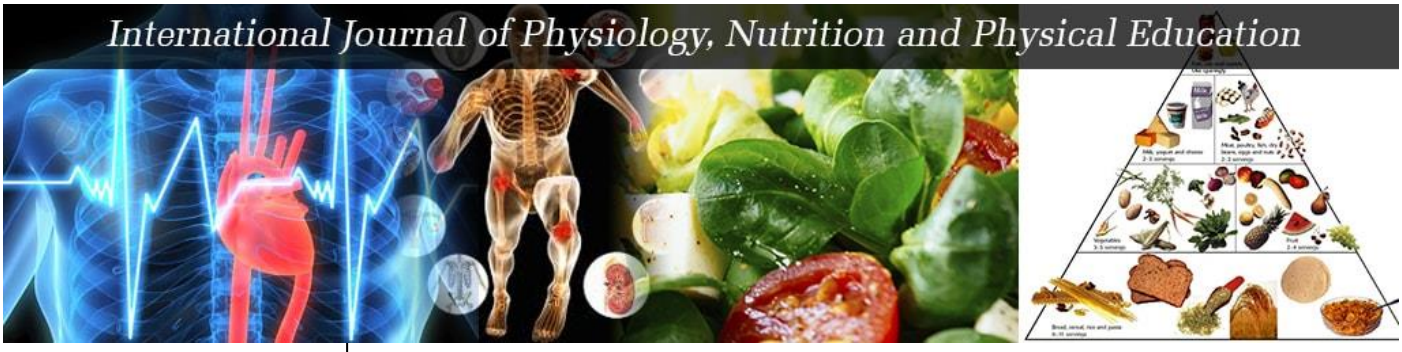

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Target training zone and load recovery ratio for enhancement of endurance

Anil K Vanaik and Rahul Vashishtha

Abstract
The purpose of the study was to workout target training zones and load recovery ratio for intermediate level sports persons for optimum development of endurance. Ten intermediate level endurance runners studying in Indira Gandhi Institute of Physical Education and Sports Science, Vikaspuri, New Delhi served as subjects for the present study. The age of the subjects ranged between18-23 years. They were under training at the Institute for the past 2 to 3 years. Dr. M. Karvonen method was used to calculate the target loads for each athlete separately. In order to work out recovery, the method suggested by Uppal was adopted.

Keywords: Target training zone, load–recovery ratio

Introduction
Sports training is an individual process and in order to be effective the training loads shall be administered to the sportsperson based on their special characteristics namely age, training age, load taking capacity, ability to recover, training state, talent and psychological factors like personality, intelligence and temperament. In the light of this principle it is important on the part of the coach to separately workout training loads for each of his sportsperson. If the above principles were not adhered to, training load in terms to stimulus intensity would either be too low or too high for the sportsperson thus not providing him benefit in terms of effort put in by the sportsperson.
Target training is the heart rate to be enhanced from the normal value, as a result of administration of training load, so as to ensure that the exercise under taken produces maximum training effect on the sportsperson. It is important to also calculate the duration of recovery period so that there will be correct proportion between load and recovery. This will ensure maximum enhancement of performance.
The ACSM currently has three different sets of exercise prescription standards, and these are compared in Table 1. Notice that when the development of endurance is the objective, the intensity of training should range between 50-85 percent of VO_{2max}or 60-90 percent of maximum heart rate. These three sets of standards complement each other, with practitioners urged to adapt recommendations in accordance with the goals and unique characteristics of the individual.

Table 1: American college of sports medicine exercise prescription recommendations of endurance training

Recommendation	Intensity (%VO_{2max})	Duration (Minutes)	Frequency (Days/week)	Purpose
ACSM, 1990	50-85%	20-60	3-5	Develop, maintain fitness, body composition
ACSM, 1991	40-85%	15-60	3-5	Designed to encompass activity that may enhance health without having a major impact on fitness.
ACSM, 1993	Moderate	30 or more	Near daily	Developed to emphasize the important health benefits of moderate physical activity.

The objective of aerobic training is to improve the capacity of the cardiovascular system. To better understand how the cardiovascular system is developed, the four basic principles that govern this development are intensity, mode, duration, and frequency of exercise.

Thomas *et al*. (1984) [8], conducted a research study in order to compare the effects of continuous running and interval training on physiological adaptations. Untrained male and female subjects were randomly assigned to four groups i.e. three experimental and a control group. The groups were: 1) running continuously at 75% HR max for four miles; 2) running continuously at 75% HR max for two miles; 3) eventually running eight one minute intervals at 90% HR max with three minute recovery intervals; and 4) no exercise control. The subjects for the study were 24 males and 35 females. Training sessions were performed three times per week for a period of 12 weeks. The analysis of data revealed that the interval training group improved significantly more than the control group in Vo2max. The training effect in both the genders was identical, although values differed between them.

In a research study Helgerud *et al*. (2001) [4] ascertained the influence of aerobic endurance training on soccer performance. High performance junior male soccer players were classified into one experimental group (N = 9) that was administered additional interval training as a stimulus for improving aerobic function The training was carried out for a period of eight weeks and a control group that trained normally. The interval training comprised of running 4 x 4-min at 90-95% HR max with a 3-min group between-repetition recovery and jog. The analysis of data revealed that the interval group was the only group that improved aerobic function. The improvement of VO2max was10.7% and lactate threshold was 15.9%. Running economy of the subjects improved by 6.7%; distance which the subjects covered in a match increased by 20%; and work level (measured by HR) improved by 3.5%. The study concluded that the introduction of interval training in a season of endurance-based sport will enhance the performance characteristics of Soccer players during competitions.

Ten intermediate level endurance runners, studying in Indira Gandhi Institute of Physical Education and Sports Science, Vikaspuri, New Delhi served as subjects for the present study. The age of the subjects ranged between 18-23 years. They were under training at the Institute for the past 2 to 3 years.

Preparation of target training zones for endurance development

There are numerous methods of calculating the target training heart rate. The first method used by researchers was to plot the slope of the line between an individual's exercise heart rates and the exercise workload in METS or VO_2. From this relationship, the exercise heart rate pertaining to a given percent of VO_{2max} can be obtained. The second method for determining the exercise heart rate for training is to calculate a given percentage of the maximum heart rate (MHR). However, this method is not the same as using the heart rate reserve or VO_{2max}; and will result in an underestimation of the training heart rate unless an upward adjustment is made. American College of Sports Medicine (ACSM) recommends that 60-90 percent of maximum heart rate gives training heart rate similar to 50-85 percent of heart rate reserve or VO_{2max}. The third method for determining training heart rate was developed by Dr. M. Karvonen of Scandinavia. The Karvonen Formula attempts to calculate the training heart rate using a percentage of the "heart rate reserve", which is the difference between the maximum and resting heart rates.

Preparation of target training zones for endurance development

The interval running method stipulates that the performer should be administered an intensity of 70% to 80% (sub-maximum intensity) of once best performance over the chosen distance. In as much as the subjects chosen for the study were intermediate level sports persons, an intensity of 70% was selected. The best time of the subject in 200m run was considered as 100%. Based on 200m run performance 70% stimulus intensity was computed for each subject. Karvonen Formula was used to work our Target Training Zones separately for each subject. In order to work out recovery, the procedure suggested by Uppal (2001) [7, 9] was adopted. The steps used for calculation of Target Training Zone and load recovery ratio were as follows

1. Best time for running 200m was recorded for each subject. This time was considered as 100%
2. 70% of that was calculated as the intensity of load separately for each subject adopting the procedure suggested by Kanvonen.
3. For working out the phase of recovery, the first load was administered at normal heart rate of the subject.
4. The remaining loads were given when the heart rate during recovery phase came down to 110 to 120.

The sub–maximum intensity worked out for each subject is given in Table 2.

Table 2: Stimulus intensity (Sub-maximum i.e. 70%) of the subjects based on 200m run performance

S. No.	Name	Intensity (Sec)
1.	Monu	38.31
2.	Vishvender	38.72
3.	Ayush	36.38
4.	Shoyeb Akhter	37.81
5.	Arun Sah	38.49
6.	Ram Kumar Yadav	37.25
7.	Gaurav Aggarwal	34.81
8.	Sudhir Yadav	39.20
9.	Pappu Yadav	36.52
10.	Lakshay	37.04

Calculation of stimulus density

Literature on science of sports training reveals that a stimulus intensity of 70% (sub-maximum load) increases the pulse rate of the performer from the normal value to between 170 to 180 beats per minute. As soon as the subject completed 200m run, the pulse of the subject was felt at the carotid artery and with the help of stopwatch the recovery time was recorded during which the pulse rate came down from 170-180 beats to 110 beats per minute. This elapsed time was recorded as the duration of recovery between two bouts of loads using interval-running method. The duration of recovery between bouts of loads is given in Table 3.

Table 3: Stimulus density (Recovery) between two bouts of 200m runs

S. No.	Name	Stimulus density (Sec)
1	Monu	95
2	Vishvender	90
3	Ayush	100
4	Shoyeb Akhter	100
5	Arun Sah	95
6	Ram Kumar Yadav	100
7	Gaurav Aggarwal	95
8	Sudhir Yadav	120
9	Pappu Yadav	105
10	Lakshay	115

Calculation of number of repetitions

Keeping in mind the principle of individual load, the number of repetitions of the selected distance i.e. 200m was worked out by the scholar keeping and mind the fitness level of the subject, in consultation with the guide as well as based on the personal experience. The number of repetitions worked out is given in Table 4.

Table 4: Number of repetitions

S. No.	Name	Repetitions (Number)
1	Monu	06
2	Vishvender	06
3	Ayush	08
4	Shoyeb Akhter	06
5	Arun Sah	06
6	Ram Kumar Yadav	08
7	Gaurav Aggarwal	08
8	Sudhir Yadav	06
9	Pappu Yadav	08
10	Lakshay	08

Conclusion

Taking help of targets worked out for training load, number of repetitions as well as duration of recovery in the above three tables, the endurance training of the subjects can be done in order to ascertain optimum development of this important component.

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