

AIR FORCE SPECIAL WARFARE · ASSESSMENT & SELECTION

Routine Blood Biomarkers Predict a Graduation Advantage

An additive biomarker-and-fitness profile identifies at-risk trainees before attrition

Presented by: Thomas Smith, MS · MHSRS 2026

Acknowledgements

Special Warfare Human Performance Squadron, JBSA Lackland, TX

Sarah Pesquera, MS; John D Mata, MS; Kathleen Hogan, PhD, ATC; Lt Col Joshua Van Wyngaarden, PT, PhD; Lt Col Lyndsey Ferris, PhD

Eglin Air Force Base, FL

Lt Col Erin Stewart PT, PhD

Air Force Research Lab 711 Human Performance Wing, Wright-Patterson AFB, OH

Lt Col Cody Butler, PT, PhD

University of Texas Health San Antonio, San Antonio, TX

Nathan Harper; Sunil Ahuja, MD

Disclaimer

The opinions expressed herein are those of the authors and do not necessarily reflect the official policy or position of the US Air Force, the Special Warfare Training Wing, or the Department of Defense.

The authors have no conflicts of interest to report.

THE PROBLEM

Half the Pipeline Is Lost — With No Early Warning

Over half of candidates entering Special Warfare Assessment & Selection do not graduate. The traditional marker of risk — musculoskeletal injury — is misleading, because it is confounded by how long a candidate stays.

1

No early-warning tool

Risk is recognized only after a candidate has already self-eliminated or been injured.

2

Injury is exposure-biased

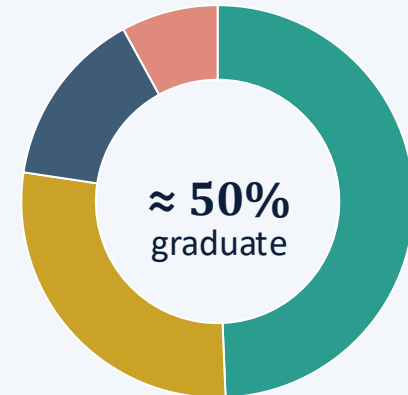
Candidates who self-eliminate leave before accumulating injuries — inflating graduate injury rates.

3

Blood draws are cheap & routine

A comprehensive metabolic panel and CBC are already drawn — a low-cost place to find signal.

Course outcomes (n = 464 first attempts)



229 graduate (114 with injury)

130 self-eliminate

68 medical elimination

37 performance elimination

STUDY COHORT

464 Candidates, Three Blood Draws

464
candidates

463 : 1
male : female

22 yrs
median age (IQR 19 - 25)

6
training classes

Sampling timeline



Measured across visits

chemistry panel · complete blood count · performance (run) · cognitive (ASVAB) · body composition — 87 variables in all

METHODS

From an 87-Variable Screen to Two Additive Models

Across 87 routine variables, three inexpensive blood markers survived multiple-comparison correction (FDR) for both run time and graduation. These — plus entry pathway and run time — built two additive logistic models, each adjusted by class, and again by class and age.



1 Fitness model

Entry pathway + 1.5-mile run time (cutoff 9.82 min).
n = 432 (missing 52 run times)

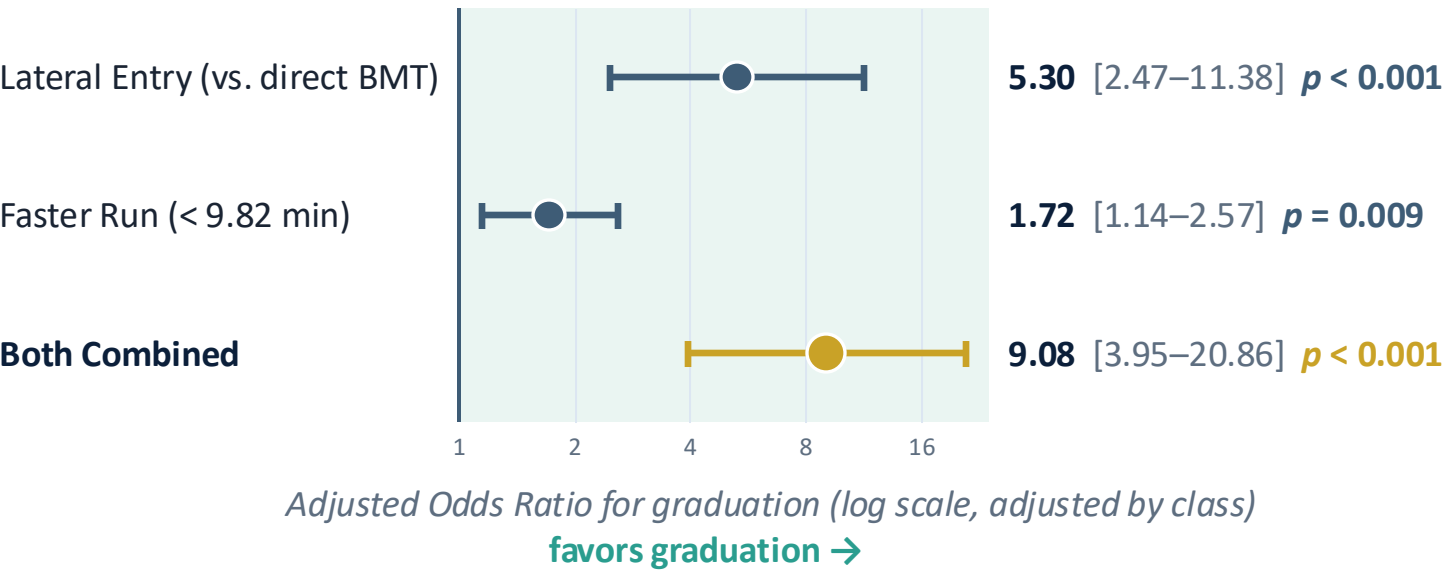
2 Biomarker model

Entry pathway + calcium (> 9.5 mg/dL) +
platelet:lymphocyte ratio (< 129.5) + albumin:globulin
ratio (> 1.9). n = 463 (missing 1 lymphocyte count)

RESULTS — MODEL 1

Entry Pathway and Run Time Predict Graduation

In the fitness model, lateral entry and a faster 1.5-mile run each independently predicted graduation — and combined, they multiply.



Pathway matters most

Lateral entrants — who have served operationally before selection — graduate at over five times the odds of candidates directly from BMT.

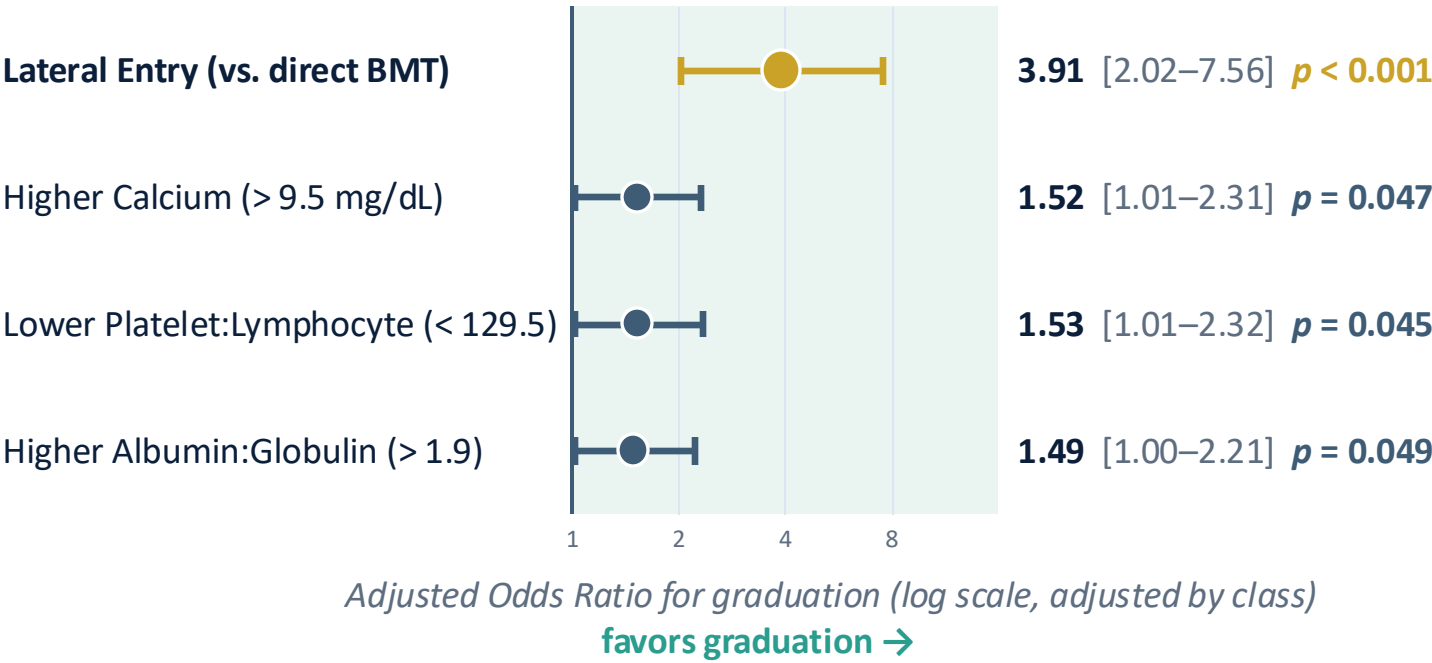
9.08×

combined odds when both factors are favorable (class-adjusted).

RESULTS — MODEL 2

Four Routine Blood Predictors

In the biomarker model, entry pathway plus three inexpensive labs each independently predicted graduation — none decisive alone.



Modest alone, powerful stacked

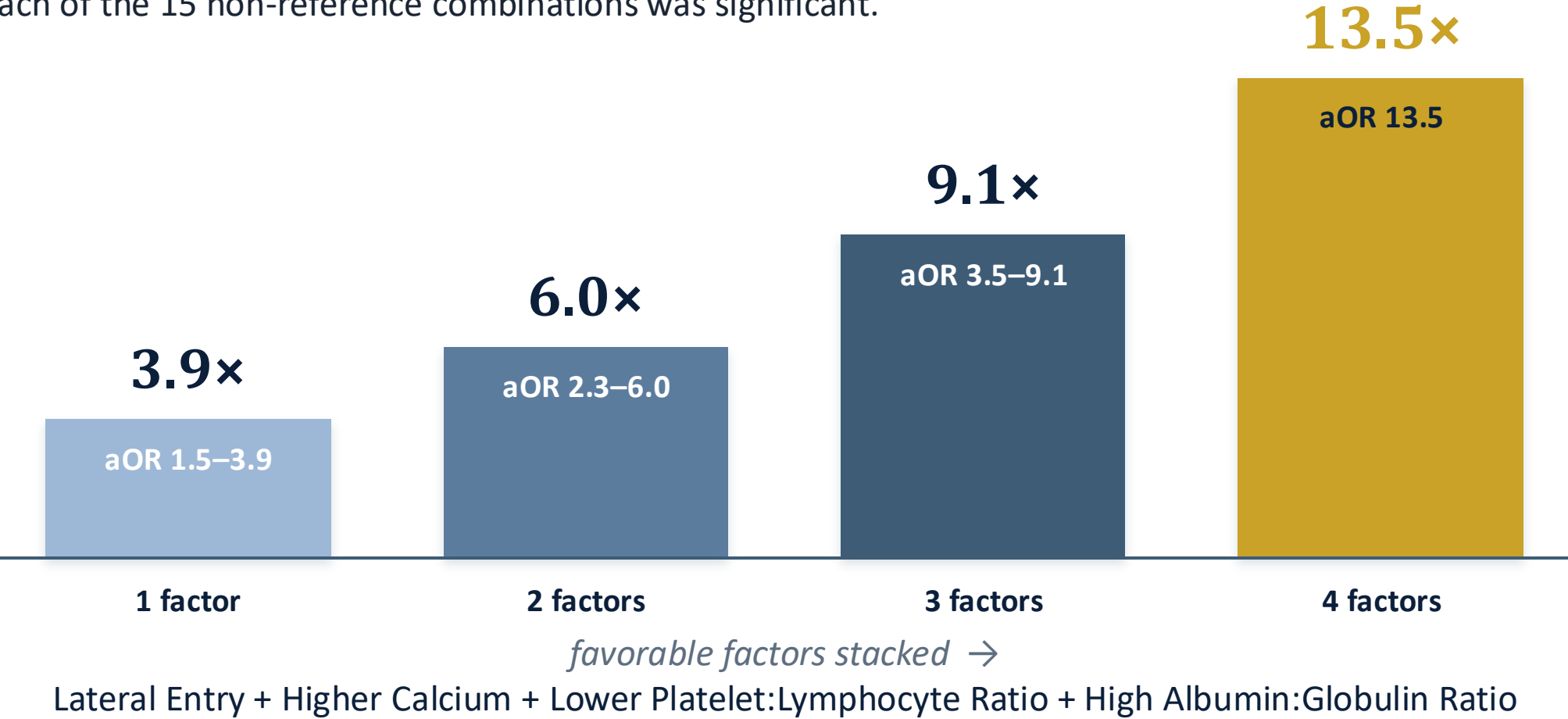
Each blood marker carries a small, significant edge (aOR $\approx$ 1.5). The value is in combining them — shown next.

All three labs come from the CMP and CBC already drawn at intake — no added cost.

RESULTS — THE SIGNATURE FINDING

An Additive, Dose-Response Climb

As favorable factors accumulate, graduation odds rise in clear steps — reaching a 13.5x advantage when all four align. Each of the 15 non-reference combinations was significant.



CONCLUSIONS

Combined Profiling — and Four Modifiable Levers

Biomarker and fitness profiles additively predict SWAS graduation with a clear dose-response. Each predictor maps to an intervention that is identifiable and modifiable before course entry.

1

Calcium

Supplementation targets the serum-calcium predictor.

2

Protein intake

Supports albumin and the albumin:globulin ratio.

3

Immune health

Limits illness-driven globulin elevation.

4

Aerobic fitness

Improves run time — the strongest fitness lever.

From ~1.5× per marker to 13.5× for the full profile.

Routine blood draws can flag at-risk trainees early — and point to what to change.

THANK YOU

Routine labs, read together, can see who graduates

Thomas Smith, MS · Special Warfare Human Performance Squadron, JBSA Lackland, TX