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ALCOHOL AND MORTALITY

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Speaking of alcohol and death in the same breath is likely to conjure up a number of vivid images: of the squeal of brakes and the sickening crash on the drunk driving TV messages; of the derelict dying in a flophouse in a bout of DT's; perhaps of the young man dropping dead after gulping down a quart of whiskey on a bet. All of these are of course authentic ways of "dying of drink," and there are many others, equally dramatic or cautionary. But most people, even those who die "before their time," do not die in such newsworthy ways; and if we are to assess the full relation between alcohol and mortality, we must look beyond the exemplary tales and the medically interesting cases to the great bulk of deaths which are noteworthy primarily to those personally affected.

In this discussion, then, our main concern is with the general relations between drinking and excess or early mortality. We are not so much concerned with establishing a list of causes of death found to be associated with alcohol, as with estimating the overall excess or early mortality associated with particular drinking behaviors and characteristics. Furthermore, we are interested in results from clinical and other specially selected populations only to the extent that they contribute to our knowledge and understanding of patterns in the population at large.

Our basic question is twofold: what are the statistical associations to be found in the available data, and what is the nature of the relationships the statistics reflect? It must be stated at the outset that there are presently no full answers to these questions, but only some partial evidence. Such seemingly simple

questions mask many complexities. Although the fact of a death is more or less certain, the cause of death and the factors which underlie and precipitate death are often indeterminate or multiple. Likewise, the types and gradations of drinking patterns and associated behaviors are varied and numerous, and it is reasonable to expect different patterns of behavior to be associated with different patterns of mortality.

Even when an association between a particular pattern of drinking and mortality is found, it does not necessarily establish that the drinking is responsible for the deaths: the association may be due to other factors common to both the drinking and the deaths. The fact of an association also does not tell us much about the nature of the association. The relationships between alcohol and death can be direct, as in death from an overdose of alcohol, or indirect, as in accidents, where the drinking produces a physical or mental state where the drinker is more at risk of death by trauma. The relationships can be long-term as in the physiological deterioration of the liver, or short-term as in murder or suicide under the influence of alcohol. In practice, different kinds of relations between alcohol and death will often be superimposed.

The multiplicity of possible causal and noncausal relationships between alcohol and mortality means that the implications of a finding of an increased mortality associated with a particular drinking behavior are not as clear as is often assumed. From the point of view of public policy and private decision-making, the important issue is whether the excess mortality would disappear if alcohol was removed from the situation. With the partial exception of the drunk driving literature, evidence on this issue is essentially unavailable; and in fact, much of the data on excess mortality are based on samples where we might expect elevated mortality even in the absence of drinking.

With alcohol, unlike many contributing factors in mortality, we are in fact dealing with a voluntary behavior that is highly valued by many who engage in it. For public policy and private decisions, then, we need not only the demonstration of an increased mortality, which might be sufficient to make decisions about less valued behavior, but also an estimate of the degree of increased risks associated with particular kinds of behavior and particular kinds of environments so that the relation of the benefits to the risks can be considered.

The question of the relation between drinking patterns and increased risk of mortality has a long history. In the nineteenth century it was expressed in the question of whether there was a "safe level" of drinking, and the common nineteenth century answer to this question was "Anstie's limit": the equivalent of one and one-half ounces of absolute alcohol per day, or about three ounces of whiskey, or half a bottle of claret or Rhine wine, or four glasses of beer; it being understood that this is to be taken only at lunch and dinner, and that the whiskey is to be well diluted. (Anstie, 1864) Curiously, this concern more or less disappeared from view in this century and there is still little evidence on whether there is an absolutely "safe level" of use or whether mortality and use are related at all levels.

This neglect was in part conditioned by the two major currents of thought in the twentieth century about alcohol problems. In the heyday of the temperance movement the question of drinking vs. nondrinking tended to override the question of a safe amount of drinking; and later the medical concept of alcoholism as a specific disease defined by a loss of control of drinking behavior diverted attention away from studying the risks of drinking for "normal" people.

These two major currents have produced their own characteristic forms of studies. From the late nineteenth and early twentieth centuries there are numerous studies comparing the mortality experience in the separate "total abstainer" and "drinker" sections that many insurance companies then operated. For instance, in a study by

Moore (1904), abstainers were compared to nonabstainers for mortality experience between 1841 and 1901. Excess mortality was shown for both male and female drinkers with overall mortality ratios of 1.46 for males and 1.15 for females for whole life policies.

The practice in these early insurance studies of lumping together all drinkers in the same category was severely criticized by Pearl (1926) and others, since it did not test for the possibility that some patterns of drinking might not be associated with excess mortality. Since the end of prohibition, insurance-company studies have tended to move to a different two-class division, between their "standard" policyholders and those who are "substandard" partly or wholly because of adverse information on the policyholder's drinking patterns. This "substandard" group is sometimes subdivided by drinking patterns (Menge, 1950), but in total represents a small and relatively extreme part of the spectrum of drinking patterns. Again, mortality for moderate drinking patterns cannot be determined, but the studies do yield useful information on the excess mortality associated with heavy drinking patterns.

Table 1 summarizes this information in the form of age-specific ratios of mortality in the "substandard" groups to mortality in "standard" groups of policyholders. It will be seen that mortality experience was uniformly worse in the groups judged substandard because of drinking habits than in the standard groups, and that the ratios are particularly high for Menge's "spree" drinkers, and in the younger age-groups. Of course, since death is a relatively rare event in the younger age-groups, a high mortality ratio still does not indicate a very high actual rate of death for the younger "substandard" policyholders.

Several factors need to be borne in mind in interpreting the relevance of these studies to patterns in the general population. Insurance-company studies of course exclude the parts of the population which do not seek life-insurance: thus the experience in Table 1 is predominantly of males, and we may also expect biases towards

those with higher income and those with family responsibilities. The studies also exclude those who are rejected for insurance; this group includes some whose drinking habits are considered too extreme for them to be insurable. Gundy's comparatively low mortality ratios are for a company with a policy of high rejection rates for drinking habits cases. Gundy also made a small study of insurance applicants who were dropped by his company because of drinking habits, and found a mortality ratio of 5.10 in this group (1965). On the other hand, there are factors which tend to make the mortality ratios in these studies especially high. The "standard" population with which the "drinking habits" cases are compared is specially selected by the insurance company to have low mortality, that is, to be not "substandard," while those who are substandard for drinking habits may also be substandard on other mortality-relevant factors. The data on drinking practices are collected under conditions where there is a strong incentive for the insurance applicant to give himself the benefit of the doubt in describing his drinking patterns, and a general tendency for his neighbors and business associates to be "unsympathetic toward questions about drinking." As an insurance-company inspector notes, "in these circumstances a [substandard] group...may be drinking several times more extensively than the inspections indicate, and an unexpectedly increased mortality is probably the result of the understatement" (Reed, 1950). Thus there are a number of reasons that results from insurance-company studies may differ from results in the population at large, probably with a net tendency for the insurance-company studies to show higher ratios.

In recent years, the definition of alcoholism as a specific disease, so that "alcoholic" drinkers are set apart from "normal" drinkers, has led to several studies comparing the mortality experience of samples of persons who have been in treatment for "alcoholism" with the mortality experience of the population in general.

The data are rather consistent for those reports that are specifically follow-up studies of alcoholic patients, such as Schmidt and deLint (1972), Sundby (1967), California Division of Alcoholic Rehabilitation (1961) and Gorwitz et al. (1966)

Table 1

Age-Specific Standard Mortality Ratios,¹ Life Insurance
 Studies of "Substandard" Policies Penalized for Drinking Habits

<u>Age at Issue of Insurance Policy</u>	<u>Davies 1965</u>	<u>Gundy 1965</u>	Menge 1950 <u>"Social Drinkers"²</u>	<u>"Spree Drinkers"³</u>	<u>Other</u>	<u>Total</u>		
10 - 19	}	}	4.21	--	--	3.89		
20 - 29			3.41	3.10	4.60	7.95	5.50	4.85
30 - 39					3.82	5.26	3.69	3.92
40 - 49			2.38	1.87	2.44	5.20	3.14	2.95
50 - 59	}	}			2.13	2.41	1.86	2.08
60 - 69			2.93	1.44	1.78	--	2.68	2.01
Overall			2.78	2.14	2.92	4.54	2.69	3.10

¹The mortality ratio is the ratio of the death rate in the group studied to the death rate in a "standard" group.

²Menge's "social drinkers": intoxicated at least 6 times a year for day or evening only.

³Menge's "spree drinkers": sometimes intoxicated for two or three days.

(Table 2). With the exception of Gorwitz et al., the mortality ratios fall within a relatively narrow range (Table 2). This high rate in the study by Gorwitz et al. is at least in part a reflection of the fact that hospital experience was counted in addition to post-hospital experience, and patients were followed for a short period of time--both factors which would lead to higher mortality rates.

As in the insurance studies, these clinical studies show higher mortality ratios for the younger compared to the older drinkers. In both cases where females were studied, their rates were about one-third higher than those of the males, a reflection perhaps of the tendency commonly noted in the clinical literature for female alcoholic patients to show more severe symptomatology than males.

Results from such clinical populations should not be assumed to be applicable to drinking categories in the general population. The exact drinking patterns and history in the clinical populations are not specified, although it is reasonable to assume that most persons who end up in treatment for alcoholism have a history of relatively heavy drinking (Room, 1968). Beyond this, there is reason to believe that such persons are not a random selection of all heavy drinkers in the general population. Recent work in general-population samples (Cahalan and Room, 1974) suggests that particular drinking patterns are less likely to be associated with drinking problems there than in clinical samples, and that in general the clinical population of problem drinkers is distinguished from other problem drinkers by the multiplicity and longevity of their problems. Differential clinical diagnoses by social class, race and sex have also been noted (Gorwitz, et al., 1970, Blane, et al., 1963). The possibility that individuals are admitted differentially on the basis of physical status has not been explored, although data of Schmidt and deLint (1972) showing increased mortality upon initial entry to the patient population support the premise that these individuals not only have drinking problems but serious physical problems that may precipitate their appearance at hospitals and clinics.

Table 2

Age Specific Standard Mortality Ratios, Clinical Samples
(for males, except where specified)

Age	Dahlgren ¹ 1951	Pearl ² 1926	Schmidt & DeLint ³ 1972		Sundby ⁴ 1967	Calif. Div. of Alcohol Rehab. ⁵ 1961	Gorwitz et al. ⁶ 1966		Pell & D'Alonzo ⁷ 1973 Mostly Male
			Male	Female			Male	Female	
15 - 19									
20 - 24	.89		2.50	6.89	2.95	3.26			
25 - 29	1.06						5.67	8.00	
30 - 34	1.26	1.18	2.21	7.35	2.25	3.87			6.20
35 - 39	.84	1.39	3.63	6.84			7.67	5.75	
40 - 44	1.56	1.53	4.17	8.72	2.96	2.63			
45 - 49	1.35	1.63	2.86	3.73			5.13	7.56	2.63
50 - 54	1.47	1.60	1.83	2.44	2.58	1.44			
55 - 59	1.17	1.41	2.04	3.29					2.96
60 - 64	1.02	1.21	1.50	1.00	2.21				
65 - 69	.87	1.04	1.27	1.54					
70 - 74	.95	.88	1.24		1.59				
75 - 79	.70	.80	1.24	.60					
80 - 84		.65	.35		1.29				
Overall	1.19		2.02	3.19	2.13	2.36	6.50	9.00	3.22

¹ Calculated as: $\frac{\text{Total observed mortality by age group for sample}}{\text{Total expected mortality by age group noncorrected}}$

² Calculated as ratio of: $\frac{\text{Age specific death rate for male heavy drinkers}}{\text{Age specific death rate for all males}}$

³ Presented in paper as ratio of: $\frac{\text{Age specific death rate for clinical population}}{\text{Age specific death rate for Ontario}}$

⁴ Calculated as ratio of: $\frac{\text{Age specific death rate in sample}}{\text{Expected age specific death rate for Norway}}$

⁵ Calculated as ratio of: $\frac{\text{Age specific death rate in sample}}{\text{Age specific death rate for California, 1950}}$

⁶ Calculated as ratio of: $\frac{\text{Age specific death rate in sample}}{\text{Age specific death rate, Maryland, 1960}}$

⁷ Presented in paper as ratio of: $\frac{\text{Death rates for alcoholics}}{\text{Death rates for control group}}$

Berkson (1946) pointed out that the ratio of multiple to single diagnoses in a hospital population is greater than that in the general population as each additional illness increases the probability of entrance into the patient population. It is likely therefore that clinic populations of alcoholics also have a greater probability of other diseases, and hence a greater risk of mortality. Excess mortality associated with drinking problems, then, is likely to be considerably exaggerated in clinical samples because they are sicker not only than the general population but also than those with equivalent drinking behavior who have not come into the clinic. Additional selective factors which increase mortality ratios such as decreased recovery rates (Levrat, /1958), higher readmission rates (Engeset, /1963) and non-cooperativeness (Blane/ 1963) as patients must also be considered when comparing mortality rates for these clinic populations to those of the general population.

These special characteristics of clinical samples of alcoholics are to some extent mitigated in the other three studies shown in Table 2. The study of Pell and D'Alonzo(1973) of employees of a large corporation who were identified as alcoholics as compared to other employees combines some of the features of the insurance study with those of a clinical study, in that those in both the numerator and the denominator of the mortality ratio were presumably selected for good health when they were hired. Dahlgren's study (1951) included all those reported for drinking habits to a Swedish Temperance Board, whether or not they had been institutionalized, and thus reaches out more towards a "general" population. Pearl's classic study (1926), from which results for male "heavy drinkers" are shown in Table 2, used broad clinical and court samples not limited to those identified as alcoholics, and the ratios shown are computed within his sample rather than with reference to external standard populations. It is noticeable that both Dahlgren's and Pearl's mortality ratios tend to be lower than those in samples drawn from alcoholism clinics.

We have already discussed a number of problems in extrapolating from the studies discussed so far to the population at large, but two of these problems must be seen as more crucial than the others: the use of heavily-selected populations in the numerator of the mortality ratio, and sometimes also in the denominator; and the general limitation of analyses to a single extreme class of drinking behavior, which in the case of the clinical samples is not defined in terms of any particular drinking behavior.

The ideal remedy to these difficulties of extrapolation is of course a community or other general-population probabilistic study. Even short of this ideal, these crucial problems of extrapolation can to some extent be avoided. In this respect, Pearl's study (1926) has never been transcended, although it certainly has problems of nonrepresentativeness and of reporting errors (Emerson, 1932). Pearl divided his drinkers into four main classes:

Moderate Occasional: "uses alcohol in any form (beer, wine, or spirits), but in small amount at any one time and never enough to become intoxicated"; and drinks less frequently than daily.

Moderate Steady: as for Moderate Occasional, except drinks daily.

Heavy Occasional: "those persons who are positively known to have been in the habit of getting drunk," on an occasional basis, with either abstinence or moderate drinking intervening.

Heavy Steady: getting drunk "regularly and frequently."

Pearl's classification thus included both drinking frequency and drinking quantity dimensions. His results remain thought-provoking. In general, Moderate drinkers had better mortality experience than Abstainers--a result which provoked considerable controversy at the time. Among males, although Moderate Steady and Heavy Occasional drinkers might well have the same overall intake of alcohol in drinks per year, drinking patterns which bunched up the drinks (Heavy Occasional) clearly had the worse mortality experience. In fact, among males the

Table 3

Age Specific Death Rates per 1000 Life Years Exposure
for Males and Females in Specific Drinking Categories, Pearl, 1926

Age	MALES				FEMALES			
	Abstainers ¹	Moderate Occasional ²	Moderate Steady ²	Heavy Occasional ²	Heavy Steady ²	Abstainers ³	Moderate Occasional ⁴	Moderate Steady ⁴
32	7.9	9.4	6.2	7.3	11.6	7.2	4.0	5.9
37	8.9	10.4	6.8	7.9	16.6	8.0	4.2	7.1
42	10.4	11.9	8.0	9.2	22.2	9.4	5.1	8.6
47	12.8	14.2	9.8	11.6	28.2	11.6	7.0	10.8
52	16.4	17.5	12.5	15.6	34.4	15.0	10.5	14.1
57	21.8	22.2	16.6	22.0	40.9	20.3	16.7	18.1
62	28.9	28.8	22.8	32.3	47.8	27.9	27.2	24.2
67	42.4	38.2	32.2	48.9	55.6	39.4	44.1	33.0
72	61.8	51.4	46.2	75.2	65.0	56.4	68.8	45.9
77	92.4	70.2	67.5	116.5	77.5	81.1	100.3	65.0
82	132.8	96.8	99.3	179.5	95.3	114.8	132.3	93.4

¹ Calculated by interpolation from Table XXVI, p. 123.² Table XXVIII, p. 127.³ Calculated by interpolation from Table XXVII, p. 124.⁴ Table XXIX, p. 128. There were too few Female Heavy Drinkers for Pearl to report them.

Moderate Steady drinkers appeared to have the most favorable mortality rate of all classes. In the oldest age-groups, the heaviest drinkers come to have the best mortality experience, a result which appears also in Dahlgren's and Schmidt and deLint's studies (Table 2). To some extent, heavy drinking may act as a selective device, so that early mortality of those of weaker constitution results in hardier survivors at advanced ages. However, it is also possible that heavier drinking at older ages is essentially an indicator of good health; those not in good health will have cut down their drinking prior to the initiation of the study.

Before turning to community and other general-population studies of overall mortality, it should be noted that there is by now considerable evidence, from clinical, insurance and other studies, on the relation of heavy drinking and alcoholism to specific causes of death. There is a lengthy tradition of such studies concerning liver cirrhosis. Cirrhosis has, in fact, often been used as an indicator of health problems due to drinking, as in the widespread use until recently of the "Jellinek Formula." Variations across nations and demographic categories in cirrhosis mortality have often been reported and analyzed (see, for example, Terris, (1967)). More recently, there has been research on such conditions as oral malignancies (Wynder, et al. 1957; Keller and Terris, 1965), ulcers (Engeset, et al. 1963), coronary and other heart disease and cerebrovascular disease (Gordon, et al. 1971; Tibblin, 1971; Sundby, 1967).

The bulk of special studies of this nature, however, has been concerned with various kinds of violent deaths. The association between alcohol and suicide is well-known. Alcoholics are more likely than others to die by suicide (Table 4), a large number of suicides are alcoholics (Rushing, 1968; Kessel and Grossman, 1961; Lonnqvist, 1971), and a number of suicides are committed under the influence of alcohol (Virkkunen, 1971). Comparable statements can be made about other forms of

violent death, including home accidents (Metropolitan Life Insurance Co., 1967), accidents in general (Brenner, 1967), motor vehicle accidents (Selzer, et al., 1969; Borkenstein, et al., 1964) and homicide (Wolfgang and Strohm, 1956).

Much attention has been paid to motor vehicle accidents, and sophisticated research designs have been developed to study the interrelationship of alcohol, automobiles, and fatalities. Zylman (1973) has quoted data from the Grand Rapids Study indicating that 36% of all adult pedestrians and 44% of all drivers killed have blood alcohol concentrations of 100 mg.% or more. Those who exhibit signs of heavy drinking are more likely to be involved in motor vehicle accidents than social drinkers (Waller, 1968).

These studies raise in a particularly acute form a general problem in assessing the relationship between alcohol and mortality -- the extent to which alcohol is actually responsible for the death. The true extent of excess mortality attributable to alcohol will only be known when we have measured mortality in situations that are identical except for the presence or absence of alcohol.

Besides the studies of particular causes of death, many of the insurance and clinical studies of general mortality we have already discussed also show mortality ratios for specific causes. Table 4 shows these ratios for those causes with a high ratio in at least one study of a heavy-drinking or alcoholic group.

In general, these results support the findings in the studies of specific diseases, although it will be noted that the ratios vary quite widely from study to study, and in some cases there is disagreement on whether the mortality is higher than in the control population. The overall U.S. mortality rate from many of the causes is also shown in the table, to give some impression of the relative importance of the causes of death. A cause which shows a high mortality ratio may be rare enough to be a small risk even to the heavy drinker, while a mortality ratio only slightly greater than one may indicate a substantially increased risk to the heavy

drinker for a very common cause of death. Thus, in spite of the relatively high mortality ratio for oral and upper respiratory malignancies, the male heavy drinker appears to have less to fear from that cause than from heart disease.

In recent years, a number of community health and mortality studies with at least limited data on drinking patterns have started to yield data on the association of drinking patterns with overall mortality in general populations, not specially selected either for health or for illness. These studies, such as those by Helgason (1964), Tibblin, (1971), Shurtleff (1970), and Belloc (1973) have in general found associations between heavier drinking and mortality. Results from two of these studies, in Framingham, Massachusetts and Alameda County, California, are shown in Table 5.

The Framingham study measured drinking in terms of overall volume of drinking per month, a measure which tends to equate infrequent heavy and frequent light patterns of drinking. In this study, at all ages and for both sexes, the data tends to show a curvilinear relation between drinking and mortality, with both abstainers and high-volume drinkers showing excess mortality.* The high-volume drinkers show the highest excess mortality at younger ages, while the abstainers show the highest at older ages. At least among the males, where the rates for high volumes are more stable because of more cases, the mortality ratios of heavy (50+) versus lighter drinkers are not especially high.

The Alameda County study measured drinking in terms of the amount usually drunk per occasion, for the type of beverage -- beer, wine or liquor -- with the highest usual amount. The top category on this measure, then, includes those who

*We have combined drinking categories from the Framingham Study in Table 5 to get sufficient deaths for stable results. Framingham reports have not emphasized the relation of mortality and drinking, since their analysis in terms of logistic function was not sensitive to curvilinear relationships.

Table 4

Cause-Specific Mortality Ratios

	Calif. Div. of Alc. Re- hab. 1961	Pell & D'Alonzo ¹ 1967	Sundby 1967	Dahlgren 1951	Schmidt & deLint 1972		Davies 1965	Menges 1950	U.S. 1960 Overall Mortality Rate per 100,000
					Male	Female			
Accidents	2.4			2.82	2.52	12.40	5.00 ³	1.03	51.3
Suicide			7.98	3.62	7.80	8.69	2.67	1.30	10.6
Accidents & Homicide			2.71				4.38	1.09	56.0
Diseases of Digestive System				1.11			4.67		
Cirrhosis	7.0	11.00 ²	9.88		11.49	25.0 ²		4.5	11.3
Diseases of digestive system minus cirrhosis			1.54		0.69	0.95			
Ulcer					3.55	6.66			6.4
Malignancies		3.98		1.31			2.32	.85	
Oral and upper respiratory			11.68		2.79	1.88			1.7
Arteriosclerotic and Degen- erative Heart Disease		2.09			1.79	4.10	2.63	1.33	307.4
Cardiovascular Disease	.58	2.28	1.86	1.04	1.14	2.43	1.33		
Tuberculosis			2.11	.85				.56	5.6
Diabetes			3.22						16.7
Chronic Alcoholism			46.00 ²		24.00 ²	33.33			1.2

¹Calculated by ratio of Cause specific mortality rate in cases

Cause specific mortality rate in controls .

²These are cases over a denominator of zero, and are therefore not true rates.

³Motor vehicle accidents only.

⁴Calculated by ratio of Cause specific mortality rates for Habits cases
Cause specific mortality rates for Basic Table .

drink 5 or more drinks of any beverage, whether they drink frequently or only on an intermittent basis, but only if they do not also drink that beverage more frequently at lesser amounts. The results from this study are less clear than from Framingham. Heavier drinkers show a higher mortality among younger men, but for other sex and age groups the results vary without a clear pattern emerging, other than a slight tendency for light drinkers to show the lowest mortality on an age-adjusted basis.

Overall, these two community studies clearly show lower mortality ratios than were found in insurance and clinical studies for heavy drinking versus other patterns. We have already explored reasons why the insurance and clinical studies might be expected to show higher ratios than would be found in the general population. There are also some reasons why the Framingham and Alameda results might be expected to show lower ratios than could result from other methods of measurement. Since alcohol was merely one item on a lengthy agenda for each study, neither study uses a measure of amount of drinking which isolates a pure group of relatively heavy drinkers. The top category in the Framingham data as we reproduce it consists of those drinking approximately two drinks a day or more, which could include some frequent light drinkers. The top category in the Alameda data is fairly arbitrary, since it will include some infrequent drinkers but exclude many heavy drinkers who also often drink lightly. Both studies, as has been usual in surveys of drinking practices, asked about current patterns of drinking, and it is possible that the generally higher mortalities for abstainers than for moderate drinkers are due in part to those in poor health, including those whose health has been damaged by drinking, who are now abstaining for health reasons. Controlling for health status or asking for a history of drinking patterns might thus result in higher mortality ratios in the general population.

Thus, although recent years have seen an initial flurry of reports on alcohol mortality in general populations, the nature and strength of the relationship remains open to considerable question. Accordingly, we present below some preliminary

Table 5

Mortality Rates by Drinking Behavior for Sex and Age, in Two Community Studies

A. Shurtleff, 1970 (Framingham): Annual Deaths per 10,000		Males					Females						
		None	0-9	10-19	20-49	50+	None	0-9	10-19	20-49	50+		
Volume of Drinking: (oz. of absolute alcohol/month)													
Age: 35-44	20	22	19	14	35	16	16	12	0	49			
45-54	99	72	77	72	107	43	53	38	55	14			
55-64	252	146	186	157	157	75	89	63	74	87			
65-74	412	265	287	389	327	206	218	60	81	*			

B. Belloc, 1973 (Alameda County): Deaths per 1000 in a 5-1/2 year period		Males					Females					
		None	1-2 drinks	3-4 drinks	5+ drinks	5+ drinks	None	1-2 drinks	3-4 drinks	5+ drinks	5+ drinks	
Amount drunk "usually" on an occasion, for beverage of highest usual amount:												
Age: Under 45	5	6	11	26	26	9	4	14	12	12		
45-54	58	30	70	52	52	26	29	24	0	0		
55-64	80	121	86	118	118	80	41	44	125	125		
65-74	273	217	357	222	222	165	136	*	*	*		
75+	386	422	*	*	*	319	361	*	*	*		
Age-adjusted	64	61	69	65	65	48	41	*	*	*		

*Base too small for computation.

findings from a new study of mortality in the general population. Since this study draws on data from studies specifically of drinking behavior and problems, we can explore in much greater detail than in previous mortality studies the relation between drinking patterns and increased mortality.

For this analysis, we use pooled information from four separate general-population samples, and data from two waves of interviewing for two of these samples. Two of the samples are of adults in San Francisco, and two are nationwide samples of adults; two of the samples -- one of San Francisco and one nationwide -- are limited to males aged 21-59. These samples have been followed for varying periods, ranging from 4 to 11 years. In the present preliminary analysis, lost cases and those not fully traced for the whole period are treated as alive for the whole period, so that the total mortality we report is somewhat underestimated.

Data from the six interview schedules were reduced as far as possible to comparable form; but where the data for a sample are incomparable or missing, that sample is excluded from that analysis. For each variable, we used data from the earliest interviews on which it was available. Since respondents were included in the sample with differential probabilities -- notably including an overrepresentation of heavier drinkers -- cases were weighted so that each sample was reconstituted to be representative of the sampled population, and the samples were added together in such a way that the ratio of weighted to "real" cases was approximately the same in each sample. The pooled data is of course not representative of any particular U.S. population, but can be described as reflecting patterns in the general U.S. population with an overrepresentation of urban and younger male populations. It should be kept in mind that the samples exclude those not living in households and those who refused or were not found for interviewing, and that self-reports of drinking substantially underreport the total U.S. consumption (Room, 1971).

Since the samples were followed for varying lengths of time, our analysis is in terms of weighted person-years of experience, so that our mortality rates are probabilities of being dead in any given year. However, the base N's in each table are given in terms of "real" respondents.

Table 6 shows the mortality rate of males and females in broad age categories for four general measures of drinking practices and problems. In terms of overall frequency of drinking (Table 6A), the relationship is broadly curvilinear: in each sex and age group, the lowest mortality is for an intermediate frequency of drinking. Under age 60, the highest death rates are for the highest frequency of drinking; above age 60, the highest death rates are for abstainers. As in previous studies, there is thus a consistent tendency for those who are currently abstainers to show a higher mortality than those who are currently moderate drinkers.

Table 6B shows mortality rates by Frequent Heavy Drinking, a measure of the frequency with which the respondent drinks 5 or more drinks on an occasion. Such relatively heavy drinking among those over 60 and females over 50 is sufficiently rare for mortality to be non-computable. Among those under 50, increased mortality appears to be specific to those drinking 5 or more drinks four or more times a week, while among males in their fifties, those drinking such amounts one to three times a week seem to show some elevation of mortality.

Tables 6C and 6D show sex- and age-specific mortality for related overall measures of problems with drinking, one for the "current" period (one year to three years, depending on the study), and one on an "ever" basis, including the current period. These overall scores include measures of the severity of social and health problems associated with drinking, feelings of dependence on drinking, and heavy and symptomatic drinking behaviors. The list of problems and details of the scoring differ somewhat from study to study, but have been converted to roughly equivalent scales.

Table 6

Mortality in Percent for Various Measures of Drinking Behavior,
by Age and Sex, Combined National-San Francisco Samples

	Males			Females		
	21-49	50-59	60+	21-49	50-59	60+
A. Overall Frequency of Drinking:						
At least twice a day	2.8	6.4	14.3	11.8	*	*
Daily or nearly daily	.9	3.0	17.2	.7	4.3	6.7
1-4 times a week	.6	6.0	12.4	1.0	2.4	8.3
Less than once a week	.9	2.6	15.9	1.0	1.3	5.3
Abstainer	1.9	3.6	18.6	.8	5.1	9.1
Total	1.0	4.0	16.1	1.0	3.5	7.6
B. Frequent Heavy Drinking: Frequency of drinking 5+ drinks in a day:						
At least 4 times a week	3.3	8.3	*	12.0	*	*
1-3 times a week	.5	5.8	*	.7	*	*
All other	.9	3.4	16.5	1.0	3.3	7.4
Total	1.0	3.8	16.3	1.1	3.4	7.3
C. Current Overall Problems Score:						
High	1.7	7.4	*	1.4	*	*
Medium	.9	6.7	8.7	1.8	2.7	*
Low	.5	2.5	11.9	1.2	3.1	1.9
None	.4	1.7	10.5	.3	1.7	5.7
Total	.7	3.0	11.2	.6	2.3	5.0
D. Ever Overall Problems Score:						
High	1.8	4.6	11.5	3.4	*	*
Medium	.3	4.1	7.9	0.6	2.0	6.3
Low	.4	2.9	10.9	1.4	3.5	3.9
None	.5	1.7	21.9	0.1	1.3	5.3
Total	0.6	3.0	11.2	0.6	2.3	5.0

*Rate not computed because based on 10 or fewer respondents.

Note: The percentages shown are in terms of weighted person-years of experience; the base numbers given are of unweighted actual respondents. The percent of weighted persons in each drinking category within age and sex groups is presented at the end of the table.

Table 6 (continued)

	Males			Females		
	21-49	50-59	60+	21-49	50-59	60+
<u>Unweighted Base N's:</u>						
<u>Overall Frequency of Drinking:</u>						
At least twice a day	146	57	25	15	4	7
Daily or nearly daily	412	138	51	118	44	31
1-4 times a week	840	170	57	238	53	34
Less than once a week	578	162	69	336	77	85
Abstainer	303	166	116	171	85	127
<u>Frequent Heavy Drinking:</u>						
At least 4 times a week	125	44	8	14	1	3
1-3 times a week	299	46	8	41	1	0
All other	1763	564	271	698	220	244
<u>Current Overall Problems Score:</u>						
High	147	44	8	19	3	1
Medium	517	116	17	72	14	8
Low	620	168	44	199	56	28
None	783	322	155	429	142	176
<u>Ever Overall Problems Score</u>						
High	367	109	21	35	7	3
Medium	683	158	35	102	18	11
Low	509	166	66	230	66	36
None	508	217	102	352	124	163

Table 6 (continued)

Percent of Weighted Persons in Each Drinking Category,
Within Age and Sex Groups

	Males			Females		
	21-49	50-59	60+	21-49	50-59	60+
A. Overall Frequency of Drinking:						
At least twice/day	6.0	7.5	6.3	.9	.9	1.2
Daily or nearly daily	16.3	18.8	15.9	8.3	10.2	9.4
1-4 times per week	36.8	23.6	20.9	20.6	16.4	8.9
Less than once a week	27.3	25.1	23.9	40.0	28.6	29.2
Abstainer	13.6	25.1	33.0	30.2	43.8	51.3
B. Frequent Heavy Drinking:						
At least 4 times a week	5.2	6.1	2.2	1.0	.3	.5
1-3 times a week	12.7	5.9	2.6	3.0	.1	0
All other	82.1	88.0	95.2	96.0	99.6	99.5
C. Current Overall Problems Score						
High	7.0	5.5	2.9	1.9	0.9	0.2
Medium	24.8	16.3	6.8	7.5	3.5	2.0
Low	28.4	24.7	20.4	21.5	18.2	12.8
None	39.9	53.5	70.0	69.0	77.4	85.0
D. Ever Overall Problems Score						
High	16.7	14.8	8.4	3.0	2.1	1.2
Medium	33.0	23.1	14.6	11.5	6.6	4.3
Low	24.6	24.8	30.9	27.8	25.0	14.0
None	25.7	37.3	46.1	57.7	66.4	80.5

The Current Overall Problems Score shows smaller differences in mortality than current amount of drinking measures among males under 50, but a more regular relationship with mortality among males in their fifties. The results with the Ever Overall Problems Score are roughly similar, although the mortality differentials are less pronounced among men in their fifties.

These results show some consistent tendencies with different measures of drinking practices and problems. The highest mortality ratios for heavy versus light drinkers are for the youngest cohort, although the absolute rates of death remain much lower at younger ages than at older ages irrespective of amount of drinking. As in previous studies, we find current abstainers showing a generally higher rate of mortality than light drinkers.

Since our studies included a question on the respondent's overall estimate of his health, we are able to test directly the extent to which this relationship seems to be due to abstention because of perceived bad health. Also, since the studies were specifically concerned with drinking practices and problems, we are able to examine the relationship between mortality and a variety of drinking-related measures.

Table 7 shows mortality rates for a variety of measures of drinking among males 21-59. Besides the four drinking measures already used in Table 6, results are shown in Table 7 for three other drinking measures. "Symptomatic Behaviors" is composed of four items describing characteristics of drinking behavior which are often treated as "warning signals" of alcoholism:

Taking a few quick drinks before going to a party to make sure

I have enough;

Sneaking drinks when no-one is looking;

Waking up the morning after drinking not being able to remember
some of the things done while drinking;

Taking a drink first thing in the morning when getting up.

Table 7

Mortality in Percent for Different Measures of Drinking Behavior,
Males under 60, Combined National-San Francisco Samples

	All Males Under 60		Males Under 60 not in Poor Health	
	Percent	(N)	Percent	(N)
<u>A. Overall Frequency of Drinking:</u>				
At least twice a day	3.9	(203)	2.7	(184)
Daily or nearly daily	1.4	(550)	1.3	(518)
1-4 times a week	1.4	(1010)	1.1	(966)
Less than once a week	1.2	(740)	.7	(711)
Abstainer	2.5	(469)	2.0	(431)
Total	1.7	(2972)	1.2	(2810)
<u>B. Frequent Heavy Drinking: Frequency of drinking 5+ drinks in a day:</u>				
At least 4 times a week	4.5	(169)	4.5	(146)
1-3 times a week	1.1	(345)	.9	(322)
All other	1.5	(2327)	1.0	(2204)
Total	1.7	(2841)	1.2	(2672)
<u>C. Current Overall Problems Score:</u>				
High	2.8	(191)	1.9	(178)
Medium	1.9	(633)	1.8	(606)
Low	.9	(788)	.8	(759)
None	.8	(1105)	.8	(1074)
Total	1.2	(2717)	1.1	(2617)
<u>D. Ever Overall Problems Score:</u>				
High	2.4	(476)		
Medium	1.0	(841)		
Low	1.0	(675)		
None	.9	(725)		
Total	1.2	(2717)		
<u>E. Symptomatic Behaviors:</u>				
Two or more	1.5	(140)		
One	1.8	(332)		
None	1.0	(2172)		
Total	1.2	(2644)		
<u>F. Most Drunk on Any Occasion in the Last Year or Two:</u>				
12+ drinks	1.5	(601)		
8-11	0.9	(463)		
1-7	1.0	(1293)		
Abstainers	1.7	(352)		
Total	1.2	(2709)		

Table 7 (continued)

	All Males Under 60	
	Percent	(N)
G. <u>Volume of Drinking: Total Number of Drinks per Month:</u>		
45+ drinks/month	2.2	(692)
17.6-44.9 drinks/month	1.0	(344)
1.0-17.5 drinks/month	1.5	(449)
Drinks but less than once a month	1.1	(175)
Abstainer	2.5	(388)
Total	1.8	(2048)

Note: The percentages shown are in terms of weighted person-years of experience; the base numbers given are of weighted actual respondents.

The potential meanings of these items in general-population surveys have recently been discussed by Cahalan and Room (1974, Chapter 2). "Most drunk on any occasion in the last year or two" is a measure of the respondent's high-point of drinking in a period varying from one to three-years according to the study, and is related to the "Quantity" and "High Maximum" dimensions of conventional summary measures of drinking patterns. "Volume of Drinking," in drinks per month, is a component of the Volume-Variability measure used in previous reports on the present studies, and is analogous to the measure of drinking used in the Framingham Study (45 drinks is roughly 25-30 oz. of absolute alcohol).

None of these three measures of drinking patterns show as high a mortality differential as the measures of drinking patterns and problems used in Table 6, although Volume of Drinking clearly reflects the same direction as the related measure, frequency of drinking. Apparently occasional very heavy drinking is less crucial to mortality than regular patterns of fairly heavy drinking, and the behaviors often taken as symptomatic of alcoholism are less important than amount of drinking or an overall measure of drinking problems.

Table 7 also shows results for the three measures of "current" behavior and problems we use throughout our analysis for those not in poor health; that is, those responding "excellent," "good" or "fair" when asked about their overall health. A report of poor health is indeed associated with subsequent mortality in our studies as among males under 60 in poor health, the mortality rate was 12%, while the rate among the remainder was 1%. However, Table 7 suggests that the removal of those in poor health from the comparisons does not substantially affect the relative mortalities. Mortality among abstainers is lower for those in good health, but so is mortality for most classes of drinking. Among those in poor health, in fact, mortality and amount of drinking show very little association (table not shown). Thus even when the comparison is limited to those in good health, abstainers show a higher mortality than moderate drinkers.

Table 8 shows the interrelationships of the measures of drinking among males under 60 not in poor health. The cross-tabulations reveal that the relation of frequency of drinking to mortality is quite specific to those who are frequent heavy drinkers, and there is apparently no excess mortality among frequent light drinkers. Likewise, the relation of the Ever Overall Problems Score to mortality is specific to those who show at least a medium score on the Current Overall Problems Score. Our data suggest that those in the general population who had past problems with drinking but few or no current problems do not show excess mortality.

Our data on mortality in the combined San Francisco and National samples thus consistently show excess mortality among those in the most extreme categories of frequent heavy drinking and of current drinking problems. The results are most reliable among males, since few females fall into these drinking categories. Even among males under 60, only 5% report frequent heavy drinking and 7% high current overall problems, so the mortality rates are based on relatively few deaths. Since the excess mortality is relatively specific to the top category on Frequent Heavy Drinking and the Current Overall Problems Score, it is also possible that within that category, the excess mortality is confined to those with patterns substantially above the minimum criteria for inclusion in the category.

In our analysis so far, we have not taken into account the possible confounding of the relation of alcohol to mortality with the relation to mortality of other factors of status and lifestyle. For instance, in previous studies we have found drinking problems to be associated with low social status and with a tense and depressed mental state, and have found heavy drinking to be associated with heavy smoking. The general literature on illness and mortality would lead us to expect that each of these factors would be associated with an increased mortality, and that there might be a large overlap in the "explanations" of early death offered by the various factors. A series of regressions on males aged 21-59 (see Appendix) showed that to a limited extent amount of smoking and amount of drinking overlapped in their prediction of early mortality, with amount of drinking showing a stronger

Table 8

Mortality in Percent for Interactions of Drinking Measures,
Males Under 60 Not in Poor Health, Combined
National-San Francisco Samples

A. Overall Frequency of Drinking by Frequent Heavy Drinking:

		FREQUENT HEAVY DRINKING			Total
		4+ times/week	1-3 times/week	Other	
<u>Overall</u>					
<u>Frequency:</u>	At least twice a day	5.2	.5	.8	2.7
	Daily or nearly daily	4.6	.6	1.0	1.3
	1-4 times a week	-	1.2	.9	1.1
	Less than once a week	-	-	.7	.7
	Abstainers	-	-	1.9	2.0
	Total	4.6	.9	1.0	1.2

B. Current Overall Problems Score by Ever Overall Problems Score:

		EVER OVERALL PROBLEMS SCORE				Total
		High	Medium	Low	None	
<u>Current Overall</u>						
<u>Problems Score:</u>	High	1.9	-	-	-	1.9
	Medium	2.5	1.5	-	-	1.8
	Low	1.0	0.5	.7	-	0.8
	None	0	0.5	1.1	0.8	0.8
	Total	1.9	1.0	0.9	0.7	1.1

Note: The percentages shown are in terms of weighted person-years of experience; the base numbers given are of unweighted actual respondents. The percent of weighted persons in each drinking category within age and sex groups is presented at the end of the table.

Table 8 (continued)

Unweighted Base N's

		FREQUENT HEAVY DRINKING		
		4+ times/week	1-3 times/week	Other
<u>Overall</u>				
<u>Frequency:</u>	At least twice a day	67	38	66
	Daily or nearly daily	66	96	318
	1-4 times a week	-	181	725
	Less than once a week	-	-	681
	Abstainers	-	-	413

		EVER OVERALL PROBLEMS SCORE			
		High	Medium	Low	None
<u>Current Overall</u>					
<u>Problems Score:</u>	High	178	-	-	-
	Medium	201	405	-	-
	Low	40	307	412	-
	None	35	106	247	686

prediction of mortality than smoking. Overall, however, the results suggest that controlling for other factors such as age, health status, social status, frequency of feeling tense, and smoking improved the prediction of mortality made by drinking patterns and problems measures. Thus, it seems that, rather than being confounded with the other mortality factors tested, the relationship of amount of drinking to mortality is to a small extent masked by the other factors.

Summary:

The results from our combined national and San Francisco general-population samples suggest a substantial excess in early mortality among frequent heavy drinkers and those with a high current problems score. However, the excess mortality appears to be mostly limited to these relatively extreme groups, who comprise only two or three percent of the total adult population. For unexplained reasons, abstainers also seem to have a higher early mortality than moderate drinkers. These results in broad terms are in concord with results from other general-population studies.

A preliminary analysis of the interaction of various habits and statuses associated with increased mortality suggests that the relation between heavy drinking and mortality is, if anything, stronger when other factors are controlled. But the prediction of mortality from amount of drinking in the heaviest-drinking fraction of the general population remains less strong than in clinical populations, suggesting caution in extrapolating findings from these special populations to the population at large.

Thus our data on general mortality suggest that for amount of drinking, apparently unlike amount of smoking, there may be some kind of threshold below which general mortality is little affected. In the absence of further evidence, in fact, we might well reinstate "Anstie's limit" as a sensible suggestion on how to drink without a substantially increased risk of early death.

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APPENDIX

COMPETING PREDICTIONS OF EARLY DEATH

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March 1974

As we have previously remarked, heavy drinking is associated with a number of other factors which have been linked to early mortality, including such factors as stress, risk-taking, low socioeconomic status, and smoking. It is possible, then, that there is a large overlap in the "explanations" of early death offered by the various factors. For instance, since heavy smoking and heavy drinking are associated, both factors may be "explaining" the same deaths in some cases. To explore this issue, regression analyses were run for relevant variables available for most of the cases in the four samples. Since our measures of drinking patterns showed a curvilinear relationship with death, the regressions were run both including and excluding current abstainers. However, excluding abstainers increased the predictive power of frequency of drinking and frequent heavy drinking, and decreased the predictive power of smoking, but did not otherwise substantially affect the results, so only the results including abstainers are reported here. The analysis was confined to males under 60, so that we could focus on premature mortality.

Table A shows the intercorrelations of the 10 variables used in this analysis. It should be noted that the high intercorrelations of the drinking measures are to some extent artifactual: Frequent Heavy Drinking requires relatively frequent drinking; Frequent Heavy Drinking is a component of the Current Overall Problems Score; and the Current is contained within the Ever Overall Problems Score.*

As we would expect, subsequent death is most highly related to the respondent's self-report of overall poor health, and to higher age. The measures of drinking patterns and problems in general provide the next best prediction of

*The inclusion of four highly correlated drinking measures of course diminishes the strength of each individual measure's contribution to the regression analyses (below).

Table A. Intercorrelations of 10 Measures, Males 21-59 in Four Samples

(N=2981)

	Death	Age	Health	High ISP	f Tense	Smoking	f Drinking	Freq Heavy D.	C.O.P.S.	E.O.P.S.
Death	-	.099	-.140	-.030	.006	.021	.003	.035	.052	.038
Age		-	-.282	-.089	-.043	-.027	-.060	-.061	-.144	-.122
Health			-	.255	-.216	-.047	.114	-.000	.029	.033
High I.S.P.				-	.029	-.144	.103	-.038	-.098	-.109
f Tense					-	.088	.035	.048	.125	.160
Smoking						-	.151	.120	.193	.219
f Drinking							-	.426	.407	.303
Freq. Heavy Dr.								-	.483	.381
C.O.P.S.									-	.794
E.O.P.S.										-

death, although frequency of drinking, a measure which separates abstainers from moderate drinkers, does not predict death when abstainers are included. The respondent's low socioeconomic status, as measured by a version of the Hollingshead Index of Social Position, provides the next best prediction of death, followed by amount of smoking. The frequency with which the respondent reports being tense and nervous does not predict death among males under 60.

In general, the predictors show stronger interrelations among themselves than with death, although to some extent this result is due to the effect of the relative rarity of death on the correlation coefficient. The non-drinking predictors in most cases show fairly strong relations with the drinking variables, with health showing the greatest variation in this regard.

Table B shows the partial correlations subsequent to a series of regression analyses, with the raw correlations with death included for comparison. Age and poor health make a very much stronger contribution to the prediction of death among males 21-60 than any other factor we have included: the multiple correlation coefficient with just these two predictors is .153, while it reaches only .171 with all nine predictors. The partial correlations resulting from the full nine-item regression show reversals in the direction of prediction for four items: for frequency of drinking and to some extent the Ever Overall Problems Score, this reflects the higher mortality among abstainers, which these scores are much more sensitive to than the other drinking scores. For frequency of feeling tense and nervous, this reflects the high association with reported poor health, while for I.S.P., it reflects the high association with good health.

Column 3 of Table B shows the partial correlations of the other variables with death after a regression using only the drinking items as predictors. Controlling for drinking behavior and problems in general increases the

Table B. Correlations and Partial Correlations with Death, after Regression Analyses with 9 Predictors

Males 21-59 in Four Samples (N=2981)

	Raw correlation with death	Partial corr. after full regression	Partial corr. after regression on drinking items	Partial corr. after regression on non-drinking items	Partial corr. after regression on "habits"
Age	.099	.069	.108		
Health	-.140	-.114	-.138		
I.S.P.	-.030	.018	.106		
f Tense	.006	-.026	.024		-.001
Smoking	.021	.011	.013		.013
f Drinking	.003	-.010		.019	-.025
Freq. Heavy Dr.	.035	.014		.039	.018
C.O.P.S.	.052	.036		.060	.034
E.O.P.S.	.038	-.004		.044	-.008
Multiple correlation coefficient of regression		.171	.059	.156	.060

predictive power of the other variables, except for smoking. To some extent, then, smoking and drinking practices are "explaining" the same mortality.

Conversely, Column 4 shows that regressing on the non-drinking items improves the predictive power of the drinking items. The last column shows the partials resulting from a regression including only the "habits" variables, i.e., drinking, smoking and frequency of feeling tense. The multiple correlation coefficient resulting from adding smoking adds very little to the prediction from drinking alone (column 3). In either case, less than one-half of one percent of the variance on death is accounted for. This result should serve to remind us that although mortality ratios for specific causes may be high for clinical samples of heavy drinkers and smokers in this age-group, dying at all is a sufficiently rare and random event in this age group in the population at large to be relatively unpredictable in terms of personal habits in the population at large.