

APPLICATION OF A MODIFIED ETRIMP TO DETERMINE INTERNAL LOAD RESPONSE TO FIRE TONE CALLS IN FIREFIGHTERS

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INTRODUCTION

- Heart rate has been used to quantify the internal load, or physiological response, in sport-athletes and more recently to a task in the firefighter population.^{1,3}
- Edward's training impulse (ETRIMP) is a measure that utilizes time spent in various HR intensity zones up to 100% of age predicted maximum heart rate (HR_{MAX}) to determine the internal load of a task.^{2,3}
- In the firefighter population, however, a fire tone call (e.g., fires [rubbish, garage, or structural] and auto extrication) may result in an internal response exceeding 100% of age-predicted HR_{MAX} due to the intensity of the tasks.
- Thus, the traditional ETRIMP may underestimate the internal load of a fire tone call in a firefighter.

PURPOSE

- The **purpose** was to compare the internal load from the traditional ETRIMP to a modified version (ETRIMP_{MOD}) that accounts for time spent above 100% maximum heart rate in fire tone calls.

METHODS

- 33 (29 male, 4 female) FFs (36.46 ± 9.13 yrs, 179.92 ± 7.02 cm, 91.43 ± 12.75 kg) volunteered to participant in this study.
- Participants donned a remote physiological strap (Zephyr™ Bioharness and BioModule™ device, Medtronic, Annapolis, MD) that continuously measured heart rate for an entire 24-hour shift.
- Department call logs determined the time for each fire tone call.
- Corresponding time-stamped heart rate data was extracted to post-hoc determine the total time (TIME) in minutes (mins) during the fire call spent in 50-59% HR_{MAX} (TIME₅₀), 60-69% HR_{MAX} (TIME₆₀), 70-79% HR_{MAX} (TIME₇₀), 80-89% HR_{MAX} (TIME₈₀), and $\geq 90\%HR_{MAX}$ (TIME₉₀₊) zones for ETRIMP (AU).
- For ETRIMP_{MOD}, the 5th HR_{MAX} zone was adjusted to reflect 90-99% HR_{MAX} (TIME₉₀) and a 6th HR_{MAX} zone was created to reflect $\geq 100\%HR_{MAX}$ (TIME₁₀₀₊).
- MHR was estimated using Tanaka's age-based prediction equation.

Statistical Analyses

- A paired t-test examined for differences between the two internal load ETRIMP measures (Arbitrary Unites; AU).
- An alpha of $p < 0.05$ determined statistical significance.

RESULTS

- The average total time spent on a fire suppression call was 15.7 ± 2.6 mins. During these fire suppression calls, ETRIMP_{MOD} was significantly greater than ETRIMP (Figure 1). The time spent in each ETRIMP zone was primarily accrued in TIME₅₀ and TIME₆₀. However, the ranges for each zone indicate the individual uniqueness of each fire suppression call (Figure 2).

Figure 1. ETRIMP vs. ETRIMP_{MOD}

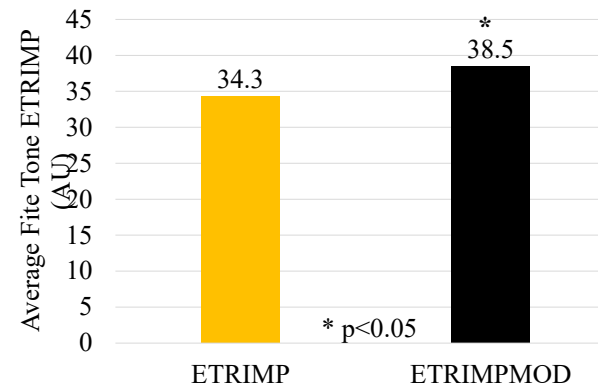
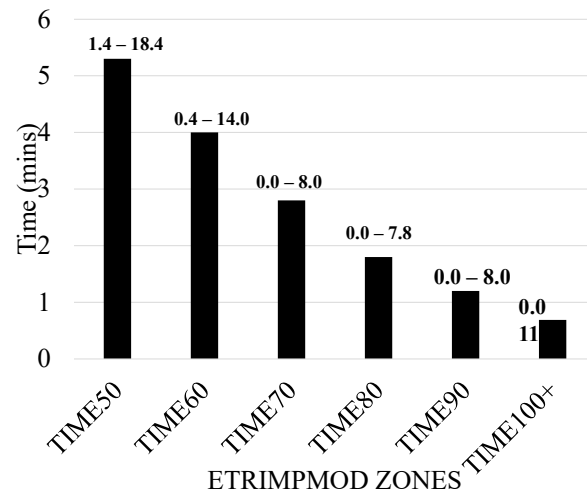


Figure 2. Average total time and range in each ETRIMP Zone



CONCLUSIONS

- The traditional ETRIMP may underestimate the internal load in a firefighter when responding to a fire tone call.
- Although the absolute time spent performing work at $\geq 100\%HR_{MAX}$ in this study is approximately 1 minute, that is nearly 1 minute spent performing work at a supramaximal intensity.
- Future research should explore ETRIMP_{MOD} in medical service calls, as well as structural fire suppression tasks only.

PRACTICAL APPLICATIONS

- The relative intensity for the work done in fire tone calls can exceed 100% of age predicted MHR and accounting for the time spent in performing work $\geq 100\%HR_{MAX}$ may be important to fully characterize the internal load response in firefighters.
- Further, recognizing the time demands in the upper internal load zones could help inform the development of training programs aimed at firefighter performance, as well as recovery strategies, to optimize cardiovascular health and minimize post-call cardiac injuries.

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