Assessing Concussion Knowledge Among Recreational Surfers and Comparing Results to Concussion Knowledge Among Soccer Players: A Pilot Study

William J. Lew BS; Troy Furutani MS; Kyoko Shirahata PhD; Nathan Murata PhD; Hyeong Jun Ahn PhD

Abstract

Concussions are caused by physical trauma to the head, face, or neck and can be sustained while surfing, increasing the risk of drowning. The purpose of this pilot study was to establish a preliminary assessment of concussion knowledge in a group of adult recreational surfers. Using the standardized Concussion Knowledge Index, an anonymous survey was conducted with 55 surfers. The Concussion Knowledge Index and similar statistical measures were used in a previous study of adult soccer players in England. Data from these 2 groups were compared. The preliminary data suggests that the group of adult surfers demonstrate more concussion knowledge than the group of adult soccer players. Further study into surfers' knowledge of concussion with a larger sample size could increase the clinical utility and generalizability of this study.

Keywords

concussion knowledge index, concussion, soccer, surfing

Abbreviations

CKI = Concussion Knowledge Index
HCAMP = Hawai'i Concussion Awareness & Management Program

Introduction

Concussion, also known as mild traumatic brain injury, is caused by physical trauma to the head, face, neck, or torso.[1] Acceleration-deceleration forces cause the softer brain tissue to press on the hard skull, while stretching the connecting neurons within, resulting in temporary neurological dysfunction. Concussions sustained while surfing are common and potentially dangerous to those who experience them, especially due to the risk of drowning. Prior literature on surfing-related concussions focused primarily on incidence, including Swinney's article which evaluated 50 surfers, 35 of which reported sustaining a head injury.[2] Kozminski's national data from United States emergency departments showed that during their study period (2001-2016), while most surfers who presented to the emergency departments had lacerations, 16.1% of them sustained concussions. Additionally, the incidence of concussion significantly increased during their study period.[3]

This pilot study is aimed at establishing a preliminary assessment of concussion knowledge in a group of 55 recreational surfers in Hawai'i and California. It also compares the results to another group of athletes consisting of 26 adult soccer players from England who were previously assessed using the Concussion Knowledge Index (CKI) in a 2013 study by Williams.[4] The CKI is a validated, standardized measurement tool for knowledge of concussion.[5] Since surfers have the added risk of drowning after sustaining a concussion, which may necessitate a higher awareness of concussions, this study tested the hypothesis that adult surfers would have greater knowledge of concussions than adult soccer players.

Methods

The survey containing the CKI assessment was chosen for this study because it allows for the quantification of concussion knowledge into a numerical score that can be statistically analyzed, and has already been demonstrated to have internal validity and test-retest reliability.[5] The CKI survey link was disseminated to members in the recreational surfing community via social media posts shared publicly to Facebook and Instagram (Meta Platforms Inc, Menlo Park, CA; **Figure 1**). Participants were required to affirm their eligibility before taking the survey by clicking a checkbox indicating that they were 18 years of age or older to ensure compliance with age restrictions. None of the participants were paid to take the survey.

Words in the CKI survey that pertain to land sports were modified to fit the language of surfing, ie, "player" to "surfer."[5] The online survey was created using Alchemer Survey Software (Alchemer LLC, Louisville, CO) and responses recorded through the survey were uploaded onto a live Google Sheets spreadsheet (Alphabet Inc., Mountain View, CA). The survey consisted of 30 multiple-choice questions (**Table 1**). Age, ethnicity, sex, education, surfing experience, and previous history of head injuries and concussion education were collected from questions 1-12. The geographical location at which each respondent submitted the survey was collected by the survey software.

Questions 13-30 assessed concussion knowledge. Each respondent's CKI score was graded on a total scale of 0-25, where correct answers earned 1 point and incorrect answers earned 0 points. Question 30 assessed concussion symptom recognition and consisted of 8 true concussion symptoms and 8 symptoms not suggestive of concussion. Up to 8 points were

awarded to the overall CKI score from question 30 (8 of the 25 possible CKI points evaluated concussion symptom recognition), depending on how many true concussion symptoms were correctly identified and regardless of what was selected for the false concussion symptoms. The grading key is summarized in **Table 1**. A Wilcoxon signed-rank sum test was used to compare the median CKI score of surfers to the median CKI score of soccer players. All statistical analyses were conducted on SAS Software, version 9.4 (SAS Institute Inc., Cary, NC), and the significance level was set at .05.

Results

Out of 59 people who were recorded by the survey software to have viewed the shared link, a total of 55 of them completed the survey (response rate: 93%). The CKI median was 20.0 (mean: 18.9 ± 3.0, mode: 21.0, range: 9-23). Results obtained for recreational surfers are summarized and compared to soccer players in **Table 2**.[4] Since the data were left-skewed and thus the assumption that the data followed a normal distribution was not valid, a parametric 1-sample t-test could not be utilized to compare the surfers' knowledge to the soccer players' knowledge. A Wilcoxon signed-rank sum test using P=.05 indicated that the CKI median score of these adult recreational surfers surveyed (20.0) was significantly higher than that of adult soccer players (15.5).[4]

The demographic results are summarized in **Table 3** with each variable listed in the left column and their respective counts (n) and percentages in the right column. Fifty-one percent of participants who submitted the survey were in Hawai'i and 49% were in California. Most participants were male (71%), and the most common age category of the participants was 18-24 years old (38%), followed by 25-34 years old (24%). Overall, two-thirds of the participants had some higher level of education beyond a high school diploma (associates, bachelor, master, or doctoral/professional).

Most participants identified longboarding as their main surfing activity (58%). In all, 38% of participants reported having experienced previous surfing-related head injuries with 9% of those injuries resulting in diagnosed concussions. Nearly half

Figure 1. Social Media Graphic for Online Survey Shared with Surfers 18 Years and Older

of the participants (49%) answered that their attitudes towards surfing-related concussions were that they were afraid of them. Almost half (49%) of the participants had previously received concussion education, with the most common mode of education being in-person (38%).

Within the CKI, the 3 most common knowledge questions correctly identified were: (1) "Symptoms of a concussion can last for several weeks" (97%); (2) "In order to be diagnosed with a concussion, you do not have to be knocked out" (95%); and (3) "If you receive one concussion and you have never had a concussion before, you do not necessarily become less intelligent" (95%). The 3 most common misconceptions were: (1) "After a concussion occurs, brain imaging (eg, Magnetic Resonance Imaging, Computed Tomography Scan, X-Ray, etc) typically shows visible damage (eg, bruise, blood clot) to the brain" (30%); (2) "After a concussion, people can forget who they are and not recognize others but be perfect in every other way" (28%); and (3) "A surfer who gets knocked out after getting a concussion is not experiencing a coma" (16%).

Other commonly identified symptoms relevant to concussion were feeling in a "fog" (90%), headache (90%), and difficulty concentrating (86%). The most commonly missed symptom was drowsiness (72%).

Table 1. 31 Multiple Choice Questions for Online Survey Shared with Surfers

Survey Questions and Answer Choices (Answers Separated by Commas, Correct Answers in Bold)
1) Which of the following options describes you the best? Possible Answers: Professional surfer (ie, receives monetary compensation for surfing or from sponsors), Amateur / Recreational Surfer
2) Which type of surf activity do you spend the most time doing? Possible Answers: Shortboard, Longboard, Stand Up Paddle, Foil - Prone, Foil - Stand up paddle, Wind Surfing, Kite Surfing, Other - Write In
3) Have you had a head injury while surfing? Possible Answers: Yes, No, Not sure
4) How many head injuries have you sustained while surfing? Possible Answers: 0, 1, 2, 3, More
5) How many surfing-related concussions have you been diagnosed with? Possible Answers: 0, 1, 2, 3, More
6) Which of the following best describes your attitude toward concussions? Possible Answers: I'm afraid of them, They're part of the sport, Other
7) Have you ever received a concussion education? Possible Answers: Yes, No
8) If you answered yes to the previous question, how did you receive concussion education and information? (Select all that apply) Possible Answers: In-Person (ie, Presentation, Workshop, Video), Online / Web-based (E-Learning), Media (ie, Movies, News, Social Media), In-Print Informative Materials (ie, Brochure, Flyer, Handout), N/A
9) How old are you? Possible Answers: 18-24, 25-34, 35-44, 45-55, 56-64, 64 or above
10) What is your gender? Possible Answers: Male, Female, Other
11) What is your ethnicity? Possible Answers: Caucasian, Asian, American Indian or Alaska Native, African American, Native American, Hispanic or Latino, Native Hawaiian or Other Pacific Islander, Other
12) What is your highest education level? Possible Answers: High school, Associate degree, Bachelor's degree, Master's degree, Doctoral or Professional degree, Other
13) There is a possible risk of death if a second concussion occurs before the first one has healed. Possible Answers: **True**, False
14) People who have had one concussion are more likely to have another concussion. Possible Answers: **True**, False
15) In order to be diagnosed with a concussion, you have to be knocked out. Possible Answers: True, **False**
16) A concussion can only occur if there is a direct hit to the head. Possible Answers: True, **False**
17) Being knocked unconscious always causes permanent damage to the brain. Possible Answers: True, **False**
18) Symptoms of a concussion can last for several weeks. Possible Answers: **True**, False
19) Sometimes a second concussion can help a person remember things that were forgotten after the first concussion. Possible Answers: True, **False**

Table 1. 31 Multiple Choice Questions for Online Survey Shared with Surfers (Continued)
20) After a concussion occurs, brain imaging (eg, CAT Scan, MRI, X-Ray, etc) typically shows visible physical damage (eg, bruise, blood clot) to the brain. Possible Answers: True, **False**
21) If you receive one concussion and you have never had a concussion before, you will become less intelligent. Possible Answers: True, **False**
22) After 10 days, symptoms of a concussion are usually completely gone. Possible Answers: **True**, False
23) After a concussion, people can forget who they are and not recognize others but be perfect in every other way. Possible Answers: True, **False**
24) Concussions can sometimes lead to emotional disruptions. Possible Answers: **True**, False
25) A surfer who gets knocked out after getting a concussion is experiencing a coma. Possible Answers: **True**, False
26) There is rarely a risk to long-term health and well-being from multiple concussions. Possible Answers: True, **False**
Scenario 1: While competing in a heat, John and Kelly collide with each other and each suffers a concussion. John has never had a concussion in the past. Kelly has had 4 concussions in the past. 27) It is likely that John's concussion will affect his long-term health and well-being. Possible Answers: True, **False**
Scenario 1: While competing in a heat, John and Kelly collide with each other and each suffers a concussion. John has never had a concussion in the past. Kelly has had 4 concussions in the past. 28) It is likely that Kelly's concussion will affect his long-term health and well-being. Possible Answers: **True**, False
Scenario 2: Lisa suffered a concussion in a contest. She continued to surf in the same heat despite the fact that she continued to feel the effects of the concussion. 29) Even though Lisa is still experiencing the effects of the concussion, her performance will be the same as it would be had she not suffered a concussion. Possible Answers: True, **False**
30) Think about someone who has had a concussion. Check off the following signs and symptoms that you believe someone may be likely to experience AFTER a concussion. (Select all that apply) Possible Answers: Hives, Feeling in a "Fog", Headache, Weight gain, Difficulty speaking, Feeling Slowed down, Arthritis, Reduced breathing rate, Sensitivity to light, Excessive studying, Difficulty remembering, Difficulty concentrating, Panic attacks, Dizziness, Drowsiness, Hair loss

Table 2. Summary of Concussion Knowledge Index (CKI) Scores of Surfers and Soccer Players Surveyed[a]

Population Sampled	CKI Score (0-25)
Recreational Surfers in Current Study (N = 55):	
Mean	18.9 ± 3.0
Median	20.0
Range	9-23
Mode	21.0
Soccer Players in 2013 Study (Williams; N = 26)[4]:	
Mean	15.5 ± 3.0
Median	15.5
Range	8-21
Mode	14.0

[a] A Wilcoxon signed-rank sum test comparing the CKI scores of the surfers and soccer players was statistically significant at $P<.05$.

Table 3. Demographics and Responses to Online Survey Shared with Surfers (N=55)

Variable	n (%)
Sex:	
Female	16 (29%)
Male	39 (71%)
Age:	
18-24	21 (38%)
25-34	13 (24%)
35-44	6 (11%)
45-55	5 (9%)
56-64	5 (9%)
64+	5 (9%)
Ethnicity:	
African American	1 (2%)
Asian	23 (42%)
Caucasian	18 (33%)
Hispanic of Latino	6 (11%)
Native Hawaiian/Other Pacific Islander	5 (9%)
Other	2 (4%)
Education level:	
High School	16 (29%)
Associate Degree	9 (16%)
Bachelor's Degree	16 (29%)
Master's Degree	11 (20%)
Doctoral or Professional Degree	3 (5%)
Location:	
Hawai'i	28 (51%)
California	27 (49%)
Most frequent surfing activity:	
Foil	1 (2%)
Longboard	32 (58%)
Shortboard	20 (36%)
Stand up Paddle	2 (4%)
Previous head injuries:	
Yes	21 (38%)
No	31 (56%)
Not Sure	3 (5%)
Number of surfing head injuries:	
>2	2 (4%)
2	8 (15%)
1	11 (20%)
0	34 (62%)
Number of surfing concussions:	
2	1 (2%)
1	4 (7%)
0	50 (91%)
Attitude toward concussions:	
Afraid of Concussions	27 (49%)
Concussions Are Part of the Sport	19 (35%)
None of These	9 (16%)
Previous concussion education:	
Yes	27 (49%)
No	28 (51%)
Mode of education (Select All That Apply):	
In-Person	21 (38%)
Online	12 (22%)
Media	8 (15%)
In-Print	7 (13%)
N/A	28 (51%)

Discussion

There appears to be a common misconception that concussions are accompanied by a noticeable wound or positive radiology finding. Thus, when delivering concussion education, it is important to emphasize that concussions are often invisible injuries that may not be evident on physical examination or in brain imaging (eg, magnetic resonance imaging, computed tomography scan, X-Ray, etc). In addition to temporary loss of consciousness and confusion, drowsiness was the most missed concussion symptom (72%), which should be included in concussion education.

In a 2022 study by Shafik et al, the CKI was also used to evaluate knowledge of concussion among women soccer players. Results showed that previous sports-related concussion education was associated with an increased knowledge of concussion. Thus, the authors suggested that concussion education should be mandated across the athletes to support their safety.[6] This recommendation is further emphasized in a 2020 clinical guideline on the management of concussion by Silverberg and colleagues, suggesting the importance of patient education as a pillar of concussion management in primary care.[7]

Overall, the surfers scored significantly higher on the CKI evaluation than the soccer players. This appeared to suggest that the surfers surveyed demonstrated greater knowledge of concussion than the soccer players surveyed. However, since the data from the surfers were collected in 2021, and the data from the soccer players were collected prior to 2013, it is possible that the efforts from organizations such as the Hawai‘i Concussion Awareness Management Program (HCAMP) to increase awareness of concussion in the past decade may have contributed to a potential difference in concussion knowledge.[8] In order to adequately support the hypothesis that surfers in general possess more concussion knowledge than soccer players, additional surveys should be conducted with larger, contemporaneous groups. Further efforts to increase concussion education among the surfing community could be beneficial to promote safer, informed actions taken by surfers after sustaining a concussion.

Conflict of Interest

None of the authors identify a conflict of interest.

Authors' Affiliations:
- Department of Quantitative Health Sciences, John A Burns School of Medicine, University of Hawai‘i at Mānoa, Honolulu, HI (WJL, HJA)
- Department of Molecular, Cellular, and Developmental Biology, University of California, Santa Barbara, Santa Barbara, CA (WJL)
- Hawai‘i Concussion Awareness and Management Program, Department of Kinesiology and Rehabilitation Science, College of Education, University of Hawai‘i at Mānoa, Honolulu, HI (TF, KS, NM)

Corresponding Author:
Hyeong Jun Ahn PhD; Email: hjahn@hawaii.edu

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