ESSENTIALS OF STRENGTH TRAINING AND CONDITIONING MULTIMEDIA SYMPOSIUM

Presentation 5:
Measurement and Evaluation

by:
Andrew Fry, PhD, CSCS
MULTIMEDIA SYMPOSIUM OVERVIEW

This multimedia symposium was developed for the specific purpose of providing individuals who sit for the Certified Strength and Conditioning Specialist® (CSCS®) certification exam with a review of facts, concepts, and theories that are relevant to strength training and conditioning.

You are encouraged to simultaneously listen and watch the symposium video presentation, view the PowerPoint® slide show, follow along in the presentation outline, and add your own notes in the spaces within the outline (more paper may be necessary).

To maximize the value of the multimedia symposium when preparing for the CSCS exam, you may find it helpful to first study the Essentials of Strength Training and Conditioning (2nd edition) text. Further, candidates who perform well on the CSCS exam typically have considerable practical experience in strength training and conditioning athletes (e.g., designing programs, teaching proper exercise technique, performing testing sessions) and a strong academic background in the exercise sciences (i.e., anatomy, physiology, biomechanics, etc.). For additional suggestions for preparing for the CSCS exam, go to www.nsca-cc.org.

NOTICE:
• Although this presentation was recorded live and then professionally edited for scope and length, there are some room sounds, voice fluctuations, abrupt video “cuts” and piecing of video clips, and content variations. Every possible effort was made to minimize these irregularities.

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• While comprehension of the information provided by the multimedia symposium should certainly increase the likelihood of passing the CSCS certification exam, it does not guarantee a successful performance. The questions on the CSCS exam are developed from numerous resources in addition to the multimedia symposium.
I. Purposes of Measurement and Evaluation
   A. Objectives of program
   B. Pre-post assessment
   C. Evaluation

II. Test Characteristics
   A. Validity
      1. General definition and example
      2. Types of validity
         a. Face/logical
         b. Content
         c. Predictive
         d. Criterion
   B. Reliability
      1. Definition and example
      2. Objective vs. subjective tests
   C. Relationship between validity and reliability
III. Test Selection

A. Appropriate for population

B. Relevant to sport/activity requirements

C. Based on gender and appropriate for age

D. Consider prior experience of subject

E. Be aware of the testing environment

F. Remove bias

G. Discriminate between high performers and low performers (Figure 1)

<table>
<thead>
<tr>
<th>Exercise Testing and Sport Division Levels</th>
<th>Division I</th>
<th>Division II</th>
<th>Division III</th>
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<tr>
<td>Bench press (kilograms)</td>
<td>144.5</td>
<td>135.2</td>
<td>128.6</td>
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<td>Squat (kilograms)</td>
<td>192.5</td>
<td>182.5</td>
<td>176.9</td>
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<tr>
<td>Clean (kilograms)</td>
<td>123</td>
<td>116.5</td>
<td>113</td>
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<tr>
<td>40-yard dash (seconds)</td>
<td>4.88</td>
<td>4.92</td>
<td>4.96</td>
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<tr>
<td>Vertical jump (centimeters)</td>
<td>72.8</td>
<td>69.3</td>
<td>67.4</td>
</tr>
</tbody>
</table>

IV. Statistical Analysis

A. Measures of central tendency

1. Mean

2. Median
3. Mode

B. Measures of variability (Figure 2)

1. Normal bell-shaped curve or distribution
2. Range
3. Standard deviation
4. Skewed data/scores (note: the speaker mentions the scores in the second view of Figure 2 are skewed to the right, but they are skewed to the reader’s left when you are looking at the figure)

C. Statistical techniques (to express data)
1. Frequency plot
2. Normative data
3. Percentiles
4. Correlations

a. Perfect relationship (Figure 3)

b. Strong and weak relationship (Figures 4 and 5)
V. Test Administration

A. Planning

B. Time constraints

C. Test sequence (in this order)

1. Non-fatiguing tests (e.g., skinfold and girth measurements, flexibility, height, weight, vertical jump)

2. Agility tests (e.g., T-test, Edgren Side Step test)

3. Maximum power and strength tests (e.g., 3RM power clean, 1RM bench press)

4. Sprint tests (e.g., 40-yard [37-m] sprint)

5. Local muscular endurance tests (e.g., 1 minute sit-up test)
6. Fatiguing anaerobic capacity tests (e.g., 400-meter [437-yd] run, 300-yard [275-m] shuttle run)

7. Aerobic capacity tests (e.g., 1.5-mile [2.4-km] run or 12-minute run)

If an aerobic endurance test cannot be performed on a different testing date, then it should be performed last (after an hour-long rest period)

D. Recording scores

E. Training testers and subjects

F. Warm-up activities

G. Practice trials

H. Supervision

I. Motivation

J. Safety
VI. Examples of Tests

A. Muscular strength

1. One repetition maximum (1RM)
   a. Free weights (Photos 1 and 2)
   b. Machines (Photo 3)
2. Isometric tests (Photo 4)

3. Isokinetic tests (Photo 5)
4. Concentric/eccentric testing (Photo 6)

B. Local muscular endurance

1. Bodyweight calisthenics (Photo 7)

   a. Sit-ups

   b. Push-ups
2. Multiple repetition tests
   a. Estimating the 1RM (Photo 8)

C. Aerobic capacity
   1. Metabolic (treadmill) cart (Photo 9)
2. Relationship of heart rate and VO$_2$ (Figure 6)

3. Sub-max bike test (Photo 10)

4. Other modalities

5. Walk/run test
6. Step test (Photo 11)

7. Arm crank (Photo 11, above)

D. Anaerobic power

1. Vertical jump (VJ)
   
a. Different types (Photo 12)

b. Estimating power
c. Varying start position, techniques, and approach (Photo 13)

2. Margaria-Kalamen test (Photo 14)

3. Wingate test (Photo 14, above)
4. Seated shot put/medicine ball test (Photo 15)

5. Machine power tests (Photos 16 and 17)
6. Weightlifting movements (Photo 18)

E. Anaerobic endurance/capacity

1. Wingate test (Photo 19)
2. 300-yard shuttle run (Figure 7)

F. Agility

1. Considerations

   a. Type/number of direction changes (Photo 20)
b. Distance run (Photo 21)

c. Sport-specific examples

2. Examples

a. AAHPERD shuttle run (Photo 22)
b. Side-to-side agility test (Photo 23)

c. NSCA T-test (Figure 8 and Photo 24)

Start / finish line

A to B = 10 yards (9.14 meters)
B to C = 5 yards (4.57 meters)
B to D = 5 yards (4.57 meters)
d. Southeast Missouri agility test (Figure 9 and Photo 25)
e. Nebraska agility test (Photo 26)

f. Spider run (Photo 27)
g. Hexagon agility test (Photo 28)

h. Nelson choice response (Photo 29)

G. Speed

1. Short distance
2. Starts
   a. Body positions (Photo 30)

   b. Stopwatch timing

   c. Flying start (Photo 31)

   d. Starting commands
3. Surface (Photo 32)

   a. Turf
   b. Grass
   c. Wood
   d. Tile
   e. Track

4. Methods of timing
   a. Hand-held stopwatch
   b. Electronic
   c. Filming
H. Flexibility/ROM

1. Sit and reach (Photo 33)

2. Goniometer (Photo 34)
3. Leighton flexometer (Photo 35)

4. Functional tests
   a. Shoulder flexibility (Photo 36)
b. Squat test (Photo 37)

I. Body composition

1. Ultrasound

2. DEXA (dual energy x-ray absorptiometry)
3. Underwater weighing (Photo 38)

4. Skinfolds (Photo 39)
5. Bioelectrical impedance (Photo 40)

6. Infrared interactance (Photo 41)
J. Anthropomorphic measurements

1. Height-to-weight ratio [to determine body mass index (BMI)] (Photo 42)

2. Waist-to-hip ratio (Photo 43)
GLOSSARY OF TERMS

**Aerobic power**—the rate of oxygen uptake during exercise

**Agility**—the ability to change the direction of body movement or body positions

**Anaerobic power**—the rate of performing work using primarily anaerobic energy systems

**Anthropometry**—the measurement of body dimensions

**Body composition**—the measurement of relative proportions of fat and lean mass

**Correlation**—the nature of the association of one variable with a second variable

**Criterion score**—the test score actually used to determine test performance

**Criterion variable**—the test score used to predict an individual’s ability on a different task

**Field test**—tests performed outside the laboratory in an applied setting

**Flexibility**—the range of motion around a joint

**Formative evaluation**—testing performed at regular intervals to determine progress

**Goniometer**—a device for measuring the degrees of motion at a joint

**Isokinetic strength**—muscular forces developed at a constant limb velocity

**Local muscular endurance**—the ability of a muscle or muscle group to repeatedly contract against a submaximal resistance

**Mean**—the average score of a distribution of scores

**Measurement error**—the scoring difference between two administrations of the same test

**Median**—the middle score of a distribution of scores

**Mode**—the most frequently occurring score in a distribution of scores

**Muscular strength**—the force that a muscle or muscle group can exert against a resistance at a specified velocity

**Normal distribution**—a distribution characterized by a bell-shaped curve, and the mean = median = mode
Objectivity—the ability of multiple scorers to agree on test performance

Percentiles—a rating system based on the percentage of scores below a specific score

Program objective—the goals of a training program

Repetition maximum—the most resistance that can be moved for a specified number of repetitions

Range—the lowest and highest scores in a distribution

Reliability—the repeatability of a test performance

Standard deviation—the score in the middle 68% of a normal distribution

T-score—also known as a standard score, this system designates the mean = 50, and each standard deviation = ± 10

Validity—the extent to which a test measures what it is supposed to measure
PRESENTATION REFERENCES


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