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Original Article

Effect of the taper phase over endurance during 20 km race walking

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Abstract
Problem Statement: The main competitions of the World Race Walking events calendar occur in cities that are located at sea level (below 700 m). This suggests that an athlete who lives and trains at moderate altitude (2,600 m), must have different atmospheric conditions for training and competing.*Approach*: Based on our knowledge and literature review, we did not find studies that used altitude training with the taper phase at height above sea level as one of the variables to be included in performance or endurance in fundamental competencies. *Purpose*: This study aimed to determine the effect oftraining plan with the taper phase at 300-maltitude,contrasted to the taper phase at 2,600-m altitude, on the percentage of velocity at maximal oxygen uptake (%v-$\dot{V}O_{2max}$),andendurance index (EI) during a 20 km race walking competition in an athlete who lives and trains at the moderate altitude of 2,600 m. *Method:*An experimental design of a single subject type A-B-A-B was performed. A 28-year-old woman(body height of 160 cm, body weight of 46.0 kg ± 0.2, body mass index of 17.6, and maximal oxygen uptake [$\dot{V}O_{2max}$] of 55 $mL \cdot min^{-1} \cdot kg^{-1}$) participated in this study.The athlete performed 12 competitions of 20 km race walking during four seasons. Every competition was part of a training macrocycle. The athlete performed six training macrocycles with the taper phase at 2,600-m altitude and six training macrocycles with the taper phase at 300-m altitude.*Results:* There were significant improvements ($p <$ .05) in%v-$\dot{V}O_{2max}$ andEI when the taper phase was performed at 300-m altitude, compared to those when the taper phase was performed at 2,600-m altitude.*Conclusions:* The training plan with the taper phase performed at 300-m altitudehas a positive effect on the improvement in %v-$\dot{V}O_{2max}$andEI in an athlete who lives and trains at 2,600 m but competes at sea level.
Key words: Acclimatization, Endurance index, Altitude training, Training plan.

Introduction

The training process of high-performance athletes requires a constant search for strategies to achieve the best results. It is clear that many hypoxic conditions or prolonged exposures to altitude result in biological costs of hypoxic adaptations that outweigh their benefits (Millet &Brocherie, 2020). One of the best methods of training in endurance sports is under hypobaric hypoxia conditions using natural methods, such as training at moderate altitude (2,000-3,000m), which improves oxygen transport processes owing to an increase in hemoglobin and hematocrit in the body (Nummela et al., 2020; Pottgiesser et al., 2009).

Altitude training increases the level of hemoglobin and hematocrit as a compensatory effect to hypoxia (Bonetti & Hopkins, 2009; Nummela et al., 2020) and, in turn, decreases the maximum oxygen uptake ($\dot{V}O_{2max}$) and maximum aerobic speed (MAS). This occurs owing to the lower uptake of oxygen(Dobrosielski et al., 2020; Robach et al., 2014).

Currently, the approach of training known as live high-train low has become popular (Levine & Stray-Gundersen, 1997; Stray-Gundersen et al., 2001; Brugniaux et al., 2006). In addition, the taper phase approach involves a reduction in the training load of athletes in the final days before an important competition, intending to optimize performance (Bosquet et al., 2007; Mujika, 2009); the effectiveness of this approach has been confirmed by wrestlers (Karimi, 2017), swimmers (Stewart & Hopkins, 2000), distance runners (Luden et al., 2010), and Taekwondo athletes (Carazo-Vargas & Moncada-Jiménez, 2018).Nonetheless, the effect of the alteration of taper components (i.e., volume, intensity, frequency, duration, and density) on performance in competitive athletes, along with the application of a training plan with the taper phase at height above sea level have not been studied until now.

The main competitions of the World Race Walking events calendar occur in cities that are located at sea level (below 700 m). This suggests that an athlete who lives and trains at moderate altitude(e.g., the city of Chia[2,600 m],Colombia), must have different atmospheric conditions for training and competing. In this regard, some researchersmanaged to analyzeacclimatization, identifiedtraining workouts to optimize iron deposition, and

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studiedthe effect of hypoxia on athletes(Brugniaux el al., 2006; Chapman et al., 1998; Chapman & Levine, 2007; Levine & Stray-Gundersen, 1997).

Chapman et al. (2014) have suggested that the optimal sea-level re-acclimatization time, for athletesreturn from moderate altitudes, should be from 7 to 14 days. This is applicable to athletes who live at sea level and perform periods of altitude training; thus, there is need for re-acclimatization.

However, for race walkers, who live and train at moderate altitude,acclimatization periods before competitions at sea level have not been considered; however, this issue iscritical for performance outcomes in endurance events (Ranisavljevet al., 2011).In addition, the current results of experimental studies show that the live high-train low approach seems to be more effective in advanced exercise performance, though it is still unclear how this approach improves performance (Çolak et al., 2020).Therefore, coaches and researchers must search for alternatives to develop the optimum speed of competition with athletes living at moderate altitude.

Based on our knowledge and literature review, we did not find studies that used altitude training with the taper phase at height above sea level as one of the variables to be included in performance or endurance in fundamental competencies.Therefore, this study aimed to determine the effect of training plan with the taper phase at 300-m altitude, compared to the taper phase at 2,600-m altitude,on the percentage of velocity at maximal oxygen uptake (%v-$\dot{V}O_{2max}$), and endurance index (EI) during the 20 km race walking competition (20 km RWC) in an athlete who lives and trains at a moderate altitude of 2,600 m; we hypothesized that the taper phase performed at 300 m improves %v-$\dot{V}O_{2max}$ and EIduring 20 km RWC in an athlete who lives and trains at 2,600-m altitude.

Materials and Methods

Participant

A 28-year-old woman participated in this study. She ismultiple national champion (in Colombia) in 20 km race walking;currently,she is a world-class race walker who competed in the Rio Olympic Games 2016 and possesses the Olympic Entry Standard for Tokyo Olympic Games 2020 of 1 hr 31 min (20 km race walking).The athlete has 15 years of sports experience; 6 years ago, she trained under a contemporary plan of blocks,with increased peaks of performance up to five during the year (Issurin, 2018).

The participant of this study provided her written informed consent to participate in it after receiving information about the study and the possible risks and discomforts associated with the experimental procedures. The study was developed according to the Code of Ethics of the World Medical Association (2013)andwas conducted according to the guidelines of the National Ministry of Health (1993), resolution 008430, article 11, which stated that the research was of minimum risk because it was a non-invasive study.

Experimental approach for the problem

A quantitative study was performed using an experimental design of a single subject type A-B-A-B. (Thomas et al., 2015).

Independent variable

An independent variable was a training plan implemented during2011-2014 seasons. During these seasons, 12 macrocycles were performed. The length of each training macrocycle, including the taper phase mesocycle, was 12 weeks (Noakes, 2003). Table 1 shows the macrocycle structure with four mesocycles. During the competition mesocycle (i.e., last two weeks), the taper phase was planned (Mujika, 2009).

Table 1
Macrocycle structure

Mesocycle	Name	Microcycles	Microcycle name	Ratio
1	Basic (Accumulation)	4	Load, Load, Shock, and Recovery	(3:1)
2	Specific (Transformation)	3	Load, Shock, and Recovery	(2:1)
3	Specific (Transformation)	3	Load, Shock, and Recovery	(1:2)
4	**Competition (Realization)**	**2**	**Taper Phase**	**(1:1)**

Note. Ratio =ratio betweenloading andrecovery phases between microcycles.

Training Load Components During the Taper Phase

The evaluated training load components were volume, intensity, frequency, and density (Bompa&Buzzichelli, 2019). Figure 1 shows the training volume of each macrocycle; the microcycle average was 120 km per week (Čillík et al., 2004).

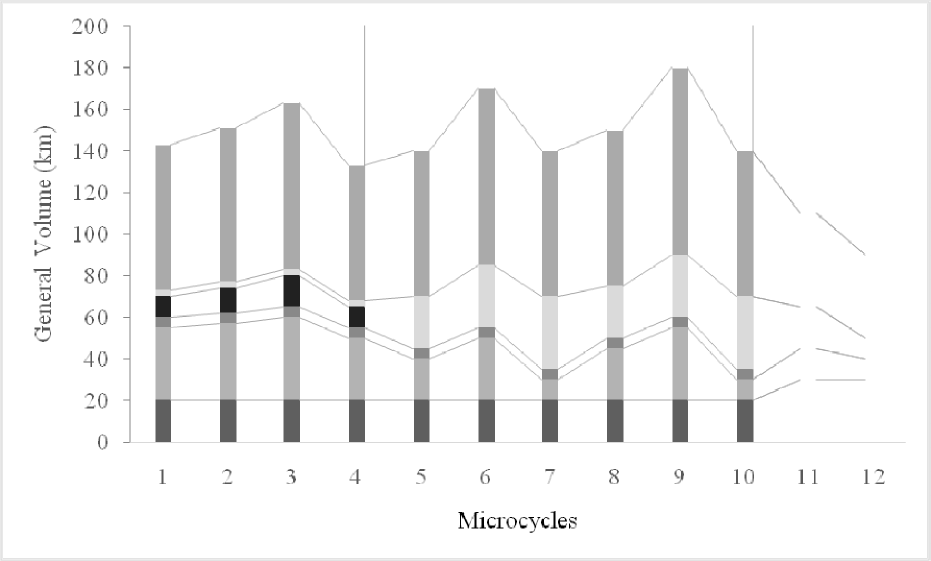

Figure 1 *Macrocycle training volume*
Note. Light bars represent the total volume performed every week;dark bars represent the total volume performed during the taper phase (microcycles 11 and 12).

Intensity was assessed using the maximum aerobic power field test of 2,000 m race walking. This research assumed the mentioned test as 100% of v-$\dot{V}O_{2max}$ (Drake et al., 2007), and 20 km RWC specific intensity corresponds to the lactic threshold.The athlete's threshold was 89% - 91% of v-$\dot{V}O_{2max}$. The training zones for this research were: regenerative training below 80% of v-$\dot{V}O_{2max}$, extensive general endurance training performed between 80% and 84% of v-$\dot{V}O_{2max}$, and specific intensity of competition between 89% and 91% of v-$\dot{V}O_{2max}$.

Training frequency during the taper phase was 6-7 training sessions per week, as shown in Figure 2. Training density during the taper phase corresponded to a 1:1 ratio betweenloading and recovery phases between training sessions.

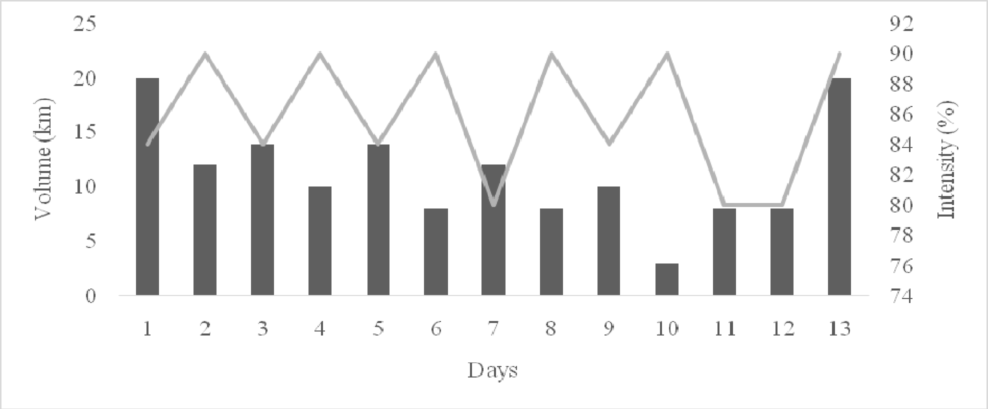

Figure 2 *Dynamic of training load during the taper phase*
*Note.*Bars show volume, and the line shows intensity.

The research variablewas the height above sea level of the city where the taper phase occurred. The research was conducted in two cities in Colombia. The selected cities were Chia and Girardot. Chiais located at 2,600-m altitude, has average temperature of 12°C, and 60% humidity. Girardot is located at 300-maltitude, has average temperature of 24°C, and 80% humidity.

Dependent variable

The dependent variables were %v-$\dot{V}O_{2max}$ and EI measured during 12 competitions of 20 km race walking during2010-2014 seasons; all competencies were certified and endorsed by the current World Athletics (WA).

%v-$\dot{V}O_{2max}$ is the percentage of $\dot{V}O_{2max}$ that can be used during an aerobic race (20 km RWC). Specifically, it is the ratio of speed that corresponds to the maximum oxygen uptake (v-$\dot{V}O_{2max}$) and speed at which 20 km RWC is performed.

EI is defined as the relationship between the percentage of $\dot{V}O_{2max}$ mobilized and race duration plotted on a non-linear logarithmic scale (Péronnet& Thibault, 1987). Thus, the authors considered endurance as a decrease in the percentage of $\dot{V}O_{2max}$.EI is expressed by the following equation:$EI = (100 - \%v\text{-}\dot{V}O_{2max}) / (Ln2{,}000\ m - Ln20\ km)$; where $\%v\text{-}\dot{V}O_{2max}$ is the percentage of v-$\dot{V}O_{2max}$,*Ln2,000 m* is the Napierian logarithm (Ln) of time (s) inthe 2,000 m race waking field test (RWFT), and *Ln20 km* isthe Ln of official time (s) in 20 km RWC.

In addition, $\dot{V}O_{2max}$ was calculated from MAS achieved in 2,000 m RWFTbecause it is known that 2,000m RWFTsare performed at 100% of the speed associated with $\dot{V}O_{2max}$(Billat, 2002); the Léger & Mercier (1983) equation was applied, $\dot{V}O_{2max} = 1.353 + (3.163\cdot v) + (0.0122586\cdot v^2)$,where $\dot{V}O_{2max}$ is $mL\cdot min^{-1}\cdot kg^{-1}$, and *v*is $km\cdot h^{-1}$.

Procedures

During 2010-2014 seasons, the athlete performed 12macrocycles with 12 mesocycles of taper phases. The mesocycles of taper phases were divided into two groups of six mesocycles each. The first group was named (a) mesocycles performed at 2,600-m altitude in Chia. The second group was named (b) mesocyclesperformed at 300-m altitude in Girardot.

Three weeks before each of 12 fundamental competitions, 2,000 m RWFT was conducted on a standard athletic track at the altitude of 2,600 m above sea level. After a 20-min warm-up to 6o% of v-$\dot{V}O_{2max}$, the athlete completed 5 laps on a 400-m track at the highest possible intensity while maintaining therace-walking technique (Drake at al., 2008).The time achieved at the end of the test and the maximum heart rate reached were recorded (Polar® M400; Polar Electro Inc, Kempele, Finland). In addition, $\dot{V}O_{2max}$ was calculated from MAS achieved in 2,000 m RWFT (Léger & Mercier, 1983).

Then, the period of development of two microcycles prior to the competition was performed, which accounted for the volume reduction in the previous mesocycle (40% and 60% in the last 2 weeks), 5 sessions for the specific rhythm of competition of 20 km race walking (89% - 91% of v-$\dot{V}O_{2max}$), and 10 sessions for extensive general endurance training (80% - 84% of v-$\dot{V}O_{2max}$).

The above-mentioned planning structure was used for12 mesocycles during the taper phase. Regarding the specific rhythm of competition, there were variations according to the athlete's performance status; therefore, the training rhythm during the taper phasewas rectified based on 2,000 m RWFT performed 3 weeks before the main competition.

At the end of the 2-weektaper phase, the athlete participated in 20 km RWC in an international championship organized by WA. Table 2 includes competitions performed using the taper phase at 2,600-m altitude in Chia(group a); Table 3 includes competitions performed using the taper phase at 300-m altitudein Girardot(group b). The athlete performed 10 competitions at sea level and two competitions at 1,500-1,600m above sea level.

Table 2 *Competitions performed using the taper phase at 2,600-m altitude in Chia (group a)*

			The Taper Phase	
	Competition	City	Term (days)	Intensity (v-$\dot{V}O_{2max}$)
1	IAAF Race Walking Challenger (2011)	Milan*	14	89% – 92%
2	World Race Walking Cup (2012)	Saransk*	14	89% – 92%
3	IAAF World Championships (2013)	Moscú*	14	89% – 92%
4	Bolivarian Games (2013)	Trujillo*	15	89% – 92%
5	South American Games (2014)	Santiago*	15	89% – 92%
6	IAAF World Race Walking Cup (2014)	Taicang*	15	89% – 92%

Note. * = sea level; v-$\dot{V}O_{2max}$= velocity at maximal oxygen uptake.

Table 3 *Competitions performed using the taper phase at 300-m altitude in Girardot city (group b)*

			The Taper Phase	
	Competition	City	Term (days)	Intensity (v-$\dot{V}O_{2max}$)
1	Central American and Caribbean Games (2010)	Mayaguéz*	14	89% – 92%
2	Pan American Race Walking Cup (2011)	Medellín**	14	89% – 92%
3	Francia Race Walking Championships (2011)	Netz*	15	89% – 92%
4	IAAF Race Walking Challenger (2012)	Rio Mayor*	14	89% – 92%
5	IAAF Race Walking Challenger (2012)	La Coruña*	15	89% – 92%
6	Pan American Race Walking Cup (2013)	Guatemala***	14	89% – 92%

Note. * = sea level; ** = 1,600 m above sea level; *** = 1,500 m above sea level; v-$\dot{V}O_{2max}$= velocity at maximal oxygen uptake.

Statistical analysis

The information was processed and analyzed using the statistical program IBM® SPSS Statistics version 26.0. The mean± standard deviation (*M*± *SD*), and 95% confidence intervals (CI) were calculated for all variables. The data were screened for normality of distribution using the Shapiro Wilk normality test,and the homogeneity of variance was verified using the Levenetest. An unpaired *t*-test was used to analyze significant differences between the taper phase groups and test the hypothesis. Cohen´s *d* was calculated to estimate the effect size (ES). The ES values were interpreted as follows: (<0.2) insignificant,(0.2 - 0.6) small,(0.6 - 1.2) moderate, (1.2 - 2.0) large,(2.0 - 4.0) very large, and (>4) extremely large effect (Hopkins et al., 2009). Significant level was set at $p < .05$.

Results

A 28-year-old woman (body height: 160 cm; body weight: 46.0 kg ± 0.2; body mass index: 17.6; $\dot{V}O_{2max}$: 55 $mL\cdot min^{-1}\cdot kg^{-1}$; anaerobic threshold: 178 bpm ± 1; v-$\dot{V}O_{2max}$: 14.17 $km\cdot h^{-1}$; competition rate of 4:30 min/km; %v-$\dot{V}O_{2max}$: 91%)participated in this study.The Shapiro Wilk normality test of taper phases ofgroups a and b is shown in Table 4.

Table4 *Normality test for both groups of taper phases*

		Shapiro WilkTest (*p*)				
Taper Phase Groups	(n)	v-$\dot{V}O_{2max}$	$\dot{V}O_{2max}$	20 km RWC	%v-$\dot{V}O_{2max}$	EI
TP GA	6	.812	.872	.479	.721	.726
TP GB	6	.490	.463	.469	.758	.757

Nota.p= significance;TP GA = taper phase group a; TP GB = taper phase group b;v-$\dot{V}O_{2max}$ = velocity at maximal oxygen uptake;$\dot{V}O_{2max}$ = maximal oxygen uptake; 20 km RWC = 20 km race walking competition;%v-$\dot{V}O_{2max}$= percentage of velocity at maximal oxygen uptake; EI = endurance index.

The homogeneity of variance was equal in both groups because non-significant (*ns*) differences were observed: v-$\dot{V}O_{2max}$, $F(1, 10) = 0.047$, *ns*;$\dot{V}O_{2max}$, $F(1, 10) = 0.009$, *ns*; 20 km RWC,$F(1, 10) = 1.617$, *ns*; %v-$\dot{V}O_{2max}$,$F(1, 10) = 0.055$, *ns*; and EI,$F(1, 10) = 0.033$, *ns*.

The results of 2,000 m RWFT and its corresponding 20 km RWC when the taper phase was performed at 2,600-mand 300-m altitudes are presented in Tables 5 and 6, respectively.EI hasa negative value because it indicates the loss of speed and a decrease in the fraction of $\dot{V}O_{2max}$used and is related totime. The value of EI above 5 indicates an athlete with low endurance (Péronnet& Thibault, 1987, 1989). At the same time, the lower value of EI suggests better endurance or better ability to sustain higher percentage of $\dot{V}O_{2max}$.

Table 5 *Results of the taper phase at 2,600-m altitude, group a*

	2,000 m RWFT (v-$\dot{V}O_{2max}$)			20 km Race Walking Competitions			
Competitions	Test (s)	Speed (m/s)	$\dot{V}O_{2max}$	Time (s)	Speed (m/s)	%v-$\dot{V}O_{2max}$	EI
1	560	3.57	44.02	6041	3.31	92.7	-3.068
2	550	3.64	44.90	5914	3.38	93.0	-2.946
3	534	3.75	46.28	5629	3.55	94.9	-2.165
4	536	3.73	46.03	5697	3.51	94.1	-2.496
5	530	3.77	46.53	5644	3.54	93.9	-2.578
6	520	3.85	47.54	5517	3.63	94.3	-2.413
M	538.33	3.71	45.88	5740.33	3.48	93.81	-2.611
SD	14.38	0.09	1.24	196.97	0.11	0.82	0.338

Note. RWFT = race walking field test; v-$\dot{V}O_{2max}$= velocity at maximal oxygen uptake;$\dot{V}O_{2max}$ = maximal oxygen uptake;%v-$\dot{V}O_{2max}$= percentage of velocity at maximal oxygen uptake;EI = endurance index.

Table 6 *Results of the taper phase at 300-m altitude, group b*

	2,000 m RWFT (v-$\dot{V}O_{2max}$)			20 km Race Walking Competitions			
Competitions	Test (s)	Speed (m/s)	$\dot{V}O_{2max}$	Time (s)	Speed (m/s)	% v-$\dot{V}O_{2max}$	EI
1	576	3.47	42.77	5907	3.39	97.5	-1.077
2	566	3.53	43.52	5904	3.39	95.9	-1.748
3	558	3.58	44.15	5796	3.45	96.3	-1.581
4	540	3.70	45.65	5651	3.54	95.6	-1.873
5	540	3.70	45.65	5604	3.57	96.4	-1.538
6	548	3.65	45.02	5756	3.47	95.2	-2.041
M	554.66	3.60	44.46	5769.66	3.46	96.15	-1.643
SD	14.62	0.09	1.18	125.94	0.07	0.79	0.333

Note. RWFT = race walking field test; v-$\dot{V}O_{2max}$ = velocity at maximal oxygen uptake;$\dot{V}O_{2max}$ = maximal oxygen uptake; %v-$\dot{V}O_{2max}$ = percentage of velocity at maximal oxygen uptake;EI = endurance index.

Figure 3compares the effects on EI of the training plan with the taper phase at 300-m altitude with those of the taper phase at 2,600-m altitude.

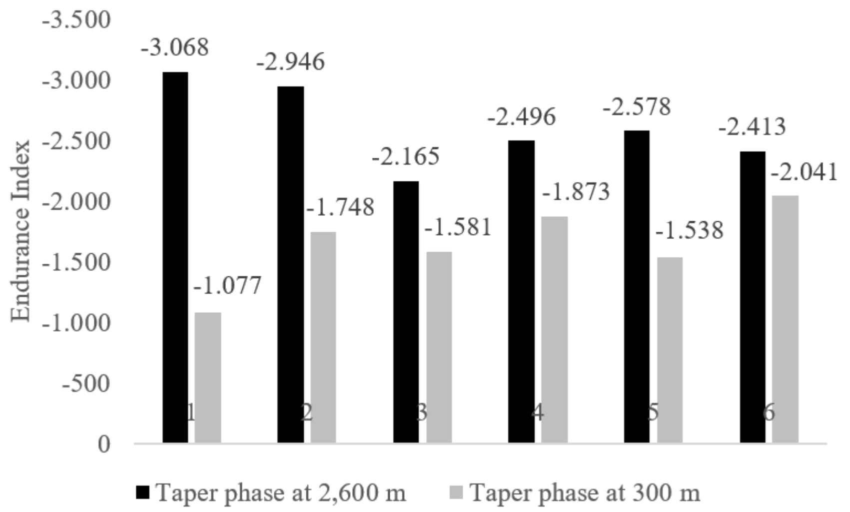

Figure 3 *Endurance indexdepending onthe taper phase at 2,600-m and 300-maltitudes*

The hypothesis was evaluated of whether a taper phase performed at 300-m altitude improved %v-$\dot{V}O_{2max}$ and EI during the 20 km RWC in an athlete who lived and trained at 2,600-m altitude. Table 7 shows the results of independent variables.

Table 7 *Results of independent variables*

Variables	M	SD	95% CI	*t*(10)	*p*	Cohen´s *d*
%v-$\dot{V}O_{2max}$	-2.333	0.468	[-3.377, -1.289]	-4.981	.001	-2.590
EI	-0.968	0.194	[-1.400, -0.535]	-4.985	.001	- 1.669

Note. %v-$\dot{V}O_{2max}$ = percentage of velocity at maximal oxygen uptake; EI = endurance index; CI = confidence interval.

Significant differences ($p< .05$) were observed between taper phases for %v-$\dot{V}O_{2max}$[ES = large; CI 95% (-3.377, -1.289), p = .001] and EI [ES = moderate; CI 95% (-1.400, -0.535), p = .001]. Non-significant differences ($p> .05$) were observed between taper phases for $\dot{V}O_{2max}$[ES = small; CI 95% (- 0.141, 2.986), p = .070] and 20 km RWC (s)[ES = trivial; CI 95% (- 242.002, 183.336), p = .765].

Discussion

This study aimed to determine the effect of training plan with the taper phase at 300-m altitude, contrasted to the taper phase at 2,600-m altitude, on %v-$\dot{V}O_{2max}$, and EI during 20 km RWC in an athlete who lives and trains at a moderate altitude of 2,600 m. The obtained results confirm the hypothesis that a taper phase performed at 300-m altitude improves %v-$\dot{V}O_{2max}$ and EI during20 km RWC. These results confirm that a training plan withtaper phases performed at 300-m altitudeis effective for a high-performance athlete who lives and trains at a moderate altitude of 2,600 m. To our knowledge, this is the first study that analyzed the effect of a taper phase performed at two different heights above sea level as another variable of the study.

The EI during 20 km RWC increases when the athlete performs the taper phase at 300-m altitude compared to the taper phase performed at 2,600-m altitude. This performance remained consistent during12 competitions performed during 4 years by an athlete who lived and trained at 2,600-m altitude. According to Gore et al. (1998), Levine and Stray-Gundersen (1997), and Stray-Gundersen et al. (2001), it is assumed that those effects are attributed to better adaptation to the specific rhythm of competition.

Likewise, those authors suggest that altitude training is not as effective as sea-level training because at moderate altitude it is not possible to maintain the same absolute intensity, nor it is possible to perform the same volume of training as at 300-m altitude.

The preparation plan and its method of load distribution coincide with the load distribution described by Krzysztof et al. (2014) in the description of a longitudinal case study. Similarly, the modified load distribution during the taper phase increases threshold workout and decreases extensive aerobic workout (Mujika, 2009).

Billat (2002) has mentioned that the lack of adaptation to hot weather can lower performance by up to 10%. If we analyze 12 competitions, during the 4 years of intervention, all competitions occurred at the temperature of 15-20 °C; therefore, training using the taper phase in hot weather at 300-m altitude allowed a series of physiological adjustments to occur, which mitigated the stress owing to weather during the competitions. Similarly, the taper phase performed at 300-m altitude by an athlete who lives and trains at a moderate altitude of 2,600 m, seems to be effective for proper altitude acclimatization and to face competitions at sea level. This acclimatization is essential for proper altitude acclimatization (Ranisavljev et al., 2011).

$\dot{V}O_{2max}$did not significantly vary during 4 years; this differs from anaerobic threshold, which improves every year. These results coincide withstudies reported by several authors (Drake et al., 2003; Farrel et al., 1979; Hagberg& Coyle, 1984; Yoshida et al., 1989).

The lactate threshold velocity in 20 km RWC suggests that success depends on the capacity to reach desired velocity and maintain it without lactate accumulation, i.e., through the contribution of energy to the resynthesis of ATP by aerobic metabolism. Apparently, the taper phase performed at 300-m altitude by, an athlete who resides and trains at a height 2,600-m altitude, allows this capacity to be improved within several days because an improvement is observed in the ratio of maximum aerobic power and capacity to use a greater percentage of velocity at maximal oxygen uptakeduring20 km RWC.

Other studies on race walkers(Brodániet al., 2015; Gomez et al., 2016; Pugliese et al., 2014; Pupis&Čillík, 2008) had several similar aspects. Specifically, athletes lived at sea level; allstudies were descriptive andfocused on observing changes in $\dot{V}O_{2max}$; some studies determined velocity at lactate threshold, and other studies analyzed the relationship between loadsand the result. However, none of those studiesexperimentally measuredeffects on the same athlete for a long period of time, and none of these studies included altitude above sea level as a variable.

Compared to other studies, this study focused on the application of a training plan with the taper phase at height above sea level as an additional variable. The taper phase was characterized by the modification of the components of the load (i.e., volume, intensity, frequency, duration, and density), i.e., a progressive decrease in the volume and an increase in or maintenance of the intensity during the phase within 7-21 days before the competition (Mujika, 2009); the effectiveness of this approach has already been confirmed (Mohan &Kalidasan, 2013). However, none of the taper phase study cases of runners or race walkers considered height above sea level as another research variable.

Conclusions

The training plan with the taper phase performed at 300-m altitude, with a duration of 2 weeks,frequency of 7 sessions a week,volume of workout of 120 km per week, a reduction of 40% and 60% in the last two microcycles,intensities between 80% and 92% of effort, anddensity ratio of 1:1 has a positive effect on the improvement of %v-$\dot{V}O_{2max}$ andEI ($p < .05$) in an athlete who lives and trains at 2,600 m but competes at sea level. When the participant performed the taper phase at 2,600 m, the endurance index was - 2611;thus,the athlete managed to sustain an average of 93% ofv-$\dot{V}O_{2max}$ during 20 km RWCover 4 years. When the participant performed the taper phase at 300-m altitude, the endurance index was - 1.643; thus, the athlete managed to sustain an average of 96% of the v-$\dot{V}O_{2max}$ during 20 km RWCover 4years.

The taper phase performed at 300-m altitude seems to be effective for proper altitude acclimatization and to facecompetitions at sea level by an athlete who lives and trains at a moderate altitude of 2,600 m. In addition, training with the taper phase in hot weather at 300-m altitude allows a series of physiological adjustments that mitigate the stress of weather during the competitions at sea level because the main competitions of the World Race Walking events calendar occur in cities that are located at sea level (below 700 m). The obtained results confirm the proposed hypothesis that the taper phase performed at 300-m altitudeimproves %v-$\dot{V}O_{2max}$ and EI during 20 km RWC in an athlete who lives and trains at 2,600 m. In addition, it isconcluded that performing 14 days of the taper phase is sufficient to produce changes in %v-$\dot{V}O_{2max}$ and EI.

Conflicts of interest - The authors report no conflict of interest.

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