

Effect of High Intensity Low Volume and High Intensity Moderate Volume Tapering Training on Mood Disturbance

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Abstract

Objective- The researchers aimed to investigate the effect of high intensity low volume and high intensity moderate volume tapering strategies on psychological traits in endurance athletes.

Methodology- Thirty-seven young endurance athletes (mean age: 20 ± 1.97 years; mean training period: 2.43 ± 0.603 years) were randomly assigned to high intensity low-volume (HILV) and high-intensity moderate volume (HIMV) taper groups. Training frequencies were five times per week conducted for 2 weeks in both groups. At baseline and after 2 weeks of the taper intervention, psychological (TMD; characterized by the aggression, depression, tension, fatigue, confusion and vigor sub states) were measured by using self administer profiles of mood state (POMS) questionnaires.

Result- We investigated the effect of the HILV and HIMV taper training on the mood disturbance of endurance athletes and positive psychological traits changes were observed in both HILV and HIMV taper groups regardless of the differences in volume reductions during the two-week taper period. Comparisons of the strategies did not reveal significant differences between the taper groups. In addition, finding from multiple regression models emphasizing on the prediction power of the tapering training strategies on the mood disturbance revealed that HILV taper could predicting the TMD in endurance athletes.

Conclusion- Both taper strategies characterized by HILV and HIMV training load have beneficial effects on the improvement of endurance related psychological traits.

Introduction

As the athletics sports become more and more popular across the world in all age levels, the need to compete well at a high level has increased dramatically⁽¹⁾. This might increase in athlete's interest to train more to attain peak performance than their competitors⁽²⁾. The extra engagement in such exhaustive training, practices and competitions cause symptoms of overtraining which could influence the physiological and psychological adaptations⁽³⁾. These routinely tough training and competition and the knowledge of optimal training regimens severely influence contemporary training and recovery methods⁽⁴⁾. In previous times, a single training bout per day was considered to be sufficient⁽⁵⁾. However, contemporary experiences show that athlete have been trained twice a day or more for an extended durations. As a result, the numbers of athletes reported to be over trained and have insufficient rest have increased⁽⁶⁾.

Exercise scientists continue to investigate the physiological and psychological benefits of different training interventions, recovery methods, and dietary intake to increase the performance of the athlete⁽³⁾. In many competitive events, performance improvements are attained or assured with a marked reduction in the athletes' training load during few up to several days prior to the competition⁽⁷⁾. This segment of reduced training load designed to help athletes to peak athletes just before a competition is generally known as the taper⁽⁵⁾.

Tapering is a specialized exercise training techniques designed to reverse the harsh training induced physical, physiological or psychological fatigue during a variable period of time, in an attempt to reduce the stresses of routine trainings and accumulated effects of fatigue for optimizing performance ^(4, 8). In an explicit way, tapering is formalized recovery training method needed to employ after a heavy training periodization ⁽⁹⁾.

Pre-event taper training can prepare an athlete both physiologically and psychologically ⁽¹⁰⁾. The taper is intended to wash out the accumulated physiological and psychological fatigue, which might have an influence on training adaptations, and performance optimization or peaking ⁽¹¹⁾. Previous studies have emphasized to the effects of tapering on the physiological and psychological traits with different approaches rather than to deal in combination ^(12, 13). The type of sport, sport, the level of conditioning and training period needs to be taken into consideration to determine proper pre-event taper, including the amount of volume to be reduced, the pattern of taper and the duration of taper to enhance the performance of the athlete ⁽³⁾.

Adequate recovery from training related stress enhances athletes performance by initiating physiological adaptations through increased the haematological components like increasing of red blood cell (RBC) volume, haemoglobin concentrations and percentages of hematocrite which insure high oxygen carrying capacity. It also increases the level of oxidative enzymes that boosts energy level and improves running economy and power out puts ⁽⁸⁾. The combinations of a reduced work load particularly the training volume and performance maintenance during the taper period promises the psychological changes that may boost the confidence level of an athlete ⁽¹⁴⁾. Optimization of athlete's physiological status characterized by high oxygen carrying capability, improved running economy and power output resulting from a well designed tapering strategy is presumably accompanied by beneficial psychological changes, including well balanced mood state, perception of effort and quality of sleep ⁽¹⁵⁾.

Physiological changes such as increasing of red blood cells (RBC) count, hemoglobin (Hgb) concentration and hematocrite (Hct) percentages and psychological changes like the reduction of tension, aggression, depression, confusion, fatigue and increasing of vigor were observed after well planned taper interventions ⁽¹⁶⁻¹⁹⁾.

Improvements of the psychological traits especially the total mood disturbance (TMD) which is characterized by the differences in the negative mood states of aggression, tension, depression, fatigue, confusion and positive mood state of vigor were indicators of progress in endurance performances ⁽²⁰⁾. Changes in these variables provide evidence on the endurance performance of the participant athletes ⁽⁸⁾.

To achieve high endurance performance ability, the taper should be designed systematically ⁽⁸⁾. The decrease in training load can be accomplished by reducing the number of practices (frequency), the intensity of the work outs (intensity), the volume of training performed in a given session (i.e distance, time, or repetition), and by varying the length of the taper or duration ⁽⁵⁾. However; the reduction of

training load should be done mainly at the expense of training volume, but not with training intensity⁽⁴⁾ for a variable segment of time that depends on individual profiles of fatigue level and adaptation. Volume could be greatly reduced but training intensity remains high for highly trained athletes⁽¹⁴⁾.

Systematic manipulation of the training variables (volume, intensity and frequency) and rest time before, during and after the training is critical to evaluate the load and the adaptation⁽⁸⁾. Care should be taken while reducing the training loads and its practice. The reduction of training volume enables to have enough recovery time which aids in super compensations and a brief high intensive training program also gives sufficient stimuli to prevent detraining⁽⁵⁾. Having adequate recovery time will assure adaptations for the physical, physiological and psychological stress of training that improves performances⁽⁴⁾

Although, no confirmed and commonly agreed tapering formula⁽²¹⁾, some studies reported that a reduction of 60–70% of the training volume is considered to be appropriate to improve endurance performance without causing detraining symptoms⁽²²⁾, while others suggest a minimum of 70% of the training load is needed to maintain training induced VO₂ max⁽²³⁾. Banister and his colleagues,⁽²⁴⁾ also have reported that, there was a recorded performance improvement after 31% of reduction of training volume. Endurance performance were improved in competitive cross-country runners following a step wise reduction of the training volume and slightly increased training intensity for seven-fourteen days just before major competitions⁽¹⁴⁾. According to Shepley et al.,⁽¹⁴⁾ runner's performance improves more when low volume, high intensity taper were used for seven days as compared to the low volume, low intensity taper, or rest groups. In addition, the procedures of total load reduction, the way to decrease the load (single step wise reduction or a progressive reduction with a more rapid or slow) can also influence the effects of tapering or performance⁽²⁴⁾.

In order to maintain or enhance the performance using tapering, it has been done through the reduction in either training volume or intensity or both in the final week/s before competition⁽⁸⁾. However, there is limited consensus on the amount of volume to be reduced, its reduction pattern and on the duration as to how long the taper period should stay⁽⁵⁾. Research on these strategies showed that tapering is mainly implemented with a reduction of the training load before competition and it have an influence on the physiological and psychological, but more investigation is needed to identify the actual amounts of load to be reduced, its duration and patterns for achieving peak performance⁽⁵⁾.

Coaches, athletes and sport experts now use different strategies to decrease the accumulated fatigue while planning to retain or further enhance the athletes fitness which leads to reach peak performance just immediately before competition, but they face difficulties and become uncertain about the best performance peaking strategies in accordance with the individual athletes experience and sport participation.

The research study attempts to investigate, compare and evaluate the high intensity low volume (HILV) and high intensity moderate volume (HIMV) tapering strategies and their effects on specific

psychological traits among young endurance athletes in selected national level athletics training centers of Ethiopia. As an indicator of the psychological state the total mood disturbance and the sub-profiles mood states like tension, aggression, depression, fatigue, confusion and vigor were assessed and evaluated.

Methodology

Location/areas of the Study

The centers of attention were the two national training centers (Maychew and Tenta) found in Tigray and Amhara regional states of Ethiopia at an altitude of 2860 and 2679 m meters above sea level and 625 and 520 km far from Addis Ababa, the capital city of Ethiopia respectively.

Sample and sampling techniques

Thirty seven competitive endurance athletes from the two athletics training centers (ATC) were volunteered to participate in this study. Census sampling could be used because they are few in numbers and all are taken as a sample. All competitive athletes having a minimum training experience of two years, being in training regularly for the last 3 months, apparently health and having weekly training load comprises 25 km -50 km could be included

Design of the study

The study was an experimental study with parallel grouping pre-post design. The parallel group design is a common method and is straight forward method of investigating in convenience from different site and uses for comparison of different interventions both within and between groups. Twelve week, uniform designed preparatory training program was administered to bring uniformity among the participants of the two training centre athletes; though, it was not the part of the intervention, but used as a base from which the taper intervention was designed from it. The taper training load was designed based on the average loads of the last four weeks training loads. Pre-post test data collection methods were used and the data were analysed by using paired t-test, independent t-test and multiple regression.

Data Collection Procedures

The Profile of Mood States (POMS) questionnaires which contain the 65 self-report items using the 5-point Likert Scale were mainly used to collect the psychological data. The questionnaires contain a series of descriptive words/statements that describe feelings of people have. Scoring for each item is recorded as zero (0) for 'Not at all' up to four (4) for 'extremely'. A Total Mood Disturbance (TMD) score is calculated by summing the totals for the negative subscales (tension, depression, fatigue, confusion, anger) and then subtracting for the positive subscales (vigor).

Data Analysis

Initially, the data were tested for assumptions of normality using the Shapiro-Wilk and kolomogrove test and it confirms normal distribution. Demographic characteristics of the participant athletes were assessed and analyzed using descriptive statistics. Independent t-test (comparing the baseline differences between groups), paired-test (changes in the pre &post test scores) and multiple regression was used association to check the prediction power of profiles of mood on the TMD. Results were

reported by using $M \pm SD$ and MD. The level of significance was set at $\alpha = 0.05$, $P < .05$. SPSS V. 20 were used for all analysis.

Ethical consideration

Ethical approval was assured from Ethical committee of Mekelle University with reference no.ERC0772/2016. Participant Consent was guaranteed. Information confidentiality and individual's right were boldly stated.

Results

Demographical characteristics of the respondents

A total of 39 (male $M = 26$ and female $F = 13$) endurance athletes' having an average age of 20 plus or minus 1.97 years was included in this study. Participants' difference across their training centre and in terms of the training period were checked and assured that there was no, observed significant difference ($p > 0.05$) between the groups with respect to the above mentioned characteristics.

Table 1

Comparison of the Total mood disturbance differences between groups (Base line difference)

Variables	Group	N	M	SD	T	Df	P
TMD	HILV	20	95.60	6.58	-1.258	35	0.216
	HIMV	17	98.32	6.90			

Where, HILV = high intensity low volume taper groups, HIMV = high intensity moderate volume taper group, TMD = total mood disturbance,, p = significant at $p < 0.05$.

There was no observed significant differences ($p > .05$) between the two groups (as seen in Table1) in their baseline scores prior to the taper intervention at $\alpha = 0.05$ level. Possible changes occurred after the taper might be because the taper program.

Table 2

Paired sample t-test results of TMD within the HILV and HIMV taper groups

Variables	Groups	Pre	Post	MD	T	df	P
		$M \pm SD$	$M \pm SD$				
TMD	HILV	95.60 ± 6.58	60.40 ± 6.29	-35.20	-14.51	19	0.000*
	HIMV	98.32 ± 6.89	75.24 ± 8.50	-23.47	-9.093	16	0.000*

*Where, TMD = Total mood disturbance, HILV = high intensity low volume taper groups, HIMV = High intensity moderate taper group, M = mean, SD = standard deviations, difference is significant at $p < 0.05$, * = indicates the significant p - values*

According to the paired t-tests analysis (Table 2), significant differences were seen ($p < .05$) within each taper group. This means, all strategies, the HILV and HIMV taper strategies had significant effects on the athlete's mood states which were measured using the POMS questionnaires develop by MacNair et al,

(25). Total mood disturbances (TMD) with MD = -35.20, at $t(19) = -14.51$, $p < .001$ for the HILV taper group and MD = -23.47, at $t(16) = -9.093$, $p < .001$ for the HIMV taper group, at $\alpha = .05$ level.

Table 3
Comparisons of the Post test score differences in the TMD between groups (using ANCOVA)

Variables	Group	N	M	SD	Df	F	P	Partial η^2
TMD	HILV	20	60.40	6.29	1,34	43.26	.000*	.591
	HIMV	17	75.24	8.50				

Where, TMD = Total mood disturbance, HILV = high intensity low volume taper groups, HIMV = High intensity moderate taper group, M = mean, SD = standard deviations, difference is significant at $p < 0.05$, * = indicates the significant p – values

Post test score differences between groups were also checked using ANCOVA (as seen in Table 3) which could help to covariate (control) differences in between participant’s gender and pre test scores. Thus, there was a statistical significant differences ($p < .001$) between the groups at $\alpha = 0.05$ level.

Table 4
Prediction of the TMD when the mood profile scores are below moderate

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std.erro	Beta		
(Constant)	64.525	5.682		11.356	.000
Σ of scores for aggression	-3.213	3.475	-.134	-.924	.363
Σ of scores for Tension	-2.927	2.611	-.139	-1.121	.271
Σ of scores for Fatigue	-2.849	2.453	-.136	-1.161	.255
Σ of scores for Vigor	15.525	3.682	.705	4.217	.000
Σ of scores for confusion	2.445	3.250	.102	.752	.458
Σ of scores for Depression	2.757	2.695	.131	1.023	.315

a. Dependent Variable: total mood disturbances

A multiple regression was conducted to predicting the TMD level on the bases of aggression, tension, fatigue, confusion, depression, Vigor, when the mood profile scores were below the average (i.e when the

responses of the athletes are “not at all” and “little”). Over all, the regression was significant at $F(6, 30) = 7.986, P < .05, R^2 = .615$ (as seen in Table 4 above). Of the predictors investigated, it was only the vigor mood profile score that show significant at $(\beta = .71, t(30) = 4.22, p < .05$ when it the average of each vigor based items were below and moderate. However; other mood profiles vigor were not significant predictor of TMD when the responses of the athletes are below moderate (i.e “not at all” and “little”).

Table 5
Prediction of the TMD when the mood profile scores are above moderate

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std.erro	Beta		
(Constant)	63.756	2.769		23.028	.000
Σ scores for aggression	3.618	1.926	.174	1.879	.070
Σ scores for tension	.085	2.243	.003	.038	.970
Σ scores for Fatigue	11.215	2.671	.509	4.199	.000
Σ scores for Vigor	-5.932	2.520	-.285	-2.354	.025
Σ scores for confusion	3.009	2.024	.139	1.487	.148
Σ scores for depression	-.976	1.686	-.045	-.579	.567

a. Dependent Variable: total mood disturbances

A multiple regression was conducted to predicting the TMD level on the bases of aggression, tension, fatigue, confusion, depression, Vigor, when the mood profile scores were above the average (i.e when the responses of the athletes are “quite a lot” and “extreme”). Over all, the regression was significant at $F(6, 30) = 33.82, P < .05, R^2 = .87$ (as seen in table 32 and 33 above). Of the predictors investigated, it was only the fatigue and vigor mood profile score that show significant prediction of TMD (as seen in Table 5 above) at $(\beta = .51, t(30) = 4.20, p < .05$ and $(\beta = -.29, t(30) = -.35, p < .05$ respectively when the responses of each fatigue and vigour related items were above moderate. Other mood profiles variables were not significant predictor of TMD when the responses of the athletes are above moderate (i.e “quite a lot” and “extreme

Discussions

Observed difference in the total mood disturbances between groups and association of the six mood state profiles of tension, aggression, depression, fatigue, confusion and vigor to the TMD were examined.

When comparing the effects of HILV and HIMV taper interventions on the psychological trait of TMD between groups, a significant difference ($p < 0.05$) was observed. The HILV taper groups have shown higher decrement of TMD than the HIMV taper group. It also noted that the high intensity-low volume taper intervention could cause large reduction in the total mood disturbances as compared it to the high intensity-moderate volume taper. From this report, one can easily realize that, the HILV taper strategy is more effective in improving the negative mood states of athletes than the HIMV taper when applied for two weeks duration. This may occur due to the higher reduction of training volume in the HILV taper group than the HIMV taper group in which participant athletes were engaged in moderate amount of the pre taper training during the two weeks tapering periods.

This research finding and justification was supported by, research reports from Beedie et al.,⁽²⁾ they stated as mood profiles are more sensitive to changes in the training load. As the training load especially the volume reduced during the periods prior to a major competition, athletes get some sort of psychological relief from the long exhaustive fatigue causing preparation training and facilitates extra adaptation process in the body physiology which initiates super compensation^(26,27). Even though; insignificant difference was observed between interventions groups, a trend towards higher increment in mean score were observed in the physiological traits of RBC count and Hgb concentration in the HILV taper group than the HIMV taper group.

According to the research findings from Mairbaurl⁽²⁸⁾, coaches or athletes who pursue larger reduction in training volume could get more encouraging results in decrement of the mood disturbance. Less mood disturbance results due to a lesser amount of cumulative effects of the negative profiles of mood states characterized by less aggression, tension, depression, confusion and fatigue. Instead the positive mood profile of Vigor would increase which might help the athletes to built their self confidence and improve endurance performance⁽²⁹⁾. A research report by Boyadjiev and Taralov,⁽³⁰⁾ demonstrates that, short bouts of intensive exercise lessened the possible negative moods and boost the positive once in athletes. The finding of this research also aligns to this report. Because, during the taper period training was mostly designed and performed in the form of intervals characterized with high bouts of intensive exercises just above the race pace level and rest periods were arranged between each bouts of exercise to provide more recovery time even during the actual training session. This might also help an individual athlete to get satisfactions and feel happy as they complete the given interval loaded training. Additional support to this finding was available from Oliveira and Melanie,⁽³¹⁾ and stated that individual's mood state, energy supply and enjoyment were improved just after the completions of a given high intensive taper exercise. Shepley et al.,⁽¹⁴⁾ also made comparative study with three groups of high intensity-low volume taper, a low intensity- moderate volume taper and a rest only taper groups on middle-distance runners and conclude that endurance performance had shown significant improvements in the high intensity-low volume taper groups than the low intensity- moderate volume and rest taper groups.

Research report by Cox et al.,⁽³²⁾ suggests that, acute bouts of exercise could provide psychological benefit however there are inconsistencies as to which intensity promotes the greatest positive influence.

Greater improvements in mood and positive well-being were reported after high-intensity exercise when compared to lower intensity ⁽³³⁾, at the same time, greater positive affect and decreases in TMD have also been documented for lower intensity training when compared to higher intensity ⁽³⁴⁾. Furthermore, there has been ample research supporting that acute bouts of physical activity decrease TMD and stress and improve positive well-being and overall feeling ^(32, 35).

Athletes could have a good adaptation in the overall psychological condition when there have a low score in the total mood disturbance (aggregation of the scores for tension, depression, fatigue, anger, and confusion) after a single session of long distance running for nearly 75 minutes ⁽³⁶⁾. Lane et al., ⁽³⁷⁾, also explain as there was an improvement in the total mood disturbance after a moderate volume (45 minutes) of aerobic exercise. Hansen et al., ⁽³⁵⁾, furthermore elaborate this issue, as there was an improved level of vigor, fatigue, and total mood after 10 minutes of low volume intensive activity.

Tapering based researches done on the psychological trait that influence athletics performances indicate that, mood disturbance affects the overall athlete's self confidence which again influence performance ^(2, 29). Thus, decrement of the total mood disturbance implies that there was a decrement of such negative mood states of aggression, tension, depression, confusion, and fatigue and increments of positive vigor mood, which could help to develop optimal levels of self confidence and improves endurance performance of the athletes.

Report from the multiple regressions analysis revealed that HILV taper, increment in fatigue level, vigor, could predicting the TMD in endurance athletes. The result showed that TMD would increase when the fatigue level increases. TMD was increased nearly by a multiple of seven with fatigue level increases progressively. On the other hand TMD would decrease in response to reduction of the training volume. The fact that the regression model revealed the vigor and fatigue variables could help to predict the status of TMD. The magnitudes of the vigor variable are positive (15.53) when it is below moderate level and negative (-5.93) when it is above moderate. Fatigue also could predict the TMD when it was above moderate level and positive magnitude (11.22). A negative regression magnitude has an opposite interpretation, that is, a one-point increase or decrease in each variable would result in a decrease or increase of the predicted score of the TMD by the value of the regression amount, assuming all other predictors were held constant. This means decrease in vigor could increase TMD by 15.53 and decrease by 5.93 when it is above moderate level. In addition, an increase in the fatigue level would increase the TMD by a multiple of 11.22.

As Halson et al., ⁽³⁸⁾; Mujika et al., ⁽⁸⁾ suggested that reducing the training load with the expense of the training volume prior to a competition could facilitate the recovery process or positive adaptations which would persuade the cumulative effects of fatigue. Thus, reduction of the training load prior to competition could help to improve endurance performance ⁽⁵⁾. A tapering protocol involves reduction in training load mainly the training volume is appropriate to facilitate the physiological and psychological adaptations which could help to achieve peak performance before competition ⁽⁸⁾. Engagements in long

exhaustive training than rest period cause the working muscle to feel fatigue which results mood disturbances among the participants leading a fail of performance ⁽³⁹⁾.

Similar findings by Neary et al.,⁽⁴⁾ aiming to investigate the psychological changes occurred due to the variations in training volume using the Profile of Mood States on the fourteen world-class canoeists revealed that, the total mood disturbance score was higher during the heavy specific preparation periods. However; there was a significant improvement of the total mood disturbance score after weeks of taper intervention just before the Olympics competition.

Conclusion

In conclusion, we observed that taper training characterized by HILV and HIMV could have positive effects on the improvements of endurance performance related psychological traits. With objective measuring of the effects of HILV and HIMV tapering on the psychological traits, it was found that there is a positive link between the reductions of training load particularly the training volume and decrements in the TMD which is considered to be the fundamental features for evaluating the psychological condition. When comparing the effects of HILV and HIMV taper interventions on the psychological trait of TMD between groups, the HILV taper intervention could have higher decrement of TMD than the HIMV taper group. Finding from multiple regression models emphasizing on the prediction power of the tapering strategies and on the mood profile revealed that HILV taper could predicting the TMD in endurance athletes. Well designed high intensity-low volume and high intensity-moderate volume taper training program applied for two weeks prior to competition would have an important contribution for the attainment of peak performance in endurance athletes.

Abbreviations

POMS: psychological terms:Profiles of Mood state; HILV:High intensity moderate volume; HILV:High intensity low volume; TMD:Total Mood Disturbances

Declarations

Ethical Considerations

Participant consent and ethical consideration were given due emphasis at the start of the also research process. Information sheet was prepared and explained well to the athletics training centre administrators, coaches and participant athletes. The Name of the participants was anonymous and kept confidential by using codes. Ethical approved was obtained from Mekelle University College of Health Sciences; Health Research Ethics Review Committee (HRERC) and permitted to carry out with Ref. No. ERC0772/201, dated 26/06/2017.

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Authors' Contributions

Ambachew Amede and Rehima Yassin, the author of this manuscript all made substantial contributions to the development of the design and concept of this research article. Ambachew Amede initiated and drafted the preliminary strategy. All we together conducted data analysis and interpretation. Rehima drafted the manuscript and finalized all the things up to this level. We, all read, and approved the final manuscript and have agreed to be personally accountable for our own contributions and to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated.

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Availability of Data and Materials

The datasets generated and analyzed during the current study are available and kept in the hand of the corresponding author and ready to show on reasonable request

Consent for Publication

All authors gave their confirmation to the publisher via written email and agreed to the publication of the article.

Competing Interests

Ambachew Amede and Rehima Yassin declare that, we don't have no any conflicts of interests relevant to the content of this manuscript.

Authors' detail

¹Both the authors' were from Wollo University, sport science academy and they are staff members of the sport science department

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