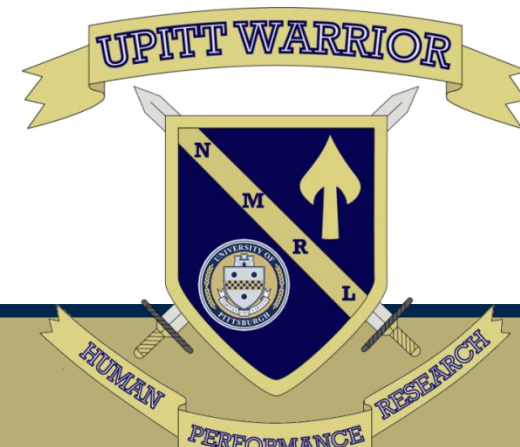




Musculoskeletal Injury Epidemiology of the Naval Special Warfare Operator and Student



Perlsweig K. A., Keenan K. A., Parr J., Lovalekar M., Beals K.
University of Pittsburgh, Neuromuscular Research Laboratory/Warrior Human Performance Center, Pittsburgh, PA

ABSTRACT

Background: Musculoskeletal injuries due to physical or tactical training are the primary cause of lost duty days among military personnel. Limited published data describe injury patterns among Naval Special Warfare (NSW) Operators and Students. To quantify changes in injury risk over the course of an Operator's career, it is important to understand the type and frequency of injuries incurred during initial entry training as well as training and deployment cycles. **Methods:** Self-reported musculoskeletal injury data from the previous one-year were captured from 874 Sea, Air, Land (SEAL) and Special Warfare Combatant-craft Crewman (SWCC) Operators and SEAL Qualification Training (SQT) Students (age: 28.3 ± 5.5 , 26.9 ± 5.9 , and 24.3 ± 2.7 years respectively). **Results:** Although the majority of individuals (74.9%) reported no injury during the one-year prior to survey, 28.1% of SEAL Operators, 24.6% of SWCC Operators, and 30.5% of SQT Students reported at least one injury. A total of 269 injuries were reported by 220 Operators and Students; approximately 1.2 injuries per individual. Across all three groups, most injuries affected the lower extremity (39.6 to 52.8%), upper extremity (27.0 to 35.4%), and spine (13.9 to 17.7%). SEAL Operators and SQT Students had a high occurrence shoulder, ankle, and lumbopelvic injuries (16.8 to 17.7%, 14.6 to 16.8%, and 8.3 to 13.9%, respectively). In contrast, injuries occurred most frequently to the knee (30.6%), shoulder (22.2%), and lumbopelvic region (13.9%) in SWCC Operators. Most injuries (33.3 to 54.7%) occurred during physical training for all groups except SEALs, who were injured more frequently during recreational activities/sports (30.2%). Most SEAL and SWCC Operator injuries during physical training occurred while weight lifting (40.9 to 42.1%), while most SQT Student injuries during physical training occurred as a result of running (43.6%). Sprains and strains were the most common type of injury in all groups (SEAL: 13.5% and 21.9%; SWCC: 19.4% and 11.1%; SQT: 22.6% and 15.3% respectively). Most injuries associated time loss resulted in less than 21 days of lost training days (41.7 to 69.4%), except for SEAL Operators, who reported 22.9% of injuries resulting in at least one month of lost training. **Conclusion:** SEAL Operators and Students have unique injury patterns (location, type) as compared to SWCC Operators. For injuries sustained during physical training, weight lifting was the primary activity for Operators while running was the most common for Students. SEAL Operators reported greater loss due to injury, potentially due to higher reports of surgery. Injury prevention relative to physical training may require modification to technique (or monitoring of technique), examination of volume of training (particularly relative to tactical demands), and/or alternative exercises/activities.

INTRODUCTION

- Musculoskeletal injuries due to physical or tactical training are the primary cause of lost duty days among military personnel
- To quantify changes in injury risk over the course of an Operator's career, it is important to understand the type and frequency of injuries incurred during initial entry training as well as training and deployment cycles
- The purpose of this analysis was to describe the injury epidemiology among Naval Special Warfare (NSW) Operators and Students using self-reported injury data

METHODS

- All participants were Sea, Air, Land (SEAL) or Special Warfare Combatant-craft Crewman (SWCC) Operators, or SEAL Qualification Training (SQT) Students (Table 1)
- Self-reported musculoskeletal injury data from the previous 365 days were captured from individual participants during a clinician-guided interview
- Musculoskeletal injury was operationally defined as an unintentional injury to the musculoskeletal system (e.g., bones, ligaments, muscles, tendons) that resulted in alteration in physical training, tactical training, or tactical activities for a minimum of one day.

	SEAL	SWCC	SQT
N	378	142	354
Age (years)	28.3 ± 5.5	26.9 ± 5.9	24.3 ± 2.7
Height (inches)	70.2 ± 2.5	71.3 ± 10.6	70.6 ± 2.6
Weight (pounds)	189.4 ± 21.6	187.5 ± 24.2	187.2 ± 18.6
Years of active duty	6.5 ± 5.2	5.1 ± 3.9	2.1 ± 1.6

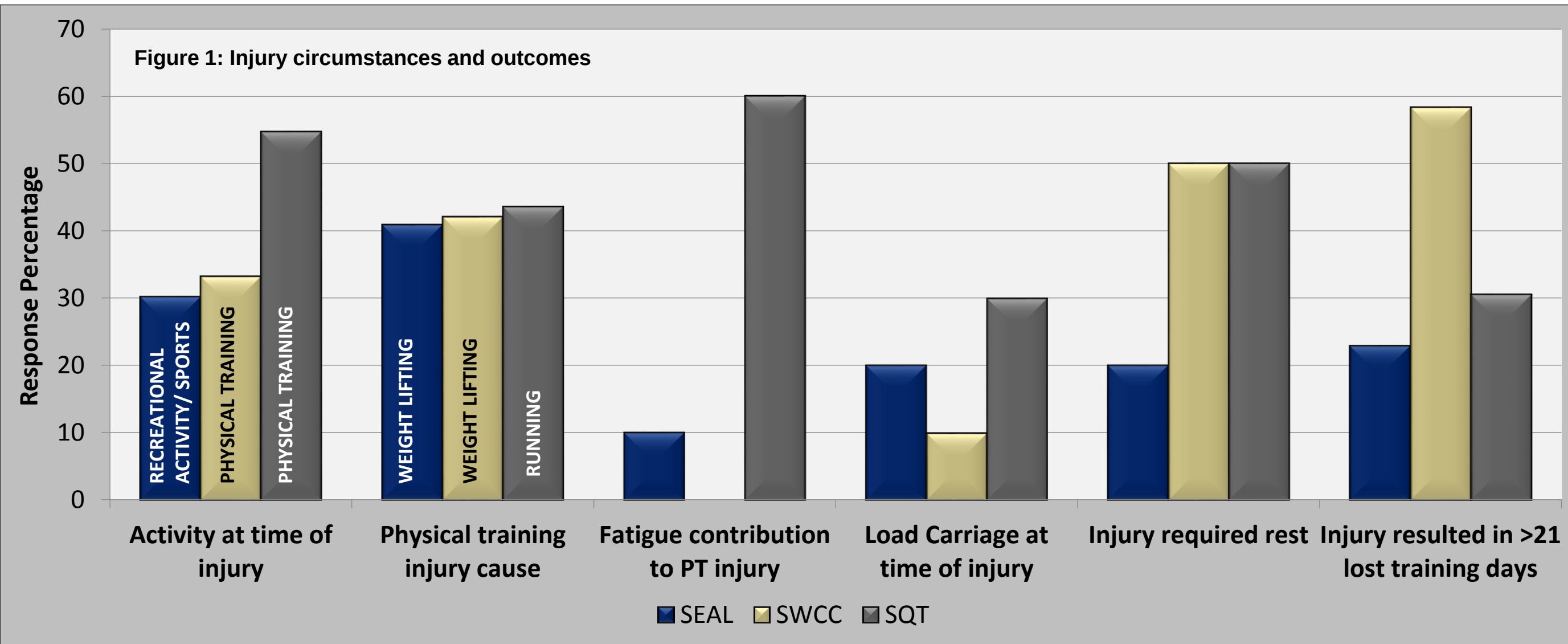
RESULTS

This analysis describes 269 injuries reported by 220 Operators and Students, approximately 1.2 injuries per individual. Injury frequency and incidence are presented in Table 2. Injury anatomic location and type are presented in Tables 3 and 4. Details surrounding the injury and time lost are presented in Figure 1.

Table 2. Injury frequency and incidence	SEAL	SWCC	SQT
Injury Frequency	25.4%	25.4%	38.7%
Injury Incidence	22.0%	19.7%	30.5%
Frequency: number of injuries per 100 subjects per year Incidence: number of injured subjects per 100 subjects per year			

Table 3. Injury Anatomic Location		SEAL		SWCC		SQT	
		n	%	n	%	n	%
Lower Extremity	Hip	3	3.1	0	0.0	5	3.6
	Thigh	7	7.3	4	11.1	6	4.4
	Knee	6	6.3	11	30.6	13	9.5
	Lower Leg	3	3.1	1	2.8	7	5.1
	Ankle	14	14.6	3	8.3	23	16.8
	Foot / Toes	5	5.2	0	0.0	14	10.2
Upper Extremity	Shoulder	17	17.7	8	22.2	23	16.8
	Upper Arm	0	0.0	1	2.8	0	0.0
	Elbow	5	5.2	0	0.0	3	2.2
	Forearm	2	2.1	0	0.0	1	0.7
	Wrist	6	6.3	0	0.0	6	4.4
	Hand / Fingers	4	4.2	2	5.6	4	2.9
Spine	Cervical	4	4.2	0	0.0	1	0.7
	Thoracic	4	4.2	0	0.0	1	0.7
	Lumbopelvic	8	8.3	5	13.9	19	13.9
	Other	1	1.0	0	0.0	0	0.0
Torso	Chest	4	4.2	1	2.8	5	3.6
	Abdomen	2	2.1	0	0.0	2	1.5
Head	Nose	0	0.0	0	0.0	2	1.5
	Unknown	1	1.0	0	0.0	0	0.0
Unknown	Unknown	0	0.0	0	0.0	2	1.5
Total		96		36		137	

Table 4. Injury Type		SEAL		SWCC		SQT	
		n	%	n	%	n	%
Bursitis		1	1.0	1	2.8	0	0.0
Chondromalacia		0	0.0	1	2.8	1	0.7
Degenerative joint disease		1	1.0	0	0.0	0	0.0
Disc injury		2	2.1	1	2.8	0	0.0
Dislocation		3	3.1	4	11.1	1	0.7
Fracture		16	16.7	2	5.6	16	11.7
Impingement		2	2.1	2	5.6	2	1.5
Inflammation		3	3.1	1	2.8	6	4.4
Labral tear		2	2.1	1	2.8	1	0.7
Meniscal		2	2.1	1	2.8	4	2.9
Nerve		2	2.1	0	0.0	7	5.1
Pain/ spasm/ ache		6	6.3	6	16.7	18	13.1
Periostitis		0	0.0	0	0.0	2	1.5
Sprain		13	13.5	7	19.4	31	22.6
Strain		21	21.9	4	11.1	21	15.3
Stress fracture		0	0.0	1	2.8	4	2.9
Subluxation		0	0.0	0	0.0	3	2.2
Tendinopathy		8	8.3	3	8.3	12	8.8
Other		4	4.2	1	2.8	6	4.4
Unknown		10	10.4	0	0.0	2	1.5
Total		96		36		137	



DISCUSSION

- Injury frequency and incidence in SQT Students were much higher than in the Operator population, which is consistent with previous reports and is likely due to extreme physical activity during these training pipelines
 - Approximately 60% of injuries reported by SQT Students were associated with lack of rest/recovery (fatigue)
 - Similar data from general-purpose forces (GPF) demonstrated lower injury frequency and incidence compared to the current NSW cohort
- The major anatomic locations injured were the lower extremity, upper extremity, and spine, with a concentration of injuries to the shoulder, ankle, and lumbopelvic region in SEAL Operators and SQT Students, and shoulder, knee, and lumbopelvic region in SWCC Operators
- Most injuries occurred during physical training in all groups, except for SEAL Operators, who were most frequently injured during recreational activities / sports
 - Running was the most common cause of injuries in SQT Students, while more injuries were attributed to lifting in both Operator groups
 - It is likely that SQT Students have a higher running volume and spend less time weight lifting than individuals at operational commands
 - This is similar to injuries reported by other branches, indicating that running and lifting during physical training result in a significant number of injuries across the Special Operations community



CONCLUSIONS

- Students and Operators suffer a wide distribution of injuries based on anatomical location, most commonly to the shoulder, lumbopelvic region, and lower extremity
- These individuals participate in rigorous physical training to prepare for the demands of tactical training and deployment, and musculoskeletal injuries are an unfortunate consequence of this training
- Injury prevention relative to physical training may require modification to technique (or monitoring of technique), examination of volume of training (particularly relative to tactical demands), and/or alternative exercises/activities



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