Occupational Fitness Standards for Beach Lifeguards

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ABSTRACT

The aim of this project was to identify the most physically demanding generic tasks undertaken by BLG in the SW of England, and determine a minimum standard for task-related performance and fitness. A survey of 91 BLG identified sea swimming while towing a casualty, board paddling with a casualty, and casualty handling as the most demanding activities. Performance of beach running, sea swimming, board paddling, pool swimming and casualty handling was measured. The aerobic demand (VO_{2max}) was determined in a swimming flume for towing a casualty, board paddling with a casualty, and freestyle swimming (N=25). A significant correlation (r=-0.82, P<0.001) was identified between distance paddled in the sea in 3.5 minutes and pool 400m front crawl swim time. On the basis of this relationship, it was concluded that if a BLG can swim 400m front crawl in a pool in less than 7.5 minutes, they should be able to paddle 310m in the sea in less than 3.5 minutes. In order to prevent irreversible cerebral damage the lifeguard must achieve the performance objective of reaching casualty in 3.5 minutes and returning a casualty in 10 minutes. Therefore, to avoid fatigue during a tow, this value should remain below 70% towing VO_{2max}, or $2.43L.min_{-1}$. This can be predicted from the relationship (r=0.83, P<0.001) identified between deltoid circumference/$\log_{10}$ 400m front crawl swim time, and between towing velocity and VO_{2max} ($L.mn_{-1}$).

INTRODUCTION

Although the standards used internationally to select beach lifeguards (BLG) are similar, it is difficult to determine the scientific rationale that underpins them. Many of the current standards appear to have been determined as a result of consultation with experienced lifeguards. Whilst this approach has merit, such standards can also be based on a systematic investigation of the tasks involved in beach lifeguarding.

There is a paucity of literature relating to beach lifeguards; most of that which has been written describes their physical and physiological characteristics (Gulbin et al, 1996) or the physical demands of lifeguarding (Daniel and Klauck, 1992) rather the minimum level of fitness required to become a BLG.

The aim of this research was to identify the most physically demanding generic tasks associated with beach lifeguarding in the South and South West of the UK and, on the basis of these tasks, determine the minimum standard of performance and fitness required to be a BLG. It was hypothesised that the performance of critical rescue tasks, including paddling and swimming performance, casualty towing and paddling performance, could be predicted from a combination of pool-based tests and anthropometric measures.

METHODS

Phase one of the study consisted of a survey of 91 BLG. This identified casualty handling, sea swimming while towing a casualty, and board paddling with a casualty as the most demanding job requirements.

The following field tests were undertaken with 28 (6 female) volunteer BLG in the UK at maximum effort, twice. A timed run 200m on the beach, a timed offshore swim in the sea 200m, a 400m prone paddle in the sea on a rescue board (Gainsborough), and a casualty handling simulation of a 41kg casualty (head and torso lift from the rear).

Additionally the BLG performed two self-paced tasks in the sea: a cross chest tow with a 50kg marine anthropometric manikin (designed to float in the sea as an unconscious 50th percentile male) using a rescue tube secured around the chest of the manikin; and a paddle, also with the manikin placed on the rescue board (manikin and subject were prone). These tasks were performed continuously for a minimum of four minutes at sea. During the last minute of each test expired gases were collected in a Douglas bag and analyzed for oxygen and carbon dioxide concentration (Servomex, UK) and volume (dry gas meter, Harvard, UK). Volumes were corrected to STPD for the calculation of oxygen consumption (VO_2).

Figure 1. Measurement of metabolic demands of self paced towing in the sea

Each subject also undertook a 200m pool swim and a 25m underwater swim + 25m surface swim in a pool at maximum effort twice. To determine if maximum effort was achieved blood lactate was measured from a finger prick blood sample taken 3 minutes after cessation of each maximum activity [ProTest meter, Arkray Inc., Japan]).

Anthropometric measures of height (cm) and mass (kg), percentage body fat Durnin & Womersley (1974) and hand grip strength were also measured (Grip ATKK 5001, Takei Scientific Instruments, Japan).

Phase 2 of the project was completed at the DNC Diving Centre, Berga Orlog Skola, Horsfjarden. The protocol was approved by the Ethical Committees of both the Karolinska Institute and University of Portsmouth.

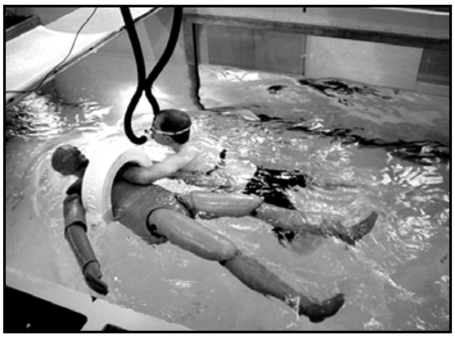

Figure 2. Measurement of maximum (VO_{2max}) capability of towing in the flume

Twenty-three volunteer subjects (13 BLG) performed a land based assessment of VO_2max, the shuttle run (Leger & Boucher, 1980), as well as many push-ups as they could in 60 seconds. In the swimming flume subjects were assessed on a maximum effort towing test, paddling test and freestyle swimming test. For these tests following four minutes of self-paced work, the velocity of the flume was increased every 0.5-1minute by 0.1-0.2m.s_{-1} until volitional exhaustion. The subjects towed or paddled with a 50kg marine anthropometric manikin. Oxygen consumption was recorded breath-by-breath using a Metamax 3B analyser (Cortex Biophysik, Germany).

Tests of 400m front crawl, 300m breast stroke and 200m one armed breast stroke were performed in a 25m swimming pool at maximum effort

Data were analyzed using Student's t-test, Wilcoxon's signed rank test and Pearson's product moment correlation coefficient with Minitab 13. Tests giving the strongest statistical relationships were investigated further using linear regression analysis. Significance was determined at the $P<0.05$ level unless otherwise stated.

RESULTS

The average (SD) metabolic demands of towing and board paddling a casualty in the sea (self paced) were determined as 3.2L.min_{-1}(0.6) and 2.1L.min_{-1} (0.4) respectively. The average board paddling speed was determined to be 1.7m·s_{-1}, 95% of BLG could cover 289m in the sea in 3.5 minutes paddling a board.

A significant correlation ($r=-0.82$, $P<0.001$) was identified between distance paddled in the sea in 3.5 minutes and pool 400m front crawl swim time.

Distance paddled in 210s = 850-(1.2 x 400m front crawl time in seconds)

Employing this regression a BLG should be able to paddle 310 metres in the sea in less than 3.5 minutes provided they can swim 400m front crawl in a pool in less than 7.5 minutes. 91% of the present subjects achieved this time.

To reach a casualty and return them within 10 minutes, from the maximum distance offshore they are likely to swim (100m), a BLG must be able to tow at a rate that requires a VO_2 1.7L.min_{-1}. To avoid fatigue during a tow, this value should remain below 70% towing VO_{2max}; which must therefore be 2.43L.min_{-1}. This can be predicted from the relationship ($r=0.83$, $P<0.001$) identified between deltoid circumference/$\log_{10}$ 400m front crawl swim time and towing VO_{2max} (L.mn-1).

$$Tow\ VO_{2max}\ (L.min^{-1}) = -1.97 + 0.106\ [deltoid\ circumference(cm) / \log_{10} 400m\ swim\ time(s)]$$

DISCUSSION

The findings of this study suggest that the performance of critical rescue tasks, including paddling and swimming performance, casualty towing and paddling performance, can be predicted from a combination of pool-based tests and anthropometric measures: as such we accept our hypothesis.

The possibility that an easy to administer, land-based, indirect assessment of running VO_{2max} (Shuttle run) would predict swimming, towing or paddling VO_{2max} was investigated. Unfortunately, the correlation between these measures was insignificant (r = 0.578, 0.248, and 0.216 respectively).

Upper body anaerobic power has been reported to predict swimming performance in events up to 400m (Hawley & Williams, 1991). The correlations obtained in the present study between towing VO_{2max} and both upper body anthropometric measures and push-ups, support the conclusion that upper body strength is an important characteristic for rescue swimming. It may therefore be beneficial to encourage potential recruits to develop their upper body strength and endurance.

TAKE HOME MESSAGE

On the basis of the results of this study the following tests are recommended for the assessment of BLG.

Task related tests

- Pool swim of 400m in less than 7.5 minutes – to predict paddling performance.
- Pool swim of 200m in less than 3.5 minutes – to predict sea swimming performance.
- 25m underwater swim immediately followed by 25m surface swim. Complete in less than 50 seconds. To assess confidence under the water and swimming efficiency.
- Lift 41kg torso manikin (could be a suitable bag of sand) by grabbing around the circumference with both arms and move backwards 10m – to simulate head end carry of a 2-man lift (appropriate training in manual handling to be provided prior to lift).

Additional tests to be used for guidance and preparation only, and <u>not</u> for selection purposes:

- Candidate's deltoid circumference (cm) to be measured and divided by the $\log_{10}$ of his/her 400m front crawl swim time (s). Resulting number to exceed 41 – to predict towing performance.
- 200m beach run as fast as possible, complete in less than 40s.
- Push-ups, body straight, knees off floor, chest lowered until it touches the clenched fist of the tester. Males to achieve 37, females 15 in one minute, resting permitted within the minute.
- A 2.4km (1.5 mile) run to achieve "good" or above according to published norms (males aged 20 years "good" = $3.55 L.min^{-1}$ [$52 mL.kg.^{-1}min^{-1}$]; females aged 20 years "good" = $2.3 L.min^{-1}$ [$43 mL.kg.^{-1}min^{-1}$], (Shvartz & Reibold, 1990). Potential male recruits should train so that they can run 1.5 miles in 10 min 15s and no slower than 11 min 44s. Potential female recruits should train so that they can run 1.5 miles in 11 min 56s and no slower than 14 min 24s.

The tests should not be used in isolation, as success on one test does not guarantee adequate physical fitness for beach lifeguarding.

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REFERENCES

Daniel K, Klauck J. Physiological and biomechanical load parameters in life saving. In: MacLaren, D. (Ed) *Biomechanics and Medicine in Swimming* 1992; E & FN Spon, London.

Durnin, J. & Womersley, J. (1974) Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16-72 years. Br. J. Nutrition. 32:77-90.

Gulbin JP, Fell JW, Gaffney PT. A physiological profile of elite surf ironmen, full time lifeguards and patrolling surf life savers. *Aus. J. Sci. Med. Sport* 1996; **28**(3):8 6-90.

Hawley, J. & Williams, M. (1991). Relationship between upper body anaerobic power

Leger, L. A. & Boucher, R. (1980) An indirect continuous multistage field test: The Universite de Montreal tract test. Can. J. Appl. Sports Sci. 5:77-84.

Shvartz, E. & Reibold, R. (1990). Aerobic fitness norms for males and females aged 6 to 75 years: a review. Aviat. Space Environ. Med. 61:3-11.

T. Reilly 1, A. Wooler 2, and M. Tipton 1. (2006). Occupational fitness standards for beach lifeguards. Phase 1: the physiological demands of beach lifeguarding. Occupational Medicine. 56; 6-11.

T. Reilly 1, C. Iggleden 1, M. Gennser 2, and M. Tipton 1. (2006) Occupational fitness standards for beach lifeguards. Phase 2: the development of an easily administered fitness test, Occupational Medicine. 56; 12-17.

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