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Acute effects of sprinting with a sledge upon regular sprinting performance

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Abstract

The aim of this study was to investigate the acute effect of sprinting with a sledge upon running performances in sprint. Thirty four (23 men and 11 women) secondary school and university students with athletics experience (age 20.21 ± 3.22yr, mass 65.04 ± 10.89 kg, 171.21 height ± 8.29 cm) participated in the study. The subjects performed this protocol in a two non-consecutive days, doing a rest day or easy training between the days of protocol. This protocol consisted of each participant perform each day a group of sprints, one day 7x60m alternating with normal and sledge running and the other day 7x60m of normal running. The weight of the sledge was 10% of body mass of each participant. It was found that training with the sledge or without it have the same training effect, thus there is no acute effect of sprinting with a sledge upon running performances in sprint. It is concluded that when an athlete reports that felt running faster after using sledge it seems ir is only a subjective feeling.

Keywords: Sledge Running, Resisted sprint training, Strength training, Sprint Training

Resumo

O objetivo deste estudo foi investigar os efeitos agudos nas performances das corridas de velocidade usando um trenó como método de treino de resistência e depois correndo normal sem resistência. Trinta e quatro (23 homens e 11 mulheres) do ensino secundário e estudantes universitários com experiência na modalidade de atletismo (idade 20,21 ± 3.22 anos, massa 65,04 ± 10,89 kg, altura 171,21 ± 8,29 cm) participaram no estudo. Os indivíduos realizaram este protocolo em dois dias não consecutivos, fazendo um dia de descanso ou de treino mais leve entre os dias de protocolo. Este protocolo consistiu em cada participante realizar cada dia um grupo de sprints, um dia alternando 7x60m com corrida de velocidade normal e com o trenó e o outro dia 7x60m apenas com corrida velocidade normal. O peso do trenó foi de 10% da massa corporal de cada participante. Verificou-se que o treino com o trenó ou sem ele teria o mesmo efeito de treino, portanto, não há um efeito agudo de correr com um trenó e após fazer corrida de velocidade normal. Conclui-se que quando um atleta diz que se sentiu mais rápido a correr após o uso do trenó, pode ser apenas um sentimento subjetivo.

Palavras-chave: Corrida de velocidade com trenó, treino de corrida com resistência, treino de força, treino de velocidade

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* indicates a significant difference ($p < 0.05$) beween thes two sprint times and all right for it.

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† indicates a significant higher stride rate ($p < 0.05$) compared to all other sprints except with sprint 3.

[a] indicates a significant lower stride rate ($p < 0.05$) between this sprint and all left from the arrow.

[b] indicates a significant higher stride rate ($p < 0.05$) between this sprint and all right from the arrow.

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1 - Introduction

In our days the speed training is essential to the sports, involves many people and methods. Throughout time we have seen an improvement in results and that is due to the improvement of the conditions and methods of training. There are different types of resistance training to improve speed on athletes, for example uphill running, parachute training (Paulson S 2011), sprint elastic-towing (Corn RJ 2003), sled towing (Clark KP 2010; Lockie M 2003) and running with a loaded weighted vest (Konstantinos Z 2014).

Sledge running is a type of resistance training usually used as a way to improve speed and acceleration in normal running performance (Makaruk B 2013). Sports like rugby, american football, soccer and track and field athletics are examples of sports that use sledge running as a way in training (Harrison AJ 2009; Hrysomallis C 2012; Makaruk B 2013) This type of improvement in normal running performance is based on theory of Post-activation potentiation. Post-activation potentiation is a mechanism which causes enhanced muscular performance after a high intensity stimulus (Tsimachidis C 2013).

The effect of resisted sled towing on acceleration and maximum speed in male rugby players was investigated by Harrison et al. (2009). They have done a 6 week period with 12 training sessions and found that loads of approximately 13% of body mass resulted in significantly improved static start 5-m sprint times. Neither the control group nor the resisted sled group improved in 10- and 30-m static start sprint times, and there was no significant difference between the groups, suggesting that traditional rugby sprint training is as effective as resisted sled towing in improving sprint speed at these distances. (Harrison AJ 2009)

Zafeiridis et al. (2005) have done sprint tests of 50meter, to observe resisted sprint training influence on sprint speed. They have a normal sprint group and a resisted sprint group of 11 physical education students each group, that performed a 3 times per week training during 8-weeks, doing 4x20meter and 4x50meter sprint. There was a significant improvement in resisted group at distances 0-10meters and 0-20m speed. Also have significant changes in normal group at distances 20-40meter, 40-50meter and 20-50meter speed. (Zafeiridis et al. 2005)

Clark et al. (2010) observed if resisted sprint training influenced sprint speed with college lacrosse players, who were divided in 3 groups, normal sprint group (7 M), resisted sprint sled group (7 M) and resisted sprint vest group (6 M). They performed 2 times per week during 7-weeks, 6-9 sets of 18-55m, the sled group used weighted sled of approximately 10% of body weight and the group of weighted vest used approximately 18.5% of body weight. On test of 18-55 meter interval, all groups have improved significantly sprint speed, with no significant differences in speed between groups. (Clark et al. 2010)

The effect of assisted and resisted sprint training in acceleration and velocity was also researched by Upton, DE (2011). He has done this evaluation on division IA female soccer athletes during 4-weeks with 12-session training program comparing resisted sprint training, assisted sprint training and traditional sprint training. Assisted and resisted group training demonstrated that maximum 40-yard velocity increased significantly in these groups and did not change in traditional sprint group. In acceleration phase (5-15yard) authors have registered a significantly increase on assisted sprint training but did not register a improve on resisted and traditional sprint training. Acceleration was increased significantly in resisted group at 15-25 yard, decreased significantly on assisted group and did not change in traditional group. The same has occurred on distance 25-40 yard with accelerations which increased significantly in resisted group and remained unchanged on assisted and traditional group. It was suggested that athletes who need to be good on short distance acceleration events can use assisted training protocol to train and thus when is required greater maximum velocity athletes should use resisted sprint training protocols. (Upton, DE 2011)

The athletes who train with sledge have usually a subjective feeling that can run faster in normal running after using sledge. However, there is a lack in the scientific knowledge regarding to this issue, and deeper analysis is needed. (Hrysomallis C 2012)

Therefore, the purpose of this study was to examine the acute effects of running with a sledge upon regular sprinting performance on athletics athletes. It was hypothesized that running after using the sledge training would be improved.

2 - Methods

2.1 - Experimental approach to the problem

This study was conducted to see if sledge running have any acute effects on running performances in normal sprint. All subjects are from an athletics group that has university and secondary students. They have done two non-consecutive day of sprint running test, one day sprint without sledge and in the other day alternating normal sprinting with sledge running to analyze if there are any acute effects on running performances.

It can be found some studies with resisted training protocol with sledge, but in other sports like ruby or football, in athletics at this moment none have done any similar combining acute effects and sledge running.

2.2 - Subjects

Thirty four (23 men and 11 women) secondary school and university students participated in this study, can be seen on table 1 the anthropometric data of them. Some subjects repeated the protocol in a different session. None of the subjects had considerable experience with this type of training. The study was approved by the local ethics committee and from all subjects a written informed consent was obtained prior to all testing.

Table 1 – Anthropometric data (mean values of age, mass and height of athletes).

	Total (n=34)	Female (n=11)	Male (n=23)
Age (years) Mean ± SD	20,2 ± 3,2	18,27 ± 3,27	21,13 ± 2,87
Mass (kg) Mean ± SD	65,0 ± 10,9	55,04 ± 4,09	69,82 ± 9,81
height (cm) Mean ± SD	171,2 ± 8,3	163,18 ± 5,95	175,04 ± 7,58

2.3 - Procedures

Each participant was available two non-consecutive days and done a rest day or easy training between days of protocol. Before data collection are recorded age, mass and height of all participants and it was calculated 10% of body mass of each one.

The protocol consisted of each participant perform each day a group of sprints, one day 7x60m alternating with normal and sledge running and the other day 7x60m of normal sprints. The weight of the sledge was 10% of body mass of each participant. A cross over design was used to avoid a learning effect, which resulted in that on each day half of athletes performed sprints alternating normal and sledge running and other half only conducted normal 60m sprints.

The start was made without the use of starting blocks and was an interval of 5 minutes between each run. Times it was recorded with photocells system like it displayed on figure 1 and was used two video cameras, one to record the entire run and other to record on the middle of the run to gather the contact times, stride length, stride rate frequency and flight time of each one.

All participants have done an identical warm-up routine, lasting approximately 20 minutes, which were included three short sprints of increasing intensity. Subjects were allowed to start in their own time. About rest periods they will have a period of 5 minutes between each trial.

Table 2. Procedures of protocol

Procedures		
Warm up	The subjects will be on groups of 10. The warm up will consist on 12minutes of easy continuous race, some dynamics skills and 3 progressive sprints of 60 meters. Then starts the procedure and each 20 seconds starts an athlete. In each day half will do day 1 procedure and the other half will do day 2 procedure.	
Procedure	Day 1 1. Normal sprint run 2. Sledge run 3. Normal sprint run 4. Sledge run 5. Normal sprint run 6. Sledge run 7. Normal sprint run Sledge: 10% of Body mass of each Rest time: 5 minutes Start in their own time	Day 2 1. Normal sprint run 2. Normal sprint run 3. Normal sprint run 4. Normal sprint run 5. Normal sprint run 6. Normal sprint run 7. Normal sprint run Rest time: 5 minutes Start in their own time

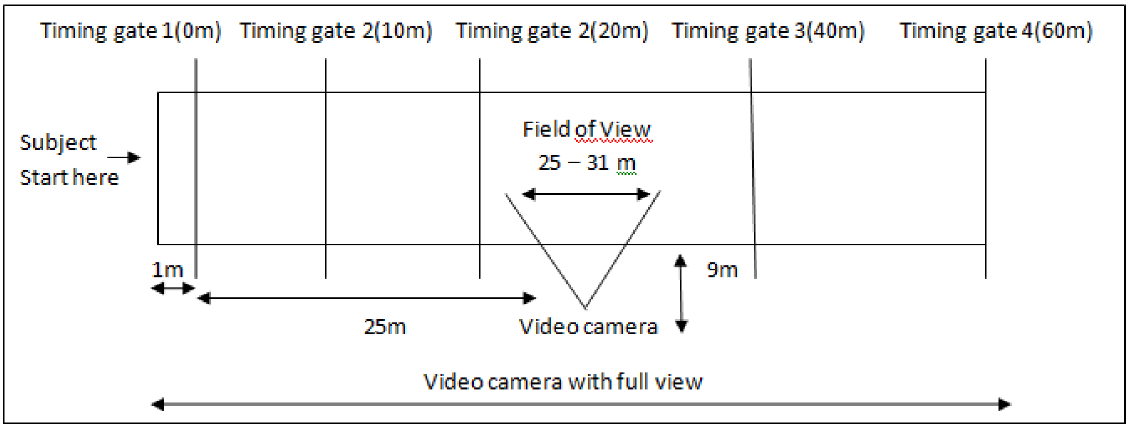

Figure.1
The experimental set-up used during data collection

2.4 - Statistical analyses

To assess eventual differences in 60m sprint times during the attempts and conditions, a repeated ANOVA 2 (condition: normal sprinting vs. normal and sledge running) x 4 (sprint attempt: 1, 3, 5 and 7) was used. When significant differences in sprinting times were found also a oneway ANOVA was conducted to locate eventual changes per condition. Post hoc comparisons with Holm-Bonferroni corrections were conducted to locate differences. All results are presented as mean ± SD. Where sphericity assumptions were violated, Greenhouse-Geisser adjustments of the *p*-values were reported. The criterion level for significance was set at $p<0.05$. Effect size was evaluated with η^2 (ETA partial squared) where $0.01<\eta2<0.06$ constitutes a small effect, $0.06<\eta2<0.14$ constitutes a medium effect and $\eta2>0.14$ constitutes a large effect. Statistical analysis was performed in SPSS, version 21.0 (SPSS, Inc., Chicago, IL). To test the reliability of the protocol and variability of the day, 13 subjects performed the test on three occasions during the season and the average times on each day was used to calculate ICC by Crombachs' Alpha.

3- Results

The reliability was very high (ICC=0.988) with no influence due to the day of season of testing (F=0.115; *p*=0.741). The average normal 60m sprint times were 8.47±0.84 s (normal sprint condition) and 8.45±0.87 s (normal and sledge running). The average sprint times with the sledge were 8.83±0.87 s.

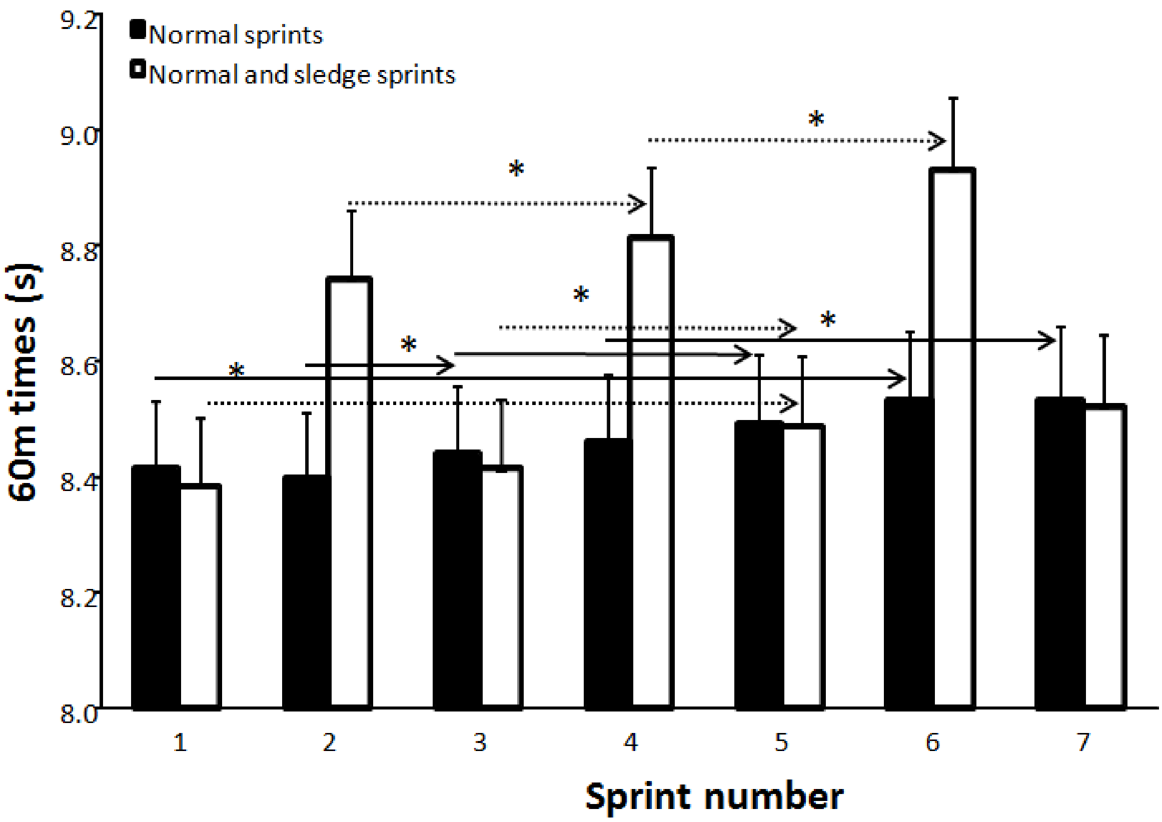

Figure. 2. Mean (±SEM) sprint times of the seven 60m sprints that consisted of either seven normal sprints or three sprints with (number 2, 4, and 6) and four sprints without sledge (sprint 1, 3, 5 and 7).

The sprint times increased significantly during the session (F=7.11; *p*=0.003; $\eta2=0.15$; Figure 2), However, no significant differences in running times were found between the conditions (F=0.056; *p*=0.815; $\eta2=0.001$; Figure 2). Post hoc comparison showed that the running times increased for the normal condition from attempt 2 to 3, 3 to 5, 4 to 7, while under the sledge condition the times increased from attempt 5 (with attempt 3 and 1). The sprint times with the sledge increased significantly every attempt (F=24.9; p<0.001; η2=0.357; Figure 2).

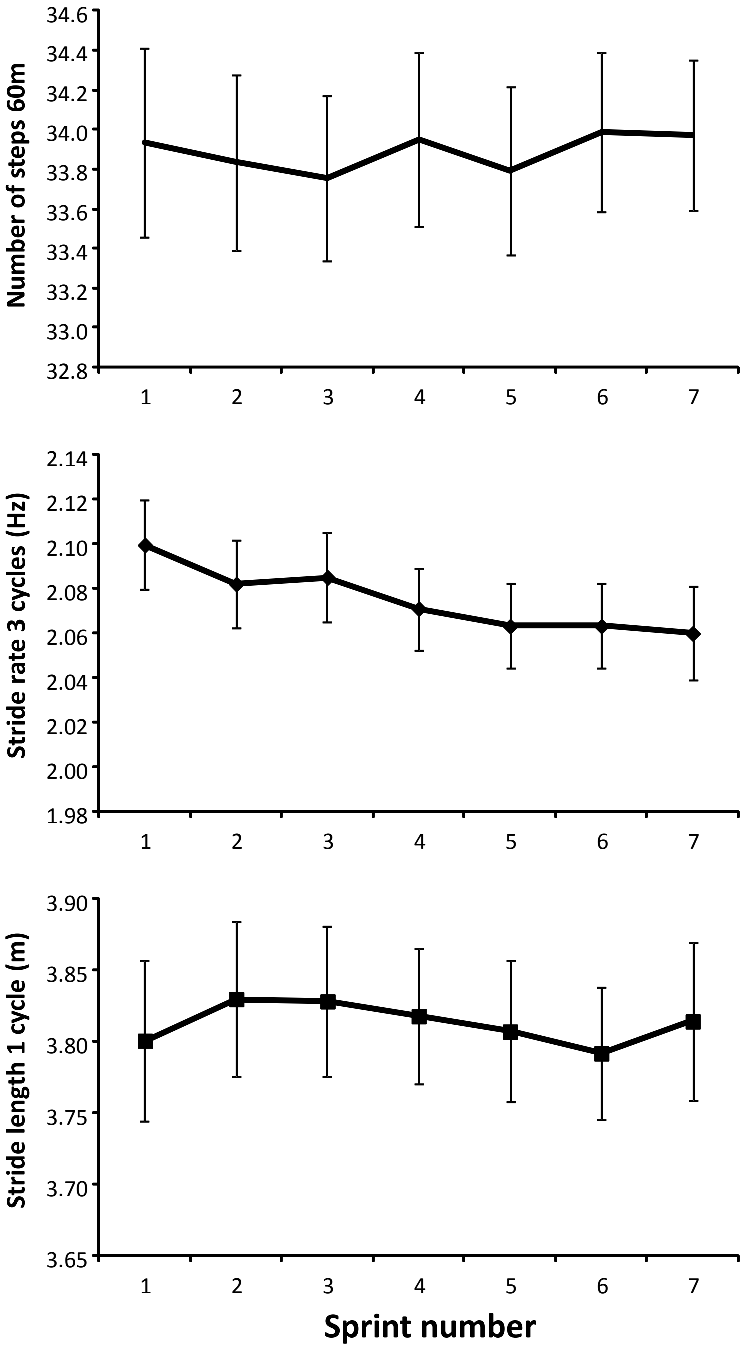

Figure. **3 A)** Total number of steps (±SEM) on the 60m, **B)** stride rate and **C)** step length for each normal sprint (Normal condition).

No significant change in total number of steps during the seven 60m sprints were found (F=1.57; p=0.156; η2=0.052; Figure 3A). Neither changed the average step length

(F=1.9; *p*=0.129; η2=0.052; Figure 3B) and the step rate during the normal seven sprints (F=0.82; *p*=0.53; η2=0.022; Figure 3C).

However, significant changes in total number of steps during the seven 60m sprints were found when alternating between normal and sledge sprints (F=161; *p*<0.001; η2=0.357; Figure 4A). This was also found for the average step length (F=7.53; *p*<0.001; η2=0.186; Figure 4B) and the step rate in this condition (F=8.1; *p*<0.001; η2=0.198; Figure 4C).

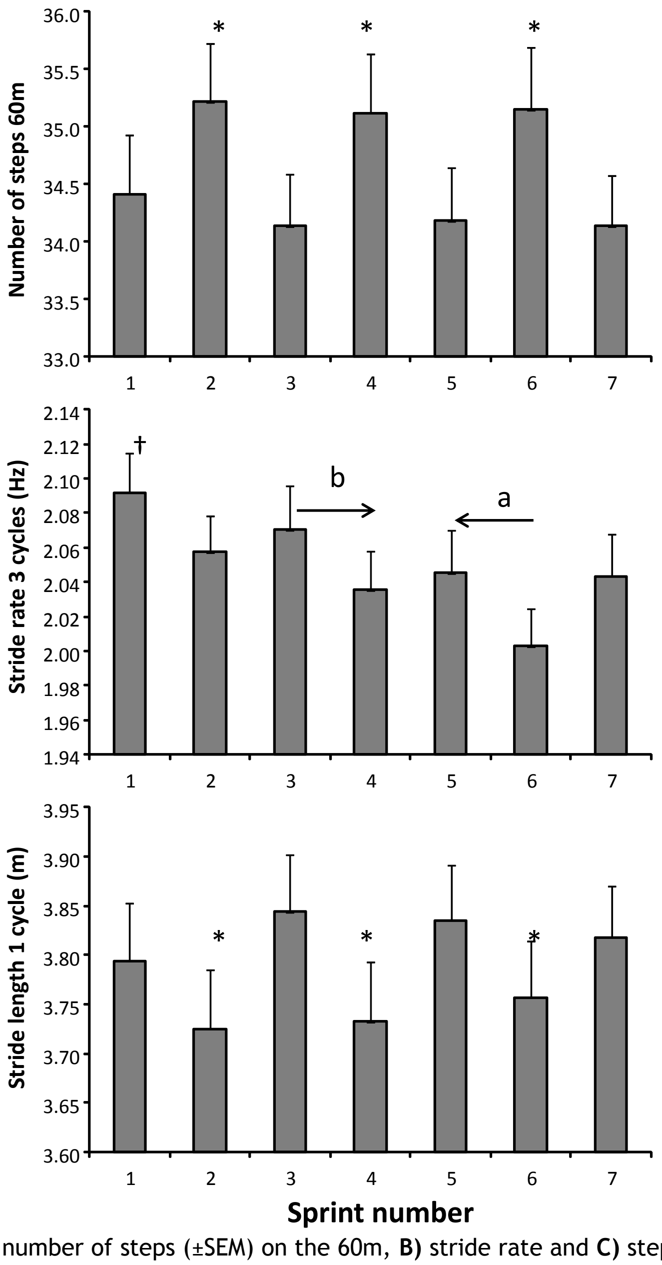

Figure. **4 A)** Total number of steps (±SEM) on the 60m, **B)** stride rate and **C)** step length for each sprint under the combined condition (number 2, 4, and 6 with sledge sprint number 1, 3, 5 and 7 without sledge).

Post hoc comparison showed that the total number of steps were significantly more, while the stride length was significantly lower when pulling a sledge compared with normal sprint runs (Figure 4A and 4C). The stride rate followed another pattern. The stride rate was significantly lower for the last two normal sprints (sprint 5 and 7) compared with sprint 1 and

3. Furthermore, only the stride rate of the last sledge run (sprint 6) was significantly lower than the earlier runs (Figure 4B).

4 - Discussion and Conclusions

The purpose of the study was to verify if there is was any acute effects of running with a sledge upon regular sprinting performance on athletics athletes. It was noticed that train running with a sledge upon regular sprinting as the same train effect that training without sledge, doing a normal sprint training.

Some athletes feel faster on regular sprint running doing train with the sledge, but this is only a subjective feeling. In reality they are getting more tired along the protocol train using sledge than doing without it. We can noticed on results that the average time of 60m normal sprints are very similar, comparing the day without sledge (8.47±0.84 seconds of average) and the normal sprints on the day with alternating sledge (8.45±0.87 seconds of average) which means that are not significant differences. The same occurred in the study of Clark et al. (2010) that showed no significant improvement comparing resisted training group with sledge, weighted vest and normal sprint group. They have all improved sprint speed.

In the study of Zafeiridis et al. (2005) it can be observed significant improvements on resisted sprint group at acceleration phase (0-10m and 0-20meter) which could be concluded that resisted sprint training could help at this phase. The same occurred in the study of Harrison and Bourke (2009) that showed significant improvement in acceleration phase (0-5 meter) with resisted training group and normal sprint running group did not improve at this phase.

The sprint times with the sledge increased significantly every attempt as showed on figure 2, the principal factor for that happened could be tiring of athletes. (Goodall S, 2014) On the other hand no significant changes have occurred in total number of steps in 60m, average step length and step rate during the seven normal sprints as demonstrated in figure 3 and its sub-images, which could suggest that even there were no changes in the running technique during the protocol.

When the seven 60m sprints alternated between normal and sledge running were analysed it could be registered significant changes on total number of steps during 60m, average step length and step rate. Athletes have the tendency to increase the number of steps and times in step rate and average step length. It can be verified that using sledge, the total number of steps was significantly more. This seems to be an important data, representing the effects of fatigue and some technical changes during the bouts, and thus this data should be analysed with deeper care in further studies.

5 - Suggestions for future research

After this work, it seems important to suggest proposals for future studies, in order to complete the investigations in this field with:

1. To extend the study to longitudinal level for at least 6 weeks.

2. To do a study in only in men and only in women.

3. If possible the sample should be composed of athletes of the same discipline of speed or to divide results counting their specialties in athletics.

4. To do a study with the best national athletes in sprint.

6 - Bibliography

Alcaraz PE, P. J., Elvira JLL, Linthorne NP, (2008). "Effects of three types of resisted sprint training devices on the kinematics of sprinting at maximal velocity." Journal of Strength & Conditioning Research Volume 22(issue 3): pp 890-897.

Clark KP, S. D., Walts CT, Miller AD, (2010). "The longitudinal effects of resisted sprint training using weighted sleds vs. Weighted vests." Journal of Strength & Conditioning Research Volume 24 (Issue 12): pp 3287-3295.

Corn RJ, K. D. (2003). "Effect of elastic-cord towing on the kinematics of the acceleration phase of sprinting." Journal of Strength & Conditioning Research Volume 17(issue 1): pp 72-75.

Cronin J, H. K., Kawamori N, McNair P, (2008). "Effects of weighted vests and sled towing on sprint kinematics." Sports Biomechanic Volume 7(issue 2): pp 160-172.

Goodall S, Charlton K, Howatson G, Thomas K (2014). “Neuromuscular fatigability during repeated-sprint exercise in male athletes.” Medicine & Science in Sports & Exercice, volume 9 of July

Harrison AJ, Bourke G. (2009). "The effect of resisted sprint training on speed and strength performance in male rugby players." Journal of Strength & Conditioning Research Volume 23(Issue 1): pp 275-283.

Hrysomallis C (2012). "The effectiveness of resisted movement training on sprinting and jumping performance." Journal of Strength & Conditioning Research Volume 26(issue 1): p299-306.

Konstantinos Z, A. S., Polyxeni A, Georgios P, Elias Z, Charilaos T, (2014). "Acute effects of loading using a weighted vest on running performance." Biology of Exercise Volume 10(issue 1): p53.

Lockie M, M. A. a. S. C. (2003). "Effects of resisted sled towing on sprint kinematics in field sport athletes." Journal of Strength & Conditioning Research Volume 17: pp 760-767.

Makaruk B, S. H., Makaruk H, Sacewicz T, (2013). "The effects of resisted sprint training on speed performance in women." Human Movement Volume 14(Issue 2): pages 116–122.

Moir G, S. R., Button C, Glaister M, (2007). "The effect of periodized resistance training on accelerative sprint performance." Sports Biomechanic Volume 6(issue 3): pp 285-300.

Paulson S, B. W. (2011). "The influence of parachute-resisted sprinting on running mechanics in collegiate track athletes." Journal of Strength & Conditioning Research Volume 25(Issue 6): pp 1680-1685.

Tillin NA, B. D. (2009). "Factors Modulating Post-Activation Potentiation and its Effect on Performance of Subsequent Explosive Activities." Sports Med Volume 39(issue 2): pp 147-166.

Tsimachidis C, P. D., Galazoulas C, Bassa E & Kotzamanidis C (2013). "The post-activation potentiation effect on sprint performance after combined resistance/sprint training in junior basketball players." Journal of Sports Sciences Volume 31(issue 10): pp 1117-1124.

Upton DE (2011). "The effect of assisted and resisted sprint training on acceleration and velocity in division IA female soccer athletes." Journal of Strength & Conditioning Research Volume 25(Issue 10): p2645-2652.

Zafeiridis A, S. P., Manou V, Ioakimidis P, Dipla K, Kellis S, (2005). "The effects of resisted sledge-pulling sprint training on acceleration and maximum speed performance." J Sports Med Phys Fitness Volume 45(issue 3): pp 284-290.