10.48047/jocaaa.2024.33.02.52

INVESTIGATION OF MAXIMUM OXYGEN CONSUMPTION ALTERATION DURING PREPARATORY PERIOD OF TRAINING AMONG HANDBALL PLAYERS

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ABSTRACT

The aim of this study was to investigate the alteration in maximum oxygen consumption during preparatory period of training among Handball Players. The present study was confined to randomly select 30 college Handball players from affiliated to *Andhra Kesari University, Ongole, Andhra Pradesh* State. The age group of the subjects were between 19-25 years with standard deviation $\pm$ 2.15. The physiological variable maximum oxygen consumption was selected as dependent variable for this study. In the present study, preparatory training of the Handball Players 12 weeks ahead of scheduled competitions was considered and the training session was further divided into three phases, namely, phase I (I to IV weeks), phase II (V to VIII weeks) and phase III (IX to XII weeks) are considered as independent variables. This research adapted "Repeated Measures Research" method to compare maximum oxygen consumption after each phase of preparatory training and the effect of each phase of preparatory training was compared with the initial scores of the subjects. Data on maximum oxygen consumption was collected at initial and at the end of three phases of preparatory training. The collected data were subjected to statistical treatment using repeated measures of Analysis of Variance. In all cases 0.05 level was fixed to test the hypothesis of this study.

Keywords: *Maximum oxygen consumption, Preparatory period, Handball Players*

INTRODUCTION

Sports training program phases revolve around peaking for major competitions phases generally progress as follows: The first of the phases of training prepares the athlete for more intensive weight training with heavier weight loads. It is referred to as the conditioning phase, the hypertrophy phase, or the starter phase. Fitness training programs typically advance to a more intensive training phase where weight loads are consistently increased until fitness training goals are met under intensive training phase. Then the athlete performs a maintenance or in-season phase in which the athlete stabilize the level of performance which enables for major competition at the right time. The off season phase permits for an active rest so that the athlete can gain recovery in preparation for the next season phase.

The purpose of a Training Plan is to identify the work to be carried out to achieve agreed objectives. Training Plans should be drawn up to identify long term objectives as well as short term plans for the forth coming season. This research is concentrating on the development of the

10.48047/jocaaa.2024.33.02.52

short-term Training Plan.

Periodization is a means of organizing and managing training to provide a greater likelihood of successful performance through year-on-year improvement and planned management of peak performance. Non-linear or undulating periodization is increasingly used but rather than an either/or situation, it is most effective when both linear and non-linear models are adopted within the same annual cycle. This is particularly true where a sport has a long, intense competition season and, in that period, non-linear periodization is, arguably, the only logical choice.

Achieving the correct taper has often been seen as the interface between coaching art and coaching science. Our constantly improving understanding of the efficacy of tapering is increasing the chances of optimal performance. However, much of our knowledge is still largely anecdotal and we look to the research literature to improve coach confidence and effectiveness. Where this is particularly true for periodization, recent research evidence provides a good guide for tapering. Namely, that a two-week exponential taper during which there is a 41-60% reduction in volume seems to result in the best performance improvements.

Based on the theoretical foundations laid by Zatsiorsky (1995), Boompa (1999), King (1999) and Mahler (2002), Mark Ginther (2002) explained that in a periodized training plan, the training period, from one competition to the next, (or macrocycle) is broken into manageable phases: preparatory, competitive, and transition, with the understanding that peak performance cannot be maintained throughout each stage. Recovery sections are built into the program and the timing of peaking is carefully planned. By having different phases with different goals and training protocol, specific attributes, such as power and endurance, that if trained for simultaneously would be mutually exclusive, can be achieved over a training period, while minimizing overtraining and the potential for injury.

To phase at the desired level of strength, (Fleck & Kraemer, 1996; Powers et al., 2006; Schmidt & Wrisberg, 2000) different phases of training progress from low intensity and high volume, to high intensity and low volume. In other words, do more repetitions with lighter weights early in training, and fewer repetitions with heavier weights later in training. Testing after each of the phases of training will help one make sound decisions for adjusting the training programme in subsequent phases. This is how one personalize the training programme to promote continuous improvement toward the goals. Thus, training programmes forms different phases. The different phases of training influence the blood circulation quickness, blood and lymph stream through the muscle, supply the cells with oxygen and nutrition removing waste products. The heart activity is accelerated exercise and strengthening its own fibers.

10.48047/jocaaa.2024.33.02.52

The investigator found very few attempts were made to find out the effect of preparatory period of training among Handball Players on physiological changes. Hence, a study to find out the effect of preparatory period of training on Vo_2max would be more beneficial to the players, especially among Handball Players.

METHODOLOGY

The present study was confined to randomly select 30 college Handball Players from affiliated to *Andhra Kesari University, Ongole, Andhra Pradesh* State. The age group of the subjects were between 19-25 years with standard deviation $\pm$ 2.15. The physiological variable maximum oxygen consumption was selected as dependent variable for this study.

Training Programme

In the present study, preparatory training of the Handball Players 12 weeks ahead of scheduled competitions was considered and the training session was further divided into three phases, namely, phase I (I to IV weeks), phase II (V to VIII weeks) and phase III (IX to XII weeks) are considered as independent variables.

Phase- I –Training: The training phase that is made to prepare for competition of any sport or game is considered as pre-season training. For the operational purpose of the study, the training a Handball Players gets for his all-round development of the four weeks prior to competition is considered as phase I training.

Phase- II –Training: The training phase II that is made during Vth week to VIIIth week prior to competition of any sport or game is considered as II phase training. For the operational purpose of the study, four weeks training a football player gets conditioning to maintain his fitness obtained through first phase and second phase through different conditioning to compete the game normally from start.

Phase -III –Training: The training III phase that is made after the second phase of training for the period IXth week to XIIth week prior to competition of any sport or game is considered as phase III training. For the operational purpose of the study, the third phase would be immediately before the competition and the training schedule conducted between ninth week to twelfth week the football player of four weeks after completing II phase training.

Statistical Technique

Data were collected at initial stage and on completion of three phases of training, namely, initial scores, initial, conditioning, phase (I to IV weeks), second phase (V to VIII weeks) and third

10.48047/jocaaa.2024.33.02.52

phase of training (IX to XII weeks) training. To analyse the data repeated ANOVA was computed. The level of significance was fixed at 0.05 level. When the F ratio was found to be significant, Scheffe's post hoc test was used to find out the paired mean significant difference. (Thirumalaisamy, 1998). Scheffe post hoc test has the greatest power and is the most conservation with respect to Type 1 error: this method leads to the smallest number of significance differences. In order to be significant, F' must equal (k – 1) ($F_{.05}$ or $F_{.01}$). Thus, the necessary F' ratios for the difference between paired adjusted mean (k-1 would be computed and compared for significance.

RESULT

In order to find out the changes during the preparatory training of Handball Players on physiological variable maximum oxygen consumption data were collected from the subjects at the time of starting preparatory training, (Initial scores); at the end of four weeks preparatory training (Phase I); at the end of eight weeks preparatory training (Phase II) and at the end of 12 weeks preparatory training (Phase III). The obtained data were subjected to statistical treatment using repeated ANOVA. The analysis of data through statistical tools descriptive statistics, mean, standard deviation, minimum and maximum on Maximum oxygen consumption is presented in Table-1.

Table-1: Descriptive Statistics, Mean, Standard Deviation and Range on Physiological Variable VO2 max at Different Phases of Preparatory Training of Handball Players

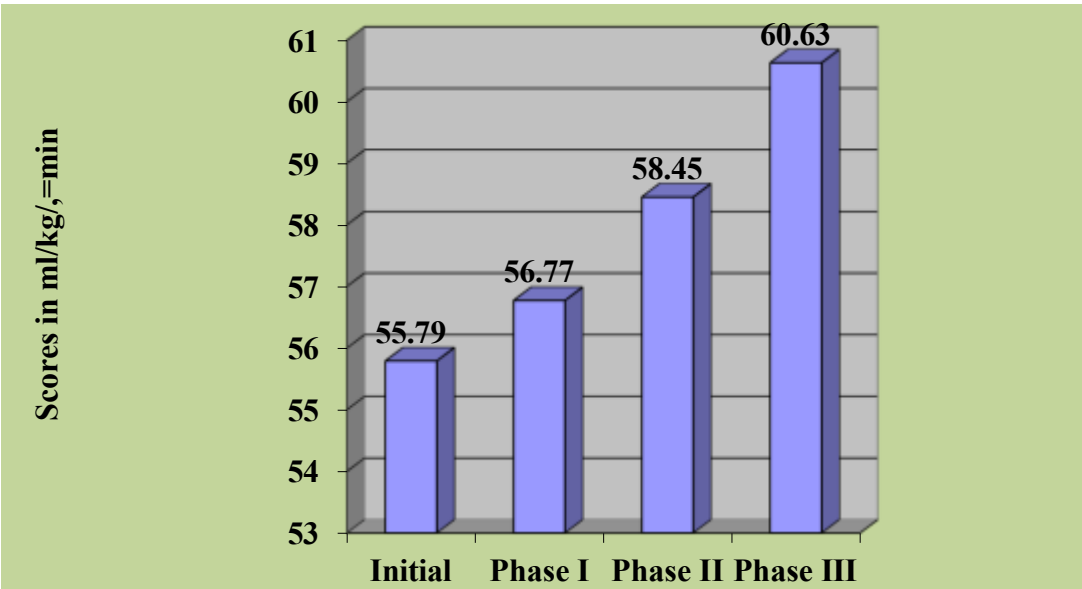
Different Phases	N	Mean	Standard Deviation	Range	
				Min	Max
Initial	30	55.79	3.30	48.50	60.78
Phase I	30	56.77	4.51	49.89	69.00
Phase II	30	58.45	4.43	51.50	70.31
Phase III	60	60.63	2.57	56.31	65.20

The results presented in Table-1 proved that the initial mean values on VO2 max was 55.79 with standard deviation $\pm$3.30. After completion of Phase I the mean value was 56.77 with standard deviation $\pm$4.51. After completion of phase II the mean value was 58.45 with standard deviation $\pm$4.43.The mean value after completion of Phase III was 60.63 with standard deviation 2.57.

The obtained means were graphically presented through bar diagram in Figure IX for better understanding of the results.

10.48047/jocaaa.2024.33.02.52

Figure-1: Mean Values of Different Phases of Preparatory Training on VO2 max among Handball Players



Since there were differences in means among different phases of preparatory training, to test statistical significance repeated measures of ANOVA was used and results presented in Table-2.

Table-2: Repeated Measures of ANOVA Results on Physiological Variable VO2 max among Handball Players

Source of Variance	Sum of Squares	Df	Mean Squares	Obtained 'F' Ratio
Subjects	517.11	29		8.00*
Trials	404.74	3	134.91	
Residuals	1957.44	116	16.87	
Total	2069.81	119		

Table F-ratio at 0.05 level of confidence for 3 and 119 (df) =2.43 .
**Significant at 0.05 level*

The obtained F value 8.00 was greater than the required F value of 2.43 to be significant at 0.05 level. As the obtained F value was greater than the required table F value, it was found that there was significant difference among different phases of preparatory training on physiological variable VO2 max of Handball Players.

Since significant F value was obtained, the results were further subjected to statistical treatment using Scheffe's confidence interval test and the results presented in Table-3.

10.48047/jocaaa.2024.33.02.52

Table-3: Multiple Comparisons of Paired Means among varied phases of preparatory training on physiological variable VO2 max

Initial	Phase I	Phase II	Phase III	MD	Required C I
55.79	56.77			-0.98	2.88
55.79		58.45		-2.66	2.88
55.79			60.63	-4.84*	2.88
	56.77	58.45		-1.68	2.88
	56.77		60.63	-3.86*	2.88
		58.45	60.63	-2.18	2.88

Reqd CI : Confidence Interval
** Significant*

The following paired mean comparisons were significant as the obtained mean differences were greater than the required confidence 2.88

Initial Vs Phase III (MD: -4.84)

Phase I Vs Phase III (MD: -3.86)

The following paired mean comparisons were significant as the obtained mean differences were greater than the required confidence 2.88.

Initial Vs Phase I (MD: -0.98)

Initial Vs Phase II (MD: -2.66)

Phase I Vs Phase II (MD: -1.68)

Phase II Vs Phase III (MD: -2.18)

DISCUSSION

Descriptive statistics, mean standard deviation, range consists of minimum and maximum of initial scores, completion of phase-I preparatory training, phase-II of preparatory training and phase-III of preparatory training on physiological variable was obtained and presented in Table-2 on maximum oxygen consumption proved that there exists differences due to different phased of training on physiological variable maximum oxygen consumption of Handball Players.

To test statistical significance of the differences, obtained data were subjected to statistical treatment using Repeated ANOVA and the results presented in Table-3 on maximum oxygen consumption. The obtained F values 15.02 was significant as the obtained 'F' values were greater than required table value to be significant.

Since significant F values were obtained, the obtained results were further subjected to post hoc analysis using Scheffe's confidence interval. The results presented in Table-3, showed comparing to initial scores maximum oxygen consumption significantly changed on completion of II and III phases of preparatory training compared to initial levels. Thus, the overall findings of

10.48047/jocaaa.2024.33.02.52

this study showed that physiological variable, maximum oxygen consumption significantly changed due to preparatory training among Handball Players compared to their initial levels.

The findings of this study were in agreement with the studies of Garcia-Pallares et al., (2010) compared training-induced changes in selected physiological, body composition and performance variables following two training periodization models: traditional (TP) versus block periodization (BP). Both TP and BP cycles resulted in similar gains in VO (2peak) (11 and 8.1%) and VO(2) VT2 (9.8 and 9.4%), Breil et al., (2010) investigated the effect of block training periodization on maximal oxygen consumption (VO2max) and parameters of exercise performance in elite junior alpine skiers. block periodization of HIT offers a promising way to efficiently improve VO2max and performance. Luca Filipas et al., (2022) investigated the effects of four different training periodization's, based on two different training intensity distributions during a 16-week training block in well-trained endurance runners. Each intervention effectively improved VO2 max, endurance surrogates and performance in well- trained endurance runners.

CONCLUSION

It was concluded that 12 weeks preparatory training, divided into three phases of training, each consisting of 4 weeks, significantly changed physiological variable, VO2max on completion of III phase of training compared to initial scores of the Handball Players. It was further recommended that Handball Players should be aware of the varied influences on their physiological benefits in preparatory training.

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