

## Appendix1

### 1.1. Assessments

The physical characteristics measured in this study include demographic and anthropometric variables. Demographic variables refer to factors such as age and sex, while anthropometric variables describe the physical dimensions and composition of the body, including height, weight, body mass index, skinfold thickness, fat mass, fat-free mass, blood pressure, and various circumference and length measurements. The physiological characteristics measured in this study include various performance metrics and cardiovascular variables. These include body mass index, resting heart rate, maximum exercise heart rate, maximum oxygen consumption, measures of leg strength and power, and endurance performance metrics such as time trials and aerobic thresholds. The training characteristics measured in this study include, living and training altitude, training habits (stretching, interval training, power training, technique training), training experience, training volume, training sessions, recovery practices (rest, massage), running surface and footwear, and nutritional intake, were assessed.

#### 1.1.1. Paired sample t-test analyses

The results of the paired sample t-test analysis showed statistically significant p-values ( $p < 0.05$ ) for both ITG and PTG. This suggests that the interval and power training interventions led to significant changes in the physical and physiological characteristics of the participants within these groups. The use of paired sample t-tests was an important statistical approach to determine the pre- and post-test differences within each training group (1,2,3).

#### 1.1.2. Effect size

Effect size is a quantitative measure of the magnitude of an experimental effect, indicating how much variance in dependent variables can be attributed to independent variables. It is calculated as the difference between the means of two groups divided by the standard deviation of one group. A larger effect size suggests a stronger relationship between groups and a lower probability of Type II errors. In the context of ANOVA, Cohen's  $d$  is commonly used for effect size interpretation, defined as:  $Cohen's\ d = (x_1 - x_2) / s$ , where:  $x_1$  and  $x_2$  are the means of the experimental and control groups, respectively, and  $s$  is the pooled standard deviation. If the standard deviations of the groups are unequal, the average of the two is used.

There are two types of Cohen's  $d$  and Eta square, Cohen's  $d$  benchmarks are: small effect:  $d = 0.2$ , medium effect:  $d = 0.5$ , and large effect:  $d = 0.8$ . In our case we used from ANOVA table the second Cohen's  $d$  i.e. Eta square benchmarks are: small effect:  $d = 0.01$ , medium effect:  $d = 0.06$ , and large effect:  $d = 0.14$ . A large effect size indicates substantial practical significance, while a small effect size suggests limited application. Effect size also helps determine sample size for future studies, as larger effect sizes typically require smaller samples for statistical significance Cohen (1988) noted on (4).

Power refers to the probability of correctly rejecting a false null hypothesis. It is represented as  $p = 1 - \beta$ , where  $\beta$  is the probability of a Type II error (failing to reject a false null hypothesis). Increasing the power of a statistical test is desirable, as it means we are more likely to detect an effect if it truly exists. There are several ways to increase the power of a test: increase the sample size: larger sample sizes generally lead to higher power, increase the effect size: larger differences between groups result in higher power, relax the alpha level: increasing the significance level (e.g., from 0.05 to 0.10) can increase power. Power analysis is the process of determining the appropriate sample size or the minimum detectable effect size for a given level of power and significance. It helps ensure that the study has sufficient statistical power to detect an effect of practical importance. The insights gained from the statistical analysis and interpretation of the results can provide valuable information to coaches and athletes (1,2,3,4,5).

### **2.1. Results of physical characteristics**

Based on the key findings the details of the first null hypothesis was largely refuted, in most physical (demographic and anthropometric) characteristics, as detailed in Table 2; chronological age (years) increased by 4.16 ( $p = 0.02$ ), body mass index ( $\text{kg}/\text{m}^2$ ) by 3.54 ( $p = 0.03$ ), fat-free mass (kg) by 11.58 ( $p = 0.000$ ), and maximum thigh circumference (cm) by 14.03 ( $p = 0.000$ ). However, a few physical characteristics not statistically demonstrated significant changes, specifically sex ( $p > 1.000$ ), fields ( $p > 1.000$ ), and body mass ( $p > 0.73$ ).

### **2.2. Results of training characteristics**

The analyzed variables included living and training altitude (in meters), as well as various training habits such as stretching exercises (yes or no) with a P value of 0.21 ( $P > 0.82$ ), interval training (yes or no) with a P value of 0.52 ( $P > 0.60$ ), and power training (yes or no) with a P value of 0.16 ( $P > 0.86$ ). Additionally, the average and maximum training volumes of running distance over the last eight months (in km/week) were recorded at 1.09 ( $P > 0.34$ ) and 0.62 ( $P > 0.54$ ), respectively. Training sessions measured in number per day/week yielded a P value of 2.89 ( $P > 0.06$ ), while the number of rest hours per day was 0.12 ( $P > 0.89$ ). Other variables included the habit of massage therapy (yes or no) with a P value of 0.13 ( $P > 0.88$ ), safety habits regarding running surfaces with footwear (yes or no) at 0.60 ( $P > 0.55$ ), and intake habits of macronutrients and fluids (yes or no) 0.53 ( $P > 0.59$ ).

#### **2.2.1. Results of descriptive statistics**

The results obtained from descriptive statistics on the physiological characteristics of the participants from pre-test (PT) to post-test (POT) are presented in Table S 1. The mean and standard deviation ( $M \pm SD$ ) values indicate a slight difference among the three groups ITG, PTG, and CTG on the measured variables.

For resting heart rate (RHR), the values were: ITG:  $60.56 \pm 2.97$  (PT)  $\rightarrow$   $60.91 \pm 2.20$  (POT); PTG:  $55.54 \pm 5.14$  (PT)  $\rightarrow$   $55.96 \pm 4.99$  (POT); and CTG:  $54.26 \pm 5.33$  (PT)  $\rightarrow$   $54.52 \pm 5.30$  (POT)

For maximum exercise heart rate (MEHR), the values were: ITG:  $179.86 \pm 6.25$  (PT)  $\rightarrow$   $179.59 \pm 5.90$  (POT); PTG:  $167.07 \pm 11.32$  (PT)  $\rightarrow$   $166.72 \pm 11.36$  (POT); and CTG:  $166.42 \pm 10.07$  (PT)  $\rightarrow$   $165.97 \pm 10.34$  (POT).

### References

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**Table 1.** Physiological characteristics results from descriptive statistics between groups.

Dependant Variables	Independent Variables (M±SD)			Total (M±SD)
	ITG N=36	PTG N=36	CTG N=36	Total N=108
PT→POT				
BMI (Kg/m <sup>2</sup> )	20.60 ± 0.29 → 20.60 ± 0.29	20.75 ± 0.53 → 20.75 ± 0.53	20.83 ± 0.24 → 20.83 ± 0.24	20.73 ± 0.39 → 20.73 ± 0.38
RHR (bpm)	60.56 ± 2.97 → 60.91 ± 2.20	55.54 ± 5.14 → 55.96 ± 4.99	54.26 ± 5.33 → 54.52 ± 5.30	56.79 ± 5.34 → 57.13 ± 5.15
MEHR (bpm)	179.86 ± 6.25 → 179.59 ± 5.90	167.07 ± 11.32 → 166.72 ± 11.36	166.42 ± 10.07 → 165.97 ± 10.34	171.12 ± 11.25 → 170.76 ± 11.32
Balke $\dot{V}O_2$ Max	61.94 ± 4.25 → 61.93 ± 4.15	51.46 ± 3.78 → 51.90 ± 3.71	58.59 ± 4.61 → 59.07 ± 5.05	57.33 ± 6.06 → 57.63 ± 6.04
LS (°/Sec)	8.14 ± 0.52 → 8.03 ± 0.57	8.75 ± 0.54 → 8.65 ± 0.58	9.19 ± 0.32 → 9.20 ± 0.36	8.69 ± 0.63 → 8.63 ± 0.70
LP 1-RM	1.26 ± 0.02 → 1.27 ± 0.03	1.32 ± 0.01 → 1.34 ± 0.02	1.29 ± 0.05 → 1.30 ± 0.05	1.29 ± 0.04 → 1.30 ± 0.05
Squat (°/Sec)	51.53 ± 2.88 → 52.61 ± 2.74	42.75 ± 1.70 → 43.89 ± 1.70	47.81 ± 5.70 → 48.79 ± 5.81	47.36 ± 5.23 → 48.43 ± 5.23
SBI (°/Sec)	61.07 ± 5.53 → 60.11 ± 5.45	76.29 ± 4.80 → 75.65 ± 4.91	69.43 ± 9.39 → 69.99 ± 9.62	68.93 ± 9.24 → 68.58 ± 9.46
Sprint AT (°/Sec)	60.30 ± 2.75 → 59.95 ± 2.78	71.37 ± 1.70 → 71.06 ± 1.71	67.87 ± 4.72 → 68.25 ± 4.74	66.51 ± 5.68 → 66.42 ± 5.77
1.5 Km TT (Sec)	265.48 ± 29.84 → 256.08 ± 30.18	297.70 ± 16.96 → 292.10 ± 14.27	271.06 ± 26.56 → 297.33 ± 17.46	278.08 ± 28.56 → 281.84 ± 28.35
3Km TT (Sec)	9.15 ± 0.38 → 9.07 ± 0.29	9.00 ± 0.53 → 8.91 ± 0.52	9.43 ± 0.60 → 9.41 ± 0.62	9.19 ± 0.54 → 9.13 ± 0.53

Notes PRT: pretest; POT: post-test; RHR: resting heart rate; MEHR: maximum exercise heart rate; Balke $\dot{V}O_2$ Max: Balke at maximum oxygen uptake; °/Sec: the symbol refers second; 1RM LP: one repetition maximum at leg press; SBI: Sprint bounding index; AT: aerobic threshold; TT: time trial; Std. Deviation: standard deviation from the mean; Std. Error: standard error from the mean; 95% CI: 95% confidence interval.

**Table 2.** Post hoc test multiple mean comparisons using Bonferroni correction.

Parameters	Group (ITG X PTG X CTG) X Time (PT X POT) Main & Interaction Effect Mean Difference												Sig. Value Interaction Effect of Group X Time
	ITG		PTG		CTG		ITG		PTG		CTG		
(I-J)	PTG	CTG X	ITG	CTG X	ITG	PTG	PTG	CTG X	ITG	CTG X	ITG	PTG	
BMI	-.15222X	-.23111*X	.1522X .15222	-.07889X	.2311*X	.0788X	.263X	.031X	.263X	1.000X	.031X	1.000X	
	-.15222	-.23111*		-.07889	.23111*	.07889	.263	.031	.263	1.000	.031	1.000	
RHR	5.0141X	6.30250*X	-5.01417*X	1.28833X	-6.30250*X	-1.28833X	.000X	.000X	.000X	.714X	.000X	.714X	
	4.95417*	6.39250*	-4.95417*	1.43833	-6.39250*	-1.43833	.000	.000	.000	.504	.000	.504	
MEHR	12.78611*X	13.44028*X	-12.78611*X	.65417X	-13.44028*X	-.65417X	.000X	.000X	.000X	1.000X	.000X	1.000X	
	12.87861*	13.62861*	-12.87861*	.75000	-13.62861*	-.75000	.000	.000	.000	1.000	.000	1.000	
Balke	10.47139*X	3.34917*X	-10.47139*X	-7.12222*X	-3.34917*X	7.12222*X7.1	.000X	.003X	.000X	.000X	.003X	.000X	
VO2M	10.03194*	2.85361*	-10.03194*	-7.17833*	-2.85361*	7833	.000	.019	.000	.000	.019	.000	
LS (“/Sec)	-.60611*X	-1.04194*X	60611*X	-.43583*X	1.04194*X	.43583*X	.000X	.000X	.000X	.000X	.000X	.000X	
	-.61861*	-1.17222*	.61861*	-.55361*	1.17222*	.55361*	.000	.000	.000	.000	.000	.000	
LP “	-.06528*X	-.03278*X	.06528*X	.03250*X	.03278*X	-.03250*X	.000X	.000X	.000X	.000X	.000X	.000X	
1-RM	-.07222*X	-.03250*	.07222*	.03972*	.03250*	-.03972*	.000	.000	.000	.000	.000	.000	
Squat	8.77833*X	3.72278*X	-8.77833*X	-5.05556*X	-3.72278*X	5.05556*X4.8	.000X	.000X	.000X	.000X	.000X	.000X	
(“/Sec)	8.72222*	3.82417*	-8.72222*	-4.89806*	-3.82417*	9806*	.000	.000	.000	.000	.000	.000	
SBI (“/Sec)	-15.21667*X	-8.35444*X	15.21667*X	6.86222*X5.6	8.35444*X	-6.86222*X	.000X	.000X	.000X	.000X	.000X	.000X	
	-15.53889*	-9.88500*	15.53889*	5389*	9.88500*	-5.65389*	.000	.000	.000	.003	.000	.003	
Sprint AT “	-11.06750*X	-7.56806*X	11.06750*X	3.49944*X2.8	7.56806*X	-3.49944*X	.000X	.000X	.000X	.000X	.000X	.000X	
	-11.11028*	-8.29778*	11.11028*	1250*	8.29778*	-2.81250*	.000	.000	.000	.002	.000	.002	
1.5 Km TT “	-32.22639*X	-5.57111X	32.22639*X	26.65528*X	5.57111X	-26.65528*X	.000X	1.000X.0	.000X	.000X	1.000X	.000X	
	-36.02639*	-41.24944*	36.02639*	-5.22306	41.24944*	5.22306	.000	00	.000	.932	.000	.932	
3Km TT “	.14722X	-.27833X	-.14722X	-.42556*X	.27833X	.42556*X	.682X	.071X	.682X	.002X	.071X	.002X	
	.14583	-.34389	-.14583	-.48972	.34389	.48972	.642	.012	.642	.000	.012	.000	

Notes I-J: the mean difference of I & J methods of training (modalities) significant at alpha level 0.05; X: represent main and interaction effect; BMI: Body Mass Index; Kg/m<sup>2</sup>: kilogram per meter square; RHR: Resting Heart Rate; bpm: beats per minute; MEHR: Maximum Exercise Heart Rate; BalkeVO2Max: Maximum Oxygen Consumption; Kg/MI/Min: kilogram per milliliter per minute; LS: leg strength; “/Sec: second; LP: leg press; 1-RM: one repetition maximum; SBI: Sprint Bounding Index; 400m sprint AT: 400m Sprint Aerobic Threshold; M: meter; 1.5KmTT: 1.5Kilo meter Time Trial USSR Kosmin; Km: Kilometer; 3Km TT: 3Kilo meter Time Trial Maximum Speed.