke, however rear choke was lower with less than 5%
130 attempt frequency. BB Kimura attempts were below 5% attempt frequency with omoplata
131 registering as the 5th most common submission attempt at blue belt despite no attempts for
132 WB. Chi-squared testing reveal no significant difference in arm bar attempts $\chi^2 (1, N = 173)$
133 $= 0.58, p = .445$, Cross collar choke $\chi^2 (1, N = 173) = 1.74, p = .186$, or triangle $\chi^2 (1, N =$
134 $173) = 2.09, p = .148$, attempts between the belts.

135

136 “Insert Figure 5 here”

137 A strong dominance of the guard was evident when investigating submission position. At
138 least 76% of arm bar, cross collar choke and triangle chokes where observed from the guard

139 (bottom) position. A greater variety of positions were observed for Kimura attempts but
140 guard was still the most frequent (30%) and side control top the next most frequent (20%).
141 The belt breakdown demonstrated a similar pattern with over 80% of arm bars, cross collar
142 chokes and triangles attempted from guard (bottom). At 63% of BB arm bars were attempted
143 from the guard, and over 75% of cross collar chokes and triangle chokes attempted from
144 guard. A statistically significant greater number of guard arm bar attempts were witnessed at
145 white belt compared to blue belt, $\chi^2(1, N = 103) = 4.13, p = .042$.

146

147 **Discussion and Conclusion**

148 The aims of this paper were to conduct an event based performance analysis of WB and BB
149 BJJ fights, and this represents the first such analysis therefore the findings are considered to
150 be novel. The findings are believed to offer players, coaches, referees and organisational
151 committees/governing body's insights into the events commonly encountered during this
152 level of BJJ match.

153 All matches commence in the standing position and the data generated by this study
154 illustrates that guardpull was by far the most common take down event and one which was
155 highly successful. Players at both belt levels achieved a high percentage of success resulting
156 in a guard control position. This strong focus on the sacrifice of the top position is highly
157 unique to BJJ, despite this previous studies have not quantified this (13,14) therefore this is
158 the first study to identify and quantify guardpull dominance in beginners BJJ. Throw analysis
159 in judo illustrated that sutemi-waza (sacrifice throws) were much less frequent and successful
160 in comparison to Te- or Ashi-waza (12). This suggests that the guard pull technique has either
161 been a strong focus of beginners BJJ or that the technique in itself is simple to master or
162 difficult to defend. It is not clear whether opponents are happy to follow this technique to the

163 ground i.e. allow the technique to be effective, in order to end up in the familiar guard top
164 position or whether effective defence to such a technique is lacking or difficult to grasp at this
165 level.

166 There were some interesting findings around the other takedowns regarding little used but
167 high success rates. A foot sweep and backwards takedown demonstrated an overall success
168 rate of 86% despite only being attempted 9% (n = 21) and 3% (n = 7) of the time
169 respectively. At WB, this success was 100% for backwards takedown, and foot sweeps 85%
170 and 88% respectively for WB and BB. This coupled with a 100% success rate for forwards
171 takedowns at blue belt suggest that certain techniques appear to be highly successful but only
172 for a few individuals. It is not known as to the back ground of these players, i.e. whether they
173 possess these skills prior to commencing training in BJJ or whether they have been able to
174 develop a high level of proficiency for these specific techniques. It seems however that the
175 players using these are highly successful with these takedowns and that these takedowns are
176 not attempted by those who are less confident of their competency.

177 However just looking at the success of the takedown does not consider the resultant position
178 achieved from the takedown. Unlike Judo, BJJ cannot be won outright by a throw/takedown
179 therefore resultant position is one of the primary aims of such techniques. This is critical to
180 understand if significant match advantage has been gained from the takedown. For example,
181 the backwards takedown resulted in equal chance of ending in side control, taking the back
182 (top) and mount (top) which could be described as attacking positions and a positive
183 outcome, however it also resulted in guard (bottom), a neutral/attacking position but in
184 addition guard (top), a negative position. Therefore, takedowns resulting in attacking
185 positions are critical to inform coaching practice. Few takedowns resulted in mount top or
186 back top, however 38% of single leg and forward takedowns and 33% of backwards
187 takedowns resulted in side control (top) for WB. This suggest that with 100% success rate for

188 backwards takedowns a 1 in 3 chance of ending up in side control (top). In addition, when
189 observing the other outcomes from this takedown, namely a 1 in 3 chance of ending in guard
190 (bottom) or back (top) this technique appears likely to result to significant attacking
191 advantage and unlikely to result in a negative position. This is in contrast with the forward
192 throw, which is usually attempted by turning your back on your opponent in standing, which
193 was only successful 53% of the time and resulted in a 1 in 4 chance of ending with your
194 opponent taking the back (top) position, one of the high scoring positions in BJJ. It did
195 however yield side control (top) 38% of the time, therefore this represents a high risk, high
196 reward tactic for WB. The single leg takedown, which resulted in side control top 38% of the
197 time also resulted in 1 in 4 landing in guard top demonstrating a medium risk for high reward.
198 Therefore for the white belt BJJ player who is keen to avoid ending up in the opponents
199 guard or a negative non attacking position, a forwards takedown or backwards takedown
200 offers low risk, however there is a high risk of a back take with a forwards takedown,
201 therefore the backwards takedown could be the preferred low risk, high reward option.

202 For BB, the 100% success observed with a forward throw resulted in ending up in guard or
203 half guard (top) 75% of the time which is not necessarily an attacking position. Similar
204 findings are evident for the foot sweep which despite a high success rate at blue belt (88%),
205 guard or half guard (top) was the outcome 63% of the time and only an attacking position
206 38% of the time. Therefore, the outcomes of such techniques for gaining advantage should be
207 questioned. The takedown most successful for securing an attacking position at BB leg
208 takedown which resulted in side control (top) almost 50% of the time. This takedown,
209 perhaps with its origins in judo (Morote Gari) where, before it became illegal, had an
210 observed successful frequency of 3% compared to all throws (15), or freestyle wrestling with
211 an observed frequency of 10% of all successful takedowns (16). Side control (top) would be
212 considered a strong attacking position and a very positive outcome from a takedown,

213 however there was a 1 in 4 chance that such an attempt would result in the opponent securing
214 the back. Moreover, despite a very low usage (only 3) the sacrifice takedowns resulted in
215 either mount (top), guard (bottom) or in back take for the opponent in equal measures.
216 Therefore, for the BB looking to secure a strong attacking position either sacrifice throw
217 (which maybe the domain of those who have grasped these techniques), or double leg
218 takedown with a high proportion ending in side control.

219 The outcomes of these takedowns have important implications for coaching, technique
220 development or tactics. It seems to suggest that either students at this level struggle to secure
221 the resultant position to take full advantage of the takedown or that defending these
222 takedowns is well developed as such to minimise the impact of the takedown. The exceptions
223 to this are the little used takedowns which seem to be adopted with those who have
224 concentrated on the development of these specific techniques. Perhaps specific drills or focus
225 should be placed on how to complete the takedown to ensure maximal advantage. This notion
226 has been identified in other combat arts and is sometimes referred to as transition. This is
227 unique in BJJ over Judo as with a perfectly executed takedown a Judo contest is over thus
228 preventing the need to secure the ground position. In contrast takedowns in BJJ serve only for
229 the transition to the ground.

230 Due to the dominance of the guard position, one of the key challenges in BJJ is passing the
231 guard. The findings of this study suggest that 93% (WB) and 71% (BB) of all guard passes
232 fall into the knee slice, bullfighter and knee pin pass categories. These were highly successful
233 at white belt suggesting either a strong focus on guard passing at this level or perhaps due to
234 less developed guard retention. The high success rates suggest this is a highly effective tactic
235 for this level of BJJ. However, this level of success reduces slightly for the knee pin and knee
236 slice for blue belt. The reasons for this are not immediately clear but suggests that as
237 experience is gained so does the ability to defend this attack. This suggests that an early focus

238 for BJJ coaching should be built around defending these very common attacks. In addition, it
239 may be tactically relevant to develop and train less common passes in order to surprise
240 opponents rather than rely on the common passes.

241 Submissions are a critical aspect of BJJ as they result in an instant victory. Therefore, BJJ
242 training is largely based around the idea of securing a submission. Over the years a great
243 number of submission techniques have been developed. Despite such a large quantity of
244 available submissions, only 8 types of submission were witnessed for white belt, and 9 for
245 blue belt. There was a strong focus on submission attempts from guard with 75% of all
246 submission attempts common from the guard (bottom) position. Of all the submission
247 attempts at white belt from the guard 37% were for the arm bar. At BB around 2/3rds of all
248 submission were from the bottom guard position and of these 1 in 5 was for the arm bar. Such
249 a propensity for one technique seems to suggest that competition results in a reductionist
250 approach to submission attempts where the submission repertoire of beginners is narrowed
251 significantly. Mixed martial arts demonstrated that the elbow locks (very similar to the arm
252 bar) were responsible for 9% of all stoppages (17) and was by far the most common joint
253 lock witnessed. This suggests such a technique is high popular and effective across a range of
254 arts perhaps due to its ease in application or effectiveness as a submission or difficultly to
255 defend. Coaches should concentrate of developing methods of appropriate defence for this
256 highly popular submission. Despite this high popularity, the triangle choke was more frequent
257 at blue belt with 1 in 4 submission attempts from the guard being for this technique. This was
258 observed to cause 2.3% of stoppages in MMA matches being the third most common (17). As
259 some of the fighter in the study by Buse (17) were from a BJJ background it is possible that
260 these skills are reflective of those learnt at beginner BJJ players. Despite these subtle
261 differences it identifies the strong emphasis of early BJJ training involving the guard. It is

262 evident that avoiding defeat at this level of competition requires an ability to defend arm bar
263 and triangle attacks from inside the guard.

264 The synthesis of these matches seems to suggest a common thread or theme to the generic
265 approach to BJJ at this level. There appears to a strong focus on the guard. Takedowns
266 dominated by guard pulls, low guard pass counts, submission attempts from guard with a
267 strong focus on arm bar and triangle and therefore this information should prove valuable to
268 players and coaches alike in developing training to defend or enhance tactical approach to
269 winning at this level.

270

271 This study demonstrates for the first time an analysis of the techniques used during beginner
272 BJJ matches. The results were dominated by the guard, from guardpull as the most common
273 takedown to submissions from guard being most prevalent. This confirms the uniqueness of
274 BJJ for developing a strong propensity for developing a competition strategy dominated from
275 being on ones back. This information will aid coaches in development of techniques and
276 tactics in order to better prepare players for competition.

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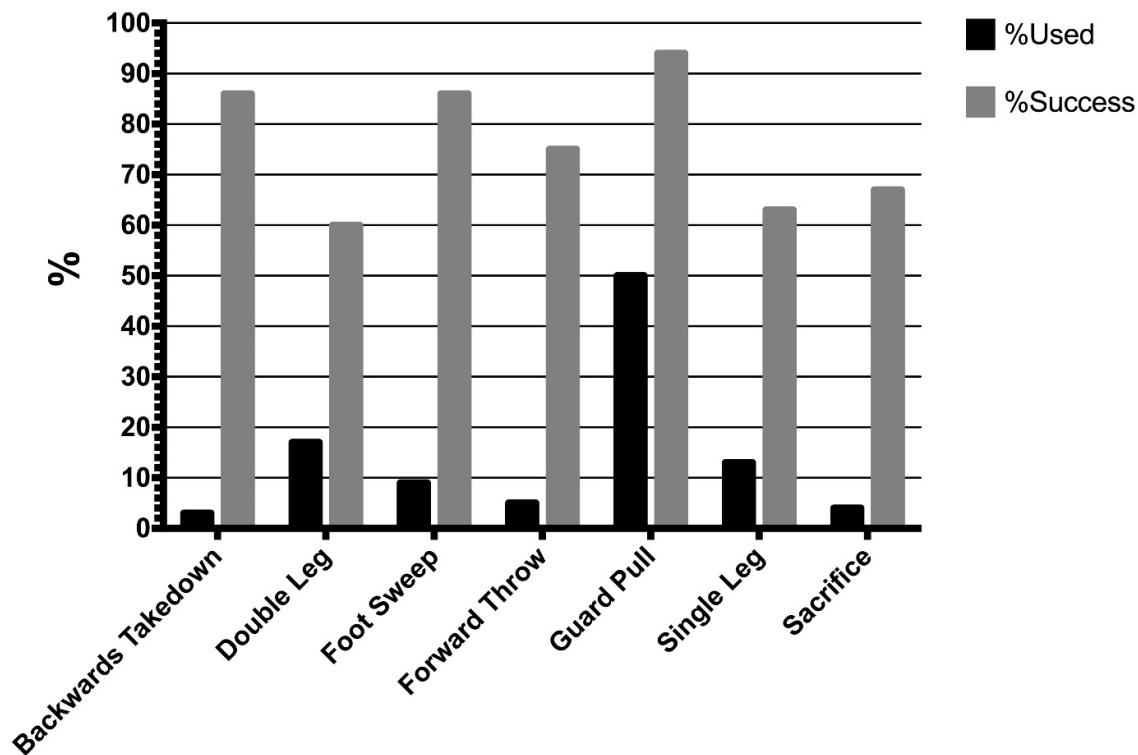


Figure 1. Percentage of takedown attempts and percentage of success

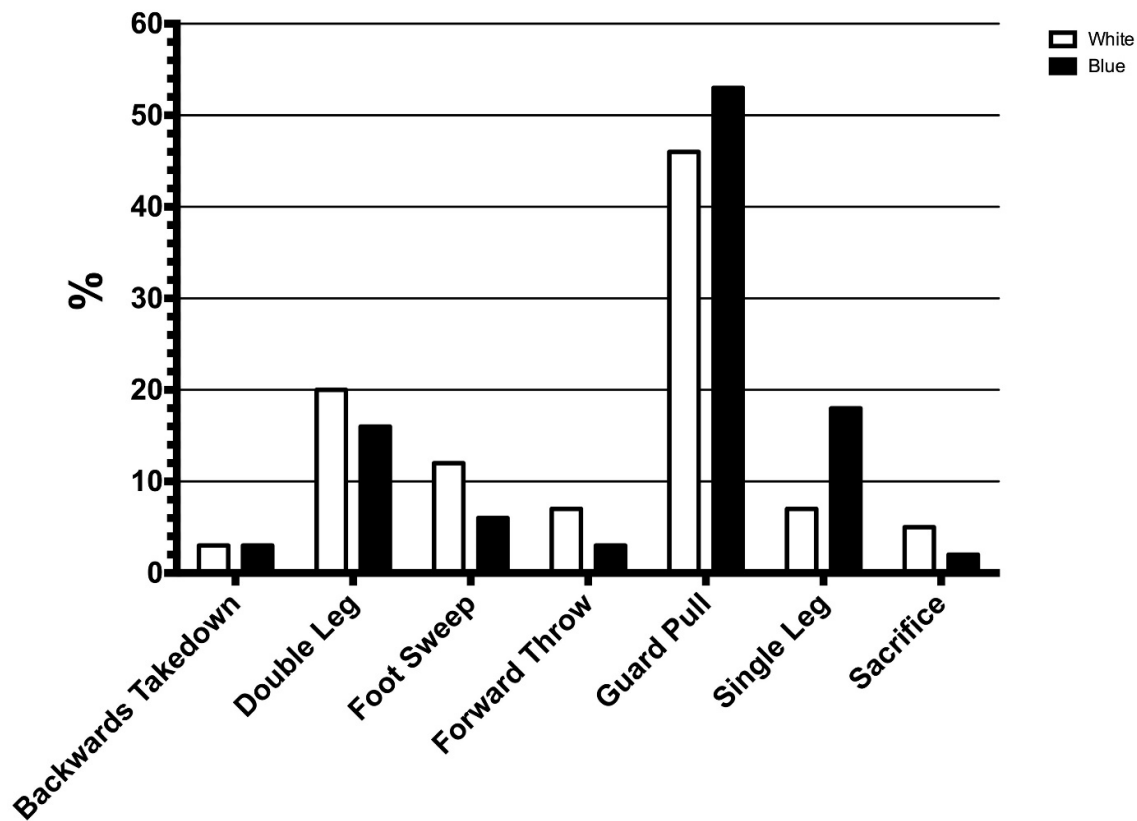


Figure 2. Percentage of use of different takedown types, split by belt.

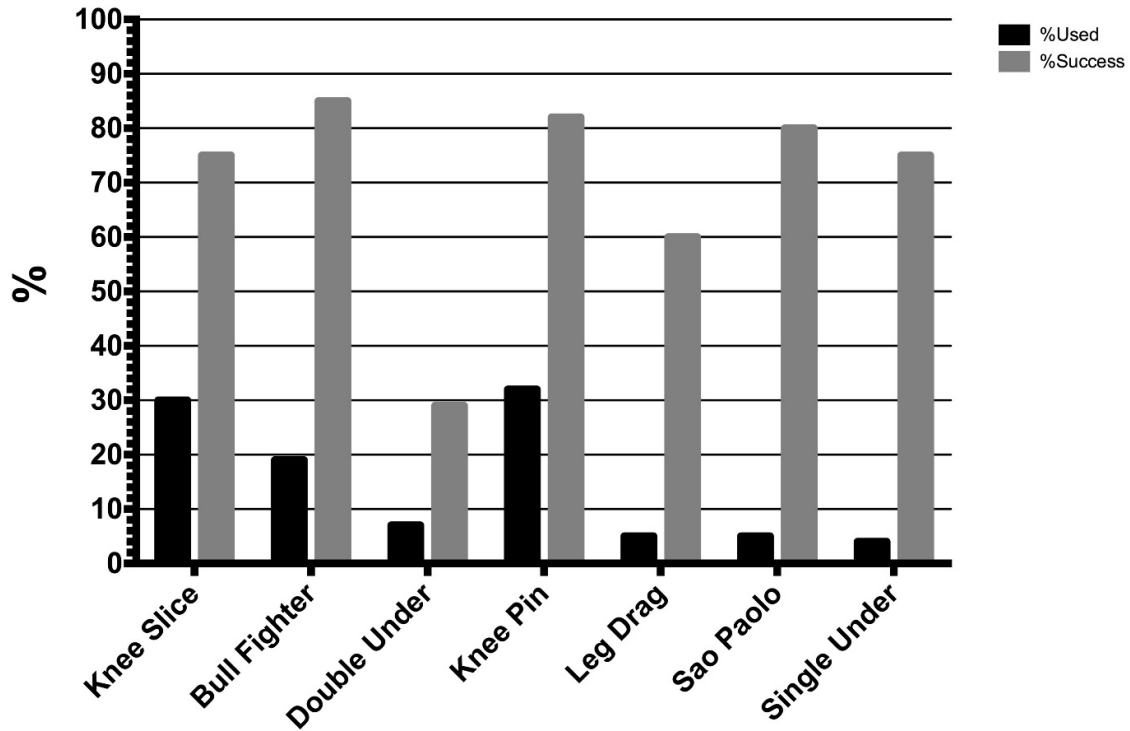


Figure 3. Overall use of guardpass attempts and percentage success

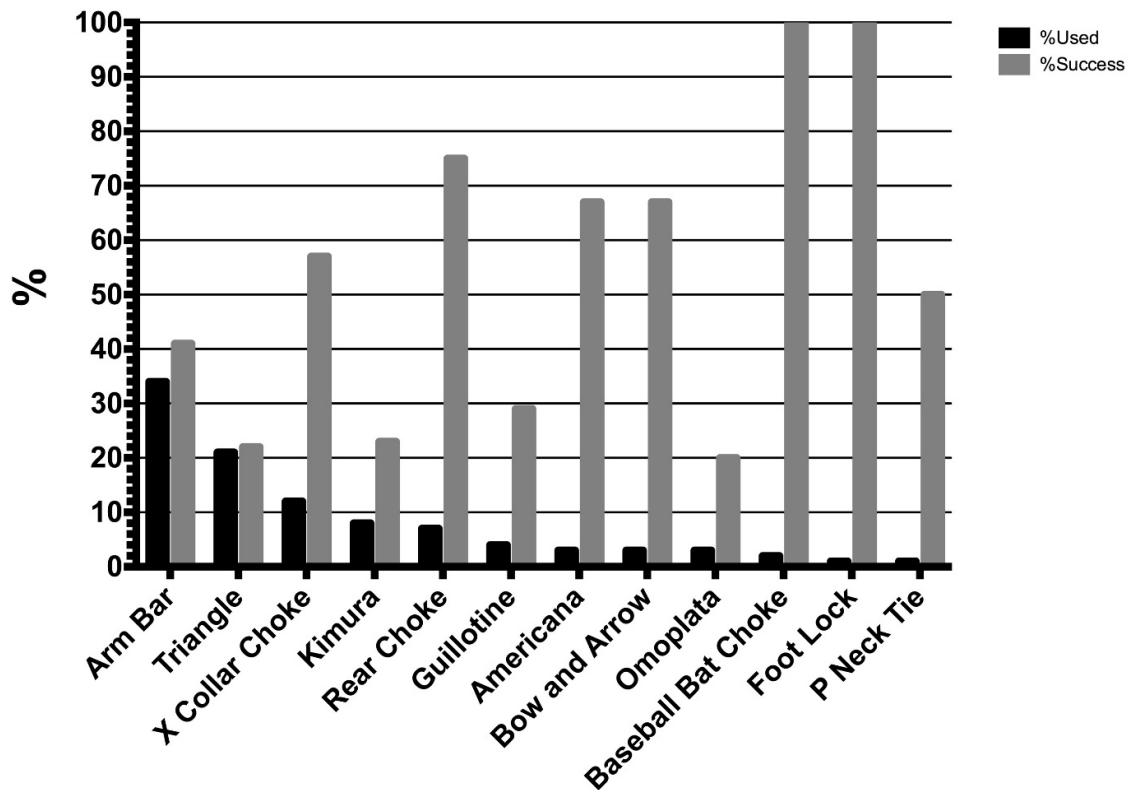


Figure 4. Use of submission attempts and percentage success

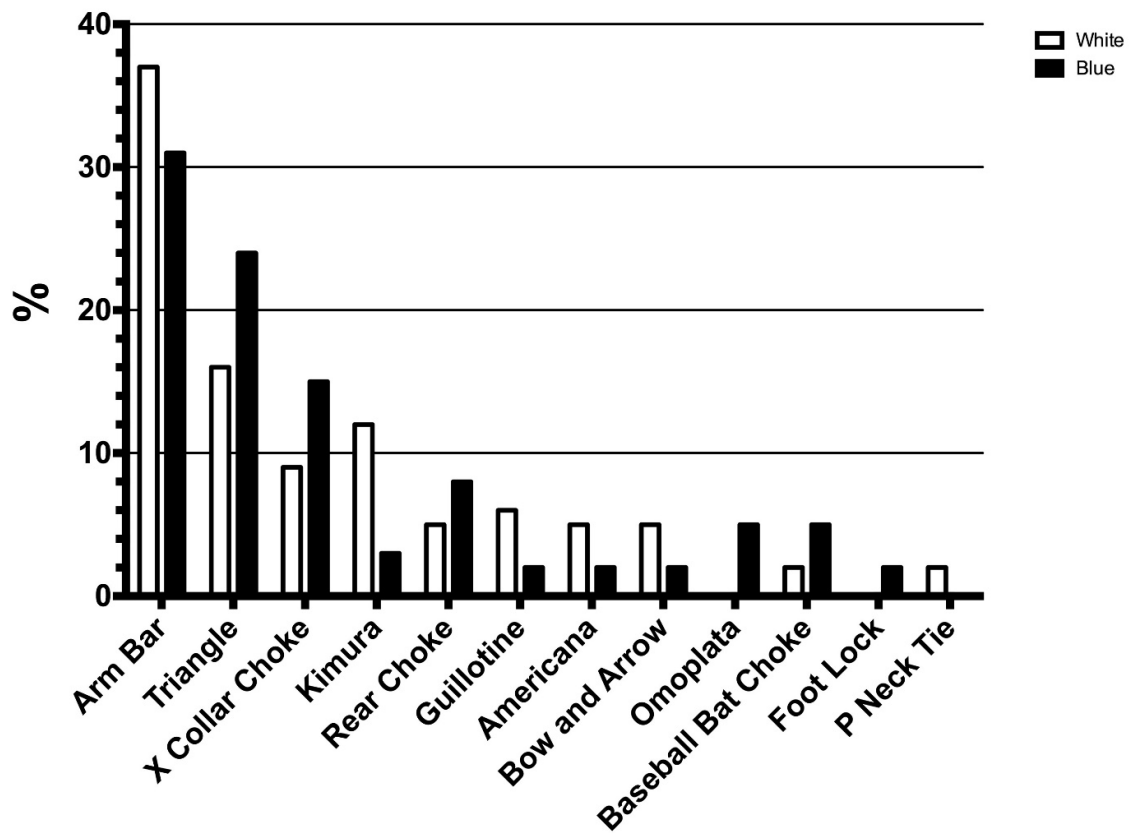


Figure 5. Submission attempts across blue and white belt.

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Dear Editor,

Re: **Technique utilisation and success in competitive Brazilian Jiu-Jitsu matches at white and blue-belt**

We would like to take this opportunity to thank you for considering our manuscript.

As corresponding author I can confirm all authors contributed significantly to the manuscript and are to be considered authors. I have the authority to act on behalf of the authors.

The material submitted is unpublished and original it had not and will not be submitted for publication elsewhere until a decision is made regarding its acceptability for publication in the Asian Journal of Sports Medicine. If accepted for publication, it will not be published elsewhere without the written permission of the Editor-in-Chief. The experimental work conforms to the highest standards of safety and ethics, and to the laws of the country in which the work took place. As the study used publically available data no consent was necessary.

We look forward to you considering our work for publication.

Yours sincerely



Dr Jonathan Williams