

Effect of Short Duration High Intensity and Long Duration Low Intensity Progressive Aerobic Exercise on Selected Health Related Fitness Components and Hematological Parameters on Male Students of Haramaya University

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Abstract- This study was conducted to compare the effect of short duration high intensity and long duration low intensity progressive aerobic exercise on selected health related fitness components and hematological parameters on male students of Haramaya University. Subjects were randomly assigned to short duration high intensity and long duration low intensity groups. Both experimental groups participated in aerobic exercise 3 days/week for 12 weeks. The variables selected for the study were: cardiovascular endurance, muscular endurance, flexibility, body composition, WBC, RBC, hemoglobin and platelets. Throughout the training program, tests were taken at pre training, during training, post training. The results obtained in this study indicated that there were significant improvement in selected variables in both groups except BMI, hemoglobin and platelets under long duration low intensity group in which they showed insignificance ($p < 0.05$). According to this study when both groups compared, the short duration high intensity training program was significantly better than long duration low intensity training program in improving cardiovascular endurance, muscular endurance, flexibility, body composition, white blood cell, red blood cell, platelets and hemoglobin.

Index Terms- Aerobic exercise, health related fitness components, hematological parameters.

I. INTRODUCTION

Exercises are generally grouped into three types depending on the overall effect they have on the human body: aerobic exercises, flexibility exercises, and anaerobic exercises. Aerobic exercise has the aim of improving the body's consumption of oxygen. Aerobic refers to our body's use of oxygen in its metabolic process (energy-generating process). Most aerobic exercises are done at moderate levels of intensity for longer periods, compared to other categories of exercise (Birch *et al.*, 2005).

Recently physiological and hematological changes due to different physical activities have received much attention from many corners of the society. Since some exercise sessions have higher intensity, especially at in-season tournaments, the

circulatory system and hematological variables may undergo changes that in the long run considerably influencing performance and the result of the competition (Fereshteh *et al.*, 2012).

Moreover exercise training causes the body to adapt and improve performance over time. One area of ongoing interest is the adaptations that take place in physical fitness and the production of blood as a response to exercise (AJH, 2011).

Today the biggest problem in the world specifically in our country is lack of physical performance. Most studies indicated that this impairment can be partially prevented by aerobic exercise. Aerobic exercise can be an important component of improving physical fitness and therefore is commonly included in comprehensive fitness maintenance program. Whilst it remains controversial which mode and intensity of exercise yields the most beneficial adaptations and is the most effective for improving performance and reduces metabolic syndrome, some research indicates that short duration, high intensity exercise reaps many benefits than continuous low-moderate exercise and the other says vice versa (Rognmo *et al.*, 2004).

The general objective of this research study was to compare the effects of short duration high intensity and long duration low intensity of progressive aerobic exercise on selected health related fitness components and hematological parameters on male students of Haramaya University. The specific objectives were to compare the effect of short duration high intensity and long duration low intensity progressive aerobic exercise on cardiovascular endurance, muscular endurance, flexibility and body composition and to find out the relative changes between short duration high intensity and long duration low intensity progressive aerobic exercise on selected hematological parameters.

II. MATERIALS AND METHODS

The Study Design

The design for the study was experimental and the layout for this study was as the following table;

Table 1. The study design layout

Total sample		
Group	Group-1 (SDHI)	Group-2 (LDLI)
Treatment	Aerobic exercise	Aerobic exercise
Frequency	3days/week	3days/week
Duration /session	45 minutes	90 minutes
Intensity	High (75-85 %HR _{max})	low (40-50%HR _{max})
Time of training	Afternoon (4:30-5:15Pm).	Afternoon (4:30-6:00Pm).

In order to determine the heart rate of the students during exercise the karvonen method formula was used.

First maximal heart rate (HR_{max}) of the individual was calculated as follows;

$$HR_{max} = 220 - \text{age of the individual}$$

Then, THR = ((HR_{max} - HR_{rest}) × % intensity) + HR_{rest} (Oscan *et al.*,2011).

Sample Size and Sampling Technique

Simple random sampling was used up on the parameters set by the researcher based on prepared aerobic exercise readiness questionnaire (PARQ). The experimental groups were divided in to two i.e. short duration high intensity and long duration low intensity group. Both groups contain 10 male students.

Methods of Data Analysis

The data collected through fitness tests and laboratory tests were analyzed, interpreted and tabulated into meaningful idea using manually and software to compare the selected health related fitness components and hematological parameters changes observed in both groups. In this study it was carried out by the Descriptive Statistical Analysis Coded and analyzed in SPSS version 16.0 software. Calculating measures of central tendency like mean and calculating measures of dispersion like standard deviation, T-test, were used in this research.

Exercise Training Protocol

Selected subjects relatively within a range of equal number of age and BMI were assigned randomly into two groups; the first group was assigned in SDHI aerobic exercise and the other group was assigned in LDLI progressive aerobic exercise. The exercise training program was consists of aerobic exercise such as treadmill running, fitness walking, jumping rope, badminton, endurance, push up, step up, cycling, aerobic dance, running and etc. for both groups. But the intensity and duration of the exercise was different. (75-85% of maximum heart rate & 45 minutes for SDHI and 40-50% maximum heart rate & 1:30 hour for LDLI aerobic exercise group).

The weekly exercise program was conducted on Monday, Wednesday, and Friday at afternoon (5:00pm-5:45pm) for SDHI group and Tuesday, Thursday, and Saturday afternoon (4:30pm-6:00pm) for LDLI aerobic exercise group.

III. RESULTS AND DISCUSSIONS

3.1. Anthropometric Test Results and Discussion

Table 2. Mean Body weight (kg), Body height (m) and Body mass index (BMI kg/m²) for male beginner athletes of Haramaya University under short duration high intensity (SDHI) and long duration low intensity (LDLI) experimental groups.

	SDHI			LDLI		
	PT	DT	PoT	PT	DT	PoT
BW	62.8 ± 3.22	63.5 ± 3.37	64.75 ± 3.26	62.85 ± 2.88	63.35 ± 2.88	63.35 ± 2.86
BH	1.77 ± 0.07	1.77 ± 0.07	1.77 ± 0.07	1.75 ± 0.05	1.75 ± 0.05	1.75 ± 0.05
BMI	20.01 ± 1.14	20.25 ± 1.33	20.67 ± 1.56	20.37 ± 1.31	20.54 ± 1.29	20.55 ± 1.35

Values are mean ± SD, SDHI= short duration high intensity, LDLI= long duration low intensity, PT= pre training test, DT= during training test, PoT= post training test, BW= body weight, BH= body height, BMI= body mass index.

Table two showed that the body weight and body mass index changed both in SDHI and LDLI experimental groups. The mean difference showed that there was an improvement in body weight in both groups even though the improvement shown in LDLI was insignificant. This was due to progressive aerobic exercise they were participated in. The SDHI improved body weight by 1.95 and the LDLI improved by 0.5 mean values.

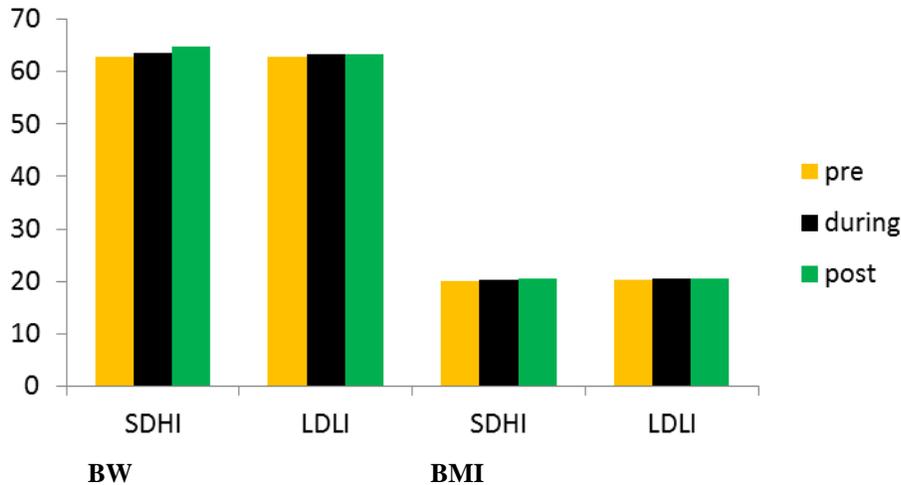
Therefore, according to this data there is a greater change in the SDHI than LDLI group.

The mean value of body mass index (BMI) was increased from pre training test to post training test in both groups and more significant change was distinguished in the SDHI group. The mean value of SDHI group before training was 20.01 and improved to 20.67 after the training program while the LDLI was

20.37 before training and increased to 20.55 after the training program. After the training program, the SDHI was exhibited an improvement of 0.66 mean values however, the LDLI was

improved by 0.18 of mean values. This result indicates that the SDHI training program was better than the LDLI training program.

Figure 1. Comparison of mean Body weight (kg), Body height (m) and BMI (kg/m²) at PT, DT and PoT for male beginner athletes' of Haramaya University under SDHI and LDLI experimental groups.



SDHI= short duration high intensity LDLI= long duration low intensity, BW= body weight BMI= body mass index

3.2. Performance Variables Test Results and Discussion.

Table 2. Mean values of Step test (bpm) Push up and Sit & reach (cm) for 20 male beginner athletes of Haramaya University students under SDHI and LDLI experimental groups.

	SDHI			LDLI		
	PT	DT	PoT	PT	DT	PoT
ST	42.49 ± 2.88	46.14 ± 2.47	47.15 ± 2.94	43.45 ± 3.08	44.97 ± 3.38	46.14 ± 2.83
PU	4.60 ± 4.27	14.40 ± 5.66	17.40 ± 6.51	8.40 ± 3.97	11.60 ± 3.30	15.00 ± 4.64
SR	1.25 ± 1.11	4.40 ± 2.28	7.35 ± 1.78	1.05 ± 1.14	4.05 ± 1.18	5.75 ± 1.16

Note: SDHI = Short Duration High Intensity, LDLI = Long Duration Low Intensity, ST=step test, PU= push up, SR= sit & reach, PT = Pre Training, DT = During Training, Pot = Post Training and All Values are Mean ± SD.

The above table shows that ST changed in both experimental groups; i.e short duration high intensity and long duration low intensity. However, when we see the mean difference between the two groups, it indicated that in SDHI it was improved by 4.66 and in LDLI by 2.69. The greater improvement in the SDHI implies that short duration high intensity aerobic exercise improved cardiovascular endurance of male beginner athletes than LDLI program. This is due to the intensity of exercise, at high intensity exercise, the number of capillaries in trained skeletal muscle, thereby allowing a greater capacity for blood flow in the active muscle.

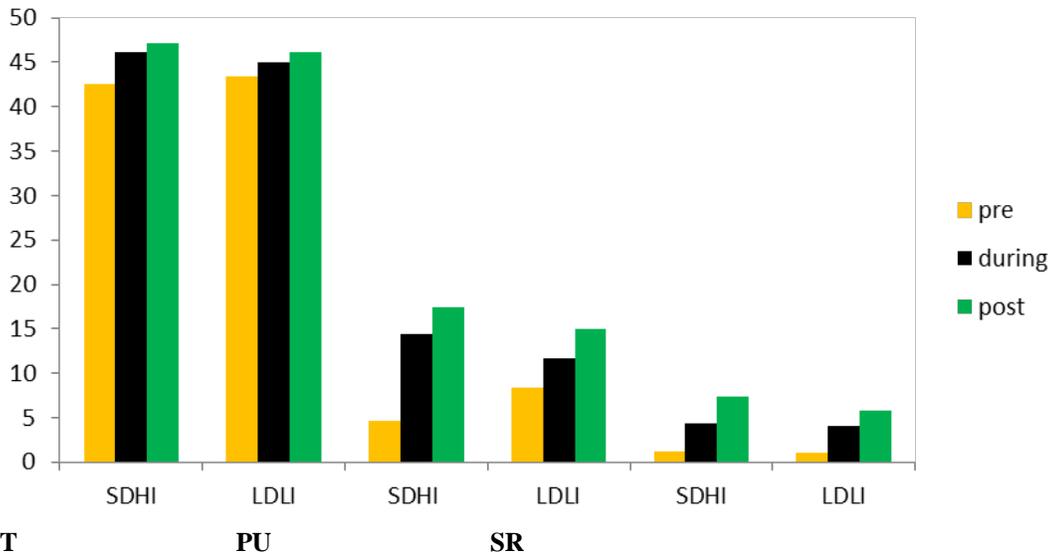
In the above push up results, the mean difference indicates that there was an improvement in both experimental groups. This is due to progressive aerobic exercise both groups were engaged in. As indicated in the above table the mean value of push up for SDHI before training was 4.60 and this result was improved to

17.40 after training program while the result of LDLI was 8.40 before training and improved to 15.00 after training. When we come to compare which exercise program had brought significant change, the mean difference of SDHI and LDLI groups were 12.8 and 6.60 respectively. Therefore, the difference in between the mean was much more in case of SDHI than the LDLI group.

There was a significant mean difference in the sit and reach tests between the SDHI and LDLI groups (table 3). Compared to LDLI group, SDHI had a better mean increment in sit and reach test during the study. As indicated in table 3, the mean value of sit and reach for SDHI was 1.25 before training and 7.35 after training and the mean value of LDLI was 1.05 before training and 5.75 after training. Then, at the end of the study period, the mean of SDHI group was increased by 6.1 however the mean of LDLI was increased by 4.7. In both experimental groups the results indicates that both SDHI and LDLI improved sit and

reach performance but, there is a greater improvement in SDHI than LDLI training program.

Figure 1. Comparison of Step test, Push up and Sit & reach at PT, DT and PoT for male beginner athletes of Haramaya University under SDHI and LDLI experimental groups.



SDHI=short duration high intensity, LDLI= long duration low intensity, ST=step test, PU= push up, SR= sit and reach.

3.3. Hematological Test Results and Discussion.

Table 3. Mean values of white blood cell (μl), red blood cell (μl), hemoglobin (g/dl) and platelets (μl) for 20 male beginner athletes of Haramaya University under SDHI and LDLI experimental groups.

	SDHI			LDLI		
	PT	DT	PoT	PT	DT	PoT
WBC	5.86±1.44	6.24±1.49	6.69±1.38	6.63±1.70	6.70±1.99	6.89±1.77
RBC	4.51±0.29	4.88±0.14	5.34±0.13	4.59±0.34	4.73±0.32	4.84±0.29
HB	15.37±0.93	15.72±0.82	16.4±0.65	16.05±0.77	16.18±0.75	16.2±0.97
PLT	263.3±55.4	277.7±51.6	308.8±51.7	297±55.4	304.4±55.8	312.9±57.4

Values are mean \pm SD, SDHI= short duration high intensity, LDLI= long duration low intensity, PT= pre training test, DT= during training test, PoT= post training test, WBC= white blood cell, RBC= red blood cell, HB= hemoglobin, PLT= platelets.

Table 4 indicates that the mean value of white blood cell (WBC) of the selected subjects were increased in the test after progressive aerobic exercise than the test before engaging in training in both short duration high intensity and long duration low intensity. The mean value of WBC for SDHI group before training was $5.86 \times 10^3 \mu\text{l}$ and $6.69 \times 10^3 \mu\text{l}$ after training. Here, the SDHI improved by 0.83 mean values, while the mean value of WBC for LDLI was $6.63 \times 10^3 \mu\text{l}$ and $6.89 \times 10^3 \mu\text{l}$ before and after training respectively. Therefore, the mean difference value of 0.26 improvements was shown in LDLI. Based on the mean difference value, the greater improvement and significant change was shown in SDHI than LDLI group. The more stress leukocyte, accompanies the exercise, the more the leukocyte increases. Especially in intense exercises, this increase is more obvious.

As indicated in table 4 the mean value of RBC distribution of SDHI group of the subjects before training was $4.51 \times 10^6 \mu\text{l}$

and after they engaged in progressive aerobic exercise, the mean value of RBC of this group was increased to $5.34 \times 10^6 \mu\text{l}$. At the end of the study period, totally the mean value of RBC of this group was improved by 0.83. Statically highly significant mean difference have been observed in SDHI group. The mean value of RBC for LDLI group before training was $4.59 \times 10^6 \mu\text{l}$ and this mean value of RBC was increased to $4.84 \times 10^6 \mu\text{l}$ after progressive aerobic training. The mean difference value of RBC for LDLI group was improved by 0.25. When we compare which training program was better, the SDHI group has shown a greater improvement than LDLI group.

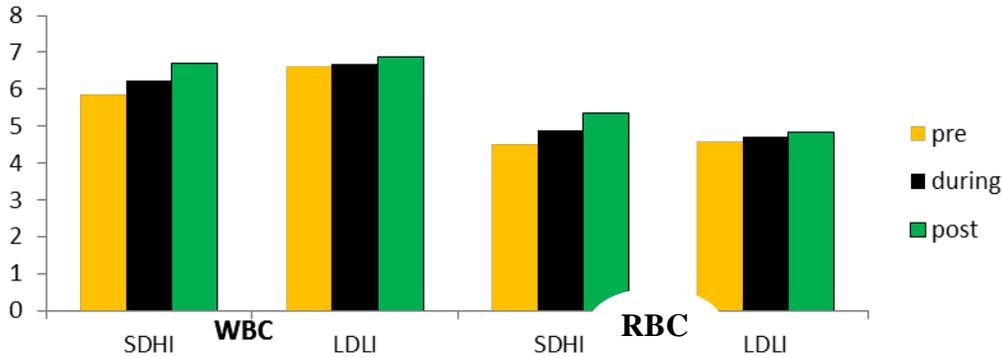
In Hemoglobin (HB) test, the mean value of both short duration high intensity and long duration low intensity group was increased. The mean difference showed that there was a better improvement in the SDHI group. The mean value of SDHI was increased from 15.37 g/dl to 16.40 g/dl and showed an improvement of 1.03 g/dl. On the other hand, the LDLI group

was increased from 16.05 g/dl to 16.20 g/dl. The mean difference for this group was improved by 0.15 g/dl even though the result was insignificant. It might be possible to conclude that the short duration high intensity of progressive aerobic exercise has positive effects on the amount of hemoglobin.

The mean value of platelet count was increased both in SDHI and LDLI. The reason was the progressive aerobic exercise program they were engaged in. The SDHI group had

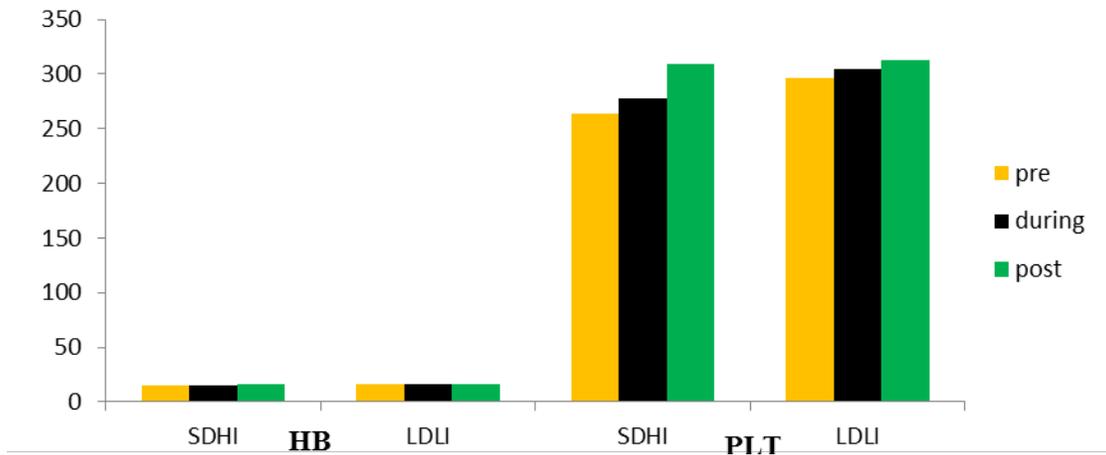
increased from $263.3 \times 10^3 \mu\text{l}$ to $308.8 \times 10^3 \mu\text{l}$. The mean difference of platelets count for SDHI was improved by $45.5 \mu\text{l}$. On the other hand, the mean value of platelets count for LDLI increased from $297 \times 10^3 \mu\text{l}$ to $312.9 \times 10^3 \mu\text{l}$. The mean difference of $15.9 \mu\text{l}$ was recorded in the LDLI group. However, when we compare both groups; the SDHI group brought a significant improvement in the amount of platelets than the LDLI group.

Figure 2. Comparison of WBC and RBC of PT, DT and PoT values for male beginner athletes of Haramaya University under SDHI and LDLI experimental group



SDHI= short duration high intensity, LDLI= long duration low intensity, WBC= white blood cell RBC= red blood cell.

Figure 3. Comparison of Hemoglobin (HB) and Platelets (PLT) of PT, DT and PoT of male beginner athletes of Haramaya University under SDHI and LDLI experimental groups.



SDHI= short duration high intensity, LDLI= long duration low intensity, HB= hemoglobin, PLT= platelets.

IV. CONCLUSIONS

With the possible limitation of the study, the following conclusions were made.

- Short duration high intensity training program was found to be better than long duration low intensity training program in improving cardiovascular endurance of the participants.
- Short duration high intensity training program was improved muscular endurance more than long duration low intensity training program of the study participants.

- Both short duration high intensity and long duration low intensity training program improved flexibility and body composition of the study participants.
- Short duration high intensity training program was better than long duration low intensity training program in improving the number of white blood cells, red blood cells, platelets and the amount of hemoglobin.

- Both, short duration high intensity and long duration low intensity progressive aerobic exercise programs had shown significant change ($p \leq 0.05$) in improving the selected variables of health related fitness components and hematological parameters except BMI, hemoglobin and platelets under LDLI in which they showed insignificant.

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