Effects of Mountaineering on Physical Fitness and Quality of Life in Aged People

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Abstract: The aim of this study was to investigate the effects of mountaineering on older age’s cardiovascular and physical fitness factors and quality of life factors. Forty three healthy elderly men (age 57.7 ± 9.3) were randomly selected through questionnaires that had been distributed in the parks of northern of Tehran. According to their activeness and type of activity, subjects divided into three groups of Mountaineer (n = 15), Trained (n = 14) and Sedentary (n = 14). Then their cardio-vascular and physical fitness factors were measured. Quality of life (questionnaire), cardio-vascular and physical fitness factors (lab test) was measured. Data were analyzed using one-way ANOVA. Also the multivariate analysis of variances (MANOVA) was used to analyzing quality of life data. The results showed that aerobic capacity was significantly higher (P < 0.01) in mountaineer group in comparison to two other groups (37.2 and 15.4% respectively). In addition, resting heart rate, fat mass percent and reaction time were significantly lower in two trained groups in comparison to sedentary group (p < 0.05). Also there was significantly difference between three groups according to total quality of life score. In other factors there were not significant differences between groups (p > 0.05). Results showed that mountaineering led to positive effects on cardiovascular factors. It is recommended to pay attention to importance and favorites of recreational mountaineer, plan regular mountaineering as a daily program.

Key words: Mountaineer %Trained %Sedentary %Cardiovascular %Physical Fitness %Aging

INTRODUCTION

The process of aging is unavoidable and natural which affects all the physiological and psychological aspects of human [1]. Aging is not just the passing of time, but it is the happening of some biological processes [2]. This happens during lifetime that led to decreasing of biologic potential progressively. On the other hand, the increasing quality of life and improving of health care activities lead to increasing of hope to life, changing of age pyramid and increasing the rate of the elderly in the society. Researchers have showed that in 2000 near 13% of people in the entire world were over 65 years' old. And 18% of those were over 84 year, also it was anticipated that this percentage will increase to 20% till 2040. In 1994, world health organization reported that factors like physical health, regular exercise, proper nutrition, social welfare, income, education and entertainments are main requirement of aged people [3].

The human life is under the influence of different elements such as heredity, environment, hygiene and the lifestyle. The lack of enough physical activity is the outcome of modern life that accelerates the process of aging and double physical, psycho, economic and social problems [1-3]. The result of Ghafouri et al. [6] on Iranian people showed that 60.40% of 15-19 year old participated in sport one or more session per week but just 9.30% of 60-64 years old do this. Along with decreasing physical activity, changing in diet program and increasing mental tension, remarkable increase in rate of cardiovascular complication and related death had been shown. Physical fitness is the ability of the body for working efficiently which involve the physical fitness in relation to health and skills. These two have different parts and each part play some role in life[4]. In order to investigate the rate of decreasing physiological capacity with aging, different researches have been conducted on the various factors of physical fitness. Faulkner et al. [8-11] and some other
studies revealed that there is a nonlinear decrease in strength and muscle function and onset of muscle atrophy and muscle mass reduction due to apoptosis. Longitudinal studies have reported the wide range of reduction in \( \text{Vo}_{2\text{max}} \). But the rate of reduction is different in various studies. For example, in some studies the amount of reduction was 5 to 7% in \( \text{Vo}_{2\text{max}} \) for passing every decade of life [5-6], but in others 10% [7] or even more reduction [8] was reported. Also, because of the disorder in automatic neuron system, cardiovascular system loses gradually its potency regulation [8-9]. The studies conducted about body composition reported the increase of body fat and body mass index simultaneously with aging [10-11].

There are various ways to encounter with the reduction of physical and psycho efficiency due to aging. As Aslankhani [1] showed that the optimum way is to choose an active life style that participating in regular physical activity as main part of living program. Although the process of aging cannot be stopped with physical activity, however it can increase the ability. There are many studies which investigate the results of exercise on physical fitness factors in aged people. The effects of exercise on physical fitness factors revealed desirable outcomes such as attenuate the decrease of \( \text{Vo}_{2\text{max}} \) due to aging [7-8, 12-14]. The improvement of metabolic potential, the decreasing of abdominal fat, the improvement of strength and aerobic capacity, the decreasing of atrophy and tiredness [14-15], the improvement of blood fat profiles [16], the improvement of flexibility [17-18], the decreasing of bone fracture [23], the increasing of hope to life [5] and self-confidence to be placed in the upper norm of health in the society [5, 17] in the elderly during rest [24] and exercise [19-20] are other results of exercise. Haight et al. [27] investigate the leisure time physical activity on elders and reported its good effects on their health specially in women. Jubrias et al. [28] reported that elderly muscles can adapt to both resistance and endurance training.

Among different exercises, mountain climbing and spending some times on the mountain are crucial and important for the elderly because to be in altitude can change the physiological functions of the body (13, 21). Iran consists of rugged, mountainous rims surrounding high interior basins. The main mountain chain is Alborz. Volcanic Mount Damavand, 5,610 meters (18,400 ft), located in the center of the Alborz near the Tehran, is the country's highest peak. Due to excellent environment in the northern areas of the Tehran and also because of some social and cultural belief that restrict families to taking part in leisure time physical activities with each others, mountaineering is the best selection for Iranian. However, Tochal where is one of the Alborz’s mountains in north of Tehran is most popular place which is equipped for all people with different rate of physical fitness. Ghafouri et al. [6] showed that recreational mountaineering was fifth and climbing was eighth Iranian favorite sport. But this sport was fifteenth and eleventh, respectively, that people regularly taking part [22].

In recent years, the number of elders who select mountain climbing for fun and fitness is increasing [23]. Because of lack of information about consequences of mountain climbing for the elderly and the importance of this exercise as a refreshing exercise, this study has been conducted to compare physical fitness factors between those elderly who go mountain climbing and other elders who exercise except mountaineering and those elderly who do not exercise. Therefore, it was hypothesized that mountaineering and trained group in aged people responded differently to physical fitness and quality of life.

**MATERIALS AND METHODS**

**Subjects:** First, to find aged subjects, 200 questionnaires contain three parts of descriptive data, health state and physical activity information were randomly distributed among aged people in the park and Tochal. Among completed questionnaires, those who were less than 50 years old or have diseases such as hypertension, diabetes, kidney disease and joint disease deleted and finally 43 healthy aged men with over 50 years old were elicited. Then subjects divided in three groups (mountaineer, trained and sedentary groups) based on type and levels of activity.

**Mountaineer Group:** Mountaineering who were fifteen men with regular mountain climbing history at least two times a week.

**Trained Group:** Training group were fourteen active men who participating regularly in physical activity programs and sports two times a week except climbing.

**Sedentary Group:** Fourteen sedentary men who considered as control group (Table 1).
Table 1: Mean (±SD) values of the subjects’ characteristics

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Age (year)</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountaineer</td>
<td>15</td>
<td>60.9±10.1</td>
<td>165.0±19.8</td>
<td>78.9±28.5</td>
</tr>
<tr>
<td>Trained</td>
<td>14</td>
<td>55.2±7.9</td>
<td>172.5±5.7</td>
<td>78.9±6.8</td>
</tr>
<tr>
<td>Sedentary</td>
<td>14</td>
<td>56.7±9.5</td>
<td>168.3±12.5</td>
<td>73.9±22.3</td>
</tr>
</tbody>
</table>

Table 2: Cardiovascular, Aerobic capacity and Body composition variables in trained and untrained aging

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mountaineer</th>
<th>Trained</th>
<th>Sedentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.R*</td>
<td>74.4±9.03</td>
<td>70.03±8.39</td>
<td>81.78±12.06</td>
</tr>
<tr>
<td>SBP*</td>
<td>129.06±15.4</td>
<td>126.07±8.6</td>
<td>129.6±11.07</td>
</tr>
<tr>
<td>DBP*</td>
<td>83.2±7.5</td>
<td>79.5±8.6</td>
<td>79.07±9.3</td>
</tr>
<tr>
<td>MAP*</td>
<td>98.5±9.5</td>
<td>95.03±9.7</td>
<td>95.9±9.01</td>
</tr>
<tr>
<td>FAT%</td>
<td>18.4±3.4</td>
<td>20.25±3.4</td>
<td>21.8±3.50</td>
</tr>
<tr>
<td>BMI</td>
<td>25.6±3.4</td>
<td>26.3±2.4</td>
<td>27.6±3.8</td>
</tr>
</tbody>
</table>

*C significant difference between Trained and Sedentary groups at rest HR

Table 3: Physical fitness variables of aging groups

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mountaineer</th>
<th>Trained</th>
<th>Sedentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic balance</td>
<td>5.18±1.84</td>
<td>6.102±4.4</td>
<td>5.91±1.41</td>
</tr>
<tr>
<td>Static balance</td>
<td>7.03±5.81</td>
<td>14.50±12.4</td>
<td>7.2±5.18</td>
</tr>
<tr>
<td>Grip (right hand)</td>
<td>42.8±8.9</td>
<td>47.5±7.5</td>
<td>41.5±9.2</td>
</tr>
<tr>
<td>Grip (left hand)</td>
<td>39.3±7.3</td>
<td>43.4±6.9</td>
<td>40±9.7</td>
</tr>
<tr>
<td>#Flexibility (%)</td>
<td>30.2±7.87</td>
<td>23.8±5.8</td>
<td>23.8±8.4</td>
</tr>
<tr>
<td>*Reaction time (s)</td>
<td>810±199</td>
<td>750±179</td>
<td>925±97</td>
</tr>
</tbody>
</table>

*C # significant difference between Trained and Sedentary groups

Procedure: All tests were performed in Physical Education and Sport Science’s laboratory in Shahid Beheshti University. Subjects were requested not to participate in intensive physical activity at least 24 hours prior to the test. First, subjects were given both oral and written information about the experimental procedures before they gave their written informed consent. Then quality of life questionnaire were completed. Then body composition and some blood factors (resting blood pressure and heart rate) were recorded. After warm-up on a cycle Ergometer (Monark, Ergomedic 839E, Swiss) for 5 minutes and dynamic and static stretching, all subjects executed three trials the tests of flexibility, Grip strength, Reaction time, Dynamic and Static balance tests stations, respectively, with 3 minutes of recovery between the tests. Finally, they did modify Balk test on treadmill (Exide Med, Techno Gym, Italy) for determining their aerobic capacity.

Modified Balk Test: After familiarization period, treadmill chest belt were fastened to record heart rate (HR) during exercise. Initial treadmill speed varied according to the individual’s physical fitness (3-3.5 km/h for inactive men and 4-4.5 km/h for active men) and was set to 75% of age predicted HR (Eq.1). Treadmill grade increased from 0% to 4% after 2 min, to 6% after 4 min and then by 2% every min up to exhaustion. Finally, the last speed and grade were used to calculate Vo2 (Eq.2).

\[ \text{HR}_{max} = 208 - (0.7 \times \text{age}) \]  
\[ \text{Vo2} = 0.1(\text{speed}) + 1.8(\text{speed})(\text{grad}) + 3.5 \text{(ml/kg/min)} \]  

Body composition: Percent body fat derived from three-site (chest, abdomen, thigh) skin fold method by caliper (SlimGuided). Eq.3 was used for assessing percent body fat from skin folds.

\[ \text{Fat\% body} = \left(\sum \text{point}\right) - 0.00105 \left(\sum \text{point}\right)^2 + 0.15772(\text{age}) - 5.18845 \]  

Flexibility: Flexibility measured by Sit-and-reach Test. The best of three trials was recorded for each subject.

Reaction Time: Using Strap device subject’s response to visual stimulation was measured. The best of three trials was recorded.

Balance Test: Both dynamic and static balance was measured. Stroke stands test used to evaluate static balance and Balance board (Satrap) used for dynamic balance. The best of three trials was recorded.

Quality of life questionnaire (WHOQOL-BREF): This questionnaire is based on standards of WHO and had used at least in 39 countries in the entire world. The Quality of Life Scale is a 28-item Likert-type scale that measures 4 domains: physical, mental, social and environmental health. Scores for each item range from 1 (terrible) to 5 (delighted). Higher Score for positive questions indicating better well-being and quality of life. The reliability (Cronbach’s alpha) of the Quality of Life Scale in this study was 0.70 [24].
Statistical Analysis: All statistical analyses were performed using the software statistical package SPSS version 16 (SPSS, Chicago, IL, USA). All data sets were tested for normal distribution using the Kolmogrov-smirnov Test. A one-way ANOVA was employed to examine the differences in mean values between three groups. When ANOVA indicated the presence a significant difference, post hoc comparisons using Bonferroni corrections were applied to determine pair wise differences. Wilks’ lambda multivariate tests (MANOVA) were performed to assess differences in quality of life questionnaire’s parts among the three groups. Values are presented as means±S.D. The level of significance in all statistical analyses was set at P<0.05.

RESULTS

Cardiovascular Factors: The results showed significant differences among the three groups in aerobic capacity index. (F2,40=22.31, P=0.01). Post-hoc analyses indicated that there was significant difference from those noted in the trained and control group (P=0.05, P=0.001 respectively) and also trained with sedentary group (P=0.001). The mean of V02 in mountaineer group was higher than two other groups (37.2%, 15.4% respectively) (Fig. 2).

Differences in resting heart rate (HR) between three groups were significant (F2,40=4.367, P=0.05). However, mean of resting HR in trained group was lower than two other groups (4.01 and 7.38 beat/min, respectively). These changes were significantly different from those noted in the control group (P=0.05). The results showed that there weren't significant differences between three groups in resting Systolic blood pressure (SBP), Diastolic blood pressure (DBP) and Mean arterial pressure (MAP) (P=0.375, P=0.724, P=0.558 respectively).

Evaluating body composition's results indicated that For BMI neither intra-group changes nor inter-group differences were significant (P=259), but was significant for percent body fat (P=0.05). Post-hoc analyses by Bonferroni showed that this difference was between trained and sedentary groups (P=0.1). Although the percent body fat data for trained group was significantly different from the control group, no significant difference was observed between the two other groups (Fig. 2).

Physical Fitness Factors: There were no significant difference in right and left hand grip in any of the groups, but were higher (8.6%) in both active groups than control group (10.82 and 10.41% respectively). The results showed that 93% of subjects used their right hand as dominant hand.

The results showed that significant differences among three groups in Reaction time (P=0.05). Post-hoc analyses indicated that there was significantly different from those noted in the trained and control group. Mean value in mountaineer and trained groups were 13.5 and 22.6% better than sedentary group, respectively.
1. Flexibility were significantly different among groups (P= 0.018). Post-hoc analyses indicated that there was significantly different from those noted in trained and sedentary groups (P= 0.019). Dynamic balance was not significant in three groups (F1, 90= 0.908, P=0.412) but mountaineer group had higher (12.43%) balance values than did sedentary groups. There was no significant difference at static balance in any of the groups (F2, 908= 2.48066, P=0.097).

Quality of Life: The results showed that there was significant difference in quality of life between three groups (F2, 40= 12.86, P=0.0005; Wilk'sLambda = 0.10). As mountaineer group had higher quality of life score (107.73) than did trained (93.07) and sedentary (80.92) groups. Additionally, Corrected Bonferroni was performed to determine the intervention of different parts of quality of life (0.012). The differences were statistically significant in physical health (F10, 39.56, P=0.001), social relationships (F10, 21.19, P=0.001), environmental health (F10, 28.72, P=0.001) and total quality of life (F10, 64.77, P=0.001). The average score of mountaineer group in physical health was higher than trained and sedentary group (20% and 47%, respectively). The difference between trained and sedentary group was significant in mental health (P=0.001). In addition, the mental health score was 26% higher in Mountaineer group than trained group, but the difference was not significant between Mountaineer and Mountaineer groups (P=0.052). Also significant difference was showed between three groups in social relationship (P=0.001). The average score for mountaineer group was better than trained and sedentary group (37% and 39%, respectively). This significant difference and higher score was also exist in environmental health (31% and 44%, respectively).

DISCUSSION

As results showed the aerobic capacity of mountaineer group was better than both other groups. These results are in agreement with some studies such as Vincent. et al. [17], Williams. et al. [19] showing the positive effects of exercise on aged people in reducing the rate of cardiovascular decline with age. The previous studies showed that there is a 10% [7] or more [8] decline in aerobic capacity as the most important parameter of cardiovascular conditions with passing every decade of life. Although the subjects in the mountaineer group were in average older than those in other two groups (this difference was not statistically significant), however their aerobic capacities were higher. The positive effects of an active lifespan on physical fitness and cardiovascular factors had been demonstrated in other investigations [25], but the main cause for this difference between them was the type [26] and amount of exercise [17] and exercise intensity [27-28]. Since the maximal heart rate decreased equally in all subjects of the three groups, may be because of decrease in cardiac muscle sensitivity to catecholamine hormones with aging [29-30], thus the main reason for the better performance of the mountaineer group, other than decrease in peripheral resistance in blood vessels, had been possibly increases in the rate of oxygen uptake by body tissues, especially muscle tissues, as the result of mountain climbing [23]. Generally, the endurance exercise in aged people lead to increase in capillary supply of muscular fibers and their oxidative enzymes with notable improve in V0\textsubscript{2max} [31].

Despite higher average ages, the average arterial blood pressure in mountaineer group was only 2.5 and 3.4 mmHg higher than trained and sedentary groups, respectively. However, this differences was non-significant (p=.558). The body fat percentage of active groups (including the mountaineers) was lower than the sedentary group (7.1 and 15.1% respectively), which is in agree with the previous investigations [16, 32]. In the previous studies, only the overall effects of physical activity on older age people had been investigated [31] and there had been no studies that investigating the effects of the special exercises such as mountain climbing on aged people.

One of the complications of aging is the increase in the body fat, especially in the abdominal region [31]. The causes of these increases include decrease in the growth hormone secretion, sexual hormones activities, resting metabolic rate and physical inactivity, that the last one is the main factor [31, 33]. However comparison of body fat between three groups showed that there is no a significant difference, but body fat percent in mountaineer group was 9% lower than the other active group. This can be implying the beneficial effects of climbing. The BMI was not significantly different between these groups, although further evaluations revealed that the trained groups had lower BMI (about 7%) compared to the sedentary group. Because of slight decreases in the body stature, the accumulation of fat tissue and decrease in the lean body mass, using BMI as a measure of body composition is controversial in aged people [34].
Also, the result of this study revealed that there were no significant difference in right and left hands grip between three groups. That was similar with results of studies conducted by Frontera et al. [41, 42] and Commodari & Guamera [35-36]. Aging led to deteriorates changes in muscle fibers that in turn led to muscle atrophy [37-38]. It is believed that sarcopenia is responsible for these effects [6, 15]. The rate of this deteriorates changes in type 2 muscle fibers is more than type 1 slow twitch muscle fibers. The rate of muscle fiber contraction decrease so produced power declined and hasty fatigue would be unavoidable. Based on this fact that muscle atrophy increase with aging, residual amount of muscle fibers are depended on amount of participation in physical activity programs and keeping active lifespan led to increase in strength and lower health related problems [5-6, 36-37]. As results of this study showed that physical activity led to positive effects on slowing the rate of strength decline with age.According to our results in this study mean strength of both right and left hand grip was higher in trained group than two other groups that were probably because of hand preference in their favorite sports.

Evaluation of the results of reaction time test showed significant differences between this three aged groups and trained group was better than two others. Reaction time strongly dependents on age, as in this time are higher and more variable in older subjects [38]. These conditions indicated the decreased capacities of central nerves system because of deteriorate changes in neural cells, decreased neural conductance and information processing capacity of neural cell [39]. Because of 15 to 35% decreased muscle’s stimulation threshold” between 20 to 60 of age, there is need to more higher neural stimulation in this ages [40]. It is known that exercise is a good way to keeping health life in aged people and results of this study demonstrate this fact again. But why the better results in mountaineer group was not statistically significant? May be because leisure climbing does not provide thought -challenging to aged mountaineer. In majority of other exercises; thought, action and reaction are important parameters that led to improvement in neural system function [40]. But it seems that these factors have lower importance in mountaineering. Also the results of static and dynamic balance that related to nerves system function are no statistically significant that is in agree with results reported by Der and Deary [38].

According to the results of this study trained group had better records in dynamic balance than mountaineer and sedentary groups (15.18 and 3.13% respectively). By doing physical activity, aged people would have better control on their movement [41]. As result showed differences between groups in static balance was not significant and trained group had better results in dynamic balance. This result was similar to some previous studies [42-43] but in contrast with others [44-45]. Different training situation, intensity and volume of training and also different age groups and body status of aged people are among reasons for these contrary results. The role of agonist and antagonist muscle in static balance is very important [42]. In the other word, it seems that role of trunk and feet muscle strength in stability and keeping body balance is more than the role of coordination factor [46-47]. Stroke stands test was used to evaluate the static balance in this study but function of this muscle to identify exact differences between subjects in their balance was not controlled.

There was significant difference in flexibility results between two active groups with sedentary group. This results similar with those of Roth et al. [54] and Begg & Sparrow [55] studies and also with studies that related to rehabilitation of aged people by flexibility training. Flexibility declines because of decreases in elasticity of soft tissues like tendons, ligaments and cartilages with aging [44-45]. Previous investigations reported that a direct relationship between declines in flexibility and increase risk of falling in aged people [44]. Likely flexibility training has profitable effects on Sarcopenia and decrease rate of deteriorate change in muscle fibers [48]. Although there is no difference between two active groups that is may be because of specialty of flexibility training and useful effects of physical activity in preventing from rapid decline in flexibility with aging. Bases the results of this research, there was significant difference between this three groups in quality of life and its component like “physical health, social relationship, environmental health and mental health”. In other word, the results showed that those older ages who planning for mountaineering regularly or have regular exercise, in compare with those older ages who do not take part in this activities, have higher scores of quality of life that agree with major of previous studies [49-50]. Brach et al. [5] showed that taking part in regular physical activities with moderate intensity (20 or 30 min per day) led to reduce movement limitation and increase play role, quality of
life and sense of excellent. In a Meta analysis by Robertson et al. [58] the results showed that sport programs led to different results on muscle strength, the ability to doing daily works independently and quality of life.

In conclusion, aging is along with gradual decrease in physiological capacities that led to decline in cardiovascular and physical fitness factor, but physical activity can delay this process. The notable results of this study specially in aerobic capacity (V\text{O}_2) and body fat percentage in mountaineer group was very important and revealed the good and useful effects of mountaineering on cardiovascular factors. Relative improvement in quality of life and its components, heart rate, flexibility, balance grip, strength and reaction time in both active groups than sedentary group emphasis the necessity of physical activity and active life style as an important part of living programs, again. In order to observed differences in several variables between mountaineer and trained group, the more comprehensive investigation bases on type and intensity of physical activity is recommended to the next interest researchers. It is recommended to older people who do not have any of knees and feet joins’-related problems to pay attention to importance and favorites of recreational mountaineering in addition to take regular participation in other sports.

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22. dr.qafuri.


