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BRIEF NOTE

# Comparison between peak oxygen consumption and its associated speed determined through an incremental test and a 400-m effort: Implication for swimming training prescription

*Comparaison entre la consommation maximale d'oxygène associée à la vitesse, déterminée par un test progressif et d'effort de 400m : implication pour la prescription d'entraînement de natation*

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## KEYWORDS

Peak oxygen consumption;  
Backward extrapolation;  
Swimming;  
Incremental test

## Summary

**Objective.** – Both 400m peak oxygen consumption ( $VO_{2Peak}$ ) calculated using the backward extrapolation technique, and mean 400m speed are used in swimming for training prescription. However, no comparison has been made between these variables observed after a 400m effort and a free swimming incremental test, when both are performed unimpeded (without snorkel; enhancing its feasibility). Thus, we aimed to determine whether  $VO_{2Peak}$  and its speed elicited after an incremental test may be interchangeable with these variables observed after a maximal 400m effort.

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**Methods.** – Nine swimmers underwent a maximal 400 m effort, and an incremental test consisting of six 200 m-stages. After the 400 m effort, and each stage of the incremental test, oxygen consumption was assessed through the backward extrapolation technique. The Student's *t*-test and Pearson correlation were adopted to analyze the results. Agreement analysis was also performed.

**Results.** – No significant difference ( $P=0.21$ ) was observed between the  $VO_{2Peak}$  after the 400 m effort ( $3.86 \pm 0.85$  L/min) and the incremental test ( $4.09 \pm 0.93$  L/min). A strong correlation was observed between them ( $r=0.85$ ;  $P<0.05$ ). The mean error was 0.23 L/min and the limit of agreement  $\pm 0.98$  L/min. The speed associated with  $VO_{2Peak}$  ( $1.39 \pm 0.12$  m/s) was higher ( $\approx 3.6\%$ ;  $P=0.001$ ) than the mean speed of the 400 m effort ( $1.34 \pm 0.13$  m/s), and they were highly associated ( $r=0.96$ ,  $P<0.01$ ).

**Conclusion.** –  $VO_{2Peak}$  and its relative speed might be used interchangeable with caution. The equation found in our study needs to be confirmed and improved on a larger population but it suggests the possibility for coaches to apply a correction to the mean speed of a 400 m swimming effort for training prescription.

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## MOTS CLÉS

$VO_{2Pic}$  ;  
Consommation  
maximale d'oxygène ;  
Natation ;  
Exercice incrémental

## Résumé

**Objectifs.** – On utilise pour la prescription d'entraînements de natation la consommation maximale d'oxygène ( $VO_{2Pic}$ ) sur 400 m calculé rétrospectivement par extrapolation et la vitesse moyenne sur 400 m. Cependant, aucune comparaison n'a été faite entre ces mesures et un test de 400 m ou un test de nage libre avec incréments, tous deux réalisés sans tuba pour davantage de facilité. Nous avons ainsi voulu déterminer si la  $VO_{2Pic}$  et la vitesse déterminées lors de ces tests de terrains plus simples donnaient des résultats équivalents aux tests de référence mentionnés plus haut.

**Méthodes.** – Neuf nageurs ont subi un effort maximal sur 400 m et un test progressif composé de six étapes de 200 m. Après le test d'effort sur 400 m, et après chaque étape du test progressif, la consommation d'oxygène a été évaluée par la technique d'extrapolation a posteriori. Les résultats étaient analysés à l'aide du *t* de Student, de la corrélation de Pearson et de test de Bland et Altman.

**Résultats.** – Aucune différence significative ( $p=0,21$ ) n'a été observée entre le  $VO_{2Pic}$  après l'effort de 400 m ( $3,86 \pm 0,85$  L/min) et le test différentiel ( $4,09 \pm 0,93$  L/min). Par contre, une forte corrélation a été observée entre eux ( $r=0,85$  ;  $p<0,05$ ). L'erreur moyenne était de 0,23 L/min et l'intervalle de confiance  $\pm 0,98$  L/min. La vitesse associée à  $VO_{2Pic}$  ( $1,39 \pm 0,12$  m/s) était plus élevée ( $\approx 3,6\%$  ;  $p=0,001$ ) que la vitesse moyenne de l'effort au 400 m ( $1,34 \pm 0,13$  m/s) et toutes deux étaient fortement corrélées ( $r=0,96$ ,  $p<0,01$ ).

**Conclusion.** –  $VO_{2Pic}$  et la vitesse qui lui correspond peuvent être utilisées de manière inchangée, avec précaution. L'équation trouvée dans notre étude doit être confirmée et améliorée sur une plus grande population, mais ces résultats portent à penser que les entraîneurs peuvent appliquer ce calcul correctif à la vitesse moyenne d'un effort de natation sur 400 m pour la prescription d'entraînement.

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## 1. Introduction

For decades, it has been shown that 30 seconds oxygen consumption recovery (backward extrapolation technique) after maximal 400 m effort can be used to assess swimmers'  $VO_{2Peak}$  [1–4]. However, it is unknown whether unimpeded swimming incremental test would elicit similar  $VO_{2Peak}$  value. Furthermore, although the 400 m speed ( $s_{400}$ ) is used to determine swimming training intensity, no study have compared it with  $sVO_{2Peak}$  observed during a free-swimming incremental test. It is important to note that small

differences between speeds could provide divergent training intensities, which can in turn over or underestimate maximal aerobic speed.

Thus, this study aimed to determine whether  $VO_{2Peak}$  and  $sVO_{2Peak}$  elicited after an incremental test may be interchangeable with the  $VO_{2Peak}$  and  $s_{400}$  obtained after maximal 400 m effort when both are performed unimpeded. Our hypothesis is that both variables are similar and highly related. This assessment would guarantee the use of 400 m effort to estimate not only  $VO_{2Peak}$ , but also to determine exercise intensity for aerobic swimming training ( $s_{400}$ ),

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