Original Article

COMPARISION OF ENERGY EXPENDITURE DURING WALKING AND RUNNING ON TRACK BEFORE AND AFTER TRAINING IN YOUNG HEALTHY ADULT WOMEN

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ABSTRACT

Aim: The purpose of this study was to evaluate the energy expenditure in healthy women before training and after training during the walking and running. **Materials and Methods:** Forty healthy women were taken as the subjects and energy expenditure was calculated before and after training during walking and running. In this study a 1600 metres (1 mile) track measured using PVC reel tape was used for walking and running. **Results:** The examination of parameters, body mass index, heart rate, energy expenditure and statistical analysis was estimated for all subjects. The data were analysed by using descriptive and inferential statistics. **Discussion:** The findings suggested a significance decrease in heart rate and blood pressure and energy expenditure in women after training as compared to before training for both during walking and running. **Conclusion:** Study for the both during walking and running shows that energy expenditure was higher compared to walking for the same distance. The energy expenditure is high in before training group compared to after training. The heart rate of the untrained subjects was also increased when compared with after training.

KEYWORDS: Energy expenditure; Heart rate, Body mass index.

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INTRODUCTION

According to principles of physics to move a specific mass a specific distance a given amount of energy is needed. Energy is an indirectly observed quantity in biology. Energy is attributed to all biological systems from the biosphere to the smallest living organism. Energy is measured in the form of calories. Humans oxidize carbohydrates, proteins, fat to produce energy. The energy is needed to maintain body functions; to breath, to keep heart beating, to keep the body warm for physical activity and for growth and repair.[1]

Energy expenditure is measured to find out the amount of energy spent by the individual.

For every physical activity, the body requires energy and the amount depends on the duration and type of activity. Energy expenditure varies from person to person. The energy cost of locomotion depends largely on body size, gait and speed.[2]

It has been suggested that energy cost of walking and running increases progressively with the speed of the movement. Differences in energy cost between walking and running have been also demonstrated [3]. Walking has been classically described as the inverted pendulum, while running has been described as the bouncing ball. [4,5]

Many investigations were done and are in progress to calculate the energy expenditure in various works. Previous works on quadrupeds has found the amount of energy used to run a mile is nearly the same whether it is run at high speed whereas studies on humans have shown that humans tend to expend more energy during running than that of walking. [6, 7]

The American college of sports medicine. Research articles provided formulae to calculate energy expenditure for both running and walking based on oxygen consumption [8, 9, 10, 11]. Cameron hall, Arturo Figueroa, Bofern hall and Jill A. Kanaley, Department of exercise science, Syracuse University, NY, also calculated the energy expenditure by using prediction equations. They found out that energy expenditure during running is more than walking.[12]

The primary purpose of this study is to calculate and compare the energy expenditure during walking and running without using maximal O_2 consumption. Before and after training it was hypothesized that running 1600 metres would result in greater energy expenditure than walking.

MATERIALS AND METHODS

Each subject was asked to walk on the 1600 mile track after which a 20 minutes rest was given. The subject was then asked to run on the same 1600 mile track. O_2 heart rate and energy expenditure were calculated using the formula:

Energy expenditure = [age x 0.2017] – [wt (lbs) x 0.09036] + HR x 0.6309 -55.0969 x time / 4.184

The same subject were then given physical training which involved walking and running for 30 minutes duration daily for 1 month and then energy expenditure was calculated both during walking and running using the above formula results were analysed.

Inclusion criteria: Healthy subjects of age group 18 – 24 were included, Subjects should be recreationally active, Subjects should be free of cardiovascular and respiratory disorders, Subjects should be able to walk or run distance of 1600 metres before training and after training.

Exclusion criteria:

Subjects having orthopaedic limitation, smoking history, hypertension, cardiovascular and respiratory disorder, medications affecting metabolisms are excluded.

Instruments: 1600 m (1 mile) track measured by using open PVC reel tape. Manual sphygmomanometer and stethoscope are used to measure the blood pressure and heart rate manually.

Examination of parameters: Which includes: Body mass index (Height and Weight)**,** Heart rate**,** Energy expenditure**,** Statistical analysis.

RESULTS

The results showed increased energy expenditure during running than during walking both before and after training. But the increase in energy expenditure during running was less after training when compared to that of before training. Also it was found that there was a significant decrease in hear rate, and energy expenditure in subjects after training when compared to before training both during walking and running.

	ENERGY EXPENDITURE ON			
	BEFORE TRAINING		AFTER TRAINING	
	MEAN	SD	MEAN	SD
WALKING	146.06	48.14	47.37	34.11
RUNNING	185.53	40.47	72.79	36.47

Table 1: Comparison of energy expenditure during walking and running on track before and after training.

	HEART RATE (BEATS/MIN)			
	BEFORE TRAINING		AFTER TRAINING	
	MEAN	SD	MEAN	SD
WALKING	126.2	11.45	106.58	11.17
RUNNING	169.25	12.45	127.93	13.25

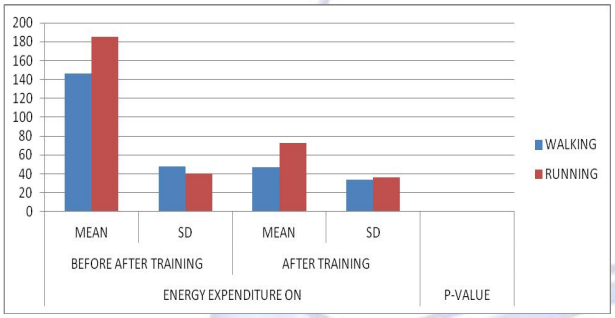
Table 2: Comparison of resting heart rate during walking and running on track before and after training.

	HEART RATE (BEATS/MIN)			
	BEFORE TRAINING		AFTER TRAINING	
	MEAN	SD	MEAN	SD
RESTING HEART RATE	78.1	9.78	68.18	7.28
WALKING	126.2	11.45	106.58	11.17

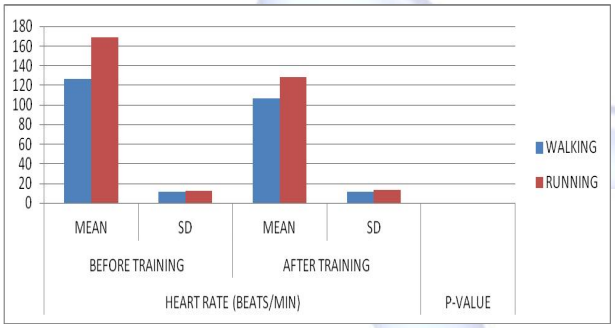
Table 3: Comparison of resting heart rate vs walking on track before and after training.

	HEART RATE (BEATS/MIN)			
	BEFORE TRAINING		AFTER TRAINING	
	MEAN	SD	MEAN	SD
RESTING HEART RATE	78.1	9.78	68.18	7.28
RUNNING	169.25	12.46	127.93	13.25

Table 4: comparison of resting heart rate vs running on track before training and after training.



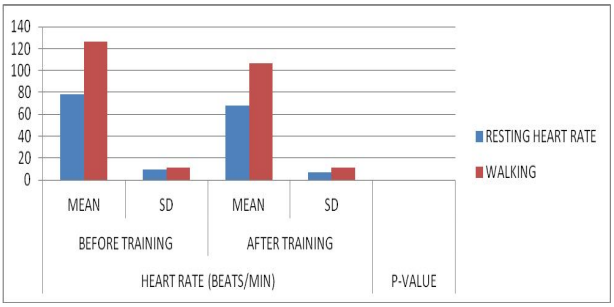
Graph 1: showing that energy expenditure during running is more than that during before and after training also the energy expenditure both during running and walking decreases after training when compared to before training. The mean values of running is significantly increased when compared to walking after training in running also the energy expenditure significantly increased when compared to walking



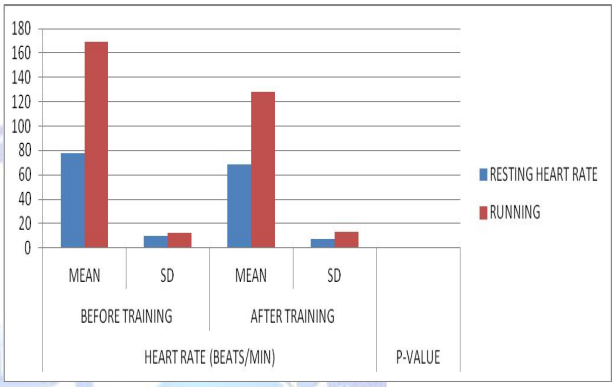
Graph 2: Showing the heart rate during walking and running before and after training. before training the running heart rate was significantly increased when compared to walking after training in running the energy expenditure was significantly increased when compared to walking.

DISCUSSION

The energy balance involves measurement of the intake and the output of energy in its various forms. The intake of energy is in the form of food and oxygen, as by the reaction of these two inside the body energy is liberated. The output of the energy is by the loss of heat to the environment. [13, 14, 15]



Graph 3: Showing the difference between resting heart rate, running heart rate before training, after training and Heart rate was significantly increased.



Graph 4: Showing the mean values between resting and running heart rate before training. Mean values are significantly increased in running for before training as well as after training.

Energy cost of level walking and running in humans have been extensively investigated. Energy cost of running is also affected by the foot landing patterns which allow a different efficiency of leg muscles and tendons and increases when muscles are fatigued. [16, 17]

Researcherss had illustrated that energy composition during locomotion increases in proportion to the horizontal impending force and energy expenditure. Pugh et.al. found that energy cost for both walking and running increased with the impending horizontal wind force [18]. Similarly, Bijker etal,, Cooke etal,, and Hoyd and Zacks found that for running against a horizontal force applied with a harness, energy consumption increased proportionally [4,19]. Chang and Kram utilized a similar method but also studied aiding forces during normal running. Recent indications suggested exercise to be equally beneficial to cardiovascular health as continuous exercise. [20]

In 2003, walker etal.; 1999 have demonstrated a higher energetic cost during running. [21]

In the case of track the space varies from person to person. Energy expenditure during walking on track is 3.39±0.47 J. The energy expenditure during running on track is 185.33±40.47 J and the speed is 6.20±1.11 kmph. After training the energy expenditure during walking on tracks 47.37±34.11 J and the speed is 3.86±0.59 kmph. The energy expenditure during running on track 72.79±36.47J and the speed is 6.82±0.87 kmph. [22, 23]

The variations in energy expenditure on track before and after training were significant. Comparison of these mean values of resting heart rate with heart rate during walking and running on track before and after training shows more significance [2]**.** Before training, the heart rate during walking and running involves muscular activity activates sympathetic nerve that pass impulses to vasoconstrictor area which acts as a "cardio acceleratory centre" situated in the reticular formation of medulla in the floor of 4th ventricle.

After train heart rate creates an imbalance between the tonic activity of sympathetic accelerator and parasympathetic depressor. Neuron in favour of greater vagal dominance a response is mediated primarily by increased parasympathetic activity and small decrease in sympathetic discharge. Training also decreases the intrinsic firing rate of sinoatrial node (pace maker). [20]

CONCLUSION

The study shows that running has higher energy expenditure compared to that walking the same distance. The energy expenditure is high in before training group compared to after training in the same group. The heart rate of the untrained subjects was also increased when compared with after training.

Conflict of interest: None

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