

Study of Protection Scores for Paramedics with Facial Hair Using A Breath-Responsive Powered Air Purifying Respirator (PAPR)

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OVERVIEW

Traditional filtering facepiece respirators (FFRs), such as N95 masks, provide limited protection against airborne viruses like SARS-CoV-2, particularly for healthcare workers with facial hair, which compromises the facial seal. Existing research has focused on a narrow range of facial hair styles, leaving a critical gap in understanding the efficacy of alternative respiratory protection for diverse facial hair types.

PROJECT DESIGN | DATA COLLECTION | RESULTS

A total of 128 field tests were conducted, with each exposure activity repeated with 32 paramedicine student and paramedic volunteers. 20 participants had light stubble, heavy stubble, trimmed beards or long beards with a control group of 12 students.

Each participant completed a series of simulated paramedic-related work scenarios — including driving, patient loading, on-scene patient assessment, and patient extrication — while wearing the PAPR.

The working environments were preloaded with nebulized water aerosols to simulate a virus-laden atmosphere.

Respirator protection scores, defined as the ratio of ambient aerosol particle concentration to the concentration within the respirator's breathing zone, were continuously measured using TSI aerosol instrumentation. A respirator protection score greater than 200 is required for adequate protection.

To ensure data validity, protection scores from tests with environmental exposure levels below 2000 particles were excluded, resulting in 121 data points for analysis.

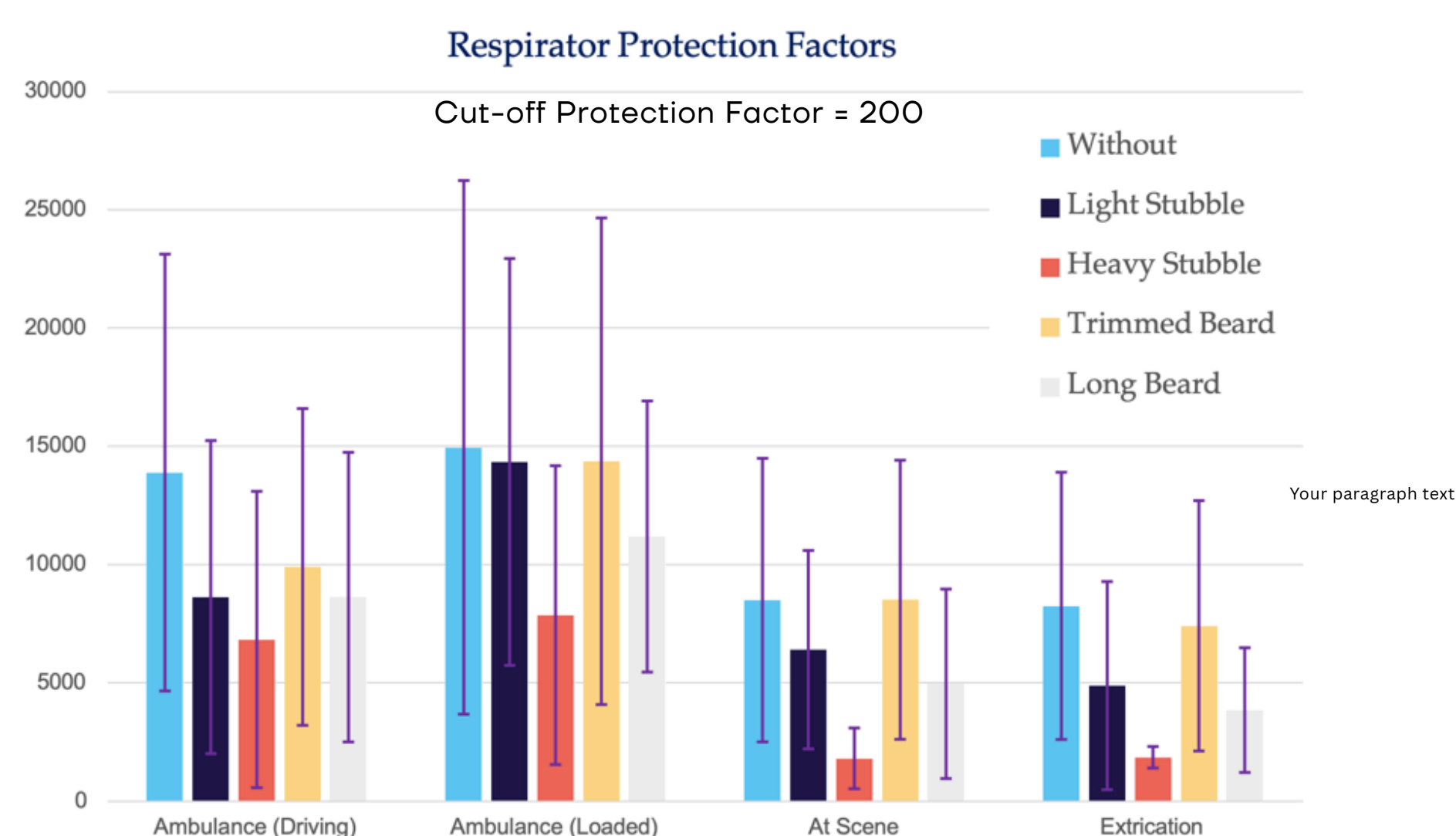


Figure 1 Effect of Facial Hair Levels on Protection Factors Across Scenarios



Figure 4: Categories of Facial Hair

RESEARCH AIMS

The aim of this research collaboration was to:

1. Examine the influence of varying levels of facial hair on the fit and protective performance of respirators.
2. Evaluate the protective performance of a breath-responsive Powered Air-Purifying Respirator (PAPR) in simulated healthcare scenarios.

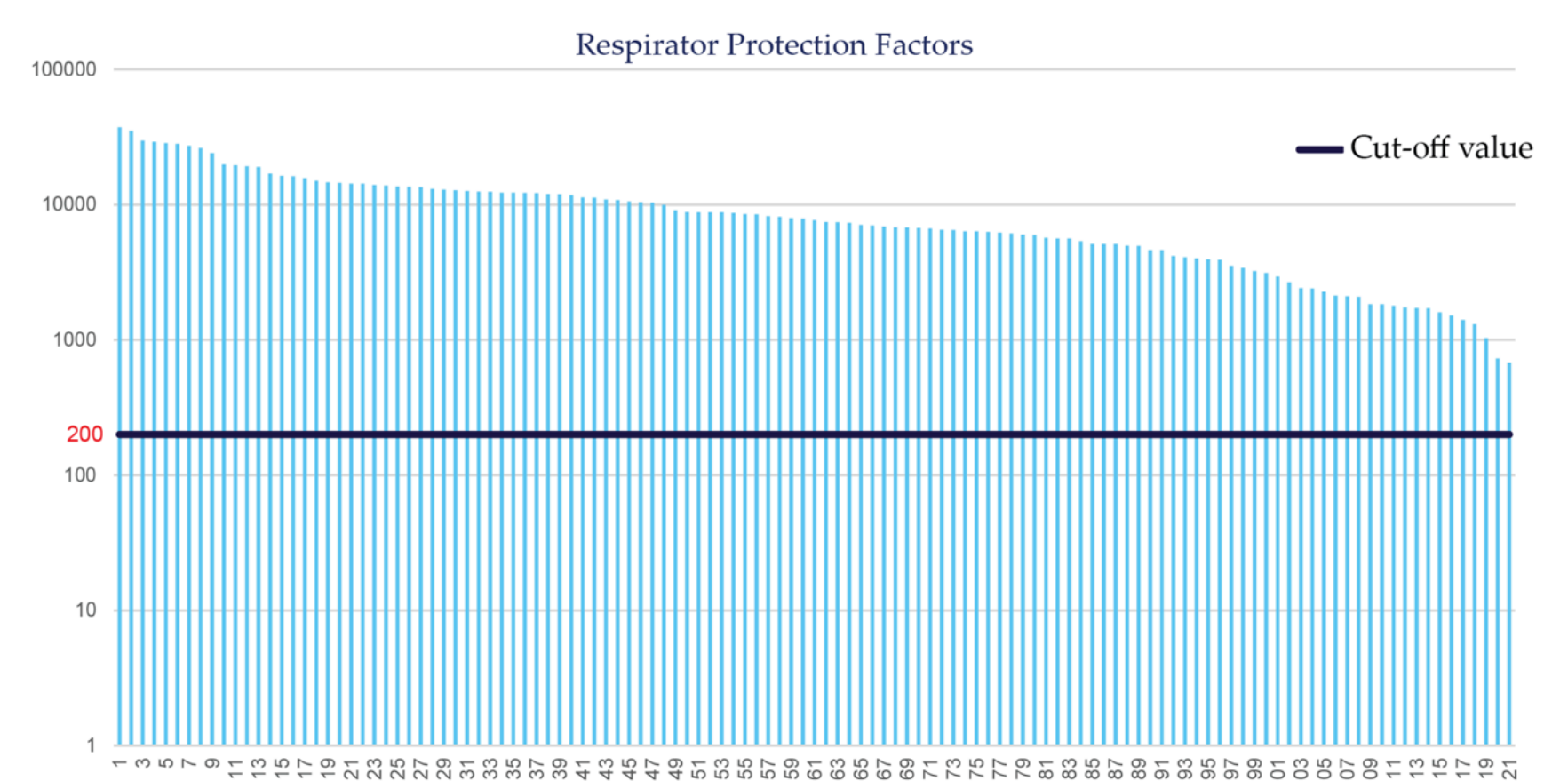


Figure 2 Protective Factors for All Participants

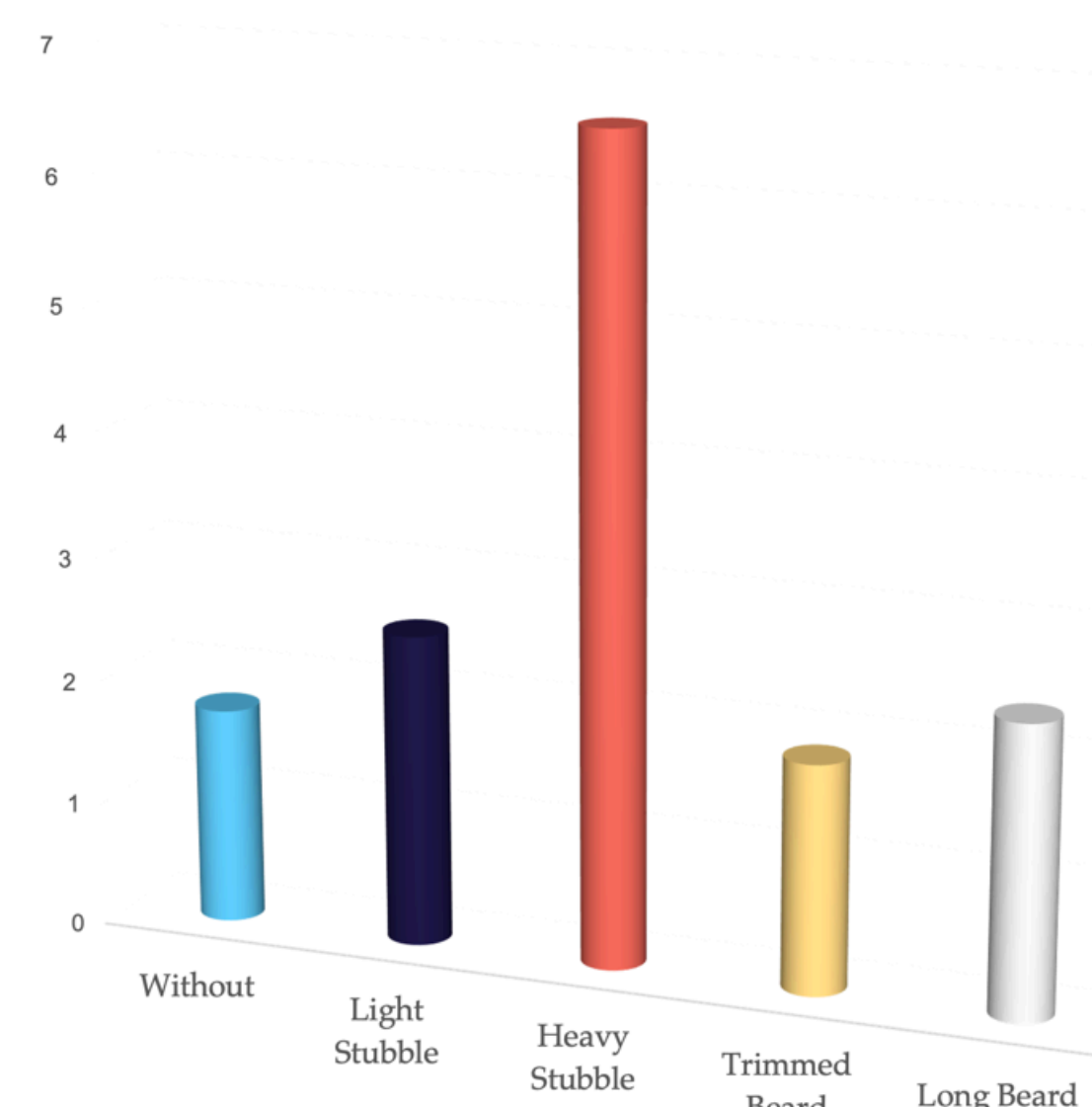


Figure 3 Internal Particles for All Participants

CONCLUSION

This study shows that powered air-purifying respirators (PAPRs) provide effective protection for paramedics with facial hair, even in high-risk simulated environments and across varied operational tasks.



Figure 5: Paramedic related work scenarios

