

# Underwater walking on non-motorized treadmill as a 'fitness tool' for both healthy and frailty subjects



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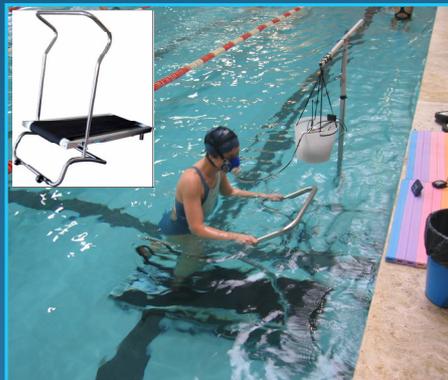
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## Introduction

Underwater walking on non-motorized treadmill is a very popular aquatic fitness activity. Although water provides reduced gravity conditions and a non weight bearing environment, water based training has been proven to be as effective as land-based training in improving health-related fitness components (Takeshima et al., 2002), and to be suitable for both healthy (Benelli et al., 2004) and frailty/pathologic (Frangolias et al., 1997) subjects. Little data is available about the metabolic demands of underwater walking exercises on motorized treadmills, whereas, to the best of our knowledge, no studies have been carried out with non-motorized aquatic treadmills (ATM). Therefore, the aim of this study was twofold: i) evaluate oxygen consumption ( $\dot{V}O_2$ ) and heart rate (HR) responses to an increasing submaximal ATM exercise performed at 2 different immersion heights; ii) to allocate the results obtained into the latest fitness oriented exercise prescription guidelines.



## Materials and Methods

15 healthy women (age  $43 \pm 3.7$  y, height  $1.64 \pm 0.05$  m, weight  $54 \pm 6.6$  kg, BMI  $22.1 \pm 2.3$  kg/m<sup>2</sup>, fat mass  $25.4 \pm 3.4\%$ ) performed a dry-land incremental exercise test to exhaustion on a motorized treadmill (to establish maximal  $\dot{V}O_2$  and HR), and 2 incremental walking exercises on an ATM (Aquatix S.r.l., Limena, Italy) interspersed by 1 week rest. Breath-by-breath  $\dot{V}O_2$  (K4b<sup>2</sup>, Cosmed, Rome, Italy) and beat-by-beat HR (Polar Electro, Kempele, Finland) were recorded continuously throughout both underwater and the dry-land exercises.

Each underwater session was performed with a different water height: hypoid process (high water) and iliac crest (low water) of each subject. The intensities of the 4-stage exercises (stride frequency of 100, 110, 120, and 130 step per minute) were chosen according to those commonly used among the ATM fitness classes, and were controlled by a metronome during the underwater exercise sessions. The 4 stages of 5 minutes each were interspersed by a 1 minute rest period for a total exercise duration of about 20 minutes.

Statistical Analyses was performed on the average  $\dot{V}O_2$  and HR values of the last 3 minutes of each stage by means of a repeated measure (4 exercise intensities) 2-way (high and low water height) ANOVA for each dependent variable. Post-hoc comparisons were made by means of the Tuckey test. The level of statistical significance was set at  $p < 0.05$ .

## Results and Discussion

ATM walking revealed to be significantly ( $p < .05$ ) more demanding in terms of both oxygen consumption and heart rate, when performed in low water compared to high water conditions, regardless which stride frequency is chosen between 100 and 130 spm (Fig.1).

This result is in line with those of other studies carried out both on motorized underwater treadmills (Gleim et al., 1989; Pohl et al., 2003).

Relatively to dry-land maximal values, underwater  $\dot{V}O_2$  and HR ranged from 64% to 85% and from 71% to 90%, respectively (Fig.2).

Both relative intensities fall within the limits of the 'vigorous' intensity range (77-95% of maximal HR, and or 64-90% of maximal  $\dot{V}O_2$ ) described in the internationally recognized current guidelines of the British Association of Sport and Exercise Sciences (O'Donovan et al., 2010) and the American College of Sports Medicine (Garber et al., 2011).

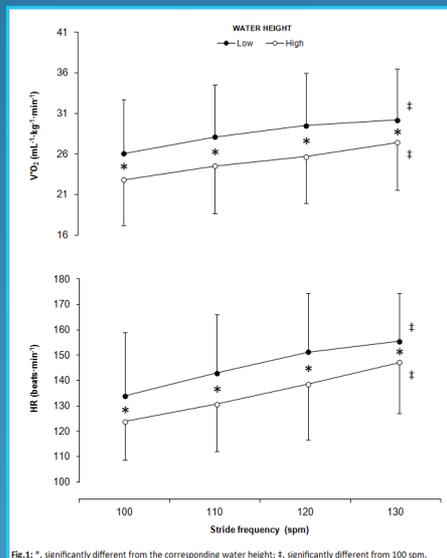


Fig.1: \*, significantly different from the corresponding water height; †, significantly different from 100 spm.

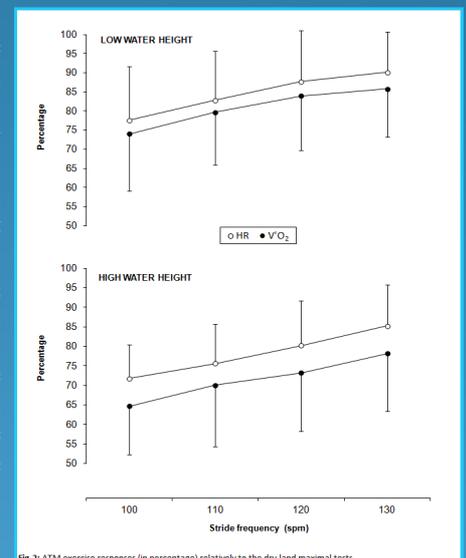


Fig.2: ATM exercise responses (in percentage) relatively to the dry-land maximal tests.

## Conclusion

Water is a 'low impact' environment of exercise, providing non-weight-bearing conditions that makes exercise suitable for both pathologic and healthy subjects. This study confirms that high water height represents a lower demanding exercise environment compared to low water height when underwater walking is performed on non motorized treadmills, irrespectively of which stride frequency is chosen between 100 and 130 spm. Therefore the non weight-bearing advantage of water exercise plus the physiological results obtained in this study provide the evidence for prescribing ATW on non-motorized treadmills to both healthy and frailty subjects that could benefit exercising at vigorous intensities.

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