Flexibility Characteristics Among Athletes Who Weight Train

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ABSTRACT

Beedle, B., Jessee, C. and M.H. Stone. Flexibility characteristics among athletes who weight train. J. Appl. Sport Sci. Res. 5(3):150-154. 1991.—Many people believe that weight training decreases flexibility. Because of the popularity of weight training today, there are different types of programs to develop strength, endurance and bulk. There is a need to know more about various weight-training programs and their possible effects on flexibility. The purpose of this ex-post facto study was to compare right shoulder and elbow flexibility in male bodybuilders, college football players, students from an overload conditioning class, olympic-style lifters and students from a control group. All subjects were male volunteers in excellent health. The bodybuilders were members of three weight-training clubs in one county. The football players were both starters and nonstarters from an NAIA college, while the students from an elective overload conditioning class were involved in a basic weight-training program twice a week and also jogged once or twice a week. The olympic-style lifters were members of the team at a large university, and the control group was not involved in any weight-training program and had not been involved for the previous six months. Circumference measurements of the subjects were taken at the right shoulder, upper arm, forearm and chest, and subjects performed the following flexibility tests: right shoulder joint flexion, shoulder joint hyperextension, shoulder joint horizontal flexion, shoulder joint horizontal extension and elbow joint flexion. All measurements were made with a protractor-type goniometer. Percent body fat was estimated from generalized equations. Significant differences existed on the five flexibility measurements. Further analyses revealed that the olympic-style lifters and the control group had significantly greater flexibility than the other groups on all measurements. Finally, selected muscle girths, skinfolds and percent fat were not good predictors of right shoulder and elbow flexibility.

KEY WORDS: bodybuilders, range of motion

INTRODUCTION

Flexibility, which is important in athletic performance, is affected by the elasticity of tendons, ligaments, cartilage, scar tissue and muscles (5). Large, bulky muscles can limit flexibility (6), although it is difficult to quantitatively define bulk.

There have been few studies done to determine the effect of weight training on flexibility. Massey and Chaudet (12) had college men lift weights for six months using two sets of six to eight repetitions for 10 exercises; the upper body muscles were emphasized. A control group participated in various sports but did not weight train. Although the weight-training group significantly increased its strength in seven of the nine tests, flexibility significantly decreased in four of the seven flexibility measures: elbow extension, hip extension, shoulder
flexion and shoulder extension. For the control group, flexibility significantly decreased in elbow extension, hip extension and hip flexion (knee straight).

Wickstrom (14) reported several studies concerning the effects of weight training on flexibility. There were no consistent findings among these studies. Gardner (4) randomly assigned 60 college men to one of four groups: a control group, a group that trained using isometric contractions, a group that trained using heavy resistance isotonic contractions with a limited range of motion of 50 degrees, and a group that trained using heavy resistance isotonic contractions over a full range of motion. After six weeks of training there was no significant difference among the groups in the flexibility of the elbow or knee joints.

Laubach and McConville (7) examined the relationship between the strength and flexibility of the trunk flexors and extensors and the hip flexors and extensors, and determined the relationship among strength, flexibility, various anthropometric measurements and somatotype of 45 men. The only significant correlation they found was between hip flexion strength and hip flexion and extension flexibility.

Leighton (8, 9, 10) has examined the flexibility characteristics of many types of athletes, but there is not any study to the investigators’ knowledge that compares the flexibility of various groups of athletes who train with weights. This information would be important because specific programs may increase or decrease flexibility. Therefore, the purposes of this study were to determine whether there were any differences in the right shoulder and elbow flexibility of male bodybuilders, football players, olympic-style lifters and a control group, and to determine what factors might predict flexibility in the shoulder and elbow joints for these groups.

The flexibility measurements were chosen because the results of several studies demonstrate that upper-body weight training either limits or has no effect on the flexibility of various joints. Leighton (10) found that right shoulder flexion and extension of weightlifters were less than those of a group of 16-year-old boys. In addition, shoulder flexion was used because of the pressing movements of the shoulders in weight training. Massey and Chaudet (12) found right shoulder hyperextension significantly decreased by six months of heavy-resistance weight training. No studies could be found that contained tests of right shoulder horizontal flexion and extension. Wickstrom (14) suggested that the flexibility of the elbow in flexion and extension movements was either decreased or not changed as a result of weight training. However, if the biceps were large and bulky, flexibility would be restricted (6). Flexibility of the trunk (3, 10) and hip and knee flexion (10) was greater for those who trained with weights.

METHODS

Subjects

The subjects were male bodybuilders (n = 13) who had been training an average of six years, college football players (n = 27) who were both starters and nonstarters from an NAIA college, a group of weight trainers (n = 10) who were members of a college conditioning class, and olympic-style lifters (n = 12) who had been training an average of seven years. There was also a control group (n = 11), made up of male college students who were not currently involved in weight training and who had not weight trained for at least six months. The physical characteristics are displayed in Table 1. Informed consent was obtained before testing.

Measurements

All measurements were taken on the right side of the body before the subject warmed up or began the workout.

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Table 1. Physical Characteristics (X ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Bodybuilders (n = 13)</th>
<th>College Football Players (n = 27)</th>
<th>Overload Conditioning Class (n = 10)</th>
<th>Control Groups (n = 11)</th>
<th>Olympic-style Lifters (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>25.5 ± 3.9</td>
<td>20.1 ± 1.4</td>
<td>19.8 ± 1.2</td>
<td>19.3 ± 0.9</td>
<td>27.1 ± 5.5</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>175.0 ± 4.3</td>
<td>185.0 ± 5.8</td>
<td>178.6 ± 6.7</td>
<td>182.6 ± 3.1</td>
<td>177.2 ± 9.1</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>89.3 ± 10.7</td>
<td>95.6 ± 16.2</td>
<td>80.5 ± 9.5</td>
<td>76.8 ± 11.5</td>
<td>86.7 ± 15.1</td>
</tr>
</tbody>
</table>
All measurements were made directly over the skin. Illustrations of the flexibility tests can be found elsewhere (11). Circumference measurements were taken with a steel tape at the shoulder, upper arm, forearm and chest. Directions for these measurements can be found elsewhere (2). Flexibility measurements were taken in the following manners:

Shoulder joint flexion: The goniometer was applied to the humerus with both of its arms over each other. With the palm of the hand resting against the side of the thigh, the subject moved the arm forward and upward as far as possible without bending the elbow or turning the arm. The movement took place in the sagittal plane. When the movement was completed, the top arm of the goniometer was moved to align itself over the flexed humerus, and then the goniometer was read.

Shoulder joint hyperextension: The starting position for the subject was the same as before. The goniometer was in the same position as before. While the elbow remained extended, the arm was moved backward in a sagittal plane past the buttocks until the movement was completed. The trunk remained erect during the movement. The top arm of the goniometer was moved backward until it was aligned over the humerus, and then the goniometer was read.

Shoulder joint horizontal flexion: While the shoulder joint was in an abducted position parallel to the floor with the elbow joint in extension and the forearm pronated, the goniometer was applied over the area of the acromion process. The arm was moved forward and across the body as far as possible without bending the elbow. The arm moved in a horizontal plane. As soon as the movement was completed, the top arm of the goniometer was moved so that it aligned over the humerus. The goniometer then was read.

Shoulder joint horizontal extension: The arm started out in the same position as in horizontal flexion, and the goniometer was applied as before. The subject moved the arm backward as far as possible while keeping the arm parallel to the floor. When the movement was completed, the top arm of the goniometer was moved to align over the humerus, and the goniometer was read.

Elbow joint flexion: While the shoulder joint was in a flexed position with the humerus approximately parallel to the floor, the elbow joint was completely extended and the forearm was supinated. The arms of the goniometer were open so that one was aligned over the humerus and one was aligned over the radius. The middle of the goniometer was over the lateral epicondyle of the humerus. Then the arm was flexed as far as possible while keeping the wrist joint from moving. The goniometer arm on the right side was moved so that it was aligned over the radius, and the goniometer was read.

Scoring

Two trials were taken and recorded to the nearest degree unless there was a difference between the first and second trials of more than four degrees.

Skinfold Measurements

Skinfolds were taken with a Lange caliper at six sites: chest, axilla, triceps, abdomen, suprailium and thigh. Directions for taking these measurements can be found elsewhere (13).

Body Composition

Percent body fat was estimated from generalized equations by Jackson and Pollock (13), which have been shown to be appropriate for determining the body composition of male athletes.

Questionnaire

Those who trained with weights were given a questionnaire that asked them to give their physical characteristics and the length of time they spent training on a regular basis. In addition, they were asked to describe in detail a typical workout including sets, repetitions, resistance used, exercises performed, types of weight used, amount of rest between sets and frequency of workouts.

Statistical Analysis

Five analyses of variance (p < 0.05) were computed, and the dependent variable for each analysis was right shoulder flexion (RSF), right shoulder hyperextension (RSH), right shoulder horizontal flexion (RSHF), right shoulder horizontal extension (RSHE) and right elbow flexion (REF). The Newman-Keuls test was used when a significant difference was found among the groups.

Five multiple regression analyses with a forward solution were performed. The dependent variable for each analysis was RSF, RSH, RSHF, RSHE and REF. All other variables, excluding the flexibility measurements, were used as predictors for each analysis.

RESULTS

The anthropometric characteristics of the various groups are displayed in Tables 2 through 4. Interval consistency reliability for all of the anthropometric measurements ranged from 0.85 to 0.99. There was a significant difference (p < 0.001) in all of
Table 2. Right Side Girth Measurements (cm) [X ± SD]

<table>
<thead>
<tr>
<th>Bodybuilders (n = 13)</th>
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<th>Olympic-style Lifters (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td>46.1 ± 3.8</td>
<td>44.7 ± 4.6</td>
<td>41.1 ± 4.5</td>
<td>38.6 ± 4.0</td>
</tr>
<tr>
<td>Upper arm</td>
<td>36.8 ± 2.5</td>
<td>34.0 ± 3.9</td>
<td>30.2 ± 2.6</td>
<td>28.4 ± 3.7</td>
</tr>
<tr>
<td>Forearm</td>
<td>3.18 ± 1.7</td>
<td>3.1 ± 3.4</td>
<td>28.2 ± 1.2</td>
<td>27.2 ± 2.4</td>
</tr>
<tr>
<td>Chest</td>
<td>112.6 ± 7.3</td>
<td>106.4 ± 9.6</td>
<td>99.3 ± 4.9</td>
<td>96.2 ± 10.3</td>
</tr>
</tbody>
</table>

Table 3. Selected Right Side Flexibility Characteristics (degrees) [X ± SD]

<table>
<thead>
<tr>
<th>Bodybuilders (n = 13)</th>
<th>College Football Players (n = 27)</th>
<th>Overload Conditioning Class (n = 10)</th>
<th>Control Groups (n = 11)</th>
<th>Olympic-style Lifters (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder flexion</td>
<td>175.5 ± 6.4</td>
<td>175.8 ± 8.8</td>
<td>174.9 ± 10.3</td>
<td>188.7 ± 7.7</td>
</tr>
<tr>
<td>Hyperextension</td>
<td>38.3 ± 12.1</td>
<td>58.7 ± 14.0</td>
<td>56.9 ± 13.9</td>
<td>63.2 ± 15.3</td>
</tr>
<tr>
<td>Horizontal flexion</td>
<td>102.8 ± 17.4</td>
<td>110.4 ± 12.6</td>
<td>107.9 ± 9.0</td>
<td>112.1 ± 13.3</td>
</tr>
<tr>
<td>Horizontal extension</td>
<td>46.6 ± 9.4</td>
<td>49.7 ± 13.4</td>
<td>49.1 ± 11.9</td>
<td>66.0 ± 16.2</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>134.2 ± 12.7</td>
<td>140.6 ± 6.0</td>
<td>139.7 ± 11.8</td>
<td>149.0 ± 5.5</td>
</tr>
</tbody>
</table>

Table 4. Skinfold Measurements (mm) [X ± SD]

<table>
<thead>
<tr>
<th>Bodybuilders (n = 13)</th>
<th>College Football Players (n = 27)</th>
<th>Overload Conditioning Class (n = 10)</th>
<th>Control Groups (n = 11)</th>
<th>Olympic-style Lifters (n = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest</td>
<td>7.2 ± 2.2</td>
<td>13.9 ± 6.9</td>
<td>15.6 ± 6.4</td>
<td>12.3 ± 6.8</td>
</tr>
<tr>
<td>Axilla</td>
<td>10.4 ± 5.1</td>
<td>16.0 ± 7.5</td>
<td>17.3 ± 5.3</td>
<td>13.1 ± 7.1</td>
</tr>
<tr>
<td>Triceps</td>
<td>7.4 ± 2.4</td>
<td>13.9 ± 5.3</td>
<td>16.6 ± 5.0</td>
<td>11.7 ± 6.4</td>
</tr>
<tr>
<td>Subscapula</td>
<td>10.5 ± 2.1</td>
<td>15.8 ± 8.3</td>
<td>14.7 ± 3.9</td>
<td>12.2 ± 8.0</td>
</tr>
<tr>
<td>Abdomen</td>
<td>10.7 ± 5.5</td>
<td>24.9 ± 10.9</td>
<td>25.4 ± 9.2</td>
<td>18.2 ± 11.3</td>
</tr>
<tr>
<td>Suprailium</td>
<td>8.1 ± 3.6</td>
<td>19.4 ± 9.9</td>
<td>22.4 ± 10.1</td>
<td>15.4 ± 8.6</td>
</tr>
<tr>
<td>Thigh</td>
<td>10.2 ± 2.8</td>
<td>15.3 ± 7.3</td>
<td>16.7 ± 6.7</td>
<td>12.3 ± 4.0</td>
</tr>
<tr>
<td>Percent Fat</td>
<td>9.6 ± 2.5</td>
<td>15.7 ± 5.9</td>
<td>17.1 ± 4.9</td>
<td>12.7 ± 5.9</td>
</tr>
</tbody>
</table>

The five flexibility measurements. Newman-Keuls test revealed that the olympic-style lifters did significantly better than the other groups on RSF and RSHF. They performed significantly better than the bodybuilders, football players and overload conditioning class on RSH and RSHE. The control group performed significantly better than the bodybuilders, football players and overload conditioning class on REF.

Five multiple regression analyses with a forward solution were computed. For RSF, right upper arm circumference and right shoulder circumference were entered into the equation (r = 0.31). For RSH, right upper arm circumference and percent body fat were entered (r = 0.43). For RSHF, percent body fat and the skinfold at the axilla site were entered (r = 0.38). For RSHE, right forearm circumference and right upper arm circumference were entered (r = 0.34). The largest amount of explained variance for the five equations was 0.23.

**DISCUSSION**

In the five flexibility tests, the olympic-style lifters and the control group did significantly better than any other group. The olympic-style lifters performed significantly better than any of the other groups in RSF and RSHF.

If the control group is used as the norm, then what is emphasized in the particular program may improve or hinder flexibility. Most of the control group were
ectomorphs and did not lift weights. Jensen and Fisher (6) suggest that if weight training is performed using a full range of motion, flexibility won't be lost. Moreover, if weightlifting exercises are performed in the same plane of motion as the flexibility measures, using a full range of motion, flexibility should increase (12).

The purpose of the particular program is also important when interpreting the data. Olympic-style lifting is comprised of two lifts, both of which cause the athlete to stress the joint structure as the weight is moved through the lift. This stress produces stretching in the tendons and ligaments, causing an increase in the range of motion. This explanation is supported because olympic-style lifters were second only to gymnasts on a battery of flexibility tests at one of the Olympics (6). For example, the olympic-style lifters did significantly better than any other group in RSF, a movement in the sagittal plane, which is developed in both the snatch and the clean and jerk. On the other hand, bodybuilders and many football players, particular linemen, are interested in developing larger and stronger muscles, and they do not perform the olympic-style lifts. Bodybuilders work specific muscle groups using multiple sets and many repetitions with the purpose of gaining hypertrophy, strength and muscular endurance, and losing fat. Going though a full range of motion may not be as important to them.

Concerning the anthropometric variable, the bodybuilders had the least amount of fat, yet they were the least flexible of all groups. However, they were larger than the other groups in all of the circumferences measurements except for the right shoulder.

According to the questionnaire responses of the bodybuilders, stretching before, during and after the workout is not emphasized as compared to the other three groups who weight trained. Only three of the 13 body builders performed a cool-down (1). Stretching helps keep the muscles from getting injured and becoming tight after the workout.

In conclusion, olympic-style lifters and the control group had significantly greater flexibility than the other groups on all measurements. Selected muscle girths, skinfolds and percent fat were not good predictors of right shoulder and elbow flexibility.

**Practical Applications**

Flexibility may not be as important to some athletes as to others. If performance in a sport depends on the flexibility in the joint, then performing the exercises using a full range of motion would be important, particularly when the movement in the exercise is in the same plane as the movement in the sport. As determined in this study, bulk above a certain amount hinders flexibility of the joint, even though skinfold thicknesses and percent body fat are low.

**References**