School-Associated Child Deaths in Kansas

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Abstract

Background. The purpose of this investigation was to review each school-associated child death in Kansas. No statewide studies of school-associated child death, regardless of cause, were found in the literature. This report details all-cause school-associated mortality in Kansas children during a 13-year period.

Methods: Files for all school-associated child deaths (ages birth through 17) were compiled for the calendar years 1994 through 2006. Data files were provided by the Kansas State Child Death Review Board. Annual census data from the Kansas State Department of Education were obtained to determine annual student death rates. Data extracted from each file included: gender, race, year of death, age at death, manner of death, cause of death, whether an autopsy was performed, and whether the death was preventable.

Results: A total of 26 school-associated deaths occurred in Kansas children over the study period. The school-associated death rate averaged 0.402 per 100,000 students per year. The median number of student deaths per academic school year was two. Thirty-one percent of all school-associated deaths were sudden cardiac deaths. Sixty-five percent of all deaths occurred during or shortly after participating in a physical activity or in sports.

Conclusions: School-associated child deaths are rare events. However, the majority of deaths were preventable through better parental or school supervision, better communication with the school about student health issues, and safety education, especially related to sports activities and transportation. *KJM 2009; 2(3):52-61.*

Introduction

Most Americans learn of child deaths at school from media reports. Violent deaths that occur at schools, such as Columbine High School in Colorado or the Amish school in Pennsylvania, particularly receive extensive media coverage. Yet, these are rare events.[1,2] The annual incidence of violent death at school in the US is .068 per 100,000 students.[1] Few studies have analyzed school-associated child deaths systematically in a defined population. This approach is necessary to put public concern about school-associated deaths into perspective and to develop prevention strategies.

Approximately 20% of the combined US adult and child population are in schools on any given day.[3] The causes of school-associated child deaths are varied. Many are sports or activity related. For example, sudden and unexpected deaths of adolescents in Allegheny County, Pennsylvania between 1972 and 1980 were identified from state death certificates.[4] Only 11.3% occurred in the school environment. Half were exertion-related, most during school sports. All exertion-related deaths were male; all non-exertion deaths were female. Most deaths occurring in the school setting were caused by disorders with nonspecific

or absent premonitory symptoms and their preventability was uncertain. The primary identifiable causes were cardiovascular and spontaneous intracranial hemorrhage.

Similarly, approximately 60-80 cases of childhood sudden death occur under school supervision every year in Japan.[5] About 71% was sudden cardiac death. The incidence of sudden death among Japanese school children increased with age. Cardiac sudden death often was related to physical exercise. Boys were more prone to sudden death than girls.

Most sudden deaths in young competitive athletes are due to structural cardiovascular abnormalities with hypertrophic cardiomyopathy being the most common.[6-9] The majority of sudden deaths were associated with four sports: football, basketball, track, and soccer.[7] The highest number of deaths occurred in football.[8] Because of the improvement in protective gear and rule changes, the main concern in football deaths in recent years was the increase in heatstroke and heart-related sudden death.[9]

National evaluation of non-traumatic sports deaths in high school athletes participating in 17 sports found 126 deaths in a 10-year period (1983-1993).[8] Death rates were more than five times greater in male than female athletes. Deaths occurred in many sports including football, track, wrestling, baseball, soccer, cross country, swimming, and tennis. Most deaths were due to cardiovascular abnormalities. Of the non-cardiac causes of death, exertional hyperthermia was the most common. The majority of deaths was preventable. A complete medical history should identify approximately 75% of problems that will affect initial athletic participation.[7]

All Minnesota high school records for 12 years (1985-1997) were reviewed in a study of sudden cardiac death.[10] Three cardiovascular deaths occurred. Each death occurred suddenly during exertion; two in cross-country or track and one in basketball. None had a history of cardiac symptoms. Further screening would have had little impact on the outcome. All had the standard pre-participation history and physical examination. No other deaths occurred related to trauma or other sports-related causes. The prevalence of sudden cardiac death for high school athletes in Minnesota was calculated at 1:200,000.

National asthma deaths were investigated over 14 years (1990-2003) including those that occurred at school, enroute to or from school, or enroute to or attending a school-sponsored event.[11] Thirty-eight asthma deaths were documented with an upward trend over time. Physical activity preceded the episode in over 40% of the deaths. Most occurred during school-sponsored sporting events. About one-third of the cases reported delays in the students receiving emergency asthma medication at the time of the fatal attack.

A Japanese study reported on 76 victims of school-associated sudden death in whom obvious causative diseases were not detected prior to death.[12] Deaths were associated with vigorous activities, particularly running, and influenced by meteorological conditions. For example, dryness and high pressure in spring were related to deaths in children running. Dry and cloudy weather was related to deaths in children participating in competitive sports.

Over an eight-year period (1987-1995), 22 school-associated child deaths related to school buses were reported in Australia.[13] Over three-fourths of the deaths resulted from children being hit crossing the road after leaving the bus. Further, four school-associated fatalities related to hanging from cloth towel dispensers were reported in Canada.[14] These incidents were likely the result of thrill seeking or risk taking behavior during a “choking/blackout game”.

The purpose of this investigation was to review each school-associated child death in Kansas using the State Child Death Review Board's (SCDRB) database. The SCDRB was created in 1992 as a multi-disciplinary, multi-agency panel to review child deaths in Kansas.[15] The SCDRB has the statutory obligation to review the death of every child who was a Kansas resident or died in the State of Kansas.

No statewide studies of school-associated child death, regardless of cause, were found in the literature. This report details all-cause school-associated mortality in Kansas children during a 13-year period including 12 academic years (fall semester of each year through the following summer).

Methods

This study is a descriptive, retrospective database review and reports a case series of school-associated child deaths. Files for all school-associated child deaths (ages birth through 17) were compiled for the calendar years 1994 through 2006. Data files were provided by the Kansas State Child Death Review Board. The age range represented children's ages under the SCDRB's authority for review. The time frame represented all years with completed data.

Cases were identified through two queries of the database. The first query documented all deaths where the event location was identified as "school". The second search queried all text fields for the word "school" to identify school-associated deaths that did not occur on school grounds. The results of the second query were reviewed individually by one investigator to determine inclusion/exclusion criteria. Events that were questionable (e.g., deaths of children going to or from school) were resolved by consensus of the authors.

A school-associated death was defined as a fatal incident or an incident leading to fatality that occurred on school grounds or during a school activity. Any event that occurred on school grounds regardless whether school was in session was included. Events that occurred at any school-sponsored activity were captured, including deaths in children riding on, going to, or waiting for a school bus. However, deaths of children going to school or returning home after school in a private vehicle were excluded by this definition.

Data extracted from each file included: gender, race, year of death, age at death, manner of death, cause of death, whether an autopsy was performed, and whether the death was preventable. If the "preventable" field was not completed by the State Child Death Review Board, the authors made the determination by consensus (Dr. Johnston and Dr. Melhorn are members of the SCDRB).

Annual census data from the Kansas Department of Education (DOE) were obtained to determine annual student death rates. The total census from all schools within the state was used to represent the total number of students in Kansas. This census included kindergarten through twelfth grade and all special programs. The DOE data were not broken down by age, therefore, some students were included in the census that were 18 years of age or older. Since most students in Kansas typically begin their senior year of high school at age 17, these data were considered as an acceptable census denominator for study purposes.

The academic school years 1993-1994 and 2006-2007 were excluded from this analysis, because complete SCDRB data were not available. Thus, academic school years from 1994-1995 through 2005-2006 were analyzed. For the purposes of this study, the school year began in August and continued through July. No other statistical analyses were calculated for this descriptive study.

Results

A total of 26 school-associated deaths occurred in Kansas children over the study period. Table 1 details the characteristics of the deaths. Table 2 provides a brief description of each death. Twenty-five of the deaths were students ranging in age from 5 to 17 (median age was 13). One death was an infant visitor to a school who died in an unusual accident where glass from a large picture frame fell on his head. Sixty-five percent (n=17) of the children was Caucasian, twenty-seven percent (n=7) was African-American, and eight percent (n=2) was Hispanic. Eighty-one percent (21 of 26) of the deaths were males. Thirty-one percent of all school-associated deaths (8 of 26) were sudden cardiac deaths attributable to hypertrophic cardiomyopathy (2), congenital heart disease (2), hypertrophic subaortic stenosis (1), coarctation of aorta (1), coronary artery aneurysm (1), or cardiac arrhythmia (1). Sixty-five percent (17 of 26) of the deaths occurred during or shortly after participating in a physical activity or in sports.

Table 1. Characteristics of school-associated deaths in Kansas.

Cause of Death	Number of School-Associated Deaths	Number (%) of Male Victims	Number (%) Related to Sports or Physical Activity	Number (%) Autopsy Completed
Sudden Cardiac Death	**8**	**5 (63)**	**8 (100)**	**6 (75)**
[With known congenital heart disease]	**2**	**1 (50)**	**2 (100)**	**1 (50)**
Head or Neck Trauma	**5**	**5 (100)**	**4 (80)**	**4 (80)**
Asthma	**2**	**2 (100)**	**2 (100)**	**0 (0)**
Homicide	**2**	**1 (50)**	**0 (0)**	**2 (100)**
Hyperthermia	**2**	**2 (100)**	**2 (100)**	**1 (50)**
Motor Vehicle Crash	**2**	**2 (100)**	**0 (0)**	**1 (50)**
Animal Attack	**1**	**1 (100)**	**0 (0)**	**0 (0)**
Asphyxia	**1**	**1 (100)**	**0 (0)**	**1 (100)**
Brain Tumor	**1**	**1 (100)**	**1 (100)**	**0 (0)**
Seizure Disorder	**1**	**0 (0)**	**0 (0)**	**1 (100)**
Train Accident	**1**	**1 (100)**	**0 (0)**	**0 (0)**

The school-associated student death rate was calculated at an average of 0.402 per 100,000 students per year (24 deaths over 12 academic school years; see Table 3). One student death that occurred during the academic school year 1993-1994 was excluded because data were collected by calendar year beginning in 1994. Thus, information from the 1993-1994 academic year was not complete. This calculation also excluded the infant (non-student) death.

Student deaths occurred during 11 of the 12 academic years. The annual school-associated student death rate for those years ranged from 0 to 1.2 per 100,000 students. The median number of student deaths per academic school year was two.

Twenty-one deaths over the thirteen years were reviewed, but excluded from analysis. Sixteen of the deaths occurred during a motor vehicle crash in a private vehicle before or after school. Two children

Table 2. Brief descriptions of school-associated child deaths in Kansas.

Cause of Death	Demographics	Description	Preventable
Animal attack	11 year old African-American male	Mauled by 3 dogs while waiting for school bus.	√
Asphyxia	15 year old African-American male	Aspirated on candy while in classroom.	√
Asthma	15 year old White male	Collapsed while playing basketball.	√
Asthma	14 year old White male	Collapsed after running two-mile race. Used inhaler during race.	√
Brain Tumor	9 year old White male	Became unresponsive playing on school swings	
Cardiac arrhythmia	13 year old White female	Collapsed while playing at summer basketball camp.	
Congenital coarctation of aorta	12 year old White male	Collapsed during basketball practice.	√
Congenital heart disease	11 year old White female	Collapsed after running race.	
Coronary artery aneurysm	6 year old White male	Collapsed while running on playground.	
Head trauma	17 year old White male	Injured during football game.	
Head trauma	7 month old White male	Struck by falling glass from large picture frame.	
Head trauma	15 year old White male	Struck head on floor while lifting weights.	√
Head trauma	17 year old African-American male	Struck head on ground while pole vaulting.	√
Homicide	15 year old Hispanic male	Shot during drive-by shooting in school parking lot on the weekend.	√
Homicide	14 year old African-American female	Stabbed during altercation on school grounds.	√
Hyperthermia	17 year old African-American male	Collapsed during football practice.	√
Hyperthermia	15 year old White male	Collapsed during football practice.	√
Hypertrophic cardiomyopathy	13 year old White male	Collapsed while running on track.	

Table 2. (continued)

Hypertrophic cardiomyopathy	**14 year old Hispanic male**	**Collapsed while running.**	
Hypertrophic cardiomyopathy	**12 year old White female**	**Collapsed while running.**	
Hypertrophic subaortic stenosis	**9 year old White male**	**Collapsed while playing kickball.**	
Motor vehicle crash	**5 year old African-American male**	**Struck by car while crossing street to board school bus.**	√
Motor vehicle crash	**6 year old African-American male**	**Died when school bus was struck by a semi-trailer truck.**	√
Neck Trauma	**12 year old White male**	**Ran into wooden sign while playing football.**	√
Seizure disorder	**11 year old White female**	**Complained of dizziness and passed out in school hallway.**	√
Train accident	**15 year old White male**	**Unsupervised on railroad tracks during field trip and struck by train. Child was deaf.**	√

Table 3. Annual school-associated student death rates per 100,000 students.

School Year	# of School Deaths	State School Population	School Deaths / 100,000 Students
1994-1995	0	490,966	0.000
1995-1996	2	493,552	0.405
1996-1997	3	496,863	0.604
1997-1998	2	499,674	0.400
1998-1999	6	500,462	1.200
1999-2000	1	501,064	0.199
2000-2001	2	501,064	0.399
2001-2002	1	500,562	0.200
2002-2003	2	499,458	0.400
2003-2004	3	499,189	0.601
2004-2005	1	497,514	0.201
2005-2006	1	478,029	0.209

were killed in accidents while riding their bicycles to or from school. One child was run over by a car while crossing a highway on the way to school. None of these events occurred on school grounds. One child was shot in a bank parking lot after school hours. This incident began with an argument at school that was managed by school personnel. Later, the event escalated into a homicide off school grounds. One child became ill at school, went home, then later transferred to the hospital and died.

Although each death had some association with "school", none was determined to meet the criteria for a school-associated death.

Discussion

School-associated child deaths are rare events in Kansas. While any child death is tragic, the actual number of school deaths is small. During the 13 years reviewed, two school-associated deaths occurred on average each year in a population of approximately 500,000 students statewide. In comparison, approximately 500 child deaths are reviewed each year by the SCDRB.[15] Further, child deaths at Kansas schools are much less than adult fatal injuries in the Kansas workplace. Kansas has a 13-year average of 56.2 workplace fatalities annually.[16]

As in previous studies, sudden cardiac death was notable in our study. All of these deaths were exertion-related. All children of middle or high school ages had pre-participation sports physicals. Although two children had previous surgery for congenital heart disease, the majority of these heart conditions was unknown before the event and judged not preventable by the SCDRB. In one case where a congenital heart problem was known, reasonable precautions had been taken. However, when cardiac disease is known, precautions must be taken before the child engages in physical activity. Shared responsibility by the parents, school personnel, and physicians is recommended to prevent such tragedies.

In our study, two exertion-related deaths were due to asthma. Both events were witnessed and each received appropriate resuscitation attempts. Yet, appropriate monitoring of asthma in children and treatment of exacerbations make such deaths preventable. Again, shared responsibility is the key to prevention.

A consensus statement by 17 organizations, including the American Academy of Pediatrics and the American Academy of Family Physicians, made specific recommendations for the appropriate medical care of secondary school-age athletes.[17] These recommend-ations included more than emergency care and event coverage. They included ongoing daily athletic health care and appropriate education and professional development for providers. This type of national recognition has aided in the reduction of sports-related deaths in recent years. Improvements have been made in protective gear and rule changes. Also, improved medical care at sporting events with a team physician and/or emergency personnel attending events is common practice in Kansas. These precautions should decrease sports-related deaths over time. Further precautions are likely as research in sports medicine provides better information and new protective gear is developed.

No school-associated homicides have occurred in Kansas since 1995. Contrary to public perception, violent crime and homicides in schools has declined dramatically since 1994.[18] Youth were over 50 times more likely to be murdered and were over 150 times more likely to commit suicide when they were away from school than at school.[19]

The Kansas data revealed a number of motor vehicle deaths involving students going to and from school. Over the study period, 19 motor vehicle-related deaths involved children driving a car, riding as a passenger in a car, riding a bike, or walking across a highway. Although these deaths were determined not to be school associated by definition, the total number approximates school deaths. Students should be educated about safety issues going to and returning from school. Adolescent automobile acci-dents occur more frequently on school days, particularly right before and after school.[20] The cluster of adolescents in one place at

one time, often in a rush, enhances the need for safety.

Interestingly, the vast majority of deaths, other than sudden cardiac deaths, was preventable. These cases included those with previous medical management (asthma and seizure disorder), easily provided prevention techniques (hyperthermia), lack of adequate adult supervision (animal attack, asphyxia, and train accident), and inadequate driving safety practices (motor vehicle crashes). No simple resolution exists for all child deaths. Some events require better parental supervision; some require better school supervision. Further, some require better community awareness. Shared responsibility to protect children is recommended.

A few general recommendations for prevention are suggested:

1. Parents should notify school personnel about chronic medical problems, especially those that require medication or restrict activities. Proper authorization should be given to administer medications as appropriate and supervise physical activities.
2. School personnel should be prepared for medical emergencies. Such preparation includes awareness of children that require medication and restriction of activities. Medication must be available in times of emergency and a plan should be in place to obtain and provide it.
3. Physicians should advise parents, repeatedly if necessary, about their children's health care needs and how they impact their daily lives. Children spend a considerable portion of their wakeful moments in school away from their parents. Therefore, physicians can assist parents to understand how best to protect their children.
4. Organized school activities require adequate adult supervision. If school personnel cannot provide the necessary supervision, assistance from parents or adult volunteers is required. Prevention requires awareness of potential problems before they occur (e.g., spotters for weight lifting or frequent water breaks).
5. Community education should focus on how to protect children, especially immediately before and after school. This education should not be restricted to speed limits in school zones, but a general awareness of children walking, riding bicycles, or driving during these hours. "Safe Routes to School" is a beneficial federal program designed for communities to increase a child's ability to walk and bicycle safely to school.[21]
6. Students should be educated, repeatedly, about safety techniques, particularly for physical activities and sports. Adult supervision for practices is important. Appropriate protective gear always should be provided and used.

This study has one primary limitation. Although it is a population-based study over several years, data were limited to only one state. Kansas is a largely rural state with two major population centers. Data from larger, more urban states may be different.

In summary, the actual number of school-associated deaths in Kansas is small. Yet, the potential exists for a reduction. Shared responsibility for the safety of children between parents, schools, and community is necessary. Often simple solutions, such as adequate supervision or enhanced diligence, can prevent a tragedy.

References

[1] Anderson M, Kaufman J, Simon TR, et al. School-associated violent deaths in the United States, 1994-1999. JAMA 2001; 286:2695-2702.

[2] Centers for Disease Control and Prevention. School-associated student homicides-United States, 1992-2006. MMWR 2008; 57:33-36.

[3] Hazinski MF, Markenson D, Neish S, et al. Response to cardiac arrest and selected life-threatening medical emergencies: The Medical Emergency Response Plan for Schools. A statement for healthcare providers, policymakers, school administrators, and community leaders. Ann Emerg Med 2004; 24:83-99.

[4] Neuspiel DR, Kuller LH. Sudden nontraumatic death in adolescence: Deaths at school. J Adolesc Health Care 1987; 8:208-210.

[5] Ito S, Haradra K. Sudden cardiac death of school-age children. Nippon Rinsho 2005; 63:1261-71.

[6] Cantu RC. Congenital cardiovascular disease: The major cause of athletic death in high school and college. Med Sci Sports Exerc 1992; 24:279-280.

[7] Carek PJ, Mainous AG III. A thorough yet efficient exam identifies most problems in school athletes. J Fam Pract 2003; 52:127-134.

[8] Van Camp SP, Bloor CM, Mueller FO, Cantu, RC, Olson HG. Nontraumatic sports death in high school and college athletes. Med Sci Sports Exerc 1995; 27:641-647.

[9] Mueller FO. Catastrophic sports injuries: Who is at risk? Curr Sports Med Rep 2003; 2:57-58.

[10] Maron BJ, Gohman TE, Aeppli D. Prevalence of sudden cardiac death during competitive sports activities in Minnesota high school athletes. J Am Coll Cardiol 1998; 32:1881-1884.

[11] Greiling AK, Boss LP, Wheeler LS. A preliminary investigation of asthma mortality in schools. J Sch Health 2005; 75:286-290.

[12] Takada K, Nagashima M, Takada H, Sugita S, Harrell JS. Sudden death in school children: Role of physical activities and meteorological conditions. Pediatr Int 1999; 41:151-156.

[13] Cass DT, Ross F, Lam L. School bus related deaths and injuries in New South Wales. Med J Aust 1996; 165:134-137.

[14] Le D, Macnab AJ. Self strangulation by hanging from cloth towel dispensers in Canadian schools. Inj Prev 2001; 7:231-233.

[15] Kansas Child Death Review Board. Kansas Cares about Kids: 2007 Annual Report. http://www.ksag.org/files/shared/SCDRB.2007.AR.pdf. Accessed: July 10, 2008.

[16] Kansas Department of Labor. 2008 Workplace Safety Report: Keeping workers safe on the job. http://www.dol.ks.gov/WC/html/workplacesafe_2008.pdf. Accessed: July 10, 2008.

[17] National Athletic Trainers' Association. Appropriate medical care for secondary school-age athletes. Consensus statement. http://www.nata.org/statements/consensus/Consensus%20Statement_Final%20Version_Sept02.pdf. Accessed: November 26, 2008.

[18] Virginia Youth Violence Project, School of Education, University of Virginia. Violence in Schools. http://youthviolence.edschool.virginia.edu/violence-in-schools/national-statistics.html. Accessed: July 10, 2008.

[19] National Center for Education Statistics, U.S. Department of Education. Indicators of School Crime and Safety: 2007. http://nces.ed.gov/programs/crimeindicators/crimeindicators2007/ind_01.asp. Accessed: July 10, 2008.

[20] Alexander EA, Kallail KJ, Burdsal JP, Ege, DL. Multifactorial causes of adolescent driver accidents: Investigation of time as a major variable. J Adolesc Health Care 1990; 11:413-417.

[21] National Center for Safe Routes to School. Safe Routes. http://www.saferoutesinfo.org. Accessed: November 30, 2008.

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