

# The Impact Of Physiological Recovery On The Optimal Performance Of Track & Field: A Gender Based Athletes Study

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## ABSTRACT

**Background:** The importance of muscular and mental recovery can not be denied at any professional sports forum to attain optimal performance from elite track & field athletes. However, the effects of muscular recovery through intervention program needs to be studied before application of recovery strategies during meso-cycle training program.

**Objectives:** The objective of this study was to determine the impact of muscular recovery on the performance female and female elite athletes of track & field events.

**Methodology:** In this research, total 80 male and female athletes were distributed into four equal stratas (A, B, C & D) each comprising of 20 athletes. Each strata was further distributed into five sub-groups: sprints (100m), long racers (5000m), long jump, and shot-put (rotational). These professionals and semi-professional athletes aged between 18-35 years were given eight weeks intervention program at Pakistan Sports Board, Islamabad. Overall, 90 minutes training program were allocated for all the groups irrespective of age and gender divisions. Moreover, all the stratas (A, B, C & D) were further assigned 5,7,9 and 11 training sessions, each of 90 minutes per week. To evaluate the pre-post intervention, statistical analysis comprising of basic descriptive techniques along with advanced methods are used through SPSS (v25) and Minitab.

**Results:** The pre-post intervention results of all track & field events showed significant difference for both genders in all groups. The H<sub>0</sub>: There is an equal improvement in the performance of male and female athletes after 8 weeks intervention was rejected and the impact of intervention showed significant difference on the basis of results of two samples Wilcoxon test. Moreover, the improvements in performance of females were observed more substantial as compared to male athletes due to various multifarious reasons.

**Conclusion:** The study concludes that eight weeks physiological training intervention have significantly improved the performance of male and female athletes in all track & field sport events.

**KEYWORDS:** VO<sub>2</sub>max, Optimal and Peak performance, Gender Study, Muscular Recovery, Strength and Endurance.

## 2. Introduction

Most of the trainers firmly believe on “**more training better performance concept**” which is considered an obsolete idea by the sports experts of modern era. These unqualified coaching staffs are known as a barrier in sports advancement particularly in sports developing countries. Declining the standards in competitive sports are also evident of overtraining and non-scientific approaches adopted by these trainers (Cadejian & Kater, 2019). The coaches of track & field professionals are still conducting more than ten training sessions per week without realizing the environment, age and nutritional requirements which are ultimately affecting the athletic performance. The concept of muscular and neuromuscular recovery is not planned and applied on the on-set of periodization by trainers (Black et al., 2017). The importance of physical and mental recovery play vital role in today’s elite performance but unfortunately it has not been given due weightage during periodization. Beside this, other issues which cause problems in attaining optimal standards at international levels are “not considering the chronological and training ages of athletes” while implementing the same program on complete group of (8-10) athletes. Human muscles are unique in nature; different athletes required different training mechanisms / protocols due to the principle of individualization to performances. Tests and measurements have always assisted coaches to identify the fatigue levels and plan recovery sessions during training cycles (Rønnestad et al., 2014). The understanding of human body structure, functioning systems help the trainers to comprehend the application of training principles.

Trainers should ensure the quality sleep of athletes, minimum eight to ten hours per day for optimal performance as evidentially proved in

many studies conducted by World Athletics (WA) at international levels. However, the fact of nutrition and hydration can not be ignored for good physical and mental recovery for improved performance. The athletes fail to ingest required carbohydrate and hydration demands, thus suffers fatigue and muscular sourness.

The poor diet especially less carbohydrate or insufficient fluid intake leads to decrease in capacity to tolerate physiological and psychological training stress during competitions (Almassmoum et al., 2018).

## 3. Literature Review

Monitoring training threshold is considered significant in achieving peak performance from elite track and field athletes. According to research conducted by World Athletics (WA), elite professional athletes needs to be trained for ten years or (10000 hours) systematically for world class international performances (Sands et al., 2019). A study which was conducted on Olympic swimmers indicates that response of athletes were not found only different in training seasons but also found diverse in between seasons too (Reardon et al., 2019). The significant factor be kept in mind is the principle of individualization in training which needs to be addressed and incorporated during planned periodization. Some athletes perform well in high volume training periodization whereas others may perform better in low volume and high intensity periodization. The monitoring and good observation by trainers will help to understand the training load threshold to improve the individualized training program for each athlete for better results and peak performance during competition (Sands etin al., 2019). It is an evident that without close monitoring athletes may fall short off in achieving set-objectives due to overtraining or under training syndromes

(Çetin et al., 2021). These questions include that; how hard, how recovered, how difficult and how stressful were the training sessions. The training sessions can easily be modified according to feedback and observed symptoms of the elite professionals. Another study conducted by Smith is also an evidence and provide guidelines for the trainers and coaches to highlight the common flaws in periodization (Zaryski & Smith, 2005). Professor smith highlighted in this study that; recovery is the most neglected factor in training often mistakes are made by trainers in macro and meso training cycles, training demands or load are placed too quickly and sometimes after recovering from injuries training load suddenly increased. Each athlete has different exercise threshold which can be improved with systematic training. Monitoring and recording symptoms on daily basis will help to improve the individual training program and ultimately improve the performance of elite professional athletes (Hemmings et al., 2000). Exercise threshold depends upon the threshold of the lactic acid produced by the body during strenuous internal and external training loads, premeditated by the coaches and trainers during micro-cycle planning (Bompa & Buzzichelli, 2019).

All techniques and strategies which reduce the fatigue and increased volume of training will definitely assist in increasing the competitive performance (Barnett, 2006). However, signs of overtraining and tiredness can easily be eluded by trainers if successfully followed by the well planned periodization training schedule. Moreover, the training program may structure complete recovery and restoration for optimal performance (Nesse et al., 2020). Continuous close monitoring of athletes by trainers may improve and adjust the overall individual training program which ultimately develops the strong association with fitness, fatigue and elite professional performance. The fact of fitness, fatigue and performance relationship can not be over-looked at any sports forum by experts

directly or indirectly involved with elite professional performance (Raeder et al., 2016). Trainers and coaches can manipulate the program of athletes by making it more useful individualized to obtain optimal performance. Trainers and athletes can prepare and set long term goals or objectives before planning systematic, scientific periodization for elite track & field athletes. Minimum of one year training periodization may be planned for elite professionals and detailed macro-cycle, meso-cycle and micro-cycle training plan be amalgamated for better results (Rana et al., 2017). Process of replenishment of energy, nutrition, muscular or neuromuscular rest for next competition or events is utmost important. The performance in sports or physical activities depends upon the restoration of required energy for the upcoming physical events in the shape of molecule known as (ATP) adenosine triphosphate which is stored in liver or muscles (Torres-McGehee et al., 2012).

Many scientific studies showed and suggested methods to promote and increase high levels of VO<sub>2</sub>max training for endurance sports (Laursen & Jenkins, 2002). Developing countries in sports need comprehensive understanding of overtraining syndrome (OTS) and remedial measures through physiological recovery to attain optimal performance from elite professional track & field athletes.

#### 4. Materials and Methods

**Data:** In this study, the data contains total 80 male and female athletes, which are further distributed into four equal stratas (A, B, C & D), each comprising of 20 athletes. Each stratas was further divided into (five athletes) into sub-groups: sprints (100m), long racers (5000m), long jump, and shot-put (rotational). The respondents aged between 18-35 years were given eight weeks' intervention program at Pakistan Sports Board, Islamabad. Overall, 90 minutes training

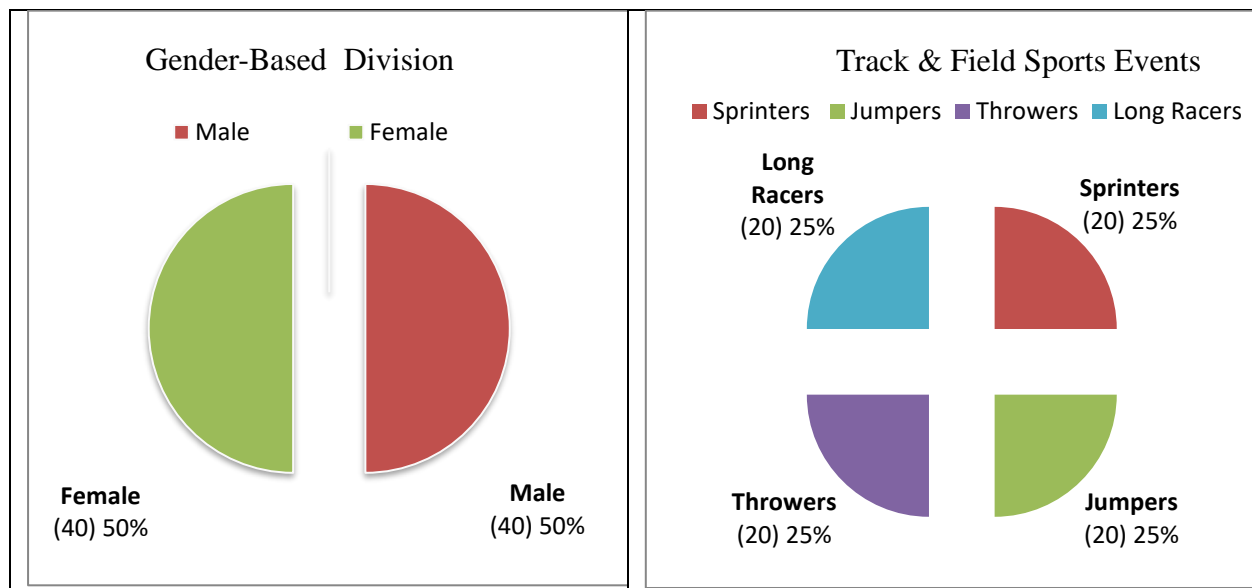
programs were allocated for all the groups irrespective of age and gender divisions. Moreover, all the stratas (A, B, C & D) were further assigned 5, 7, 9 and 11 training sessions, each of 90 minutes per week. Overall total of (40 male and 40 females) athletes gone through the eight weeks intervention program.

**Methodology:** To evaluate the pre-post intervention, statistical analysis comprising of basic descriptive techniques along with advanced methods are used through SPSS (v25) and Minitab. Initially, pie charts are portrayed to represent the qualitative variables. Later on, Mean  $\pm$  SD are computed as descriptive statistical measures to assess the average and rate of diversity from the average from the demographic variables of track & field events at

both pre-post levels for males and females. The Wilcoxon non-parametric test was used as a substitute of two samples t-test to evaluate the significant differences. The data was also assessed through ANOVA for assessing the equality of all track and field events.

## 5. Results

In this section, the results are calculated to determine the impact of muscular recovery on the performance of male and female elite athletes of all track & field events. Both descriptive and inferential statistical techniques are used. Initially, gender based division of all track and field athletes is represented by using the pie chart (see, Figure 1) where there is an equal distribution of males and females.



**Figure 1:** Gender wise distribution of respondents (left panel) exhibiting equal inclusion of (40) 50% males and (40)50% of females out of total (n= 80) whereas the pie chart of four Track & Field events: Sprinter, Jumpers, Long Racers and throwers (right panel).

Like gender, the data of four Track and Field event has been represented by using the pie charts (see, right panel of Figure 1). The 20 athletes distributed equally in main four sports which are sprinters (100m), Jumpers (long jump), Throwers (Shot-put rotational) and Long racers (5000m) of track and field respectively.

**Table 1: Demographic Descriptive Statistics (Mean  $\pm$  SD) of all Strata**

Demographic Variables	Group A	Group B	Group C	Group D
Chronological Age (Years)	23.45± 3.39	24.90± 1.99	24.50± 2.56	23.80± 2.68
Training Age (Years)	5.15 ± 2.60	6.60± 1.69	5.85± 2.49	5.35± 2.68
Body Weight (Kgs)	67.85± 13.83	69.10± 13.37	66.05± 13.89	69.55± 11.56
Height (Meters)	1.67± 7.15	1.73± 5.36	1.68± 7.64	1.69± 8.92
BMI (kg / m <sup>2</sup> )	23.67± 3.53	22.85± 3.78	23.33± 3.80	24.31± 3.23

In table 1, descriptive statistics (Mean ± SD) of chronological age (years), training age (years), body weight (Kgs), Height (Meters) and BMI (kg / m<sup>2</sup>). Here the (Mean ± SD) are expressing the measures of central tendency along with SD of all four groups / strata. The mean ± SD of BMI of strata A, B, C and D have been reflected against each Strata in table respectively and same have been indicated for other quantitative measures.

### 5.1 Application of Two Samples Wilcoxon Test for Analysis of Performance

In this sub-section, the two samples Wilcoxon test for the analysis of four track and fields (sprinters, long racers, jumpers and long racers) have been considered at pre-post levels for both male and female athletes.

**Table 2:** Represents the actual event performance of all sporting events of Track and Field of both the gender.

Track & Field Events	Status	Gender	n	Mean± SD	P-Value
Sprinters (Seconds)	Pre	Male	12	10.87±0.11	<0.001
		Female	08	12.68±0.07	
	Post	Male	12	10.68±0.14	<0.001
		Female	08	12.41±0.18	
Long Racer (Minutes)	Pre	Male	08	15.67±0.33	<0.001
		Female	12	20.46±0.55	
	Post	Male	08	15.23±0.50	<0.001
		Female	12	19.79±0.69	
Jumpers (Meters)	Pre	Male	08	7.16±0.11	<0.001
		Female	12	5.22±0.18	
	Post	Male	08	7.29±0.13	<0.001
		Female	12	5.42±0.29	
Throwers (Meters)	Pre	Male	12	15.75±0.49	<0.001
		Female	08	12.12±0.22	
	Post	Male	12	15.96±0.47	<0.001
		Female	08	12.35±0.27	

Table 2; showed that all track and field events: Sprinters, Long Racers, Jumpers and Throwers have a significant pre-post intervention performance w.r.t gender because p-value is less

than the level of significance ( $\alpha = 0.05$ ) in all cases. Thus all null hypotheses corresponding to each track and field events are rejected,

representing that athletes have improved their post-performance significantly.

### 5.3. Gender Based Intervention Analysis of all Track & Field Events

To perform the gender based pre-post intervention analysis of track & field events (sprinters, long racers, jumpers and long racers), gender based histogram (see Figures 3-4) showing the percentage improvements in both the genders.

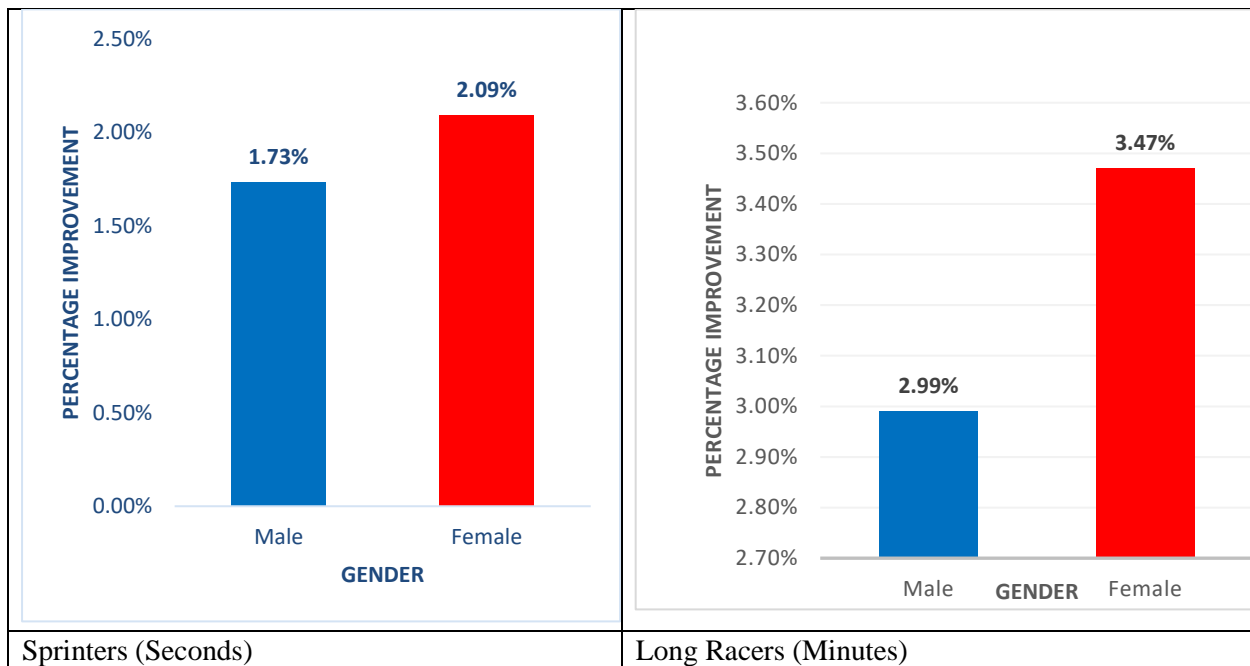


Figure 3: Graphical display of gender-wise overall Improvement in Sprinters and Long Racers

Figure 3 represents the gender wise improvement of sprinters (100m) [left panel] and long racers (5000m) [right panel] time related events of all strata showed the significant difference of improvement of females as compared to male sprinters and long racers. The female sprinters of all groups improved (2.09%) in comparison with male athletes which is (1.73%) in 8 weeks

training intervention whereas; the long racers females (5000m) improved (3.47%), better than male athletes which were (2.99%) respectively. The significant improvement in female performance was purely due to more room for improvement in pre-actual performance as compared to male athletes of all strata.

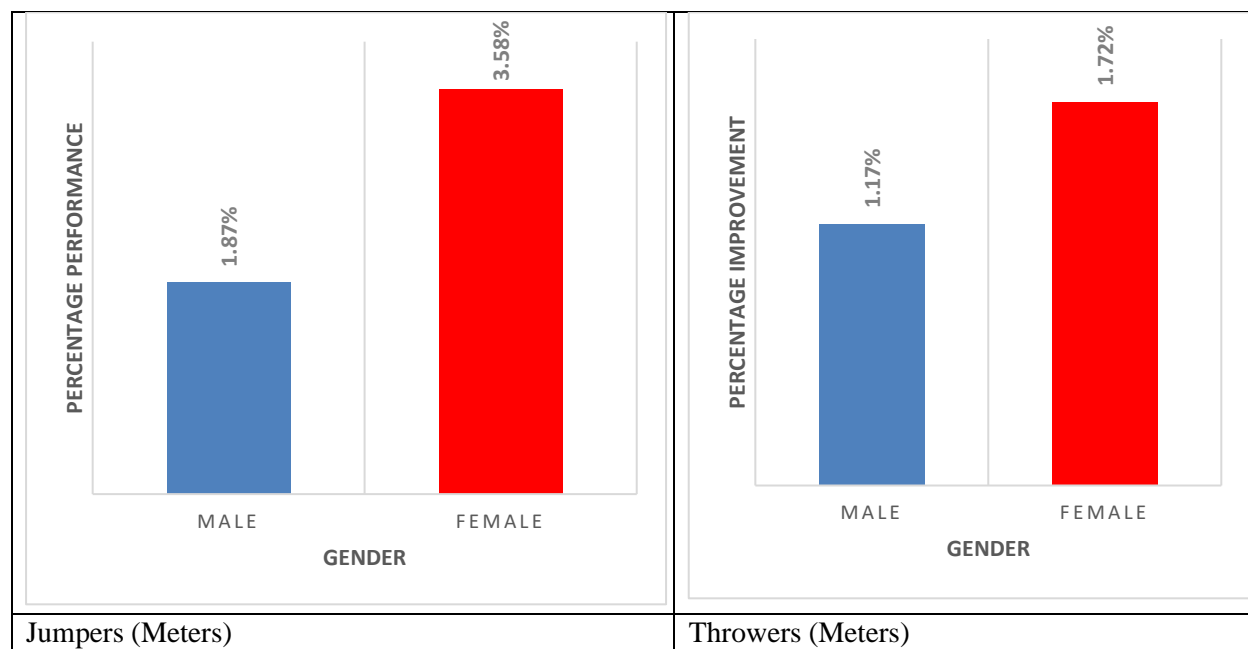


Figure 4: Graphical display of Gender wise overall Improvement in Jumpers and Throwers

This figure showed graphically the gender wise overall improvement of actual event performance of jumpers (long jump) [left panel] and throwers (Shot-Put) [right panel] of groups of all strata. According to jumpers group the improvement of female jumpers were at power to male jumpers i.e. (3.58%) as compared to male (1.87%). Similarly, the improvement of throwers male and female athletes were found 1.17% and 1.72% respectively. Moreover, the improvement of females in jumpers’ groups was much greater as

compared to shot put event which is purely the strength dominant event.

### 5.3 Significance of four Strata through ANOVA

To test the strata-wise significance effect, analysis of variance is considered at 5% level of significance with null and hypothesis as:

H<sub>0</sub>: The mean performances of all track and field events are equal

H<sub>A</sub>: The mean performances of all track and field events are not equal

Table 3: Significance of all Strata through Analysis of Variance (ANOVA)

Sports Events	Source	df	Sum of Squares	Mean Squares	F-value	R <sup>2</sup>	P-Value
Sprinters (100m)	Event	3	0.132	0.0441	4.25	44.34%	0.022
	Error	16	0.166	0.0104			
	Total	19	0.299				
Long Racers (5000m)	Event	3	2.311	0.7703	7.02	56.83%	0.003
	Error	16	1.756	0.1097			
	Total	19	4.066				
Jumpers (L-Jump)	Event	3	0.1172	0.0390	3.99	42.78%	0.027
	Error	16	0.1568	0.0097			
	Total	19	0.2740				
Thir	Event	3	0.1580	0.0527	14.55	73.17%	0.000

	Error	16	0.0580	0.0036			
	Total	19	0.2162				

Results of combined ANOVA table (see, table 3) showed that all four Strata (A, B, C & D) are significantly different as  $p\text{-value} < 0.05$  for all track and field events (Sprinters, Long Racers, Jumpers and Throwers). The values of coefficient of determination ( $R^2$ ) is 44.34%, 56.83%, 42.78% and 73.17% for Sprinters, Long Racers, Jumpers and Throwers respectively representing goodness of fit of the analysis of variances for all strata.

## 6. Discussion

The performance of track and field depends upon the muscular and neuromuscular recovery planned by the professional trainers during the periodization. Muscular recovery can easily be designed while planning the number of training session per-week for all events (sprinters, distance runners, jumping and throwing). Factors which needs due consideration, while planning physical recovery are the gender, biological or training ages of the athletes besides the environment and competition levels. During this 8 weeks intervention program, the data have been processed to evaluate the impact of muscular recovery on the performance of male and female elite athletes of all track & field events. Descriptive measures of all demographic variables for all strata were assessed and then two samples Wilcoxon test was applied for pre-post intervention significance assessment. The descriptive analysis showed that Mean  $\pm$  SD in biological Age (years)  $23.45 \pm 3.39$ ,  $24.90 \pm 1.99$ ,  $24.50 \pm 2.56$  and  $23.80 \pm 2.68$  for group A, B, C & D. Similarly, the Mean  $\pm$  SD of BMI (kg / m<sup>2</sup>) of all strata A, B, C & D were observed  $23.67 \pm 3.53$ ,  $22.85 \pm 3.78$ ,  $23.33 \pm 3.80$  and  $24.31 \pm 3.23$  (kg / m<sup>2</sup>) respectively. The results based on two samples Wilcoxon test at 5% level of significance showed the  $p\text{-value} < 0.05$  representing the rejection of null hypothesis and confirming the significance of post actual event

performance of both the genders. The female sprinters of all groups improved (2.09%) in comparison with male athletes, which was (1.73%) during eight weeks training intervention and long racers females (5000m) improved (3.47%), better than male athletes which were (2.99%) respectively. The performances of female jumpers were at power to male jumpers i.e. (3.58%) as compared to male (1.87%). Similarly, the improvements of throwers male and female athletes were found 1.17% and 1.72% after the intervention respectively. Moreover, the values of coefficient of determination ( $R^2$ ) are 44.34%, 56.83%, 42.78% and 73.17% for (sprinters, long racers, jumpers & throwers) representing goodness of fit of the analysis of variances for all strata.

According to study available on 5000m distance runners (Dhokrat, n.d.), in which total fifty athletes were divided into two equal groups (experiment and control group), aged 16-18 years collegiate boys which were given 8 weeks intervention program to analyze the uphill-downhill training effects. The study showed significant improvement with pre-post intervention Mean  $\pm$  SD performance results from  $24.00 \pm 1.07$ ,  $24.44 \pm 0.76$  (minutes) and post intervention  $23.11 \pm 1.56$   $0.89$  (minutes) for experiment and control group each ( $n=25$ ) respectively. The improved score of both the groups experiment and control were (- 0.89 and 0.09 minutes) respectively.

According to another research on throwing event (Kyriazis et al., 2022), ten trained track & field throwers (7 male and 3 females) followed a 34-week intervention program. The track and field throwing performance during peak period was increased significantly by  $5.4 \pm 2.9\%$  and  $1.9 \pm 1.7\%$ , for both genders respectively, with a significant difference ( $p < 0.001$ ). Thus, results also propose that 4 weeks of complex training



during the pre-competition period bring greater escalations in track & field (shot-put) throwing performance. According to another authentic research on the jumping and sprinting events (Philpott et al., 2021), in which, (27) elite professional athletes (9 x males & 7 x females sprinters) and (5 x males & 6 x females high jump height or from the take-off limits between the sprinters and high jumpers. These time series analysis showed that sprinters maintained a lower Centre of Mass (COM) position during the latter concentric phase. The male athletes jumped higher than the females (by 10.0 cm or 24.2%;  $p < 0.001$ ) with expressively peak power (17.9%,  $p = 0.002$ ) and significantly shorter eccentric time (17.4%,  $p = 0.035$ ).

The presently gender based study is fully aligned with the latest available research work. However, to improve the optimal performance in future the research can be conducted on the effects of high altitude training and specific nutrition for both the genders in future. Besides this the author also suggests that, it can be extended and applied by the trainers and experts of the track & field at all levels.

## 7. Conclusion

This research work concludes that eight weeks physiological intervention have significantly improved the performance of male and female athletes in all track & field sport events. However, the performance of female athletes improved greater than the male athletes due to more available room for improvement in standards.

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