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The comparison of physical fitness in secondary male students in altitude and coastal areas

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Abstract

The aim of this research is the comparison of physical fitness in secondary male students in altitude and coastal areas and difference between the physical fitness on based AAHPERD test. The samples consist of 450 subjects of 1017 subjects in altitude (Shahrekord) and coastal area (Mahmood Abad) in Iran in years of 2013 which were selected cluster- randomly sampling by Morgan Table. We investigated the effect of high altitude on the tests of physical fitness resident students near sea level (-5 m) and in Altitude (2100 m). The tests of physical fitness include: Pull-ups test, Sit-ups test, Agility test (4 x 9), 45 Sprint test, 1600m running, Long jump and Flexibility test. For determining of different between physical fitness of altitude and coastal area students was used t- test. The result of this research shows that there is no significant difference between the average of Pull-ups test (t=0.965; p=0.385), Flexibility (t=1.722; p=0.089), Agility (4 x 9 m) test (t=1.765; p=0.084) and 45 sprint (t=1.24; p=0.221) of students in coastal area and altitude. There is significant difference between the average of Sit-ups (t=2.29; p=0.016), 1600m running (t=11.132; p=0.001) and Long jump (t=3.18; p=0.004) in altitude. The students of altitude have higher power and cardio-respiratory endurance rather than coastal area. But the students of coastal area have stronger abdominal muscles rather than altitude. High altitude reduces the distance covered by youth athlete students during tests. Neither acclimatization nor lifelong residence at high altitude protects against detrimental effects of altitude on tests activity profile.

Keywords: AAHPERD test; altitude areas; physical fitness; sea level.

INTRODUCTION

Today, the value and the importance of physical education in relation to the growth and development of physical, social and intellectual aspects of human life are clear. Therefore, physical engagement is inevitable. In the shadow of physical activity, human can enjoy from living full time (9). At the beginning of physical education, physical fitness was the goal. And also the goal of physical fitness at the beginning was individual's preparation for self defense and its use in prevention of diseases (12). Physical structure of humans is well able to with stand physical oxygen gravity. Of course, the decrease or increase of height causes the functional changes in physical activities (7). The human body so that it can play its role effectively in life must be in good physical condition that is to continuously provide the energy needed in order to perform their duties efficiently. When we speak of fitness, the purposes of having such a heart, blood vessels and lungs and muscles that can perform their duties well and participate vigorously in all recreation and activities that in normal and disabled people are incapable of doing it. Several factors contribute to physical fitness, but four factors have over the role of other factors. These factors include (muscles force, muscle endurance, flexibility, and cardio-respiratory endurance) (10). The factors that can change the above conditions are: height, temperature changes, humidity, windflaw, and sun. When a man goes from sea level to the altitude lands or chooses to live in such areas, the amount of oxygen pressure is reduced in terms of the amount of height. Due to the increase of height, the moisture reduces and the intensity of solar radiation increases. However, each of these factors creates physiological problems for people during the climbing (7). Research shows that more than 1500m altitude affects the ability to work. Of course, people who are at altitude will have different physiological reactions toward the cardio-respiratory and metabolic system (1,8). With climbing to the altitude, atmosphere pressure will reduce and the number of air molecules per unit volume will reduce. So, for being able to receive the same amount of oxygen, molecules from breathing at sea level and height, we should add to the number of our breathing (1,7,12). When we climb to the 2500 m above the sea level, the pressure of arterial oxygen reduces to about 60 mm Hg, but the oxygen pressure of tissues remains 20 mm Hg (7). Therefore, the difference between the pressure of arterial oxygen contribution and the pressure of tissue oxygen contribution will reach from 74 mm at sea level to 40 mm Hg at 2500 height. Any decrease in pulmonary oxygen will cause the cardiovascular system to compensate the decrease and also causes to increasing blood volume and heart beat (12). The researches investigate the effect of height on altitude lands and sea level residents. In this research 10 climbers with 4000m height were compared with 11 samples of low-lying areas with 450m height. The results show that heart beat and systolic, diastolic pressure in climbers is lower than the residents of low-lying areas (1,7). In another arterial blood pressure research, seven healthy young men were measured at intervals of rest between workouts. It shows that during hypoxia in 4300 height, the resting blood pressure was equal to the blood pressure at sea level. But, after 3 weeks adjustment with 4300 m altitude, resting blood pressure at acute hypoxic conditions was 20mm Hg altitude than sea level (2). Plasma volume decreases by up to 25% within the first few hours of exposure to altitude and doesn't plateau until after a few weeks. This is partially a deliberate response by the body as reducing plasma (the watery part of blood) in effect increases the density of red blood cells. While no extra red blood cells have been produced in this acute phase, the amount of hemoglobin per unit of blood (hematocrit) is now increased resulting in greater oxygen transport for a given cardiac output (4). Increase in red blood cells and hemoglobin in height increases oxygen transport, on returning to sea level. Despite the fact that the evidence shows that this change is unstable and transitory and not last only days more but it can be considered as an advantage for athletes (10). Sargent et al. (11) studied 8 healthy men (age range: 21-31 years) in simulated altitude (hypobaric chamber) during the sleeping period. SaO_2 at sea level was 97±1%, at 4,572m it was 79±3%, at 6,100m it was 62±11%, and at 7,620m it was 52±2%. During maximal exercise at 8,848m in a cycloergom, the mean SaO_2 reached 49% with a mean PH of 8 (11). The result of research Buchheit et al. (3) shows that the combination of heat and hypoxic exposure during sleep/training might offer a promising conditioning cocktail in sport. Several studies show a reduction in VO_2 at rest and/or at certain level of exercise at moderate and high altitudes (12). At lower altitudes, 2,500m, Clark et al. (5) observed a 12% reduction of the peak VO2 in a population of 20 old people, during the acute exposure; VO_2 reached normal values after acclimatization. In another extremity, at the simulated altitude of Mount Everest, an 80% drop in the maximal VO_2 in relation to sea level was found. The physiological mechanisms are the following: 1) increase in the pulmonary ventilation. 2) Reduction in the HR previously. 3) Increased in the acute response. 3) Decrease in the plasmatic volume. 4) Reduction of the accumulation of lactate in the blood during submaximal exercise in relation to the more elevated levels of acute response. 5) Improvement of the cardiorespiratory capacity for exercise, also related to the initial exposure to the hypobaric hypoxia. 6) Increase in the secretion of renal erythropoietin, in the hemoglobin mass and in the hematocrit (5). Fast Activities as it takes less than a minute, the average elevations usually do not interfere with such activities are not require a lot of oxygen transport and aerobic metabolism, In addition, the thin air at an altitude provides less aerodynamic resistance against the motion athletes. For example, in the thin air of Mexico City Olympic Games in 1968 contributed to the fast runners and jumpers (10). Research conducted in sample students in North Country shows that there is a significant increase among the average sit-ups and long jump test at ages 11, 12, 13 compared to the national norm (1,2). Gaeini et al. (6), in a research entitled in The effect of different conditions of maturation on % BF, BMI, and WHR in non-athlete adolescent girls in cold and warm climate regions, concluded that the weather conditions of cold and warm areas has a different effect on anthropometric indicators of physical and non-athletic teenage girls (6). The aim of this research is the comparison of physical fitness in secondary male students in altitude and coastal areas and difference between the physical fitness on based AAHPERD test.

MATERIALS & METHODS

This research is cross sectional. Statistical population of this research were 1107 students in coastal area with (-5 m) altitude and the high altitude lands between 2000 - 2200 m (2100m) in Shahrekord. Statistical samples are concluded of 450 subjects in the Mahmoud Abad (234 person) and Shahrekord (216 person) with (age: 12 ±1 years), height (157±5cm) and body mass (55±5 kg) by Morgan Table. Samples were selected by cluster- randomly sampling. The measurement tools were AAHPERD physical fitness test that measure:

- Modified corrected Pull-ups test, for measuring arm muscle and scapula endurance in 1 minute.
- Modified Sit- ups test for measuring abdominal muscle endurance in 1 minute.
- Jump test for measuring explosive power for leg muscles.
- Shuttle run test (4×9m) for measuring agility in seconds.
- 45m sprint test for measuring speed in seconds.
- 1600m running test for measuring cardio - respiratory endurance.

After conducting the tests according to the regulations in altitude and coastal area regions, there were assigned a score to the student's performance on each of the physical fitness tests by specified time. The means and standard deviations for physical fitness parameters were calculated by descriptive statistics. To compare physical fitness parameters between coastal and altitude areas, t-test for independent sample were used. The Statistical Package for the Social Sciences (SPSS) version 18.0 was used for all the analyses. The level of significance was set at 0.05.

RESULTS

In altitude, total distance per minute was reduced by a small magnitude in the first tests at altitude, and this was also true for the Shahrekord. Low-velocity running per minute was higher by a small magnitude in Mahmoud Abad than in Shahrekord in the second tests at near sea level. High-velocity running per minute was moderately higher in Mahmoud Abad compared with Shahrekord in the second test at near sea level, and higher by a small magnitude in Shahrekord compared with Mahmoud Abad.

According to the results of Table 1, there is no significant difference between the pull-ups test of students in coastal and altitude regions (t=0.965; p>0.05) and between the student's flexibility test (t=1.722) in coastal and altitude areas at 0.05 level.

Table 1. The results of the male student's AAHPERD test in coastal and altitude areas.

AAHPERD tests	Areas	Mean	SD	t	p
Pull-ups test	Coastal	17.86	5.36	0.965	0.385
	Altitude	17.36	6.20		
Flexibility test(cm)	Coastal	30.55	6.30	1.722	0.089
	Altitude	30.85	6.26		
Sit-ups test	Coastal	42.86	8.65	2.29	0.016*
	Altitude	38.69	9.36		
Long jump test (cm)	Coastal	173.19	19.52	3.18	0.004*
	Altitude	180.26	18.99		
(4 x 9) Agility test (s)	Coastal	10.75	0.61	1.765	0.084
	Altitude	10.55	0.65		
45 m sprint test(s)	Coastal	8.35	0.53	1.24	0.221
	Altitude	8.34	0.56		
1600m running test(min)	Coastal	10.58	0.85	11.132	0.001*
	Altitude	11.45	0.95		

* Significant difference at p<0.05.

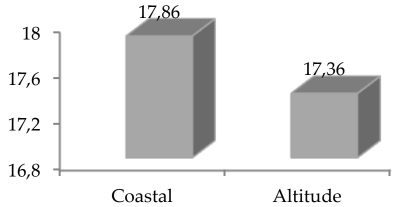

Figure 1. Male student's pull-ups test in coastal and altitude areas.

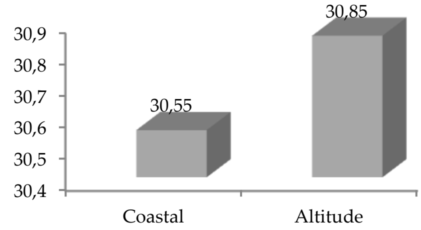

Figure 2. Comparing the results of male student's flexibility test at secondary school in coastal and altitude areas.

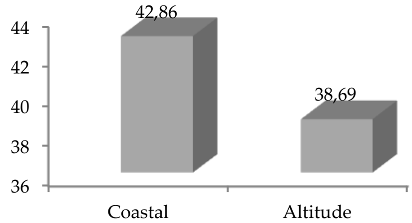

Figure 3. Comparing the results of male students sit-ups test at costal and altitude areas.

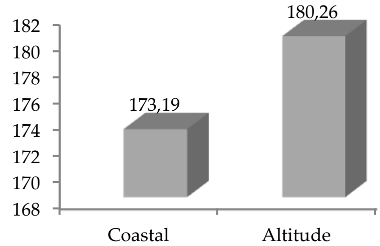

Figure 4. Comparing the results of male secondary students long jump test at coastal and altitude areas.

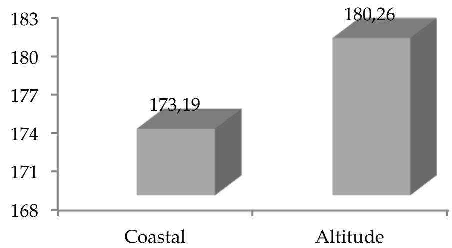

Figure 5. Comparing the results of male secondary students agility test at coastal and altitude areas.

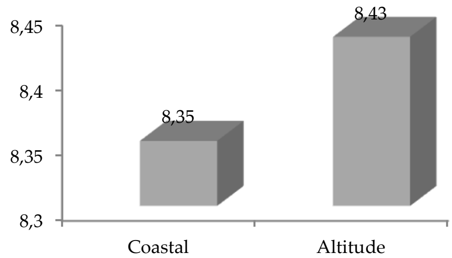

Figure 6. Comparing the results of male secondary students 45m sprint test at coastal and altitude areas .

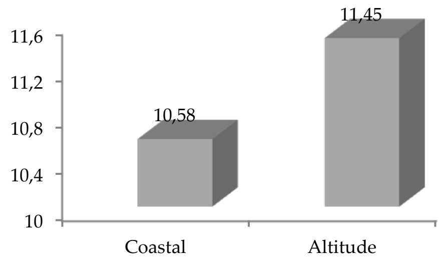

Figure 7. Comparing the results of male secondary students 1600m running test at coastal and altitude areas.

According to the results of Table 1, there is a significant difference between the secondary students sit-ups test (t=2.29) in coastal and altitude areas at 0.05 level. So, it can be concluded that secondary students at sea level have superior abdominal endurance rather than students at height.

According to the results of Table 1, there is a significant difference between the results of long jump test (t=3.18; $p<0.05$) of secondary students at coastal and altitude areas. So, it can be concluded that secondary students at altitude levels have highly explosive power rather than students at sea level.

According to the results of Table 1, there is no significant difference between secondary students agility test (t=1.765; $p<0.05$) at coastal and altitude areas.

According to the results of Table 1, there is no significant difference between the secondary students 45m running (t=1.24) at coastal and altitude areas at 0.05 level .

According to the results of Table 1, there is a significant difference between the secondary students 1600m running test (t=11.132) in coastal and altitude areas at 0.05 level. So it can be conducted that students at altitude areas have superior cardiorespiratory endurance rather than students at coastal areas.

The total time of 1600m running test in Mahmoud Abad is reduced in physical fitness tests. The reduced total time may be a result of self-modulation of activity under environmental stress to protect the capacity to perform higher intensity actions, or perhaps it reflects a lack of sensitivity in picking up transient reductions in high-intensity activity during tests. Recently, our group established that the activity profile of athlete students is also altered at moderate altitude (2100m) compared with that at sea level.

DISCUSSION

This research attempted to quantify adaptation of physical fitness performance of students in sea level-resident and high altitude resident. Maximal oxygen uptake begins to decrease significantly above an altitude of 1600m (5249ft). For every 1000m (3281ft) above that VO_2 max drops by approximately 8-11%. At the summit of Everest, an average sea level VO_{2max} of 62ml/kg/min can drop to 15ml/kg min. For individuals with a sea level VO_{2max} less than 50 ml/kg/min would be unable to move as their VO_{2max} would drop to 5 ml/kg/min enough only to support resting oxygen requirements (5). As would be expected the acute responses mentioned above have a detrimental effect on exercise performance in particular the endurance events. VO_{2max} decreases significantly as altitude increases. Running at 12km/h for example will equate to a higher percentage of VO_{2max} when completed at altitude compared to sea level (4). Conversely, anaerobic events lasting under a minute such as sprinting, throwing and jumping activities are not impaired at moderate altitude. In fact, they can actually be improved due to the thinner air and less aerodynamic resistance (2).

The average pull- ups test is not significant in two selected groups of coastal and altitude areas. this suggests that the two groups Scapula muscle endurance do not have much difference due to the height. Oxygen tension, tempreture and a slight decrease in the acceleration of gravity. However, perhaps the slight difference between the two groups in mean caused by feeding type of routine exercise in those areas and also human genetic structure. There is no statistical significant difference between the average of flexibilty test in coastal and altitude areas. This suggests that the 2 selected groups are relatively homogeneous in flexibility of hamstring muscles. However, perhaps the slight increase of flexibility exercise and the increase in range of motion. There is a significant difference between the average of sit-ups test in two groups of coastal and altitude areas. this suggests that abdominal muscles endurance is altitudeer in coastal areas. this consistent probably takes place more in the course of an aerobic glycolysis and short-term endurance in coastal residents. There is a significant difference between the average score of long jump in 2 groups of coastal and altitude areas. This suggest that the increase of power in lower muscles in altitudelands residents is due to common and daily power activities. Perhaps the effect of slight decrease in acceleration gravity is effective in long jump record. There is no significant difference between the average score of agility test in two groups of coastal and altitude areas. so we can conclude that the height is not effective in the agility of male secondary students. However, slight increase of agility in altitudelands residents probably is due to the peoples physical and routin activities. There is no significant difference between the average score of 45m sprint running test in 2 groups of coastal and altitude areas. so we can conclude that height variable is not effective on sprint of male secondary students. perhaps the slight increase in altitude area group is due to the peoples compatibility with physical activity. There is a significant increase between the average score of 1600m running test in 2 groups of coastal and altitude areas. This indicates that despite the reduced tension of oxygen in altitude areas due to cardio-respiratory adaptations during the life time, and the residents have altitudeer cardio-respiratory endurance.

So, the general conclusion is that physiological adaptation even with reduced oxygen tension prevents the reduction of endurance performance and despite the increase in height, the male secondary students cardio-respiratory endurance increases in 1600m running.

The goal of physical fitness programs, supporting people to carry out the duties assigned to them as well. The benefits of participation in physical fitness activities can imply to improve muscle strength, cardio-respiratory fitness, body waste, controlling obesity and reduce the likelihood of vulnerabilities. The tests will help to reduce of mental stress and anxiety and increase the proportion of deep sleep daily. Physical params (number, frequency, duration, intensity) that can be corrective in physical fitness are affecting on incidence of injuries. Physical Fitness, not only the risk of injuries and loss of muscle and bone are reduced, but also, increased their physical performance as well.

This was the first research to document the effects of high altitude on the tests activity profile of sea level-resident. The major findings of this research are: high altitude reduced tests running in friendly tests; the altitude-induced reduction in activity profile in student's tests was variable, but it was similar in sea level and high-altitude. Thus, neither acclimatization for coastal area nor lifelong residence at altitude could protect against reduced output during tests at altitude. The effect of altitude on high-intensity activity during the physical fitness tests reported in this research was uncoupled from the physical capacity testing data reported in the companion paper.

It is suggested to increase the physical fitness of students should be considered as the most important purpose of physical education in schools and informed of the progress of physical fitness for student and improvement of provincial and national norms of physical fitness is a priority. As well as those responsible for physical education secondary school students pay more attention to physical fitness to participate in the schools do not win matches. It is recommended to remove the causes of injury and fitness program designed by teachers of physical education, physical fitness tests repeated creation of educational spaces and proper exercise, doing stretching exercises before each practice and provide safety devices, to increase the physical fitness of students and these injuries can be prevented in the future.

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