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Validation of a One-Minute Abdominal Crunch Test with the Canadian Curl-Up Test

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Abstract

The purpose of this study was to validate a one-minute abdominal SEMO crunch test by comparing it to the Canadian Curl-up Test (CCT). The SEMO crunch test was designed to evaluate muscular endurance via a one-minute timed effort. The CCT is a valid curl up test which ensures that an equal amount of work is being performed with each repetition. The advantage of the SEMO crunch test is time efficiency when testing large groups of subjects. All participants [n=179 (82 females; 97 males)] voluntarily consented to the study. Mean age (M=21.6 yr, F=21.4 yr), height (M=180.6 cm, F=165.8 cm), weight (M=79.7 kg, F=61.1 kg), and hours of activity per week (M=8.1, F=6.8) were reported for the participants. Participants were given specific instructions for each test prior to administration. The order of testing was counterbalanced and a minimum five-minute resting period between the two tests was required. Correlation coefficient between the CCT and the SEMO crunch test demonstrated a weak but significant relationship ($r=0.185$, $p<0.01$). The correlation coefficient for females was significant ($r=0.325$, $p<0.01$), however, the correlation coefficient for males ($r=0.058$, $p>0.05$) was not. The results indicate the SEMO crunch test is valid, however, the practical significance is questionable due to the poor relationship with the CCT. In addition, there appears to be a difference between males and females which may be attributable to the nature of the criterion measure.

Muscular endurance is defined as the ability of a muscle or muscle group to execute repeated submaximal con- tractions over a period of time [1]. Assessment of abdominal muscular endurance is important for determining baseline fitness level and exercise prescription. Poor abdominal muscular endurance has been associated with muscular low back pain [2-4]. Weak abdominal muscles can exacerbate low back pain due to compromised con- trol of pelvic tilt. Reduced strength and endurance in the abdominal muscles is related to a higher incidence of loss of mobility in the trunk, and lack of hamstring and iliopsoas extensibility in back pain patients [4].

Abdominal muscular endurance testing is a common part of fitness assessment, however the most recent Ameri- can College of Sports Medicine Guidelines for Exercise Testing and Prescription calls into question the sensitivity of testing in determination of risk for low back pain [1]. Regardless, numerous abdominal muscular endurance assessment protocols have been developed through the years, and a variety of these protocols are employed by health and fitness professionals in fitness assessments. Few of these protocols are practical for testing large groups of individuals simultaneously such as would be needed for physical education classes or large fitness screenings [3,5]. For testing large groups, the more observation required and instruction complexity, the more difficult it is to administer. Thus, a test with strict termination criteria that requires close observation by a tester i.e., Canadian Curl-Up (CCT) [4] may be an excellent test but is impractical when testing large groups of individuals.

Tests which do not have stringent criteria for what defines a repetition are easier to proctor, thus, easier to administer to large groups. A sit-up test should be easily administered, but this test does not isolate abdominal muscles and may not be optimal depending on the purpose of the test. Tests for large groups should be easily self-monitored, yet still assessing abdominal muscle endurance, while reducing or eliminating the role of the hip flexors. The SEMO crunch test is an easily administered test conducted over a 60-second period. The purpose of this study was to validate the SEMO crunch test using the Canadian Curl-Up Test (CCT) as a criterion measure.

Method

Subjects

One hundred seventy-nine participants (82 females and 97 males) between the ages of 16 and 43 years volunteered to participate after providing informed consent. The majority of the participants were physically active on a regular basis. The criteria for physically active was adapted from the 2008 Physical Activity Guidelines Advisory Committee Report [1]. Participants were not selected based upon current physical activity status or the basis of any other preset criteria. Characteristics of the participants are presented in Table 1.

SEMO Crunch Test	N	Mean	SD
Sample	179	55.49	15.18
Males	97	57.31	15.29
Females	82	53.33	14.85

Table 1. to be Cont....

Canadian Curl-UP Test	N	Mean	SD
Sample	179	19.29	7.09
Males	97	19.97	6.8
Females	82	18.49	7.37

Table 1: Results of Abdominal Muscular Endurance Tests

Protocol

Participants completed two abdominal muscular endurance tests with a rest period of no less than 5 minutes between each test. The order of testing was counterbalanced. The test procedures were verbally explained to the participants prior to completion of the written informed consent and again prior to performing each test. Participants were instructed to give their best effort and strictly monitored for technique. An investigator counted the repetitions during each test. Participants were informed of the time every fifteen seconds throughout the test period.

The SEMO crunch test is 60 seconds, with each crunch/repetition requiring the torso be lifted to a 45-degree angle to the floor. The crunch test starting position specifies that participants be supine with knees bent at a 90-degree angle and feet not anchored. The feet are crossed and hands are placed behind the ears. A repetition is defined as lifting the torso off of the floor sufficient for the scapula to clear the surface.

The standard guidelines for the CCT have been previously published [3,4,6]. Test duration is 60 seconds and is paced by a metronome set at 50 beats.min-1. Therefore, the maximum number of repetitions that can be performed during the course of one test is 25. The participant starts with the knees at a 90-degree angle and the hands palms down on the mat. The hands must remain in contact with the mat at all times during the test. With the first beat of the metronome the subject raises the torso and the hands slide along the mat to a mark that represents a 10 cm distance. The completion of a 10 cm movement of the hands counts as one repetition. If the participant's hands are raised off the mat, if the feet are raised, or pace is not maintained a verbal warning is issued. Upon the second violation of the protocol, the test is terminated. The CCT was selected as the criterion measure for this study because the amount of work with each repetition is fixed (i.e., little variation between the force exerted to accomplish each repetition).

Statistical Analysis

Data were analyzed by a Pearson Product-Moment Correlation Coefficient to determine relationships between the two tests. Alpha level was set at 0.05. Test-retest reliability and norms for the SEMO crunch test protocol were determined by a previous study [7]. The test-retest reliability was re-established in the current study with a subpopulation of 26 randomly selected participants.

Results

All subjects completed both muscular endurance tests. The results of the tests are shown in Table 1. The results of the two tests are plotted in Figure 1.

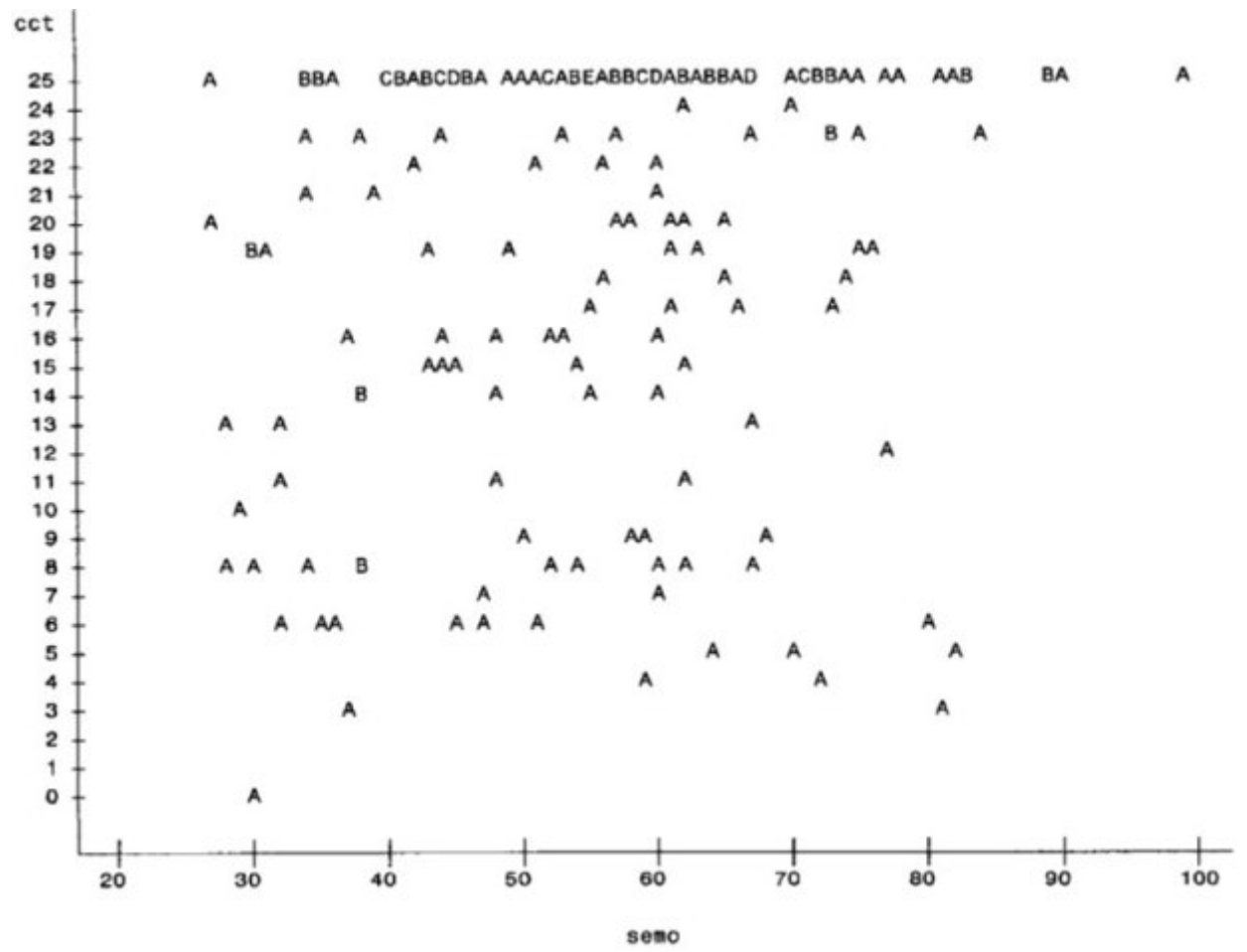

Figure 1. Plot of Canadian Curl-Up and SEMO Crunch Test Results

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The Pearson r between the tests for the whole sample was 0.185 ($p<.01$). The correlation coefficient between the tests for females was $r = 0.313$ ($p<.01$), and for males was $r = 0.052$ ($p>.05$).

The test-retest reliability for the SEMO crunch test using the 26 subject sub-sample was found to be high ($r=0.85$).

Conclusions

The results indicate a weak correlation between the two abdominal muscular endurance tests. The correlation coefficients between the two tests reached the level of statistical significance. Only the analysis for the female subjects showed a significant correlation coefficient. The correlation coefficient for the male subjects failed to reach a level of statistical significance. The CCT is a strictly controlled test of muscular endurance that requires an equivalent amount of work to be performed with each repetition. If monitored properly the test will yield an excellent indication of abdominal muscular endurance. The SEMO crunch test clearly requires a repetitive contraction of the abdominal muscles. However, when comparing the test to the criterion measure in which it is easy to distinguish the work requirements. The SEMO crunch test does not control for the amount of work completed with each repetition, only the minimum amount of work required to satisfy the criterion. Therefore, it is likely that there are great interindividual differences. The SEMO crunch test does not explain enough of the variance in CCT performance to be considered a suitable substitute ($r2 = 0.034$). Therefore, when testing large groups using this crunch test or a similar test will not provide a valid estimate compared to the CCT.

Some of the participants, particularly the males, had difficulty with the rhythmic movement required during the CCT. The required rhythm of the criterion measure may have impacted the results of the study.

Given the level of supervision of the testing in this study was strict and the poor correlation observed, it is unlikely the SEMO crunch test would be any more useful if employed using large groups. When testing larger groups the adherence to the SEMO crunch test protocol would be largely self-regulated and the end result would be a test outcome that holds little validity. The SEMO crunch test does not meet the needs of individuals wishing to test the abdominal muscular endurance of large groups.

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