



12-2004

# A Survey of Lightning Safety Policy in Selected High Schools

Katie Groszek

*Western Michigan University*

Follow this and additional works at: [https://scholarworks.wmich.edu/masters\\_theses](https://scholarworks.wmich.edu/masters_theses)



Part of the [Health and Physical Education Commons](#)

## Recommended Citation

Groszek, Katie, "A Survey of Lightning Safety Policy in Selected High Schools" (2004). *Master's Theses*. 3333.  
[https://scholarworks.wmich.edu/masters\\_theses/3333](https://scholarworks.wmich.edu/masters_theses/3333)

This Masters Thesis-Open Access is brought to you for free and open access by the Graduate College at ScholarWorks at WMU. It has been accepted for inclusion in Master's Theses by an authorized administrator of ScholarWorks at WMU. For more information, please contact [maira.bundza@wmich.edu](mailto:maira.bundza@wmich.edu).



A SURVEY OF LIGHTNING SAFETY POLICY IN  
SELECTED HIGH SCHOOLS

by

Katie Groszek

A Thesis  
Submitted to the  
Faculty of The Graduate College  
in partial fulfillment of the  
requirements for the  
Degree of Master of Arts  
Department of Health, Physical Education, and Recreation

Western Michigan University  
Kalamazoo, Michigan  
December 2004

## A SURVEY OF LIGHTNING SAFETY POLICIES IN SELECTED HIGH SCHOOLS

Katie Groszek, M.A.

Western Michigan University, 2004

Our research will entail a survey of high school certified athletic trainers in the Great Lakes Athletic Trainers' Association (District 4) of the National Athletic Trainers' Association (NATA) on lightning safety policy. The NATA has written a position statement (Walsh, 2000) on lightning safety to educate athletic trainers and other individuals on the dangers of lightning and safety guidelines to follow. The National Collegiate Athletic Association (NCAA) also has lightning safety guidelines for the schools it governs. Despite the recommendations of the NATA and NCAA, there has been a demonstrated lack of lightning safety policy. The purpose of this study is to identify the existence of lightning safety policies in the high school setting. It will also aim to demonstrate a lack of lightning safety policy and provide encouragement for institutions without formal policies to create their own.

A recent survey conducted at the Division I collegiate level by Walsh, 1997, showed a lack of lightning safety policy, with only 8% of institutions surveyed having a written policy in place. Currently, no research on this topic has been conducted at the high school level. This research will aim to encourage high schools that have not implemented a lightning safety policy to adopt a policy to meet their specific needs.

© 2004 Katie Groszek

## TABLE OF CONTENTS

LIST OF TABLES.....	iv
INTRODUCTION.....	1
METHODS.....	4
Statistical Analysis.....	4
RESULTS.....	6
Current Lightning Safety Policy and Total Number of Outdoor Sports.....	6
Current Lightning Safety Policy and Authority to Suspend Activity.....	6
Current Lightning Safety Policy and Authority for Return to Activity.....	7
Methods Used for Monitoring Weather Conditions.....	7
Method Used to Suspend and Resume Outdoor Activities.....	8
DISCUSSION.....	9
APPENDICES.....	14
A. Human Subjects Institutional Review Board Acceptance Letter.....	15
B. Email Broadcast.....	17
C. Questionnaire.....	19
D. Tables.....	23
Table 1 Location of High Schools and Lightning Safety Policy.....	24
Table 2 Total Number of Outdoor Sports and Lightning Safety Policy.....	25
Table 3 Relationship of Lightning Safety Policy and Authority for Return to Play.....	26
Table 4 Methods Used for Monitoring Weather Conditions.....	27

Table of Contents—Continued

REFERENCES.....28

## LIST OF TABLES

1. Location of High School and Lightning Safety Policy.....	24
2. Total Number of Outdoor Sports and Lightning Safety Policy.....	25
3. Relationship of Lightning Safety Policy and Authority for Return to Play.....	26
4. Methods Used for Monitoring Weather Conditions.....	27

## INTRODUCTION

Lightning causes more casualties annually in the United States than any other storm-related phenomenon except floods<sup>1</sup>. Approximately 25,000,000 lightning strikes hit the ground<sup>1</sup>, causing over 100 deaths and hundreds of injuries each year<sup>2</sup>. Injuries due to lightning strikes range from loss of consciousness, cardiac arrest, confusion and amnesia, paralysis, coma, seizures, altered behavior, psychiatric illness, burns, eye and ear pathology, to a vast variety of systemic problems.<sup>2,3</sup> Most lightning strikes occur during the hours of 10:00am and 7:00pm from May to September, when a majority of outdoor sporting events and practices take place.<sup>2</sup> Even though lightning injury and fatality is not frequent, lightning still poses a threat to athletes participating in outdoor sports.

The National Athletic Trainers' Association (NATA) has developed a position statement on lightning safety for athletics and recreation,<sup>2</sup> and yet many institutions overlook the need for a lightning safety policy. The NATA advises that institutional lightning safety policies should include: safe locations for shelter, the monitoring of local weather reports, the designation of weather watchers, and the creation of a chain of command. The NATA's position also recommends that individuals in leadership positions appreciate lightning as a hazard, learn proper safety guidelines, and encourage safe behavior.

Another important component that the NATA recommends for lightning safety policies includes criteria for the suspension and resumption of outdoor athletic activities. It advises the use of the flash-to-bang method as a way to monitor lightning in the

immediate area. When lightning flashes, one should begin counting until the following sound of thunder. Divide the time in seconds by 5 to get the distance in miles to the lightning flash. A time of at least 30 seconds or 6 miles should be the minimum to evacuate to a safe location. To resume activities, 30 minutes should be allowed to elapse after the last flash of lightning is seen.

The College of William and Mary in Virginia has developed a lightning safety policy for athletics that has been used as a model for many institutions,<sup>5</sup> including high schools. Two of the most important aspects of the lightning model are education and prevention.<sup>5</sup> Certified athletic trainers should know background information on lightning and understand the physics behind lightning strikes. The College of William and Mary's policy closely follows the NATA's position statement for lightning safety in athletics and recreation. However, individuals who feel they are in danger due to lightning activity have the right to evacuate a field or venue without penalty according to this specific policy. Additionally, the supervising coach has the authority to remove a team or individuals from an athletic site.

The National Collegiate Athletic Association (NCAA) also has its own lightning safety guidelines.<sup>6</sup> It is very similar to the NATA and The College of William and Mary's with a few exceptions. It was added that there should be an awareness of the National Weather Service-issued thunderstorm "watches" and "warnings". A "watch" designates that conditions are favorable for severe weather to develop in a specific area. A "warning" designates that severe weather has already been reported in a specific area. The NCAA also advises that blue sky and the absence of rain do not mean there is not a

threat of lightning. Lightning can strike up to ten miles away from the rain.<sup>6</sup> The NCAA also warns that if an individual feels their hair stand on end or skin tingle they should immediately crouch on the ground because this could be indicative of an impending lightning strike.

Although there are many policies regarding lightning safety, many institutions still have not taken the initiative to implement a policy of their own. Walsh (1997) conducted a telephone survey with a 100% return rate at the Division I level. The survey consisted of seven questions and found a lack of lightning safety policy in the top five states for lightning injuries and deaths. Of the 48 universities that participated in the telephone survey, only 8% had a formal, written lightning safety policy. Currently, no research on lightning safety policy implementation has been conducted at the high school level. The purpose of this study is to identify the existence of lightning safety policies in the high school setting, determine who has authority to suspend and resume outdoor activities, and discover what methods are used to suspend and resume outdoor activities.

## **METHODS**

A questionnaire was developed to assess current lightning safety policies of high schools. The survey consisted of 26 questions including demographic information, current lightning safety policies, decision making for the postponement of outdoor sporting activities, and criteria for return to play of outdoor sporting activities. This instrument was initially given to three high school certified athletic trainers to examine validity. Modifications were made to the questionnaire according to their suggestions. The questionnaire was then inputted into Survey Said for the Web (version 11.0, DePere, WI), a web-based survey computer program.

The survey was sent to regular-certified and graduate student certified athletic trainers employed at a high school or work through a clinic/high school outreach program. The study was limited to the Great Lakes Athletic Trainers' Association (GLATA) District 4 region of the NATA. This study included all of the high school certified athletic trainers in the NATA email database within the states of: Michigan, Wisconsin, Minnesota, Illinois, Indiana, and Ohio. Participants were made aware that there were no risks involved, their answers will be kept confidential and anonymous, and their return email addresses will not be recorded. After two weeks, a reminder to complete the survey was sent to the subjects by the NATA Information Coordinator.

### Statistical Analysis

The surveyed question regarding lightning safety policy implementation has two levels: high schools that have implemented a lightning safety policy and high schools that have not implemented a lightning safety policy. The demographic information

surveyed includes: (1) the location (state) of high school (2) the number of outdoor sports (3) the individual who has authority to suspend activities (4) the individual who has the decision to authorize return to play (5) what methods are used to monitor weather conditions and (6) what methods are used to suspend and resume outdoor activities.

Statistical analysis was conducted with the Statistical Package for Social Sciences (SPSS, Inc. 11.2, Champaign, IL.) computer software for standard descriptive statistics.

## RESULTS

Of the 813 questionnaires that were sent to regular-certified and graduate student certified high school athletic trainers in the NATA District 4 region, and 25 were returned due to incorrect email addresses. A total of 788 electronic questionnaires were sent with a 36% (286) return rate. There were 192 (69%) high schools that reported having a current lightning safety policy. The states with the most lightning safety policies are shown in Table 1. These results show that most high schools in District 4 of the NATA report having a lightning safety policy.

### Current Lightning Safety Policy and Total Number of Outdoor Sports

Current lightning safety policy and total number of outdoor sports were compared in Table 2. It can be interpreted that as the number of sports increased so did the probability that there was a current lightning safety in place. But as the number of “yes” answers increased, so did the number of “no” answers. Table 2 shows the outcome of these answers.

### Current Lightning Safety Policy and Authority to Suspend Activity

When asked who at the institution has the authority to suspend outdoor athletic activities due to lightning, athletic directors (65%) were chosen most often when a lightning safety policy was in place at the high school. The athletic director was followed by the certified athletic trainer (54%) as the individual responsible for suspending activities. The team coach was selected third (48%). It must also be reminded that the certified athletic trainers who responded had the choice to choose all that apply to their specific situation. These results differ with what has been reported at the collegiate level

by Walsh<sup>7</sup>. At the collegiate level the athletic director is not in the picture as he or she is at the high school level. Walsh found that the certified athletic trainer in conjunction with the team coach was selected first in authority to suspend outdoor activities (37.5%). Next came just the certified athletic trainer (35%) and finally a distant third was the team coach (10%).

#### Current Lightning Safety Policy and Authority for Return to Activity

When asked who has the authority to resume activities once the threat of lightning and severe weather has passed, surveyed certified athletic trainers chose their athletic directors (61%) when there is a current lightning safety in place at the high school (Table 3). Following the athletic director was the certified athletic trainer (55%). The team coach again came in third (37%). Walsh<sup>7</sup> did not ask in their telephone survey of certified athletic trainers who had the authority at their institution to resume activity once it had been called off due to severe weather.

#### Methods Used for Monitoring Weather Conditions

The certified athletic trainers surveyed were asked what methods they use to monitor weather conditions. They had the option of choosing all that apply to this question. Options included: weather radio, lightning detector, television, internet, am/fm radio, and they could write in another response. Internet, am/fm radio, and weather radio were the top three responses chosen. See Table 4 for the frequency of all the responses.

### Method Used to Suspend and Resume Outdoor Activities

Certified athletic trainers in our study were asked if they use the flash-to-bang method to remove athletes from fields in the event of severe weather. Of the responses, 214 (76%) reported that they did use the flash-to-bang method to suspend outdoor activities.

## **DISCUSSION**

This study is the first to look at lightning safety policies in the high school setting. It was interesting to find that our results differ with what has been reported by a telephone survey conducted at the Division I level.<sup>7</sup> Our research showed that a majority of high schools who responded have a written lightning safety policy; whereas Walsh<sup>7</sup> showed a lack of written lightning safety policy and that universities relied on ‘good judgment’ to protect athletes and support staff from severe weather. This was found despite the NATA’s and NCAA’s lightning safety position statement and guidelines.

Our results showed when current policy and location were examined, over half of high schools that responded have a current lightning safety policy in place. All of these states are located in the midwestern United States, where severe thunderstorms can be a frequent occurrence. It could be interpreted that these high schools are taking a proactive approach to the safety of their athletes and to the dangers of lightning.

Of the six states that responded, Minnesota was the only one that had more schools that did not have a current lightning safety policy than those that did have a current lightning safety policy (Table 1). Minnesota also had a relatively small number of responses meaning there may not be sufficient information to make a justified conclusion. Minnesota also may not have as many certified graduate student athletic trainers or regular-certified athletic trainers registered with the NATA’s email database. A higher return rate for Minnesota would guarantee an increase in the validity of this data. When examining lightning strikes per state, Minnesota had the least amount of strikes of any state in District 4.<sup>8</sup> This could be another reason why high schools in this

state do not feel the need for a lightning safety policy. The Minnesota State High School League does have a board policy in their 2003-2004 Athletic Rules and Policies Manual concerning lightning and threatening weather. Because of this policy, Minnesota high schools may feel they do not need to create their own policy. Future research could look at all fifty states and compare state level lightning safety policies to policies actually used in high schools within that state.

Reasons for a lack of policy may be the assumed myths of lightning: (a) small metal objects attract lightning, so individuals are safer outside without any metal around, (b) wearing jewelry, metal cleats, carrying golf clubs or an umbrella will make an individual more susceptible to a strike, (c) lightning never strikes the same place twice, (d) lightning only strikes good conductors like metal, (e) lightning does not strike water, and (f) rubber shoes, boots, and tires act as insulators and therefore protect against a lightning strike.<sup>9</sup> If athletes and coaches believe these myths are true, they potentially could be putting themselves and others at risk for being struck. This is why certified athletic trainers should educate their athletes, coaches, spectators, and support staff on the dangers and prevention techniques of severe weather, including lightning.

As the number of outdoor sports increased, so did the number of high schools with implemented lightning safety policies. This may suggest that with more sports practicing and competing outside, the high schools saw the need for a lightning safety policy for the protection of their athletes. However, the schools with lower numbers of outdoor sports still need to be aware that lightning can still be a threat despite the fact that they have a small number of athletes participating outdoors.

The current study only surveyed certified athletic trainers. If there is not a safety policy in place that all individuals in authority are aware of, there may be some confusion as to who have the authority to suspend or resume play. In our study, the athletic director was the primary individual followed by the certified athletic trainer in both authority to suspend activity and authority to resume activity. Walsh<sup>7</sup> found that the certified athletic trainer (35%) was the individual responsible for suspending activities and 10% of the certified athletic trainers responded the team coach was responsible. It was also discovered that 37.5% replied that both the certified athletic trainer and team coach had authorization to suspend events. This may be the expected outcome because the athletic director has direct authority over high school sporting events, but the athletic director may not always be at events. For this reason, there should be a chain of command in place that everyone in authority, from the athletic director, certified athletic trainer, coaching staff, principal, and support staff understands. At the beginning of every season where outdoor sports occur, there should be a safety meeting to review the lightning threat. Then everyone in authority is aware of the specific chain of command.

Coaches and principals were also answers that could be selected in our research on authority to suspend and resume activities, but they were not chosen with frequency. Principals have many responsibilities within the high school, therefore they may not be at all sporting events and may not be a wise choice to have the authority to suspend play and resume play. Giving coaches this authority may prove to be a conflict of interest. They are also distracted and often not paying attention to the weather as closely as possible. Frequently, coaches may want to complete events before severe weather is

imminent. The results of Walsh et al (1997) showed that certified athletic trainers who listed their coaches as the individuals with the power to suspend activities had mixed feelings about this arrangement. Half said their coaches were conservative and would not hesitate to cancel practice, with the remaining coaches reluctant to suspend practice and would therefore place their staff and athletes in harm by remaining outside.

An individual in power without bias should have the authority to suspend and resume activity. However, the College of William and Mary's lightning safety policy rests the safety of their athletes on the coach. Everyone in authority at the high school level should have the knowledge of the chain of command before the sport season begins, even if they do not have the authority to suspend, and should also be involved in the process of creating this chain of command.

Additional research on lightning safety should not only look at high schools with a lightning safety policy, but at those that do not and why they do not. Do they feel lightning is not a threat in their area? Do they follow their respective state high school athletic association lightning safety policy? The answers to these questions may make these high schools that do not have a lightning safety policy realize they should take the initiative to create one of their own.

In conclusion, the results of our survey showed that 69% of high schools had a lightning policy in place. We also discovered that as the number of outdoor sports increased, so did the likelihood that there was a lightning safety policy. It was also shown that in schools with a lightning safety policy that athletic directors, followed by certified

athletic trainers, had the authority to suspend activities when severe weather was in the immediate area and then resume outdoor activities when the threat was gone.

Hopefully with the information gathered by this research, high schools without a formal, written lightning safety policy will take the initiative to create one of their own and tailor it to meet their needs. The threat of lightning should be taken seriously and should not be overlooked. Education and prevention are the key to the safety of spectators, support staff, coaches, and athletes.

## APPENDICES

Appendix A

Human Subjects Institutional Review Board Acceptance Letter



Date: October 27, 2003

To: Michael Miller, Principal Investigator  
Katie Groszek, Student Investigator for thesis

From: Mary Lagerwey, Chair

A handwritten signature in cursive script that reads "Mary Lagerwey".

Re: Approval not needed for Project 03-10-21

This letter will serve as confirmation that your project "A Survey of Lightning Safety Policy in Selected High Schools" has been reviewed by the Human Subjects Institutional Review Board (HSIRB). Based on that review, the HSIRB has determined that approval is not required for you to conduct this project because the data being collected is about institutions, not individuals. Thank you for your concerns about protecting the rights and welfare of human subjects.

A copy of your protocol and a copy of this letter will be maintained in the HSIRB files.

Appendix B  
Email Broadcast

Dear Colleague,

You are invited to participate in a research project entitled “A Survey of Lightning Safety Policy of Selected High Schools.” This study is designed to identify whether high schools contained in GLATA have implemented lightning safety policies and procedures for outdoor sporting events. This research is being conducted by Katie Groszek, ATC, (student investigator) and Michael G. Miller, EdD, (principle investigator) from Western Michigan University, Department of Health, Physical Education, and Recreation. It is being conducted as part of the master’s degree thesis requirements for Katie Groszek, ATC.

This survey consists of multiple-choice questions pertaining to lightning policies and procedures as well as demographic questions. Around 1000 selected high school athletic trainers in District 4 (GLATA) with a listed email address are being asked to submit this questionnaire. The total time commitment will be approximately 10 minutes. There are no foreseen risks in participating in this study. If you choose to participate, please click on the link at the end of this document. If you decide not to participate, simply disregard this message. If you choose to participate, you may stop participating at any time or refuse to answer any question without prejudice or penalty. Your answers to the questions are strictly confidential and anonymous and your return email address will not be recorded. You may choose to not answer any question by simply leaving it blank.

If you have any questions, you may contact Katie Groszek (269-353-9967) or Dr. Michael G. Miller (269-387-2728).

As a fellow athletic trainer, your knowledge and opinions regarding this topic makes your input invaluable. Please take a few minutes to fill out this anonymous questionnaire you will find by clicking on this link:

<http://homepages.wmich.edu/~mmiller/katie.htm>

Thank you for your time and consideration.

Sincerely,

Katie Groszek, ATC  
Graduate Student  
Health, Physical Education, and Recreation Department  
Western Michigan University  
kgroszek@hotmail.com

Appendix C  
Questionnaire

## High School Lightning Safety Questionnaire

### **Demographics**

1. In which state is your high school located?
  - a. Michigan
  - b. Ohio
  - c. Illinois
  - d. Indiana
  - e. Wisconsin
  - f. Minnesota
2. Is your high school public or private?
  - a. public
  - b. private
3. What is the approximate number of students at your high school?
4. What is the total number of outdoor sports (ex. Soccer, baseball, football; freshmen, junior varsity, varsity; men's and women's) at your high school?
  - a. 1-6
  - b. 7-13
  - c. 14-20
  - d. >20
5. What is the approximate number of athletes participating in outdoor sports? (Count athlete twice if they participate in more than one outdoor sport).

### **Lightning Safety Policy**

6. Do you currently have a policy regarding lightning safety?
  - a. Yes
  - b. No- go to question #11
7. If "yes" to Question #6, is it in writing?
  - a. Yes
  - b. No
8. If "yes" to Question #6, how long has this plan been in place?
  - a. < six months
  - b. one year
  - c. one to five years
  - d. > five years
9. If "yes" to Question #6, how often is it revised?
  - a. Every season
  - b. Every year
  - c. Every other year
  - d. Never

10. If “yes” to Question #6, who carries out this policy? (Select all that apply).
- Athletic Trainer
  - Athletic Director
  - Coach
  - Principal
  - Other, please specify: \_\_\_\_\_
11. Is there an evacuation plan for each venue?
- Yes
  - No
12. What methods are used for monitoring the weather? (Select all that apply).
- weather radio
  - commercial lightning detector
  - TV
  - Internet
  - AM/FM radio
  - Other, please specify: \_\_\_\_\_
13. Who is considered a weather watcher? (Select all that apply).
- Athletic Trainer
  - Athletic Director
  - Coach
  - Student Athletic Trainer
  - Student Manager
  - Other, please specify: \_\_\_\_\_
14. Do you obtain a weather report each day before outdoor activities take place?
- Yes
  - No
15. Do you feel lightning is taken seriously by coaches at your high school?
- Yes, all take it seriously
  - No, none take it seriously
  - Some take it seriously

## Decision Making

16. Who has the authority to suspend/postpone outdoor activities? (Select all that apply)
- Athletic Trainer
  - Athletic Director
  - Coach
  - Principal
  - Other, please specify: \_\_\_\_\_
17. Are all athletic fields cleared during a weather threat?
- Yes
  - No
  - It is a judgment call by each team

18. What methods of communication are used for clearing an athletic field? (Select all that apply)
  - a. Walkie Talkies
  - b. Cell phones
  - c. Horns
  - d. Whistles
  - e. Personal communication
  - f. None, it is a judgment call for each team
19. Approximately how often have practices been cancelled due to severe weather during the past school year?
20. Approximately how often have scheduled events been cancelled due to severe weather during the past school year?
21. Approximately how often have practices/events continued even though there was a threat of severe weather (ex. during a severe weather watch) during the past school year?

### **Criteria for Return to Play**

22. Do you follow the flash-to-bang (30-30) rule to determine when to cancel and resume practices/games? (Canceling practice when there is less than 30 seconds between lightning flash and thunder; resuming practice 30 minutes after the last sound of thunder or flash of lightning)
  - a. Yes
  - b. No
23. If “No” to Question #24, what method do you use?  
Please specify: \_\_\_\_\_
24. Who has the authority to make the decision to return to play after severe weather threat is gone? (Select all that apply)
  - a. Coach
  - b. Athletic Trainer
  - c. Athletic Director
  - d. Principal
  - e. Other, please specify: \_\_\_\_\_

## Appendix D

### Tables

Table 1 Location of High Schools and Lightning Safety Policy

State	Policy		Total
	Yes (69%)	No(31%)	
Illinois	55	15	69
Ohio	50	19	70
Michigan	42	11	53
Indiana	24	11	35
Minnesota	8	21	29
Wisconsin	13	10	23
Totals	192	87	279

Table 2 Total Number of Outdoor Sports and Lightning Safety Policy

Total # of Outdoor Sports	Policy		Total
	Yes(68%)	No(31%)	
1-6	9	2	11
7-13	42	33	75
14-20	63	28	91
> 20	77	24	101
Total	191	87	278

**Table 3 Relationship of Lightning Safety Policy and Authority for Return to Play**

		<b>Athletic Director</b>		
		Yes	No	Total
Current Policy	Yes	170	22	192
	No	64	23	87
		<b>Athletic Trainer</b>		
		Yes	No	Total
Current Policy	Yes	153	39	192
	No	40	47	87

(n = 279)

Table 4 Methods Used for Monitoring Weather Conditions

(n = 286)

Method	Frequency
Internet	209 (73%)
AM/FM Radio	153 (54%)
Weather Radio	132 (46%)
Lightning Detector	106 (37%)
Television	102 (36%)
Other	41 (14%)

\* Respondents had the option to choose all that apply which is why the numbers do not correspond

## REFERENCES

1. Zimmermann C, Cooper MA, & Holle RL. Lightning safety guidelines. *Ann Emer Med.* 2002;39:660-664.
2. Walsh KM, Bennett B, Cooper MA, Holle RL, Kithil, R, & Lopez RE. National athletic trainers' association position statement: lightning safety for athletics and recreation. *J of A T.* 2000;35:471-477.
3. Cwinn AA & Cantrill SV. Lightning injuries. *J of Emer Med.* 1985;2:379-388.
4. Lifschultz BD & Donoghue ER. Deaths caused by lightning. *J For Sci.* 1993; 38;353-358.
5. Bennett BL. A model lightning safety policy for athletics. *J of A T.* 1997;32:251-253.
6. Michael V. Lightning safety: NCAA Guidelines. *NCCA Sports Medicine Handbook.* 1998-99;Kansas: The National Collegiate Athletic Association.
7. Walsh KM, Hanley MJ, Graner SJ, Beam D, & Bazluki J. A survey of lightning policy in selected division I colleges. *J of A T.* 1997;32:206-210.
8. U.S. National Lightning Detection Network. 2002. 5-year Flash Density Map 1996-2000.
9. West Virginia's Severe Weather Center; 2004. *Lightning myths.* Retrieved October 3, 2003.
10. Fahmy FS, Brinsden MB, Smith J, & Frame JD. Lightning: The multisystem group injuries. *J of Tra.* 1999;46:937-940.
11. Holle RL & Lopez RE. Updated recommendations for lightning safety-1998. *Bulletin of the American Meteorological Society.* 1999;80:2035-2041.
12. Cherington M. Lightning injuries in sports: Situations to avoid. *Sports Medicine.* 2001;31:301-308.
13. Curran, Holle, & Lopez, 1997. Lightning fatalities, injuries, and damage reports in the United states, 1959-1994, NOAA Tech. Memo. No. NWS SR-193, October 1997.