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## Common Lower Extremity Injury Sites Among Service Members and Combat Sport Athletes: A Systematic Review

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## Introduction

## Methods

## Results

## Discussion

Combat sports and military training are intensely physical activities with a high risk of injury. The pattern of injury location is shared between combat athletes and tactical athletes due to overuse, direct trauma, external factors, such as terrain and equipment, and improper conditioning. In these emerging settings, it is important to recognize the similar demands and injury patterns shared between tactical and combat athletes. As the demand for clinicians in these areas grows, this knowledge will be beneficial for clinicians moving into either of these two settings.

Compared to contemporary athletes, combat athletes endure a high degree of trauma from both competition and practice. As the sport primary objective is to physically overpower their opponent these athletes face direct contact injuries, as well as overuse injuries from a high volume of training. Tactical athletes will face injury risk both during training and while deployed to combat areas. In order to be successful in the field these injuries need to be identified and addressed quickly and treated efficiently.

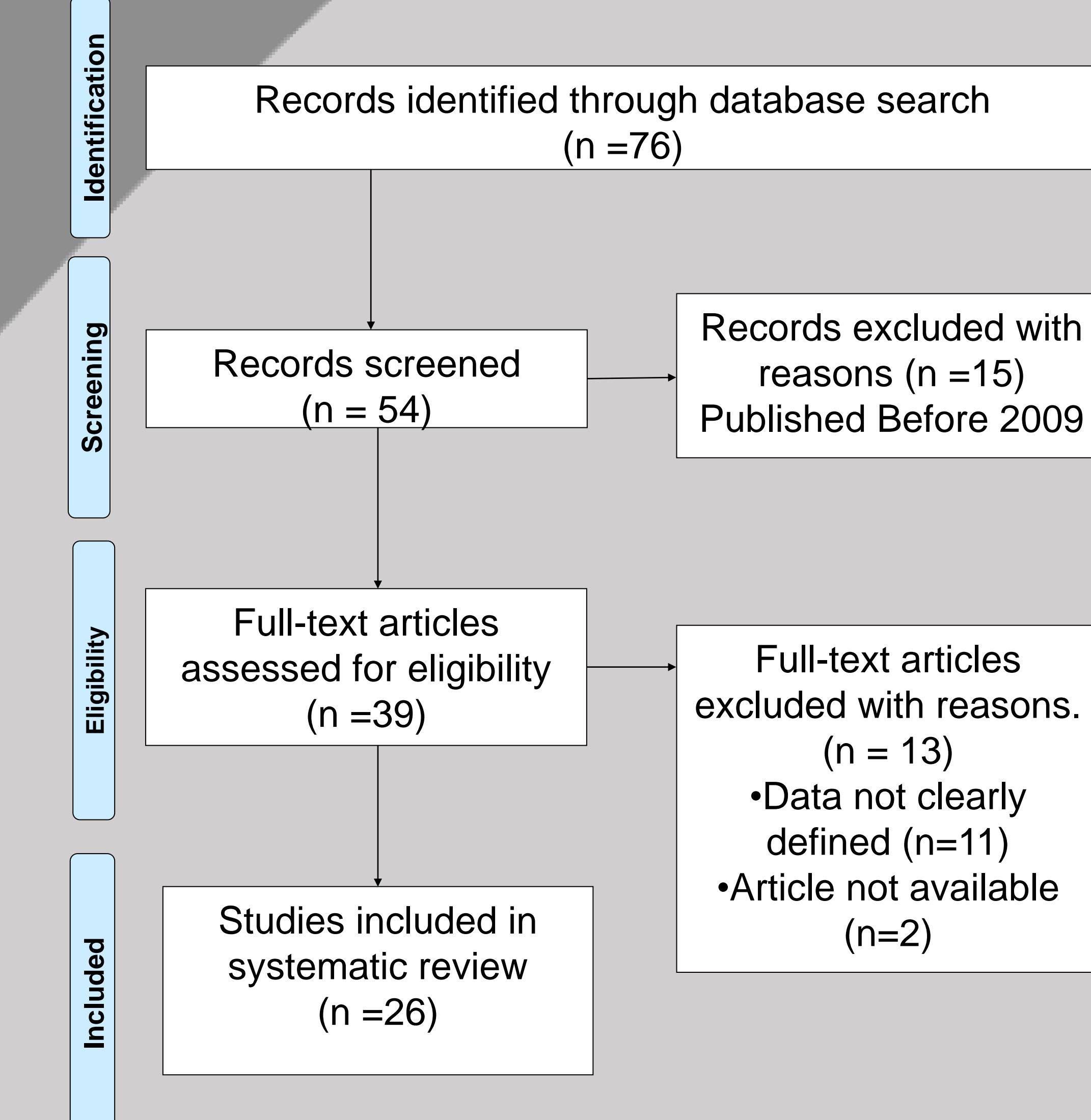
In order to best serve these populations in diagnosing and treating injuries it is important to identify injury rates and patterns among these groups in order to treat them in the most effective way possible. By comparing tactical and combat athlete groups clinicians can begin to identify similar injury patterns in the lower extremities. As both cohorts require a stable lower body that is also capable of exerting high forces under fatigue, improving the understanding of injury incidence and identifying any patterns between cohorts the clinicians can be more successful in providing rehabilitation services. This in turn provides a greater insight for clinicians when designing rehabilitation exercise plans in order to best minimize time lost and improve performance in the field or during competition.

## Purpose

The purpose of this systematic review was to identify similar lower extremity injury patterns within combat sports and tactical athlete populations.

A database search was performed utilizing PubMed in October 2020. A combination of keywords were utilized and divided into three levels: population (Military OR Tactical OR Combat OR "Martial Arts" OR MMA OR Kickbox\*), anatomical area ("Lower Extremity" OR LE OR Ankle OR Knee OR Hip OR Foot OR "Lower Leg" OR Thigh OR Pelvis OR Lumbar OR "Low Back"), and injury ("Injury Rate" OR "Injury Occurrence" OR "Injury Incidence"). Studies were included that involved tactical athletes (military and law enforcement) or combat sports athletes (karate, tae kwon do, judo, Brazilian jiu-jitsu, mixed martial arts (MMA), kickboxing, and kendo). Studies needed to include injuries by location, mechanism of injury, training time lost, and return to sport or activity.

Out of 76 articles originally sourced 26 were selected for full text review based on inclusion and exclusion criteria. The following studies were organized via PRISMA flowchart (figure 1). Data extraction included injury location by anatomical site sustained by both populations. Training and competition data was collected for combat athletes and both combat zone and non-combat injury data was collected for tactical athletes. Table 1 categorized injury incidence data for tactical athletes. Table 2 categorized injury incidence data for combat sports athletes. Both categorized injury data by anatomical regions: low back, hip/groin, thigh, knee, lower leg, ankle, ankle/foot, and foot/toes.



**Table 1. Tactical athlete injury incidence**

Study	Setting	Sample Size	Lumbar Spine	Hip/Groin	Thigh	Knee	Lower leg	Ankle	Ankle/foot	Foot/toes	Lower Extremity
Neves 2009	Training	26,626	18 (9.5%)	6 (3.2%)	23 (12.2%)	40 (21.2%)	--	--	62 (32.8%)	--	--
Belmont 2010	Combat	4122	0.135	0.025	0.013	0.135	0.04	0.135	--	0.073	--
Childs 2010	Training	4313	11%, 13.3%	--	--	--	--	--	--	--	30.7%/31.5%
Knapik 2011	Training	531	0.057	--	7.7%, 9.1%	9.8%, 9.1%	0.003	4.8%, 20.5%	--	--	--
Roy 2012	Combat	593	0.174	--	--	0.127	--	--	--	--	--
Scherman 2018	Training	106	--	3.4/1000 PM	--	16.1/1000 PM	--	4.8/1000 PM	8.9/1000 PM	--	--
Martin 2018	Training	6865	--	--	--	0.358	--	0.363	--	--	--
Roos 2015	Training	619	--	4.98	--	0.3151	--	0.0707	--	0.0997	0.6006
Orr 2011	Training	3828	--	--	--	--	--	1	--	--	--
Kuikka 2013	Training	128,584	--	--	--	0.008	--	--	--	--	--
Schwartz 2018	Training	2519	0.23	0.01	--	0.22	0.41	--	--	0.06	--
Schwartz 2018	Training	23,841	0.21	--	--	0.21	0.34	--	--	--	--
Stahlman 2018	Training	9 years	0.404	--	--	0.207	0.35	--	0.618	--	--
Schram 2019	Training	2 years	--	2.9%/13%	3%/85	12.9%/14.7%	10%/11.3%	11.1%/8%	--	9.8%/4.7%	--
Schwartz 2018	Training	20,000	0.19	0.02	--	0.22	0.34	--	--	0.08	--

**Table 2. Combat sports injury incidence**

Study	Setting	Sample Size	Lumbar Spine	Hip/Groin	Thigh	Knee	Lower Leg	Ankle	Foot/Toes	Other/Unspecified	Lower Extremity
Kreiwirth 2014	Competition	62	-	-	-	12	-	8	-	-	-
Moriarty 2019	Training	1287	6.5% (83.65)	3.5% (45)	0.8% (10.3)	20.8% (267.7)	1.4% (18)	5.4% (69.5)	5.9% (75.93)	0.6% (7.72)	44.6% (574)
Scoggin 2014	Competition	46	-	1	-	7	-	2	3	-	-
Frey 2019	Competition	3511	-	-	-	-	-	-	-	-	737
Arriaza 2009	Competition	497	-	-	-	7	-	-	-	-	-
Schultze 2016	Training	307	-	-	-	-	-	0.651	-	-	-
Lystad 2015	Competition	481	-	3	2	15	17	4	11	181	-
Fares 2019	Competition	291	-	-	-	-	-	-	-	-	17
Geblein 2020	Training/Competition	82	-	13	9	22	3	22	5	18	-
Kazemi 2009	Competition	891	68* ("back")	19	84	75	55	71	183	-	487
Son 2020	Training/Competition	285	17	16	22	51	18	70	72	1	-

### Tactical Athletes

Tactical athletes suffer lower extremity injuries in a wide variety of ways, i.e. overuse from physical training or heavy weight bearing and acute from unstable surfaces or poor footwear. A better understanding of how certain injuries are sustained will lead to a better understanding of how to treat the injuries effectively. Overuse injuries in tactical athletes is the most troublesome problem faced by tactical health care workers. Nearly all studies examined mentioned making some modifications to fitness programs or work requirements in order to reduce overuse injuries. Understanding injuries in different populations will allow the clinician to prepare rehabilitative exercise plans that may be tailored to the individual.

### Combat Athletes

Lower extremity injuries in combat athletes are considered some of the most prominent injuries, especially pertaining to the knee, ankle and foot. Multiple disciplines permit the use of legs for both offensive and defensive techniques, including using the shin and knee to "check" the opponent's incoming kick. This blocking technique can result in a variety of injuries if not executed properly and the use of the leg for attacking an opponent increases the potential for injury for both the attacker as much as the defender. Grappling disciplines displayed similar incidence and injury types, compared to striking disciplines. This is interesting as grappling do not permit any sort of striking, however the nature of grappling disciplines include various takedowns, throws and slams that can result in compromising positions for both practitioners. Grappling matches typically end via submission, and while many tournaments do not allow lower extremity joint locks for the lower ranks, they do allow techniques such as "knee bars" and "heel locks" to be permitted by black belts and higher. There was a higher incidence of injury among more experienced practitioners, compared to those of lower belt ranks. This is likely due to more advanced practitioners utilizing more advanced techniques which results in a higher degree of risk and higher amounts of force. The findings of this group demonstrated that while there is a large degree of difference between grappling and striking martial arts, there are very similar injury incidence rates and injury types across all disciplines.

## Conclusions

While combat and tactical athletes share many of the same injuries, the mechanisms are vastly different. For tactical athletes, understanding the injuries that frequently occur in different age populations, the AT can prepare rehabilitation plans ahead of time that may be easily tailored to the individual. For combat sports athletes, an understanding of the athlete's experience level can assist the AT in anticipating what types of injuries they may encounter when covering a tournament or competition. This systematic review demonstrated that combat sports athletes and tactical athletes do suffer many of the same lower extremity injuries.