

THE DIFFERENCES IN LIMITS OF STABILITY BETWEEN MALES AND FEMALES WHILE DONNING MILITARY GEAR AND EQUIPMENT

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Introduction

Musculoskeletal injuries (MSIs) are a significant concern in military populations, accounting for 81% of incident injuries for all U.S. active-duty service personnel in 2021. Slips, trips, and falls (STFs) are a notable subset, representing 20% of outpatient MSI encounters, highlighting the importance of balance and postural control in prevention.

Purpose

The purpose of this study was to examine the differences in limits of stability (LoS) between males and females while donning military equipment and gear (EQG).

Subjects

Seventeen males (21.715 ± 2.71 yrs; 179.48 ± 7.95 cm, 87.45 ± 18.55 kg) and seventeen females (22.35 ± 3.95 yrs; 168.28 ± 9.28 cm, 68.42 ± 14.00 kg) were recruited for this study. To participate in the study all participants had to be regularly engaged in moderate activity, such as tennis, biking, jogging, or weightlifting 2 or 3 times a week for at least 30 minutes.

Methodology

Subjects completed a balance task under two conditions: without EQG and with EQG. The subjects wore shorts, t-shirts, and tennis shoes for the without EQG condition.

The EQG condition required individuals to wear a full combat load [helmet (3-4 lbs.), rucksack, (40lbs.), and tactical vest (12lbs.)] and standard issue combat boots (3.5lbs.). For each condition, participants performed two 30-second balance tests. The first test (Normal Stability Test) required the participants to stand as still as possible on a 50cm x 46cm balance platform with their eyes open, hands-on hips, and feet equidistant from the midline of the balance platform at a width equal to their shoe length. Upon completion of the first test, the subjects immediately performed test two, the LoS (see Figure 1). The main outcome measures, LoS Stability (LoSS) Score and directional LoS Scores, are shown in Figures 2 and 3.

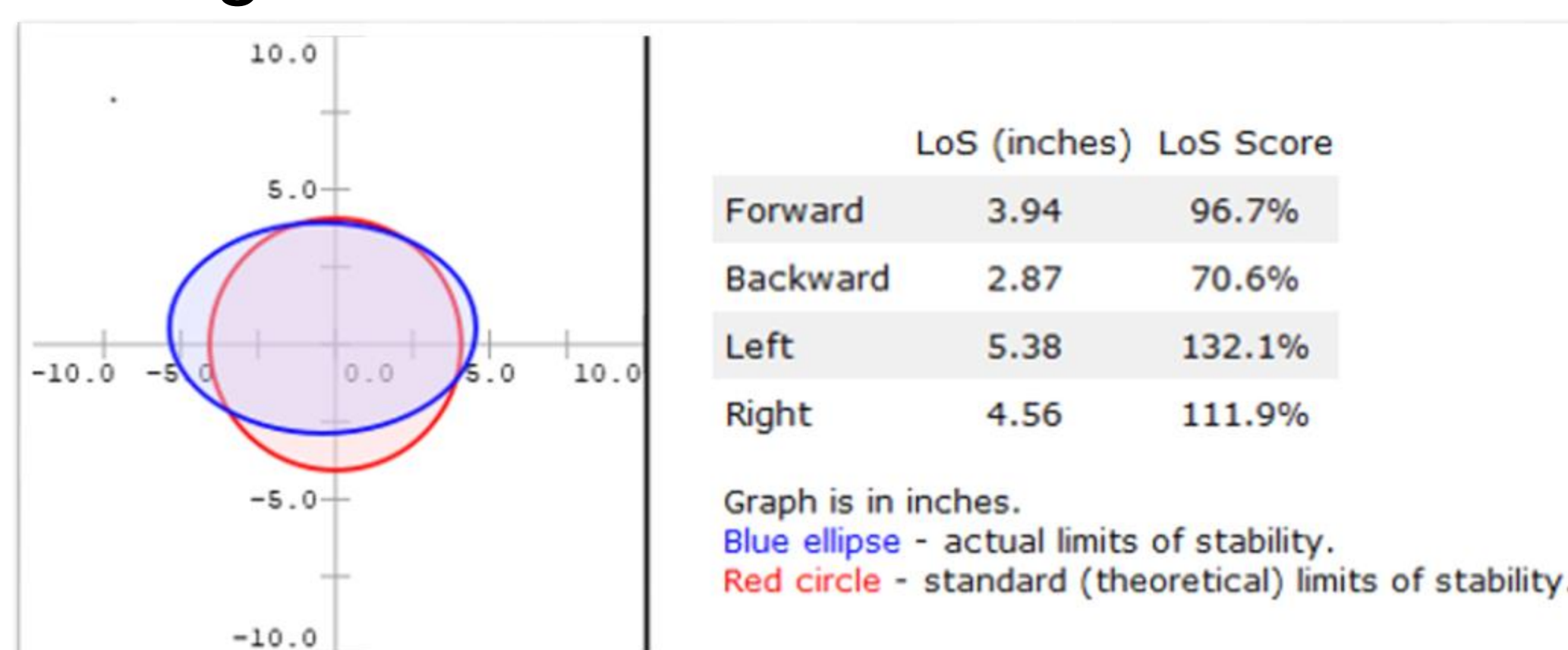


Figure 1. LoS Test

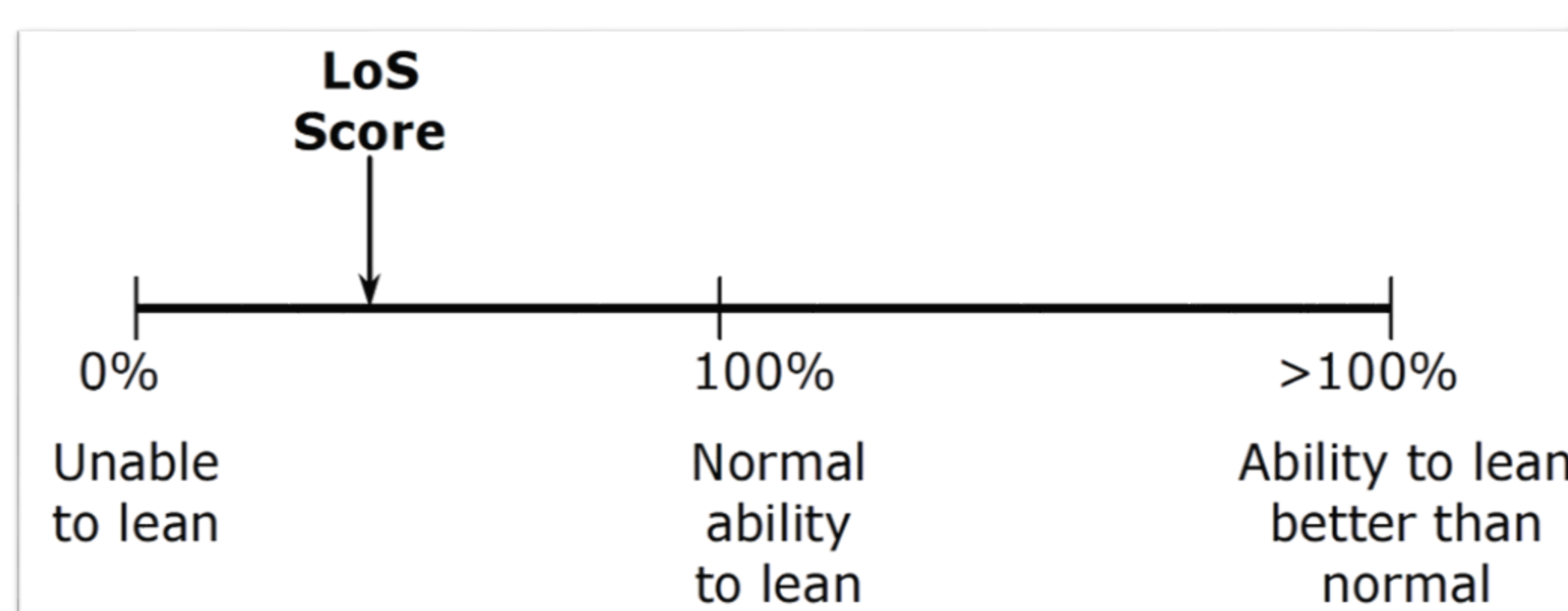


Figure 2. Directional LoS Scores

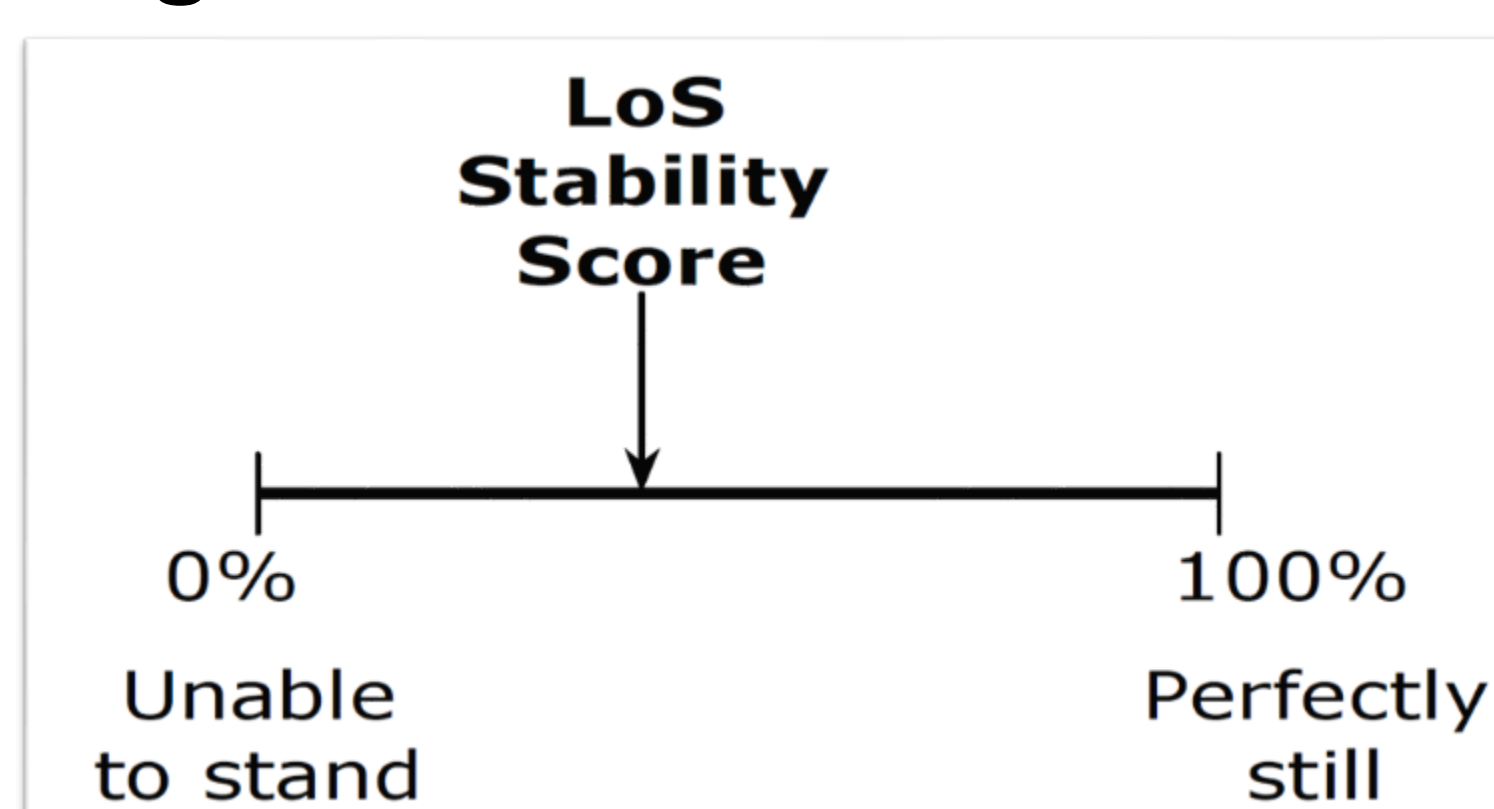


Figure 3. LoSS Score



Figure 4. Loaded Balance Task

Data Analysis

Multiple independent t-tests were run to determine the differences between males and females. A Bonferroni correction to adjust the alpha level was used to mitigate the risk of a type 1 error when performing multiple statistical tests. The adjusted alpha level was set at .01

Results

All means (M) and standard deviations (STDEV) are reported in Table 1. Descriptive data reveals that males and females do not have a normal ability to lean in the anterior or posterior directions while donning EQG. As indicated by LoS Scores in the anterior and posterior direction, they are less than 100%. There were no significant differences found in the LoS with EQG score between males (86.12 ± 7.87) and females (75.12 ± 21.51) conditions

Similarly, no significant differences were observed for loaded LoSS percent load carriage for the front, backward, left, or the right directions.

	Sex	N	M	STDEV
LoSS Score	Male	17	86.12	7.865
	Female	17	75.12	21.51
LoS Scores (%)	Anterior	Male	74.45	13.26
		Female	81.01	16.50
	Posterior	Male	48.77	20.87
		Female	41.83	16.05
	Left	Male	105.73	22.88
		Female	100.79	19.14
	Right	Male	108.93	26.59
		Female	17	107.34

Table 1. Mean and STDEV

Conclusions

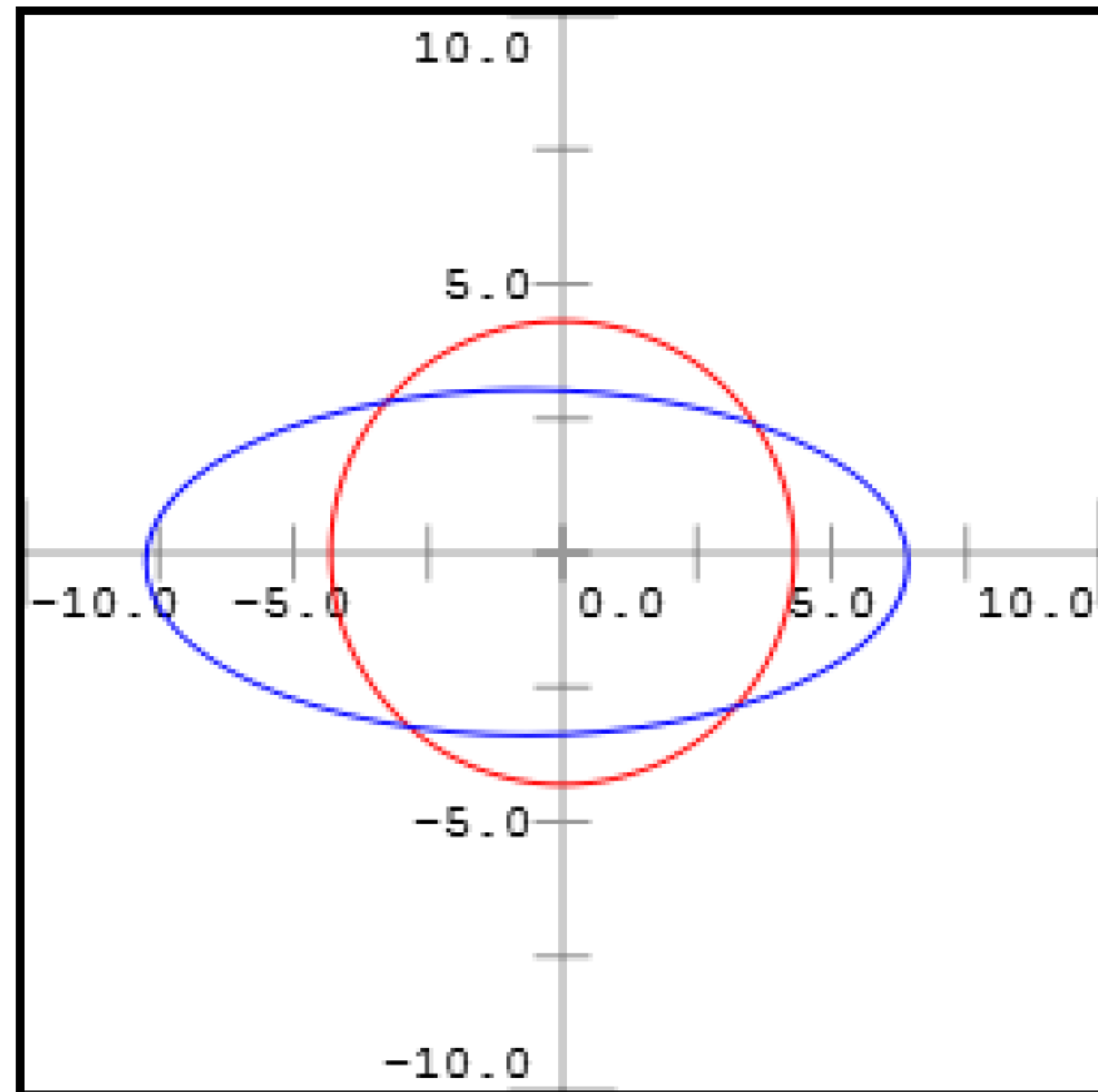
The results suggest males and females have no statistical differences in the limits of stability while donning military gear, indicating similar balance capabilities in both sexes. The results also suggest males and females present anterior and posterior stability deficits while donning EQG.

Practical Application

The findings can inform military training programs and equipment design, ensuring the balance-related tasks focus more on how to improve overall LoSS Scores and improve balance anteriorly and posteriorly.

References

Phyon, C.; Schuh-Renner, A.; Mahlmann, O.; Canham-Chervak, M. *U.S All Services Injury Surveillance 2021 Summary*; Defense Centers for Public Health - Aberdeen, Injury Prevention Branch, 2024

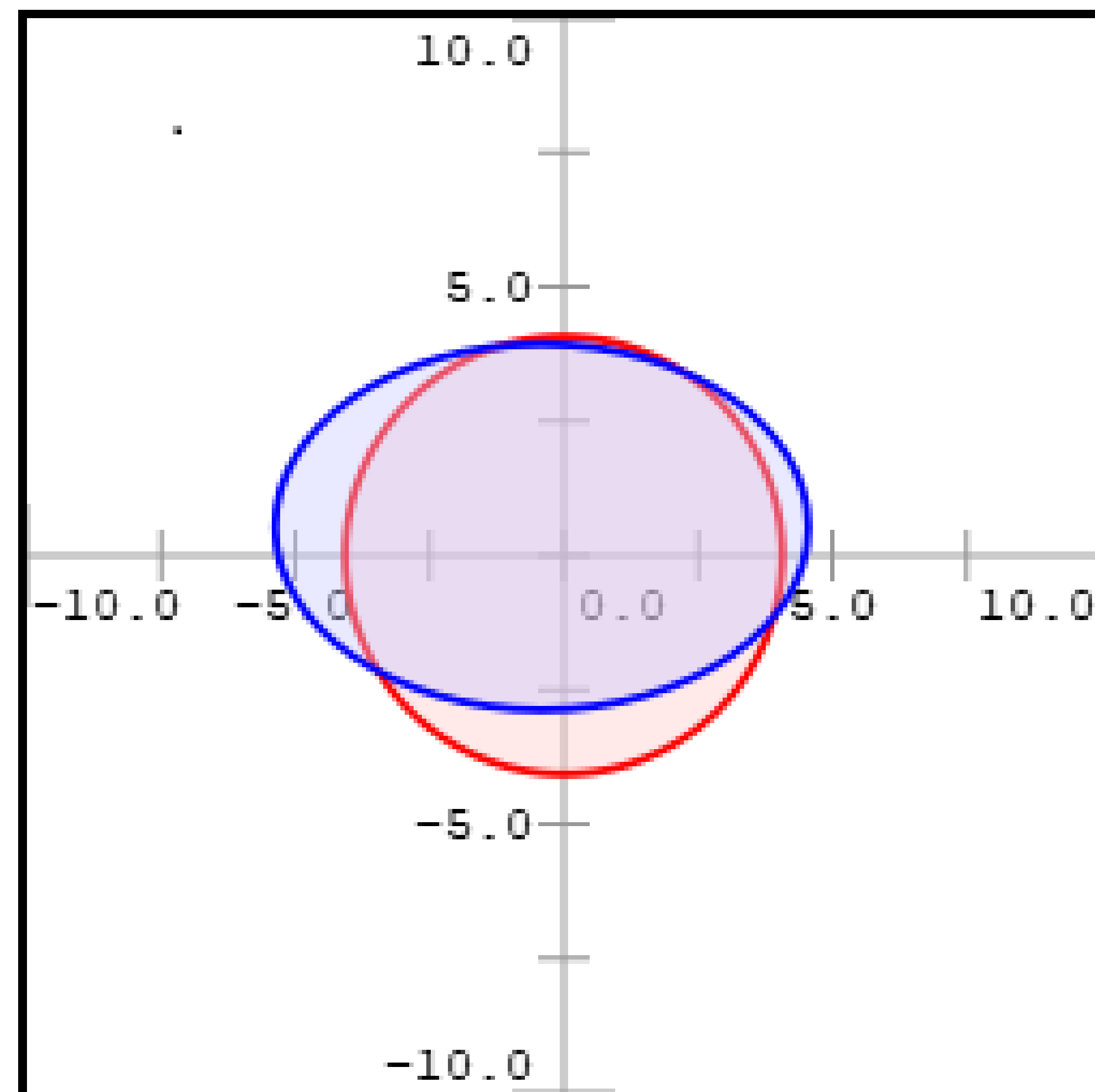


	LoS (inches)	LoS Score
Forward	3.03	70.2%
Backward	3.39	78.5%
Left	7.74	179.4%
Right	6.43	149.0%

Graph is in inches

Blue ellipse - actual limits of stability.

Red circle - standard (theoretical) limits of stability.



	LoS (inches)	LoS Score
Forward	3.94	96.7%
Backward	2.87	70.6%
Left	5.38	132.1%
Right	4.56	111.9%

Graph is in inches.

Blue ellipse - actual limits of stability.

Red circle - standard (theoretical) limits of stability.