

KEY FINDINGS

The Performance Problem

- Firefighters carry 20–25 kg of gear into some of the most physically demanding conditions of any occupation
- Heart rate during firefighting reaches up to 90% of maximum — demanding elite-level aerobic and muscular capacity
- Most fitness tests don't predict whether you can actually do the job

How the Study Was Done

- 20 career firefighters tested on five fitness parameters: VO2max, body fat, weight, upper and lower body power
- Performance measured on seven simulated firefighting tasks including rope climb, stair climb with load, and ladder carry
- Machine learning model achieved 98.75% predictive accuracy linking fitness to task performance

What's At Stake

- Knowing which fitness variables predict job performance lets you train for the job — not just pass a test
- High body fat percentage was associated with poor performance on all seven tasks
- Without targeted evaluation, firefighters may be fit by general standards but not fit for the job



Relationship between Firefighter Physical Fitness and Special Ability Performance

SUMMARY:

Why This Matters to You

Not all fitness is the same — and not all fitness tests tell you whether you can actually do the job. This study used machine learning to identify exactly which physical fitness parameters predict performance on seven simulated firefighting tasks. The findings give firefighters and departments a science-based framework for what to measure, what to train, and what actually matters when the bell rings.

Fitness That Predicts Job Performance: What the Science Identified

FINDINGS:

The Most Important Things to Know

- VO2max was the strongest performance predictor: As maximal oxygen uptake increased, completion time on every one of the seven simulated tasks decreased significantly — aerobic capacity is the foundation every other fitness quality is built on.
- Body fat percentage hurt performance across all seven tasks: Higher body fat was consistently associated with slower task completion on every test — making body composition the most broadly impactful correctable variable in this study.
- Both upper and lower body power matter: As muscular power increased in either the upper or lower body, task completion times improved significantly across the board — strength and power are not optional for fireground readiness.
- General fitness tests don't tell the whole story: VO2max alone was only moderately related to rescue and suppression task performance — a complete evaluation requires measuring aerobic capacity, body composition, and muscular power together.

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SCIENCE CAN



CONDITIONS, ACTIONS, & NEEDS

Big Picture: What Actually Works

FIRE STATION TALKS

- Fitness evaluation should predict job performance, not just general health. This study achieved 98.75% accuracy predicting task performance from five fitness variables — VO2max, body fat, weight, upper body power, and lower body power.
- Aerobic capacity is the foundation. VO2max predicted performance improvement across all seven tasks — and the NFPA recommends a minimum of 42 mL/kg/min. Below that threshold, firefighters cannot safely and effectively meet the physiological demands of the job.
- Body composition is the most broadly correctable variable. High body fat was associated with poor performance on every single task. It places extra burden on both the cardiovascular and musculoskeletal systems.
- Strength and power are non-negotiable. Forcible entry, hose pulling, ladder carrying, victim rescue — these tasks require high levels of muscular power to perform safely. Upper and lower body power both predicted task performance independently in this study.



Key Actions: Evaluate and Train for the Job

TAKEAWAYS

- Evaluate the right things. VO2max, body fat percentage, and both upper and lower body power together predicted job task performance with 98.75% accuracy. If your evaluation doesn't measure all of these, it's not giving you the full picture.
- Train aerobic capacity first — then build power on top of it. VO2max was the strongest single predictor across all tasks. Build your cardiovascular base, then layer in strength and power work targeted at the upper and lower body.
- Address body composition directly. Body fat was negatively associated with performance on all seven tasks. Managing body composition is not about appearance — it is about being able to do the job when it counts.

Data Sources:

XU, D., SONG, Y., MENG, Y., ISTVÁN, B., & GU, Y. (2020). RELATIONSHIP BETWEEN FIREFIGHTER PHYSICAL FITNESS AND SPECIAL ABILITY PERFORMANCE. INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH, 17, 7689.

What Chiefs Can Do: About Fitness Evaluation

TAKING THE LEAD

- Use evaluation data to drive individualized training. Knowing which component — aerobic capacity, body composition, or muscular power — is limiting a firefighter's performance tells you exactly where to focus training investment.
- Set body composition standards alongside aerobic standards. Body fat was associated with poor performance on every task in this study. Departments must track more than VO2max.
- Align training with the physical demands of the job. The seven tasks in this study are the job. Training should build the specific fitness qualities these tasks require, not generic gym fitness.
- Adopt a multi-component fitness evaluation. A single aerobic fitness test misses body composition and muscular power — both of which independently predicted task performance. Evaluation should measure all three to give a picture of job readiness.
- Educate members on what their fitness numbers mean for job performance. Firefighters who understand the direct link between their VO2max, body composition, & task performance are more motivated to improve.
- Evaluate regularly, not just annually. Fitness changes across a career. More frequent assessments catch declining trends before they become performance or safety issues on the fireground.

Conclusion

NOT ALL FITNESS IS THE SAME — AND NOT ALL TESTS TELL YOU IF YOU CAN DO THE JOB. THIS STUDY IDENTIFIED VO2MAX, BODY FAT, AND MUSCULAR POWER AS THE VARIABLES THAT PREDICT FIREGROUND TASK PERFORMANCE WITH 98.75% ACCURACY. EVALUATE THE RIGHT THINGS, TRAIN FOR THE JOB, AND ADDRESS BODY COMPOSITION DIRECTLY. FITNESS THAT DOESN'T TRANSLATE TO TASK PERFORMANCE IS JUST CHECKING A BOX.

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