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A Longitudinal Observation of the Influence of Michigan Sports Concussion Law on Parents Knowledge and Perception of Sport-Related Concussion

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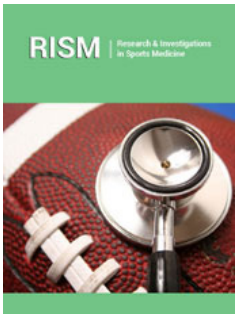

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Abstract

Introduction: In 2013, Michigan enacted legislation requiring parents and athletes to receive educational material on Sport-Related Concussion (SRC). The aim of this study was to follow trends in concussion knowledge of parents from one community following implementation of Michigan's Sports Concussion Laws (MSCL).

Methods: Parents of students from a suburban school district were surveyed via district email at 1 year and 5 years post-implementation of MSCL. Results were compared to a survey obtained prior to the law. Individual questions were compared between the three surveys by Chi-square analysis with significance at $p<0.05$.

Results: A total of 381 responses were obtained in the 1-year post-MSCL (1yMSCL) and 178 in the 5 year post-MSCL (5yMSCL) survey. Awareness of district policy regarding concussion was much higher after implementation of the law (77% at 1yMSCL and 71% at 5yMSCL) compared to prior (18% pre-MSCL, $p<0.0001$). As the law matured, parental knowledge improved. Respondents to the 5yMSCL survey were more aware of medical guidelines surrounding "return to play" after SRC compared to 1yMSCL (84.8% v 78.7%, $p=0.01$). At 5yMSCL, more respondents agreed that head injury can cause more brain damage to children than adults (86.5% v 78.7% at 1yMSCL, $p=0.03$). Lastly, parents continued to rate the concussion educational material as the most helpful information source on SRC.

Conclusion: Since implementation of MSCL, parental knowledge increased in awareness of medical guidelines for SRC and potential brain damage risks to children. This increase may be in part from maturation of policy changes from MSCL.

Keywords: Concussion; Sports; Youth; Athletics; Traumatic brain injury; Parental attitudes

Abbreviations: NFL: National Football League; MTBI: Mild Traumatic Brain Injury; CTE: Chronic Traumatic Encephalopathy; MSCL: Michigan's Sport Concussion Law

Introduction

In 2016, the National Football League (NFL) settled almost 1 billion dollars over thousands of lawsuits regarding Mild Traumatic Brain Injury (MTBI), better known as concussion. Today, the settlement is still ongoing. This came after new insight in recent years about the long-term consequences of concussions including Chronic Traumatic Encephalopathy (CTE). A study published in JAMA in 2017 showed that 110 of 111 former NFL players had CTE evident on brain autopsy [1]. This helped further fuel mainstream media attention on concussion in contact sports. Naturally, this has raised questions over risk to children in athletics. Organized sports have long been an integral piece of American culture and upbringing. Football has gained the most attention for highest incidence of concussion, however many other sports pose significant risk of concussion including soccer, lacrosse, baseball, softball, ice hockey, and others [2]. For over 2 decades, there have been guidelines and sideline assessment tools (i.e., SCAT5) available to coaches, trainers and physicians to assess athletes after head trauma [3]. It has not been until more recent years that emphasis has been placed on training school professionals and parents who have more continued contact with children. This was seen with the CDC's HEADS UP initiative which began in 2003 with educating health care professionals and has rapidly expanded to school-wide programs and partnerships with large

sports organizations. In 2011, a study performed by LaBond et al. [4] entitled "Sports Related Head Injuries in Students: Parents' Knowledge, Attitudes, and Perceptions," demonstrated that survey respondents in one community had limited knowledge regarding concussions [4]. Since that study, Michigan and several other states passed legislation to improve parental education of concussions in child athletes. Michigan Public Acts 342 and 343 were enacted in 2013 and amended in 2017 with Public Act 137. These laws required that an educational handout be distributed to parents of child athletes and that both parent and child sign an acknowledgement form before participating in school-sponsored athletics [5].

Following Michigan's Sport Concussion Law (MSCL) enacted in 2013, parents' knowledge and attitudes regarding Sport-Related Concussion (SRC) were studied at 1-year post-MSCL (1yMSCL) and 5 years post-MSCL (5yMSCL). The aim of this study was to evaluate changes and trends in parental knowledge and perceptions of SRC with maturation of the law. This was achieved by comparing results of our 1 and 5 year post-MSCL surveys with the survey performed pre-MSCL in the study mentioned above. It was hypothesized that with further maturation of the law and policy change along with heightened media attention of SRC, overall parental knowledge on concussion would be increased.

Methods

This research study was a survey of parents and guardians of student-athletes who were enrolled in a district-wide email list of a suburban, middle-class school district in Clarkston, Michigan. The same population was surveyed at 1-year post-MSCL in 2014 and again at 5 years in 2018. Prior to dispersing surveys, approval from the Institutional Review Board and Superintendent of Schools was obtained. Individuals who were enrolled in the school district email list were sent an electronic survey link. Emails were entitled "HELP US LEARN ABOUT CONCUSSIONS, HELP YOUR SCHOOL WIN 50 NEW HELMETS." Respondents were asked to follow a link to a Survey Monkey™ website to complete a questionnaire (Appendix A). The first question described the nature of the survey and asked for consent. The last question of the survey gave respondents the opportunity to select a school within the district to win fifty free bicycle helmets. This was offered as a small incentive for parents to complete the survey and the school with the most votes would receive the helmets. There are approximately 6,500 emails within the school district list for over 7,000 students. The email system potentially includes duplicate listings, non-active listings, or listings for more than one parent/guardian per student. The survey link was sent 2-3 times over several weeks to maximize responses. Identical surveys were used for both 1yMSCL and 5yMSCL surveys to ensure comparability. All questions on these surveys were the same as the pre-MSCL survey except for two additional items that asked respondents about awareness of the Michigan law and usefulness of various resources on concussion information. Data sets were collated and compared. Aggregate correlation coefficients were calculated comparing the previous responses to the current responses. Individual questions were compared between the three surveys by Chi-square analysis with significance at $p<0.05$. Specifically, question responses were compared between the pre-MSCL survey and 5yMSCL, as well as between the 1yMSCL and 5yMSCL surveys. A minimum of 170 respondents in each time period was required to achieve power of 80% to test whether there is a relative change in awareness of 35% for a total of at least 340 respondents across each survey comparison group.

Appendix A: Survey: Sports-Related Head Injuries in Student Athletes

1) Dear Participant,

You are invited to participate in a research study being conducted by the faculty of the Genesys Health System. The purpose of the research is to determine what parents and guardians know about head injuries suffered by children and teens while playing sports.

You are one of approximately 6500 people that are invited to participate in this project. Your participation in this research project is completely voluntary. You may decline altogether, or leave blank any survey questions you don't want to answer. There are no known risks to participation beyond those encountered in everyday life. Your responses will be confidential and data from this research will be reported only as a collective combined total. No one will know your individual answers to this questionnaire. We will send the results of this study via this email system when our project is complete. If you agree to participate in this project, please click on the link below to complete the survey. Answer the questions on the survey as best you can. It should take approximately 10-15 minutes to complete. Be sure to answer the last question, which is your vote for the school that will receive the 50 new bike helmets. The method of distribution will be determined by the school staff. Each helmet will be professionally fit by a safety specialist and the recipient will be instructed about its proper use. If you have any questions about this project, please feel free to contact Dr. Karyn Liebsch atkaryn.liebsch@ascension.org. Information on the rights of human subjects in research is available through the Institutional Review Board, One Genesys Parkway, Suite 2442, Grand Blanc, MI 48439; phone (810)606-7722.

Thank you for your assistance in this important endeavor.

Sincerely yours,

Karyn Liebsch, DO

Virginia LaBond, MS MD FACEP

1) Do you agree to participate?

a) Yes

b) No

2) Are you the parent and/or guardian to a student enrolled in the Clarkston School District?

a) Yes

b) No

3) What is your relationship to the student/students?

a) Mother

b) Father

c) other

4) If you answered "other" to question #3, please enter your relationship here.

5) Check all grades that your student/students currently attend:

a) Preschool/Kindergarten

b) Grades 1-5

c) Grades 6-7

d) Grades 8-9

e) Grades 10-12

6) Select all sports your student/students have been involved in:

a) Football, Baseball, Soccer, Basketball, Lacrosse, Tennis, Swimming, Diving, Cheer, Dance, Hockey, Track & Field, Wrestling, Volleyball, Softball, Golf, Bowling, Ski/Snowboarding, Equestrian, Cycling, Other

7) If you answered other on #6, please specify:

8) In the past year, have your students participated in a school-organized sport?

a) Yes

b) No

9) If yes, did you receive an informational handout about concussions?

a) Yes

b) No

10) Have any of your students ever sustained a head injury requiring medical attention?

a) Yes

b) No

11) Have you ever sustained a head injury requiring medical attention?

a) Yes

b) No

12) What is your age in years?

13) What is your gender?

a) Male

b) Female

c) Other

14) What is your highest level of education?

a) Some high school

b) High school graduate

c) Some college

d) Trade school

e) Bachelor's degree

f) Graduate degree

15) Does Clarkston Community School District have a policy on sports related head injuries?

a) Yes

b) No

c) Don't know

16) Are there some circumstances under which a student athlete can return to play immediately after sustaining a concussion?

a) Yes

b) No

c) Don't know

17) Are there medical guidelines to determine when a student athlete should return to play after concussion?

a) Yes

b) No

c) Don't know

18) Repeated head trauma in the teen years can result in permanent early dementia.

a) True

b) False

c) Don't know

19) Head trauma can cause more damage in children than in adults because their brains are still developing.

a) Yes

b) No

c) Don't know

20) There is enough attention paid to safety in organized sports.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

21) After having a concussion and before returning to play, a child should be evaluated by a doctor.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

22) Coaches should be required to have training on head injury management.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

23) All parents should know the signs and symptoms of a concussion.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

24) Compared to professional sports, amateur sports should have modified rules that insure safety.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

25) I can recognize a concussion in my child/student.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

26) After a concussion, I can determine when my child/student is ready to return to playing sports.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

27) Playing competitive sports as a child will increase an individual's professional success as an adult.

a) Strongly Agree.

b) Agree

c) Disagree

d) Strongly Disagree

28) I am responsible for teaching my child/student to make healthy choices.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

29) Fighting in professional hockey is an acceptable tradition.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

30) It is important that my child/student succeed in his/her sporting activities.

a) Strongly Agree

b) Agree

c) Disagree

d) Strongly Disagree

31) Are you aware of the new Michigan Law (Public Acts 342 and 343 of 2012) regarding concussions and sports-related head injuries?

a) Yes

b) No

32) In your experience, which of the following sources have been the most helpful for learning about concussion safety. Please rank them 1-5, with 1 being the most helpful and 5 being the least helpful.

a) Michigan Law (Public Acts 342 and 343)

b) Concussion fact sheet and acknowledgement form that was signed and returned to the school

c) Changes in athletic training of your child's/childrens' sport (tackling techniques, practice durations)

d) Internet (Google searches, social media, etc)

e) Physicians and health care professionals

33) Which Clarkston school would you like to receive 50 new bike helmets? The method of distribution will be determined by the school staff. Each helmet will be professionally fitted by a safety specialist and the recipient will be instructed in its proper use.

a) Andersonville Elementary

b) Bailey Lake Elementary

c) Clarkston Elementary

d) Independence Elementary

e) Pine Knob Elementary

f) North Sashabaw Elementary

g) Springfield Plains Elementary

h) Sashabaw Middle School

i) Clarkston Junior High School

j) Clarkston High School

k) Renaissance High School

l) Early Childhood Education

Results

Approximately 6,500 email addresses were utilized using the school district listserv. A total of 381 responses were obtained in the 1yMSCL survey, and 178 in the 5yMSCL survey. The pre-MSCL study had 245 respondents. Of our 178 respondents (at 5yMSCL), the vast majority were female (90%) with a mean age of 44 (SD 9.06). The majority (90%) identified themselves as parents or guardians. A small percentage were school employees or other family members. Over 80% of total respondents earned a bachelor's degree or higher. Demographics of the 5yMSCL respondents were similar to that of 1yMSCL respondents. Of our respondents, 17% reported personally sustaining a head injury in their lifetime, compared

to nearly one-third (31%) of their student-athletes. Overall, respondents had students in similar distribution from preschool to high school (Table 1). The number of students exceeded number of respondents due to having more than one child enrolled during the time of the survey. The most commonly played sports within this district were soccer (47%), swimming (35%), ski/snowboarding (33%), basketball (33%), football (30%), and baseball (30%), followed by 26 other sports (Table 2). This was similar distribution to the pre-MSCL and 1yMSCL surveys. Approximately half (52%) of total athletes were enrolled in a school-sponsored sport in the year previous to our survey. Awareness of a school district policy regarding concussions (Figure 1) was 71% at 5yMSCL, down from 77% at 1yMSCL (p=0.15), but still significantly higher than at pre-MSCL (18%, p<0.0001). Attitudes towards student health and sport participation remained largely unchanged across surveys. In both post-MSCL surveys, 100% of parents and guardians felt they are responsible for teaching their child to make healthy choices, essentially unchanged from the pre-MSCL (99.5%). Seventy-two percent of respondents felt it was important for their child to succeed in his or her sporting activities, unchanged from 71% in the 1yMSCL (p=0.88) and 68% at pre-MSCL (p=0.44). One area of changing attitudes was noted with 65%of respondents at 5yMSCL feeling that playing competitive sports as a child would increase professional success as an adult, down from 72% at 1yMSCL (p=0.08) and 75% at pre-MSCL (p=0.02). Trending with maturation of the law, parents do not feel sports are as important to future professional success. Cultural perceptions regarding safety and head injuries in athletics remained largely unchanged. At 5 years post-MSCL, only 52% of respondents felt enough attention was paid to safety in organized sports, unchanged from 51% at 1yMSCL (p=0.95). Pre-MSCL, 43% (p=0.09) of respondents felt there was enough attention paid to safety. Compared to professional sports, 84% of respondents felt amateur sports should have modified rules for safety. Again, this was unchanged from the previous studies (84% at 1yMSCL and pre-MSCL; p=0.70, p=0.96). Interestingly, 26% of respondents felt that fighting in ice hockey was an acceptable tradition, which is unchanged from previous surveys (1yMSCL 28%, p=0.68; pre-MSCL 30%, p=0.35).

Table 1: BStudent-athlete grade level.

Grade	Number of Athletes
Preschool/kindergarten	36
Grades 1-5	79
Grades 6-7	51
Grades 8-9	44
Grades 10-12 (High School)	74
	Total: 284*

Source: *Number of students exceeds respondents due to multiple child households.

Table 2: Sports participation.

Sport	Number of Athletes 1yMSCL	Number of Athletes 5yMSCL
Soccer	**221**	**83**
Swimming	153	62
Ski/snowboard	149	59
Basketball	141	58
Football	130	54
Baseball	145	54
Dance	122	38
Track and Field	86	31
Cycling	73	23
Softball	56	23
Cheerleading	45	22
Golf	66	22
Tennis	52	22
Lacrosse	40	21
Hockey	34	19
Bowling	60	18
Volleyball	65	17
Wrestling	30	17
Other: Gymnastics, Cross Country, Karate, Field Hockey, Marching Band, Figure Skating, Weightlifting, Tae Kwon Do, Diving, various other sports/ activities	96	46
	Total: 1783	Total: 689

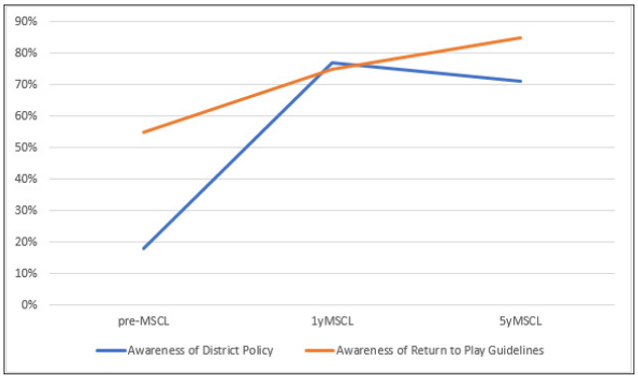

Figure 1: Parental awareness over time.

The majority of parents and guardians feel they can recognize a concussion in their child (79%), which has increased over the past two surveys (74% in 1yMSCL, p=0.17; 63% in pre-MSCL, p=0.0003). After a child has sustained a head injury, 20% feel they can determine when their child is ready to return to play which is unchanged from 1yMSCL (20%, p=0.93). This is increased from pre-MSCL, when 10% (p=0.003) felt they could determine readiness. Overall, parental knowledge on concussions has increased over the

course of the 3 surveys (Figures 2 & 3). When asked if head trauma in childhood can cause more damage to the brain compared to adults because their brains are still developing, 87% of respondents agreed, which was increased from the 1yMSCL survey (78%, p=0.03) and pre-MSCL survey (67%, p<0.0001). Seventy-seven percent of respondents also agreed that repeated head trauma in teen years can lead to early dementia, increased from 71% (p=0.13) at 1yMSCL and 65% (p=0.01) at pre-MSCL. Most encouraging, 85% of parents were aware of medical guidelines that determine when an athlete should return to play after SRC. This increased from 75% (p=0.01)at 1yMSCL and 55% (p<0.0001) pre-MSCL (Figure 1). When asked if there are circumstances in which an athlete can return to play immediately after sustaining a concussion, 61% answered "no." At 1yMSCL this was 67% (p=0.20). This was still much higher that pre-MSCL where only 39% (p<0.0001) felt there were not circumstances allowing immediate return to play. A third of parents (34%) reported they didn't know if there were circumstances that would allow immediate return to play. All respondents felt that parents should know the signs and symptoms of concussion (100%), unchanged from previous surveys (100%, p=0.47, p=1.00). All respondents (100%) felt that coaches should receive special training on head injury management, unchanged from previous surveys (98% 1yMSCL, p=0.09; 100% pre-MSCL, p=1.00). After a child sustains a head injury and prior to returning to play, nearly 100% of respondents felt the child should be evaluated by a doctor. This was also unchanged from previous surveys (98% 1yMSCL, p=0.22; 99% pre-MSCL, p=0.41). Parents and guardians were also asked about their awareness of the Michigan law regarding SRC. Of respondents, 41%were aware of the law and this was consistent with the previous survey (41%, p=0.88). Lastly, parents were asked to rank the resources they found most helpful in regard to concussion education (Figure 3). In our study, 42% of total respondents ranked the concussion fact sheet as most helpful. When taking into account which respondents recall receiving the educational handout, 78% of those recalling the handout ranked it as most helpful. The next most helpful resource was physicians, with 29% of respondents ranking them as the most helpful educational resource. The educational handouts and physicians were also ranked as most helpful in the 1yMSCL survey. The least helpful resources for concussion safety information were the Michigan law, sport-specific athletic training, and the internet.

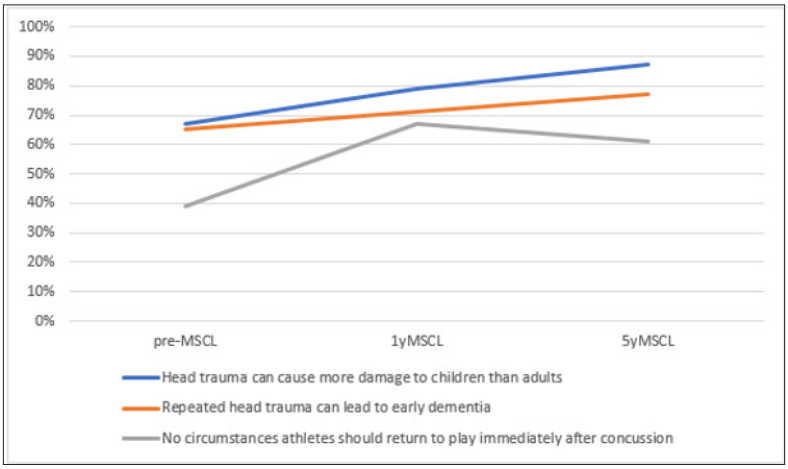

Figure 2: Parental knowledge over time.

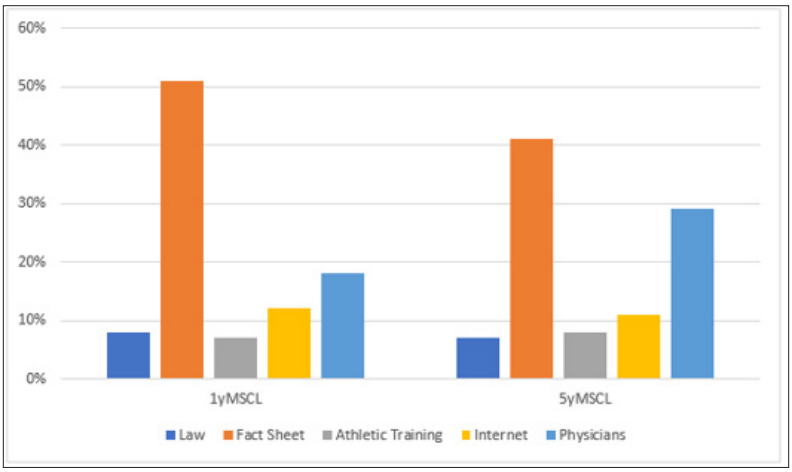

Figure 3: Resources ranked as "Most Helpful" on concussion.

As respondents reported the concussion fact sheet to be the most helpful for learning about concussions, we looked at knowledge base differences based on whether respondents did or did not recall receiving the handout. One area of difference in answers was in response to whether parents felt they had the ability to recognize a concussion in their child. In the group who recalled receiving the handout, 25% answered "strongly agree" compared to 13% in the group who did not recall receiving the handout. Those recalling the handout were also more likely (71%) to answer "no" to the existence of circumstances that allow return to play immediately after sustaining a head injury. Those who did not recall the handout were less likely (45%) to answer "no" to this question.

Discussion

According to the Consensus in Sport Group (CISG), concussion can be broadly defined as "a traumatic brain injury induced by biomechanical forces" that is further characterized by a set of features relating to mechanism, neuropathological changes and clinical sign and symptoms [3]. The CISG continues to adapt and change the definition as expert opinions evolve, which speaks to the gaps in research that limits our understanding of the pathophysiology behind concussion. The importance of education and prevention of SRC has gained momentum in the last 2 decades. Since 2007, all 50 states have passed legislation addressing youth sport-related concussion. However, not all states require coaches or trainers to undergo formal training [6]. Furthermore, many states require that parents have access to educational material (i.e., forms posted on a website or distributed), but do not require acknowledgment of receipt or informed consent prior to an athlete's participation in sport [7]. Given the findings of our study, we hypothesize that mandating parents to acknowledge receipt of educational materials may increase their ability to recognize concussion in their student-athletes and be more familiar with return to play practices. Of our respondents, 17% reported personally sustaining a head injury in their lifetime, compared to nearly one-third (31%) of their student-athletes. This could represent a number of changes between one generation and the next. This increase may be a reflection of increasing athletic participation and therefore opportunities to sustain SRC. It may also represent better education and recognition of concussion by coaches, trainers, doctors and lay-persons. When comparing knowledge, attitudes, and perceptions of this community from prelaw, initiation of the law, to maturation of the law, there were many cultural attitudes that remained unchanged. However, we did see improvement in parental knowledge in regard to the awareness of medical guidelines for return to play and the potential damage SRC poses to a developing brain. The majority of parents and guardians felt that the concussion educational handout they received was the most helpful source of information. As not all states have legislation requiring this type of parent education, we feel further nationwide legislation would give parents the tools to prevent and recognize concussion in their children leading to improved overall safety in athletics.

Limitations

Education level of parents has been showing to impact knowledge base on concussions. A study from 2015 showed that parental concussion knowledge correlated with education level [8]. Our study was done in a middle-class suburban population with the majority of respondents having higher degrees of education. This may decrease the generalizability of our study. As changes in parents' knowledge trend towards safety, multiple factors besides the implementation of the public acts and educational materials may have led to these changes. There has been increased media attention around SRC in the past several years including the large settlement with the NFL over traumatic brain injury and the movie Concussion which debuted in 2015.

Conclusion

Since implementation of Michigan's Sports Concussion Laws, parents and guardians of student athletes in one community demonstrate increased knowledge of policy regarding head injuries. This study demonstrates increased awareness of medical guidelines and long-term effects of SRC. This increase may be in part from maturation of the policy changes of Michigan Public Acts 342 & 343 but is likely multifactorial given the increases in mainstream media attention given SRC.

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