



TASK DESCRIPTION AND PHYSIOLOGICAL DEMAND OF MARINE SPECIAL OPERATIONS STUDENTS DURING AMPHIBIOUS TRAINING



Shawn R. Eagle*, Takashi Nagai*, John Abt#, FACSM, Nicholas Heebner#, Necia Williams‡, Brad Lambert‡, Joshua D. Winters#, Scott Royer#, Scott Lephart#, FACSM

*Neuromuscular Research Laboratory & Warrior Human Performance Research Center, Department of Sports Medicine and Nutrition, School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, PA

#College of Health Sciences, University of Kentucky, Lexington, Kentucky ‡Marine Special Operations Command, Camp LeJeune, North Carolina

ABSTRACT

The amphibious operations skillset is crucial for Marines. For Marine Special Operations (MARSOC) students, this training includes small boat operation, open-water navigation, and beach reconnaissance. Training is highlighted by a daily 2000 meter swim with fins, and night-time navigation exercises in speed boats. Understanding the relevant tasks and physiological demand of this training can help identify the necessary physical traits for this population's success in amphibious operations. **PURPOSE:** To investigate the physiological demands and mechanisms associated with injury risk in Marines during MARSOC amphibious training. **METHODS:** Ten male Marines (age=25.4±2.5 years, mass=87.1±5.0 kg, height=181.6±4.9 cm) participated in a two-day observation. Marines wore a GPS-watch during the swim to estimate energy expenditure. A Borg Scale was used to estimate their Rate of Perceived Exertion (RPE) immediately post-swim. A trained clinician documented potentially injurious mechanisms during each exercise and consulted on-site corpsmen about injury complaints. **RESULTS:** Swims were completed in 50.3±3.1 mins and students expended approximately 445±58.4 kcals. Swimming was an aerobic activity, completed at a RPE >8. Corpsmen reported the high intensity/repetitive nature of the swim led to common complaints of hip flexor/peroneal tendonitis. Boat preparation was an anaerobic activity that occurred over several hours with short periods of lifting heavy objects, such as the fuel bladder, engine and boat itself. Thus, lumbar/thoracic spine injury from improper lifting technique is possible. Those seated in the front of the boat are susceptible to repetitive, rapid forward flexion of the neck/lower back, similar to a "whiplash" mechanism. **CONCLUSION:** Amphibious training has a high physiological demand in this population. Several tasks were identified with injury risk, based on clinician observation and reports from corpsmen. Prior to training, increasing muscular strength/endurance of the hip flexors, peroneals, and lower back/neck musculature while emphasizing aquatic exercise with proper form could help prevent such injuries. Future research should investigate the effects of a preventative program aimed at improving these characteristics on injury rates in MARSOC amphibious training.

INTRODUCTION

- Amphibious operations is a crucial skillset for Marine Special Operations (MARSOC) students.
- Amphibious training includes small boat operation, open-water navigation, and beach reconnaissance.
- Training is highlighted by a daily 2000 meter swim with fins, and night-time navigation exercises in speed boats.

EXPERIMENTAL DESIGN AND METHODS

- Ten male Marines (age=25.4±2.5 years, mass=87.1±5.0 kg, height=181.6±4.9 cm) participated over two-days
- Marines wore a GPS-watch during the swim to estimate energy expenditure.
- A Borg Scale was used to estimate their Rate of Perceived Exertion (RPE) immediately post-swim.
- A trained clinician documented potentially injurious mechanisms during each exercise and consulted on-site corpsmen about injury complaints.



RESULTS

- Table 1 reports each subject's hours of sleep, swim time and swim RPE over the observation period
 - Students expended approximately 445 ± 58.4 kcals each swim
- Corpsmen reported the high intensity/repetitive nature of the swim led to common complaints of hip flexor/peroneal tendonitis.
- Boat preparation was an anaerobic activity that occurred over several hours with short periods of lifting heavy objects, such as the fuel bladder, engine and boat itself.

Table 1. Hours of sleep, swim time, and swim RPE for each subject on Days 1 and 2

Subject	Day 1			Day 2		
	Sleep (hours)	Swim Time (min:sec)	RPE	Sleep (hours)	Swim Time (min:sec)	RPE
1	7.5	51:50	9	5	52:15	9
2	6	55:20	5	4	45:15	8
3	7	50:45	8	5	51:41	9
4	6.5	51:15	9	5	51:15	10
5	6	47:40	9	4	48:45	8
6	7	54:15	8	5	55:30	9
7	7	47:50	9	5	48:30	8
8	7	50:30	9	3	48:20	9
9	6	48:15	8	4.5	49:20	9
10	7	45:05	10	5.5	46:10	9

SUMMARY & CONCLUSIONS

- This study revealed a high physiological demand during amphibious training in this population
- Several tasks were identified with injury risk, based on clinician observation and reports from corpsmen.
 - Thus, lumbar/thoracic spine injury from improper lifting technique is possible.
 - Those seated in the front of the boat are susceptible to repetitive, rapid forward flexion of the neck/lower back, similar to a "whiplash" mechanism.
- Increasing *muscular strength and muscular endurance* of the hip flexors, peroneals, and lower back/neck musculature could help prevent injuries and/or pain that present during amphibious training
- Special emphasis should be placed on aquatic exercise with proper form to help prevent such injuries prior to training

Ongoing Research

- The University of Pittsburgh has ongoing studies using both a flume and pool-based approach to:
 - validate a new VO_{2Max} swimming protocol
 - Evaluate the relationship between land-based and pool-based physiological performance
 - Evaluate the difference in physiological demand between sidestroke and flutterkicks
 - Evaluate the effects of gear and fins on physiological performance

Future Research

- Future studies should investigate the effects of a preventative training program aimed at improving these characteristics on injury rates in MARSOC amphibious training.
- Pool-based evaluations of VO_{2Max} performance using flutterkicks and sidestroke with and without gear/fins are crucial for predicting and improving swim performance during this evolution

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www.nmrl.pitt.edu/content/shawn-eagle-mat-lat-atc-cscs
seagle@pitt.edu

