Sports-Related Concussion in Hawaii State Public Schools during 2010-12

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Context
On a national level concussion incidence continues to increase. Adolescent student-athletes may be more susceptible to both the initial concussive injury as well as potentially severe acute and long-term complications, affecting multiple facets of their well-being. Improved clinical management of these injuries begins with a thorough understanding of their epidemiological trends and patterns. Such data for Hawaii public high schools has not been previously reported.

Objective
To investigate the epidemiology of sport-related concussions in Hawaii state public schools by comparing rates and trends across multiple sports.

Design
Descriptive epidemiological study.

Setting
Athletic trainers from 43 public high schools in Hawaii utilized a comprehensive concussion management program (CMP) to report concussions for the school years 2010-12 (SY).

Participants
A total of 30,031 student-athletes who participated in 13 contact sports.

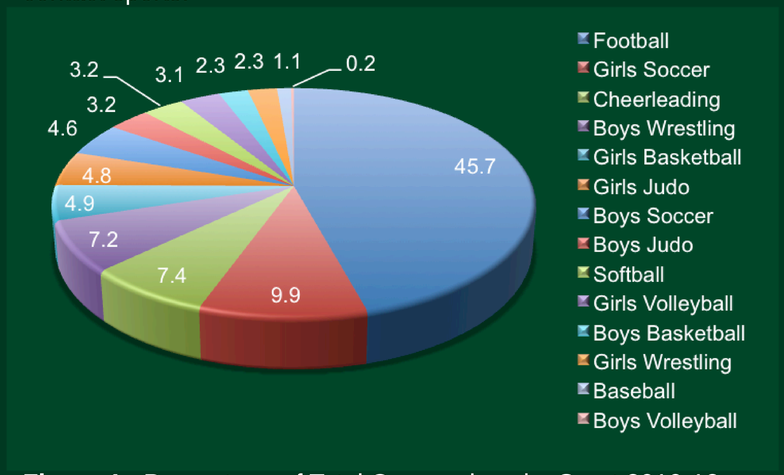

Figure 1. Percentage of Total Concussions by Sport 2010-12. Football had the highest PTC (PTC 45.7%) followed by girls' soccer (PTC 9.9%), cheerleading (PTC 7.4%), and boys' wrestling (PTC 7.2%).

Interventions
De-identified data were retrospectively analyzed for concussed athletes through the CMP for SY 2010-12. An athlete-exposure (AE) was equal to one athlete participating in one practice or competition. Overall and sport specific injury rates (IR) were calculated by dividing injury incidence by AEs using raw case counts and then reported per 10,000 AEs.

Main Outcome Measures
Overall concussion IR, IR by sport and gender, the number of reported concussions (n), percentage of total concussions by sport (PTC), the average length of time between onset and return to full participation, standard deviation, and 95% confidence intervals (CI) were reported.

Results
During SY 2010-12, 930 concussions were reported during 2,213,444 AEs for an overall IR of 4.2. The highest number of concussions reported resulted from participation in football (PTC=45.7%, n=425), followed by girls' soccer (PTC=9.9%, n=92), cheerleading (PTC=7.4%, n= 69), and boys' wrestling (PTC=7.2%, n=67) (Figure 1).

Table 1. Concussion Injury Data for SY 2010-12

Sport	Total # of Athletes SY 2010-12	Athletes Exposures (AE) SY 2010-12	Total # of Concussions SY 2010-12	Hawaii Concussion Injury Rate (per 10,000 AE) SY 2010-12	Standard Error	Confidence Interval IR Lower	Confidence Interval IR Upper	% of Total Concussions
Football	7082	545370	425	7.8	0.000038	7.05	8.53	45.70
Girls Soccer	2693	192478	92	4.8	0.000050	3.80	5.76	9.89
Boys Soccer	2025	144534	43	3.0	0.000045	2.09	3.86	4.62
Cheerleading	1685	162414	69	4.2	0.000051	3.25	5.25	7.42
Girls Basketball	1901	135707	46	3.4	0.000050	2.41	4.37	4.95
Boys Basketball	2242	160407	21	1.3	0.000029	0.75	1.87	2.26
Girls Wrestling	823	58929	21	3.6	0.000078	2.04	5.09	2.26
Boys Wrestling	1975	140868	67	4.8	0.000058	3.62	5.90	7.20
Girls Judo	698	45996	45	9.8	0.000146	6.92	12.64	4.84
Boys Judo	1143	75180	30	4.0	0.000073	2.56	5.42	3.23
Girls Volleyball	2576	176309	29	1.6	0.000031	1.05	2.24	3.12
Boys Volleyball	1455	100133	2	0.2	0.000014	-0.08	0.48	0.22
Softball	2460	175825	30	1.7	0.000031	1.10	2.32	3.23
Baseball	1273	99294	10	1.0	0.000032	0.38	1.63	1.08
Total	30031	2213444	930	4.2	0.000014	3.93	4.47	100.00
Male	17195	1265786	598	4.7	0.000019	4.35	5.10	64.30
Female	12836	947658	332	3.5	0.000019	3.13	3.88	35.70
Gender Comparable Sports*								
Male Sports	10113	720416	173	2.4	0.000018	2.04	2.76	18.60
Female Sports	11151	785244	263	3.4	0.000021	2.94	3.75	28.28

Results (*continued*)
However, girls' judo had the highest injury rate (IR=9.8), followed by football (IR=7.8), boys' wrestling (IR=4.8), and girls' soccer (IR=4.8). In gender-comparable sports, females had a higher concussion IR (IR=3.3) than males (IR=2.4) (Table 1). The average length of time between onset and return to full participation was 21.51±14.78 days (CI=20.45-22.57).

Conclusions
These findings have not been previously reported for the State of Hawaii and they demonstrate a higher overall IR than that of other high school populations in the nation. Although football had the highest PTC, girls' judo had the highest IR. Hawaii is unique in that students participate in judo as a sanctioned high school sport. However, judo is a sport with both national and international participation, so these findings have widespread applicability. To our knowledge, these are the first concussion IRs reported for the sport of judo in a high school population. These findings provide athletic trainers with essential objective injury data that directly influences the development of concussion education, prevention and management programs.

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*Gender Comparable Sports included soccer, basketball, wrestling, judo, volleyball, baseball, and softball.