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Causes of Mortality Among American College Students: A Pilot Study

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This pilot study from self-selected institutions of higher education provides an estimate of the causes and rates of mortality among college students between the ages of 18 and 24 years old. One hundred fifty-seven 4-year colleges participated in an online survey of student deaths during one academic year. A total of 254 deaths were reported. The mortality rates (per 100,000) were as follows: total accidental injuries, 10.80; suicide, 6.17; cancer, 1.94; and homicide, 0.53. Within the accident and injury category, alcohol-related vehicular deaths (per 100,000) were 3.37 and alcohol-related nontraffic injuries were 1.49. Men had significantly higher rates of suicide (10.46) than women (2.34). Suggestions for future research and implications of these findings are discussed.

KEYWORDS accidental injuries, alcohol, American college students, causes, mortality, suicide

College students represent an important subpopulation of the United States, with 18 million students enrolled at any one time, and nearly 55% of the population attending college at some point in their lives (U. S. Census Bureau, 2011). Although there are many epidemiological studies of mortality in this age group, in our search we found only one publication, now more than

70 years old, which uses institutions as the unit of analysis and provides comparative information about the causes of death among college students at multiple schools (Diehl & Shepard, 1939, p. 100). In 202 responding institutions providing information on 327 deaths over 10 years, the five leading causes by proportion were accidents (26.3%), suicide (8.0%), heart and circulatory diseases (7.7%), pneumonia (7.3%) and tuberculosis (6.4%). Motor vehicle accidents were the cause of more than half of the accidental deaths. In a second study that retrospectively evaluated deaths at one institution over 35 years, accidents were the leading cause of death among college students, followed by heart and circulatory diseases, and then suicide (Parrish, 1956).

Contemporary mortality rates among college students have been published for certain conditions, notably suicide and unintentional injuries. Deaths due to alcohol-related unintentional injuries have been extrapolated from national census and accident data (Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002; Hingson, Heeren, Winter, & Wechsler, 2005; Hingson, Zha & Weitzman, 2009). These studies have assumed rates of deaths due to vehicular and nontraffic accidents among college students are identical to the same-age general population. However, a survey of colleges in Virginia in 2007 found actual mortality rates due to vehicular accidents were significantly lower than the general population rates (Turner, Bauerle & Keller, 2011a).

This pilot study's objective was to investigate the leading causes and rates of mortality for students at a sample of U.S. institutions of higher education (IHEs), with a particular interest in investigating the prevalence of suicide and alcohol-related mortality.

METHODS

All mortality data was de-identified; no private health or student information was reported by participating schools. All members of the study team except one (EVL) were blinded to individual school data; institutions were assigned a unique study number for purposes of statistical analysis. Consultation with the first author's institutional review board indicated no requirement for formal approval for analyzing or publishing the data from this study.

Survey

The American College Health Association (ACHA) administered a 42 question retrospective survey online in the summer and early fall of 2010. The instrument was entitled "the American College Health Association 2009–2010 Survey on College Student Mortality Rates," and was sent to a single individual at each college/university represented in the ACHA membership database. For ACHA Institutional Members, the survey recipient was

the Representative of the Member Institution (RMI). For Individual Members of ACHA at Noninstitutional member schools, the instrument was sent to the Individual Member of ACHA. If there were multiple Individual Members, the instrument was sent to the person with the highest level of responsibility such as the Medical Director of the health center. The survey queried school characteristics (public vs. nonprofit private, 4-year degree vs. 2-year degree, institutional location by Census Bureau Region and community size); the number and causes of deaths, age, and gender of decedents between August 1, 2009 and May 31, 2010; and the source(s) of information regarding student deaths. The survey, and five reminders, was sent to 858 ACHA institutional members and 296 ACHA individual members at nonmember institutions. Eighty-eight percent of the recipient institutions were 4-year colleges.

Enrollment and Institutional Data

Sample and national enrollment data for 2009/2010 was accessed from the Department of Education, National Center for Education Statistics (National Center for Education Statistics, 2009). Because previously published mortality rates for college age individuals are for those between 18–24 year olds, this analysis is limited to 18–24 year olds. Sample and national institutional characteristics were accessed from the Carnegie Foundation's national database (Carnegie Foundation for the Advancement of Teaching, n.d.).

Statistical Analysis

Data management and analysis was accomplished using both Excel 2007 and the Statistical Package for Social Sciences (SPSS) version 19. Sample comparability to the population of 4-year IHEs in the United States was examined for institutional control (public vs. private), community size (large urban, small urban/suburban, rural) and Census Bureau Region (Northeast, Midwest, South, West). Similarly, the enrollment of 18–24-year-old students in the sample schools was compared to national enrollment of 18–24 year olds in 4-year institutions on the variables of gender, institutional control, Census Bureau Region and community size. The National Center for Education Statistics database does not provide breakdowns of ethnicity by age category, but only by undergraduate or graduate/professional status. Therefore ethnicity comparisons are based on the undergraduates in the sample versus the total U.S. undergraduate population in 4-year IHEs.

The number of deaths was reported by schools over a 10-month period and annualized to 12 months to calculate mortality rates. Deaths were reported by various school offices (see Results section). The number of deaths due to alcohol-related motor vehicle accidents and alcohol-related other unintentional deaths was calculated as a percentage of total motor vehicle

deaths and other unintentional deaths, using rates from previously published work (Hingson et al., 2009). In that study, alcohol was estimated to play a role in 49% of vehicular deaths and 38.5% of nontraffic unintentional deaths.

Overall mortality rates (deaths per 100,000), with 95% Confidence Intervals (95% CIs), were calculated for each type-of-death category based on enrollment totals for the study sample, and within categories for gender, institutional control, Census Bureau Region and community size when the number of deaths in each category reached six or more. Odds ratios (OR), with 95% CI, were computed to compare relative risk for different categories of the four descriptive variables (gender, institutional control, Census Bureau Regions, community size).

RESULTS

One hundred sixty-six IHEs completed the survey: 157 four-year schools and 9 two-year associate degree institutions. Because of the small number of 2-year institutions, the final analysis was limited to a sample of 157 four-year schools, or roughly 14% of the schools from which data were solicited.

The total enrollment of 18–24 year olds among the sample schools was 1.36 million, with 53% female students, compared to 55% female students nationally. Enrollment distribution by institutional type (public vs. private), Census Bureau Region, and community size reveal similarities and differences between the sample and national population (Table 1.) Ethnicity of undergraduates among the sample and population demonstrates overrepresentation of whites among the sample (Table 2).

The schools reported multiple sources used to identify student death information, including offices of the dean of students (33%), student health and counseling services (26.3%), campus security (15%), registrar (8.4%), central administration (7.2%), public affairs (6.6%), and other miscellaneous sources (3.5%).

A total of 254 deaths were reported (Table 3). For the sample of all-age students, there were 54 illness deaths, 41 of which were cancer; this analysis includes only cancer-related illness deaths for 18–24-year-old students. Seventy-nine schools reported at least one death (with a range of 1–19 deaths per school), while 78 reported no deaths.

Accidental injury (combined vehicular and nontraffic) was the leading cause of mortality. Separating accidental deaths into vehicular and nonvehicular categories, and accounting for alcohol as a contributing factor, the leading accidental causes in declining order of frequency were: non–alcohol-related vehicular accidents, alcohol-related vehicular accidents, non–alcohol-related nontraffic injury, and alcohol-related nontraffic injury (Table 3). Table 3 also shows rates for suicide, homicide, and cancer. The table includes predicted mortality rates for causes of death from national reference sources.

TABLE 1 Comparison of Enrollment of 18–24-Year-Old Undergraduates in 157 Sample Schools Versus All (2,345) 4-Year Institutions

Enrollment (18–24 year olds)	Sample		Population	
	Number	Percent	Number	Percent
By Gender				
Males	640,829	47.07	3,533,683	45.09
Females	720,475	52.93	4,303,070	54.91
Total	1,361,304	100.00	7,700,741	
By Institutional Type				
Public	1,078,861	79.25	5,206,725	66.44
Private	282,443	20.75	2,630,028	33.56
Total	1,361,304	100.00	7,836,753	100.00
By Census Bureau Region				
Region 1: Northeast	303,151	22.27	1,654,795	21.12
Region 2: Midwest	316,837	23.27	1,878,057	23.96
Region 3: South	557,568	40.96	2,696,910	34.41
Region 4: West	182,213	13.39	1,470,979	18.77
Territories	1,535	.11	136,012	1.74
Total	1,361,304	100.00	7,836,753	100.00
By Community size				
Large urban	675,063	49.59	3,435,585	43.84
Small urban/Suburban	440,385	32.35	2,949,559	37.64
Rural	245,450	18.03	1,451,609	18.52
Other/Not assigned	406	.03	0	0
Total	1,361,304	100	7,836,753	100

TABLE 2 Comparison of Enrollment of Undergraduates Among Sample and All U.S. Undergraduates by Ethnicity

Race/Ethnicity	Undergraduates in All 4-Year Institutions		Undergraduates in Sample Schools	
	N	Percent	*n*	Percent
White	6,982,692	60	979,518	69
Black	1,253,626	11	114,592	8
Hispanic	1,176,294	10	88,520	6
Asian/Pacific	716,915	6	95,483	7
American Indian/ Alaska Native	94,695	1	10,231	1
Nonresident alien	560,158	5	43,601	3
Unknown	843,006	7	84,219	6
2 or more	560,158	5	5,687	0
Total	11,627,386	100.00	1,421,851	100

Men had significantly higher mortality rates due to suicide (OR = 4.43, 95% CI: 2.6, 7.55), unknown causes (OR = 3.07, 95% CI: 1.54, 6.12), all nontraffic injuries (OR = 2.60, 95% CI: 1.45–4.67) and all injuries (OR = 1.86, 95% CI: 1.33–2.6) than women and a trend toward higher mortality rates in all other categories (Table 4). No statistically different rates for any

TABLE 3 Mortality Rates for 18–24 Year Olds at 4-Year Institutions ($n = 157$)

Category of Death	Number	Imputed Cases	12 Months	Sample n	Rate per 100,000	95% CI for Rate Lower	95% CI for Rate Upper	Predicted Rate per 100,000
All Injury	122		147	1,361,304	10.80	9.05	12.54	
Vehicular Injury	78		94	1,361,304	6.88	5.6	8.15	29.21[a]
Non–alcohol-related		40	48	1,361,304	3.51	2.6	4.41	
Alcohol-related		38	46	1,361,304	3.37	2.48	4.26	14.1[b]
Nontraffic Injury	44		53	1,361,304	3.88	2.92	4.83	14.71[a]
Non–alcohol-related		27	32	1,361,304	2.39	1.64	3.13	
Alcohol-related		17	20	1,361,304	1.49	0.90	2.09	4.9[b]
Suicide	70		84	1,361,304	6.17	4.97	7.38	11.72[a],7.0[c]
Unknown	34		41	1,361,304	3.00	2.16	3.84	1.72[a]
Cancer	22		26	1,361,304	1.94	1.27	2.62	2.7 to 5.4[d]
Homicide	6		7	1,361,304	0.53	0.18	0.88	15.78[a], .315[e]
Total	254		305					

[a]18–24-year-old general population (Centers for Disease Control and Prevention, n.d.).

[b]Cases of alcohol-related injury are imputed using 49% for alcohol-related vehicular mortality and 38.5% for alcohol-related nonvehicular mortality (Hingson, Zha, & Weitzman, 2009).

[c]College students at 4-year universities 2004/2005–2008/2009 (Schwartz, 2011).

[d]NCI provides mortality rates for general population ages 15–19 and 20–24 only; rate reflects these two age groups (Howlader et al.,2010).

[e]All 4-year colleges, all incidents of murder (includes students and nonstudents; U.S. Department of Education Office of Post Secondary Education, n.d.).

cause of death were observed between public versus private institutions or by Census Bureau Region. Comparing rates by community size, the only significant differences in mortality rates were higher rates among students at rural schools in the categories of motor vehicle accidents. For alcohol-related motor vehicle accidents, rural schools trended to a higher mortality than large urban (6.23 vs. 3.14 per 100,000; OR = 1.96, 95% CI: 1.01, 3.8) and had a higher mortality than small urban/suburban (6.23 vs. 2.14 per 100,000; OR = 2.99, 95% CI: 1.21, 6.83).

DISCUSSION

In this pilot study, over 70 years after the 1939 multi-institution study (Diehl & Shepard, 1939), accidents and suicide remain very important causes of death among college students. Not unexpectedly, cardiovascular and infectious diseases are no longer frequent causes of death. Notably, mortality rates for all known causes were significantly lower among 18–24-year-old college students than predicted by reference data from the same aged general population (Centers for Disease Control and Prevention, n.d.; Hingson et al., 2005; Hingson et al., 2002; Hingson et al., 2009; Howlader et al., 2010).

When combining all types (vehicular and nontraffic), unintentional accidental deaths remain the leading cause of mortality among college students. Suicide also continues as an important known cause of death in this sample. Though significantly lower than the rate predicted for the general population, the reported suicide rate is comparable to previously published studies of college students, including the higher rate among males (Schwartz, 2011).

Mortality rates due to alcohol-related vehicular and nontraffic injuries are substantially lower in this study than those predicted for college students in previous studies (Hingson et al., 2009). However, the rate of alcohol-related vehicular deaths we found is similar in magnitude to a recent study reporting vehicular deaths after a survey of colleges in Virginia (Turner, Bauerle, & Keller 2011a). These findings contradict the widely held perception that alcohol-related deaths on campuses are disproportionately high, and suggest there may be important protective factors within the college environment. Campus-wide alcohol prevention and educational interventions have been associated with significant decreases not only in drinking and driving, but many other serious negative consequences (DeJong et al., 2006; Haines, Barker & Rice, 2006; Marlatt & Witkiewitz, 2002; Perkins & Craig, 2006; Turner, Perkins, & Bauerle, 2008). In addition, campuses have elaborate student support services for early detection of problem drinking as well as referral and access to health, counseling, and preventive services.

Despite highly publicized murders on campuses in the past, the very low homicide rate observed in this study is consistent with national data (U.S. Department of Education Office of Post Secondary Education, Campus

TABLE 4 Mortality Rates for 18–24 Year Olds in 4-Year Institutions by Gender and Category of Death

Category of Death	Number	Imputed Cases[a]	12 Months	Sample n	Rate/100000	95% CI for Rate Lower	95% CI for Rate Upper
Men							
All Injury	76		91	640,809	14.20	11.28	17.12
Vehicular Injury	45		54	640,809	8.43	6.18	10.67
Non–alcohol-related		23	28	640,809	4.37	2.75	5.99
Alcohol-related		22	26	640,809	4.06	2.50	5.62
Nontraffic Injury	31		37	640,809	5.77	3.91	7.63
Non–alcohol-related		19	23	640,809	3.59	2.12	5.06
Alcohol-related		12	14	640,809	2.18	1.04	3.33
Suicide	56		67	640,809	10.46	7.95	12.96
Unknown	25		30	640,809	4.69	3.15	6.22
Cancer	12		14	640,809	2.25	1.19	3.31
Women							
All Injury	46		55	720,495	7.63	5.62	9.65
Vehicular Injury	33		40	720,495	5.55	3.83	7.27
Non–alcohol-related		17	20	720,495	2.78	1.56	3.99
Alcohol-related		16	19	720,495	2.64	1.45	3.82
Nontraffic Injury	13		16	720,495	2.22	1.13	3.31
Non–alcohol-related		8	10	720,495	1.39	.53	2.25
Alcohol-related		5	6	720,495	.83	.17	1.50
Suicide	14		17	720,495	2.34	1.32	3.35
Unknown	9		11	720,495	1.50	0.68	2.32
Cancer	10		12	720,495	1.67	0.81	2.53

[a]Cases of alcohol-related injury are imputed using 49% for alcohol-related vehicular mortality and 38.5% for alcohol-related nonvehicular mortality (Hingson, Zha, & Weitzman, 2009).

Safety, and Security Statistics) and likely reflects the generally safe and controlled environment afforded by campus security measures and affirms the efforts devoted to protecting the learning community (Strauss, 2010).

There are limitations to this pilot study. This study uses a self-selected convenience sample with a low response rate from the reference population. The data sources of reports of student deaths varied from school to school. Although in certain respects a representative sample of schools and students was achieved (Tables 1 and 2), the sample underrepresents nonwhite students and disproportionately comprises public (vs. private) students, differences that might result in somewhat different rates than would be true for the population. This study was conducted during one academic 10-month period, with rates annualized on the assumption that prevalence does not change during the summer months. Future research would ideally cover a far longer period of data collection, because with rarely occurring events such as suicide, which can vary from year to year at any given institution, data aggregated over lengthier periods would provide more stable population base rates.

Another limitation is the lack of a standardized methodology for institutions to track and report student fatalities. As in other studies of student mortality, institutional records serve as the primary source of mortality information, because a student's departure from school due to death entails multiple administrative responses. Although not well documented in the literature, there are many examples of campuses that have developed internal reporting mechanisms following a student death (Ohio University, 2007; Pennsylvania State University, n.d.; Turner, Bauerle, & Keller, 2011b; University of California, San Diego, 2003). Nonetheless, there are likely schools that may not have ready access to enough information to report death statistics in a national survey. In addition, schools may have chosen not to participate out of a desire to keep their information private or may have underreported to protect their institution's reputation. Although participants were promised anonymity and those campuses with established reporting procedures hopefully responded accurately to the survey, it is certainly possible that a reporting bias could result in significantly different rates of death among the various categories.

Using an imputation method (estimating values) to account for alcohol-related injuries may underestimate alcohol's contribution to a death. However, even if one were to assume that all deaths due to any injury (vehicular and nontraffic) were attributed to alcohol, the aggregate rate would still be lower than those extrapolated for college students from the general population.

Finally, a recently published national study of injury-related mortality revealed that as of 2009 rates of motor vehicle associated deaths had been overtaken by suicide as the leading cause of death among the general

population (Rockett et al., 2012). It is possible our observations detected a change in the causes of mortality in America.

Despite these methodological questions, this pilot project provides suggestive new comparative information about the leading causes of mortality among students that brings into question the validity of extrapolating rates for students from age-matched general population rates. When compared to widely cited national data (Table 3), the participating campuses in this study have lower rates of suicide by 47% (consistent with prior studies), alcohol-related vehicular deaths by 76%, alcohol-related nontraffic deaths by 60%, and homicide by 97%, suggesting that future research on the epidemiology of college students should use campus-generated data rather than deriving estimates from age-matched general population data. Better data collection will be facilitated as more student health centers adopt electronic health records. More research is needed to replicate these findings and to test hypotheses about the factors contributing to a protective environment.

These results, if confirmed in future research, should reassure students, parents, college administrators, and other stakeholders that campus communities may afford relatively safe and supportive environments. Of course, despite low mortality rates, alcohol-related morbidity remains a critical issue on campuses (Wechsler et al., 2002). It is thus important to continue prevention efforts to reduce the many serious nonfatal negative consequences of alcohol abuse. Finally, though lower than the rate among the general population, suicide remains a leading cause of death among college students. These findings highlight the importance of a national priority on suicide prevention, mental health promotion, and the availability of mental health services for college and university students. Indeed, suicide among college students remains a "call to action" (Westefeld et al., 2006).

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