The Effects of Aging on Muscle Strength, BMI, BF% and VO$_2$ MAX of Healthy Iranian Males

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Abstract: Loss of muscle strength as a result of normal aging is reported to impair functional ability in various communities. Aging is associated with remarkable number of change in body composition and metabolism. The aim of this study was to determine the effect of age passing on grip hand strength, BMI, BF% and VO$_2$ max of healthy Iranian males. A sample of 1587 healthy Iranian males aged 20-60 years participated in this study. The subjects were divided into 4 age groups, each representing a decade. Maximum isometric strength of grip hand was measured using a hand – held dynamometer. Height and weight variable measured and suitable numbering done according to subjects physical activity score during week. The grip hand strength remained unchanged in the 20 - and 30 – year old age groups. By increasing age from 20 to 60year VO$_2$ max and grip hand strength gradually decline. Average of VO$_2$ max of males was 34/93 ml/kg/min. Average of grip hand strength was 43/91 kg. In addition By increasing age BMI and BF% began gradually increase. Average of BMI was 25.58kg and Average of BF% was 22/68 percentage. One- way ANOVA test showed that grip hand strength, BMI, BF% and VO$_2$max differed (P<0.01) among decades. Changes in Muscle strength and body composition have asignificant relationship to aging. Clinically, these results may provide clinician with guide to the strength level of normal grip hand strength, BMI, BF% and VO$_2$max of healthy Iranian males in relation to the normal aging process.

Key words: Aging. Grip hand strength, BMI, BF%, VO$_2$max.

INTRODUCTION

Advantage adult age is associated with profound change in body composition (Andrews, A.W., 1996; Cochrane, T., 1998; Larsson, L., 1979). One of the most prominent of this change is sarcopenia. Sarcopenia is a life – long process that likely begins in young adulthood this loss of skeletal muscle mass is also associated with increasing body fatness, decreased basal metabolic rate and daily energy needs, loss of bone mass, reduction strength and functional status. Nutrient requirements also may change with age (Miyashita, M., 1971; Nordstrom, P., 1995; Rantanen, T., 1996; Simmonds, M.,).

Loss of muscle strength as a result of normal aging is reported to impair functional ability in various communities (Jackson, A.S., et al., 2002; Hurley, M., 1998; Bohannon, R., 1997). There is controversy in the literature as to when loss of muscle strength and the pattern of changes in strength and functional ability as it corresponds to aging begin (Jackson, A.S., et al., 2002; Bohannon, R., 1997; Larsson, L., 1979).

This information can provide clinicians with accurate guidelines for the normal changes in muscle strength and functional ability throughout aging. This study aims to establish a preliminary baseline for the effects of aging on muscle strength and functional ability of healthy adult Iranian males.

Subjects and Methods:
A sample of 1587 Iranian males aged 20-60 years volunteered to participate in this study. All were Tehran residents, originally from different parts of the Tehran city. Subjects were healthy, and claimed no known musculoskeletal, neuromuscular or cardiovascular pathology affecting their functional ability. None were engaged in active sports for more than two per week. They were aware of the purpose of the tests and were not paid for their participation. All were able to follow instructions. The age, activity score, height and weight of subjects were recorded (Table 1).

Grip Hand Strength Testing:
Isometric grip hand strength was measured with hand – held dynamometer (6, 15.21). Subjects sat upright in a test chair with hips and knees flexed at approximately 90 s. The subjects were asked to build force to a maximum over a 2-second period and maintain the maximum effort for approximately 3seconds. The subjects
were then requested to stop. This procedure has been shown to be reliable and adequate to measure the maximum isometric grip hand strength.

Table 1: Characteristics of subjects grouped by decade (mean ± SD; n= number of subjects).

<table>
<thead>
<tr>
<th>Decade</th>
<th>Age (yr)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>Activity score</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30 (n=417)</td>
<td>25 ± 7</td>
<td>171 ± 8</td>
<td>73/5 ± 8</td>
<td>3/2 ± 0/4</td>
</tr>
<tr>
<td>30-40 (n=369)</td>
<td>36 ± 5</td>
<td>171 ± 11</td>
<td>75/8 ± 6</td>
<td>2/5 ± 0/4</td>
</tr>
<tr>
<td>40-50 (n=408)</td>
<td>44 ± 7</td>
<td>173 ± 9</td>
<td>79/2 ± 9</td>
<td>1/8 ± 0/6</td>
</tr>
<tr>
<td>50-60 (n=381)</td>
<td>53 ± 6</td>
<td>175 ± 8</td>
<td>81/5 ± 7</td>
<td>1/1 ± 0/5</td>
</tr>
</tbody>
</table>

Height and weight variable measured and suitable numbering done according to subjects physical activity score during week. Therafter BF% and VO₂max calculated for all Individuals by Jackson and Pollock predictor equations.

**BMI Testing:**

Height and weight variable measured, thereafter BMI calculated for all Individuals.

**BF% Testing:**

When BMI calculated for each subject, BF% measured by Jackson and Pollock predictor equations (Cooper, C., 1988; Brown, M., 1995).

\[
[BF\% = (1/61.BMI) + (0/13. Age)-12/1 -13/9]
\]

**VO₂max Testing:**

Thereafter recorded the Age, physical activity score during week, and BMI of subjects VO₂max calculated for all Individuals by Jackson and Pollock predictor equations (Cooper, C., 1988; Brown, M., 1995).

\[
[55/688-(0/362.Age) - (0/331. BMI) + (4/31. A score) - 0/096 (BMI.Ascore)]
\]

**Data Analyses:**

One-way ANOVA was used to determine the difference among the age groups. If a statistical difference existed, Bonferroni post-hoc test was used to determine which group was different from the other groups, with alpha level set at 0.05. Multiple regression analysis was also used to determine the nature and degree of the relationship between grip hand strength, BMI, BF%, VO₂max and age. The SPSS software statistical program was used to analyze the data

**Results:**

A summary of the grip hand strength, BMI, BF%, and VO₂max measurements for each age group is presented in Table 2. The grip hand strength in the second decade was 51/2 ± 7 kg and 45/4 ± 5 kg in third decade, respectively. A stable pattern of grip hand strength continued throughout. A gradual decline in the grip hand strength and VO₂max continued to the fourth decade. One-way analysis of variance test showed a significant difference was found between the grip hand strength, BMI, BF%, and VO₂max in the second and third decade and age groups (P<0.001).

Table 2: Mean ± SD grip hand strength, BMI, BF%, and VO₂max of tests of different age groups.

<table>
<thead>
<tr>
<th>Decades</th>
<th>Grip hand strength</th>
<th>BMI</th>
<th>BF%</th>
<th>VO₂max</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-30</td>
<td>51/2 ± 7</td>
<td>24/9 ± 6</td>
<td>19/5 ± 3/5</td>
<td>40/5 ± 8/2</td>
</tr>
<tr>
<td>30-40</td>
<td>45/4 ± 5</td>
<td>25/8 ± 4</td>
<td>23/8 ± 4/8</td>
<td>36/2 ± 12/5</td>
</tr>
<tr>
<td>40-50</td>
<td>41/5 ± 7</td>
<td>28/4 ± 5</td>
<td>25/5 ± 6/6</td>
<td>32/2 ± 6/3</td>
</tr>
<tr>
<td>50-60</td>
<td>36/8 ± 6</td>
<td>29/3 ± 6</td>
<td>27/6 ± 4/5</td>
<td>27/4 ± 4/7</td>
</tr>
</tbody>
</table>

**Conclusion and Discussion:**

In this study, the grip hand strength, BMI, BF%, and VO₂max not remained stable throughout the second and third decade of life. A gradual significant loss started at the third decade in these groups of subjects. It is not clear if the reduction in muscle strength and functional ability during the third decade was due to age-related changes or from a sedentary lifestyle, or a combination of both. However, the significant correlation between age and grip hand strength, BMI, BF%, and VO₂max among the subjects in their third decade. Researchers may be encouraged by this study to review the relationship between the muscle morphology and biochemistry, sensory input and the impact of lifestyle on muscle strength and physical performance of people. Whatever the
causes of declining muscle strength and remarkable number of change in body composition. Third decade is considered a turning point for muscle strength and physical performance.

The gradual declines in grip hand strength, BMI, BF%, and VO_{2} max as a result of aging have also been reported in various communities (Bohannon, R., 1997; Cochrane, T., 1998; Ivrson, B.D., 1990; Ploeg, R., 1991). This decline is related to various normal aging processes, (Ivrson, B.D., 1990; Jackson, A.S., 2002; Rantanen, T., 1996) lifestyle, and vocation, behavioral, cultural and physical activities (Andrews, A.W., 1996; Bohannon, R., 1997). However, the degree and pattern of decline differ from one community to another. These studies cannot be compared with our study because of differences in equipment and procedures used in measuring. Also, specific comparisons are difficult because of the inconsistent grouping of the subjects in various studies.

The results of this study, like those of others, demonstrate a relationship between age, upper extremity muscle strength and functional ability.

In this study the loss of strength and increasing body fat percentage began during the third decade of life. In another study, isometric grip hand strength began to decline in the fourth or fifth decade (Larsson, L., 1979). The awareness of losing muscle strength and endurance was also reported to occur at about age 40 (Tinetti, M., 1988). These variations may be due to different anthropometric characteristics and habitual level of functional activity of the participants in the various studies (Tinetti, M., 1988; Marks, R., 1992; Larsson, L., 1979). Differences in equipment and procedures used to measure muscle strength may also contribute to the variations. Body weight and height have been shown to correlate with strength (Larsson, L., 1979; Tseng, B., 1995). Habitual level of physical activity and the degree of physical effort have been reported to affect muscle strength (Andrews, A.W., 1996; Bohannon, R., 1997).

This study confines the extreme importance of muscle strength for activities of daily living (Hurley, M., 1988; Ivrson, B.D., 1990; Ploeg, R., 1991). A regular endurance and muscle strengthening program may be helpful in maintaining functional activity (Wiles, C., Y. Karni, 1983).

Muscle strength has an integral role in the structure and function of joints and bone mass. The degree to which muscle strength loss in the third decade of life will affect the structure and function of joints and bone mass in the elderly is a question that needs to be answered (Tseng, B., 1995; Vandervoort, A.A., 1992).

Health care expenditures increase when subjects begin to lose their functional ability (Wiles, C., Y. Karni, 1983). This could imply that people aged 30 and older in Iranian may spend more money on health care than the younger population. Consequently, to lower health care expenditure for people aged 40 and over, it is necessary to find a proper solution to reduce the reported loss in functional ability. Regular physical exercise, such as balancing, strength training, low-impact aerobic exercises, body flexibility exercise and functional exercise, and health promotion in the workplace, have been documented to improve functional ability and self-reported health status in various communities (Jackson, A.S., 2002; Nordstrom, P., 1995; Robinett, C., M. Vondran, 1988; Tseng, B., 1995). These exercises and health promotion in the workplace could also be used in Iranian to reduce declining functional ability.

The increasing in body fat percentage and reduction in strength and VO_{2}max between the third and the sixth decades of life could indicate an increased risk factor. Falls are the most important reason for elderly people being admitted to the hospital and apprehension about falling is a source of distress in 25% to 50% of community – dwelling elderly people (Snow-Harter, C., 1990; Wiles, C., Y. Karni, 1983). Strength and endurance weakness has been associated with an increased incidence of falls in elderly subjects. An intervention program of muscle strength and balance exercise has been suggested to prevent falls (Miyashita, M., 1971).

In summary, endurance and strength is able to determine the level of physical activities that can be performed during the aging process. Subjects in their third decade of life and above are at increased risk for a variety of physical and functional limitations.

REFERENCES


