



A TRAINING PROGRAM FOR IMPROVING FIREFIGHTER HEALTH & PERFORMANCE

*The Health and Human Performance Foundation
Henderson, Kentucky Fire Department*

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Summary:

- This 6-week, 18-session aerobic and breath training program was feasible among a small group of active-duty firefighters.
- Firefighters' aerobic work capacity increased ($p < 0.05$) from program beginning to end, both in the erg sessions and the FAS drills (see Table). No trends were seen in physiological (CO₂T, RR, HR, BP), performance (SCBA unit air depletion), or psychometric measures (stress, burnout).
- Other fire departments may benefit from adopting this or similar programs for helping keep their firefighters healthy, performing optimally, and on the job.

Background

Repeated trauma exposure associated with firefighting can have significant negative impacts on firefighters' (FFs) mental health and well-being. FFs also face increased risk of cardiac events due to the cardiovascular strain associated with firefighting activities.^{1,2,3}



Regular practice of nasal, diaphragmatic breathing can improve CO₂-O₂ exchange, cardiorespiratory fitness and physiological stress responses.^{4,5,6,7,8} Because nasal breathing entails working against resistance similar to that of self-contained breathing apparatus (SCBA) use, its practice may further FF performance when using SCBA during emergency situations.



The firefighting community has experimented with use of different breathing techniques during exertion to improve outcomes such as SCBA air depletion time, work completed prior to SCBA air depletion, and cardiorespiratory responses during SCBA use.^{9,10,11,12,13,14,15} However, there remains a need for programs that mitigate cardiorespiratory responses, improve FF performance, and support FFs' emotional recovery following such activities.

In response to this need, HHPF has developed a FF training program that may lead to improved FF performance and reduced stress-related burnout, with the ultimate goal being to help keep firefighters healthy, performing well, and staying on the job. The program was recently piloted at the Henderson Fire Department (FD), a career department in Kentucky.

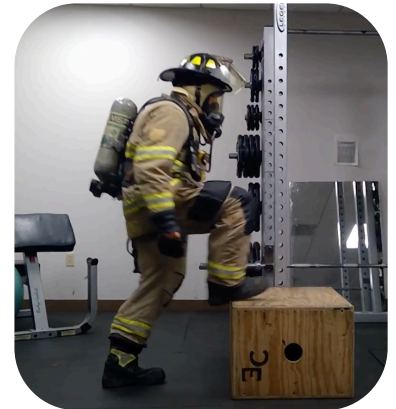
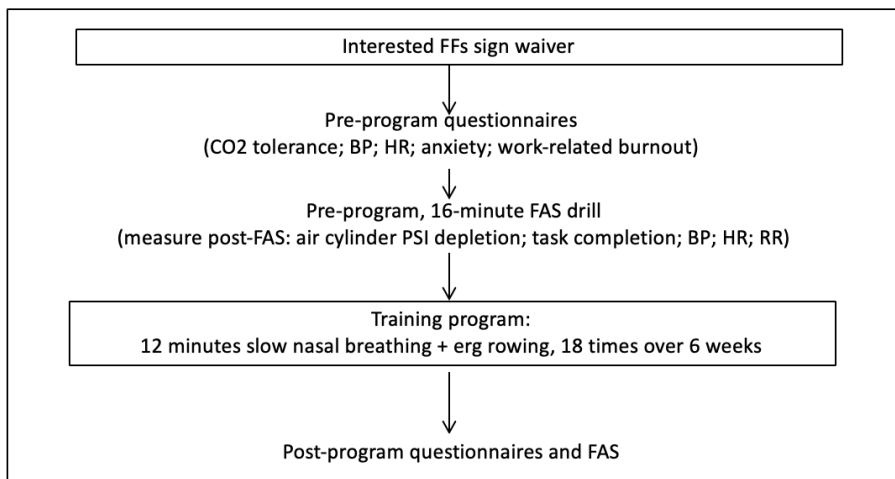


Program overview

The program lasted 6 weeks, comprising (Figure 1):

- **Before and after program implementation:** brief mental health (stress and burnout), physiology (CO₂ tolerance, BP, RR, HR), and performance (FAS) assessments
 - Firefighting activity simulation (FAS) with full protective gear and self-contained breathing apparatus;
- **Training program:** 18 individual sessions over 6 weeks of 12-minute regulated breathing practice while on ergonomic rowing machine. The sessions were done at the FD and during the FFs' 24-hour shift.

Figure 1. Flowchart of 6-week slow-breathing firefighter program

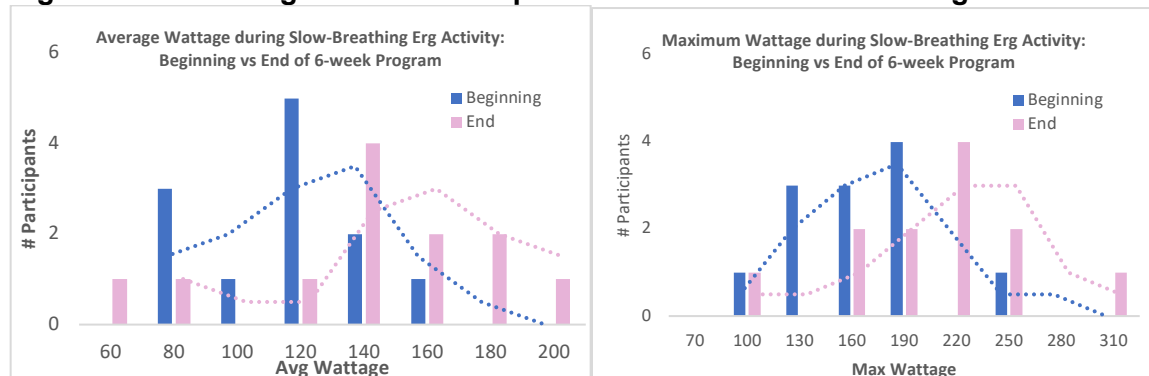


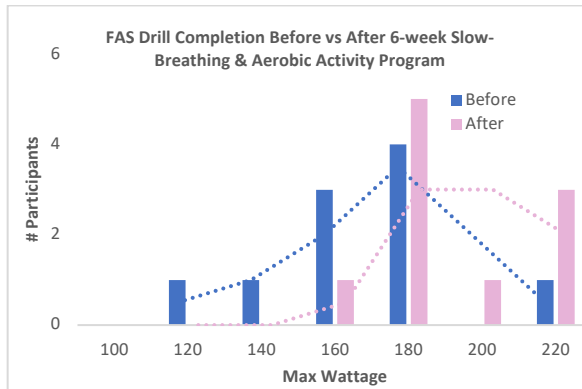
BP, blood pressure; CO₂, carbon dioxide; FAS, firefighting activity simulation; FF, firefighter; HR, heart rate; PSI, pounds per square inch; RR, respiration rate

Program evaluation findings:

- This 6-week, 18-session aerobic and breath training program was feasible among a small group of active-duty firefighters. Among the 17 who initiated the program, 12 completed ≥ 6 regulated-breath erg sessions and of those, 10 completed both pre and post-program questionnaires and assessments.
- Firefighters' aerobic work capacity increased ($p < 0.05$) from program beginning to end, both in the erg session output and in FAS drill task completions (see Table, Figures 2a-c). No trends were seen in other measures: physiological (CO₂T, RR, HR, BP), performance (SCBA unit air depletion), or psychometric measures (stress, burnout).

Figures 2a-c. Wattage and Drill Completion Before-After 6-week Program





- Other fire departments may benefit from adopting this or similar programs for helping keep their firefighters healthy, performing optimally, and on the job. In so doing, they may consider the following program modifications, depending on whether their primary purpose is helping FF performance or mental health:
 1. Performance metrics: Provide more practice in the CO2TT and FAS drill to allow these assessments to be more valid and reliable measures of performance changes associated with the program in each FF population. For example, the FFs might CO2TTs before and after each erg session and doing the FAS drill 1-2 times prior to program start to ensure familiarity.
 2. Mental health metrics: measure short-term anxiety before and after each erg session, using a short and simple scale such as that used here or something even simpler such as a validated visual analogue scale using numeric or pictorial representations of stress levels.

Table. Changes from program beginning to end in participants' ergometer average and maximum wattage and FAS drill task completion

Participant	# completed sessions	Increase in FAS drill completion*±	Increases program beginning to end	
			Average wattage [±]	Max wattage [±]
1	6	36	18	124
2	18	24	24	24
3	15	50	9	8
4	18	24	75	82
5	15	18	12	15
6	18	38	52	93
7	18	13	5	3
8	18	1	40	27
9	12	16	-5	-5
10	10	26	13	39
11	18		60	6
12	18		36	60

* 12 participants completed ≥ 6 erg sessions and of those, 10 completed both the pre-and-post program questionnaires and FAS drills.

± $p < 0.05$



Given the feasibility, accessibility, and potential benefits in this group of FFs, this type of breath-and-aerobic training program could be implemented with some simple modifications in other fire departments to keep more FFs healthy, performing well, and on the job. Future programs and research could build on this program evaluation to further explore associations between this type of FF training and CO2 tolerance, burnout, anxiety, and performance.



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