NAME MacKay, Jack Whiting, Jr. FILE NO. 3238

| Course Sym. | Course No. | TITLE | Hrs. per Wk. Rec. | Hrs. per Wk. Lab | Hrs. Attempted | Hours Passed | Grade | Q. P. |
|---|---|---|---|---|---|---|---|---|
| Record transferred from Howard College, Birmingham, Alabama | | | | | | | | |
| 1959-60 1S | | | | | | | | |
| Eh | 101 | Freshman English | | | | 3 | C | |
| Ch | 111 | General Inorganic Chemistry | | | | 5 | D | |
| PE | 101 M | Touch Football | | | | 1 | C | |
| Hi | 101 | Western Civilization | | | | 3 | B | |
| Ma | 101 | College Algebra | | | | - | F | |
| 2S | | | | | | | | |
| Ch | 112 | General Inorganic Chemistry | | | | - | F | |
| Eh | 102 | Freshman English | | | | - | F | |
| PE | 102 M | Softball for Men | | | | 1 | B | |
| Hi | 102 | Western Civilization | | | | 3 | C | |
| Ma | 101 | College Algebra | | | | 3 | C | |
| | | ACADEMIC PROBATION | | | | 19 | | 18 |
| | | | | | | | | - 1 |
| Record transferred from Auburn University, Birmingham, Alabama | | | | | | | | |
| Summer 1960 | | | | | | | | |
| Eh | 101 | English Composition | | | | 5 | D | |
| Zy | 101 | General Zoology | | | | - | F | |
| Mh | 102 | Trigonometry | | | | - | F | |
| Fall Qtr 1960 | | | | | | | | |
| Zy | 101 | General Zoology | | | | 5 | D | |
| PE | 132 | Tennis | | | | 1 | B | |
| Mh | 102 | Trigonometry | | | | - | F | |
| Eh | 102 | English Composition | | | | - | F | |
| | June 2, 1961 - Suspended - Failure to meet | | | | | 11 Qtr Hrs | | |
| | Continuation in Residence Requirements | | | | | 7 1/3 Sem Hrs | | |
| | | | | | 14 | 7 | | 1 |
| | | | | | | | | -13 |
| Record transferred from Itawamba Junior College, Fulton, Mississippi | | | | | | | | |
| 1961 2S | | | | | | | | |
| Math | 123 | Plane Trigonometry | | | | 3 | D | |
| Eng | 123 | Grammar & Composition | | | | 3 | D | |
| Biol | 124 | Vertebrate Zoology | | | | WD | | |
| Ec | 123 | Prin of Economics | | | | 3 | C | |
| Ec | 113 | Prin of Economics | | | | 3 | C | |
| 1961-62 1S | | | | | | | | |
| Bio | 213 | Gen Botany | | | | - | F | |
| Agri | 213 | General Horticulture | | | | 3 | C | |
| Agri | 233 | Feeds & Feeding | | | | 3 | C | |
| Agri | 253 | Farm Machinery | | | | 3 | B | |
| Acct | 113 | Prin of Accounting | | | | - | F | |
| 2S | | | | | | | | |
| Agri | 143 | Dairying | | | | 3 | B | |
| Agri | 263 | Poultry Production | | | | 3 | B | |
| Agri | 283 | Animal Husbandry | | | | 3 | B | |
| Soc | 143 | The Family | | | | 3 | A | |
| | | | | | 39 | 33 | | 45 |
| | | Admitted on probation | | | | | | |
| | | School - Agriculture | | | | | | |
| | 3238 | FALL 1962 | | | | | | |
| AH | 533 | BRDS & TYPES | 1 | 4 | 3 | 3 | D | |
| PS | 113 | AM GOVT | 3 | | 3 | 3 | D | 3 |
| AH | 651 | SEMINAR | 1 | | 1 | 1 | A | 3 |
| GB | 423 | BUS LAW I | 3 | | 3 | 3 | C | 4 |
| CH | 114 | GEN CHEM | 3 | 3 | 4 | 4 | C | 6 |
| AG | 203 | FARM CROPS | 2 | 2 | 3 | 3 | B | 6 |
| | | | | | 17 | 17 | | 16 |
| | | | | | 17 | 17 | | 16 |
| | | Passed English Proficiency Examination | | | | | | |
| | 3238 | SPRING 1963 | | | | | | |
| VS | 323 | DISEASES FARM | 2 | 2 | 3 | 3 | B | 6 |
| AE | 513 | AG SURV & DRAI | 2 | 3 | 3 | 3 | C | 3 |
| CH | 214 | GEN CHEM | 3 | 3 | 4 | | F | |
| AH | 543 | FARM MEATS | 1 | 4 | 3 | 3 | D | |
| PO | 513 | GENETICS I | 2 | 2 | 3 | 3 | B | 6 |
| | | | | | 16 | 12 | | 15 |
| | | | | | 33 | 29 | C | 31 |

ENTERED September 11, 1962 FROM Itawamba Junior College, Fulton, Mississippi

HIGH SCHOOL Sewanee Military Academy, Sewanee, Tennessee

CHURCH Presbyterian

BIRTH DATE-PLACE December 16, 1940 - Jefferson Co., Alabama

PARENT or GUARDIAN Jack Whiting MacKay, Birmingham, Alabama

DEGREE CONFERRED

DATE

DEAN

MISSISSIPPI STATE UNIVERSITY
State College, Mississippi
Not an official transcript without the University seal

ACT Test Date
STANDARD SCORES:
Eng ___ ; Math ___
S.S. ___ ; Sci. ___
Comp ___ ; Sum ___

ENTRANCE UNITS

| | | |
|---|---|---|
| ENGLISH | 4 | Spanish |
| HISTORY | 3 | Trig |
| BIOLOGY | 1 | |
| ALGEBRA | 2 | |
| P. GEOMETRY | 1 | |
| S. GEOMETRY | | |
| CHEMISTRY | 1 | GRADUATED |
| GEN. SCIENCE | 1 | |

SEMESTER HOURS

| | Scheduled | Approved | Passed |
|---|---|---|---|
| Total | | | |

Military Service Credits

Transfer Credits Accepted

TOTAL

Q.P.
AVE

MISSISSIPPI STATE UNIVERSITY — LEARNING · SERVICE · RESEARCH — 1878

MSU 000001

D14860

Transcript(s) issued:
[illegible] 3 1964 F
APR 27 1964 (1) pd
DEC 19 1964 (1) pd
JAN 4 1965 (1) pd
JAN 8 1965 (1) pd
JUN 18 1969 (5) [illegible]
AUG 15 1986

NAME MacKay, Jack Whiting, Jr. FILE NO. 3238

| Course Sym. | Course No. | TITLE | Hrs. per Wk. Rec. | Hrs. per Wk. Lab | Hrs. Attempted | Hours Passed | Grade | Q. P. |
|---|---|---|---|---|---|---|---|---|
| | | School - Agriculture | | | | | | |
| 03238 | 1ST SIX | -WEEKS, SUMMER SCHOOL | 1963 | | | | | |
| BOT | 113 | GEN BOTANY | 9 | | 3 | 3 | B | 6 |
| SP | 313 | ORAL COMMUN | 9 | | 3 | 3 | D | 0 |
| | | SEMESTER TOTAL | | | 6 | 6 | | 6 |
| Q.P.AVE. 0.94 | | CUMULATIVE TOTAL | | | 39 | 35 | | 37 |
| 03238 | 2ND SIX | -WEEKS, SUMMER SCHOOL | 1963 | | | | | |
| MIC | 543 | SAN SCI & PUB HEALTH | 9 | | 3 | | IF | |
| | | SEMESTER TOTAL | | | 3 | | | |
| Q.P.AVE. 0.88 | | CUMULATIVE TOTAL | | | 42 | 35 | | 37 |
| 03238 | | FALL SEMESTER - 1963 | | | | | | |
| CH | 214 | GEN CHEM | 3 | 3 | 4 | | F | 0 |
| AG | 513 | FORAGE & PAST CROPS | 2 | | 3 | | F | 0 |
| OH | 854 | PHYSIOL OF REPROD | 3 | 2 | 4 | 4 | C | 4 |
| AH | 593 | ANIMAL BREEDING | 2 | 2 | 3 | | F | 0 |
| AH | 573 | SWINE PRODUCTION | 2 | 2 | 3 | | F | 0 |
| | | SEMESTER TOTAL | | | 17 | 4 | | 4 |
| Q.P.AVE. 0.69 | | CUMULATIVE TOTAL | | | 59 | 39 | | 41 |
| | Academic Failure. Eligible for readmission June, 1964. | | | | | | | |
| 03238 | 2ND | 6-WEEKS SUMMER, 1964 | | | | | | |
| CH | 214 | GEN CHEM | 9 | 9 | 4 | | WF | |
| | | SEMESTER TOTAL | | | 4 | | | |
| Q.P.AVE. 0.65 | | CUMULATIVE TOTAL | | | 63 | 39 | | 41 |
| | | Withdrew August 12, 1964 | | | | | | |
| | Academic Dismissal. | | | | | | | |

END OF RECORD

SEP - 8 [illegible]

MSU 000002

Resume of:

Jack MacKay, Jr.

Route 1, Box 92

Highway 49 E.

Mt. Pleasant, Texas 75455

EMPLOYMENT EXPERIENCE                                    Jack MacKa , Jr.

1983-1989- Employment contract as Operations and Management Consultant for Sunburst Farms, Inc., Columbus, Mississippi. MacKay Farms was sold to a group of investors in 1982 and became Sunburst Farms, Inc. The terms of the sales contract called for Jack MacKay, Jr. to consult for seven years. (6,000 acre farm involved in production of soybeans, hybrid sunflowers for seed, pecans, wheat and cattle.)

1973-1983- President, Owner and Chief Executive Officer; MacKay Farms, Ltd., Columbus, Mississippi. (6,000 acre farm, 400 acres pecan orchards, seed plant.)

President, Owner and Chief Executive Officer; Helicopter Services Inc., Columbus, Mississippi. (Operated three helicopters, powerline patrol, agriculture, medivac.)

President, Owner and Chief Executive Officer; Alpha Prarie [illegible]hy Inc., Aliceville, Alabama. (Pellet production of dehydrated crops for feed supplement.)

President, Owner and Chief Executive Officer; Explosive Engineering Inc., New Hope, Mississippi. (Demolition and construction explosive work.)

1971-1973- President, Owner and Chief Executive Officer, New Dimension Homes Inc., Columbus, Mississippi. (Manufactured mobile homes and modular homes.)

President, Owner and Chief Executive Officer; New Dimension Factory Outlet Inc., Columbus, Mississippi. (Retail sales outlets in twelve states retailing mobile homes.)

President, Owner and Chief Executive Officer; New Dimension Products Inc., Columbus, Mississippi. (Manufactured products for mobile home industry.)

1970-1971- Executive Vice President, Purchasing and Manufacturing, Chief Executive Officer; All Winston Subsidiaries, Winston Industries Corporation, Double Springs, Alabama. (Manufactured Mobile Homes.)

1967-1970- Southern Region Purchasing Agent (14 plants) Kaiser Industries Corporation, New Orleans, Lousiana. (Manufactured aluminum and chemicals.)

-965-1970- Assistant Purchasing Agent and Junior Buyer; Lone Star Steel Company, Lone Star, Texas. (Manufactured steel slab, pipe, and various steel products.)

1964-[illegible]- Contract helicopter pilot, Special Air Warfare Group, Military Assistance Command, Vietnam. (Helicopter pilot and unit commander Air Warfare Group.)

EDUCATION AND TRAINING — Jack MacKay, Jr.

1955-1959- Sewanee Military Academy, Sewanee, Tennessee
High School Diploma- Pilot License

1959-1961- Itawamba Junior College, Fulton, Mississippi
Graduated Agriculture Engineering, Genetics Minor

1961-1963- Mississippi State University, Starkville, Mississippi
B.S. Agricultural Engineering, Minor Business, Marketing

1963-1964- Delta State University, Cleveland, Mississippi
Graduate Work, Business Administration

1964- Ordinance and Explosives School, Ft. Benning, Georgia
D. . Explosive Systems School and Certification

1965- IBM Fortran Course, System 1405
IBM Fortran Course, System 360
A.C. Wingie Seminar, Purchasing Methods
I.C.S. Certificate, Purchasing Agent Course

1966- General Motors Training Course, Purchasing Agent
General Motors Training Course, Euclid, Diesel Engines
Caterpillar Factory School, Pruchasing Agent

1967- Master Purchasing Certificate, Caterpillar Corporation
Industrial Purchasing Course, Harvard University
DeRose Purchasing Seminar, Harvard University
Material Handling Seminar, LSU, Baton Rouge, Lousiana

1968- DeRose Export Shipping Seminar, Harvard University
Computer Purchasing Course, Harvard University

1969- Dupont Explosive Engineering Course
Society Explosives Engineer, New Product Seminar

1970- Computer Design Engineering Course, University of Georgia
United Laboratories School, Manufactured Housing Institute

1971- E.P.A. Training School, Restricted Chemicals and Explosives
Manufactured Housing Purchasing Course

1973- E.P.A. Training School, Certificate in Restricted Chemicals
and Registered Chemicals

1974- F.A.A. Restricted Chemical Application License Issued

1975- F.B.I. Specialized Hostage Negotiation School

1977- U.S.D.A. Genetics Seminar, Hybrid Sunflower Production
International Sunflower Association Seminar, Paris, France

1978- C.P.R. Lifesaving Course, Columbus Air Force Base [illegible]- Society Explosives Engineer, New Products Seminar

[illegible]- Mississippi Agricultural Aviation Association, Design Seminar

[illegible]- Mississippi State University Seminar, Grain Future Marketing. Guest Instructor Mississippi State University, Hybrid Production Methods and Cytoplasm Restrictions

[illegible]- Mississippi State University Seminar, Commodity Markets, Grain Production and Futures Markets.

[illegible]- Oklahoma State University, Cary Ward Baseball School

[illegible]- Technical Adviser Louisville Slugger (Hillerich and Bradsby, Co.), Baseball Bat Design.
Manager Mt. Pleasant American Legion Baseball

AWARDS AND HONORS | Jack MacKay, Jr.

[illegible]- Eagle Scout, Silver Palm Award, Bronze Palm Award
Order of the Arrow Award, Silver Beav[illegible]

[illegible]- Distingui[illegible]ed Cadet Award, Sewanee Military Academy
All Mid South Football Team
All Mid South Track Team
[illegible]e State Record 100 Yard Dash
[illegible] Athlete of the Year Award

[illegible]- Mississippi Junior College Conference, 100 yard dash record

[illegible]- N.H.R.A. National Record Holder AA Fuel Dragster

1963- Qualified All SEC Track Meet, 100 yard dash

1964- A.P.B A. Runner-up Intercoastal Regatta

1965- A.P.B.A. Sportsmanship Award

1966- Sturdivant Master Mechanic Award

1967- Bearcat Industrial Tire Design Award

1968- Sturdivant Trophy, Turbine Engine Design

1969- God Save The Tiger Award, Kaiser Industries

1970- National Record N.H.R.A.- AA Fuel Dragster

1971- American Manufactured Housing Award, Modular Homes

1972- United Laboratories Design Citation, Modular Homes
World Champion N.H.R.A., AA Fuel Dragster

1973- Car Craft Magazine, All American Racing Team
Desi[illegible] Citation Southeast Manufactured Housing Association
Mississippi State Skeet Shooting Champion

1974- Presidential Sports Award, Skeet Shooting
Winchester Western 500 Award

[illegible]- Interna[illegible]nal Sunflower Association, Breeder Award, Hybrid Seed

1975- U.S.D.A. Oil Crop Advisory Team, Russia Trip
Jaycee Young Businessman of the Year Award

1978- President Southern Sunflower Assosiation
Mississippi Soil I[illegible]ovement Association, Breeder Award, Hybrid Seed

1979- International Sunflower Conference, Literary Award, Educational Publication
U.S.D.A. Sunflower Test, Brooksville Winner

[illegible]- Mississippi Seed Improvement Association, Hybrid Seed
Mississippi Farmer of the Year Award

[illegible]- U.S.D.A. Foundation Seed Breeder Award

[illegible]- Mt. Vernon Texas Rotary Club Citizenship Award

[illegible]- U.S.D.A. Agricultural Advisory trip, Brazil, South America

[illegible]- Dixie Youth Baseball, Runner-up State Champion, Coach

[illegible]- American Legion Baseball, State Champion, Coach
Connie Mack Baseball, Division Champion, Coach
Texas Teen-Age Baseball, State Champion, Coach

## ASSOCIATIONS & CLUBS

Jack MacKay, Jr.

National Purchasing Management Association
Governors Staff Alabama, Young Advisor
National Young Council Advisory Board
Editorial Advisory Board Sunflower Magazine
Editorial Advisory Board Pecan South Magazine
International Sunflower Association
National Sunflower Association
National Livestock Marketing Association
Society Explosive Engineers
Mississippi Quarter Horse Association - Life Member
American Quarter Horse Association - Life Member
National Cutting Horse Association
Mississippi Cattlemens Association
Mississippi Soybean Growers Association
American Soybean Association
Southern Farmer Association
American Pecan Council
Southern Manufactured Housing Association
Georgia Manufactured Housing Association
Alabama Manufactured Housing Association
Advisory Board National Hot Rod Association
Advisory Board American Hot Rod Association
National Skeet Shooting Association
International Skeet Shooting Association
American Water Ski Association
Federation International Automotive Competition Committee
Animal Nutrition Research Council
Mississippi Seed Producers Association
Tennessee Seed Producers Association
Alabama Seed Producers Association
American Seed Manufacturers Association
Mississippi Pecan Growers Association
Dearbrook Country Club, Pittsburg, Texas
Mt. Pleasant Country Club, Mt. Pleasant, Texas
Ducks Unlimited Inc.
Mobile Housing Association of America

## Sunburst Farms, Inc.

## 1983 - 1989

Responsibilities:

Management and Operations Consultant.

Sunburst Farms, Inc., was formed when MacKay Farms Limited was sold to foreign investors in 1982. The sale contract called for me to be an active consultant for a period of seven years and handle the transition period involved with the sale of MacKay Farms, Inc., to Sunburst Farms, Inc.

I trained a new manager and set up procedures whereby the new owners could keep abreast of farm activities and performance.

I still do certain genetic work for Sunburst Farms, Inc. on a case by case basis as the need arises. Sunburst Farms, Inc. acquired all genetic work done and in process prior to 1982, and I retained ownership of all new work or progeny developed after 1982.

Highlights:

I established several supply contracts both domestic and foreign which will run for a period of several years. These contracts call for genetic progeny to be supplied to several foreign countries as well as educational publications for foreign producers to use in the production of hybrid and oil seed sunflowers.

I made several trips to Africa where interest in sunflower production is high and working through the USDA and several private companies arrangements have been made to produce Sunburst Hybrid Planting Seed for six African projects. These projects started in 1983 and will ongoing for a period of ten years.

I established a market in Mississippi for sunflower seed producers with two major grain companies who will export part of the crop and broker the balance to several U.S. producers of cooking oil. These established long term contracts for Mississippi farmers have allowed the southern sunflower producer to contract his crop in advance of production thus creating some market stability in the sale of his crop.

Sunburst Farms, Inc. was an important force in getting sunflowers added to the New Orleans Grain Commodity Exhange in 1981. Sunburst Farms will continue to be the largest producer of hybrid sunflower seed for years to come.

Sunburst Farms Inc. operates 6,000 acres of farm land, 400 of which are pecan orchards, pecan processing plant, sunflower seed processing plant, hybrid seed production, and a hybrid seed sales company.

In January of 1979, a production and management booklet was prepared by MacKay Farms, Ltd., to provide prospective southern producers a concise summary of the Sunflower Industry. Information and recommendations came from the latest research and technical data available from the U.S.D.A., Cooperative Extension Service, SEA-FR, private research and testing companies, and MacKay Farms production experience during the last six years. This book won many awards and citations.

MacKay Farms, Ltd. was the leading force in the development of a sunflower market in the southeast United States. This market was developed by MacKay Farms, Ltd., working with three multinational grain exporters to provide a continuing market for producers of sunflower seed. Initially most of the crop was exported but as manufacturers of cooking oil began producing sunflower cooking oil some 40% of this southeast crop was used by these domestic producers.

MacKay Farms, Ltd. was a motivating force in getting sunflowers placed on the New Orleans Grain Commodity Board and this gave stability to the price paid producers in our area.

<u>Alpha Prairie Dehy, Inc.</u>

This company was an outgrowth of MacKay Farms operation in experimental forage crops. A plant was constructed to dehydrate and pelletize forage crops grown in a five county area for use as livestock feed. Alpha Prairie Dehy formulated and processed many new pellet feeds from forage crops with special nutrients added per specific livestock end use. In 1982, Alpha Prairie Dehy produced some 1,000,000 tons of pellet feed.

<u>Helicopter Services, Inc.</u>

This was another outgrowth of MacKay Farms. I purchased my own helicopter to do my own agricultural spraying on MacKay Farms. The spraying by helicopter was so successful that other farms soon requested that we do their spraying work. Thus a new company was incorporated and two additional helicopters added to meet the volume of spraying work. Several innovations in aerial application were designed and implemented during the next years by Helicopter Services, Inc.

<u>Explosive Engineering, Inc.</u>

I had special training in manufacturers schools and with the U.S. Government in explosives. MacKay Farms was involved in extensive ditching, clearing and irrigation construction. During this construction period, I performed an extensive amount of explosive work and soon was requested to do additional work for other farmers in the area and the Corp of Engineers on the Tennessee Tombigbee Water Project. During the next years Explosive Engineering actually contracted to do demolition work, ditching work and general explosive work in a four state area. I continue to do some special explosive work for various contractors.

In 1982, I sold MacKay Farms, Ltd., Helicopter Services and Alpha Prairie Dehy, Inc. to several foreign investors. I agreed to manage the farm for the balance of 1982 and stay on a close consultant basis for seven additional years through 1989.

MacKay Farms, Limited

Alpha Prairie Dehy, Inc.

Helicopter Services, Inc.

Explosive Engineering, Inc.

1973 - 1982

Responsibility:

President, Chief Executive Officer and Owner, MacKay Farms, Ltd., Alpha Prairie Dehy, Inc., Helicopter Services, Inc., Explosive Engineering, Inc. Supervised and managed operational and financial aspects of all four companies for ten years until they were sold in 1982 to foreign investors.

Highlights:

In October of 1972, I sold the mobile and modular home plant I had built in Columbus, Mississippi. In 1973, I purchased the Spurlock Plantation and the Vaughn Plantation which consisted of 6,000 acres in South Lowndes County, Mississippi and Pickens County, Alabama. These two plantations were merged into one large farm and operated as MacKay Farms, Ltd.

Originally MacKay Farms was operated as a soybean, wheat, and pecan operation with some sunflowers grown experimentally in 1973 and 1974. MacKay Farms' initial involvement in the sunflower industry stemmed from an experimental planting in 1973 of a few bags of Russian open pollinated sunflowers imported from Canada. The experiment proved the practicability of sunflowers as a new cash crop in the southeastern states. As the years passed, improvements were made in the production, marketing and processing of sunflowers, and as sunflowers proved their profitability to U.S. farmers, acreage increased rapidly.

Quality planting seed became a very important factor. Initially, the available varieties were susceptable to rust and downy mildew. For this reason, MacKay Farms continued to experiment with various sunflower varieties.

The discovery of a feasible way to produce hybrids by Dr. Leclercq of France and Dr. Kinman of Texas led to a revolution in the sunflower seed industry. MacKay Farms began experimental production of hybrids in 1973 when the first parental lines were released by the U.S.D.A. program in Texas. Hybrids became available to farmers two years later and the experimental hybrids produced by MacKay Farms became the registered brand "Sunburst" Hybrid Sunflower Seed. Sunburst seed is the leading sunflower producer in the southeast.

New Dimension Homes, Inc.

Factory Building Supply Co.

New Dimension Factory Outlet, Inc.

1971 to 1973

Responsibilities:

President and Chief Executive Officer, Owner; Subsidiaries, New Dimension Factory Outlet, Inc.; Factory Building Supply, Inc.; Employed some 321 people. Supervised all purchases, labor relations, design and manufacturing activities. Handled all NLRB negotiations with union, etc.

Highlights:

In June of 1971, I resigned from Winston Industries, Inc. to form my own mobile home manufacturing plant. Through information and experience obtained at Winston Industries and through some of the leading manufacturers in the country that I had been associated with while at Winston, I was able to put together an operation of completely trained personnel and managed to construct the manufacturing facility from start to finish in just three months. Before New Dimension Homes, Inc. was one year old, the plant was doing $1,000,000 of business monthly. I personally supervised all design engineering, purchasing, sales and manufacturing. The plant had no union although a vote was taken in 1972. I personally handled all union and labor relations from 1971 to 1973.

I designed a complete computer purchasing and production system whereby production scheduling and purchasing were intigrated. When an order was sold the order would be scheduled in a lot run in production and the raw materials needed for production were automatically ordered. This system allowed New Dimension to produce twelve complete units per 8 hour shift and prevented inventory shortages which usually occur in an operation of this size.

New Dimension Homes was the largest single plant producers of mobile and modular homes in the southeast United States during 1972 and 1973.

In mid 1973 after a complete audit of New Dimension Homes, Inc., I was advised that the company was very profitable but needed more working capital in relation to accounts receivable, to attain the production it was designed for and already capable of at that point in time. I had been approached by several large companies about the purchase of my plant during 1972 and 1973.

I agreed to sell the plant in October of 1973 and purchased the Vaughn And Spurlock Plantations, which involved some 6000 acres, South of Columbus, Mississippi, which ultimately became McKay Farm, Ltd.

Kaiser Industries

1967 to 1970

Responsibilities:

Regional Purchasing Agent for fourteen Kaiser plants both domestic and foreign, namely; Kaiser Aluminum, Chalmette, Louisiana; Kaiser Aluminum, Gramercy, Louisiana; Kaiser Aluminum, Baton Rouge, Louisiana; Kaiser Chemical, Gramercy, Louisiana; Kaiser Chemical, Baton Rouge, Louisiana; Kaiser Bauxite, Kingston, Jamaica; Kaiser Bauxite, Port Rhodes, Jamaica; Kaiser Aluminum Corporation, Queensland, Australia; Kaiser Aluminum Corporation, Valco, Africa; Kaiser Aluminum & Chemical Corporation, Kenya, Africa; Kaiser Aluminum & Technical Corporation, Valco, Africa; Kaiser Engineers, Attached Valco Project; all of the purchasing and shipping for [illegible] above listed subsidiaries of Kaiser was done from New Orleans, Louisiana, Regional Office, which purchased in excess of 800 million dollars annually.

Highlights:

Designed and instituted Purchase Order Draft System, Vendor Release System, Consignment Vendor Release System, Economic Order Quantity and Economic Order Value System; Quantitive Purchasing Analysis Program, and Plan for Profit Program. Effected price savings documented in excess of $11,000,000 dollars annually.

Additionally, during previous employment and early employment with Kaiser, I attended training courses at Harvard University that related to Computer Purchasing, Computer Warehousing and Quantitive Purchasing. The knowledge obtained from these courses enabled me to have a good working knowledge of computers and how they could be used to benefit the purchasing system.

I recruited engineers and certain trained personnel from various plant departments for the Regional Purchasing Office in New Orleans. These people were assigned the Purchasing responsibility for commodities which they had worked with daily before coming to the Purchasing Department. This program proved a tremendous success and is [illegible]ll in use at Kaiser today.

I served as President of the New Orleans Chapter of the National [illegible]asing Management Association for one year and was invited by several multi national corporations to give seminars related to certain programs I had installed at Kaiser.

I authored many technical reports while at Kaiser that did a great deal to educate the field personnel as to how to order certain commodities which were built to close specifications. I also did researc[illegible] several items that Kaiser was looking at for future purchases. Some of these articles have been published in various technical and purchasing magazines.

## Winston Industries, Inc.

## 1970 to 1971

**Responsibilities:**

Executive Vice President Purchasing and Transportation, Chief Executive Officer all Winston Industry Subsidiaries, namely; Hennesey Aluminum Company, Allied Fiberglass Company, Thames Manufacturing Company, Winston Carriers, Inc., Winston Transportation Company and Winston Aviation Division.

**Highlights:**

Winston Industries operated some twenty four mobile home plants in the southeast and some eight support operations as listed above. I was personally in charge of the total purchasing effort for Winston Industries and it's sudbidiaries. All purchasing activities were centralized in one office. I was in charge of total management for all Winston Subsidiaries whose annual purchases exceeded $100,000,000.

I personally authored the Purchasing Manual, set up the entire Purchasing Procedure, installed the Vendor Release System, installed the Computer Warehousing and Computer Purchasing System and initiated the Plan for Profit Program which saved a documented $3,000,000 in annual purchases, determined by actual audit.

I further revamped all subsidiaries and took three from loss positions to positive earning positions and increased the earning position of the other subsidiaries. I filed for and obtained contract carrier rights for the transportation company, which has given Winston a real advantage in the marketplace due to transportation savings. I became quite involved with the manufacturing functions, labor relations, union relations, acquisition and product design.

I centralize the entire purchasing program for the twenty four Winston plants at Double Springs, Alabama and with the aid of the computer purchasing program I was able to purchase inventory in larger quantities and as needed. This effecuated transportation savings as well as price savings on large quantities.

I was responsible for getting Winston in compliance with the ASTM building code and obtaining UL approval for products manufactured by Winston.

I initiated an outsell policy for Winston Subsidiaries whereby these subsidiaries actually sought outside sales to other producers of mobile and modular homes. This policy created large gains in Winston's overall sales volume.

I resigned and sold my stock in June of 1971 to form my own company.

## Lone Star Steel Company
## 1965 to 1967

**Responsibilities:**

Assistant Purchasing Agent and Junior Buyer. Personally responsible for a given set of commodities namely; bearings, spare parts, all mobile equipment, lubricants, safety items, tires, all mining equipment, fuel, acquisition of all new equipment.

**Highlights:**

Lone Star Steel Company is a completely integrated steel plant that do their own mining of iron ore up to and including the manufacture of finished steel goods such as steel pipe, steel castings, cast iron pipe, skelp coils, galvanized pipe, spiral weld pipe, pig iron, cale and oil field goods.

In 1965, when I took over the Purchasing responsibility for all mobile equipment the availability percentage of all mobile equipment was 38.61 percent. Through thorough familiarizing myself with the equipment that caused the greatest difficulty and downtime and through systems of Vendor Inventory and consignment the availability of the entire Lone Star fleet was brought to 82.33 percent by 1967. Further, I instituted a Standardization Program and a Bearing Interchange Program from Original Equipment Manufacturer to Bearing Manufacturer which saved many thousands of dollars.

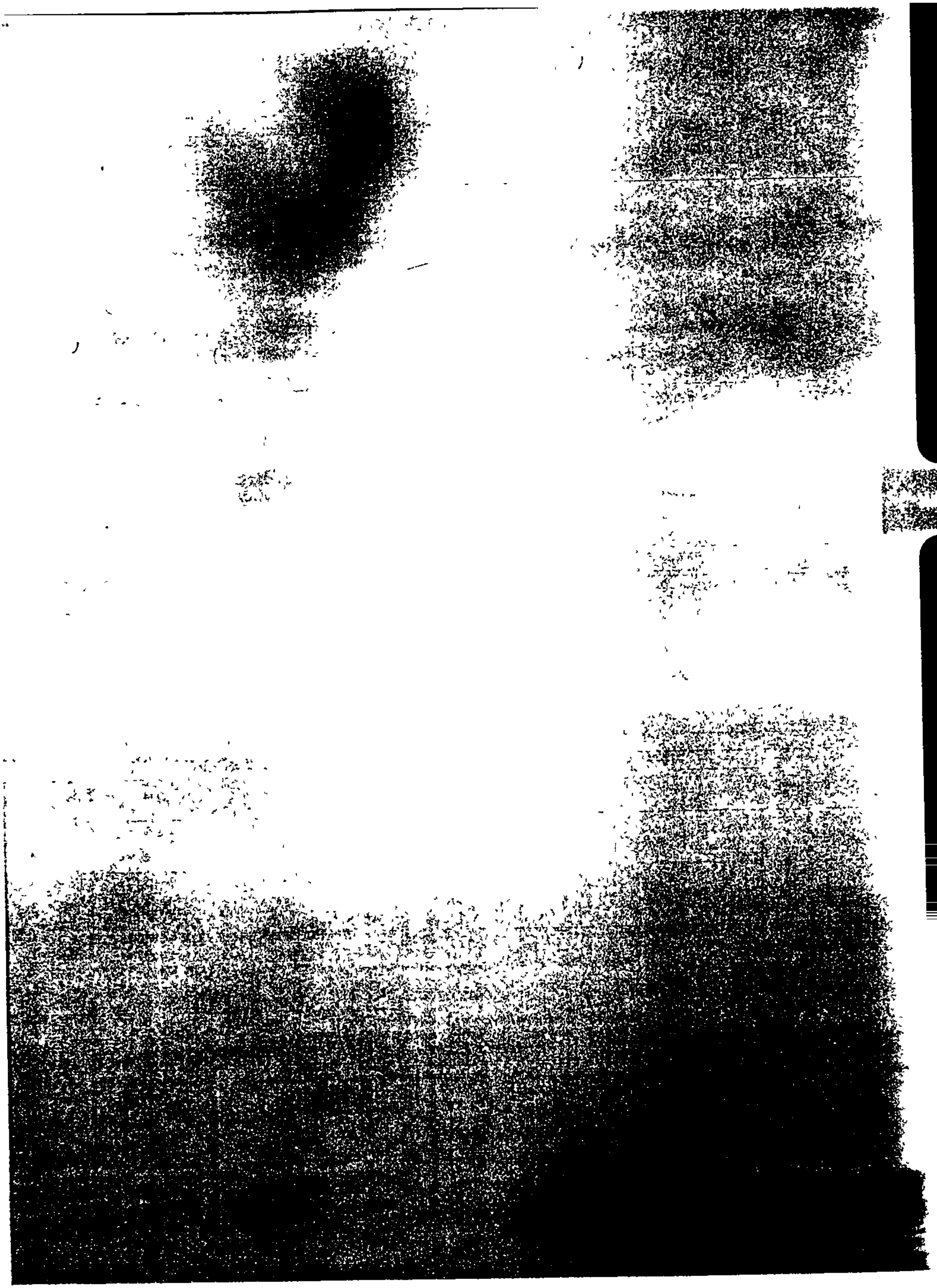
Many innovations in warehousing spare parts were made which allowed us to lower warehouse spare part inventories but retain the same backup availability. Many "dead inventory" items were removed from warehouse and traded for current parts.

In 1966 a Vendor Warehousing and Inventory Program was initiated whereby vendors were required to stock certain inventory for Lone Star Steel's exclusive use. It was my responsibility to oversee this inventory and see that proper amounts were on hand at all times.

During my two years with Lone Star Steel, computer purchasing was just being implemented and I worked closely with the IBM representatives on the new 360 computer Lone Star had acquired in 1965. Many phases of Lone Stars operations were being placed on computer and I was the purchasing representative in these programs.

The computer purchasing and inventory techniques I learned at Lone Star were the basis of many programs I developed and worked on in future years with other companies.

I resigned to accept a position with Kaiser Industries.



NCAA NEWS RELEASE

**FOR IMMEDIATE RELEASE**
Friday, July 12, 2000

**CONTACT:**
Wallace I. Renfro
Director of Public Relations

## NCAA BASEBALL RULES COMMITTEE RECOMMENDS NO IMMEDIATE CHANGES IN EQUIPMENT RULES

INDIANAPOLIS---There will be no immediate changes in the specifications for manufacturing baseball bats and balls based on recommendations approved today by the NCAA Baseball Rules Committee.

At its annual meeting in Indianapolis, the committee considered recommendations from the NCAA Baseball Research Panel, reviewed results from laboratory testing and performance during the 2000 season, and put forward a set of recommendations that calls for no changes in specifications for the 2001 season.

"We agree with the research panel that the recommendations they made a year ago restored balance between offense and defense in the college game of baseball and made metal bats perform more like wood bats," said Don Kessinger, associate athletics director for internal affairs at the University of Mississippi and chair of the rules committee. "The panel was concerned this year that there may be some loopholes in our testing procedures that we need to address to avoid problems in the future, and we have tried to do that."

Specifically, the committee made the following changes:

- A moment-of-inertia (MOI) standard will be set for each bat length and weight based on bats previously certified by the NCAA Bat Certification Program. All currently certified bats will meet the MOI standard. The MOI of future bats may not be less than the lowest MOI for bats of that length and weight recorded during the certification process for the 2000 season. The committee will continue to monitor the effect of MOI on the integrity of the game. Moment-of-inertia affects how weight is distributed along the barrel of the bat during the swing and can affect performance.

- During the 2001 season, the NCAA will conduct random testing of baseballs for coefficient-of-restitution (COR) compliance. All baseballs used for regular and postseason play must have a COR value of between .525 and .555 to be eligible for play in the 2002 season. The NCAA will collect data to determine if an additional or substitute standard is necessary.

- Effective January 1, 2003, a sliding scale for swing speed based on the bat length will be implemented as part of the NCAA Bat Certification Program. The scale will be based on the original exit speed standard of 97 miles-per-hour for a 34-inch bat.

- The committee supported the Baseball Research Panel recommendations that further study be conducted on the possible effects of bat "workhardening" and that the NCAA collect data to determine the accuracy of the NCAA Bat Certification Program testing procedures.

The research panel had recommended a change in the COR for baseballs from .525-.555 to .515-.535. The rules committee voted to certify baseballs for all competition, instead of championship competition only, at the current COR.

"We want to assure that baseballs being used throughout the season are meeting the standard, and we think that is the first important step," Kessinger said. "We may want to make adjustments in the future, but we want to take this one step at a time."

Kessinger said the committee had the same concern about making a change to the MOI. The research panel had recommended creation of a minimum MOI standard for the 2002 season.

"Again, we may want to adjust the MOI in the future, but we want to get another season of competition under our belts with the certified bats we are using today before we do that," Kessinger said. "We agree with the panel regarding a sliding scale for swing speeds during testing, but we want to put that off another two years.

"The bottom line is that two years ago, coaches were calling members of the committee to say that something was wrong and we needed to make some changes in specifications for the bats," he said. "After this season and the changes we saw in the field as a result of the new specifications, those coaches were calling to say they liked how the game was played this year."

According to season statistics in college baseball over the last 20 years, batting averages, scoring and home runs had remained steady until the last five years. From 1981 through 1995, batting averages were steady at .296, home runs at .80 per game, and scoring at 6.49 to 6.52 per game.

From 1995 through 1999, batting averages increased to .301, home runs to .91 per game, and scoring to 6.81 per game. In the just completed 2000 season, following changes to bat specifications, batting averages returned to .297, home runs to .80, and scoring to 6.53.

The Championships Committees in Divisions II and III and the Championships/Competition Cabinet in Division I will consider the rules committee's recommendations when they meet in the fall.

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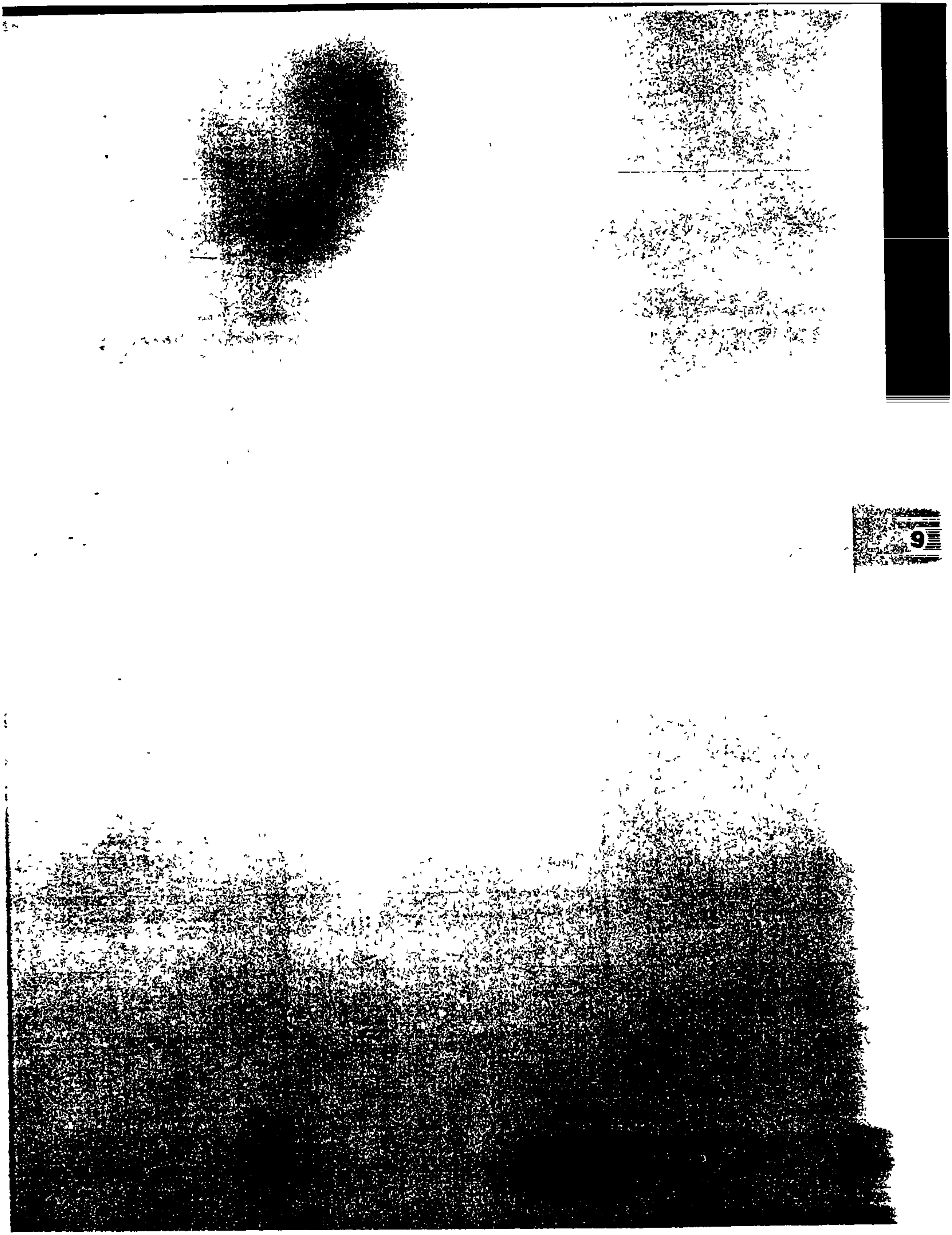

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January 18, 2000

CONFIDENTIAL

TO:
University of Mass at Lowell Research Foundation
ATTN. Louise Griffin
600 Suffolk St.
Lowell, Mass 01854

EXHIBIT
20

VIA Fax: 978-4536586

FROM:
Steve Baum

My previous correspondence has clearly notified the University of material breaches of the license agreement between Baum Research and U-Mass Lowell. The University response was and is unsatisfactory, incorrect, without scientific evidence, and does not provide any reasons or information why the material breaches should not cause termination; therefore I am writing to inform the University that your license to use the Baum Hitting Machine under the current license agreement and U.S. Patent # 5988861 will terminate on January 31, 2000. We are however; willing to discuss and attempt to reach a possible amended agreement if all of the items noted in the breach letter of November 22, 1999 are amicably resolved or corrected prior to that date. I also wish to make it very clear we are not in any fashion waving our rights to pursue other damages, against the University or other parties as the facts of this situation become unraveled. To the end of attempting to resolve the matter at hand, and to allow the use of the Baum Hitting Machine by the University, I am suggesting that we deal with some of the major problems in the following manner:

1. The payment to Baum Research of our daily test rate of $5000.00 for every day of commercial testing conducted by the University. Under the license agreement your records of all testing are to be made available once a year. We request that information for the year 1999.
2. The agreement by the University to continue NCAA ***challenge*** testing and follow-up testing ***only***. This would be done under the protocol improperly established by the NCAA and enacted by the University. This includes aggressive immediate field and new bat testing of non wood bats which passed the current standard, at NCAA expense and immediate with out charge testing of any challenge bats submitted and pre tested on the Baum Hitting Machine # 1 by Baum Research. As the University is clearly aware the Baum Hitting Machine agreed upon protocol was changed, distorted and key comparison points eliminated to allow 1999 bats to become 2000 legal and for



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Baum/H&B

new 2000 bats to have exit velocities in excess of their wood counterparts. These bats would have been illegal in their tested state if the agreed upon original protocol had been followed. With that said and not changeable and with the fact that many of these bats just managed to pass the test in their non "worked" state (a testing condition eliminated from the original protocol) the follow-up testing and challenge testing now becomes essential to determine the speeds of these bats in their worked state.

3. The agreement that all future compliance testing be limited to two attempts per manufacturer, per model, per length - weight class, per year at passing any compliance rules. Testing in excess of two attempts is clearly commercial testing and not must not be entertained or allowed by the University. A "model" definition must be also clearly worked out to prevent constant submission of actual developmental bats with just different model numbers or notations vs bats developed and ready for compliance testing.
4. The agreement that any further (other than the challenge testing and follow-up testing mentioned above) NCAA testing and NFHS testing will be done ***only*** under the protocol concept (subject to minor fully agreed upon definition changes and revisions in writing and the completion of center of gravity testing) as per the comments in my correspondence dated December 29, 1999 to the NFHS and Dr. Sherwood. A copy is attached. It is also worthwhile to note that Dr. Sherwood has already stated and agrees that "this proposed protocol approach is uncheatable"

It is very obvious that the Baum Hitting Machine, by everyone's accord can do its job of testing baseball bats and balls without equal. This can be accomplished only if the proper comparisons are made and if the correct protocol is followed.

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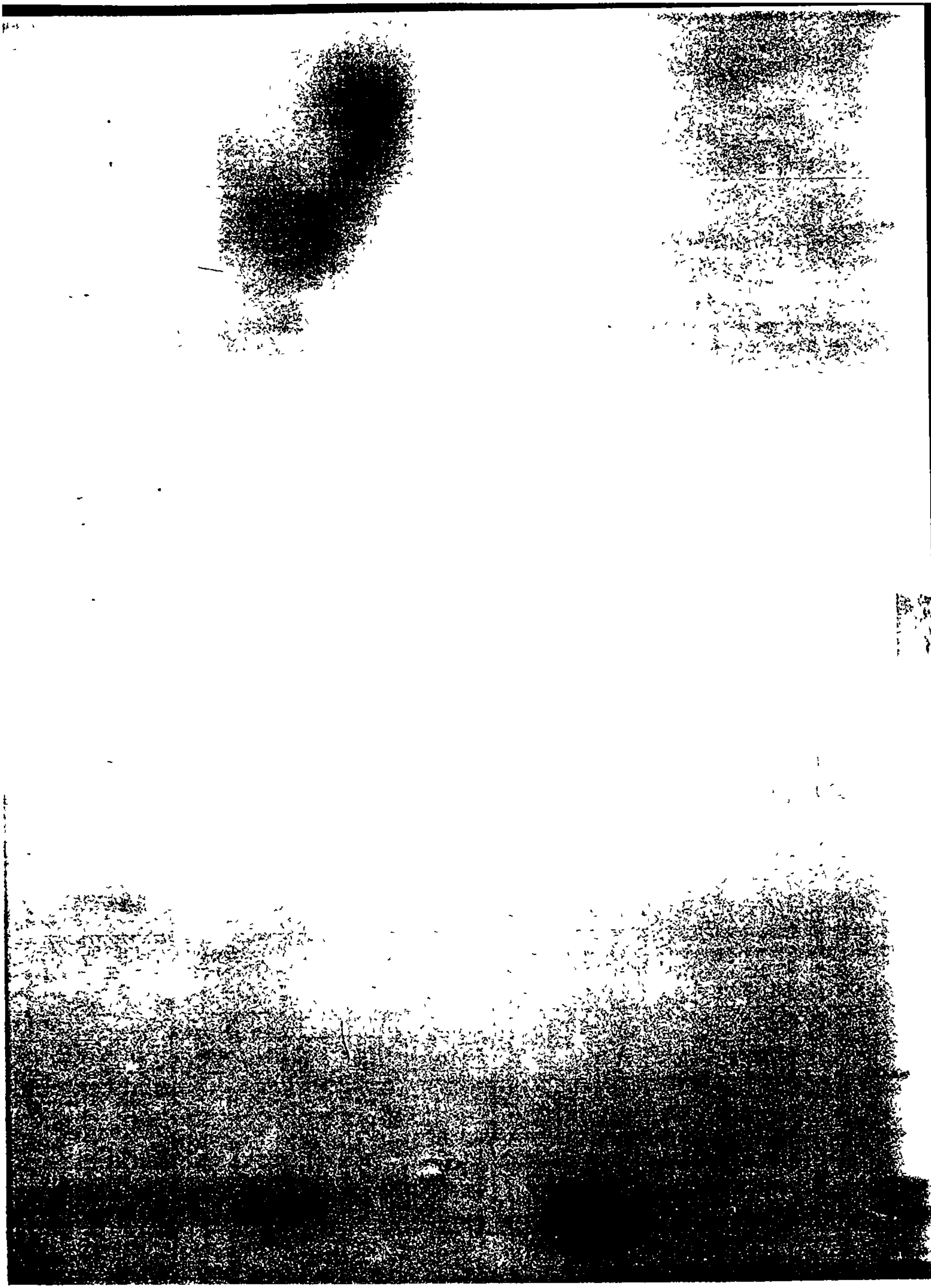

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# LITTLE LEAGUE BASEBALL STATEMENT ON NON-WOOD BATS

Little League Baseball has received numerous inquiries from its volunteers and media regarding the safety of non-wood bats.

## Background

Recent innovations in metal alloys have allowed a reduction in the weight of some models of bats, while allowing the bats to remain in conformity with the length and diameter guidelines in the various divisions of Little League Baseball and Softball. Some volunteers and those in the media have raised questions about whether the weight of the bats used in Little League games should be limited, relative to the length.

Non-wood bats were first developed, partly through research by Little League, as a safer and more cost-effective alternative to wooden bats. Non-wood bats were first used in Little League in 1971, and have almost completely replaced wood bats in all divisions of play. Wood bats, which can break in half if not used properly, are now widely used only in professional baseball.

As a member of USA Baseball, the governing body for all amateur baseball in the U.S., Little League Baseball follows the recommendation of the USA Baseball Medical and Safety Advisory Committee. The position of the Advisory Committee is that further research and data needs to be collected before any changes are made to Little League rules regarding the weight of bats. There is currently no rule in any division of Little League Baseball or Softball that places a maximum or minimum limit on the weight of bats.

## Statement

At present, injury data in all divisions of Little League Baseball and Softball shows there has been a 76 percent decrease in reported injuries to pitchers as a result of batted balls over the eight-season period beginning in 1992. Data on injuries to pitchers is being used because the pitching position is nearest the batter, and the pitcher is the least likely among all fielders to be fully prepared when the ball is hit.

During that same eight-year period, the number of injuries to other fielders as a result of batted balls has remained relatively constant or decreased. A summary of the data is attached, along with participation figures and the current bat specifications for each division.

In 1997 alone, nearly 60,000 children ages 5 to 14 were treated in hospital emergency rooms for in-line skating-related injuries, according to the National Safe Kids Campaign (NSKC). Among the same ages in the same year, more than 150,000 football injuries and 200,000 basketball injuries were treated, NSKC reported. That year, NKSC said, more than 125,000 baseball and softball injuries were treated in hospital emergency rooms nationwide. However, only 70 injuries in Little League Baseball and Softball activities, ages 5 to 18, were reported that year.

Annually, less than three-tenths of one percent of U.S. Little Leaguers are injured in games or practices to the point of requiring medical treatment. Injury data for Little League are obtained through analyzing medical claims on accident insurance provided by Little League though CNA Insurance. More than 95 percent of the chartered Little League programs in the U.S. are enrolled in the Little League Group Accident Insurance plan.

In conclusion, there appears to be no indication that would cause Little League to mandate a limit on the weight of bats, based on the most current facts. Statistics show that Little League's record on safety continues to be outstanding not only among youth sports, but in baseball and softball in particular.

However, Little League Baseball will continue to monitor this situation closely, and will react accordingly and appropriately when indicated.

# FACTS AND FIGURES

**Total Reported Injuries to Pitchers (Batted Ball) in the U.S. by Age Group***

| | *1992* | *1993* | *1994* | *1995* | *1996* | *1997* | *1998* | *1999* |
|---|---|---|---|---|---|---|---|---|
| **Little Lg. Baseball (ages 5-12)** | 120 | 110 | 109 | 73 | 53 | 41 | 33 | 22 |
| **Jr., Sr., Big Lg. Baseball (13-18)** | 25 | 33 | 25 | 16 | 22 | 12 | 10 | 6 |
| **Baseball Totals** | **145** | **143** | **134** | **89** | **75** | **53** | **43** | **28** |
| | | | | | | | | |
| **Little Lg. Softball (ages 5-12)** | 13 | 10 | 8 | 9 | 11 | 7 | 7 | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 12) | | | | | | | | |
| Jr., Sr., Big Lg. Softball (13-18) | 5 | 11 | 11 | 7 | 7 | 10 | 5 | 5 |
| Softball Totals | 18 | 21 | 19 | 16 | 18 | 17 | 12 | 10 |
| GRAND TOTALS | 163 | 164 | 153 | 105 | 93 | 70 | 55 | 38 |

| Participation Figures in Little League Baseball and Softball, U.S.* | | |
|---|---|---|
| | 1992 | 1999 |
| Baseball | 2,389,320 | 2,518,755 |
| Softball | 299,910 | 392,370 |
| Totals | 2,689,230 | 2,911,125 |

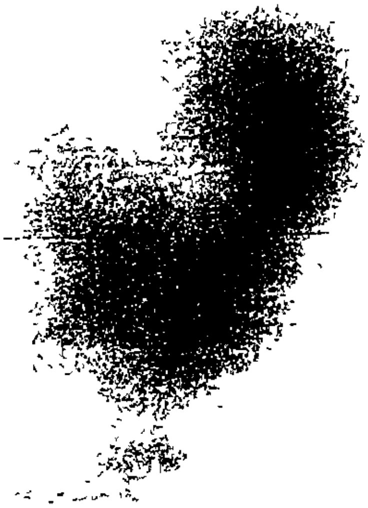
* Injury statistics are those reported as a result of claims filed by those leagues that have purchased group accident insurance offered through Little League Baseball More than 95 percent of the local Little Leagues purchase group accident insurance through Little League Baseball, Incorporated

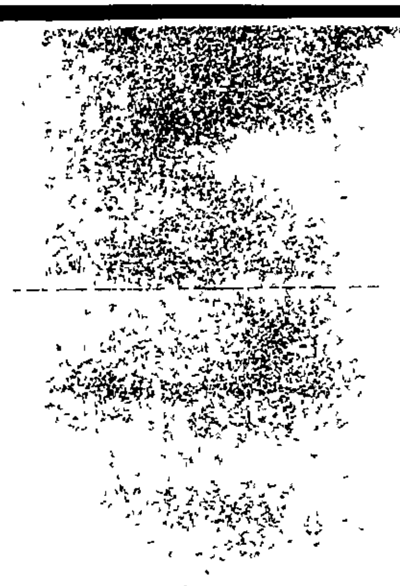
| Maximum Bat Length/Diameter Specifications in Little League Baseball/Softball | | | |
|---|---|---|---|
| | *Age Range* | *Max length* | *Max diameter* |
| Baseball | 12 year olds and under | 33 inches | 2 1/4 inches |
| Baseball | 13-16 year olds | 34 inches | 2 3/4 inches |
| Baseball | 16-18 year olds | 38 inches | 2 3/4 inches |
| Softball | 12 year olds and under | 33 inches | 2 1/4 inches |
| Softball | 13 year olds and over | 34 inches | 2 1/4 inches |

| Pitching Distances | | |
|---|---|---|
| | *Age Range* | *Distance* |
| Baseball | 12 year olds and under | 46 feet |
| Baseball | 13 year olds and above | 60 feet, 6 inches |
| Baseball | Junior League 13-15 year olds (optional) | 54-foot |
| Softball | 12 year olds and below - Majors | 40 feet |
| Softball | 12 year olds and below - Minors | 35 feet |
| Softball | 3 year olds and above | 40 feet |

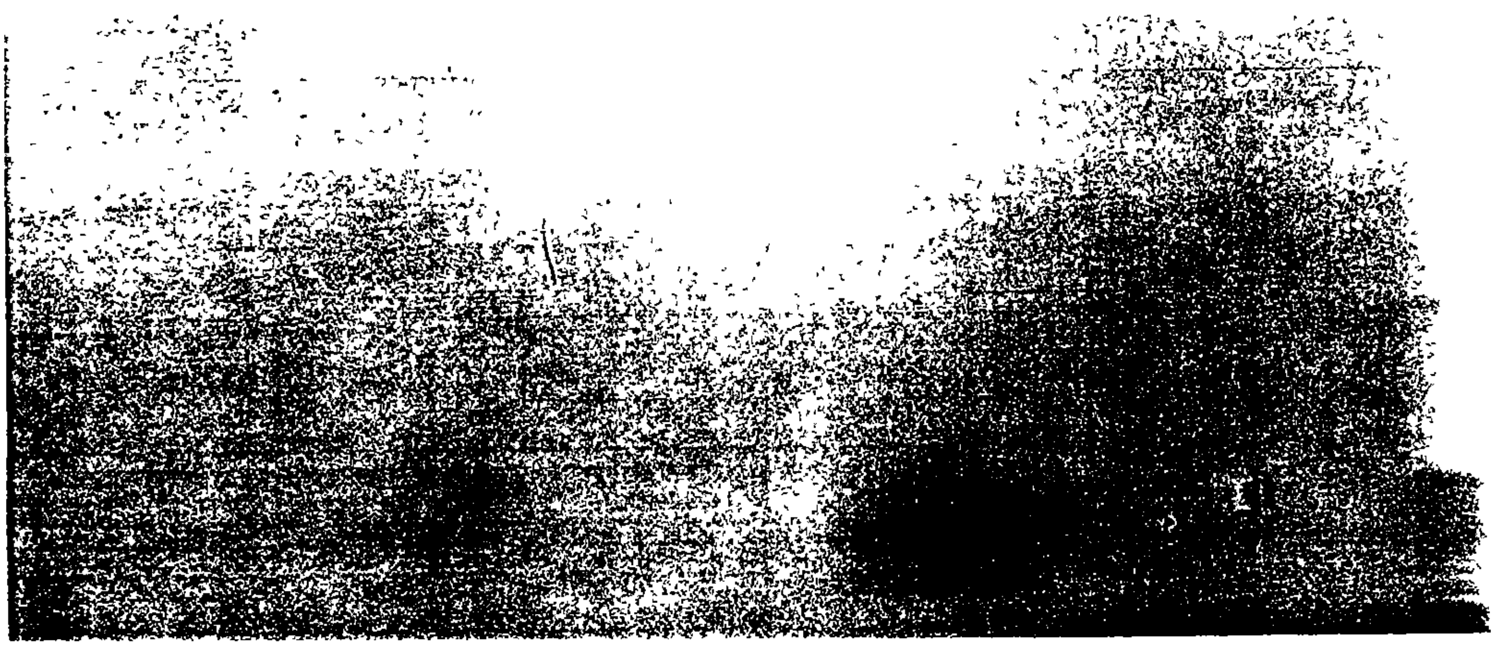
*For more information contact:*
*Lance Van Auken, Director of Publications and Media Relations*
*Little League Baseball International Headquarters 570-326-1921 (after hours: 570-326-7872)*
*Media E-mail: media@littleleague.org*

*Note. Information from the web site "www.safekids.org" was used in this report.*









LITTLE LEAGUE BASEBALL® INCORPORATED
INTERNATIONAL HEADQUARTERS

January 8, 1999

OFFICE OF THE
SENIOR ADVISOR

Mr. Rex Bradley
Amateur Relations and Special Projects
Hillerich & Bradsby Company
P. O. Box 35700
Louisville, KY 40232

Dear Rex:

Enclosed is a table reporting the number of pitchers hit by a batted ball in Little League Baseball for the years 1992-1997. The 1998 report has not been finalized.

You will note that the number of pitchers hit by a batted ball has decreased each year. Also significant is the number of injuries to the pitcher from the batted ball.

There are 200,000 teams in our program which play an average of 18 games per season which would total 3,600,000 games involving 7,200,000 pitchers. It can be quickly deduced that the incidence of injuries to the pitchers by batted balls is infinitesimal There are many more players fatally injured by lightning and while going to and from practices and games.

Since the non-wood bat (aluminum) was approved in 1971, there has not been a single fatal injury to a pitcher from a batted ball; whereas, since we have been keeping injury data, there have been three pitchers in our program which were fatally injured during instances where wood bats were used.

Little League Baseball's position is to retain present specifications of bats until the research, now under way, establishes the dynamics of wood and non-wood bats. Since bats are not the only factor in the velocity of a ball hit by a batter, we are also studying the dynamics of the baseball. In my judgment, there has been too much emphasis on the bat and inadequate concern about the ball.

Everyone is looking forward to the results of the research undertaken by Dr. Crisco in order that we can rely upon factual information and not emotional responses.

Sincerely,

Creighton

CREIGHTON J. HALE
Senior Advisor

CJH/bg

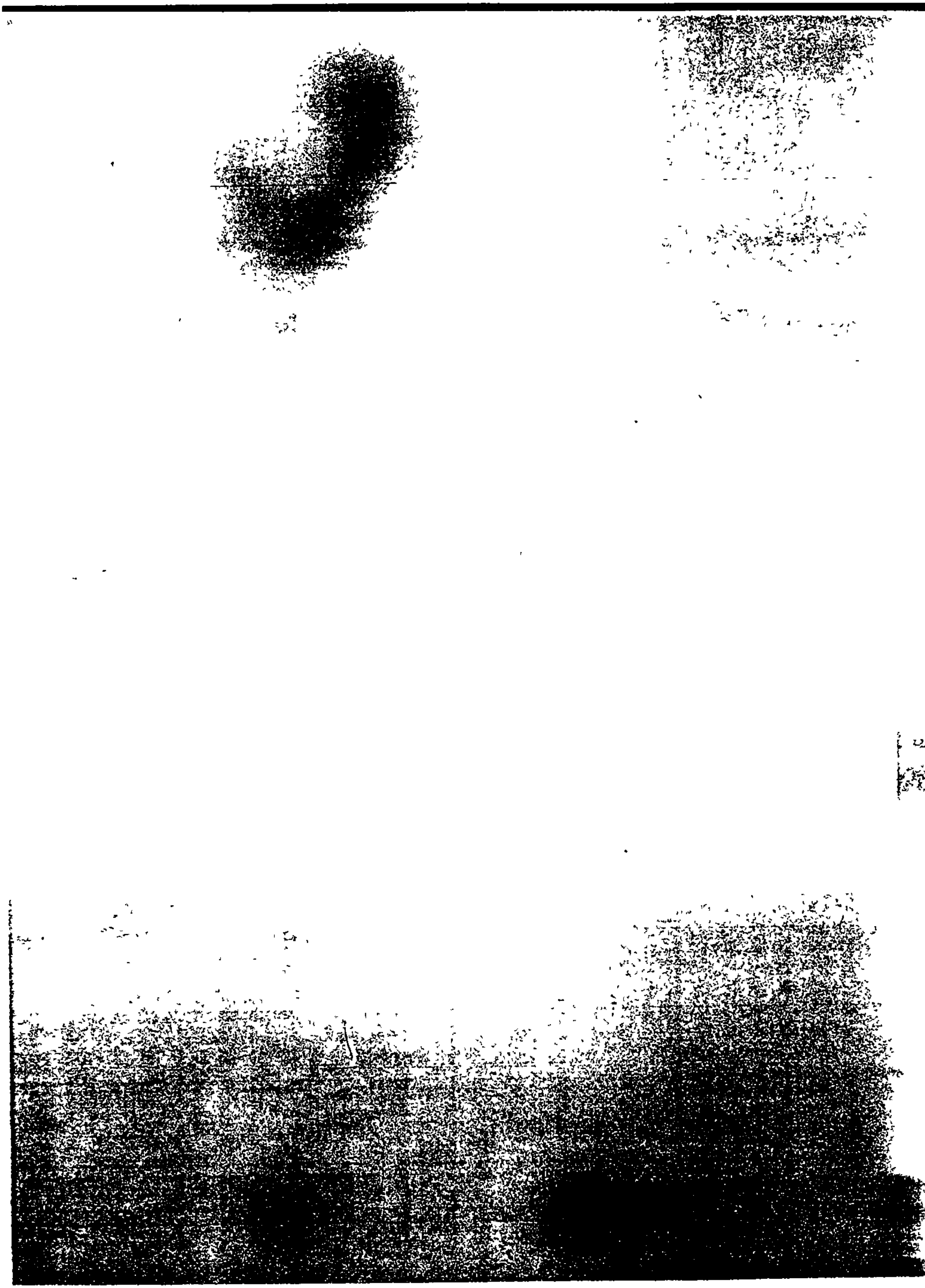
P.O. Box 3485 • WILLIAMSPORT, PENNSYLVANIA 17701 • (717) 326-1921 FAX (717) 326-1074

PITCHERS HIT BY BATTED BALL

| | BASEBALL | | | SOFTBALL | | | |
|---|---|---|---|---|---|---|---|
| YEAR | *LL | SR | BL | *LL | SR | BL | TOTAL |
| *1992 | | | | | | | |
| Players | *1,995,453 | 209,061 | 28,038 | 201,316 | 71,085 | 8,896 | 2,473,839 |
| Injuries | 120 | 23 | 2 | 13 | 5 | 0 | 163 |
| Percent | .006% | .011% | .007% | .007% | .007% | .000% | .007% |
| *1993 | | | | | | | |
| Players | *2,004,094 | 212,819 | 28,876 | 215,841 | 77,776 | 10,461 | 2,549,867 |
| Injuries | 110 | 28 | 5 | 10 | 11 | 0 | 164 |
| Percent | .006% | .013% | .017% | .005% | .014% | .000% | .006% |
| 1994 | | | | | | | |
| Players | 2,046,979 | 306,648 | 31,641 | 246,239 | 91,797 | 11,865 | 2,735,369 |
| Injuries | 84 | 24 | 1 | 8 | 10 | 1 | 128 |
| Percent | .004% | .008% | .003% | .003% | .011% | .008% | .005% |
| 1995 | | | | | | | |
| Players | 2,060,558 | 300,122 | 30,028 | 260,529 | 96,867 | 11,242 | 2,759,346 |
| Injuries | 73 | 15 | 1 | 9 | 6 | 1 | 105 |
| Percent | .004% | .005% | .003% | .004% | .006% | .009% | .004% |
| 1996 | | | | | | | |
| Players | 2,078,439 | 288,122 | 29,873 | 271,655 | 99,563 | 11,596 | 2,779,148 |
| Injuries | 63 | 21 | 1 | 11 | 7 | 0 | 93 |
| Percent | .003% | .007% | .003% | .004% | .007% | .000% | .003% |
| 1997 | | | | | | | |
| Players | 2,061,795 | 272,977 | 29,290 | 269,467 | 95,884 | 11,221 | 2,740,634 |
| Injuries | 41 | 11 | 1 | 7 | 10 | 0 | 70 |
| Percent | .002% | .004% | .003% | .003% | .010% | .000% | .003% |

* participation has increased, level of injuries has decreased

Challenger division is included in LLBB totals. Challenger contains some players above the age of 12.
*1992 and 1993 LL includes all minors 5 - 18 and the Challenger Division.



# Sports Injuries: An Important Cause of Morbidity in Urban Youth

Tina L. Cheng, MD, MPH*‡§, Cheryl B Fields, MPH‡, Ruth A. Brenner, MD, MPH¶, Joseph L. Wright, MD, MPH‡§‖, Tracie Lomax‡; Peter C. Scheidt, MD, MPH*‡§; and the District of Columbia Child/Adolescent Injury Research Network#

ABSTRACT. *Introduction.* Sports injuries account for substantial morbidity and medical cost. To direct intervention, a population-based study of the causes and types of sports injuries was undertaken.

*Method.* An injury surveillance system was established at all trauma center hospitals that treat residents 10 to 19 years old in the District of Columbia and the Chief Medical Examiner's Office. Medical record abstractions were completed for those seen in an emergency department, admitted to the hospital, or who died from injury June 1996 through June 1998.

*Findings.* Seventeen percent ($n$ = 2563) of all injuries occurred while participating in 1 of 6 sports (baseball/softball, basketball, biking, football, skating, and soccer) resulting in an event-based injury rate of 25.0 per 1000 adolescents or 25.0/1000 population year. Rates were higher in males for all sports. The most common mechanisms were falls (E880–888) and being struck by or against objects (E916–918). Hospitalization was required in 2% of visits and there were no deaths. Of those requiring hospitalization, 51% involved other persons, 12% were equipment-related, and 8% involved poor field/surface conditions. Of all baseball injuries, 55% involved ball or bat impact often of the head. Basketball injuries included several injuries from striking against the basketball pole or rim or being struck by a falling pole or backboard. Biking injuries requiring admission included 2 straddle injuries onto the bike center bar and collision with motor vehicles. Of all football injuries, 48 (7%) involved being struck by an opponent's helmet and 63 (9%) involved inappropriate field conditions including falls on or against concrete, glass, or fixed objects. In soccer there were 4 goal post injuries and a large proportion of intracranial injuries. There were 51 probable or clear assaults during sports and an additional 30 to 41 injuries from baseball bat assaults.

*Conclusions.* Many sports including noncontact sports involved injuries of the head suggesting the need for improved head protection. Injuries involving collisions with others and assaults point to the need for supervision and enforcement of safety rules. The 16% of sports injury visits and 20% of hospitalizations related to equipment and environmental factors suggest that at least this proportion of injury may be amenable to preventive strategies. Design change may be warranted for prevention of equipment-related injuries. The many injuries involving inappropriate sports settings suggest the need for and use of available and safe locations for sports. *Pediatrics* 2000;105(3). URL: http://www.pediatrics.org/cgi/content/full/105/3/e32; *sports injuries, surveillance, sports, adolescent injuries.*

From the *Department of General Pediatrics and Adolescent Medicine, Children's National Medical Center, Washington, District of Columbia, the ‡Children's Research Institute, Washington, District of Columbia, the §George Washington University School of Medicine, Washington, District of Columbia; the ‖Department of Emergency Medicine, Children's National Medical Center, Washington, District of Columbia, and the ¶National Institutes of Child Health and Human Development, Bethesda, Maryland

#The District of Columbia Child and Adolescent Injury Research Network group members are listed in the "Acknowledgments" section.

Received for publication May 16, 1999; accepted Sep 13, 1999

Address correspondence to Tina L. Cheng, MD, MPH, Department of General Pediatrics, Children's National Medical Center, 111 Michigan Ave, NW, Washington, DC 20010 E-mail tcheng@cnmc.org



Involvement in sports has many advantages and participation is increasing. Unfortunately, injuries in youth sports account for substantial morbidity and cost.[1,2] Injury prevention interventions have been successful in preventing the occurrence or decreasing the severity of sports injuries through many mechanisms including development and enforcement of safety rules, protective gear, and changes in sports equipment and environments. Examples include decreased incidence of severe neck injuries in football after forbidding spear-tackling,[3] decreased ankle and leg injuries after the introduction of breakaway bases,[4] and decreased head injuries after enforcement of bike helmet laws.[5] Understanding the epidemiology of sports injury is a first step in developing prevention strategies.

Current surveillance systems to monitor sports-related injuries exist, but present a limited view of sports injuries. Surveillance by schools and other organizations sponsoring sport teams have provided useful information on injury rates in organized sports;[6,7] however, it is estimated that 25% to 30% of sports injuries among youth occur in organized sports.[2] The Consumer Product Safety Commission monitors injuries in sports related only to equipment and products. Hospital surveillance systems often rely on injury E-codes which describe cause of injury, but do not specify injuries occurring in sports except in a limited number of mechanisms. For instance, an injury caused by a fall on the same level from a collision, pushing, shoving by or with other persons in sports would be coded as E886.0. A fall in sports related to slipping, tripping, or stumbling would be coded as E885 which is not specific for sports. Thus, studies of sports injuries using of E-codes may not be complete in case ascertainment. Our hospital surveillance system specifically abstracted data on sports injuries. The purpose of our study was to describe the epidemiology of youth sports injuries in an urban population to guide prevention.

## METHODS

Data from the District of Columbia Adolescent Injury Surveillance System were used for this study. Injuries occurring to a District of Columbia resident 10 to 19 years old that led to an emergency department visit, hospitalization, or death on all days between June 15, 1996 and June 15, 1998 were abstracted by trained research assistants. An injury case was defined as an event of trauma, poisoning, or other injury caused by external factors. Trained research assistants reviewed emergency department logs or charts at each hospital to identify eligible cases. After case ascertainment, data were abstracted directly onto laptop computers and downloaded at the data-coordinating center at Children's National Medical Center. If a patient was hospitalized, chart abstraction included review of the entire medical record after discharge.

Study sites included emergency departments of all 6 designated hospital trauma centers located in the District of Columbia which care for the vast majority of adolescent fatal and nonfatal injuries. An additional hospital in southeast District of Columbia was also included because it receives the second highest number of emergency medical service transports of adolescents in the District of Columbia. Information on deaths in the target population was obtained from hospital records, the District of Columbia Office of the Chief Medical Examiner and the Vital Statistics Branch of the Commission of Public Health. The study was approved by the institutional review board at each site.

Chart information gathered included patient age, gender, race/ethnicity, residence by block or census tract, date of visit, time of visit, health insurance, date and time of injury, injury circumstances, and disposition. If the chart mentioned that the patient was involved in a sport activity at the time of the injury, the case was defined as a sports injury in our study and type of sport and documented use of protective gear were recorded. If activity at the time of injury was not mentioned, the case was not be included as a sports injury. Injuries were classified using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnostic N-codes and the Supplementary Classification of External Causes of Injury and Poison E-codes which provide information on the injury mechanism.[8] All codes were assigned by a trained coder and checked by a second experienced coder.

The 6 sports with >50 injuries in the 2 years of our surveillance database were analyzed (baseball/softball, basketball, biking, football, skating, and soccer). Assaults during sport activity and injuries caused by baseball bats outside of sports were analyzed separately. Patients that came to the emergency department for an injury but treatment was not authorized or patients that left before receiving treatment were excluded. Individual descriptions of the injury event were reviewed by sport and were coded regarding involvement of other persons, specific sports equipment, inappropriate sports settings (eg, falls on glass, football tackle on cement), and motor vehicle collisions.

Mechanisms to ensure quality included a training period for research assistants, use of standardized computerized coding forms, random review of emergency department logs and charts, random reabstraction of charts, review of all E-codes, and range and consistency checks of data. Case ascertainment was repeated on 10% of surveillance days by a second research assistant and was also cross-checked with data from trauma registries at those sites with functioning registries. Case ascertainment was maintained at >90% and discrepancies were discussed with research assistants. At least 3% of charts were randomly reabstracted by a second research assistant at each site. Reliability testing found >90% agreement on 5 variables (gender, race, disposition, use of alcohol and drugs, and use of weapons). E-codes possibly involving sports including struck in sports (E917.0), fall in sports (E886.0), bicycle-related injuries (E813.6, E826.0, E826.1, E826.9), overexertion and strenuous movements (E927), or while using motorized or nonmotorized recreational vehicles (E821.9, E825.9, E848, E886.9) were reviewed to ensure complete ascertainment of all sports injuries. If the chart mentioned that the patient was involved in a sport activity at the time of the injury, the case was included as a sports injury.

E-codes were grouped into mechanism-by-intent categories of the *Recommended Framework for Presenting Injury Mortality Data*.[9] Event-based and person-based rates were calculated as injury events per 1000 population per year. Repeat visits for the same injury were excluded from event-based rates and were identified by matching on a unique identifier (first 2 letters of first name, last 2 letters of last name, date of birth, and gender) and on date of injury and injury description. Person-based rates were calculated after matching on unique identifier and reflect the number of people who experienced 1 or more injuries in the 2-year period. Denominator data were derived from the US Census Bureau estimates of the population in 1997, the midpoint of the surveillance.

## RESULTS

During the 2-year study, nearly 5% of the adolescent population experienced 1 or more sports-related injury events (2563 injuries in 6 sports) that resulted in medical attention. These 6 sports made up 17% of all injury events in the surveillance. There were 2563 injury events among 2331 persons resulting in an event-based injury rate of 25.0 injuries per 1000 adolescents/year and a person-based injury rate of 22.7/1000/year. There were 51 hospitalizations (0.5/1000/year) and no deaths because of injury in the 6 sports. Males accounted for 84% of all sports injury events. The rates of injury to males were higher than females for all 6 sports (Fig 1). The most common mechanisms were falls (E880–888) and being struck by or against objects (E916–918).

Hospitalization was required in 2% (51) of visits. The percent distribution of patients hospitalized and not hospitalized for injury by sport is presented in Fig 2. Bicycling injuries accounted for the greatest proportion of hospitalizations; 6 of the 20 hospitalizations involved collisions with motor vehicles. Of those requiring hospitalization, 51% involved other persons, 12% were equipment-related, and 8% involved injury from poor field conditions. Equipment-related injuries included 2 bicycle straddle injuries onto the bike center bar resulting in a patient with testicular rupture and another with a severe vulvar hematoma. Other equipment-related hospitalizations included a basketball backboard falling on a player and internal injury from falling into handlebars. Inappropriate field conditions included injury from sharp objects on the field and falling on cement in football, and running into fixed objects during basketball.

There were 13 assault injuries inflicted during sports activity, 30 baseball bat assaults, and 11 baseball bat injuries of unclear circumstances and intent which were analyzed separately. Some assaults were precipitated by disagreement during the game. The 13 assaults included 4 stabs (basketball and football), 2 gunshot wounds (basketball and biking), 3 assaults with other objects, and 4 unarmed assaults. An additional 38 injuries in the sports database were coded as possible assaults in which the description of injury

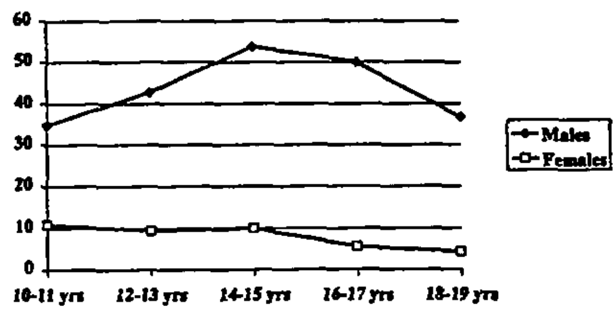



Fig 1. Rates of sports injuries by age and gender

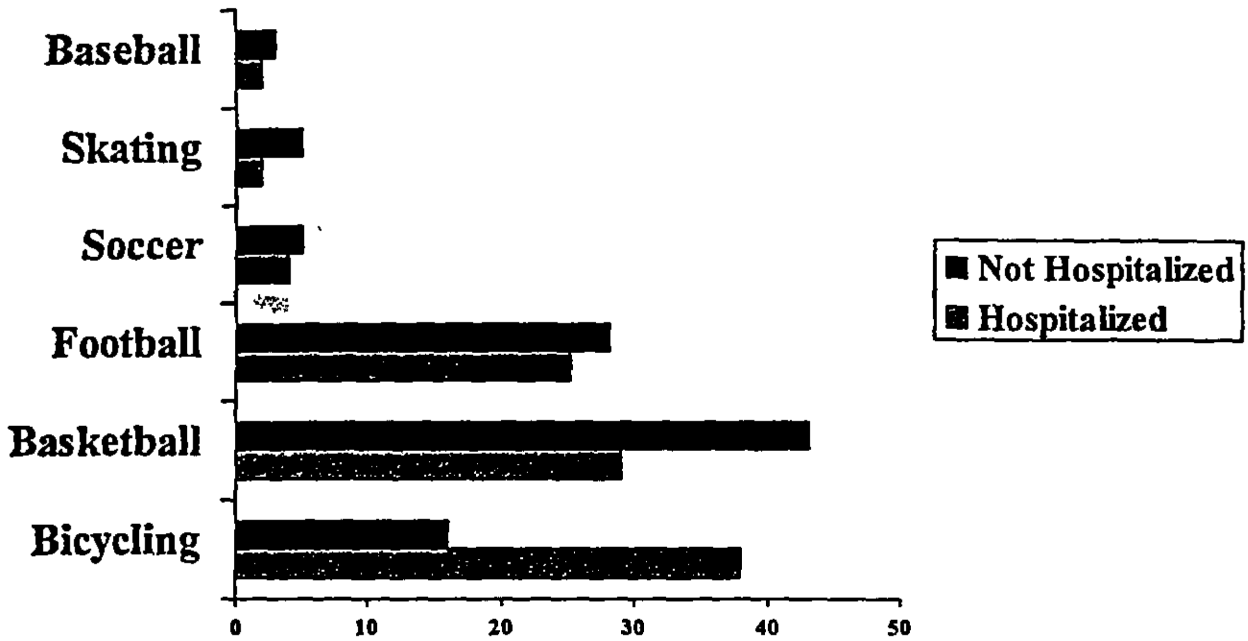



Fig 2. Percent distribution of patients hospitalized ($n$ = 51) and not hospitalized ($n$ = 2512) for sports injury by sport

was unclear to intent or contradictory. These possible assaults included human bites inflicted during basketball and football (2 requiring hospitalization), soccer brawls, aggressive football tackles, and other possible altercations.

Injury type (percent within sport) and body location (percent within sport) are presented in Table 1. Baseball/softball, bicycling, and soccer had a high proportion of intracranial and other head injuries Skating had the highest proportion of fractures mostly of the upper extremity related to falls Tables 2 and 3 present selected injuries related to equipment and environmental factors. Overall, 416 (16%) of injuries were related to equipment and environmental factors Documented use of protective gear was low In head injuries in football and bicycling, only 17% documented whether helmets were used Of those documenting use or nonuse, 42% of football injury patients and 10% of bike injury patients had worn helmets

Reviewing injuries by sport, 55% of baseball/softball injuries involved ball or bat impact often of the eye or other parts of the head Basketball injuries were most commonly finger injuries and lower extremity sprains. At least 23% of injuries involved collision with other persons. Several injuries were related to striking against the basketball pole or rim or being struck by a falling pole or backboard. Five percent of injuries were related to hitting fixed objects or falling on sharp objects. Biking injuries included many falls from bikes or collisions with fixed objects (74%) or collisions with motor vehicles (22%) Straddle injuries from the bike center bar caused 10 injuries including 2 hospitalizations. Several injuries were related to tires released during riding and falling against bicycle handlebars Of all football injuries, 48% involved collision with other persons, 48 (7%) struck by an opponent's helmet Additionally there were several injuries related to running into poles (probably the football goal post) and 63 (9%) injuries involving inappropriate field conditions (falls on or against concrete, glass, or fixed objects). Skating injuries included rollerblading (57%), ice skating (11%), skateboarding (9%), and skating unspecified (23%). Ninety-two percent of skating injuries were because of falls Wrist fractures and sprains were most common. Four (3%) skating injuries involved collision with a moving motor vehicle. In soccer, 37% of injuries involved collisions with other persons. There were 4 goal post injuries and a large proportion of intracranial injuries.

TABLE 1. Injuries in 6 Sports Injury Type and Body Location (Percent Within Sport)

| Sport | n | Injury Type (% Within Sport)* | | | | | Body Location (% Within Sport)* | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Intracranial | Fracture/ Dislocation | Open Wound | Contusion/ Abrasion | Sprain/ Strain | Head | Upper Extremity | Lower Extremity | Torso |
| Baseball/softball | 76 | 7 | 24 | 17 | 20 | 32 | 37 | 32 | 26 | 3 |
| Basketball | 1093 | 2 | 23 | 13 | 17 | 44 | 17 | 34 | 45 | 4 |
| Bicycling | 419 | 9 | 20 | 27 | 34 | 8 | 29 | 34 | 29 | 7 |
| Football | 728 | 5 | 29 | 11 | 23 | 31 | 16 | 47 | 28 | 8 |
| Skating | 127 | 4 | 39 | 9 | 17 | 25 | 10 | 50 | 30 | 9 |
| Soccer | 120 | 10 | 26 | 7 | 30 | 25 | 22 | 30 | 41 | 8 |

* Percentages may not add to 100 because of rounding or other injuries

TABLE 2. Selected Equipment-related Injuries

| Sport | Equipment | Injury Cause and Injury Type |
|---|---|---|
| Bicycling | Bike center bar | 10 straddle injuries from falls |
| | | 4 labial/scrotal/penile open wounds |
| | | 3 labial/scrotal/penile contusions |
| | | 2 vulvar*/scrotal hematomas |
| | | 1 testicular rupture* |
| | Tire release | 8 injuries from falls due to tire release |
| | | 3 open head wounds |
| | | 2 closed head injuries |
| | | 2 facial contusions |
| | | 1 extremity contusion |
| | Handlebars | 14 injuries from striking against handlebars |
| | | 6 contusions |
| | | 5 lacerations |
| | | 1 closed head injury |
| | | 1 intraabdominal trauma |
| | | 1 finger fracture |
| Soccer | Goal post | 4 injuries from striking goal post |
| | | 3 closed head injuries |
| | | 1 arm contusion |
| Baseball/Softball | Baseball bat | 11 injuries being struck by bat in sport† |
| | | 3 open head wounds |
| | | 2 facial fractures |
| | | 2 closed head injuries |
| | | 2 arm fractures |
| | | 1 scalp contusion |
| | | 1 extremity contusion |
| | Baseball | 31 injuries from being struck by baseball |
| | | 8 open head wounds |
| | | 5 eye injuries |
| | | 4 hand fractures |
| | | 4 hand sprains |
| | | 3 closed head injuries |
| | | 3 hand contusions |
| | | 2 facial fractures |
| | | 1 leg contusion |
| | | 1 chest contusion |
| Basketball | Backboard and pole | 5 injuries being struck by falling backboard or pole |
| | | 3 head lacerations |
| | | 1 head contusion |
| | | 1 leg fracture* |
| | | 17 injuries from striking basketball pole |
| | | 8 extremity contusions |
| | | 4 open head wounds |
| | | 2 hand fractures |
| | | 2 torso contusions |
| | | 1 head contusion |
| | Basket rim | 8 injuries from striking basket rim |
| | | 5 hand fractures |
| | | 2 hand lacerations |
| | | 1 hand abrasion |
| Football | Helmet | 48 injuries from being struck by helmet |
| | | 19 contusions |
| | | 13 fractures |
| | | 9 sprains/strains |
| | | 5 lacerations |
| | | 2 extremity effusions |
| | Football pole | 11 injuries from striking pole |
| | | 3 open head wounds |
| | | 2 closed head injuries |
| | | 3 extremity contusions |
| | | 1 leg sprain |
| | | 1 head contusion |
| | | 1 penile laceration |

* Injury for which patient was hospitalized
† There were an additional 11 baseball bat injuries of unclear circumstances and intent and 30 baseball bat injuries by assault (see text).

## DISCUSSION

A significant proportion of this urban adolescent population (5%) experienced at least 1 sports-related injury event requiring medical attention during the 2-year period. These injuries resulted in 2563 emergency department visits. Although we were not able to disentangle exposure from inherent danger of different sports, prevention efforts should be directed

**TABLE 3.** Selected Injuries Related to Environmental Factors

| Sport | Environment | Injury Cause and Injury Type |
|---|---|---|
| Football | Cement | 26 injuries from falls on cement |
| | | 8 open wounds (4 head) |
| | | 8 contusions |
| | | 6 closed head injuries* |
| | | 3 sprains |
| | | 2 leg fractures |
| | Walls, fences, cars | 23 *injuries from striking against objects* |
| | | 6 open wounds (3 head) |
| | | 6 sprains/strains |
| | | 5 leg contusions |
| | | 3 closed head injuries |
| | | 2 leg fractures |
| | | 1 clavicle fracture |
| | Glass, metal, sticks, stones | 12 injuries from falling on sharp objects |
| | | 11 open wounds |
| | | 1 eye injury* |
| | | 1 arm contusions |
| Basketball | Walls, fences, cars, bleachers, signs | 37 injuries from striking against objects |
| | | 14 open wounds (8 head) |
| | | 11 sprains/strains |
| | | 5 contusions |
| | | 4 closed head injuries* |
| | | 3 *extremity fractures** |
| | Glass, metal, sticks, stones | 12 injuries from falling on sharp objects |
| | | *11 open wounds (6 hand)* |
| | | 1 arm contusions |
| Bicycling | Motor vehicle collision | *92 injuries from collision with motor vehicle* |
| Skating | Motor vehicle collision | 4 injuries from collision with motor vehicle |

* Injury for which patient was hospitalized

toward injuries of high frequency and severity to reduce injury-related morbidity. Most previous studies have been sport-specific or of limited samples. We study the epidemiology of youth sports injuries across several sports allowing comparative review of the severity and prevalence of specific injuries and offering clues to prevention strategies.

Limitations to the study should be considered. First, this study underestimates the true rate of adolescent sports injury in this population because this study did not include all health care facilities to which District of Columbia youth may have gone. We did include all trauma hospitals in the District of Columbia and likely included the serious sports injuries. Second, chart abstraction data are limited to what is asked of patients and what is documented. Many charts do not mention the activity during the injury or the injury circumstances and may simply state "sprained ankle." Again, this underestimates sports injuries and the contribution of equipment and environmental factors. Third, the cases included are mainly representative of acute injury events and do not describe the many chronic injuries related to sports. Finally, we calculate population rates of injury, but because we did not know the number of youth involved in sports, we were unable to calculate injury rates among sports participants.

Hergenroeder[2] outlines 6 potential mechanisms for reducing injuries in youth sports including 1) the preseason physical examination, 2) medical coverage at sporting events, 3), proper coaching, 4) adequate hydration, 5) proper officiating, and 6) proper equipment and field/surface playing conditions. Other mechanisms which may be included in the latter category include the development and regulation or legislation of protective gear use and redesign or elimination of equipment. This study highlights some potential sports injury interventions.

Many sports including noncontact sports involved collisions with other persons and injuries of the head. Large proportions of soccer and basketball injuries involved contact with other persons. The large proportion of head injuries in baseball/softball, soccer, and bicycling suggest the need for further study of head protection. The proportion of intracranial injuries among soccer injuries was especially high warranting further investigation. Unfortunately, chart documentation of helmet use or nonuse in sport activity was poor and thus, conclusions could not made about specific prevention strategies needed. Helmet use, safety rules, proper officiating, and supervision may all play a role in preventing these injuries.

The large number of assaults or possible assaults during sports is of concern. Our estimates of sports-related assaults are likely underestimates because documentation of contact with others and intentional motive may be incomplete or difficult to ascertain. For instance, there were many injuries involving human bites, head butting, and elbow throwing in basketball which may have been unintentional or may have been intentional acts, with or without intent to cause harm.[10] One study of men's soccer attributed 30% of soccer injuries to foul play.[11] Some have advocated involvement in sports as a means to keep young people involved in activities and out of trouble, although others have believed that sports competition can precipitate disagreements and promote physical aggression. Participation in sports allows the opportunity to address issues of peer socialization and conflict resolution The high number of interpersonal contact injuries and possible assaults in our study suggest the need for adequate supervision, coaching, development and enforcement of safety rules, and teaching of sportsman-like behavior to ensure safety in youth sports

The large number of equipment-related injuries suggest redesign possibilities. The bike straddle injuries, 2 requiring hospitalization, could be ameliorated with padding on the center bar or removal of the bar in boy's bikes We found several handlebar injuries which have previously been reported as "hidden spears" in need of redesign [12] The goal post injuries in soccer, and pole injuries in basketball and football suggest the need for padding or break-away posts. Although football inherently involves collisions between people, the large number of injuries from impact with the helmet suggests the need to consider helmet redesign and padding Several helmet injuries resulted from impact with the hard helmet whereas others involved fingers caught in helmet face pieces.

Finally, the large proportion of youth injured in unsafe sports settings is disconcerting Although we do not know the actual location or setting of the injury event, the descriptions of the mechanism of injury suggest poor field conditions or unsafe locations. In many areas including this urban area, sports playing areas are in short supply and may not be properly maintained Injuries in bicycling and skating because of collisions with motor vehicles suggest that separation of bicyclers and skaters from motorists with bike lanes or other sports-designated areas may be effective Encouraging youth to use such locations and protective gear may reduce sports injuries. Clearly, safe and available locations for recreation are needed if youth are to enjoy the many benefits of sports.

This study demonstrates the usefulness of injury surveillance in identifying potential prevention strategies. Although surveillance requires an investment in resources, describing the epidemiology of injury is the first essential step in public health model of injury prevention and control.[13] This study highlights the need for further more detailed surveillance with greater focus on equipment and protective gear use, field conditions, and circumstances of injury. This might include more focused interviews with patients and witnesses of the injury and viewing the actual equipment, damage, and environment where the injury occurred. Additionally, biomechanical studies are needed to explore the equipment-related injuries and guide possible design modifications. Finally, regulatory approaches to coaching and officiating qualifications and curricula, and maintenance and monitoring of youth athletic facilities should be explored. Despite advances in injury prevention in sports, sports injuries continue to affect a significant proportion of the population The 16% of sports injury visits and 20% of hospitalizations related to equipment and environmental factors suggest that at least this proportion of injury may be amenable to preventive strategies.

## ACKNOWLEDGMENTS

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# Change in Bat Rule Proposed in High School Baseball

FOR IMMEDIATE RELEASE	Contact: Brad Rumble

KANSAS CITY, MO (July 29, 1999) — The National Federation of State High School Associations' Baseball Rules Committee has proposed a change in the specifications for non-wood bats that in size, weight and moment of inertia would replicate wood.

The new rule, which, if adopted by the NFHS Board of Directors, would be phased in through the 2001 season, would require that non-wood bats have a 2 5/8-inch maximum barrel diameter, a minus-3 unit maximum differential (measured without the grip) and a minimum moment of inertia of 9,000 $oz\text{-}in^2$ measured at the 6-inch point from the knob. Such a weight and moment of inertia would cause the effort required to swing a non-wood bat to replicate closely the effort required to swing a wooden bat.

The committee noted that it intends to adopt a maximum exit ball speed as well, but stated that it believed it was premature to do so at this point and will consider adoption of a maximum exit speed of the ball next summer, with a target implementation of January 2002.

Currently, high school baseball rules limit the barrel diameter to 2¾ inches and allow for a minus-5 difference in the length and weight of the bat, which means that a bat cannot weigh more than 5 ounces less than the length of the bat, e.g., a 35-inch-long bat cannot be less than 30 ounces. If the new rule is approved, a 35-inch-long bat could not weigh less than 32 ounces.

Because of the unusually high level of interest and the diversity of opinion that exists throughout the nation with respect to baseball bats, the NFHS Board of Directors decided that this proposed bat rule change should be circulated to the NFHS membership and other interested parties known to the NFHS, as well as released to the media and the general public through the NFHS Web site (nfhs.org). Individuals will have 30 days (until August 19) to respond to this proposed change in baseball bats, and public comment is invited. After the 30-day period, the NFHS Board of Directors will meet by conference call to consider adoption of the proposal.

The Baseball Rules Committee had the following to say regarding its proposal to implement the aforementioned bat standards:

"We do not want to act in a way that imposes undue hardship on any of the affected parties – student-athletes, parents, high schools, dealers and manufacturers. Rules are exact, but the rule-making process often cannot be. We must do the best job we can in the midst of well-meaning but often conflicting interests and beliefs. At this time, the changes we are proposing seem to us to be appropriate for play at the high school level.

"With respect to implementation, we are guided by the premise that the greater the safety risk posed by a given product or procedure, the greater the economic dislocation appropriate when fashioning a remedy. Bats pose some safety risks to student-athletes, coaches, umpires and spectators. The abrupt disallowance of certain previously permissible bats would cause some hardship to student-athletes, parents, high schools, dealers and manufacturers.

"We are aware that student-athletes have suffered bat-related injuries in 1999 and in previous years. However, the committee is not aware of a material change in the rate of such injuries. Nor does the committee believe that the rate of such injuries has yet become materially greater than it would be if wooden bats were in general use. The change proposed by the committee may be viewed, in part, as precautionary against a future uptrend in injuries."

The rule change suggested by the committee is a lowering of the ceiling of permissible bat performance. Non-wood bats meeting the new three-part criteria set forth herein have always been permissible, and student-athletes and high schools are free to utilize them immediately.

The committee has recommended a two-year phase-out period for bats that are currently permissible, but that would no longer be allowed after the new rule takes full effect. During the first year (the 2000 season), such bats, whenever purchased, could be used. During the second year (the 2001 season), such bats that were purchased before the end of the 1999-2000 academic year could be used. Effective with the 2002 season, such bats would no longer be permissible.

###

**MEDIA CONTACT:** Bruce Howard or John Gillis, 317.972.6900

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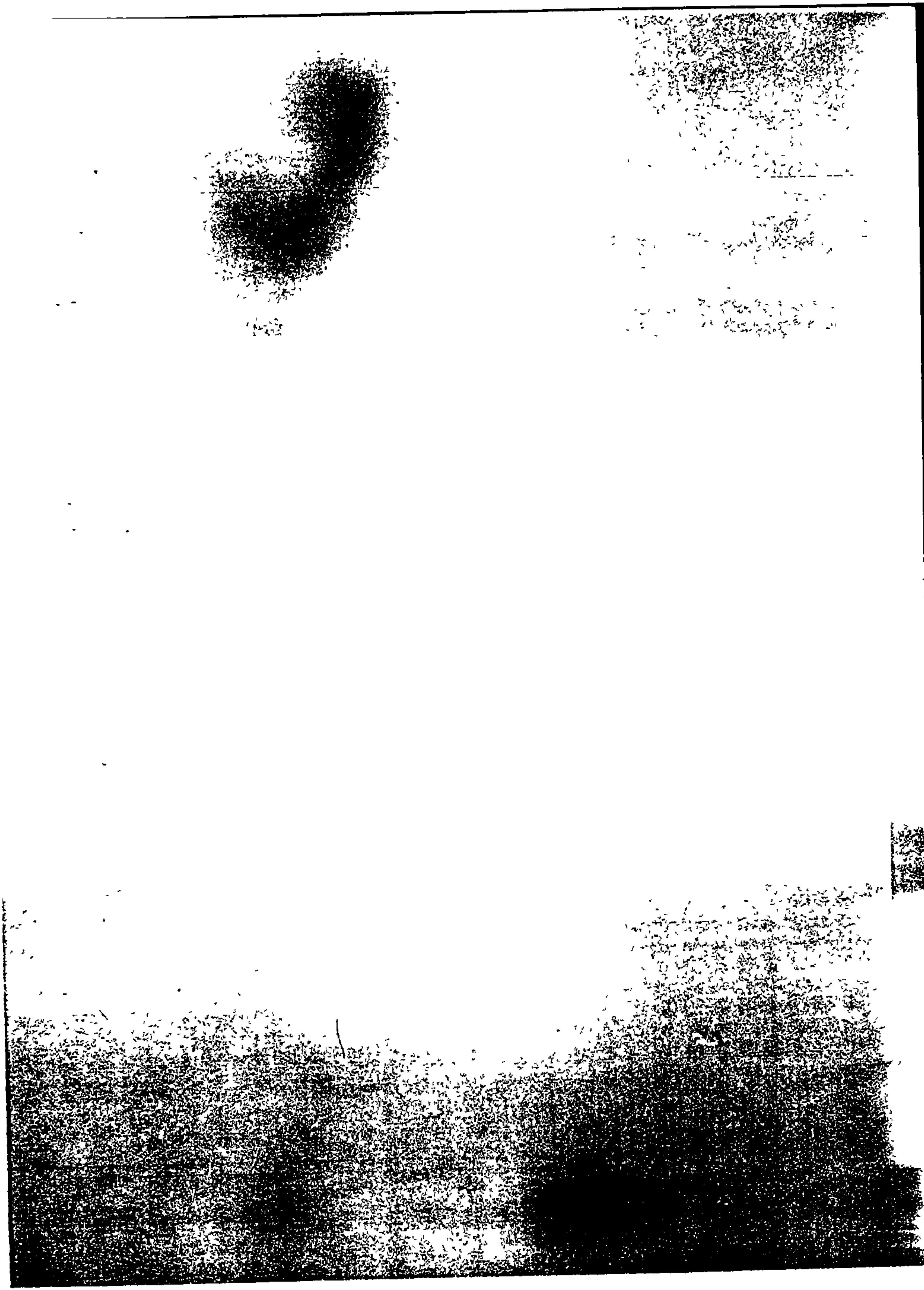

National High School

# BASEBALL COACHES ASSOCIATION

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MEMORANDUM



August 11, 1999

TO: NFHS Board of Directors.

SUBJECT: Proposed Bat Rule Changes.

The National High School Baseball Coaches Association (BCA) appreciates having the opportunity to express the views of the majority of its membership on the use of the current aluminum bats and the recommended rule changes.

The association knows the Federation's Baseball Rules Committee has worked diligently on trying to do what is best for high school baseball with regard to aluminum bats.

The Rules Committee listed three factors considering rule changes: 1. Risk minimization; 2. Balance between offense and defense; and 3. Preservation of the sound traditions of baseball.

The Rules Committee acknowledged "that the rate of such (aluminum bat) injuries has yet to become materially greater than it would be if wooden bats were in general use".

Thus, with the risk factor not being a need for change the other major concerns were the balance between offense and defense and the tradition of baseball.

Our association would offer the following information it developed in hopes of finding some form of a measuring stick on scoring during the 1999 season.

The BCA used the state championships and the major tournaments' final scores to obtain the average runs scored by the two teams.

In championship finals games, the two teams averaged a total of 10.62 runs (2055 runs in 193 games). That's a 6-5, 7-4 or however you want to break-it-down game score.

The highest scoring game was the Arizona 3A finals where Payson defeated Cactus Shadows 23-11. The lowest scoring game was Xaverian's 1-0 win over Iona Prep in the New York City Catholic League finals.

In the tournament finals, the two teams averaged a total of 12 runs (425 runs in 35 games). The biggest score came in the International Paper Classic where Lexington (SC) defeated Mauldin (SC) 14-10, while the low score came in the Horizon National Invitational in Arizona where host Horizon nudged Chaparral 1-0.

In the BCA's opinion, the championship and tournament finals survey shows high school baseball continues to be competitive with no reason to fear about the integrity of the game. There will be wild scores just as there will be pitching duels — that's baseball.

Baseball at all levels is having great success, perhaps the greatest ever. Doesn't that translate into the players and fans enjoying the game?

One final concern our association has is participation. Each year the participation survey conducted by the Federation has continued to show an increase in baseball, which is not true of all sports.

The fact that a youngster regardless of size has an equal chance to hit is a major attraction in baseball for kids. The current aluminum bats provide that opportunity and any change to heavier bats could eliminate it.

If the recommendations are approved by the Board of Directors, may we suggest the Federation test the new standards before making them new rules. We believe it is important to know the effects of any proposed standard. Bat manufacturers undoubtedly would be agreeable to making prototype bats for testing to provide the needed information on the effect of any change.

Like it or not, the aluminum bat has been good for high school baseball as well as colleges and youth programs. Realistically, in many cases, the aluminum bat has saved the sport of baseball from elimination.

We offer this information and suggestions in hopes of maintaining the popularity of baseball and its vast playing opportunity for youngsters.

JERRY MILES
Executive Director

JAM:em

# Traumatic Brain Injury in High School Athletes

John W. Powell, PhD, ATC
Kim D. Barber-Foss, MS, ATC

**Context** The potential seriousness of mild traumatic brain injury (MTBI) is increasingly recognized, however, information on the frequency of MTBI among high school athletes is limited

**Objective** To identify the type, frequency, and severity of MTBI in selected high school sports activities

**Design** Observational cohort study

**Setting and Participants** Two hundred forty-six certified athletic trainers recorded injury and exposure data for high school varsity athletes participating in boys' football, wrestling, baseball and field hockey, girls' volleyball and softball, boys' and girls' basketball, and boys' and girls' soccer at 235 US high schools during 1 or more of the 1995-1997 academic years

**Main Outcome Measures** Rates of reported MTBI, defined as a head-injured player who was removed from participation and evaluated by an athletic trainer or physician prior to returning to participation National incidence figures for MTBI also were estimated

**Results** Of 23 566 reported injuries in the 10 sports during the 3-year study period, 1219 (5 5%) were MTBIs Of the MTBIs, football accounted for 773 (63 4%) of cases; wrestling, 128 (10 5%), girls' soccer, 76 (6 2%), boys' soccer, 69 (5 7%), girls' basketball, 63 (5 2%), boys' basketball, 51 (4 2%), softball 25 (2 1%), baseball, 15 (1 2%), field hockey, 13 (1 1%), and volleyball, 6 (0 5%) The injury rates per 100 player-seasons were 3 66 for football, 1 58 for wrestling, 1 14 for girls' soccer, 1 04 for girls' basketball, 0 92 for boys' soccer, 0 75 for boys' basketball, 0 46 for softball, 0 46 for field hockey, 0 23 for baseball, and 0 14 for volleyball The median time lost from participation for all MTBIs was 3 days There were 6 cases of subdural hematoma and intracranial injury reported in football Based on these data, an estimated 62 816 cases of MTBI occur annually among high school varsity athletes participating in these sports, with football accounting for about 63% of cases

**Conclusions** Rates of MTBI vary among sports and none of the 10 popular high school sports we studied is without the occurrence of an MTBI. Continued involvement of high school sports sponsors, researchers, medical professionals, coaches, and sports participants is essential to help minimize the risk of MTBI

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High school students who choose to participate in sports place themselves at risk for a sports-related injury.[1] An important area for concern is injury that may result from a rotational or linear force applied to the head and brain from a direct impact or indirect force (ie, acceleration/deceleration).[2] These forces may result in a minimal injury to the brain or may cause permanent disability or death.

The term *concussion* previously was defined as "a clinical syndrome characterized by immediate and transient posttraumatic impairment of neural function, such as alteration of consciousness and disturbance of vision or equilibrium due to brain-stem involvement."[3] In recent literature, concussion has been defined as a trauma-induced alteration in mental status that may or may not involve a loss of consciousness.[4,5] Recently, the terms *mild head injury*, *traumatic brain injury*, or *mild traumatic brain injury* (MTBI) have been used to describe brain injuries.[2,6,7] The definitions of these terms include a review of the signs and symptoms and the loss of consciousness and amnesia. In this article we use MTBI to describe injuries for which the injured player was removed from participation and evaluated for a traumatic brain or head injury by the athletic trainer, physician, or both, prior to returning to participation.

**See also pp 954, 964, 971, 974, and 989.**

In this study, we examined the frequency patterns for MTBI that are associated with participation in 10 selected high school sports football, boys' and girls' basketball, boys' and girls soccer, wrestling, field hockey, baseball, softball, and girls' volleyball.

## METHODS

This study used data from the National Athletic Trainer Association (NATA) injury surveillance program, which was designed to assess the impact that sport-related risk factors have on the incidence of injuries among high school varsity athletes Data recording materials were designed to use the strengths of the National Athletic In-

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jury/Illness Reporting Systems, the 1986-1988 NATA study and injury surveillance systems in place for the National Collegiate Athletic Association, the National Football League, and the National Hockey League.[8,9]

### Schools and Subjects

From the 350 NATA-certified athletic trainers who volunteered to participate in the project, 246 were selected to participate. For athletic trainers to participate, they had to (1) work directly with high school sports programs on a daily basis, (2) work within a geographic distribution among the 50 states, and (3) fit a broad representation from different-sized schools within the various parts of the country. These procedures created a stratified cluster sample representing high schools with different-sized student enrollments.

The distribution of the NATA study sample by size of school enrollment was similar to size of school distribution reported by the National Center for Education Statistics in 1994.[10] Compared with National Center for Education Statistics data, the study had less representation in schools with enrollments of fewer than 500 (11.9% vs 15.3%) and 500 to 1000 (20% vs 30.2%), higher representation in schools with enrollment of 1001 to 1500 (31.9% vs 24.7%) and 1501 vs 2000 (22.6% vs 14.5%), and similar representation for schools with more than 2000 students (13.6% vs 14.4%).

A total of 114 high schools participated for 3 years of the study, 42 recorded data for 2 of the 3 school years, and 79 (27 in 1995, 20 in 1996, and 32 in 1997) contributed complete data for only 1 school year. Because not all schools offered all 10 sports, the number of team-seasons (1 team in 1 season) for each sport varied. For the majority of schools, 1 athletic trainer recorded data for all sports. As new athletic trainers entered the study, special emphasis was given to them to provide a smooth transition into the recording process and the system requirements.

The subjects in the study are athletes who were included as participants on the varsity sports rosters at the study schools. No effort was made to manipulate or control the athlete's participation in sports. All references to the player's data that were submitted to the research office were coded by the participating athletic trainers so that the player could not be identified. The project did not place players at risk, but only observed and recorded the experiences of this population of athletes as they participated in their chosen sport. The certified athletic trainers were required to submit to the research office a written permission to participate statement from their school's athletic director prior to submitting data.

### Definitions and Data Reporting

Prior to the beginning of the study, the operational definitions and reporting requirements were included in a user's manual and distributed to all athletic trainers. Data were recorded by the athletic trainers using a customized version of the Sports Injury Monitoring System (Med Sports Systems, Iowa City, Iowa) and were transferred to the central database using manual or electronic procedures. Schools without access to computers provided data using paper forms that paralleled the software. All reported data were subject to specific procedures for verification. Data collected included player height, weight, age, type of session (game or practice), number of participants, player position and player activity, team activity, playing surface at the time of injury, and time lost from participation.

A reportable injury in the NATA study included an incident that caused cessation of customary participation in the current session (game or practice) or on the day following the day of injury onset. A reportable injury was also any fracture or dental injury that occurred, even though the athlete might not have missed a scheduled session.

A reportable MTBI in the NATA study was identified by the certified athletic trainer when the injury required the cessation of a player's participation for initial observation and evaluation of the injury signs and symptoms before returning to play, either in the current session or subsequent sessions. By using this definition of MTBI, athletic trainers were able to report cases that they observed or were reported to them for which they conducted an evaluation for MTBI. Athletic trainers were not asked to grade the injury, but only to report that the player's participation was suspended while an evaluation for MTBI was conducted.

The days lost from participation following an MTBI was used as an indicator of the relative effect the injury had on the player's participation in sports. Players were classified as having injuries that resulted in loss of participation for fewer than 8 days, between 8 and 21 days, or more than 21 days.[1,8,9,11,12]

### Data Analysis

Injury rates per 100 player-seasons reflect the number of injuries reported divided by the number of players who were subjects in the study. Using the case rates per 100 player-seasons, the individual season data were statistically tested to determine if the year of recording showed variation in the injury rates.[13] The results identified homogeneity among the seasons for each sport. The 95% confidence intervals for the injury rates were calculated using statistical software (EpiCalc 2000, Version 1.0, Brixton Health, Llanidloes, Powys, Wales) using methods described by Kirkwood.[14]

Athlete exposure or opportunities for injury are calculated by aggregating the number of participants for each game or practice. For example, 100 players in each of 5 practices would equal 500 athlete exposures. Only those persons who played in the game accumulated game exposures. Injury rates for the aggregate of the 3 study years are compared with a reference base of 1000 athlete exposures.

The incidence density ratio (IDR) was used to compare injury rates among sports and within the conditions of the sport. The IDR was based on the injury rates per 1000 athlete exposures and used as an estimate of the relative risk of injury. For example, the IDR that compares practices and games was cal-

**Table 1.** Mild Traumatic Brain Injury Cases, Injury Rates, and Rates per 1000 Athlete Exposures

| | Boys' Sports | | | | |
|---|---|---|---|---|---|
| | Baseball | Basketball | Football | Soccer | Wrestling |
| Team-seasons | 324 | 406 | 400 | 315 | 328 |
| Player seasons | 6502 | 6831 | 21 122 | 7539 | 8117 |
| No. of MTBI cases (% of all MTBI) | 15 (1.2) | 51 (4.2) | 773 (63.4) | 69 (5.7) | 128 (10.5) |
| Percentage of all reported injuries (95% CI) | 1.7 (1.0-2.9) | 2.6 (2.0-3.5) | 7.3 (7.1-8.1) | 3.9 (3.1-4.9) | 4.4 (3.7-5.2) |
| Injury rate (95% CI) per | | | | | |
| 100 player-season exposures | 0.23 (0.11-0.35) | 0.75 (0.54-0.95) | 3.66 (3.40-3.92) | 0.92 (0.70-1.13) | 1.58 (1.30-1.85) |
| 1000 athlete exposures | 0.05 (0.02-0.07) | 0.11 (0.08-0.15) | 0.59 (0.19-1.04) | 0.18 (0.14-0.22) | 0.25 (0.24-0.29) |
| 1000 practice exposures | 0.03 (0.01-0.05) | 0.06 (0.03-0.08) | 0.25 (0.16-0.34) | 0.04 (0.01-0.06) | 0.17 (0.13-0.21) |
| 1000 game exposures | 0.12 (0.04-0.19) | 0.28 (0.18-0.38) | 2.82 (2.58-3.07) | 0.57 (0.43-0.72) | 0.51 (0.38-0.64) |
| Incidence density ratio (95% CI)† | 4.5 (1.76-11.5) | 4.9 (2.9-8.1) | 11.4 (10.1-12.8) | 16.2 (9.9-26.6) | 3.1 (2.2-4.2) |

*CI indicates confidence interval
†Calculated as game divided by practice

**Table 2.** Relative Frequency and Injury Rates Based on Time Lost From Participation Following Mild Traumatic Brain Injury (MTBI) 1995-1997

| | Boys' Sports | | | | |
|---|---|---|---|---|---|
| Time Lost From Participation | Baseball | Basketball | Football | Soccer | Wrestling |
| <8 d | 8 | 45 | 620 | 57 | 98 |
| MTBI cases % | 53.3 | 88.2 | 77.8 | 82.6 | 76.6 |
| Injury rate (95% CI)* | 0.12 (0.04-0.21) | 0.67 (0.47-0.85) | 2.92 (2.70-3.17) | 0.75 (0.56-0.95) | 1.23 (0.97-1.45) |
| 8-21 d | 7 | 5 | 140 | 8 | 18 |
| MTBI cases % | 46.7 | 9.8 | 17.6 | 11.6 | 14.1 |
| Injury rate (95% CI)* | 0.11 (0.03-0.19) | 0.07 (0.01-0.14) | 0.66 (0.55-0.77) | 0.11 (0.11-0.18) | 0.23 (0.12-0.32) |
| >21 d | 0 | 1 | 37 | 4 | 12 |
| MTBI cases % | 0 | 2.0 | 4.6 | 5.8 | 9.4 |
| Injury rate (95% CI)* | 0 | 0.01 (0-0.04) | 0.17 (0.12-0.23) | 0.05 (0-0.11) | 0.15 (0.06-0.23) |

*Per 100 player seasons. CI indicates confidence interval

culated by dividing the injury rate in games by the injury rates for practice and describes the relative risk of injury for games compared with practices. To test the null hypothesis of no difference between the 2 injury rates, a procedure that uses a standard normal approximation to the binomial distribution was used.[15] Test-based 95% confidence intervals were calculated according to the methods of Miettinen.[16]

Subdural hematoma and episodes of intracerebral bleeding are included in the patterns of injury and removed from the analysis when time lost consideration is presented. These more serious brain injuries are described separately.

To estimate national incidence of MTBI in these 10 sports, the number of players in the United States was estimated from the participation data obtained from the National Federation of State High School Association's handbooks for 1995, 1996, and 1997. The Federation estimates that its records account for approximately 89% of US high school participants. For this study, the US participation numbers were estimated by dividing the National Federation of State High School Association data by 0.89. The incidence estimates were calculated by multiplying the injury rate per player times the estimated number of players.

## RESULTS

For the 10 high school sports we studied during the 1995, 1996, and 1997 academic years, the NATA project documented 74 298 player-seasons from 3195 team-seasons, 23 566 reportable injuries, and more than 4.4 million opportunities to be injured (athlete exposures). Of the reported injuries, 1219 (5.5%) were MTBIs. The median time loss for reported MTBI was 3 days. In 89% of the cases, the injured player was removed from the session and 54.8% of the injured players were referred to a physician, medical clinic, or hospital for additional evaluation. (The findings of these medical evaluations are not included in this study.) Data on rates of MTBI for the 10 study sports are shown in TABLE 1 and TABLE 2.

### Football

Of all sports, football had the highest number and rates of MTBI (Table 1). Injury rates were 11 times higher (IDR, 11.4) for games than for practice. The conditions surrounding the tackle, either tackling or being tackled, accounted for the greatest frequency for MTBI in both practices (61.1%) and games (63.5%). The median time lost due to an MTBI was 3 days.

The largest proportions of MTBIs occured among linebackers (14.3%), run-

| Girls' Sports | | | | |
|---|---|---|---|---|
| Basketball | Field Hockey | Softball | Soccer | Volleyball |
| 395 | 128 | 311 | 292 | 296 |
| 6083 | 2805 | 5435 | 5642 | 4222 |
| 63 (5.2) | 13 (1 1) | 25 (2 1) | 76 (6.2) | 6 (0 5) |
| 3.6 (2.9-4 7) | 2.5 (1 4-4 4) | 2 7 (1.9-4 2) | 4 3 (3 4-5 4) | 1 0 (0 4-2 3) |
| 1 04 (0 78-1.29) | 0 46 (0 21-0 72) | 0 46 (0.28-0 64) | 1 14 (1 04-1 65) | 0 14 (0 03-0.26) |
| 0.16 (0 12-0.21) | 0 09 (0 04-0 15) | 0 10 (0 06-0 14) | 0 23 (0 18-0.28) | 0 02 (0-0 03) |
| 0 07 (0.04-0 10) | 0 02 (0-0 05) | 0 08 (0 04-0 12) | 0 05 (0 02-0 08) | 0 02 (0-0 05) |
| 0.42 (0.29-0 54) | 0 29 (0 12-0 46) | 0 13 (0.05-0.22) | 0 71 (0 53-0 88) | 0 01 (0-0 03) |
| 6.1 (3.8-9.7) | 14 4 (4 6-44 9) | 1 6 (0 70-3 5) | 14 4 (9 0-23 0) | 0 5 (0 09-2 48) |

| Girls' Sports | | | | |
|---|---|---|---|---|
| Basketball | Field Hockey | Softball | Soccer | Volleyball |
| 54 | 11 | 23 | 61 | 5 |
| 83 1 | 84 6 | 88 5 | 80 3 | 83 3 |
| 0 90 (0 65-1.12) | 0 39 (0 16-0 62) | 0 42 (0 25-0 60) | 1 06 (0 81-1 35) | 0 12 (0 02-0.22) |
| 9 | 2 | 3 | 14 | 1 |
| 13.8 | 15 4 | 11 5 | 18 4 | 16 7 |
| 0 15 (0 05-0.25) | 0 07 (0-0 17) | 0 06 (0-0 12) | 0 25 (0 19-0 38) | 0 02 (0-0 07) |
| 2 | 0 | 0 | 1 | 0 |
| 3 1 | 0 | 0 | 1 3 | 0 |
| 0.03 (0-0 08) | 0 | 0 | 0 2 (0-0 05) | 0 |

ning backs (14.0%), and offensive linemen (13.4%). The highest injury rate per 100 team-game positions (ie, the number of team games multiplied by the number of players in the various positions [1 quarterback, 1 tight end, 2 running backs, 2 wide receivers, 3 linebackers, 4 defensive linemen, 5 offensive linemen]) was for the quarterback (1.3) compared with running backs (0.74) and linebackers (0 52).

During the study, 693 different players sustained an MTBI while playing football, including 621 (89 6%) who sustained only 1 injury, 65 players who had 2 MTBIs, 6 players who had 3 MTBIs, and 1 player who had 4 MTBIs Of the 72 players who were reinjured, 47 had a second MTBI in the same season and 14 had a second MTBI in the next season. One person had 3 MTBIs in 1 season and 1 person had 4 MTBIs in 1 season. There were 4 cases of subdural hematoma and 2 cases of intracerebral bleeding reported in the 3 seasons of football and none in any of the other sports Of these 6 players, 3 returned to football the following season and 3 did not but did return to participate in other types of sports and physical activities There were no deaths

### Wrestling

More than half of the cases of MTBI in wrestling (53%) occurred during practices. The injury rate for MTBI in matches is 3 1 times higher than practice sessions. The MTBI cases were fairly evenly distributed among the various weight classes for both matches and practices Player activity most often associated with MTBI was the takedown or attempted takedown both in practice (64 6%) and in matches (70 0%) During the 3 study years, 115 different players sustained an MTBI, and 11 players had a second MTBI The median time lost due to an MTBI was 2 days

### Basketball

Games accounted for 62 8% of the reported MTBIs in boys basketball, with an IDR 4 9 times the MTBI injury rate for games compared with practices The MTBI occurred most often as a result of collisions between players in both practices (42 1%) and games (53 1%) Players designated as guards accounted for 62 5% of the game-related MTBIs whereas forwards sustained 68 4% of the practice-related MTBIs The median time lost due to an MTBI was 2 days There were 51 different players who sustained an MTBI One person sustained an MTBI in 1 season followed by 1 in the next season

In girls' basketball, 68 3% of MTBIs occurred in games with an IDR 6 1 times the injury rate for practices The injury pattern shows MTBIs occurring in guards accounting for 56 4% of the game-related cases with 62.5% of practice-related MTBIs occurring in forwards. In games, 41 3% of the MTBIs occurred during rebounding and 46.5% of the cases resulted from collisions with players The median time lost due to an MTBI was 2 days Fifty-nine different players sustained an MTBI, and 4 players sustained a second episode.

### Soccer

Boys' soccer games accounted for 85 5% of the injuries and the injury rate was 16 2 times greater for a game than a practice. Players on the forward line and the halfbacks sustained 66.1% of the injuries and the goalkeeper accounted for 11 9% of MTBIs The MTBI most often occurred from collisions while heading the ball (59.3%). The second most frequent cases of MTBI occurred from collisions with other players (30.5%). The median time lost due to an MTBI was 3 days There were 67 different players who sustained an MTBI and 2 sustaining a second occurrence.

For girls' soccer, games had an IDR 14 4 times higher than practice sessions. Players on the forward line and

**Table 3.** National Estimates of Mild Traumatic Brain Injury Frequency for Selected High School Sports, 1995-1997

| | Boys' Sports | | | | | Girls' Sports | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseball | Basketball | Football | Soccer | Wrestling | Basketball | Field Hockey | Softball | Soccer | Volleyball |
| No of players | 501 356 | 612 016 | 1 081 054 | 333 258 | 253 908 | 504 836 | 63 383 | 336 628 | 333 258 | 412 641 |
| Estimated | 1153 | 4590 | 39 566 | 3068 | 4012 | 5250 | 292 | 1548 | 3799 | 578 |
| Expected per team* | 0 05 | 0 13 | 1 93 | 0.22 | 0 39 | 0 16 | 0 10 | 0 08 | 0 26 | 0 02 |

*Calculated as injury rate per athlete exposures multiplied by the average number of exposures per school

the halfbacks had 70 3% of the injuries and the goalkeeper accounted for 18 8% of the MTBI cases The MTBI most often occurred from collisions while heading the ball (40 6%) and from collisions with other players (42 2%) The median time lost due to an MTBI was 3 days Sixty-seven players sustained an MTBI and 9 players sustained a second episode Of the 9 reinjured players, 5 were reinjured in the same season, 1 was reinjured in the next season, and 3 were reinjured 2 seasons after the first MTBI.

### Baseball and Softball

The baseball game injury rate was 4 5 times higher than for practice. Among the 15 MTBIs, 9 occurred from collisions between players, 3 from collisions with a bat, 2 from being hit by a pitch, and 1 from sliding The median time lost due to an MTBI was 3 days with 53 3% of the MTBI cases requiring fewer than 8 days and none requiring more than 21 days to return to participation. In the 3 seasons, 15 different players sustained an MTBI

Among the 25 MTBIs in girls' softball, 13 occurred as a result of collisions with other players. There was 1 MTBI from being hit with a bat and 2 from being hit by a batted ball. Six MTBIs occurred from collisions during a sliding activity and 3 MTBIs occurred from being hit by a pitch The median time lost due to an MTBI was 2 days. Twenty-three different players sustained an MTBI with 2 players being reinjured.

### Field Hockey

Games had an injury rate 14 4 times higher than practices Of the 13 cases of MTBI, 4 occurred from being hit with a stick and 4 occurred from being hit with a ball The remaining 5 cases resulted from collisions with other players The median time lost due to an MTBI was 3 days There were 12 different players injured with 1 person sustaining a second MTBI

### Volleyball

Four of the 6 MTBI cases reported in volleyball occurred in practice and 2 in games Collision with a ball accounted for 3 cases, digging for 2 cases, and collision with a player for 1 case. The median time lost due to an MTBI was 1 day Six different players sustained an MTBI in 3 seasons.

### National Estimates

The annual national estimate of MTBIs among the 10 high school sports is 62 816 cases, with football accounting for nearly 63% of the injuries (TABLE 3) Based on the frequency reported in the NATA study and the number of participating teams, the expected number of cases of MTBI per team per season is projected in Table 3 For instance, a football team can expect an average of 2 MTBI cases per year, whereas in volleyball, 2 cases of MTBI in 100 team-seasons are expected.

## COMMENT

Recent research efforts have begun to investigate the incidence, prevalence, and management of MTBIs For example, the National Football League (Elliot Pellman, MD, oral communication, September 1998) and the National Hockey League (Charles Burke, MD, oral communication, September 1998) have initiated projects to document the natural history of MTBI Other programs include systematic sideline evaluation procedures,[17] neuropsychological measurements to assess the head-injured player's ability to process information,[18] biomechanical studies of balance as an evaluation tool,[19] and the neurobiology of the MTBI [20] Incidence data are important in designing research programs and for evaluating the success of intervention programs

The data in the current study are limited to injuries, specifically MTBIs that were reported by NATA-certified athletic trainers who were on-site at the study schools on a daily basis Within this group of certified athletic trainers, 55% had graduate degrees and 73% were employed as full-time members of the school's faculty

The definition used to record incidence data will change the frequency of reported cases and the magnitude of estimated injury While the athletic trainer did not question every player after every session, we assume that events reported to or observed by the athletic trainer were reported in the study data

Gerberich et al[21] estimated the magnitude of concussions in high school football in the late 1970s and found an injury rate of 19 concussions per 100 players with 24% of all injuries listed as concussions. These injuries occurred prior to the implementation of the National Operating Committee for Safety in Athletic Equipment helmet protection standards in 1980, which may have an impact on their injury rates compared with current football injuries nearly 20 years after the introduction of the rule In a prospective study of college football players from 1982 through 1986, Barth et al[2] found 195 injuries among 182 different players in a population of 2350 athletes; 7.7% of the study group had sustained a reportable mild head injury In our study using NATA data, 693 athletes (3.9%) had MTBIs in a population of 17 815 athletes. The difference may reflect differences in the population (college vs high school), the period (1982-1986 vs 1995-1997), the study design, and mechanisms of documentation. McCrea et al[17] recently reported 33 concussions (5.8%) among a group of 353 high school and 215 college football players. The article also reports high school data for 1995 as 6 concussions in 141 players (4.3%), which is comparable with the current study at 3.9%.

The findings of our study highlight the importance of collisions, in all forms, as a contributing factor for MTBI in sports. Football, a sport characterized by collisions, compared with girls' volleyball represent opposite ends of the continuum. In basketball, the collisions seem to occur between players in the open court not necessarily under the basket. In soccer, the collisions occur between players and during heading of the ball. However, the current data are unable to clearly differentiate an MTBI from head-to-ball contact vs head-to-body or ground contact during the heading process. The data on field hockey point to collisions with objects, such as the stick or the ball, as well as player collisions as risk factors. The potential for collision among players as well as with bats and balls is low in baseball and softball. Even with the low potential, there are MTBIs that result from these collisions.

Given the close association of MTBI with a variety of different types of collisions, prevention strategies may be most successful when interventions are aimed at controlling the participation environment. Modifications in player skills, teaching techniques, and playing rules may be required to reduce the potential risk from different types of collisions in sports. In addition, sports medicine professionals should focus on accurate identification of MTBIs and consistent management throughout the recovery period. Players and coaches must be encouraged to report all suspected head injuries to athletic trainers and team physicians.

Clearly identifying the MTBI, carefully documenting the signs and symptoms at the time of injury, reevaluation of the signs and symptoms until they disappear, and monitoring of brain function through neuropsychological profiles may lead to greater success in prevention of reinjury. While not all MTBIs can be prevented, accurate and consistent medical management of those that occur will minimize the potential for reinjury and subsequently reduce the potential for the long-term effects that have been associated with MTBI. Modifications of player skills, rule changes, and protective equipment can only go so far in the prevention of MTBI. Only through the continued cooperation of sports sponsors, researchers, medical professionals, coaches, and sports participants can the goal of minimizing the risk of MTBI and its long-term disability be achieved.

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Acknowledgment: We appreciate the hard work and dedication of the certified athletic trainers who volunteered to participate in this project. Their patience and professionalism made the process of collecting and maintaining the project data efficient. Without their dedication, the project could not have been done. We also thank Mario Schootman, PhD, epidemiologist for the Iowa Public Health Department, Mark Lovell, PhD, chairman of neuropsychology at Henry Ford Health Systems, and Kenneth S. Clarke, PhD, senior vice president of risk analysis at SLE Worldwide Inc for their counsel regarding the analysis and presentation of the findings in this report.

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# *National Center for Catastrophic Sport Injury Research*

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Medical Director: Robert C. Cantu, M. D.
SIXTEENTH ANNUAL REPORT
FALL 1982 - SPRING 1998
Research Funded by a Grant from the
National Collegiate Athletic Association
American Football Coaches Association
National Federation of State High School Associations

## Introduction

In 1931 the American Football Coaches Association initiated the First Annual Survey of Football Fatalities and this research has been conducted at the University of North Carolina at Chapel Hill since 1965. In 1977 the National Collegiate Athletic Association initiated a National Survey of Catastrophic Football Injuries which is also conducted at the University of North Carolina. As a result of these research projects important contributions to the sport of football have been made. Most notable have been the 1976 rule changes, the football helmet standard, improved medical care *for the participants and better coaching techniques.*

Due to the success of these two football projects the research was expanded to all sports for both men and women, and a National Center for Catastrophic Sports Injury Research was established. The decision to expand the research was based on the following factors:

1. Research based on reliable data is essential if progress is to be made in sports safety.
2. The paucity of information on injuries in all sports.
3. The rapid expansion and lack of injury information in women's sports.

For the purpose of this research the term catastrophic is defined as any severe injury incurred during participation in a school/college sponsored sport. Catastrophic will be divided into the following three definitions:

1. Fatality
2. Non-Fatal - permanent severe functional disability.
3. Serious - *no permanent functional disability but severe injury.* An example would be a fractured cervical vertebra with no paralysis.

Sports injuries are also considered direct or indirect. The definition for direct and indirect is as follows:

**Direct** - Those injuries which resulted directly from participation in the skills of the sport.
**Indirect** - Those injuries which were caused by systemic failure as a result of exertion while participating in a sport activity or by a complication which was secondary to a non-fatal injury.

## Data Collection

Data were compiled with the assistance of coaches, athletic directors, executive officers of state and national athletic organizations, a national newspaper clipping service and professional associates of the researchers. Data collection would not have been possible without the support of the National Collegiate Athletic Association, the National Federation of State High School Associations and the American Football Coaches Association. Upon receiving information concerning a possible catastrophic sports injury, contact by telephone, personal letter and questionnaire was made with the injured player's coach or athletic director. Data collected included background information on the athlete (age, height, weight, experience, previous injury, etc.), accident information, immediate and post-accident medical care, type injury and equipment involved. Autopsy reports are used when available.

In 1987, a joint endeavor was initiated with the Section on Sports Medicine of the American Association of Neurological Surgeons. The purpose of this collaboration was to enhance the collection of medical data. Dr. Robert C. Cantu, Chairman, Department of Surgery and Chief, Neurosurgery Service, Emerson Hospital, in Concord, MA, has been responsible for contacting the physician involved in each case and for collecting the medical data. Dr. Cantu is also the Past-President of the American College of Sports Medicine.

**Summary**

***Fall Sports****(Tables I - VIII)*

As indicated in Tables I through VIII, football is associated with the greatest number of catastrophic injuries. For the 1997 football season there was a total of 29 high school direct catastrophic injuries, which is an increase of six from 1996, but a dramatic decrease when compared to the 1993 season. This is the fourth highest number since 1982, and future reports should be monitored closely. College football was associated with six direct catastrophic injuries in 1997, which is an increase of two when compared to 1995 and 1996.

In 1990 there were no fatalities directly related to football. The 1990 football report is historic in that it is the first year since the beginning of the research, 1931, that there has not been a direct fatality in football at any level of play. This clearly illustrates that this type of data collection and constant analysis of the data is important and plays a major role in injury prevention. The 1994 data shows zero fatalities at the high school level and one at the college level, with a slight rise in 1995 to four and zero. These numbers are very low when one considers that there were 36 football direct fatalities in 1968.

In addition to the direct fatalities in 1997 there were also eight indirect fatalities. Seven of the indirect fatalities were at the high school level and none at the college level. Six of the high school indirect fatalities were heart related and one was heat related. One indirect death was associated with sandlot football and was heart related.

In addition to the fatalities there were nine permanent paralysis cervical spine injuries in 1997. This number is low when compared to the 25 to 30 cases every year in the early 1970's. Seven injuries were at the high school level, one at the college level, and one in sandlot football. Football in 1997 was also associated with cerebral injuries that resulted in permanent disability. Seven injuries were at the high school level and one at the college level.

Serious football injuries with no permanent disability accounted for 12 injuries in 1997 - nine in high school and three in college. High school athletes were associated with five cervical spine fractures and four subdural hematoma injuries with full recovery. College athletes were associated with one cervical spine contusion, one herniated cervical disc, and one with transient cord symptoms.

This decrease in catastrophic football injuries illustrates the importance of data collection and being sure that the information is passed on to those responsible for conducting football programs. A return to the injury levels of the 1960's and 1970's would be detrimental to the game and it's participants.

Cross country was associated with one indirect injury in 1997. For the sixteen years indicated in Tables I through VIII, cross country was associated with one direct non-fatal injury and 11 indirect fatalities at the high school level and one indirect fatality at the college level. All eleven of the indirect injuries were heart related fatalities. Autopsy reports revealed congenital heart disease in three of these cases.

Table I shows that high school soccer had no direct serious injury in 1997 and a total of 12 catastrophic injuries for the past sixteen seasons. The three direct catastrophic injuries in 1992 was the highest number in the past sixteen years. There were no high school soccer indirect fatalities in 1997. In 1997 college soccer was not associated with any direct catastrophic injuries, but was associated with two indirect injuries. One of the indirect injuries was a heart death, and the other involved a player being struck by lightning with permanent disability.

In 1988 field hockey was associated with its first catastrophic injury since the study began in 1982. It was listed as a serious injury at the college level. The athlete was struck by the ball after a free hit. She received a fractured skull, had surgery and has recovered from the injury. The 1996 data shows two field hockey direct injuries at the high school level. Both injuries involved being hit by the ball and resulted in a head and an eye injury. There were no field hockey injuries in 1997.

In 1992-93 high school water polo was associated with its first indirect fatality and in 1988-89 college water polo had its first indirect fatality. There were no water polo injuries in 1997.

In summary, high school fall sports in 1997 were associated with 29 direct catastrophic injuries. All 29 were associated with football There were six fatalities, 14 involved permanent disability, and nine were considered serious. For the sixteen year period 1982-1997, high school fall sports had 418 direct catastrophic injuries and 374 or 96.4% were related to football participants In 1997 high school fall sports were also associated with seven football indirect fatalities, and one in cross country for a total of eight indirect fatalities. For the period from 1982-1997 there was a total of 126 indirect fall high school catastrophic injuries. One hundred and twenty-five of the indirect injuries were fatalities and 95 were related to football. Two of the indirect fatalities involved females - a soccer player in 1986 and a cross country runner in 1992.

During the 1997 college fall sports season there was a total of six direct catastrophic injuries and all six were in football. For the sixteen years, 1982-1997, there was a total of 96 college direct fall sport catastrophic injuries and 94 were associated with football There were two indirect college fatality during the fall of 1997. Both, one fatality and one disability, were associated with soccer. From 1982 through the 1997 season there was a total of 30 college fall sport indirect catastrophic fatalities. Twenty-four were associated with football.

High school football accounted for the greatest number of direct catastrophic injuries for the fall sports, but high school football was also associated with the greatest number of participants. There are approximately 1,500,000 high school and junior high school football players participating each year. As illustrated in Table II, the sixteen year rate of direct injuries per 100,000 high school and junior high school football participants was 0.29 fatalities, 0.71 non-fatal injuries and 0.77 serious injuries. These catastrophic injury rates for football are higher than those for both cross country and soccer, but all three classifications of catastrophic football injuries have an injury rate of less than one per 100,000 participants. Table IV shows that the indirect fatality rates for high school football, soccer and cross country are similar and are also less than one per 100,000 participants. Water polo rates are high, but are based on only six years of data, and water polo has approximately 10,000 participants each year.

College football has approximately 75,000 participants each year and the direct injury rate per 100,000 participants is higher than college soccer and field hockey. The rate, for the sixteen year period indicated in Table VI, for college football fatalities is less than one per 100,000 participants, but the rate increases to 1.92 per 100,000 for non-fatal injuries and 5.42 per 100,000 participants for serious injuries.

Indirect fatality rates are similar in college cross country and soccer, increase in football, with water polo being associated with the highest indirect fatality rate. Water polo has approximately 1000 participants each year (Table VIII). There were two college female athletes receiving a direct or indirect catastrophic injury in a fall sport for this sixteen year period of time. One was a serious injury in field hockey, and the other was an indirect death in soccer.

Incidence rates are based on sixteen year participation figures received from the National Federation of State High School Associations and the National Collegiate Athletic Association. (Figure I)

**Winter Sports** (Tables IX - XVI)

As shown in Table IX, high school winter sports were associated with nine direct catastrophic injuries in 1997-1998. Three injuries were related to basketball, one to ice hockey, one to swimming, and four to wrestling.

High school winter sports were also associated with eight indirect injuries during the 1997-1998 school year (Table XI). All of the injuries were fatalities, and all were associated with basketball. Five of the fatalities were heart related, one was listed as natural causes, one was related to asthma, one was listed as unknown. One of the eight was a female, and her death was heart related.

College winter sports, Tables XIII - XVI, did not have any direct catastrophic injury during the 1997-1998 season. College sports were also associated with six indirect fatalities during the 1997-1998 school year. Two were in basketball, three in wrestling, and one in volleyball. The two basketball deathes were heart related, all three wrestling deaths were heat related and associated with weight reduction, and the volleyball death was a female and heart related.

A summary of high school winter sports, 1982-1998, show a total of 80 direct catastrophic injuries (6 fatalities, 43 non-fatal, and 31 serious) and 84 indirect. Wrestling was associated with 37 or 45.7 percent of the direct injuries. Gymnastics was associated with 12 or 14.8 percent of the direct injuries. Ice hockey was associated with 12, swimming was associated with eight direct injuries, volleyball one, and basketball ten. Basketball accounted for the greatest number of indirect fatalities with 62 or 73.8 percent of the winter total.

College winter sports from 1982-1998 were associated with a total of 19 direct catastrophic injuries. Gymnastics was associated with six, ice hockey seven, basketball three, swimming one, skiing one and wrestling one. There were also 25 indirect injuries during this time period. Fourteen or 56% were associated with basketball, three in wrestling, two in ice hockey, four in swimming, one in skiing, and one in volleyball.

High school wrestling accounted for the greatest number of winter sport direct injuries, but the injury rate per 100,000 participants was less than one for all three injury categories. High school wrestling has approximately 237,000 participants each year. High school basketball and swimming were also associated with low direct injury rates. As shown in Table X, ice hockey and gymnastics were associated with the highest injury rates for the winter sports. Gymnastics has averaged approximately 4,600 male and 27,300 female participants during the past sixteen years. Ice hockey averages 23,000 participants each year. A high percentage of the ice hockey injuries involve a player being hit by an opposing player, usually from behind, and striking the skate rink boards with the top of his/her head.

Indirect high school catastrophic injury rates, as indicated in Table XII, are all below one per

100,000 participants.

Catastrophic direct injury rates for college winter sports are higher when compared to high school figures. Gymnastics had five non-fatal and one serious injury for the past sixteen years, but the injury rate is 25.51 per 100,000 participants for non-fatal male injuries and 8.16 per 100,000 for female non-fatal injuries. Participation figures show approximately 735 male and 1530 female gymnastic participants each year.

College ice hockey was associated with three serious and four non-fatal injuries in sixteen years, but the injury rate is 6.50 per 100,000 participants for non-fatal and 4.97 for serious injuries. There are approximately 4000 ice hockey participants each year. Swimming non-fatal incidence rates were not as high as gymnastics or ice hockey, but could be totally eliminated if swimmers would not use the racing dive into the shallow end of pools during practice or meets. In fact there has not been a direct injury in college swimming since the one non-fatal injury in 1982-1983.

College wrestling had only one catastrophic injury from the fall of 1982 to the spring of 1998. For this period of time there were 115,172 participants in college wrestling for an average of approximately 7,198 per year. The injury rate for this sixteen year period of time was 0.87 per 100,000 participants. College skiing has approximately 505 female participants each year and the one fatality in 1989-1990 produced a sixteen year injury rate of 12 50 per 100,000 participants. This was the only skiing direct fatality since the study was initiated.

Injury rates for college indirect fatalities were high when compared to the high school rates. Basketball had an injury rate of 6.08 fatalities per 100,000 male participants, skiing 8.61, ice hockey 1.62 and swimming 3.14. The female indirect injury rate for basketball was 0.55 per 100,000 participants, and 2.10 per 100,000 for volleyball. This is the first year where there were any indirect fatalities in wrestling. the wre three deaths due to heat strke associated with te wrestlers trying to make weight for a match. the indirect injury rate for wrestling was 2.60 per 100,000 participants.

Spring Sports (Tables XVII - XXIV)

High school spring sports were associated with seven direct catastrophic injuries in 1998. Baseball was associated with four and track three. One of the track injuries were associated with the pole vault and resulted in death. The two other track injuries involved participants being struck by a discuss and a shot put. These track injuries do not include the death of a coach who was demonstrating the pole vault, bounced off the end of hte mat, and struck his head on concrete. There were no indirect fatalities in high school spring sports during the 1997-1998 school year.

College spring sports were only associated with one direct injury in 1998 and it was in baseball. There were no college indirect injuries in the spring of 1997.

From 1983 through 1997, high school spring sports were associated with 70 direct catastrophic injuries (Table XVII). Twenty-three were listed as fatalities, 23 as catastrophic non-fatal and 24 as serious. Baseball accounted for 28, track 39, lacrosse one, and softball two. Injury rates were less than one per 100,000 participants for each sport. There were three direct injuries to females in track and two in softball. There were also 29 indirect fatalities in high school spring sports during this time span (Table XIX). Nineteen were related to track, seven in baseball, two in lacrosse and one in tennis. Four of the indirect fatalities involved female track athletes.

As illustrated in Table XXI, college spring sports were associated with 16 direct catastrophic injuries from 1983 to 1998. Four of these injuries resulted in fatalities, six were listed as non-fatal and six were listed as serious. Baseball accounted for four injuries, lacrosse four and track eight. Table XXIII shows that there were also six indirect fatalities in college spring sports during this time. Two indirect fatalities were associated with tennis, one was associated with track, two in baseball and one in lacrosse.

Injury rates for high school spring sports direct injuries were low as illustrated in Table XVIII. Baseball participation reveals approximately 420,000 players each year, track 850,000, and tennis 265,000. The baseball figures do not include the 274,000 softball participants each year. Lacrosse has approximately 30,000 participants each year. Injury rates, as shown in Table XX, for high school indirect injuries are also low.

College spring sports, Table XXII, are related to low injury rates for direct injuries. Men's lacrosse had two non-fatal and two serious injuries and the injury rates were slightly higher than the other sports. Participation figures reveal approximately 5,000 men and 3,000 women lacrosse players each year. The 1991 injury was to a female lacrosse player.

Rates for indirect college fatalities in baseball, tennis, and track are low with lacrosse being slightly higher. There were two indirect tennis fatalities, one male and one female, but participation figures are low. Men average approximately 7,700 and women 7,450 participants each year. (Table XXIV)

**Discussion**

Football is associated with the greatest number of catastrophic injuries for all sports, but the incidence of injury per 100,000 participants is higher in both gymnastics and ice hockey. There have been dramatic reductions in the number of football fatalities and non-fatal catastrophic injuries since 1976 and the 1990 data illustrated an historic decrease in football fatalities to zero. This is a great accomplishment when compared to the 36 fatalities in 1968. This dramatic reduction can be directly related to data collected by the American Football Coaches Association Committee on Football Injuries (1931-1998) and the recommendations that were based on that data. Non-fatal football injuries, permanent disability, decreased to one for college football in 1995. There was a dramatic reduction in high school football from 15 in 1990 to four in 1991. There was an increase to ten in 1992 and 13 in 1993, but a reduction to five in 1994 The 1997 data show an increase to fourteen. Permanent disability injuries in football have seen dramatic reductions when compared to the data from the late 1960's and early 1970's, but a continued effort must be made to eliminate these injuries. In addition, there were 12 serious injuries in football in 1997 - nine in high school and three in college. All of the serious cases involved head or neck injuries and in a number of these cases excellent medical care saved the athlete from permanent disability or death.

Football catastrophic injuries may never be totally eliminated, but progress has been made. Emphasis should again be focused on the preventive measures that received credit for the initial reduction of injuries.

1. The 1976 rule change which prohibited initial contact with the head in blocking and tackling. There must be continued emphasis in this area by coaches and officials.
2. The NOCSAE football helmet standard that went into effect at the college level in 1978 and at the high school level in 1980. There should be continued research in helmet safety.
3. Improved medical care of the injured athlete. An emphasis on placing athletic trainers in all high schools and colleges. There should be a written emergency plan for catastrophic injuries both at the high school and college levels.
4. Improved coaching technique when teaching the fundamental skills of blocking and tackling. **Keeping the head out of football!**

It should be noted that since 1979, according to the Consumer Product Safety Commission, there have been at least 18 deaths and 14 serious injuries to children when movable soccer goals have fallen on them. The most recent case involved a 10 year old male in May 1998. A soccer goal frame fell on his head while he was helping move it. The injury left him paralyzed. According to the Consumer Product Safety Commission, climbing and hanging on the goals, as well as high winds, can cause the goals to tip. The Commission suggests that goals be anchored and that participants be warned not to climb on the goals. There has been one fatality in this study which involved a college athlete hanging on a soccer goal and the goal falling and striking the victim's head. A Loss Control Bulletin from K & K Insurance Group, Inc., Fort Wayne, IN, suggests the following safeguards:

1. Keep soccer goals supervised and anchored.
2. Never permit hanging or climbing on a soccer goal.
3. Always stand to the rear or side of the goal when moving it - NEVER to the front.
4. Stabilize the goal as best suits the playing surface, but in a manner that does not create other hazards to players.
5. Develop and follow a plan for periodic inspection and maintenance (e.g., dry rot, joints, hooks).
6. Advise all field maintenance persons to re-anchor the goal if moved for mowing the grass or other purposes.
7. Remove goals from fields no longer in use for the soccer program as the season progresses.
8. Secure goals well from unauthorized access when stored.
9. Educate and remind all players and adult supervisors about the past tragedies of soccer goal fatalities.

There is also a list of guidelines available for movable soccer goal safety and warning labels. To obtain a copy contact the following:

The Coalition to Promote Soccer Goal Safety
C/O Soccer Industry Council of America
200 Castlewood Drive
North Palm Beach, FL 33408

High school wrestling, gymnastics, ice hockey, baseball and track should receive close attention. Wrestling has been associated with 37 direct catastrophic injuries during the past sixteen years, but the injury rate per 100,000 participants is lower than both gymnastics and ice hockey. Due to the fact that college wrestling was only associated with one catastrophic injury during this same time period, continued research should be focused on the high school level. High school wrestling coaches should be experienced in the teaching of the proper skills of wrestling and should attend coaching clinics to keep up-dated on new teaching techniques and safety measures They should also have experience and training in the proper conditioning of their athletes. These measures are important in all sports, but there are a number of contact sports, like wrestling, where the experience and training of the coach is of the utmost importance. Full speed wrestling in physical education classes is a questionable practice unless there is proper time for conditioning and the teaching of skills. The physical education teacher should also have expertise in the teaching of wrestling skills. It should also be emphasized that wrestling coaches need to be aware of the dangers associated with athletes making weight. Improper weight reduction can lead to serious injuries and death. During the 1997-1998 academic year there were three college that died while trying to make weight for a match. all three died of heat stroke complications. These were the first wrestling deaths associated with weight reduction, but there is no information on the number of wrestlers who had medical problems associated with weight loss, but recovered. all three of these wrestlers were trying to lose large amounts of weight in a short period of time. all three were also working out in areas of high heat, and were all wearing sweat clothes or rubber suits. Making weight has always been a part of the wrestling culture, but it is dangerous and life threatening. New rule changes went into effect for the 1998-99 high school and college seasons, and hopefully, making weight will be a thing of the past and will never result in the deaths of young high school and college athletes.

Men and women gymnastics were associated with high injury rates at both the high school and college levels. Gymnastics needs additional study at both levels of competition. Both levels have seen a dramatic participation reduction and this trend may continue with the major emphasis being in private clubs.

Ice hockey injuries are low in numbers but the injury rate per 100,000 participants is high when compared to other sports. Ice hockey catastrophic injuries usually occur when an athlete is struck from behind by an opponent and makes contact with the crown of his/her head and the boards surrounding the rink. The results are usually fractured cervical vertebrae with paralysis. Research in Canada has revealed high catastrophic injury rates with similar results. After an in-depth study of ice hockey catastrophic injuries in Canada, Dr. Charles Tator has made the following recommendations concerning prevention:

1. Enforce current rules and consider new rules against pushing or checking from behind.
2. Improve strength of neck muscles.
3. Educate players concerning risk of neck injuries.
4. Continued epidemiological research.

Catastrophic injuries in swimming were all directly related to the racing dive in the shallow ends of pools. There has been a major effort by both schools and colleges to make the racing dive safer and the catastrophic injury data support that effort. There has not been a a college injury for the past 15 years, but in 1997-98 a high school swimmer was paralyzed after diving into the shallow end of a pool while practicing a racing dive It is a fact that since the swimming community was made aware of this fact, and along with rule changes and coaches awareness, the number of direct catastrophic injuries in swimming has been reduced. The competitive racing start has changed and now involves the swimmer getting more depth when entering the water. Practicing or starting competition in the deep end of the pool or being extremely cautious could eliminate catastrophic injuries caused by the swimmer striking his/her head on the bottom of the pool. The National Federation of State High School Associations Swimming and Diving Rules Committee voted that in pools with water depth less than three and one-half feet at the starting end, swimmers will have to start the race in the water. This rule change is a refinement of a 1991-1992 rule change and took effect in the 1992-1993 season. The new rules read that in four feet or more of water, swimmers may use a starting platform up to a maximum of 30 inches above the water. Between three and one-half and four feet, swimmers may start no higher than 18 inches above the water. Less than that, it's in the pool. In April 1995 the National Federation revised rule 2-7-2, which now states that starting platforms shall be securely attached to the deck/wall. If they are not, they shall not be used and deck or in-water starts will be required. These new rules point out the importance of constant data collection and analysis. Rules and equipment changes for safety reasons must be based on reliable injury data.

High school spring sports have been associated with low incidence rates during the past sixteen years, but baseball was associated with 32 direct catastrophic injuries and track 42. A majority of the baseball injuries have been caused by the head first slide or by being struck with a thrown or batted ball. The 1998 data show one player paralyzed after sliding head first into home plate. If the head first slide is going to be used, proper instruction should be involved. Proper protection for batting practice should be provided for the batting practice pitcher and he/she should always wear a helmet. This should also be true for the batting practice coach. During the 1998 baseball season a high school coach as struck in the head by a batted ball and died. There are always a number of non-school baseball injuries and the cause of injury is usually the same.

The pole vault was associated with a majority of the fatal track injuries. There have been fourteen high school fatal pole vaulting injuries from 1983 to 1998. This does not include the coach who was demonstrating in 1998, bounced out of the pit, struck his head on concrete, and died. In addition to the fatalities there were also seven permanent disability and six serious injuries. All 27 of these accidents involved the vaulter bouncing out of or landing out of the pit area. The three pole vaulting deaths in 1983 were a major concern and immediate measures were taken by the National Federation of State High School Associations. Beginning with the 1987 season all individual units in the pole vault landing area had to include a common cover or pad extending over all sections of the pit.

Every time there is a pole vaulting death there are more proponents of eliminating the event. The crux of the opposition to the event appears to be the potential liability and also the lack of qualified coaches to teach the pole vault. Additional recommendations in the 1991 rule book: stabilize the pole vault standards so they cannot fall into the pit, pad the standards, remove all hazards from around the pit area and control traffic along the approach. Obvious hazards like concrete or other hard materials around the pit should be eliminated. The state of Ohio has developed a program to teach proper techniques to coaches. It has been estimated that there are approximately 25,000 high school pole vaulters. If this number is true, the catastrophic injury rate for high school pole vaulters would be higher than any of the sports included in the research.

There have also been twelve accidents in high school track involving participants being struck by a thrown discus, shot putt or javelin. In 1992, a female athlete was struck by a thrown discus in practice and died. In 1993, a track manager was struck in the neck by a javelin, but he was lucky and completely recovered from the accident. In 1994, a female track athlete was struck in the face by a javelin and will recover. In 1995, a male athlete was struck in the head by a shot put during warm-ups and had a fractured skull. In 1997, a male athlete was struck by a discus and died. In 1998 a femaile athlete was struck by a discus and died, and a male athlete was struck in the head by a shot-put but recovered. There have also been spectators struck by the discus during high school meets. Safety precautions must be stressed for these events in both practice and competitive meets with the result being the elimination of this type of accident. The National Federation of State High School Associations put a new rule in for the 1993 track season that fenced off the back and sides of the discus circle to help eliminate this type of accident. Good risk management should eliminate these type of accidents. Good risk management should eliminate these type of accidents. These types of injuries are not acceptable and should never happen.

The one fatality in high school lacrosse during the 1987 season was associated with a player using his head to strike the opponent. He struck the opponent with the top or crown of his helmet. This technique is prohibited by the lacrosse rules and should be strictly enforced. Lacrosse has been a safe sport when considering the fact that high school lacrosse has only been involved with two catastrophic injuries in sixteen years.

College spring sports are also associated with a low injury incidence. Injury rates are slightly higher in lacrosse but the participation figures are so low that even one injury will increase the incidence rate dramatically. It is important to point out that there have been only three college male lacrosse catastrophic injuries during the past sixteen years. One injury was the first in women's lacrosse.

For the sixteen year period from the fall of 1982 through the spring of 1998 there have been 707 direct catastrophic injuries in high school and college sports. High school sports were associated with 102 fatalities, 234 non-fatal and 240 serious injuries for a total of 576. College sports accounted for 11 fatalities, 41 non-fatal and 79 serious injuries for a total of 131. During this same sixteen year period of time there has been a total of 300 indirect injuries and all but five resulted in death. Two hundred and thirty-nine of the indirect injuries were at the high school level and 61 were at the college level. It should be noted that high school annual athletic participation for 1997-1998 includes approximately 6,333,453 athletes (3,763,120 males and 2,570,333 females). National Collegiate Athletic Association participation for 1997-1998 was unknown at the time of this writing. College participation for 1997-98 used the 1996-1997 numbers (331,282 athletes: 201,997 mailes and 129,285 females).

During the sixteen year period from the fall of 1982 through the spring of 1998 there have been 87,331,640 high school athletes participating in the sports covered by this report. Using these participation numbers would give a high school direct catastrophic injury rate of 0.66 per 100,000 participants. The indirect injury rate is 0.27 per 100,000 participants. If both direct and indirect injuries were combined the injury rate would be 0.93 per 100,000. This means that approximately one high school athlete out of every 100,000 participating would receive some type of catastrophic injury. The combined fatality rate would be 0 39 per 100,000, the non-fatal rate 0.27, and the serious rate 0.28.

During this same time period there were a total of 4,663,808 college participants with a total direct catastrophic injury rate of 2.81 per 100,000 participants. The indirect injury rate is 1.31 per 100,000 participants. If both indirect and direct injuries were combined the injury rate would be 4.21. The combined fatality rate would be 1.50, the non-fatal rate 0.92, and the serious rate 1.69.

## Female Catastrophic Injuries

There have been a total of 62 direct and 28 indirect catastrophic injuries to high school and college female athletes from 1982-83 - 1997-98, which includes cheerleading. Forty-one of these were direct injuries at the high school level and 21 at the college level. The 41 high school direct injuries included nine in gymnastics, 19 in cheerleading, two in swimming, two in basketball, four in track, two in softball, two in field hockey, and one in volleyball. The 24 high school indirect fatalities included nine in basketball, five in swimming, four in track, one in soccer, one in cross country, one in volleyball, and three in cheerleading. The 21 college direct injuries were associated with cheerleading (16), gymnastics (2), field hockey (1), skiing (1) and lacrosse (1). The four college indirect fatalities included one in tennis,one in basketball, one in soccer, and one in volleyball. Catastrophic injuries to female athletes have increased over the years As an example, in 1982-83 there was one female catastrophic injury and during the past 15 years there has been an average of 6.0 per year. A major factor in this increase has been the change in cheerleading activity , which now involves gymnastic type stunts If these cheerleading activities are not taught by a competent coach and keep increasing in difficulty, catastrophic injuries are going to be a part of cheerleading. High school cheerleading accounted for 46.3% of all high school direct catastrophic injuries to female athletes and 76.2% at the college level. Of the 62 direct catastrophic injuries to female athletes from 1982-83 - 1997-1998, cheerleading was related to 35 or 56.5%. The cheerleading numbers have been updated from previous reports. Read the special section on cheerleading.

Athletic administrators and coaches should place equal emphasis on injury prevention in both female and male athletics. Injury prevention recommendations are made for both male and female athletes.

Athletic catastrophic injuries may never be totally eliminated, but with reliable injury data collection systems and constant analysis of the data these injuries can be dramatically reduced.

## Recommendations for Prevention

1. Mandatory medical examinations and a medical history taken before allowing an athlete to participate.
2. All personnel concerned with training athletes should emphasize proper, gradual and complete physical conditioning in order to provide the athlete with optimal readiness for the rigors of the sport.
3. Every school should strive to have a team trainer who is a regular member of the faculty and is adequately prepared and qualified. There should be a written emergency procedure plan to deal with the possibility of catastrophic injuries.
4. There should be an emphasis on employing well trained athletic personnel, providing excellent facilities and securing the safest and best equipment available.
5. There should be strict enforcement of game rules and administrative regulations should be enforced to protect the health of the athlete. Coaches and school officials must support the game officials in their conduct of the athletic contests.
6. Coaches should know and have the ability to teach the proper fundamental skills of the sport. This recommendation includes all sports and not only football. The proper fundamentals of

blocking and tackling should be emphasized to help reduce head and neck injuries in football. Keep the head out of football.

7. There should be continued safety research in athletics (rules, facilities, equipment).
8. Strict enforcement of the rules of the game by both coaches and game officials will help reduce serious injuries.
9. When an athlete has experienced or shown signs of head trauma (loss of consciousness, visual disturbance, headache, inability to walk correctly, obvious disorientation, memory loss) he/she should receive immediate medical attention and should not be allowed to return to practice or game without permission from the proper medical authorities. It is important for a physician to observe the head injured athlete for several days following the injury.
10. Athletes and their parents should be warned of the risks of injuries.
11. Coaches should not be hired if they do not have the training and experience needed to teach the skills of the sport and to properly train and develop the athletes for competition.
12. Weight loss in wrestling to make weight for a match can be dangerous and cause serious injury or death. Coaches should be aware of safety precautions and rules associated with this practice.

*****SPECIAL NOTE*****

All of the information has been thoroughly checked and the data cleaned. Some of the numbers in Tables I - XXIV have been changed due to this process. All of the data in this report now meet the stated definition of injury for high school and college sports. It is important to note that information is constantly being updated due to the fact that catastrophic injury information may not always reach the center in time to be included in the current final report.

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## CASE STUDIES

## FOOTBALL

### HIGH SCHOOL

A 16 year old high school football player collapsed and died during the second quarter of a game on October 17, 1997. He was 6-1 and weighed 250 pounds. He was a defensive lineman at the time of the accident, when he received a blow to the chest while being blocked. According to the autopsy cause of death was commotio cordis (cardiac arrest) due to the blow to the chest.

A 17 year old high school football player received a brain injury during the third quarter of a game while making a tackle on the goal line. The accident took place on October 18, 1997. He died late that night in the hospital. During the tackle the tackler's head made contact with the knee of the running back. Cause of death was a brain injury.

A 15 year old junior high school football player was injured in a game on September 18, 1997. He collapsed after the game while sitting on the team bench. He died on September 24, 1997. The activity at the time of the injury was unknown. Cause of death was a subdural hematoma.

A 17 year old high school football player was injured in a game on September 19, 1997 and died on September 23, 1997. The activity at the time of the injury was unknown. The injured player was a fullback. Cause of death was a subdural hematoma.

A 14 year old middle school football player received a brain injury during a game on October 2, 1997. He collapsed at the end of the game and was taken to the hospital where he died the next day, October 3, 1997. The activity at the time of the injury was unknown. Cause of death was a brain injury.

A high school freshman football player was injured in a scrimmage on September 6, 1997. He was a linebacker and a running back. He came out of the scrimmage complaining of a headache. Activity at the time of the injury was unknown. The player died in the hospital on September 12, 1997. Cause of death was a brain injury.

A 15 year old high school football player collapsed during wind sprints at the end of practice on August 5, 1997. He was rushed to the hospital where he died a few hours later. Cause of death was due to a congenital heart defect.

A 15 year old high school football player collapsed while running wind sprints on July 31, 1997. He died later at the hospital. Cause of death was heart related.

A 17 year old high school football player collapsed on the field shortly after practice on August 11, 1997. He died later the same day at the hospital. Cause of death was dilated cardiomyopathy.

A 17 year old high school football player collapsed at a team meeting after practice. He was given CPR and was taken to the hospital where he later died. Cause of death was heart related.

A 14 year old high school football player caught a touchdown pass during a game on October 28, 1997. Six plays later he ran to the sideline, collapsed, and was taken to the hospital. He died on October 30, 1997. Cause of death was heart related.

An 18 year old high school football player died on August 10, 1997. He was running sprints with the team after the first practice in full pads. He collapsed and was taken to the locker room where he was placed in a whirlpool of cold water. He was taken to the hospital by ambulance where he later died. Practice was in the early afternoon in 93 degree heat. Cause of death was heat stroke.

A 13 year old high school football player collapsed in the dressing room after practice No other information was available. Death was heart related.

A 17 year old high school football player was injured while tackling in a game on September 5, 1997. He was playing linebacker at the time. The exact activity at the time of the injury was unknown. He had surgery on a fractured cervical vertebra and at the present time is quadriplegic.

A 17 year old high school football player injured his neck while being tackled. He was playing quarterback and was tackled head on. As he was going down he was hit by a second tackler. At the present time recovery is incomplete. The injury took place on October 18, 1997.

A 17 year old high school football player fractured his 6th cervical vertebra while blocking on a kick off return. He hit the opponent with his head down. Surgery was performed and at the present time recovery is incomplete. The injury took place on August 21, 1997.

A 16 year old high school football player fractured a cervical vertebra while tackling in a practice scrimmage in August 1997. At the present time he is quadriplegic.

A 16 year old high school football player injured his 5th and 6th cervical vertebrae while tackling in a game on October 24, 1997. Surgery was performed and at the present time he is quadriplegic.

A high school football player fractured a cervical vertebra while tackling on a kick off. He was tackling with his head down and the top of his head hit a teammate in the hip. At the present time he is quadriplegic. The injury happened on September 12, 1997.

On November 7, 1998 a high school football player fractured two cervical vertebrae while tackling with his head down in a game. He was playing safety and his head hit the hip of the ball carrier. At the present time recovery is incomplete.

A 16 year old high school football player was attempting to block an extra point in a game on October 10, 1997. As he hit the ground the top of his head made contact with the ground. At the present time he is quadriplegic.

An 18 year old high school football player injured his neck in a game on September 27, 1997. He did not inform his coaches of the injury and played in a game on October 3, 1997. On October 4th he suffered a stroke. At the present time recovery is incomplete.

A 16 year old high school football player was injured while blocking in a practice drill on August 12, 1997. He was in a coma after surgery for a subdural hematoma He did complain of a headache after a routine hit. Recovery is incomplete.

A 17 year old high school football player was in a coma for 11 days after being injured in a preseason practice on September 3, 1997. He has been released from the hospital and recovery is incomplete.

A 17 year old high school football player had a brain injury and was in a coma after a collision in a game on September 12, 1997. He may have suffered a concussion in the previous weeks game. Recovery is incomplete.

A high school football player was injured in a scrimmage game on August 12, 1997. He came off the field complaining of a headache and collapsed on the sideline. He had surgery for a subdural hematoma and recovery is incomplete.

A 17 year old high school football player collapsed on the sideline during a game on September 26, 1997. Surgery was performed and recovery is incomplete. The exact activity at the time of the injury was unknown.

A 17 year old high school football player was injured in a game on September 26, 1997 while being blocked covering a punt. He was playing eight man football. He was in a coma and in critical condition, and recovery is incomplete.

A high school football player suffered a subdural hematoma in a game on November 26, 1997. He woke up the next morning with blurred vision, a headache, and vomiting. He had complete recovery.

A high school football player received a severe concussion during a scrimmage game on August 21, 1997. He was unconscious and motionless on the field for twenty minutes. Recovery was complete.

An 18 year old high school football player was injured in a game in late October 1997. He had headaches for a couple of days after the game. On November 31, 1997 he received another hit to the head in a game and suffered a subdural hematoma. Recovery was complete.

A 17 year old high school football player was injured in a game in October 1997. He fractured cervical vertebra 1 while tackling with his head down. He had complete recovery, but will not be able to play anymore football.

An 18 high school football player fractured his 6th cervical vertebra while blocking on a kickoff. His head hit into the chest of the opponent. Recovery was complete

A high school football player fractured his 1st cervical vertebra while making a tackle in the open field. He made contact with his head. Recovery is complete.

A high school football player fractured a cervical vertebra in an August 1997 practice. He was tackling with his head down at the time. After surgery recovery was complete.

A 14 year old high school football player was tackling on a kickoff in a game and fractured cervical vertebrae 6 and 7. Recovery was complete.

1996 update - A high school football player suffered a head injury in preseason practice and suffered headaches for a period of time In a game on September 4, 1996 he suffered another hit to the head and a subdural hematoma. He had surgery and recovery was complete.

## COLLEGE

A 21 year old college football player injured cervical vertebrae 3, 4, and 5, in a game on November 15, 1997. He was tackled while running with the ball at the quarterback position. He was hit by two tacklers after he vaulted over another player. At the present time recovery is incomplete.

A college football player had emergency surgery for a subdural hematoma on April 12, 1997, and recovery is incomplete. He suffered a concussion in practice two weeks earlier.

A college football player was injured in preseason practice in 1997. His injury was to the cervical vertebrae and the injury was transient paralysis. No other information was available.

A college football player received a herniated disk in practice and recovery was complete. The player was out for the season.

A college football player was injured in October 1997 during a game. He was playing defensive tackle and the offensive player's knee hit him on top of the head. He suffered a spinal contusion and recovery was complete.

# CROSS COUNTRY

## HIGH SCHOOL

A 17 year old high school cross country athlete collapsed while running with the cross country team on October 9, 1997. He was taken to the hospital where he died. Cause of death was an undiagnosed heart abnormality - hypertrophic cardiomyopathy.

# SOCCER

### COLLEGE

A 21 year old college female soccer player collapsed and died during an exhibition game on campus. She was rushed to the hospital where she died. The accident took place on March 28, 1998. Pending an autopsy, cause of death was unknown.

A 22 year old college male soccer player was struck by lightning as a storm forced his team to end practice early. He was picking up cones and balls when struck. The accident took place on April 16, 1998. He has nerve damage and a long scar on his body, but full recovery is expected. At least 100 people are killed each year by lightning.

## VOLLEYBALL

### COLLEGE

An 18 year old college female volleyball player felt chest pains during a match, left the court, and passed out on the sidelines. She died later when emergency technicians could not revive her. Cause of death was hypertrophic cardiomyopathy.

## ICE HOCKEY

### HIGH SCHOOL

A 15 year old male high school ice hockey player crashed head first into the boards and suffered a fracture dislocation of cervical vertebrae five and six. It was a junior varsity game and the player was a defenseman. At the time of this writing he is paralyzed.

## SWIMMING

### HIGH SCHOOL

On January 30, 1998, a 16 year old high school swimmer was completing a warm-up racing start dive in the shallow end of the pool. He hit his head on the bottom of the pool and fractured the 5th cervical vertebra. At the present time recovery is incomplete. Water depth was 42 inches and he was using the starting blocks.

## BASKETBALL

### HIGH SCHOOL

A 16 year old high school basketball player collapsed on the court during a game. He later died at the hospital. Cause of death was heart related.

A 16 year old high school basketball player collapsed after an off-season workout on August 19, 1997. The athlete died and cause of death was heart related.

A 17 year old high school male basketball player collapsed in the locker room after practice. The athlete died and cause of death was heart related.

A 13 year old middle school male basketball player collapsed at practice and died on the gym floor. Autopsy results showed the athlete died from a bronchial asthma attack.

A 17 year old female high school basketball player collapsed on December 5, 1997, during a game. The athlete died and cause of death was a congenital heart defect.

A 13 year old middle school male basketball player was chasing a player on a fast break, blocked the shot, and fell hitting his head into a padded mat on the gym wall. He fractured cervical vertebrae 1 and 2. The athlete died.

A 16 year old male high school basketball player collapsed during warm-ups prior to a game. The athlete died and cause of death was listed as natural causes.

A 17 year old male high school basketball player collapsed during a tournament game on March 16, 1998. The athlete died at the hospital and cause of death was unknown.

A 16 year old male high school basketball player collapsed and died during a game on January 30, 1998. Cause of death was unknown.

A 15 year old male high school basketball player dove for a loose ball during practice and hit into a padded wall. He fractured a cervical vertebra and is paralyzed.

A 14 year old male high school basketball player was rebounding during a game on February 6, 1998. The opposing player fell on him. The athlete received a fractured skull, blood clot on the brain, and had surgery. The athlete has recovered.

### COLLEGE

A 21 year old male college basketball player collapsed during practice and died. Cause of death was idiopathic hypertrophic subaortic stenosis of the heart.

An 18 year old male college basketball player collapsed during stretching exercises on October 19, 1997. He died later at the hospital Cause of death was hypertrophic cardiomyopathy.

## WRESTLING

### HIGH SCHOOL

(1997 update) A male high school wrestler was injured while wrestling in 1997. He fractured his 6th cervical vertebra and recovered. There was no information about how or exactly when the accident happened. He did wrestle in 1998.

A 17 year old male high school wrestler was injured in a match after falling to the mat on his head and shoulders. He was flown to the hospital and placed in ICU. At this time recovery is incomplete.

An 18 year old male high school wrestler was injured in a state tournament meet. He had surgery on a fractured cervical vertebra There was no information on how it happened Recovery is incomplete.

A high school wrestler was taken to the hospital with a neck injury after being injured in a meet. No other information was available.

### COLLEGE

A 21 year old college wrestler died from excessive training while trying to make weight. According to the autopsy results he was trying to lose too much weight too fast. He was engaged in a two hour workout in a 92 degree room while dressed in a rubberized suit. He was trying to lose 17 pounds in one day in order to wrestle in the 150 pound class.

A senior college wrestler collapsed and died after a four hour workout to bring his weight down for a match the next day. He was pedaling an exercise bike in a steam filled room while wearing a rubber suit and a sweatsuit to sweat off weight.

A 19 year old college wrestler collapsed and died while exercising in an effort to lose six pounds. He worked to exhaustion during the workout that started at 2 AM. Cause of death was related to the exercise.

## LACROSSE

### HIGH SCHOOL

(1997 update) A 17 year old high school male lacrosse player was injured on April 10, 1997 during a game. He was playing goalie at the time. He came out of the goal area to get the ball and during a collision with an opponent received a knee to the head. He fractured cervical vertebrae 3,4, and 5. The athlete is quadriplegic.

## BASEBALL

### HIGH SCHOOL

A 16 year old high school baseball player was injured on February 26, 1998. He was hit in the chest with a pitched ball after turning toward the pitcher to bunt. He died of cardiac arrest.

A high school baseball player was struck in the head with a batted ball while pitching during an intersquad game on June 9, 1998. He was in a coma for 1 1/2 days. He had a fractured skull and surgery. He had a full recovery.

A high school baseball player was injured in a game on April 3, 1998, while sliding head first into home plate and striking his head against the catchers chest. He had a fractured cervical vertebra and surgery. Recovery is incomplete.

A 17 year old high school baseball player was injured on March 31, 1998, during pick-off practice. He was struck in the neck by the ball and had to have three surgeries for aneurysms and bleeding in the skull cavity. He did have a full recovery.

An high school coach was hit in the head by a line drive during batting practice. He died two days later.

## TRACK

### HIGH SCHOOL

A volunteer high school track coach died in a pole vaulting accident on March 2, 1998. He was demonstrating the pole vault when he bounced out of the landing mat and struck his head on concrete. He was taken to the hospital but never regained consciousness.

A 14 year old middle school track athlete walked into the danger zone to pick up a discus, and was struck in the back of the head by a thrown discus. She had a fractured skull, but recovered.

A 16 year old high school track athlete died on May 4, 1998, after bouncing out of the pole vault pit to a hard surface. He struck his head on the hard surface.

A 16 year old track athlete was struck in the head during practice by a shot put. He was bent over picking up his shot when he was struck by another throwers shot. He was in critical care at the hospital, but has had a full recovery.

### COLLEGE

A college freshman pole vaulter died from injuries suffered after doing a handstand on an 11 foot observation tower. He planned to drop to the mats below, but his back hit the platform and he fell forward into metal supporting pipes. He severed an artery near his heart and had liver damage.

## Special Section on Cheerleading

The Consumer Product Safety Commission reported an estimated 4,954 hospital emergency room visits in 1980 caused by cheerleading injuries. By 1986 the number had increased to 6,911 and in 1994 the number increased to approximately 16,000. Granted, the number of cheerleaders has also increased dramatically during this time frame. It is important to stress that catastrophic injuries have been a part of cheerleading during the last 16 years, and coaches and administrators should be aware of the situation.

The National Center for Catastrophic Sports Injury Research has been collecting cheerleading catastrophic injury data during the past fifteen years, 1982-83 - 1997-98. There were no injuries during the 1997-1998 school year. Following is a sample review of the data:

1. In the early 1980's a female college cheerleader fractured her skull after falling from a human pyramid. She recovered and returned to cheerleading after several weeks in the hospital.

2. In 1983 two female college cheerleaders received concussions within a period of five days in the same gymnasium. One struck her head on the floor after falling from a pyramid and the second cheerleader struck her head on the floor after falling backward from the shoulders of a male partner.
3. In the summer of 1984 a female high school cheerleader was injured at practice when she fell from a pyramid. She was partially paralyzed.
4. A male college cheerleader was injured in a tumbling accident during a basketball game in December 1983. He fractured and dislocated several cervical vertebrae and was paralyzed. He received his injuries after diving over a mini-trampoline and several cheerleaders. The stunt is called a dive into a forward roll. He has made progress and can now walk unaided for several blocks and is able to feed himself.
5. In 1985 a female high school cheerleader was paralyzed from the chest down after attempting a back flip off the back of another cheerleader.
6. In 1985 a female college cheerleader fractured her skull after a fall from the top of a pyramid striking her head on the gym floor. She was in critical condition for a period of time but has made progress and is back in school. She is now involved in occupational therapy.
7. A male college cheerleader was paralyzed after a fall in practice. He was attempting a front flip from a mini-trampoline. He dislocated several cervical vertebrae and is now quadriplegic.
8. In 1986 a female college cheerleader fell from a pyramid and was knocked unconscious after striking the floor. Her status was unknown at the time of this writing
9. In 1986 a college female cheerleader died from injuries suffered in a cheerleading accident. She suffered multiple skull fractures and massive brain damage after falling from the top of a pyramid type stunt and striking her head on the gym floor.
10. In 1987 a 17 year old high school cheerleader fell from a pyramid. She was tossed into the air by two other cheerleaders and was supposed to flip backwards and land on the shoulders of two other girls. Her spinal cord was not severed but she is paralyzed from the waist down.
11. During the 1987-1988 school year a female cheerleader suffered a fractured collarbone, a damaged ear drum and a basal skull fracture. She was practicing a pyramid and was six feet off the gym floor with no spotters. She has suffered partial hearing loss and has to wear special glasses for reading.
12. In January 1988 a female cheerleader fell from a pyramid and landed on her face and shoulder. She suffered a fractured collarbone and head injuries. She was in a light coma in the hospital but complete recovery is expected.
13. In January 1989 a high school cheerleader fractured a cervical vertebra after falling from a mount in practice. She will recover with no permanent disability.
14. On July 11, 1989 a 16 year old high school cheerleader fractured a cervical vertebra and is quadriplegic. She slipped while doing a series of back flips on damp grass.
15. On March 10, 1990 a female high school cheerleader was thrown into the air by two other cheerleaders. She fell to the floor onto her neck and was in the hospital for one week. The routine was called a basket toss. She has recovered and is back in school.
16. On March 1, 1990 a 21 year old male college cheerleader was injured at practice. In attempting to do a back flip he hit his head against a wall. He was taken to the hospital by ambulance. He has since recovered and the injuries were not serious.
17. In June of 1991 a 15 year old cheerleader suffered injuries to the head. She was struck in the head by her falling partner and also after striking the ground. The injury took place in a cheerleading camp. The cheerleader was taken to the hospital but her condition is not known at this time.
18. A middle school cheerleader was injured in October 1991 and died the next week. She fell from a double level cheerleading stance during practice. She hit her head on the gym floor.
19. A 20 year old college cheerleader suffered a head injury while practicing a cheerleading stunt in which she was thrown into the air but was not caught by her teammates. She landed on the gym floor. She was in critical condition but has been upgraded to serious and is expected to recover.
20. In May of 1992 a college cheerleader was doing a tumbling sequence when she landed on her back and fractured T-12. The practice was not supervised. There was a complete recovery.
21. A high school cheerleader was injured during a basketball game doing a back handspring tuck. She hit her head on the floor. She had surgery to remove a blood clot. Her condition is not