



Female and male differences in the associations between Body Mass Index and Stress Fractures: A Nationwide Cohort of 193,047 Combat Soldiers

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At the moment of truth,
IDF MEDICAL CORPS.

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Non-disclosure

I have no conflicts to report.



About me

28 years old

Medical doctor, MPH

Surgeon of 435 infantry battalion in the Givati Brigade 84

Surgeon of the Givati Infantry Brigade during the Swords of Iron War and operation "Lion's Roar".



Background



Stress fractures
result from
repeated stress
over time



Uncommon but
costly



Applicable to elite
athletes



Peak bone mass in
early adulthood

Imbalance between
osteoblast and
osteoclast activity,
favouring bone
breakage

Health hazards, unit
competence

Insight to bone
strength in healthy
young adults

Low BMI in youth,
weaker bones later

Is BMI a reliable indicator of bone health in healthy adults?

References:

1. Beck et al, Bone, 2000, 2. Simchoni et al, JAMA Network, 2025, 3. Barrack et al, Am J Sports Med, 2014

Abbreviations: BMI, Body Mass Index



Aim

Assess the association between BMI and the incidence of stress fractures among male and female soldiers in combat training



Abbreviations: BMI, Body Mass Index





Bedno et al, 2019

Exposure

BMI

Outcome

MSK Injury

Males

Underweight - OR 1.27
Overweight - OR 1.14
Obese - OR 1.54

Females

No significant difference
between BMI groups



Knapik et al, 2018

%BF (BMI, age, sex)

Stress Fractures

Lowest %BF – OR 1.27
Highest %BF – OR 1.15

Lowest %BF – 1.20
Highest %BF – 1.04, insignificant



Hollander et al, 2020

BMI

Overuse Injuries

Underweight – OR 0.94
High-normal – OR 1.09
Overweight – OR 1.22
Obese – OR 1.39

Not included

References:

1. Bedno et al, Injury Prevention 2019. 2. Knapik et al, BMC Musculoskeletal Disorders, 2018. 3. Hollander et al, Obesity Facts, 2020

Abbreviations: BMI – body mass index, MSK – musculoskeletal, BF – body fat, OR – Odds Ratio



Methods

Settings

Retrospective cohort

Population

Male and female recruits to
combat service in the IDF
2014-2024

Study arms

BMI categories (kg/m^2) <18, 18-
<20, 20-<25 (reference), 25-
<32, 32-<35
Subgroups – combat intensity

Outcomes

Any stress fractures (ICD Coded)
Clinically significant stress fractures
(pelvis/femur)
Stress fracture with activity
restriction

Follow up definitions

From recruitment to end of
mandatory service

Statistics

Propensity score weighted
survival analysis | Restricted
Mean Time Lost Ratio (365
days)



Abbreviations:

IDF, Israeli Defense Forces; BMI, Body Mass Index; ICD, International
Classification of Diseases



Results

	Males	Females
Population	164,333	28,714
Mean age	18.95	18.73
High intensity combat training*	64.8%	32.8%
Drafted 2020-2024	46.8%	57.2%
BMI		
<18	8050 (4.8%)	320 (1.1%)
18-<20	32223 (19.6%)	4549 (14%)
20-<25	91708 (55.4%)	17179 (59.8%)
25-<32	30080 (18.3%)	6454 (22.5%)
32-<35	2272 (1.4%)	512 (1.8%)

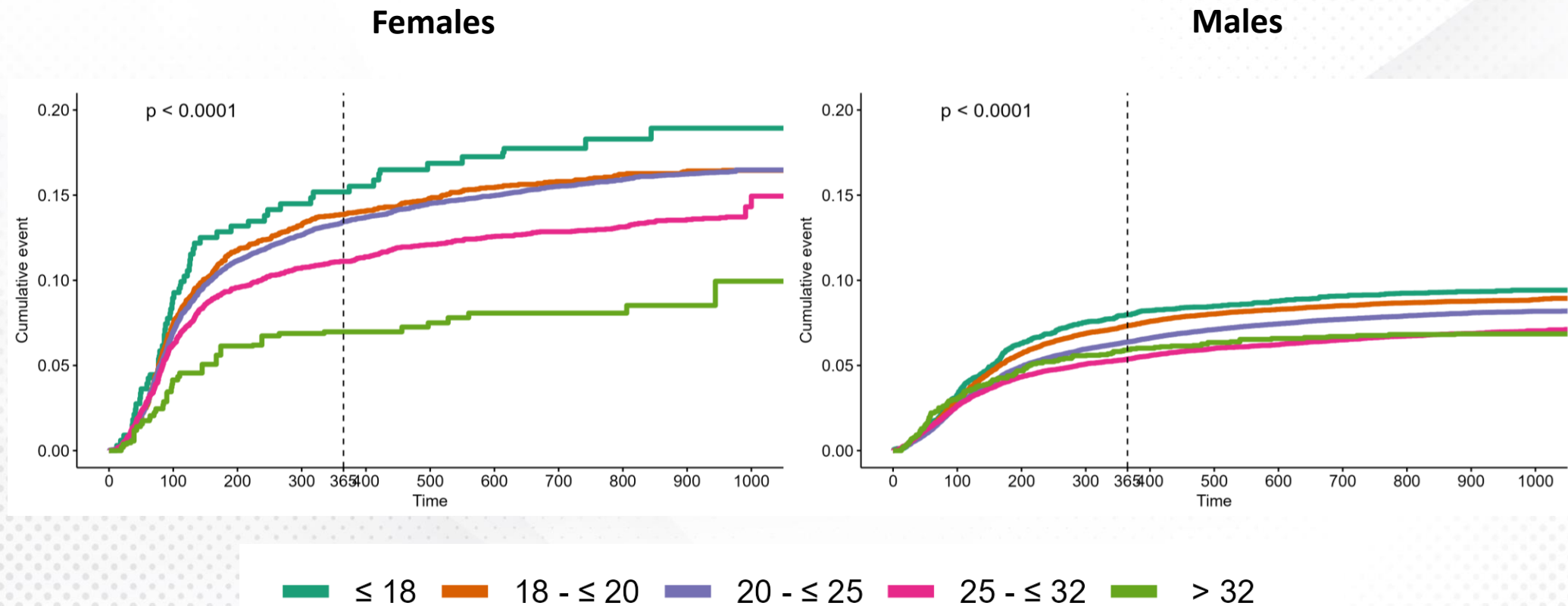
High intensity - Infantry, combat engineering, light troops, special units

Low intensity - Armored corps, artillery, search and rescue



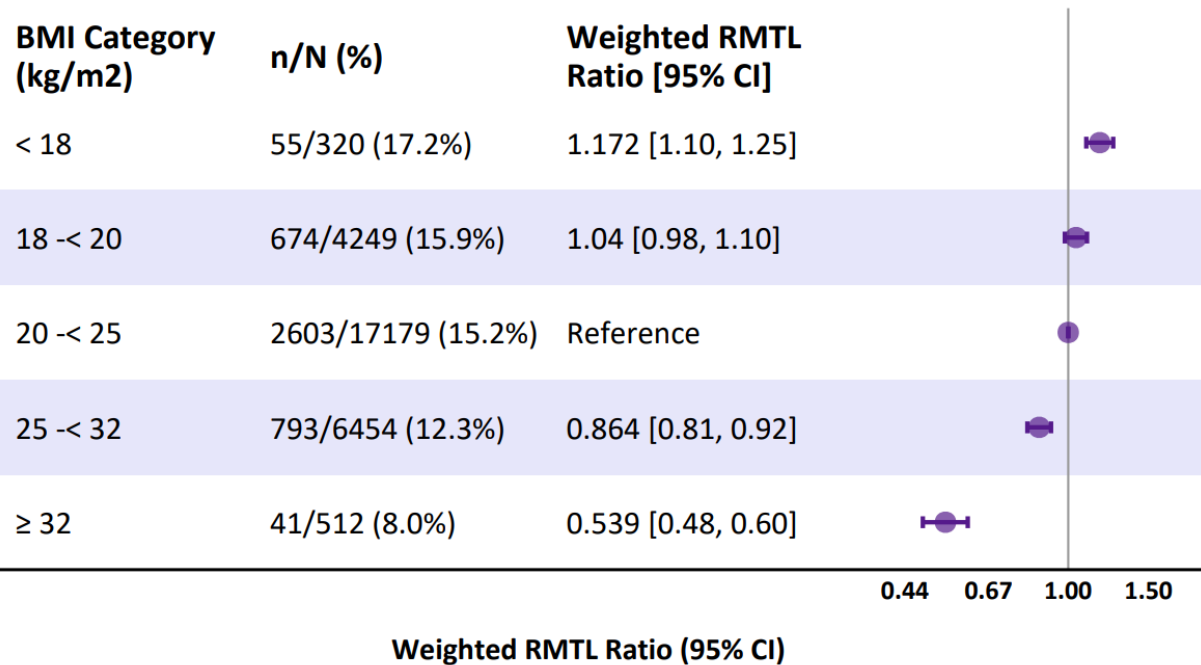
Association of BMI with incidence of stress fractures

Any stress fractures;
weighted

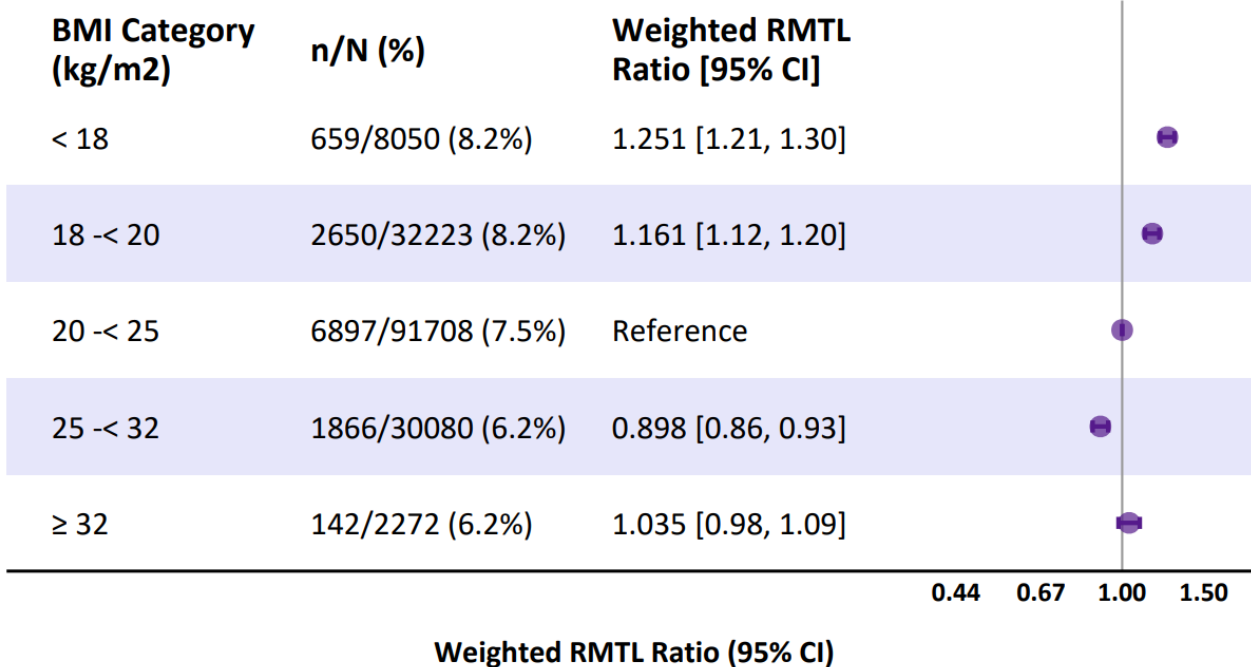


Any stress Fractures

Any stress fracture - Overall Females



Any stress fracture - Overall Males



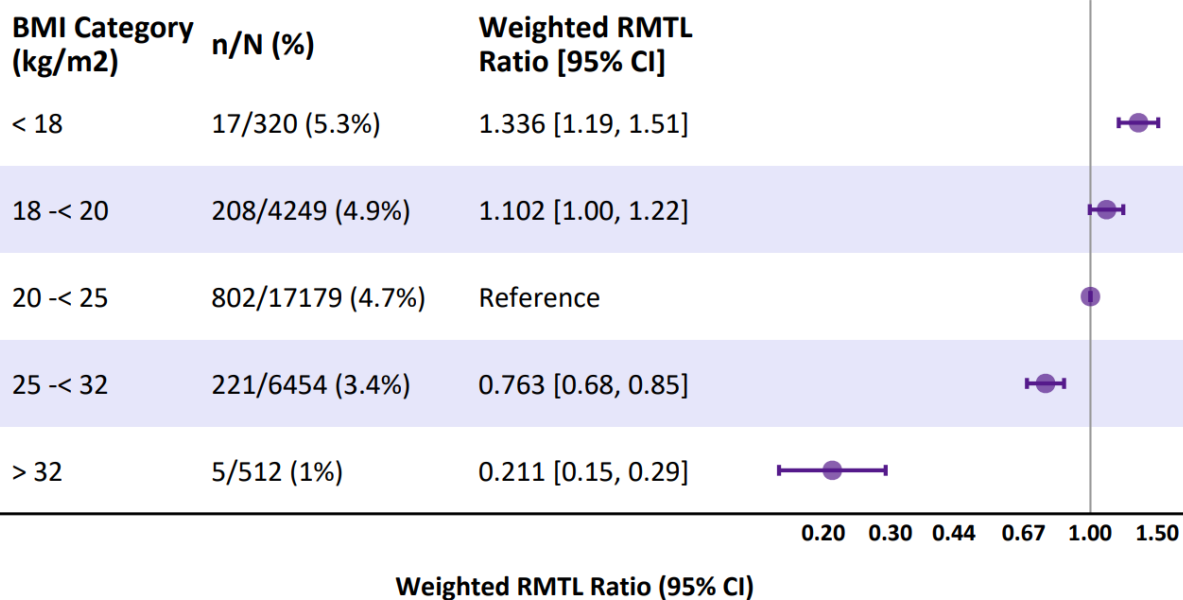
Abbreviations:

BMI, Body Mass Index; RMTL, Restricted Mean Days Lost

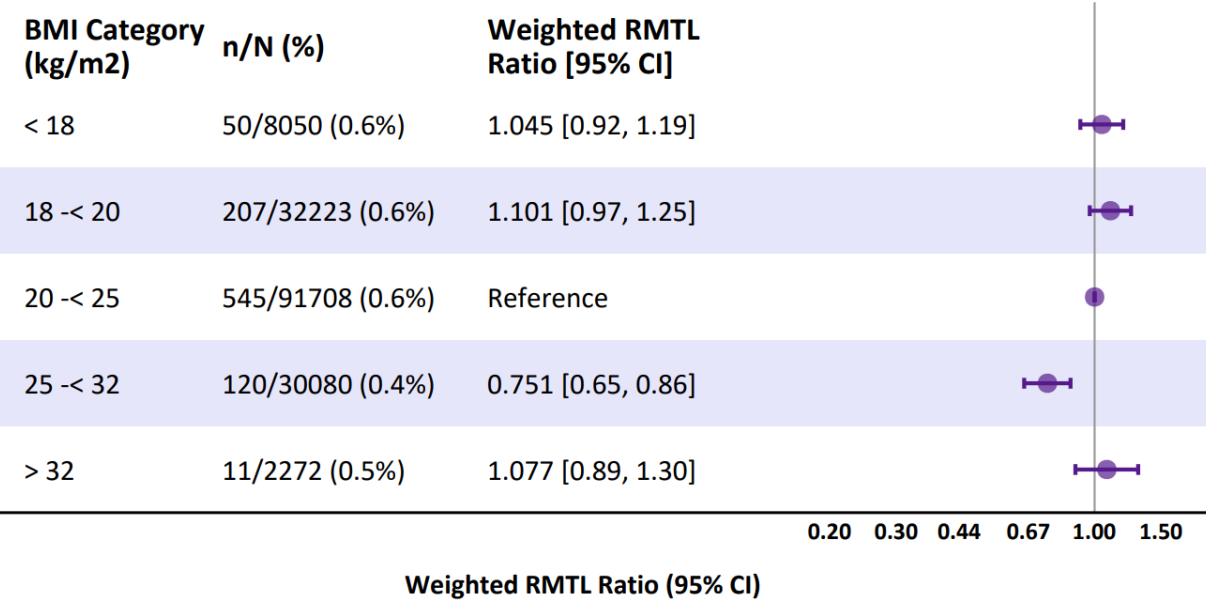


Clinically Significant Stress Fractures

Clinically Significant SF - Females



Clinically Significant SF - Males

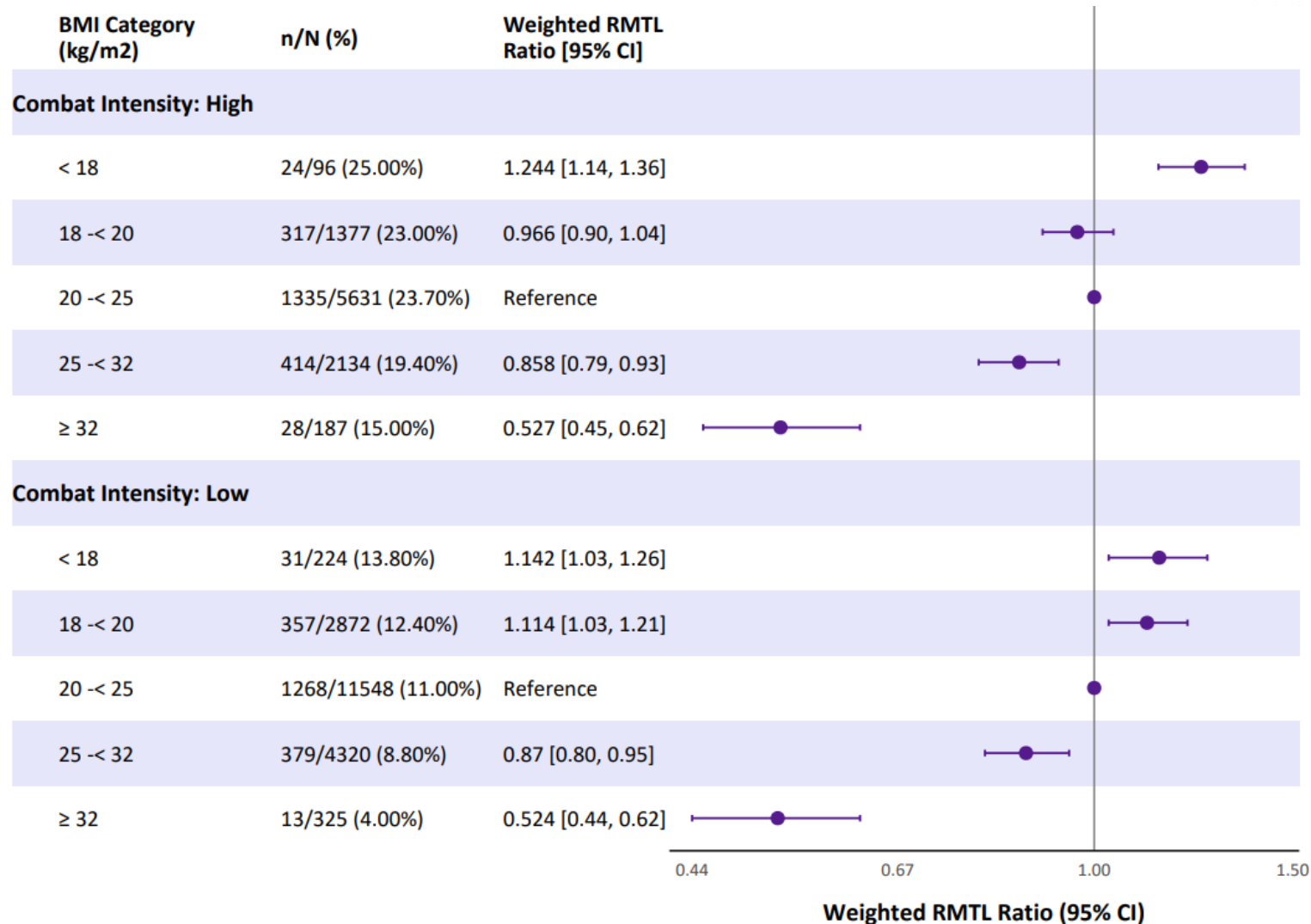


Abbreviations:

BMI, Body Mass Index; RMTL, Restricted Mean Days Lost



Any stress fractures by training intensity - females



High intensity
Infantry, combat engineering,
light troops, special units

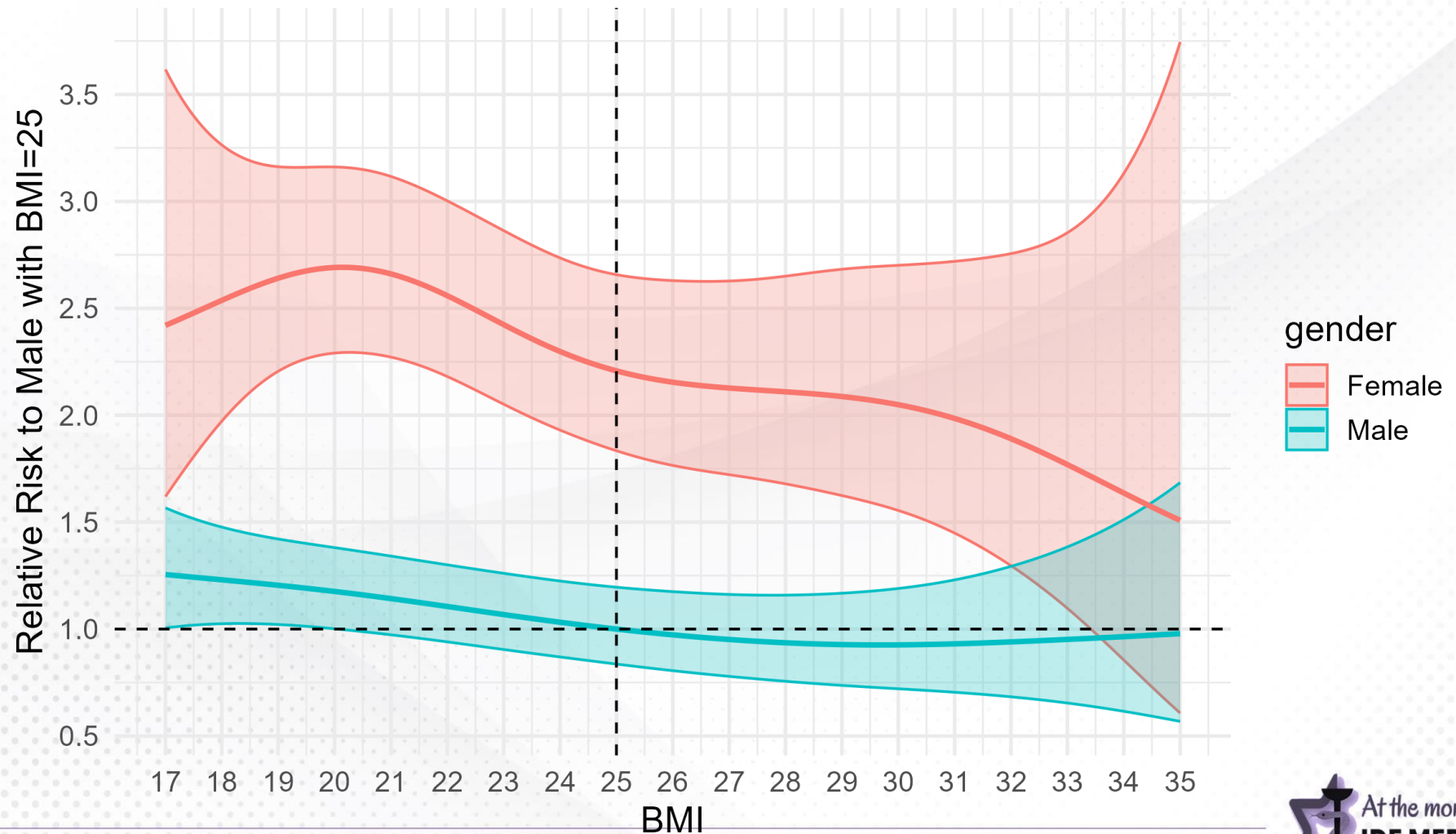
Low intensity
Armored corps, artillery, search
and rescue

Abbreviations:

BMI, Body Mass Index; RMTL, Restricted Mean Days Lost



BMI as a Continuous Variable



Abbreviations:
BMI, Body Mass Index



Conclusions

- Female soldiers are at a higher risk of stress fractures compared with male
- Lower BMI is associated with higher risk of stress fractures in men and women

Limitations

- Retrospective data
- Use of physician diagnosis
- Sample size was lower in the extreme BMI levels, especially in women
- Assessment of training intensity is difficult to characterize and changes over the years



Abbreviations:

BMI, Body Mass Index



Take Home Message

- Implementing data-driven policy to optimize recruit selection and training programs
- BMI can potentially serve as a surrogate measure of bone health
- Future studies should assess whether strategies that preserve lean body mass (e.g., high protein-diet and directed physiotherapy) can reduce the risk of stress fractures in combat soldiers at high risk



Abbreviations:

BMI, Body Mass Index; RMTL, Restricted Mean Days Lost



Questions?

