Analysis of the relationship of MCS-measured squat pattern and countermovement jump measures of collegiate football varsity athletes

John Paul S.D. Jalandoni, Jose Maria Luis R. Bonoan, Carmen Naomi A. Damian, Paolo Luis J. Romero
University of the Philippines, Diliman, Quezon City

The aim of this study was to investigate if there was a correlation between squat pattern and countermovement jump (CMJ) measures. The participants in the study were 15 collegiate male football varsity players in the University of the Philippines — Diliman (age = 18 ± 1.10; height = 170.1 ± 5.31 cm; weight = 63.36 ± 8.79 kg). The measures used for the analysis and correlation were squat score from the MCS, vertical jump flight time, height, power, and initial speed. The MCS score sheet was used for the squat. The Boscosystem Chronojump application was used to gather the measures for the vertical jump. The test yielded the following results for the CMJ Test: flight time: 0.485 ± 0.0516 s; jump height: 29.177 ± 6.111 cm; power: 734.136 ± 100.140 J; and initial speed: 2.377 ± 0.252 m/s. The Pearson Correlation between the squat score from MCS and the 4 vertical jump measures are as follows: flight time = 0.360; jump height = 0.369; power = 0.162; and initial speed = 0.359. The analysis showed that there was a weak significant relationship between squat pattern and 3 CMJ measures — flight time, height, and initial speed. However, the correlation between squat pattern and jump power appeared to be too low and, thus, showed low correlation.

Keywords: football, squat, movement competency screen, MCS, countermovement jump, CMJ, vertical jump

INTRODUCTION

Information presented by Kritz (2013) has shown the implications of the squat as a movement screen, demonstrating the bodyweight squat as an optimal movement screen to determine stability in the knee, ankle, hip, and lower back.

Kritz (2013) states that movement competency is one's ability to perform a movement without dysfunction or pain. He also states that movement dysfunctions contribute to the likelihood of contracting injury rather than improving performance. Hence, the criteria in the Movement Competency (MCS) score sheet are geared towards the proper form of performing, in the case of this study, a squat. A higher score indicates a better form. This would also mean that the individual was able to comply with the standard movement expectations of the squat without any compensation.

The vertical jump is a common movement in most sports, such as volleyball, handball, and football (Leard et al., 2007). In football, this may be evidently seen when a player attempts to perform a header. Positioning and body movement demonstrate the preparatory form of the vertical jump from that of an athletic stance to almost a squat.

Recent research has shown that adjusting muscle stimulation patterns is crucial for vertical jump performance (Prokopow et al., 2005). Bobbert and van Soest (1993) have demonstrated that the musculoskeletal system is very sensitive to precise control and that muscle properties play an important role in movement control. The studies also showed that better coordination and proper order of muscle stimulation improve vertical jump measures. A study on the relationship of Functional Movement Screen (FMS) and CMJ has been conducted by Conlon (2013). In his thesis, he showed that there was a significant correlation between FMS and CMJ height. Further, he stated that this result implies that better functional movement not only reduces injury but also improves performance on the vertical jump. The purpose of this study, in contrast, was to identify if there is a relationship between the score in the MCS for squat and kinetics of the vertical jump from the Countermovement Jump (CMJ) Test.

Much attention has been given to squat-loading and its effect on the vertical jump; however, few studies have been geared towards the relationship between squat pattern efficiency (i.e., accounting a greater score in the MCS for squat) and vertical jump. Moreover, little research has been done in relation to these movements in the sport of football.

METHODOLOGY

Participants

The participants for this study were 15 collegiate male football varsity players in the University of the Philippines, Diliman (age = 18 ± 1.10; height = 170.1 ± 5.31 cm; weight = 63.36 ± 8.79 kg). The participants' activity orientation, as mentioned above, is categorized as varsity athlete. The participants in order to participate must not have been carrying any form of injury or illness. The participants must have refrained from any strenuous activity between their training time and designated time for testing. The participants were given an informed consent and a copy of the Declaration of Helsinki.

Procedures

The venue for testing was in the UP College of Human Kinetics Exercise Laboratory. There was only 1 session throughout the testing period. Gathering of anthropometric measures marked the beginning of the procedure. These measures were mainly the participants' height and weight. After the measurement, the researchers introduced the subjects to the warm-up and procedures of the MCS and CMJ Test. After this was the testing proper.

The experimenters collected the following vertical jump measures: power (Joules), initial velocity (meters/second), jump height (centimeters), and flight time (seconds). The main program used was the Boscosystem Chronojump as it has a specialized function for jump-testing. For the squats, the score sheet for the Movement Competency Screen was used for assessment.

The subjects were first asked to perform specific warm-up exercises; each had 10-second transition intervals. Warm-up is a necessary component of the testing and has been observed to have positive impacts on performance in the rate of force development and improvement of muscle strength and power (Jeffreys, 2008). One of the testers guided the subjects. First was a 5-minute jog around the venue. This was followed by 3 repetitions of lunge and reach for each leg, where the participants held their lunge for 4 seconds and held the reach for 4 counts as well, with a final 4-count set for returning to original position. Next is the knee hug to quad stretch. There was a 4-second hold for the knee hug and another 4 seconds for the quad stretch. This was repeated in the other leg. After this was the cradle to side lunge. The cradle was held for 4 counts, as well as the side lunge. The cradle to side lunge warm-up also had 3 repetitions per leg. The participants were then asked to perform 5 repetitions of half squats. Lastly, there was an inch-worm exercise for 3 repetitions. After the warm-up, the subjects were given a 1-minute rest interval before the testing proper began.

There were 2 stations, 1 for each test. For the station designated for the squat test, a camera and tripod was set up. The participants were asked to perform squats as they normally would and were videotaped from the frontal and sagittal planes. The squats of the subjects were assessed and scored by only 1 of the testers, using the Movement Competency Screen. This was done to assure the reliability of the rating.

The test for the countermovement jump was a slightly modified version of the Bosco Countermovement Jump Test. The station for this part of the test was separate from the squat station. Chronojump platforms and a laptop were set up in order to record the data from the jumps. The participants were required to wear shoes as the platform may cause pain.

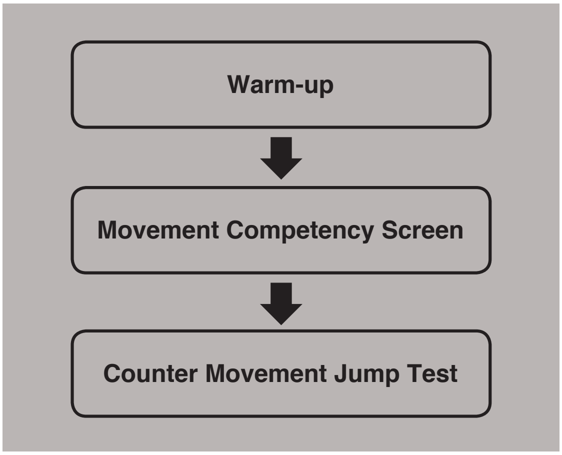

Figure 1. Testing Flow

Measures

Squat Pattern — MCS. The Movement Competency Screen was the first measure taken. The participants were asked to execute squats as they normally would, with their hands at the back of their head. Each participant was videotaped for later assessment by the researcher. The participants performed 1 trial. A trial consisted of 2 squat repetitions in the frontal view, followed by 2 repetitions in the sagittal view. The squat portion of the MCS score sheet was used.

Countermovement Jump Performance. The participants were asked to stand on a Chronojump platform, feet shoulder-width apart. The subject performed a countermovement jump as high as possible. Certain rules that were applied include (1) hands must have been on the waist at all times; (2) take-off must have used both feet and no initial movements allowed; (3) movement must have been continuous — it was a bad trial if the subject paused in the squat sequence; and (4) the subject must have landed on both feet at the same time. If the subject failed to follow any of the guidelines, the trial would be void, and another would immediately ensue. After a successful trial, the subjects were given a 30-second rest interval before moving to the next trial. A total of 3 trials were recorded for each participant. The average of the trials was taken under consideration. The Boscosystem Chronojump displayed the desired information — power, initial velocity, jump height, and flight time.

Analysis

The researchers made use of the Pearson Bivariate Correlation for their statistical analysis. Paired data — MCS score and any of the 4 vertical jump measures — were given a value from 1 to −1, and the strength and relationship depended on the value given by the correlation.

RESULTS

The test yielded the following results: flight time: 0.485 ± 0.0516 s; jump height: 29.177 ± 6.111 cm; power: 734.136 ± 100.140 J; and initial speed: 2.377 ± 0.252 m/s. Individually, the data were much varied, especially that of power.

The Pearson Correlations between the MCS score and the 4 vertical jump measures are flight time = 0. 360; jump height = 0.369; power = 0.162; and initial speed = 0.359.

Table 1. Individual measures of the 15 participants.

Participant	Height	Weight	Flight Time	Height	Power	Initial Speed	MCS Score
1	176	73.2	.456	25.9	802	2.24	1
2	171	67.5	.475	27.6	770	2.33	2
3	168	62.2	.587	31.6	758	2.49	1
4	177	65.0	.543	36.5	851	2.673	2
5	161	54.0	.474	27.6	615	2.33	2
6	161	48.5	.523	33.5	609	2.57	1
7	171	66.0	.477	28.1	756	2.34	1
8	174	65.0	.444	24.2	693	2.18	2
9	167	56.0	.386	18.5	520	1.90	2
10	170	60.0	.597	43.7	860	2.93	3
11	177	64.5	.504	31.0	780	2.47	3
12	168	56.0	.494	29.9	664	2.42	2
13	164	58.5	.487	29.0	684	2.39	2
14	172	69.0	.494	29.9	818	2.42	3
15	175	85.0	.408	20.5	833	2.00	1

Table 2. Correlations between the vertical jump measures and MCS score for squat.

		Flight Time	Height	Power	Initial Speed	MCS
Flight Time	Pearson Correlation	1	.996(**)	.442	1.000(**)	.360
	Sig. (2-tailed)	.000	.000	.099	.000	.188
	N	15	15	15	15	15
Height	Pearson Correlation	.996(**)	1	.446	.997(**)	.369
	Sig. (2-tailed)	.000	.	.095	.000	.176
	N	15	15	15	15	15
Power	Pearson Correlation	.442	.446	1	.441	.162
	Sig. (2-tailed)	.099	.095	.	.100	.564
	N	15	15	15	15	15
Initial Speed	Pearson Correlation	1.000(**)	.997(**)	.441	1	.359
	Sig. (2-tailed)	.000	.000	.100	.000	.189
	N	15	15	15	15	15
MCS	Pearson Correlation	.360	.369	.162	.359	1
	Sig. (2-tailed)	.188	.176	.564	.189	.000
	N	15	15	15	15	15

DISCUSSION

The data acquired showed that there is a weak significant correlation between squat pattern and the flight time, jump height, and initial speed components of the CMJ. On the other hand, there is a low correlation between the squat pattern and power. It can be seen that the correlation between the MCS score and the jump height is the highest, while the lowest is between the MCS score and power. As stated earlier, few studies have focused on showing the relationship between movement competency in squat and vertical jump measures. The data above has shown that the movement competency of the athletes in the squat had a weak significant correlation with the vertical jump variables. It should be noted that the correlation is at least positive, indicating that an improvement of one may lead to a small or significant improvement in the other, although possibly not significantly. The researchers also observed that the correlation was more significant or that it mostly followed in extremely high and extremely low values. These outlier values may have caused the shift in the data (i.e., skewed to the left graphically, due to an extremely high value). Consequently, the extreme values along with the large variations in the data of nonextremes may have affected the outcome of the correlation.

The study was done to present and assess the existence of any significant relationship between the squat pattern via MCS score and the countermovement jump variables. Findings of the study showed a weak significant correlation, given the data.

The study is not without limitations. The first is that the sample size of fifteen may be too small in order to generalize or form a significant conclusion. This is seen through the results that exhibit different correlation measures that demonstrate the varied relationship of the MCS and components of the vertical jump. Another is that the participants are all male football players, and hence, the study will be only applicable to male football players of the same activity orientation. However, the weak correlation for MCS score and power output for males follows the same small correlation in squat score from the MCS and lower body power found by Kritz (2012). Squat pattern may not be the only factor for determining vertical jump performance. Another factor to consider would also be the build or the musculature of the player. Players with stronger leg muscles will tend to have better vertical jump performances, but that does not automatically suggest that their squat patterns are fundamentally correct. However, the weak significant correlation indicates that correcting the squat pattern may help improve performance but not to a great magnitude. In line with this, better coordination may be seen with the necessary correction, which also helps produce better performance as Prokopow's (2005) study suggests.

Lastly, it should be noted that the MCS rater is a student and does not consider himself an expert, though experienced.

One possibility for the weak correlations found may be that of the compensation that the players commit. Although players compensate for their movements, they may still be able to perform well but not always as well compared with those who meet the standards of the movement. The players' habituation to compensated movements may be a factor in determining the varying measures among the players despite having the same score for the MCS. The same can be said for those having a lower MCS score, yet scoring only slightly higher than the other.

Interestingly, these components were shown to have a medium correlation to squat movement competency. An implication of this is that, although it may not be the priority, improving the basic squat movement of the athletes can be beneficial for overall performance.

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