Microstudy

The difference 50cm makes on 20m sprint performance time

By Jaymee Dudley BSc

Abstract

Purpose: The purpose of this study was to determine the difference in times from a standing split start and a 0.5 metre flying start on a 20-metre sprint. **Methods**: 15 voluntary participants (12 female and 3 male, age 23.13 ± 10.41y, height 163.13 ± 15.74cm, weight 61.23 ± 17.07kg) completed three 20-metre sprint tests. Each test was started with a standing split start and each participant was instructed to run as fast as possible through several timing gates and continue running through a set of flags placed five metres after the final timing gate. Two timing systems were used to measure the sprint times for the 20-metre sprint from the standing split start and a 0.5 metre flying start. Timing gates were set at 0, 0.5, 5, 5.5, 10, 10.5, 20 and 20.5 metres. Timing began as soon as the first timing gate was broken. A 3-minute recovery was given between each trial. **Results**: A significant difference was found between the standing split start and the 0.5 metre flying start over the first five metres (9.68% ± 3.16%). A difference was also found over the second five metres (5 to 10 metres) and the final 10 metres (10 to 20 metres) however it was insignificant. The final time taken was significantly different between the standing split start and the 0.5 metre flying start, with the 0.5 metre flying start 4.06% ± 1.54% faster than the standing split start. **Conclusion**: The data showed that there was a significant difference between the standing split start and the 0.5 metre flying start over the first five metres due to the participant having a short distance to build momentum before passing through the initial timing gate. Although there were no major differences in times throughout the rest of the 20-metre sprint, the overall time differences were significant, meaning that the first five metres of acceleration are important in sprint timing. It was concluded that a flying start produces a faster sprint time over 20 metres than a standing split start.

Keywords: Flying start, standing split start, sprinting, timing.

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CHAPTER I

INTRODUCTION

Being able to move a certain distance in the shortest time possible is advantageous in many sports and is mainly measured using timing gates (Cronin et al., 2007). Sprinting is a major component in most sports and is necessary for success. Individuals who can move faster will be able to beat their opponent to the finish line, to the ball or to a scoring opportunity. Athletes of different sports are required to sprint varied distances, with track athletes sprinting for 100 plus metres, whereas team sports athletes sprint an average of 15 – 21 metres at a time (Andrzejewski et al., 2013; Gabbett, 2012). With sprints usually lasting between two and four seconds (Bangsbo et al., 1991), it is suggested that team sports athletes reach their maximal speeds in a much shorter distance than track athletes. Benton (2000) demonstrates that team sports athletes reach their maximal speed at around 40 metres from a standing start and 29 metres from a flying start, whereas track sprinters continue to accelerate until about 50 metres during a 100-metre sprint (Brown, 2012).

Speed tests are used to solely measure an athlete’s linear speed capability. Sprint tests of 10 – 20 metres are considered to measure the athlete’s acceleration ability, whereas sprint tests of up to 40 metres are used to measure both acceleration ability and maximal velocity (Young et al., 2001). Most court sports (netball, tennis, basketball etc.) use a 20-metre sprint test due to the relevance to the court sizes and actual sprint distances covered by these athletes during games. Field sports (soccer, rugby, hockey etc.) cover a larger distance and due to the pitch size, maximal velocity may be reached in competition games (Duthie et al., 2006). Therefore, for field sports, a 20-metre sprint can be used to measure acceleration ability, or up to 40 metres can be used to measure acceleration ability and maximal velocity.

Assessment of sprinting time can be measured in several ways, with researchers using manual or electronic timing. Manual timing consists of coaches or experienced, trained personnel using hand-held stopwatches, starting the timing when the participant starts moving and stopping when the participant crosses the finish line. However, each individual may have a different interpretation of a starting movement and also, one individual may have a quicker reaction time than another. The positioning of the individual conducting the timing can also affect their vision of the start as they are not able to be in line with both the start and finish at the same time. Due to the potential of human error, manual timing is subject to inaccuracy. Electronic timing is an alternative timing method that eliminates the effect of human error and reaction time. Laser timing gates are the most used method of speed timing for athletes. There are a diverse range of timing gates available, and researchers use different equipment distributed from different countries around the world. Altmann et al. (2015) and Mujika et al. (2009) used a single beam timing system (Timer S4, Austria), whereas Haughen et al. (2015), Cronin et al. (2007) and Duthie et al. (2006) used dual beamed timing systems (Biorun, Norway; Swift Sports Performance, Australia). Alternatively, Haughen et al. (2012) used Omega's Scan 'O' Vision, Brower Timing System, Dartfish Video Timing and Floor Plate Triggering.

When using different timing equipment, the athlete's starting position should be carefully considered to avoid any premature starts and inaccurate data. For example, if the starting stance involves a forward lean, the athlete could unseeingly break the first timing gate, leading to a false timing, which is why some researchers start the athletes a short distance behind the start line (Moir et al., 2004). Researchers have conducted sprint time trials with a variety of different starting distances including starting on the initial start line and flying starts, starts behind the line, ranging from 0.3 metres up to 30 metres. Due to the difference in starting positions, no comparisons can be made as the tests are not the same as the different lengths of flying starts will have affected the overall times.

The way the athlete stands when starting a sprint test can also affect their overall time as the weight distribution may limit the amount of movement occurring before the start of the sprint, yet other starting positions may allow for a slight gain in momentum before the participants body crosses the start line. The most common stances used in sprint timing are parallel (both feet on the start line), split (leading foot on the start line with other leg back) or false (start in parallel, then drop to split start before moving forward) (Cronin et al., 2007). Other starts include 3-point start, starting from blocks and rocking start.

Aim

To determine the difference in results between a standing start and a 0.5 metre flying start.

Hypothesis

Null: There will be no significant differences in results between the standing start and the 0.5 metre flying start.

Alternative: There will be significant differences in results between the standing start and the 0.5 metre flying start.

Rationale

To determine whether a standard sprint protocol should be developed for measuring sprint performance as there are many different protocols used, resulting in inconsistent results and no option to compare results.

CHAPTER II

LITERATURE REVIEW

Several studies have investigated the effect of starting stance on initial sprint performance (Haughen et al., 2012; Cronin et al., 2007; Duthie et al., 2006). Using a sample of 25 track and field athletes, Haughen et al., (2012) compared the effect of a block start, 3-point start and standing start on sprint running performance over 40 metres. The researchers' found that performance time was statistically significantly different and much larger than the typical variation from test to test, meaning that the way an athlete stands when completing a sprint can have a significant difference on their overall performance time. Cronin et al. (2007) also looked at 3 different starts on sprint performance, however, the starts were all standing (parallel, split, and false) and it only looked at distances of five and 10 metres, meaning it focused more on acceleration. Using 158 sport and exercise science university undergraduates it was found that the parallel start was significantly slower than the other two stances over both distances and the split and false start times were significantly different in women only. The within trial variability was not significant over both distances. This research suggests that standing parallel to the start line is not the most effective start as it requires an extra movement to allow the athlete to move in the forward direction. Research conducted by Duthie et al. (2006) used another three starting techniques and each starting technique had a different timing triggering system with all techniques measured over 10 metres. The first start was a standing start where timing began when the first timing gate was triggered, the second was a standing start where timing was initiated when the front foot was moved off a timing mat and the final start was a 3-point start triggered by a thumb switch. The results of the testing showed that there were significant differences between the foot start and standing start (0.22 ± 0.00 seconds) and the foot start and the thumb start (0.38 ± 0.00 seconds), with the foot start being the fastest in both cases. A significant difference was also found between the standing start and thumb start (0.16 ± 0.06 seconds) with the standing start being the fastest. The three starts used in this study all involved the participant's centre of mass already moving before any timing had commenced, meaning that there was a form of momentum: a flying start. It was concluded that due to the significant differences in times between the different starts, a consistent start is required if results are to be compared. However, it is questionable whether a start that requires familiarization pre-test (e.g. 3-point start) is beneficial to use during sprint testing.

The distance in which an athlete starts behind the initial timing gate can also influence timings, as shown by Altmann et al., (2015). The purpose of the study was to quantify the effect of three different starting distances (0.3, 0.5 and 1.0 metres) behind the initial starting gate on a five-metre sprint, using 13 male sports students. It was found that the times for the 1.0 metre start behind the initial gate (0.98 ± 0.06 seconds) were significantly faster than the 0.5 metre and 0.3 metre starting distances recorded (1.05 ± 0.07 and 1.09 ± 0.08 seconds respectively). Haughen et al. (2015) also conducted a study analysing the effect the starting distance can have on performance time. Using 44 well trained junior soccer players, sprint times were recorded with flying starts of 0.5, 1, 1.5, 2, 5, 10 and 15 metres. A performance enhancement of approximately 0.15 seconds was found by increasing the flying start distance from 0.5 metres to 1.5 metres and the time saving differences increased until around the 5-metre flying start distance and plateaued thereafter. This study concluded that the impact of a small change in flying start distance can have a bigger impact on overall time than the gains that would be obtained from specific training. This could have been expected as the athlete had a further distance to increase their speed before reaching the actual timing area, meaning they will be moving faster, therefore covering the distance in a shorter period. However, in several team sports, sprints very rarely occur from a static standing position, rather from a walking or jogging start. Therefore, for sport specific sprint timing, a flying start is more likely to reflect the true speed and sprint ability of the athlete. Nonetheless, to provide a comparison for all athletes and to compare athletes from sport to sport, a standard protocol needs to be used.

Differences in sprint timings have been found between manual and electronic timing, with a variety of conclusions. Moore and colleagues (2007) conducted a study that found electronic timing produced a faster time by 0.08 seconds, however Brechure (2005) found that electronic timing was approximately 0.22 seconds slower than manual timing. Alternatively, Hetzler et al. (1969) found that there was no difference at all. A more recent study by Ebben et al. (2009) compared the difference between electronic and manual timing on 20- and 40-yard sprints. A sample of 90 NCAA Division III NFL players completed two 40-yard sprints that were timed simultaneously by manual and electronic timing methods. Four trained and experienced timers conducted manual timing using hand-held stopwatches, whilst electronic timing was conducted with an infrared laser timing system. A significant difference was found in overall timing of both the 20- and 40-yard sprints. The average manual times were approximately 0.20 seconds (6.4%) faster than the electronic times over the 20-yard sprint and approximately 0.27 seconds (5.3%) faster over 40 yards. Although the electronic timing produced slower results, there was less variability (SD = 0.024 seconds) compared to the manual timing (SD = 0.049 seconds), leading to the conclusion that electronic timing produces more accurate results. A second study comparing the difference between manual and electronic timing methods was conducted on 46 NCAA Division II NFL players over two 10-yard and two 40-yard sprints with each sprint timed simultaneously by two coaches and an infrared electronic timing system. There was no significant difference between trial one and trial two for each manual timer. However, there was a significant difference on the 10-yard sprint between each timer (0.06 ± 0.04 seconds), but no significant difference on the 40-yard sprint (0.07 ± 0.06 seconds). The average of the hand times over both sprints were significantly faster than the times of the electronic times (0.13 ± 0.06 seconds). This supports the findings of Ebben et al. (2009).

CHAPTER III

METHODOLOGY

Participant Information

Fifteen participants (12 female and 3 male, age 23.13 ± 10.41y, height 163.13 ± 15.74cm, weight 61.23 ± 17.07kg) volunteered to participate in this study (Table 1). The participants were active, healthy, and displayed no complications that would affect them participating. They were informed of the sprint-testing procedure through posters and physical demonstration. Written informed consent and parental consent where necessary, were gathered from all participants before any testing was undertaken.

Table 1: Participant information.

Participants	Gender	Age (Years)	Height (cm)	Weight (kg)
n=15	3M, 12F	23.13 ± 10.41	163.13 ± 15.74	61.23 ± 17.07

Procedures

A wireless Sport Gates™ system (Sporttesting, Toronto, Ontario, Canada) consisting of timing gates, Sport ID™ scanning and Core Capture™ technology were used to record sprint times (Figure 2). A total of 8 sets of gates were set up at 0, 0.5, 5, 5.5, 10, 10.5, 20 and 20.5m (Figure 1). A line of tape was placed between the first set of gates at 0 metres to identify a start line. A laptop, connected wirelessly to Sport Hub™, was used to register each participant as a RFID number to a rubber RFID band and collected all timing in real-time to eliminate human typing error whilst entering results. Sprint tests were conducted indoors on an even surface in a university gymnasium with participants using appropriate trainers for footwear.

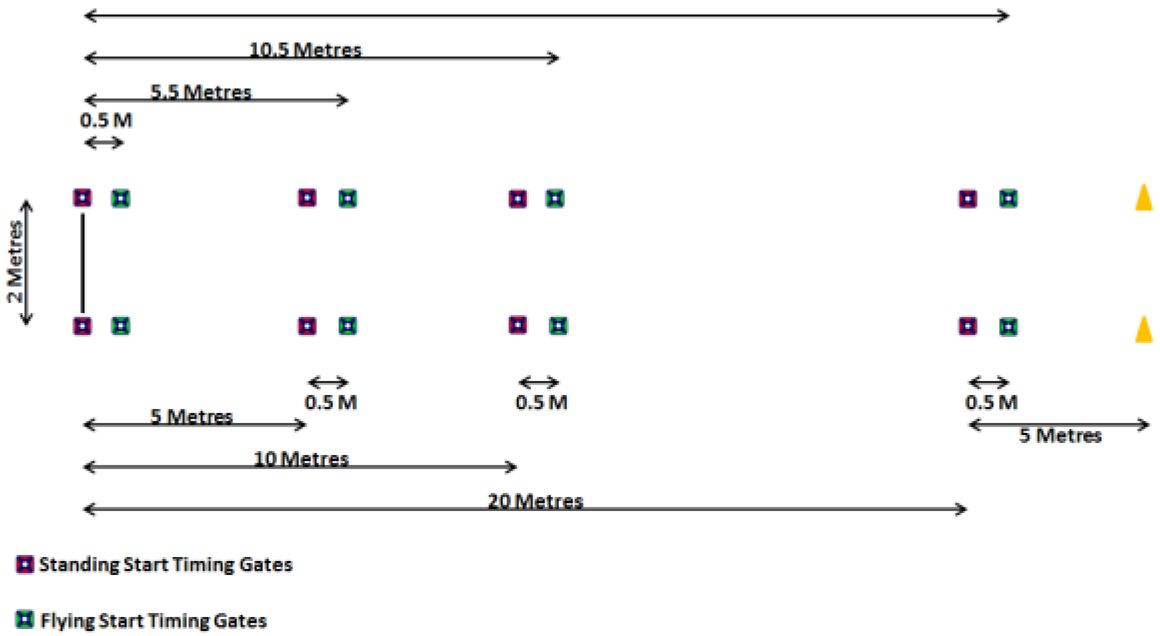

Figure 1: The setup of the timing gates to measure both standing split and flying starts simultaneously.

Protocol

After a standardized warm up, including aerobic exercise and dynamic stretching, and a practice run through the sprint protocol, the sprint testing began. One participant at a time stepped up to the Sport ID™ scanner (Figure 2), and using the assigned RFID band, scanned themselves on to allow the system to recognise who was completing the test via the participant's RFID number. Once scanned on, the gates would all light up green ready for the test to begin. The participant then lined up with a split start and the toes of the front foot in line with the bottom of the marked start line. In their own time, the participant was instructed to run as fast as possible through all the gates and carry on through the set of flags placed 5 metres after the final gate. Time began as soon as the first timing light was broken. Any starts that broke the first timing gate prior to the participant running were disqualified and repeated. Three trials were performed, and the mean time was used as a final result for analysis. Participants were given 3 minutes recovery between each sprint trial.

Figure 2: Sporttesting timing gates, RFID band and Sport ID™ Scanner.

Statistical Analysis

Data is presented as mean values and SD. A paired t-test was used to determine whether there was a significant difference between standing start and flying start times. A value of p<0.05 was used to determine whether the differences were significant.

CHAPTER IV

RESULTS

All timings for both the standing split and flying starts for each participant are shown in Appendix A Table 2 with the mean times and SD shown in Table 3.

Table 3: Average times with standard deviation for standing split start and flying start splits.

	Standing Start				0.5m Flying Start			
	0-5m (s)	5-10m (s)	10-20m (s)	Total (s)	0-5m (s)	5-10m (s)	10-20m (s)	Total (s)
Average	1.34 ± 0.08	0.87 ± 0.06	1.54 ± 0.16	3.75 ± 0.28	1.22 ± 0.08	0.85 ± 0.09	1.53 ± 0.16	3.60 ± 0.29

There was a decrease in all average times of approximately 0.12 (0-5m), 0.02 (5- 10m), 0.01 (10-20m) and 0.15 (total time) seconds. The first 5 metres was found to be significantly slower with a standing split start compared to the flying start (p = 0.00000001). However, there was no significant difference between 5 to 10 metres and 10 to 20 metres (p = 0.33 and 0.32 respectively). This shows that the start of a sprint has a substantial impact on the overall timing of a sprint as there was a significant difference in total time (p = 0.00000003).

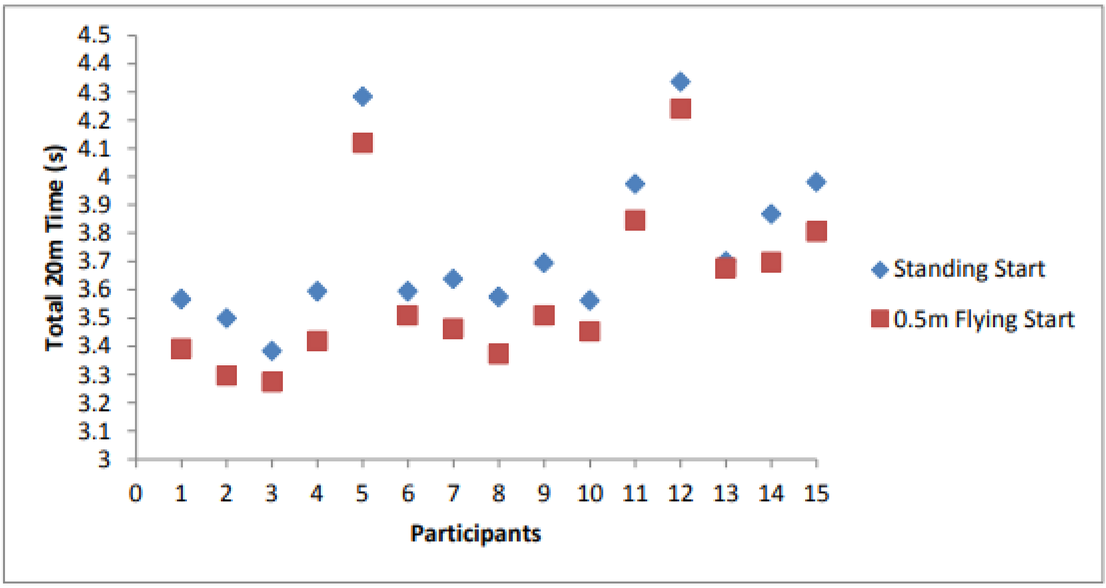

Figure 3: Relationship between standing split start and flying start times for all participants.

The percentage difference between the flying start and standing split start for each participant is shown in Appendix A Table 4 with the mean percentages and standard deviation shown in Table 5.

Table 5: Average percentage differences with standard deviation of split times of 20m sprint between standing split start and flying start.

	0-5m (%)	5-10m (%)	10-20m (%)	Total (%)
Average	-9.38 ± 3.16	-2.08 ± 6.16	-0.59 ± 2.15	-4.06 ± 1.54

The most noticeable difference was for the first five metres, with differences up to 16.48%. The differences decreased over the duration of the sprint, with ~<1% difference for the 10 to 20 metre split.

CHAPTER V

DISCUSSION

The aim of the present study was to determine the difference in results between a standing split start and a 0.5 metre flying start on a 20-metre sprint. If the different distances in which athletes start behind the initial timing gate influences sprint timings, as indicated by Altmann et al. (2015) and Haughen et al., (2015), it was hypothesised that there would be a significant difference in timing between the standing split start and the 0.5 metre flying start. This would be due to the participant having some distance to increase their speed and gain momentum before crossing the start line, meaning they will be able to cover the distance in a shorter period. The results of the present study support this previous research as a significant difference was found in the first five metre split and total time between both sprints.

A significant difference was found between the standing split start and flying start over the first five metres of 9.68% ± 3.16% (~0.12 seconds) and this can likely be attributed to the movement already occurring before the participant passes through the first timing gate. There was still a difference between 5 and 10 metres and 10 and 20 metres (2.08% ± 6.16% (~0.02 seconds) and 0.59% ± 2.15% (~0.01 seconds) respectively) although it was not significant. Moreover, the total time taken to complete the 20-metre sprint from start to finish using the standing split start was 4.06% ± 1.54% (~0.15 seconds) slower than the flying start, which was significant.

The difference in time over the first five metres agrees with a previous study by Altmann et al., (2015). It was found that a flying start of 1.0 metres produced a time that was 7.14% faster than a 0.5 metre flying start (0.98 and 1.05 seconds respectively) and a 0.5 metre start produced a time 3.81% faster than a 0.3 metre flying start (1.05 and 1.09 seconds respectively), whereas the present study found a difference of 9.68% ± 3.16% between a 0.5 metre flying start and a standing split start. This shows that the further an athlete has to increase their momentum, the faster they will cover the timed distance. As the participants in this study were completing the sprint from a static standing split start and comparing to a 0.5 metre flying start, the difference was going to be obviously more noticeable.

The second five metres, from 5 to 10 metres, still showed an improvement in time with the 0.5 metre flying start being faster; however, the difference was not significant as it was only approximately two hundredths of a second. The first five metres with the standing split start produced a time that was 54.02% slower than the second five metres, yet the flying start produced a time that was 43.53% slower. This is due to the first five metres being the initial acceleration stage, requiring the participant to start moving from a static state an increasing momentum as well as generating power. By the second five metres, the participant is already moving and gaining more and more momentum, leading to them travelling at more speed.

The final 10 metres, from 10 to 20 metres, also showed an improvement in time between each start, but again it was not significant as there was only approximately one hundredth of a second difference. The second 10 metres took 35.29% less time to complete from a standing split start compared to 43.51% less time with a flying start. By the time the participant reached the 10-metre split time, they were still accelerating but due to the distance they had already covered, they were moving at an increased speed compared to the first 10 metres where they started from a static start. At this stage, the impact of the flying start was not obvious.

Although the middle 15 metres, from 5 to 20 metres of the overall 20 metre sprint were not significantly different in time between the standing split start and flying start, the total times were significantly different. There was an average of ~0.15 seconds (4.06 ± 1.54%) difference. This is in line with previous research where Haughen et al., (2015) found that a 1.0 metre flying start was 2.27% faster than a 0.5 metre flying start (3.08 and 3.15 seconds respectively). As there was a significant difference in timing for the first five metres and not thereafter, the first five metres of acceleration is key and having an extra 0.5 metre can impact the timing dramatically.

The 20-metre sprint distance was used in this study as the aim of the experiment focussed on the acceleration stage of a sprint and what impact a flying start had on the sprint times. If a longer sprint test was used, no further information would have been found as the data collected showed that the flying start had a major effect on the first five metres and the benefit then wore off as the distance increased. Also, 20 metres is the most used distance in sprint testing, especially by the Australian Institute of Sport (AIS) (Tanner, 2013). A 20-metre sprint with a standing start is used by the AIS for Australian football, Basketball, Rugby League, and Tennis and with a ‘crouch ready’ start for Soccer and Netball. A 20-metre sprint is also used but with a flying start of 0.5 metres for Cricket and 0.3 metres for Rugby Union.

Both tests during this study were measured simultaneously to increase reliability. As both the standing split start and flying start were measured on the same sprint trial, there was no room for error as there would be if each was measured on individual sprints. If measured separately, the participant may have run at a different speed through the 20 metres, meaning that any differences found would not be true differences. Overall, the differences recorded were absolute.

A split start was used due to previous research concluding that a parallel start was significantly slower and would have had more of an effect on the timing of the sprints (Cronin et al., 2007). The previous research found that the parallel start was ~8.3% slower for a five-metre sprint and ~5.9% slower over 10 metres due to the stance not allowing optimal force production and the centre of mass of the participant being closer to the initial timing gate.

The validity and reliability may have been affected in this study and can be improved in further studies by several factors. Firstly, previous studies have used many participants whereas the present study only used a total of 15 participants. The participants were of various sporting backgrounds (NFL, AFL, soccer, and general activity), yet previous studies have been conducted on athletes of specific sports to provide relevance. Finally, there was a wide range of variability in the participant information (age, weight, height, gender). Although these variables may affect the reliability and the validity, the results still yielded the same differences throughout.

CHAPTER VI

CONCLUSION

The purpose of this study was to determine the difference in times from a standing split start and a 0.5 metre flying start on a 20-metre sprint. It was found that the flying start was significantly faster than the standing split start for the first five metres and the overall time taken, accepting the alternative hypothesis. Therefore, if athletes were to complete a sprint test with a flying start, they would not be able to compare their results to standing start results as there would be a definite difference in timing. However, to make a sprint test sport specific, flying starts of various distances may be used, yet any results would only be valid for comparisons with other results gathered from following the same protocol.

LIMITATIONS

Due to different starts required in different sports, developing a standard sprint protocol would not benefit everyone. For example, using a flying start for an athletic sprinter will not be beneficial as they are required to start with a static start in their race. However, using a standard protocol for team sports (e.g. football, NFL, rugby etc.) would be beneficial as they all involve sprints that are not started from a static standing start. A standard protocol will allow comparison of athletes for sport scientists and coaches. Sport specific sprint tests can be developed with flying start distances relevant to in game movements, but results gathered from these sport specific tests would only be able to be compared with other results of the same protocol.

Although the participants of this study were of different genders, ages and sporting ability, all results pointed the same way. Therefore, to increase the reliability and validity of the results, further testing could be conducted on separate genders, participants of similar ages and participants of the same sporting level.

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APPENDIX A

Table 2: Recorded sprint times for each participant for standing split and flying starts with split times for 0-5m, 5-10m and 10-20m.

	Standing Start				0.5m Flying Start			
Participant	**0-5m (s)**	**5-10m (s)**	**10-20m (s)**	**Total (s)**	**0-5m (s)**	**5-10m (s)**	**10-20m (s)**	**Total (s)**
1	1.277	0.848	1.441	3.566	1.152	0.797	1.442	3.391
2	1.293	0.818	1.388	3.499	1.164	0.708	1.424	3.296
3	1.220	0.788	1.375	3.383	1.119	0.790	1.365	3.274
4	1.307	0.844	1.442	3.593	1.175	0.807	1.437	3.419
5	1.448	0.963	1.872	4.283	1.326	0.946	1.847	4.119
6	1.383	0.808	1.403	3.594	1.327	0.793	1.390	3.510
7	1.305	0.861	1.472	3.637	1.200	0.788	1.475	3.563
8	1.274	0.815	1.485	3.574	1.175	0.798	1.399	3.372
9	1.294	0.882	1.517	3.693	1.206	0.836	1.468	3.510
10	1.247	0.841	1.474	3.562	1.108	0.832	1.513	3.453
11	1.366	0.929	1.678	3.973	1.267	0.885	1.693	3.845
12	1.465	0.998	1.872	4.335	1.303	1.095	1.886	4.240
13	1.355	0.844	1.500	3.699	1.297	0.900	1.479	3.676
14	1.463	0.844	1.530	3.867	1.314	0.870	1.513	3.967
15	1.435	0.909	1.636	3.980	1.232	0.944	1.628	3.804

Table 6: T-test results to find significant difference. Significant difference = $p<0.05$.

	0-5m	**5-10m**	**10-20m**	**Total**
P-value	0.00000001	0.331692688	0.315966673	0.00000003

Table 4: Percentage differences between standing split start and flying start split times for each participant.

Participant	0-5m (%)	5-10m (%)	10-20m (%)	Total (%)
1	-10.85	-6.40	0.07	-5.16
2	-11.08	-15.54	2.53	-6.16
3	-9.03	0.25	-0.73	-3.33
4	-11.23	-4.58	-0.35	-5.09
5	-9.20	-1.80	-1.35	-3.98
6	-4.22	-1.89	-0.94	-2.39
7	-8.75	-9.26	0.20	-5.02
8	-8.43	-2.13	-6.15	-5.99
9	-7.30	-5.50	-3.34	-5.21
10	-12.55	-1.08	2.58	-3.16
11	-7.81	-4.97	0.89	-3.33
12	-12.43	8.86	0.74	-2.24
13	-4.47	6.22	-1.42	-0.63
14	-11.34	2.99	-1.12	-4.60
15	-16.48	3.71	-0.49	-4.63

Table 7: Percentage difference between first five and second five metres and first 10 and second 10 metres.

	Standing	**Flying**
	% Difference	**% Difference**
First 5 to second 5 metres	43.53	54.02
First 10 to second 10 metres	35.29	43.51

APPENDIX B

Consent Form

I understand that I may be participating in activities that involve physical exercise at, or close to, maximal capacity. I understand the risks associated with maximal capacity (e.g. light headedness, shortness of breath, raised blood pressure and nausea) and that there may be unavoidable risks of physical injury associated with any exercise performed at high intensity.

I confirm that my participation in the testing is completely voluntary and made with full knowledge of all risks and damage that could occur during the testing. I understand that I am able to withdraw my consent at any time, freely and without prejudice.

I confirm that I do not know of any medical condition, symptom or reason that will prevent me from participating in high intensity testing.

I confirm that I will present myself in a suitable condition and failure to comply with this will result in being removed from the testing. This involves no influence of alcohol or drugs.

I understand that all my results will be recorded into a database and all information will be treated with confidentiality.

I understand that my test data will be used for statistical calculations and all personally identifiable information will be removed before any data is shared. I am over the age of 18 and consent to participating due to the terms above.

Signed ____

Name ____

Date ____

Figure 4: Consent form for participants over the age of 18 to be signed and dated

Consent Form - Child

I understand that my child may be participating in activities that involve physical exercise at, or close to, maximal capacity. I understand the risks associated with maximal capacity (e.g. light headedness, shortness of breath, raised blood pressure and nausea) and that there may be unavoidable risks of physical injury associated with any exercise performed at high intensity.

I confirm that my child's participation in the testing is completely voluntary and made with full knowledge of all risks and damage that could occur during the testing. I understand that my child is able to withdraw at any time, freely and without prejudice.

I confirm that I do not know of any medical condition, symptom or reason that will prevent my child from participating in high intensity testing.

I confirm that my child will present themselves in a suitable condition and failure to comply with this will result in being removed from the testing. This involves no influence of alcohol or drugs.

I understand that all my child's results will be recorded into a database and all information will be treated with confidentiality.

I understand that my child's test data will be used for statistical calculations and all personally identifiable information will be removed before any data is shared. I am over the age of 18 and consent to my child participating due to the terms above.

Signed ____

Name ____

Child's Name ____

Date ____

Figure 5: Consent form for participants under the age of 18 to be signed and dated by parent/guardian