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Original Article

Effects of randomization versus pre-orientation of subjects for the prediction of maximum oxygen uptake using the twelve minutes run test

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ABSTRACT

Assomo, P., Mandengue, S., Guessogo, W., Nguimouth, A., Temfemo, A. & Etoundi-Ngoa, S. (2013). Effects of randomization versus pre-orientation of subjects for the prediction of maximum oxygen uptake using the twelve minutes run test. *J. Hum. Sport Exerc., 8*(3), pp.829-836. Aim: To compare the results from twelve minutes run test (12-MRT) when subjects run singly with those obtained when subjects run in randomized groups and in pre oriented groups. Methods: 33 subjects performed the 12-MRT in four variants: Achieving alone the 12-MRT on a 400 m track (Alone); Achieving in randomised groups of three the 12-MRT on a 400 m track (Group); Achieving in preoriented groups of three the 12-MRT on a 400 m track (PO-Group); Completing alone the 12-MRT on a 200 m tract (Half-Track). At the end of each test, the rate of perceived exertion was determined. Results: No significant difference ($p>0.05$) was found in predicted VO2max between tests. RPE was significantly higher during PO-Group compared to Alone. Underperforming athletes elicited an underestimation of predicted VO2max in Alone more important to PO-Group (12.1%) compared to Group (8%). No change of predicted VO2max was observed in the middle athletes between Alone, Group and PO-Group. For the fastest athletes, predicted VO2max was significantly lower ($p<0.05$) for PO-Group compared to Alone where as for the Group, predicted VO2max was higher ($p<0.05$) compared to Alone. Conclusion: These results suggest that prediction of VO2max using the 12-MRT is influenced by peer relationship and the training status of athletes. **Key words**: FIELD TEST, PERFORMANCE, PEER RELATIONSHIP.

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INTRODUCTION

The twelve minutes run test (12-MRT) was developed by Cooper in 1968. This test is based on the study of Balke (1963) which indicated that the maximum oxygen uptake (VO2max) during various run-walk tests could relate either to the distance covered in a given time or to the time taken to cover a given distance. In the 12-MRT, the individual is instructed to cover the maximum distance possible in 12 minutes, preferably by running but also walking whenever necessary to avoid becoming excessively exhausted (Balke, 1963; Cooper, 1968). The 12-MRT as well as other submaximal tests can be used to predict maximum oxygen uptake, to diagnose and assess functional limitations, to access the outcome of interventions such as physical exercise, to measure the effects of pharmacological agents, and to examine the effect of recovery strategies on exercise performance (Hagberg, 1994; Questead & Alquist, 1994; Marciniuk & Gallagher, 1994; Dean, 1996). The use of the 12–MRT for estimating maximum oxygen uptake, offers the advantage of requiring minimal equipment (athletes' track and timer) and studying at the same time several individuals (Penry at al., 2011); giving the possibility to collect data of many individuals in a shorter time.

Few studies have explored the interpersonal relationship of the presence of peers during the estimation of the VO2max during the 12-MRT test. A recent study (Assomo et al., 2012), reported that the predicted VO2max was underestimated by 4% when participants ran alone; and by 9.3% in Halftrack (running in a reduced space). In studies interested in the reliability and validity of the 12-MRT with participants running in group, the constitution of groups is always randomized; whereas subjects constituting a given group may have similar or different performance. It is known pairing provides some motivation (Jowett & Lavallee, 2008) and is therefore a psychological aspect, which influences the final performance of participants. The motivational environment created by grouping is an important factor in achieving athletic performance. The influence of motivational factors on pacing strategies and performance is equivocal, and while some studies have shown positive effects (Perreault & Vallerand, 1998; Mauger et al., 2011) others have not (Hulleman et al., 2007).

In this study, we hypothesized that running in a group is a leading contributor to the improvement of maximum oxygen uptake and investigated the effects of pre-orientated group versus randomized during the 12 - MRT.

MATERIAL AND METHODS

Ethical clearance and Subjects
The study was approved by the National Ethic Community. The experimental procedure was in accord with the ethical standards of the Helsinki Declaration of 1975. Thirty three (33) healthy males (age: 27.1 ± 3.6; height: 1.76 ± 0.06 m; weight: 71.9 ± 8.6 kg) from the National Institute of Youth and Sports consented to participate in the study. They were permanently involved in a variety of sports, of endurance in nature, with different levels of ability and training.

Design
Subjects performed the 12-MRT in four variants (V): In V1, each subject ran alone (Alone), covering the greatest possible distance on a 400m athletic track in twelve minutes. In V2, subjects performed the test on the same track as in V1 but in randomized groups of three (Group). In V3, subjects performed the test in preoriented group (PO-Group) of three i.e, subjects were grouped into high, intermediate and low performances according to the results obtained in V1. In V4, subjects ran alone but on a 200m athletic track (Half-Track). V2, V3 and V4 were performed randomly.

VO2max was predicted from the distance covered at the end of the twelve min period by substituting the distance covered in the Cooper regression equation:

VO2max (mL.min-1.kg-1) = [22.351 X D (distance completed in km)] - 11.288 or

VO2max (mL.min-1.kg-1) = [D (distance completed in m) - 504.9] /44.732.

At the end of each test, we noted the feeling of physical exertion due to the exercise. Prior to each exercise, participants were explained the Borg's 6-20 RPE scale.

Statistical analysis

Data are presented as mean ± S.D. The analysis involved the analysis of variance (ANOVA) with repeated measures. When differences were significant, the location of mean differences was determined using Tukey's post hoc procedure. All statistical analysis were conducted using SAS version 9.2 (SAS Inc., Cary, NC, USA) for windows and p was set at 0.05.

RESULTS

No significant difference (F(1,42) = 2.25; p=0.08) was found in predicted VO2max between tests. We noted an increase of 4% in Group compared to Alone. For the same parameter, only 0.7% was observed in the PO-Group compared to Alone (Table 1).

Table 1. *Mean (SD) performance parameters during the four testing protocols*

12- MRT	Distance (m)	Predicted VO_2 max (mL.min^{-1}.kg^{-1})	Average speed (m.min^{-1})
Alone	2860 ± 323.5	52.7 ± 7.3	238.3 ± 27.0
Group	2957.1 ± 318.3	54.8 ± 7.1	246.4 ± 26.5
PO– Group	2881.5 ± 272.2	53.1 ± 6.1	240.1 ± 22.7
Half– Track	2767.2 ± 292.7	50.5 ± 6.5	230.6 ± 24.4

SD: Standard Deviation; 12-MRT: Twelve Minutes Run Test; Alone: running alone; Group: running in group of three randomized; PO-Group: running in group of three preoriented; Half – Track: running alone in a reduce track.

Oxygen uptake output (mL.min-1.kg-1.km-1) was significantly higher (p=0.01) during Group test compared to Half-Track (Figure 1).

No significant differences (p>0.05) was found in RPE between Alone and Group (Figure 2). RPE was significantly higher (F(1,42) = 14.46; p<0.0001) in PO-Group and Half- Track compared to Alone.

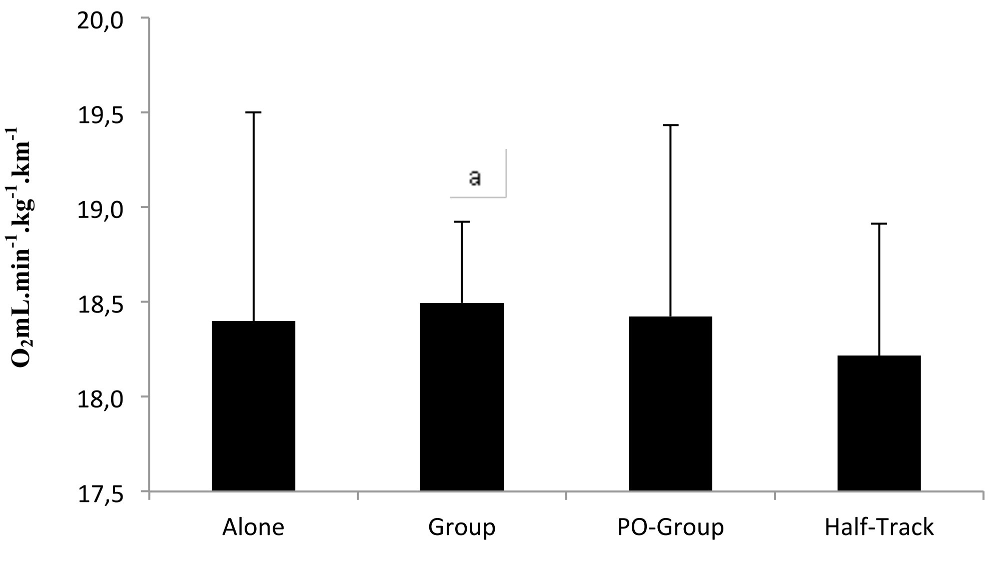

Figure 1. *Oxygen uptake per km during testing protocols*

O2mL.min-1.kg-1.km-1 : Oxygen uptake per km
a: significant difference from Half-track
Alone: running alone; Group: running in group of three randomized; PO-Group: running in group of three preoriented; Half – Track: running alone in a reduced track

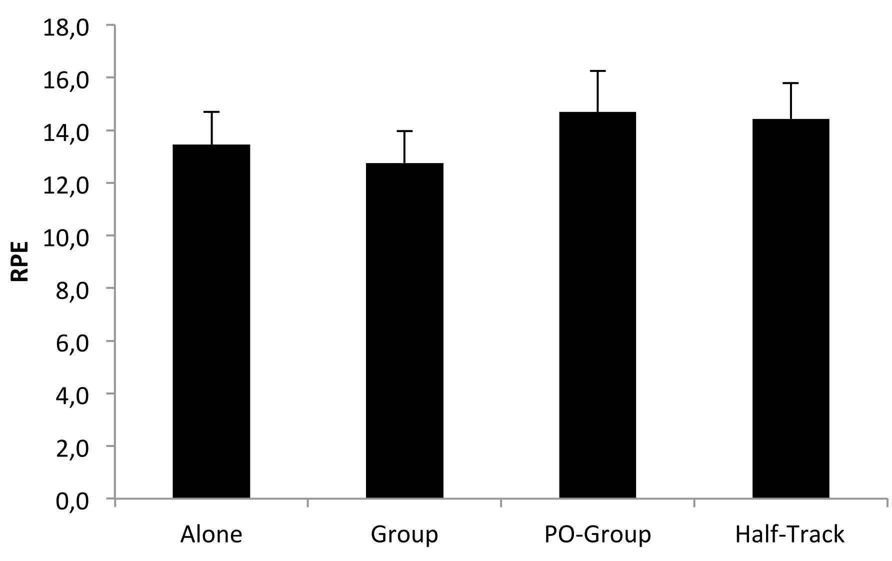

Figure 2. *Oxygen uptake per km during testing protocols*

RPE: Rating of Perceived Exertion
Alone: running alone; Group: running in group of three randomized; PO-Group: running in group of three preoriented; Half – Track: running alone in a reduced track
a: significant difference from Pre In-Group; b: significant difference from Short-Track
c: significant difference from Pre In-Group; d: significant difference from Short-Track

In low performing athletes (according results obtained when subjects ran alone) predicted VO2max was higher ($F(1,42) = 1.35$; $p=0.27$) in PO-Group compared to Alone (50 ± 6.9 mL.min-1.kg-1 vs 44.7 ± 4.7 mL.min-1.kg-1) against Group compared to Alone (48.7 ± 6.2 mL.min-1.kg-1 vs 44.7 ± 4.7 mL.min-1.kg-1) or Half -Track compared to Alone (46.5 ± 7.6 mL.min-1.kg-1 vs 44.7 ± 4.7 mL.min-1.kg-1).

In intermediate athletes (according to the results obtained when subjects ran alone), the results obtained in Predicted VO2max between Alone (53.5 ± 3.2 mL.min-1.kg-1), Group (53.7 ± 3.3 mL.min-1.kg-1) and PO-Group (53.4 ± 2.7 mL.min-1.kg-1) were similar. However, all these variants (Alone, Group and PO-Group) differed significantly ($F(1,42) = 2.95$; $p=0.04$) from Half-Track (50.1 ± 4.6 mL.min-1.kg-1).

In high performing athletes (according to the results obtained when subjects ran alone), there was significant difference ($F(1,42) = 4.01$; $p=0.01$) in predicted VO2max between tests. Predicted VO2max was significantly lower in Group compared to Alone (55.6 ± 6.6 mL.min-1.kg-1 vs 59.8 ± 4.3 mL.min-1.kg-1) where as for the Group, predicted VO2max was greater compared to Alone (61.6 ± 5.2 mL.min-1.kg-1 vs 59.8 ± 4.3 mL.min-1.kg-1).

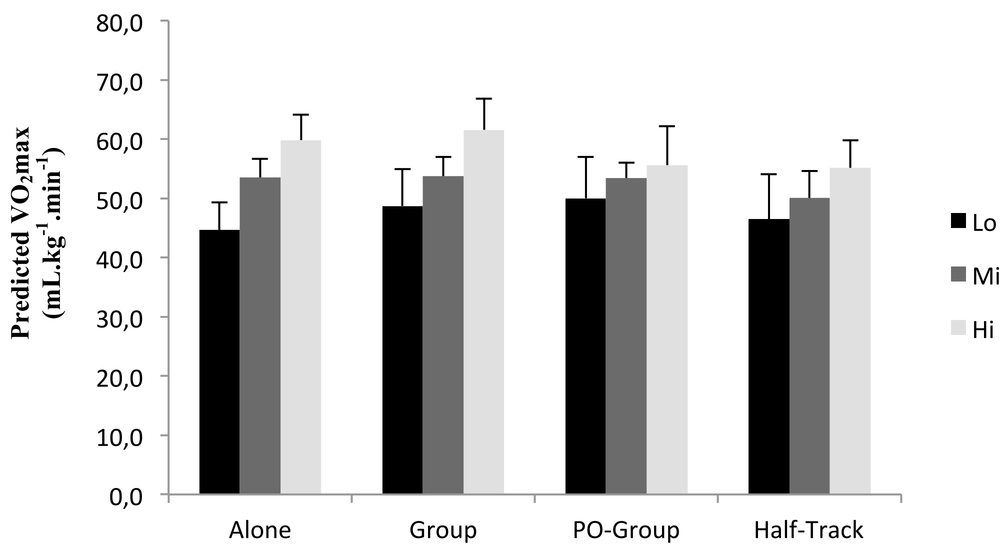

***Figure 3.** Predicted VO2max during testing protocols for each performance group*

Lo: low performance; Mi: intermediate performance; Hi: high performance
Alone: running alone; Group: running in group of three randomized; PO-Group: running in group of three preoriented; Half – Track: running alone in a reduced track
a: significant difference from Ran In-Group; b: significant difference from Alone
c: significant difference from Alone; d: significant difference from Ran In-Group
e: significant difference from Short-Track

DISCUSSION

Our study found that running in a group improves the performance. Grouping created a motivational climate. One of the main theoretical frameworks that have been used to study motivation and behavior in youth sports is the theory of goal achievement. According to this social-cognitive framework, the major focus in achievement settings is the demonstration of competence and the avoidance of showing incompetence (Jowett & Lavallee, 2008). Individuals can evaluate their competence in two different ways which will be manifested in the adoption of two different achievement goal orientations. The first goal orientation call task orientation is evident when perceptions of competence are self referenced and based upon personal improvement and exerting maximum effort. The second goal orientation call ego orientation is evident when competence is normatively referenced by demonstrating superior ability and outperforming others (Jowett & Lavallee, 2008). A plethora of research studies found that high task orientation, compared to high ego orientation, is related to more positive outcomes in youth sports (Jowett & Lavallee, 2008). In our study, randomized group brought about a greater increase in VO2max than that observed in the pre-oriented group (4% vs 0.7%). This result can be justified by the achievement goal theory. The randomized group was more task-oriented while the pre-oriented group was more ego oriented. It has also been established that the psychological state is occasionally linked to physiological variables such as muscle force output, heart rate, ventilation, respiratory rate, oxygen uptake, and blood lactate concentrations (Robertson, 1982; Cafarelli, 1992).

The perception of an athlete's previous performance is an important factor in the motivation and influences the subsequent performance. A couple of studies (Perreault & Vallerand, 1998; Mauger et al., 2011) showed that positive performance feedback increased motivation and a negative performance feedback decreased motivation. In our study, we had a different classification of performance between the tests. Performance obtained at the four tests for the same athletes showed either a decrease or an increase in performance in some. An investigation (Mauger et al., 2011) showed that an athlete, who felt less efficient on the basis of its past performance achieved during a 4 km cycling race, saw its speed reduced and altered its overall performance. This demonstrates the key role of demotivation in performance. This can explain the significant decrease in performance ($p<0.05$) obtained after the 12-MRT conducted alone on short distance (Half-Track) in our study compared to the 12-MRT for the randomized group (Group) in the middle and high performing athletes (figure 3). The reduction of the track to half gave to the athletes the impression that the duration of the test was extended (the test was lasting longer). This situation increases the subjective sensation of effort and physical strain resulting in the impairment of performance. The inhibitory effect of the reduction of area can be due to the increasing of numbers of turns. In Half-track (200m), the numbers of turns increases in 93.5% compared to classical track (400m). This induced the number of decelerations and consequently muscle activation (Besier et al., 2003). By observing the behavior of an athlete in comparison of the other two, a variety of pacing strategies appeared.

In the group of intermediate performing athletes, we observed that some athletes feeling unable to catch up with high performers, decreased in motivation, and we suggest that this could explain the stability of their performances compared to running alone. In fact, Bath et al. (2012) found that the presence of a second runner (considered as a pace-maker) did not affect the performance of athletes during a 5 km race.

The presence of more efficient runners induced the improvement of performance in low performing athletes. This is consistent with Perrault et al. (1998) who found a link between the motivational climates established by peers in an athlete and the latter's ability to run more against an opponent who has exceeded in the race. The athlete is more motivated and tries to regain the top spot. The level of motivation generated by the presence of other riders was more efficient to develop a superior performance (compared to the individual race). This finding is more important in the consideration of factors affecting the prediction of VO2max by the 12-MRT. One of the criticisms against the 12-MRT is that the duration of 12 minutes is far higher than the average time the runner is able to support at a given VO2max; therefore, the VO2max is underestimated. Our results showed that a predicted VO2max during the 12-MRT is significantly improved by the presence of peers. In an investigation (Grant et al., 1995), authors made the subjects to run in groups and obtained an excellent correlation (0.92) between the VO2max measured directly and the VO2max predicted by the 12-MRT.

In the group of high performing athletes, we suggest that running with low and intermediate performers athletes installed a feeling of complacency and a lack of motivation. Athletes did not feel compelled to develop greater effort to win the race; and this may explain why the performance obtained after the test group decreased compared to the individual race.

CONCLUSIONS

Running in group improved predicted VO2max in low performing athletes and decreased in high performing in the situation where these athletes run together. The improvement of VO2max is more important in randomized group than in preoriented. Further investigations should be oriented in finding the ideal number of peers in a group in the one hand, and pre-orienting the groups with athletes of same performance.

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