Pilot Implementation of a Heat Illness Prevention Program in the Southeastern US

Daniel J. Ruiz, Lindsey E. Eberman, Michelle A. Cleary, Brady L. Tripp
Florida International University, Miami, FL

Objective: To evaluate the ease of application of a heat illness prevention program (HIPP). **Design:** A mixed-method research design was used: questionnaire and semi-structured interview. **Setting:** Eleven South Florida high schools in August (mean ambient temperature=84.0˚F, mean relative humidity=69.5%) participated in the HIPP. **Participants:** Certified Athletic Trainers (AT) (n=11; age=22.2±1.2yr; 63.6% female, 36.4% male; 63.6%) implemented the HIPP with their football athletes which included a pre-screening tool, the Heat Illness Index Score- Risk Assessment. **Data Collection and Analysis:** Participants completed a 17-item questionnaire, 4 of which provided space for open-ended responses. Additionally, semi-structured interviews were voice recorded, and separately transcribed. **Results:** Three participants (27.7%) were unable to implement the HIPP with any of their athletes. Of the 7 participants (63.6%) who implemented the HIPP to greater than 50% of their athletes, a majority reported that the HIPP was difficult (54.5%) or exceedingly difficult (18.2%) to implement. Lack of appropriate instrumentation (81.8%, n=9/11), lack of coaching staff/administrative support (54.5%, n=6/11), insufficient support staff (54.5%, n=6/11), too many athletes (45.5%, n=5/11), and financial restrictions (36.4%, n=4/11) deterred complete implementation of the HIPP. **Conclusions:** Because AT in the high school setting often lack the resources, time, and coaches' support to identify risk factors, predisposing athletes to exertional heat Illnesses (EHI) researchers should develop and validate a suitable screening tool. Further, ATs charged with the health care of high school athletes should seek out prevention programs and screening tools to identify high-risk athletes and monitor athletes throughout exercise in extreme environments. **Key Words:** Exertional heat illness, high school football, prevention program, Heat Illness Index Score

High schools students account for the largest proportion of athletes in the United States today, contributing approximately 6 million athletes from 20,000 schools.[1] The National Federation of State High School Association estimates 53.5% of high school students participate in athletics.[2] Evidence suggests, however, that secondary schools fail to provide adequate medical coverage from physicians, certified athletic trainers (AT), emergency medical technicians (EMT) or paramedics.[3] Compared to collegiate and professional athletes, the inadequate medical coverage provided to high school athletes may lead to injuries and medical conditions going undetected and untreated. Only 10.6% of high school football games in Chicago have a physician present and only 8.5% have an AT on-site.[3] In North Carolina, only 56% of private or public high schools provided medical coverage through an AT and only 27% of schools believed the coverage in place was adequate.[4] Currently, high school students out-number ATs 800:1[5] and it is nearly impossible to cover every game, let alone every practice. Compounding the issues caused by inadequate coverage is the frequency of injuries occurring during practice and not competition.[6] The lack of medical coverage becomes alarming in sports with elevated risks for catastrophic injury such as football.[1,6] Poor medical coverage during athletics concerns health care providers and parents of high school participants. The American Academy of Family Physicians recommends the employment of ATs at all secondary school

settings "as an integral part of the high school athletic program," to help prevent and manage athletic injuries.[7] Further, research also indicates that prevention can begin with the pre-participation physical examination (PPE).[8]

Health care professionals use PPEs to screen the large number of students participating in high school sports. PPEs help detect underlying pathologies and pre-disposing conditions which could be exacerbated with athletics.[8-11] The latest research indicates that 49 states require PPEs before high school students are allowed to participate in athletics.[12] Unfortunately, 78% of athletes use the PPE as their yearly check-up,[11,13] which may significantly add to the care required when administering a PPE. In addition, certain states allow a variety of medical professionals the right to conduct a PPE with standards fluctuating between areas of specialization.[14] Controversy exists about extending the scope of the PPE to include screening for cardiovascular and respiratory conditions.[8-10] Although cardiovascular abnormalities and asthma are potential deadly conditions if not immediately detected, prevention may be beyond the scope of a sports medicine professional. Additionally, the PPE is neither sport–specific nor geographically sensitive to the environmental conditions an athlete will endure. Therefore, current PPE tests and criteria may fail to adequately detect potentially catastrophic conditions associated with football due to the rising number of participants, lack of standardized PPE forms, and the exclusion of environmental factors that lead to injury.

Football places unique demands on athletes that far surpass most other sports, and increase the incidence of mild head injuries,[14] cervical fractures,[15] and exertional heat illnesses (EHI).[16] Exertional heat illnesses commonly occur in football because of the intense training performed during the warm summer months, the protective equipment, and the chronic dehydration that occurs over the course of pre-season conditioning. Although research has improved training strategies and altered coaching philosophies, many high school coaches still practice at mid-day, and use water as a reward rather than a necessity. This lack of education creates an advantageous environment for an EHI to occur and is evident by the high number of deaths occurring in the secondary school setting.[17] The tragic death of two professional football players has raised public awareness about the consequences of EHI and football. Although EHIs are preventable, risk factors may be present precipitating an EHI incident. Such risk factors include hydration status, body mass index, acclimatization, ergogenic aids, and pathophysiological conditions such as sickle cell trait.[16] Recent research has demonstrated that football players report to pre-season conditioning mildly dehydrated (69 veteran football players; age= 20.1$\pm$1.2yr; body mass= 229.7$\pm$44.4lb; height= 72.2$\pm$2.1in; urine specific gravity= 1.026$\pm$0.010µg) (Minton DM, Eberman LE, Cleary MA, Emerson CC, unpublished data, August, 2006). Therefore, the National Athletic Trainers' Association (NATA) suggests ATs should monitor weight changes, and attempt to prevent dehydration levels above 2% during the course of pre-season conditioning.[16] However, few states recommend a urinalysis be performed during a PPE and it is not recommended by the American Academy of Pediatrics as part of a routine screening.[13]

Professional organizations have sought to address the shortcoming of PPEs by publishing position statements outlining proper medical treatment and the appropriate standard of care.[16] For example, the NATA published recommendations for the prevention, recognition, and treatment of EHI.[16] The NATA recommends performing a physician-supervised PPE before the beginning of the season to identify athletes at risk for EHI.[16] The NATA also recommends educating athletes and coaches regarding all aspects of EHI.[16] Although an abundance of information is available regarding the effects of EHI on performance, little is known on how ATs

implement the recommendations prescribed by the NATA and even less is known about how effectively ATs comply with the standard of care at secondary school settings in the US. The purpose of this investigation was to implement a heat illness prevention program (HIPP) and evaluate the ease of application at a secondary school setting in the subtropical environment of South Florida.

Methods

Research Design

We used a mixed-methods research design. We surveyed ATs after the first two weeks of preseason football practice. The data collection form used was a 17-item questionnaire, with 4 questions allowing opened ended responses. Following completion of the questionnaire, participants scheduled an individual semi-structured interview with the primary investigator. The primary investigator and secondary investigator voice recorded each interview session. The primary investigator and secondary investigator separately transcribed the interviews to ensure trustworthiness.

Participants

Eleven AT (age=22.2$\pm$1.2yr; 63.6% female, 36.4% male; 63.6%) were conveniently sampled to participate in implementing the HIPP at their current place of employment. All ATs were certified and licensed in the state of Florida and held graduate assistantship positions at Florida International University. All participants graduated from an accredited athletic training education program and all currently worked in a secondary school setting. The majority of participants (72.7%, n=8/11) had one year or less experience working in a subtropical environment.

Instruments

The HIPP is a comprehensive program designed to help athletic trainers identify and mitigate athletes at risk for developing an EHI often associated with exercise in a hot, humid environment. The HIPP is comprised of two screening forms and two reporting forms. The screening forms consist of the Initial Athlete Screen, and the Heat Illness Index Score (HIIS) Risk Assessment. The two reporting forms are the Heat Illness Incident Reporting Form and a Practitioner Evaluation form. Additional resources in the HIPP include a hydration chart, a urine color chart, and educational resources for the coaches and athletes.

The primary evaluation tool within the HIPP is the HIIS, recently validated by a panel of 6 EHI experts using the Delphi survey method. After 3 rounds of revisions, 100% of the panelists reported agreeing (n=3/6) or strongly agreeing (n=3/6) with the final instrument. In addition, researchers validated the HIIS through clinical implementation. Three ATs implemented the HIIS in a pilot investigation to a team of Division I-A collegiate American football players. During this pilot investigation, investigators excluded seventeen participants (27.4%) because the athletes failed to complete all parts of the HIIS. The ATs used four indicators to identify 6 at-risk athletes: total HIIS score (14 participants, 33.3%, score$\geq$20), previous history (11 participants, 24.4%, HIIS score$\geq$2), body mass index (19 participants, 42.2%, HIIS score=4) and VO_{2max} Run Test (27 participants, 60.0%, HIIS score=4). And, over 15 days of preseason practices, 13 incidents of EHI occurred with 61.5% (8/13) of the incidents occurred to the at-risk individuals (Eberman & Cleary, 2006, unpublished data).

Procedures

Researchers provided participants with a policies and procedures manual for the implementation of the HIPP as well as verbal and written directions during a brief familiarization session. Participants were then instructed to return to their high schools and implement the HIPP

to the best of their abilities. The primary investigator instructed ATs to administer the Initial Athlete Screen to the entire football team. Information from the Initial Athlete Screen aided the ATs in red flagging athletes who possessed characteristics that may predispose them to an EHI. Subsequently, the AT completed the HIIS Risk Assessment with any athlete identified as potentially at-risk. After the AT completed the HIIS with each the red flagged athlete, the AT tallied the results and allotted a score. The AT categorized the athlete as low, moderate, or high risk for developing an EHI. Following the completion of the HIIS, the score was calculated and the athlete was categorized as low, moderate, or high risk for developing an EHI.

Following preseason football practices, the primary investigator asked each participant to complete a 17-item questionnaire designed to identify the ease of application of the HIPP. Participants were also asked to contribute additional feedback in a semi-structured interview to elaborate on their experience of implementing the HIPP.

Statistical Analysis

To analyze the quantitative responses from the HIPP Practitioner Feedback Form, we used descriptive statistics and frequencies of responses. The primary investigator and secondary investigator transcribed the responses from the open ended questions and semi-structured interviews which were voice recorded and separately transcribed with peer-checking to ensure trustworthiness. Data were analyzed using open- and closed-coding techniques. The researchers established and compared themes found within the transcribed interviews and open ended questions.

Results

All participants attempted to implement the HIPP in a high school setting using the athlete screen with individual follow-up. Three participants (27.7%) were unable to implement the HIPP to any athletes; however, several ATs were able to implement the HIPP to at least part of their populations. A majority of participants (81.8%, n=9/11) also reported several factors that prevented their full implementation of the HIPP (Table 1). Participants reported that implementing the HIPP was difficult (27.3%, *n*=3/11), exceedingly difficult (18.2%, *n*=2/11), or easy (18.2%, *n*=2/11). Further evaluation suggested that the following deterrents prevented full implementation of the HIPP: lack of appropriate instrumentation (81.8%, *n*=9/11), lack of coaching staff/administrative support (54.5%, *n*=6/11), insufficient support staff (54.5%, *n*=6/11), too many athletes (45.5%, *n*=5/11), and financial restrictions (36.4%, *n*=4/11). Specific sections prevented ATs from fully implementing the HIIS (Table 2) including the VO_{2max} Run Test and obtaining urine samples. Participants reported that collection and analysis of urine was difficult: “The urine samples were difficult to collect so we resorted to utilizing the urine color chart which was very beneficial in student-athletes monitoring their hydration status.” A lack of coaching/administrative support was a common theme found in the open ended responses: “One head coach stated we did not have time to do the HIPP since the uniforms were not even given out yet.” One AT stated that “We were unable to conduct the 12 minute run as the coach indicated that the student-athletes were running the entire summer. It would not be fair to test them on it now nor did he want to take the time out of practices to implement the test.” He said he feels he does a great job of giving the athletes water breaks and keeping them hydrated.” Another theme found that deterred ATs from implementing the program was lack of time. One AT stated that the appropriate time required for a prevention program of this magnitude was an obstacle: “It’s a little time consuming… requires a lot of help… if the only one there working with your football team at a high school and you’ve got to get you team ready for practice, you don’t have time to be monitoring urine.”

Discussion

The purpose of this investigation was to evaluate the ease of application of the HIPP in a secondary school setting. Our results suggest that trained ATs had difficulty implementing the HIPP because of obstacles found within their employment setting. A lack of support from the administration and coaching staff suggests that football coaches are not well educated on the risks of EHI during the early days of pre-season football. Lack of additional support staff during pre-season football created a dichotomy for the role and responsibilities of a high school AT. ATs often face the challenges of prioritizing among several responsibilities, yet implementing the HIPP may have eliminated incidents of EHI. Our ATs found the lack of support provided by the coaching staff and administrative staff severely impeded the implementation of the program. Financial restrictions were also identified as an obstruction in the implementation of our prevention program. However, further education about the cost-effectiveness of preventative equipment may enlighten ATs, athletic directors, and coaching staff about how money should be allocated.

Overall, ATs reported that the HIPP was difficult to implement, but more than half, (n=7/11) believed the HIPP was a practical approach to preventing EHI. Many ATs appreciated that HIPP provided greater insight into athletes' health status before beginning pre-season football. ATs also suggested they were more aware of which athletes may be at higher risk because the HIPP required them to discuss risk factors for EHI with all their athletes.

Clinical Implications

Exertional heat illnesses are preventable, yet catastrophic events continue to occur in high risk environments. Coaches and school administrators have to be educated on the prevention of EHI. Athletic Trainers play a key role in the educational process and should work to reshape coaches' common misconceptions and myths regarding EHI. For instance, it is well known that dehydration leads to the development of an EHI and maintaining fluid balance for young adults is difficult.[18] However, coaches may not be aware that numerous risk factors exists that have the potential to increase the likelihood of an EHI; such as the intensity of practice, duration, schedule of fluid breaks, uniform configuration, and number of practices per day.[16] All of the aforementioned are circumstances that a head coach controls but may not necessarily be aware that in combination with each other could exacerbate the chance of developing an EHI. In addition to further educating coaches and parents, and increasing the educational standards for becoming a coach could aid in the prevention of EHI.

Currently, the state of Florida requires all coaches become certified in cardiopulmonary resuscitation, regardless of whether the high school has an AT or not.[19] The Florida High School Association treats all sports uniformly. Research suggests that coaches can only recognize approximately 45% of practice injuries and approximately 85% of game injuries,[20] clearly suggesting a need for coaching education. According to the National Youth Sports Safety Foundation, fewer than 10% of the 2.5 million volunteer coaches and 33% of interscholastic coaches have any type of formal coaching education.[21] These figures are alarming when taking into consideration the amount of exposure coaches have with athletes and that the majority of injuries occur during practice times.[4] Currently, the NATA,[16] National Center for Sports Safety,[21] and the Inter-Association Task Force on Exertional Heat Illness[22] are in favor of increasing the standards for coach education and if a greater emphasis is placed on sports safety, then the possibility of reducing an EHI may be exponentially increased. Increasing awareness is a responsibility that falls on the shoulders of each AT. The NATA in cooperation with other organizations should to continue their quest to educate all individuals that are involved in

physical activity or coaching the physically active.

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Table 1. Instruments Available to ATs

Instrument	% Able to Access
Triple Beam Physician Scale	36.4
Digital Physician Scale	9.1
Sadiometer	9.1
Tape Measure	27.3
Clinical Refroctometer	9.1
Urine Reagent Strips	9.1
Urine Color Chart	63.6
Weigh-in Chart	81.8
Sling Psychrometer	0.0
Digital Psychrometer	18.2
Specimen Cups	36.4
Access to the Internet	36.4

Table 2. HIIS Sections that deterred full implementation

Section Unable to Implement:	% Affected
Patient History	36.4
Baseline Height	54.5
Baseline Body Mass	54.5
Urine Specific Gravity with Clinical Refractometer	72.7
Body Mass Index	63.6
VO_{2max} Run Test	45.5
Sickle Cell Trait Test	100.0