KENTUCKY TRAUMATIC BRAIN INJURY PREVALENCE STUDY

January 2004

Prepared For

The Kentucky Traumatic Brain Injury Trust Fund Board

and

The Kentucky Department of Mental Health and Mental Retardation, Brain Injury Services Unit,
Colleen A. Ryall, Ed.D., Director

***Report Prepared by*:**
Robert Walker, M.S.W., L.C.S.W., Assistant Professor
TK Logan, Ph.D., Associate Professor
Carl Leukefeld, D.S.W., Professor and Director
Erin Stevenson, M.S.W., Research Coordinator

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UK UNIVERSITY OF KENTUCKY
Center on Drug and Alcohol Research

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January 2, 2004

Governor Ernie Fletcher
Commonwealth of Kentucky
Capitol Building
Frankfort, Kentucky 40621

Dear Governor Fletcher:

This report on the prevalence of brain injuries among Kentucky households is a first step for the TBI Trust Fund Board in getting a better understanding of the scope of the problem in Kentucky and what services are needed for persons with brain injuries. These findings will also be important for the Department of Mental Health and Mental Retardation in its planning efforts.

Kentucky is among the first states in the nation to undertake a prevalence study of brain injury, and we think that our continuing effort to develop prevalence estimates will result in important and valid findings over the next year. This study was carried out under a contract with the University of Kentucky Center on Drug and Alcohol Research.

Our Board wanted to share this report with you in the hopes that the planning efforts concerning persons with brain injuries will benefit from the new data.

Sincerely yours,

Mary Hass,
Chairperson
Traumatic Brain Injury Trust Fund Board

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KENTUCKY TRAUMATIC BRAIN INJURY PREVALENCE STUDY

EXECUTIVE SUMMARY

Kentucky is one of the first states in the country to begin studying the prevalence of brain injury among its residents. These findings from the KENTUCKY TRAUMATIC BRAIN INJURY PREVALENCE STUDY suggest that Kentucky has many residents with a history of brain injuries and that health service planning should include awareness of persons who have survived brain injury as well as their associated service needs.

From a survey of 3,267 Kentucky households, there are several key findings:

- ***Almost one-fifth of Kentucky households (19.4%) report having at least one member with a history of a head injury***
- ***There are an estimated 202,488 to 214,032 Kentucky residents with head injuries, which means that between 5.0% and 5.3% of the population have head injuries***
- ***Almost two-thirds (61.0%) of the injured persons were male***
- ***Motor vehicle accidents are the leading cause of the reported injuries (34.0%)***
- ***Over half (60.0%) of the injuries were reported to have occurred before age 21***
- ***Almost half (44.5%) of those who were reported as having a brain injury lost consciousness as a result of the injury***
- ***Over three-fourths (85.4%) of the injured persons were taken to a hospital emergency department***
- ***Almost half (42.1%) of the injured persons were hospitalized for at least one night following the injury***
- ***Almost one-fourth (24.2%) reported increased memory problems after the injury***
- ***Over one-fifth (20.5%) experienced increased depression after the injury***
- ***Almost one-fourth (23.3%) experienced increased anxiety after the injury***
- ***Almost one-third (31.6%) were reported needing professional services following this injury***

KENTUCKY TRAUMATIC BRAIN INJURY PREVALENCE STUDY
FINAL REPORT

Introduction

This study was funded by the Kentucky Traumatic Brain Injury (TBI) Trust Fund Board pursuant to a statutory mandate. KRS 211.470 established the TBI Trust Fund Board to administer funds as a payer of last resort for persons with brain injuries who need services that are not covered by existing insurance or other private or governmentally funded programs. Kentucky law mandates that the TBI Trust Fund Board cover the cost of ten key services that meet the needs of persons with brain injuries; provide for investigating the needs of persons with brain injuries and identifying gaps in current services for persons with brain injuries; assist the Cabinet for Health Services, Department of Mental Health and Mental Retardation to develop programs for persons with brain injuries. In order to meet the requirement for examining the needs of persons with brain injury and to assist in developing services, there is a need for information about the scope of brain injury in Kentucky. Kentucky is not alone in this need. Many states are in the process of developing services for persons with brain injuries and are, as a result, seeking data about the scope and prevalence of brain injury among their residents. However, to date, it does not appear that any state has actually implemented brain injury prevalence information by surveying households among the general population. Most states are developing incident surveillance mechanisms to identify brain injury incidents for prevention and other health planning purposes.

Consistent with the identification of service needs and the scope of brain injury problems among Kentucky residents, the TBI Board is mandated to implement a registry of individuals who incur brain injuries. These data are obtained from hospital trauma centers and are based on discharge data for each person admitted with a diagnosis of an acquired brain injury. These data, while very important in identifying new incidents of brain injury, are not useful for estimating the full scope of the problem of brain injury among Kentuckians. Incident data only identify injury events, and, given the hospital source of the data, only the most severe injuries can be identified. In other words, incident data are collected from discharge information from trauma centers and a few other participating hospitals; but mild brain injuries that did not result in a hospital stay are not reported.

Due to improved emergency medical services, which include helicopter transport to specialized trauma centers, improved medical and surgical interventions, and improved rehabilitation services, more people are surviving brain injuries. However, improved emergency treatment means that there are an ever increasing number of persons with a history of brain injury. While incidence reporting identifies new cases of brain injury, it does not provide data to estimate the number of

Kentuckians with brain injuries. Obtaining information about the prevalence of brain injury is important for health planning and the development of services for injured persons. The decision to carry out a prevalence study of brain injury was made by the TBI Board after examining the findings from two previous years data on incidence from trauma centers and other national trauma databases (Christian, 2001; 2002). The 1998 trauma center data include findings for 1,573 persons with acquired brain injury (ABI) or 40 per 100,000 of the Kentucky population (Christian, 2001). The FY 2002 report shows a total of 3,038 acquired brain injury events for a per 100,000 rate of 76.7 (Christian, 2002). The Board was concerned that many persons with brain injuries do not receive trauma center services and are not accounted for through this method of data collection. While one study has examined the household prevalence of brain injury incidents in the previous 12 months, it did not address prevalence of a history of brain injury among household members (Sosin, Thurman & Sniezek, & Thurman, 1996). In reviewing extent data, The TBI Board's interests expanded beyond the incidents of new cases to a focus on the growing number of persons with a brain injury among the general Kentucky population.

This study was carried out under a contract by the Department of Mental health and Mental Retardation with the University of Kentucky Center on Drug and Alcohol Research (CDAR). CDAR has a twelve year history of federal and state-funded research in Kentucky on substance abuse, violence, mental health problems, and other behavioral health problems. The Center has also conducted three needs assessment projects that include household surveys to estimate the prevalence of substance use disorders among the general population.

Background

Traumatic brain injury, which can result in death, disability and long-term changes in quality of life, is clearly a significant health problem in the United States (Thurman, Alverson, Dunn, Guerrero, & Sniezek, 1999). Data from the Centers on Disease Control (CDC) suggest that approximately 50,000 U.S. residents die as a result of traumatic brain injury (TBI) each year. Persons who survive an incident of brain injury often experience neuropsychological problems that result in disabilities affecting work, schooling, educational progress, training, and/or socialization (Adekoya, Thurman, White, & Webb, 2002). For example, during the period from 1979 - 1992, traumatic brain injury-related death rates in the United States declined by 22%, from 24.6 to 19.3 deaths/100,000 population (Adekoya, et al., 2002). However, traumatic brain injury still represents a major cause of morbidity and mortality in the United States (Thurman, Jeppson, Burnett, Beaudoin, Rheinberger, & Sniezek, 1996). Each year, TBI-related deaths represent more than one-third of all injury-related deaths (Adekoya, et al., 2002). Survivors of moderate to severe brain injuries often require extensive rehabilitation services and even long-term care while those with mild injury can

experience life-changing problems that are often difficult to treat (Luchter & Walz, 1995). For example, in 1995, the total direct and indirect financial costs of traumatic brain injuries were estimated at $56 billion (Thurman, 2001).

The Federal Interagency Head Injury Task Force identified traumatic brain injury as a critical public health problem in 1989 (U.S. Department of Health and Human Services, 1989). In 1995, the CDC developed guidelines for surveillance of TBI (Thurman, Sniezek, Johnson, Greenspan, & Smith, 1995) and, with funding authorized under Public Law 104-166 (the Traumatic Brain Injury Act of 1996), the CDC supported the development of a multi-state TBI surveillance system (Adekoya, 2002). However, additional population-based epidemiologic studies of TBI are needed to assess trends in etiologic factors, to provide additional guidance for public policy, and to develop and evaluate brain injury prevention strategies. Despite the decline in fatal TBI incidents, traumatic brain injuries remain a significant challenge for public health and mental health planners.

Previous household surveys of brain injury have focused on brain injury incidents that occurred in the previous 12 months rather than the presence of a history of brain injury among members of the household (Sosin, et al., 1996). The Sosin, et al. study focused on injuries that resulted in hospital stays and diagnoses of brain injury. These approaches to data collection do not include most mild brain injuries because very few mild injuries result in hospital stays and, in fact, many may even receive no medical attention. The National Health Interview Survey, updated to the 1990 census, estimated there are about 1,975,000 head injuries each year in the United States (Collins, 1990) and from 300,000 – 525,000 persons are hospitalized each year for brain injuries (Guerrero, Thurman, & Sniezek, 2000; Kraus & Sorenson, 1994). However, from half to three-quarters of these hospitalizations are estimated to be for mild traumatic brain injury (National Institutes of Health, 1999; Silver & McAllister, 1997; Kraus & Sorenson, 1994). In addition, about half of mild brain injury cases receive no medical care or only outpatient treatment (Torner, Choi & Barnes, 1999). Thus, mild brain injury poses a special identification problem since the acute and chronic sequelae such as memory deficits may be less immediately observable. In fact, memory deficits and other attentional problems are not always associated with severe and overt brain injury, but can result from mild to moderate injury even when there is no loss of consciousness (Dixon, Taft, & Hayes, 1993; Kelly, 1999; Malec, 1999; National Institutes of Health, 1999). The recent attention to mild traumatic brain injury (Malec, 1999) points to the need to examine brain injury in the general population rather than among trauma center clinical populations.

Traumatic brain injury has been associated with alcohol and drug use both as a contributing factor to the injury and as a complicating factor for rehabilitation (Boyle, Vella, & Moloney, 1991;

Hestad, Updife, Selnes, & Royall, 1995; Miller, 1992). For example, blood alcohol concentrations have been reported in one half of brain injury victims (Kraus, Morgenstern, Fife, Conroy, & Nourjah, , 1989) and up to two-thirds of brain injury cases have histories of substance use before the injury (Corrigan, 1995). The high prevalence of drug and alcohol problems among traumatic brain injured individuals suggests that substance abusers might be at high risk for brain injury and vice versa. Drug and alcohol use prior to brain injury also can contribute to severity as measured both by coma ratings and by neuropsychological measures (Kelly, Johnson, Knoller, Drubach, & Winslow, 1997; Miller, 1992; Solomon & Sparadeo, 1992; Sparadeo & Gill, 1989; Sparadeo, Strauss, & Kapsalis, 1992).

There is a need to examine brain injury in rural as well as urban areas. Kentucky brain injury estimates are critical in order to evaluate and plan for future service needs and to improve the availability and quality of community based services in a state that includes a large rural population. Kentucky is one of only 15 states in which more than one-half (55%) of residents live in non-metro areas and almost two-thirds of residents live in places with less than 25,000 people. Kentucky has 120 counties and a 2000 census population of 4,041,769 persons (U.S. Census, 2000) living in a state of 39,679 square miles for an average population density of 101.8 persons per square mile. Kentucky's population is predominantly white with 90.1% reporting white only as race in the 2000 census and 7.3% as African American only and 2.6% as other or combinations of race (U.S. Census, 2000). The population is 48.9% male and 51.1% female with 97.2% of persons living in households. Average household size is reported at 2.47 persons. Almost three-fourths (74.1%) of Kentuckians 25 years or older have a high school diploma or GED or higher while 15.8% of (individual) live in poverty. Over 30% of Kentuckians smoke tobacco, and 30.9% are at risk of tobacco related illness, 19.0% rarely or never use seat belts, 37.5% are overweight, and 24.6% are obese as reported in the Kentucky Behavioral Risk Factor Surveillance Study for 2001 (Centers for Disease Control, 2003). Kentucky plans for mental health, mental retardation, and substance abuse treatment services in the context of the 14 regional mental health centers that are defined in Kentucky statute (KRS 210) as regional planning authorities and service providers.

The fourteen mental health regions vary significantly in population size, from just over 55,000 to almost 900,000, and they vary in their urban/rural composition. There are three largely urban regions (the areas around Louisville, Lexington, and Northern Kentucky) and eleven that range from small urban to rural environments. Four regions are largely Appalachian and four regions are Midwestern in character. Traumatic brain injuries can be analyzed by region to examine broader regional characteristics as well as rural and urban differences.

Study Method

This study of the prevalence of brain injury among Kentucky household members builds on earlier efforts to identify the incidence and prevalence of brain injury (Sosin, et al., 1996; Thurman, 2001). The primary focus of research on brain injury in the general population has been on injury incidents rather than the prevalence of persons with a history of brain injury. Rather than relying on clinical samples with diagnosed brain injury, this study examines self-reported head injuries among Kentucky household members. The study uses telephone interviews with household members to learn about the presence of a history of head injury among household members. Ideally, face-to-face interviews should be used in order to obtain more in-depth information and to obtain information from households without telephones. While funding constraints limited this study to telephone interviews, telephone surveys have been used extensively in epidemiological studies to examine other health problems. The specific approach used in this study was a random telephone survey of the total households in Kentucky. Cell telephone numbers were not included. Telephone numbers were selected using randomized digit dialing – a process that ensures a random selection of households by region.

The study was reviewed and approved by the University of Kentucky Medical Institutional Review Board (IRB). The study protocol included a description of the study, risks and benefits, and the study process at the beginning of each call. Participants were informed that they could terminate the interview at any point or not participate at all. Participants received no incentive for their participation in the study. In addition, this telephone survey asked the adult person answering the telephone to respond to the questions about individuals with head injury in the household rather than speaking to the person with the brain injury. There were two reasons for this approach: 1) Many individuals with brain injuries are unable to give accurate information about their injuries and related problems; and 2) The purpose of the survey was not to collect clinical information, but to develop estimates of the number of households with head injuries.

The survey questions used the term “head injuries” rather than “brain injuries” since brain injury is a diagnosed condition whereas head injury is an experienced event. People may or may not know whether they have had a brain injury, but they are able to recount a head injury. Head injuries may or may not result in brain injuries. This is one of the reasons for including follow-up questions about problems that were experienced post injury. Given current research on the effects of mild brain injuries (Kelly, et al., 1997; Malec, 1999), brain injury can be inferred from head injuries that have subsequent problems in emotion, memory, and other behavioral problems. Also, previous studies have used head injury as a proxy for brain injury (Sosin, et al., 1996).

Sample selection was developed by the University of Kentucky Survey Research Center under the direction of Ronald E. Langley, Ph.D. Interviewers were trained by Robert Walker, the Principal Investigator for this study, and by Dr. Langley. The interviews began in November 2002 and were completed by May 2003.

The Survey Research Center used the WinQuery Computer-Assisted Telephone Interviewing (CATI) system, a 22-line telephone bank, and 28 computer workstations. The full-featured CATI system enables the interviewer to enter responses to each question directly into the computer. CATI provides automatic skips, preprogrammed prompts, and the routine coding of all open-ended questions. All data are entered at the time of the interview, allowing for constant monitoring of productivity and quality. CATI logged all attempted calls and provides an automatic scheduling algorithm to ensure that phone numbers were attempted at different hours on different days until contact is made.

Survey Items

This survey was not intended to obtain a complete in-depth set of clinical information on persons with brain injuries, but to collect prevalence information. The survey was two-tiered with basic demographic information including household size and county of residence, and a question about whether any household member had ever received a head injury. Respondents who stated "no" to this question completed the interview with this response and the respondent was thanked for participating. Respondents who answered "yes" to this question were then asked several other questions. In order to identify respondents with more severe injuries, several follow-up questions were used. These questions were used to help clarify characteristics of the injury that are associated with more severe injuries and were considered indicators of severity. These questions included asking about emergency room visits, staying at least one night in a hospital, experiencing behavior changes following the injury, and using professional services as a result of the injury (Guerrero, et al., 2000; Malec, 1999). These questions served as indicators of severity by focusing on selected consequences of mild brain injury. For example, having been in a hospital may be an indicator of severity of brain injury. However, almost half of the disability days related to brain injury occur among persons who were not hospitalized (Fife, 1987). Sequelae to brain injury can also indicate longer term severity of injury as well as a need for services for the injured person. In addition, asking about changes in personality or mood can provide information about the severity and service needs of the injured person. Depression and anxiety are also common among persons with brain injury including mild injury (Hibbard, Uysal, Kepler, Bogdany, & Silver, 1998: Mateer, 2000). A question was included about the need for substance abuse counseling following the injury. This question was

included because of the literature on associations of brain injury with substance use (Kelly, et al. 1997; Miller, 1992; Solomon & Sparadeo, 1992; Sparadeo & Gill, 1989; Sparadeo, et al., 1992).

Data Analysis

Responses from each call were entered electronically into a database as the interview was conducted. Data were submitted to the Principal Investigator and converted to an SPSS database for analysis. Frequencies were run for each of the survey variables. Data were analyzed by mental health region because: (1) Kentucky House Bill 843 initiated a renewed needs assessment for mental health, mental retardation, and substance abuse treatment services for each region of the state; (2) the Cabinet for Health Services Brain Injury Services Unit was established in the Department of Mental Health and Mental Retardation which uses regional plans for services; and (3) A legislative task force on brain injury also received service data from regional sources. Hence, the mental health regions were used as geographic units to analyze for regional differences in brain injury prevalence rates.

Results

This final report includes data from 3,267 households that were contacted between December 2002 and May 2003. The response rate for completing the telephone interview was 49.8% of all attempted calls with only a 19.4% refusal rate. Over one-third (36.7%) of the calls were to numbers that had been disconnected. Another 22% had a variety of reasons for an incomplete interview, including caller ID blocking, language problems, no answer, or the line was busy on all attempts.

The distribution of households by region is shown in Table 1. Table 1 shows the 2000 Kentucky population for each region and each region's percent of the state population as well as the number of households contacted by region with their percents to total as well. The distribution of calls for all regions is consistent with the distribution of regional population with one exception. The percent of Bluegrass region respondents (18.7) was significantly greater than the Bluegrass percent of the state population (17) ($p<.01$). The percent of NorthKey respondents was lower than its share of the state population, but not significantly lower.

Table 1. Total Households Contacted by Mental Health Region Compared with Regional Population (n=3,267)

Mental Health Region	Number Contacted	Percent	2000 Census Regional Population	Percent of Total State Population
1 Four Rivers – Paducah	174	5.3	203,299	**5.0**
2 Pennyroyal – Hopkinsville	158	4.8	205,715	**5.1**
3 Valley – Owensboro	185	5.7	207,377	**5.1**
4 Lifeskills – Bowling Green	190	5.8	255,225	**6.3**
5 Communicare - Elizabethtown	197	6.0	243,202	**6.0**
6 Seven Counties – Louisville	664	20.3	869,306	**21.5**
7 NorthKey – Covington	283	8.7	391,417	**9.7**
8 Comprehend - Maysville	37	1.1	55,229	**1.4**
10 Pathways – Ashland	178	5.4	212,086	**5.2**
11 Mountain – Prestonsburg	101	3.1	160,532	**4.0**
12 Kentucky River – Jackson	97	3.0	120,656	**3.0**
13 Cumberland River – Corbin	215	6.6	238,270	**5.9**
14 Adanta – Somerset	177	5.4	193,452	**4.9**
15 Bluegrass - Lexington	611	18.7**	686,003	**17.0**
Total	3267	100.0	4,041,769	**100.0**

***p <.01*

Table 2 shows the regional distribution of households that reported at least one person with a head injury. The table also presents the 2000 census population for each region. The distribution of households with persons with brain injuries is consistent with regional population distribution, suggesting that there are no significant regional differences in prevalence. There were 633 households with at least one person with a brain injury.

Table 2. Mental Health Region for Households with a Person with a Brain Injury (n=633)

Mental Health Region	Households with Injured Persons	Percent of Total	2000 Census Regional Population	Percent of Total State Population
1 Four Rivers - Paducah	29	4.6	203,299	5.0
2 Pennyroyal - Hopkinsville	21	3.3	205,715	5.1
3 Valley - Owensboro	39	6.2	207,377	5.1
4 Lifeskills - Bowling Green	23	3.6	255,225	6.3
5 Communicare - Elizabethtown	51	8.1	243,202	6.0
6 Seven Counties - Louisville	132	20.9	869,306	21.5
7 NorthKey - Covington	53	8.4	391,417	9.7
8 Comprehend - Maysville	9	1.4	55,229	1.4
10 Pathways - Ashland	33	5.2	212,086	5.2
11 Mountain - Prestonsburg	19	3.0	160,532	4.0
12 Kentucky River - Jackson	25	3.9	120,652	3.0
13 Cumberland Valley - Corbin	49	7.7	382,706	5.9
14 Adanta - Somerset	37	5.8	193,452	4.9
15 Bluegrass - Lexington	113	17.9	686,003	17.0
Total	633	100	4,041,769	100.1[a]

[a] Sum over 100% due to rounding.

Table 3 shows the number of households reporting a member with a brain injury and the number of injured persons in that household. Specifically, 633 households reported at least one person with a history of a brain injury. This means that 19.4% of the contacted households reported having at least one person with a brain injury. Of this number, 116 households reported more than one household member with a brain injury. This means that of the 19.4% of households that reported at least one member with a brain injury, 3.4% of all households, or 18.5% of households with a reported head injury among its members, reported having more than one person with a head injury. The average household size in this study was 1.9, which is smaller than the statewide average of 2.5.

Table 3. Households by Number of Members with Brain Injury (n=633)

Households with One or More Persons with a Brain Injury	Number of Households with this Number of Injured Persons	Percent of Total Households
Households with 1	517	81.7
Households with 2	96	15.2
Households with 3	17	2.7
Households with 4	3	0.5
Total Households with Persons with Injuries	633	100

Data were also collected about persons who had injuries while they were in the household. While there were 633 households reporting at least one injured person, the total number of injured persons was 772. Table 4 presents the current living situation of the person with a head injury. The majority (84.6%) of the injured persons were still living in the same household and only 12.7% were reported living elsewhere. Less than three percent (2.8%) died from either the head injury or other causes. Consequently, 751 surviving individuals were reported with a head injury.

Table 4. Where the Injured Person Lives (n=772)

Injured Person Still Living In The Household	Number of Injured Persons	Percent
Person still living in the household	653	84.6
Person living elsewhere	98	12.7
Person died as a result of the injury	12	1.6
Person died of other causes	9	1.2

Table 5 presents the gender of persons who were identified with a head injury. In this study, 61% were male. There was a slightly higher rate of injury for females (39%) than is reported in national mortality data with nearly three-fourths (73%) of brain injury deaths typically being male (Adekoya, 2002). However, emergency department studies of brain injury have the same distribution of male (61%) to female (39%) patients (Guerrero, et al., 2000). The data in that study included mild head injuries as well as fatal injuries which could explain the different proportion of female injured persons.

Table 5. Gender of Injured Persons (n=772)

Gender of Injured Persons	Number of Injured Persons	Percent
Male	471	61.0
Female	301	39.0

Table 6 shows the age of the person at the time of the head injury. Over half (60%) of the injuries occurred among persons under age 21, a finding that is consistent with other incidence data (Guerrero, et al., 2000). The prevalence of reported head injuries among Kentucky households decreased among older persons with the over 50 year-old group at 6.9% of the total head injured persons.

Table 6. Age at the Time of the Head Injury (n=770)

Injured Persons Still Living in the Household	Number of Injured Persons	Percent
Under age 21	462	60.0
Between the ages of 21-30	130	16.9
Between the ages of 31-40	77	10.0
Between the ages of 41-60	48	6.2
Over the age of 50	53	6.9

Table 7 presents the reported causes of head injuries. Motor vehicles represented about one-third (34%) of the reported causes and sports accounted for 17.1% of the injuries. Only 3.7% of the injuries were from assaults or fights, while falls accounted for 27% of the injuries. Additional factors were also included such as failure to use a helmet (11.1% of the cases), and failure to use a safety belt (9.3% of the cases). Speeding or risky driving accounted for 5.1% of the cases.

Table 7. Causes of Head Injury
(n=767)

Cause	Number of Injured Persons	Percent
Motor vehicle accident	261	34.0
sports or other recreational activity	131	17.1
Work-related accident	46	6.0
Assaults or fights	28	3.7
Falls	207	27.0
Other	94	12.3
Additional Factors Associated with the injury		
Cases not using a helmet	85	11.1
Cases not using a safety belt	71	9.3
Speeding or risky driving	39	5.1

Tables 8 and 9 provide information about the immediate consequences of the reported head injury and post injury loss of consciousness. Table 8 specifically presents information about loss of consciousness which is one indicator of brain injury severity. Data were available for 737 of the reported injured persons. Almost half (44.5%) of the cases involved a loss of consciousness following the injury.

Table 8. Loss of Consciousness
(n=737)

Loss of Consciousness	Number of Injured Persons	Percent
Person **lost** consciousness	328	44.5
Person **did not** lose consciousness	409	55.5

Table 9 reports on the use of an emergency department for health assessment or treatment following a brain injury which can be an indicator of injury severity. Data on this measure were available for 745 injured persons who survived the injury. Table 9 shows that 85.4% of the persons reported with a head injury were taken to an emergency department following their injury.

Table 9. Use of Emergency Department
(n=745)

Did the Person Go to an ER	Number of Injured Persons	Percent
Yes	636	85.4
No	109	14.6

Another indicator of brain injury severity is hospitalization following the injury. Table 10 shows that 42.1% of the persons who were reported with a head injury stayed in a hospital at least one night.

Table 10. Hospitalization
(n=636)

Was the Person Kept in a Hospital for at Least One Night	Number of Injured Persons	Percent
Yes	268	42.1
No	368	57.9

Table 11 presents the changes in mood or personality after a head injury. Among the 772 persons with a head injury, information about changes in mood or personality was available for the 751 who survived the injury. The survey asked about "increased" depression, anxiety and memory problems as a way of examining changes after the injury rather than for overall prevalence of these problems. These measures were indices of injury severity. Over one-third (39%) had at least one change in mood or personality following the injury. About one-fifth (20.5%) were reported with increased depression following the injury and 23.3% had increased anxiety. Almost the same percentage (21.3%) was reported with changed personality traits. Almost one-fourth (24.2%) had memory problems following the injury. Surprisingly, only 5.9% were reported to have increased substance use following the injury.

Table 11. Changes in Mood or Personality (n=751)

Changed Trait	Number of Persons Injured	Percent
Persons reported with increased **depression**	154	20.5
Persons reported with increased **anxiety**	175	23.3
Persons reported with **changed personality traits**	160	21.3
Persons reported with increased **substance use**	44	5.9
Persons reported with increased **memory problems**	182	24.2
Total persons reported to have **at least one** of the above problems	298	39.7

Figure 1 presents the four most frequently reported changes in personality or mood after the injury. These changes were not mutually exclusive choices. Hence, persons with increased depression could also have experienced increased memory problems. Increased memory problems were cited for almost one-fourth of the head injury cases.

Figure 1. Most Reported Changes After the Head Injury (n=751)

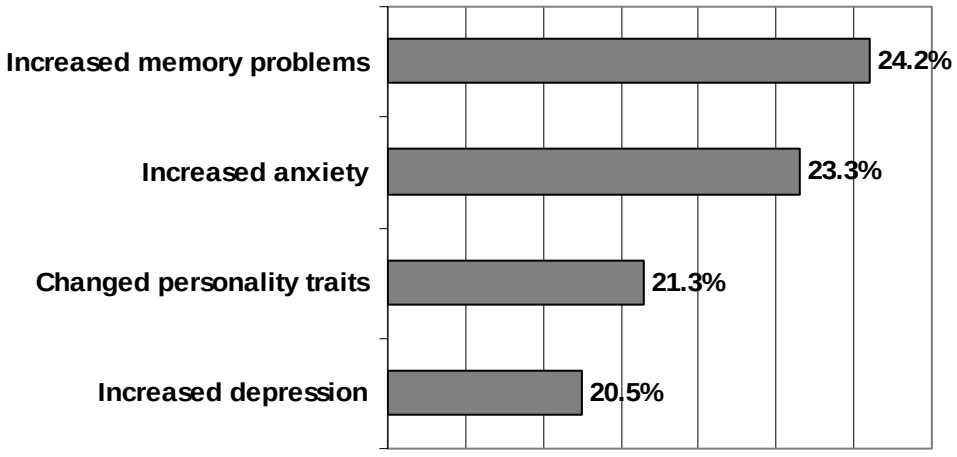

Table 12a presents the number of persons who accessed professional services after the injury. Almost one third (31.6%) of the injured persons needed professional services after their injury. The specific services are shown in Table 12b which includes number of persons and type of services needed as a percent of those who needed professional services. Over one-fourth (29.8%) needed mental health services and 26% needed specialized equipment. Almost one-half (40.4%)

needed physical therapy, occupational therapy or speech therapy. A much smaller number (11.1%) were reported as needing vocational training. Over one-fifth (21.7%) needed residential treatment or rehabilitation. Environmental modifications were needed by 13.2% of the injured persons and 36.6% needed other medical services. Of those who used professional services, 87.6% used at least one service as a result of their injury.

Table 12a. Use of Professional Services (n=744)

Did the Person Need Professional Services	Number of Injured Persons	Percent
Yes	235	31.6
No	509	68.4

Table 12b. Use of Professional Services: Specific Services (n=235)

Type of Professional Services Needed	Number of Injured Persons Needing Services	Percent of Persons Needing Services
Mental health services	70	29.8
Specialized equipment	61	26.0
Physical Therapy, Speech, or Occupational Therapy	95	40.4
Vocational training	26	11.1
Substance abuse counseling	12	5.1
Personal care assistance	53	22.6
Environmental modifications	31	13.2
Residential Treatment or Rehabilitation	51	21.7
Other medical services	86	36.6
Total Who Used at Least One Service	206	87.6

Table 12c presents the method of payment most people used for their professional services. Over half (60.4%) paid for services using private insurance coverage. Nearly one-fifth (19.1%) paid out-of-pocket and 15.3% used Medicaid or Medicare to pay for services.

Table 12c. How Paid for Professional Services

How Paid for Services	Number of Injured Persons	Percent
Private Insurance	142	60.4
Medicaid/ Medicare	36	15.3
Paid Out of Pocket	45	19.1

Table 13a and 13b show a loss and return to work or schooling. Almost one-half (45.3%) of the injured persons were reported as having lost a job or school placement after their injury. However, over three-fourths (84.1%) were able to return to work or school.

Table 13a. Did the injury result in a loss of work or being unable to go to school (n=748)

Did the Person Lose a Job or Schooling	Number of Injured Persons	Percent
Yes	339	45.3
No	409	54.7

Table 13b. Has the injured person returned to work or school? (n=339)

Was the Person Able to Return to Work or School	Number of Injured Persons	Percent
Yes	285	84.1
No	54	15.9

Discussion

These Kentucky brain injury findings represent a departure from the predominant epidemiological studies of brain injury in the United States. Most states, along with the Centers for Disease Control have focused on the incidence of brain injury by examining hospital and emergency department records. This study offers a new direction in brain injury research by examining the prevalence of reported head injuries among households in one state.

With more persons surviving brain injuries, it is most important to have estimates of the growing number of persons who might require ongoing health, mental health, substance abuse treatment, and rehabilitation for problems related to brain injuries. Incidence data alone will not help health planners in identifying this ever increasing number of persons with service needs. The identification of 19.4% of the households with one or more persons with a brain injury is an

important contribution to the understanding of health problems in Kentucky and may be an important step toward a better epidemiology of brain injury.

There are several implications from this survey. Health planners and providers may need to be more cognizant of brain injury-related problems as they plan or implement interventions. The findings from this study suggest that brain injury is more prevalent than expected. In addition, findings about problems experienced by people after the injury support recent research about the long-term effects of mild brain injury. Since only about half of mild brain injury incidents result in medical care and may only receive outpatient clinic treatment (Torner, Choi, & Barnes, 1999), it is important to examine more than hospital discharge data to estimate the scope of the brain injury problem. Mild brain injury has continued to present a challenge for health care planners since it is difficult to obtain prevalence data and may be all the more difficult because the acute and chronic sequelae of mild brain injury are less severe and less immediately observable. More importantly, the current understanding of brain injury sequelae includes the possibility of recovery long after the injury (Prigatano, 1999). Some of the problems from brain injuries can develop long after the injury, and recovery of functions can occur with focused rehabilitation even years after an injury (Mateer, 2000; Prigatano, 1999). The recent research and clinical attention to mild traumatic brain injury (Malec, 1999) suggests a continuing need for research among the general population in addition to clinical populations in trauma centers and acute rehabilitation.

Limitations

This study has several limitations that need to be considered. First, only households with telephones were included, thus many persons or households without telephones were excluded. This could decrease generalizability because households without telephones could have higher or lower head injury rates. Second, the study did not select individuals with diagnosed brain injuries and this may mean that persons were reported with head injuries without subsequent brain injury. Brain injured persons may or may not be reliable informants about their history and condition. Third, this study excluded many other questions that could have been potentially interesting due to financial constraints. One of the trade-offs for the study was to reach a large sample with a short interview rather than a small sample with a long interview. This study targeted a larger sample in order to better estimate the prevalence of brain injury among Kentuckians. Fourth, while this study examined selected consequences of head injury that can indicate injury severity, the study did not assess the severity of brain injury or disabilities among subjects. Hence, the findings do not address differences in need between persons with severe and mild brain injury.

Concluding Remarks

These findings represent one of the first efforts to survey the general population of a state to obtain prevalence estimates of head injury. The finding that 19.4% of households have one or more persons with a history of a head injury is surprising. In Kentucky, the 2000 Census identified 1,590,647 households. These findings suggest that statewide, there could be 308,586 households with at least one member with a head injury ranging from mild to more severe injuries. Extrapolating from households to persons, 3,267 households had an average size of 1.93 persons, or 6,305 persons in this sample. There were 751 surviving household members (11.9%) with a head injury among the 6,305 of the household sample. Hence, 11.9% percent of the sample population had at least a mild head injury. This finding suggests that 480,970 Kentucky residents have a lifetime history of a mild or severe head injury. In applying a range of severity indicators to the estimated 480,970 injured persons, 44.5% of injured persons in this study had a loss of consciousness subsequent to the injury, and 42.1% had at least an over night stay in the hospital after the injury. Using these two severity indicators, we can estimate a range of between 202,488 and 214,032 Kentucky residents experiencing a lifetime head injury with related and potentially significant clinical sequelae. Many persons with mild brain injury do not experience loss of consciousness and yet still experience changed moods and "odd" behavior post injury (McAllister & Flashman, 1999). The range of injured persons in this sample from a household survey suggests that between 5.3% and 5.0% of Kentucky residents may have a head injury that could affect their future functioning. Current research continues to indicate that even mild brain injuries can result in lasting changes to mood, affectivity, memoral process, and personality characteristics (McAllister & Flashman, 1999). These findings suggest that the ever increasing number of persons in Kentucky with a brain injury may represent a growing problem for health care planning. Brain injury may be contributing to service demands and to problems in daily living long after the acute phase of the injury and after acute medical and rehabilitation services. Future research with household populations should examine brain injury in more detail in order to better understand the scope and extent of injuries on people's lives.

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