

# Disability Status, Unemployment, and Alcohol-Related Liver Disease (ALD) Mortality: A Large Sample Individual Level Longitudinal Study

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**Purpose:** Unlike previous research, we evaluate disability within expanded employment status factors and stratify gender, race and ethnicity in alcohol-related liver disease (ALD) mortality in a large sample individual level longitudinal study.

**Materials and Methods:** The National Longitudinal Mortality Study (NLMS) was used covering the period 1990–2011. Statistical analysis involved the use of proportional hazards regression on a sample of almost 1.4 million people aged 18 and older, of whom 2638 died of ALD by the end of the follow-up period.

**Results:** With expanded employment status factors, disability (HR=3.76 [95%] CI 3.22, 4.39), unemployment (HR=1.90, CI 1.56, 2.31), and those not otherwise in the labor force (HR=2.31, CI 2.08, 2.56) were strongly related to ALD mortality compared to the employed. When stratified, gender, race, and ethnicity were not important modifiers in the relationships between disability, unemployment, those not in the labor force and subsequent ALD mortality. Consistent with other studies, males, minority status, living in a highly urban area, renting as opposed to owning a home, lower educational attainment, marital statuses other than marriage, low income, and age were related to ALD mortality.

**Conclusion:** In addition to unemployment which has been previously studied in a large longitudinal sample, disabled people who were unable to work and those not looking for work had a higher risk of ALD mortality. Alcohol consumption, abuse and morbidity in these populations are of considerable clinical concern.

**Keywords:** cirrhosis, hepatitis, disability, unemployment, gender

## Introduction

Alcohol consumption is a continuing public health concern in the United States with an expected 75% increase in alcohol-related liver disease (ALD) by 2040.<sup>1</sup> ALD is also associated with a high economic burden said to involve \$5 billion of direct health care costs.<sup>2</sup> Among demographic groups in the US, young people between the ages of 25 and 34 currently have the highest relative increase in ALD mortality.<sup>3</sup>

Epidemiological research has focused on males and minority status as significantly associated with ALD mortality,<sup>3–5</sup> with some exceptions based on samples with small sizes.<sup>6,7</sup> Marital status too has been related to ALD mortality with statuses other than marriage generally at high risk.<sup>8–10</sup> In one recent study from South Korea, widowed status had a lower risk of ALD mortality.<sup>11</sup> Research on socioeconomic status has found that ALD mortality increases with lower status,<sup>12,13</sup>

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but unemployment and other employment categories have been less studied. One exception is United States research from the years 1935–1997 covering almost 200,000 people, in which unemployment was highly related to ALD mortality.<sup>14</sup> Alcohol consumption is related to disability status,<sup>15–17</sup> but studies of disability and ALD mortality have been limited, and we are unaware of research on ALD mortality and disability in large sample longitudinal studies.<sup>18</sup> The purpose of this study is to evaluate ALD mortality by evaluating disability status and those otherwise unemployed and not looking for work, and by stratifying gender, race and ethnicity with appropriate covariates in a large longitudinal sample.

## Materials and Methods

### Sample

Data come from the Public Use Microdata Sample (PUMS) of the National Longitudinal Mortality Study (NLMS). The purpose of the NLMS is to develop a greater understanding of mortality related to disparities across diverse populations in the US. It is conducted by the US Bureau of the Census in collaboration with the US National Center for Health Statistics. A full description of the NLMS and PUMS has been provided elsewhere and in our previous work.<sup>19,20</sup> The data include approximately 1.4 million people of whom almost 161,000 had mortality events from April 1990 to 2011. The sample was restricted to those aged 18 and over in order to evaluate marital status because that is the age when people are able to marry in all jurisdictions in the US. The resulting sample was 1,384,507 individuals, 160,750 all-cause mortality events, and 2638 who died of ALD.

### Measurements

The outcome variable was ALD mortality, codes K70.1-4,9 from the International Statistical Classification of Diseases.<sup>21</sup> These categories include cirrhosis, alcoholic fibrosis and hepatitis, fatty liver, and hepatic failure. Dummy variables were used for all variables. For example, employment status categories included the employed as the reference category, with 1 each for unemployed but looking for work; those who were disabled and unable to work; and those otherwise not in the labor force—retired, housekeepers, students, and others doing something not classified. Note that many people who are disabled are able to work and are therefore in the employed category. Race and ethnicity categories included non-Hispanic

whites, and non-whites, combining African Americans, Asians, Hispanics and Native Americans. These groups were collapsed into minority status for small cell size problems, but results for each group were available upon request. Place of Residence categories involved areas in Standard Metropolitan Statistical Areas (SMSA), and rural places. Housing Tenure categories included those who owned their own homes and those who did not. Marital status categories included the married, divorced/separated, single/never married, and widowed. Educational Attainment categories were some college, high school graduates, and those with less than high school attainment. Family Income categories comprised seven income categories with those earning less than \$20,000 the lowest, and \$60,000 or more the highest. There were three age groups, 18–44, 45–64, and 65 and older.

### Statistical Analysis

Cox proportional hazards regression was used (PHREG in SAS version 9.4) with estimates exponentiated for 95% confidence intervals and adjusted hazards ratios (HR).<sup>22</sup> As noted previously, the utility of logistic versus Cox proportional hazards regression depends on whether the variables are related to the follow-up period.<sup>23,24</sup> If so, results from the Cox and logistic models will be different. In the present study, no variables were related to the follow-up period and so results for the Cox model are presented. However, similar results for logistic regression are available upon request.

## Results

As can be seen in Table 1, based on the statistics for the full sample, unemployment, disability, and those not in the labor force were significantly related to ALD mortality, respectively (HR=1.90 [95%], CI=1.56, 2.31; HR=3.76, CI=3.22, 4.39; and HR=2.31, CI=2.08, 2.56). Similar to the previous literature, males and non-white–minority status were related to ALD mortality, respectively (HR=2.83, CI=2.60, 3.09; and HR=1.55, CI=1.53, 1.85). Generally, similar results were found for marital status with respect to the divorced/separated and widowed, respectively (HR=1.73, CI=1.54, 1.94; and HR=1.51, CI=1.33, 1.70), with the exception that the single/never married were negatively related to ALD mortality (HR=0.79, CI=0.68, 0.92). Among socioeconomic variables, renting status, low educational attainment and low family income were significantly related to ALD mortality. Of these, the highest HR was for low family income (HR=1.42, CI=1.19, 1.69). Living in a central city of a SMSA had a significant effect on ALD mortality

**Table 1** Descriptive Statistics and Results for Alcohol-Related Liver Disease Mortality, Entire Sample

Variable	Event	Population	$\beta$	HR	95% CI
<b>Employment Status</b>					
Employed	922	856,118	Reference	1.00	Reference
Unemployed	114	56,826	0.64***	1.90	1.56, 2.31
Disability	224	30,767	1.32***	3.76	3.22, 4.39
Not in the Labor Force	1378	433,425	0.84***	2.31	2.08, 2.56
<b>Sex</b>					
Female	988	733,017	Reference	1.00	Reference
Male	1650	644,119	1.04***	2.83	2.60, 3.09
<b>Race and Ethnicity</b>					
Non-Hispanic White	1907	1,057,447	Reference	1.00	Reference
Non-White—Minority Status	730	318,753	0.14**	1.56	1.53, 1.85
<b>Place of Residence</b>					
Outside Central City in SMSA	960	550,298	Reference	1.00	Reference
Central City in SMSA	885	384,647	0.12**	1.13	1.03, 1.24
Rural Area	793	442,191	-0.13**	0.88	0.80, 0.97
<b>Housing Tenure</b>					
Own Home	1803	962,608	Reference	1.00	Reference
Rents	835	414,528	0.14**	1.15	1.04, 1.26
<b>Educational Attainment</b>					
Some College	673	525,477	Reference	1.00	Reference
Less High School	1102	337,322	0.19***	1.15	1.04, 1.26
High School Graduate	863	514,337	0.10	1.11	0.99, 1.22
<b>Marital Status</b>					
Married	1536	857,554	Reference	1.00	Reference
Divorced/separated	432	138,263	0.55***	1.73	1.54, 1.94
Single/never Married	244	278,939	-0.23***	0.79	0.68, 0.92
Widowed	426	102,380	0.41***	1.51	1.33, 1.70
<b>Family Income</b>					
\$40,000–49,999	150	113,210	Reference	1.00	Reference
< \$20,000	1321	431,373	0.35***	1.42	1.19, 1.69
\$20,000–29,999	421	254,190	0.06	1.06	0.87, 1.27
\$30,000–39,999	272	194,164	0.01	1.01	0.82, 1.23
\$50,000–59,999	203	159,544	0.03	1.03	0.83, 1.27
\$60,000+	218	199,915	-0.18	0.83	0.67, 1.02
Income Missing	53	24,740	0.15	1.16	0.84, 1.58
<b>Age</b>					
18–44	496	780,869	Reference	1.00	Reference
45–64	1202	376,873	1.50***	4.49	4.00, 5.03
65+	940	219,394	1.51**	4.52	3.93, 5.19
LRS			333***		
Df			21		
R <sup>2</sup>			0.243		
Events			2638		
Population at Risk			1,377,136		

Notes: \*\*p < 0.01; \*\*\*p < 0.001.

(HR=1.13, CI=1.03, 1.24), but living in a rural area had a negative impact with reference to central city residence (HR=0.88, CI=0.80, 0.97). Finally, as expected, the higher the age category, the stronger the effect on ALD mortality.

In order to see if other covariates modify the relationship between unemployment, disability, those otherwise not looking for work and ALD mortality, Table 2 stratifies males by minorities and non-Hispanic whites with the findings that

**Table 2** Minority Men and Non-Hispanic White Men: Alcohol-Related Liver Disease Mortality

Variable	Minority Men					Non-Hispanic White Men				
	Event	Pop.	$\beta$	HR	95% CI	Event	Pop.	$\beta$	HR	95% CI
<b>Employment Status</b>										
Employed	196	100,676	Ref	1.00	Ref	504	367,632	Ref	1.00	Ref
Unemployed	31	10,542	0.45*	1.57	1.07, 2.31	60	21,303	0.78***	2.19	1.67, 2.87
Disabled	61	5274	1.24***	3.47	2.55, 4.73	98	10,979	1.37***	3.94	3.13, 4.97
Not in the Labor Force	179	27,547	0.91***	2.47	1.93, 3.16	520	99,699	0.83***	2.28	1.93, 2.68
<b>Place of Residence</b>										
Outside Central City in SMSA	118	47,485	Ref	1.00	Ref	488	212,295	Ref	1.00	Ref
Central City of SMSA	249	65,024	0.28**	1.33	1.06, 1.66	293	109,539	0.06	1.06	0.91, 1.22
Rural Area	100	31,530	0.01	1.00	0.76, 1.31	401	177,779	-0.15*	0.86	0.75, 0.98
<b>Housing Tenure</b>										
Own Home	1803	962,608	Ref	1.00	Ref	862	377,469	Ref	1.00	Ref
Rents	835	414,528	-0.02	0.98	0.79, 1.20	320	122,144	0.30***	1.35	1.17, 1.55
<b>Educational Attainment</b>										
Some College	65	44,134	Ref	1.00	Ref.	377	217,428	Ref	1.00	Ref
Less High School	280	54,901	0.75***	2.11	1.57, 2.82	415	103,763	0.13	1.14	0.97, 1.33
High School Graduate	122	45,004	0.54***	1.71	1.25, 2.32	390	178,422	0.07	1.08	0.93, 1.24
<b>Marital Status</b>										
Married	283	84,622	Ref	1.00	Ref	801	341,040	Ref	1.00	Ref
Divorced/separated	91	13,984	0.46***	1.59	1.24, 2.03	191	39,046	0.66***	1.94	1.63, 2.29
Single/never Married	66	41,689	-0.34*	0.71	0.52, 0.95	94	106,798	-0.41***	0.67	0.52, 0.83
Widowed	27	3744	0.06	1.06	0.78, 1.59	96	12,729	0.48***	1.62	1.29, 2.02
<b>Family Income</b>										
\$40,000–49,999	29	11,438	Ref	1.00	Ref	74	45,526	Ref	1.00	Ref
< \$20,000	254	55,415	0.09	1.10	0.73, 1.64	496	118,349	0.40**	1.49	1.15, 1.93
\$20,000–29,999	75	28,345	-0.11	0.90	0.58, 1.38	204	93,489	0.10	1.10	0.84, 1.44
\$30,000–39,999	47	19,404	-0.11	0.89	0.56, 1.42	125	76,925	-0.04	0.96	0.72, 1.28
\$50,000–59,999	22	11,888	-0.26	0.77	0.44, 1.34	116	69,111	0.13	1.13	0.84, 1.51
\$60,000+	32	15,657	-0.11	0.89	0.53, 1.48	136	86,529	-0.02	0.98	0.73, 1.30
Income Missing	8	1892	0.18	1.20	0.54, 2.62	31	9684	0.39	1.48	0.96, 2.24
<b>Age</b>										
18–44	126	93,540	Ref	1.00	Ref	200	279,433	Ref	1.00	Ref
45–64	234	35,581	1.32***	3.75	2.93, 4.79	564	143,616	1.58***	4.87	4.07, 5.80
65+	107	14,918	1.06***	2.87	2.06, 4.00	418	76,564	1.62***	5.05	4.04, 6.30
LRS			529.33***					1458.54***		
Df			19					19		
R <sup>2</sup>			0.367					0.291		
Events			467					1182		
Population at Risk			144,039					499,613		

Notes: \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

unemployed minority and non-Hispanic white men were highly related to ALD mortality, respectively (HR=1.57, CI=1.07, 2.31; HR=2.19, CI=1.67, 2.87). Similar results were found for disabled minority and non-Hispanic white men, respectively (HR=3.94, CI=3.13, 4.97; HR=3.47, CI=2.55, 4.73), and for those otherwise not in the labor force (HR=2.47, CI=2.93, 3.17; HR=2.28, CI 1.94, 2.69). Other significant findings in the positive direction included minority men living in a central city of a SMSA, divorced/separated, and age. Single/never married minority men were significant in the negative direction. For non-Hispanic white men, renting a home, divorced/separated, widowed status, low income, and age were significant in the positive direction. For non-Hispanic white men, living in a rural area and single/never married were negatively related.

Table 3 stratifies females by minority and non-Hispanic whites. Here, non-Hispanic white and minority women who were disabled were, respectively, 337% and 234% more likely to die of ALD compared to the employed (HR=4.37, CI=3.04, 6.28; HR=3.34, CI=2.05, 5.43). Minority and non-Hispanic white women not in the labor force were also highly related to ALD mortality, respectively (HR=2.13, CI=1.54, 2.96; HR=2.50, CI=2.04, 3.06), and while unemployment was not significant for minority women, it was significantly related to ALD for non-Hispanic white women (HR=1.76, CI=1.07, 3.05). For minority women, widowed status and age were significantly related to ALD in a positive direction, and for non-Hispanic white women divorced/separated, widowed, low income, and age were positively related. Living in a rural area was negatively related to ALD for non-Hispanic white women.

## Discussion

The research literature has shown that along with covariates such as males, minority status, marital status other than marriage, and low socioeconomic status, unemployment (people looking for work) is related to ALD mortality. The current study advances this understanding by showing that disabled persons who are unable to work, and those not otherwise in the labor force and not seeking employment, are at high risk for ALD mortality. The disabled who are unable to work and the retired are especially concerning regarding ALD mortality because their non-working status is often permanent. Others not looking for work, such as students and housekeepers are likely to enter the workforce at some point, and the unemployed

and those looking for work may similarly find employment.

The main limitation of the study is that the NLMS does not include genetic factors and psychiatric morbidity. Some race and ethnic groups appear to be genetically predisposed to ALD morbidity, and for them, the relationship between those not working because of disability and ALD mortality may be modified such that these factors are less important.<sup>25</sup> In addition, depression and other psychiatric disorders may have an important role in the likelihood of ALD morbidity and mortality.<sup>26</sup> More effort is needed to incorporate such variables into large longitudinal US datasets. Also, disability status and being without work not only contributes to ALD mortality but also alcohol abuse, addiction and morbidity increase disability and long-term unemployment. For example, in the current study alcohol abuse and morbidity in employed persons at the beginning of the study may have caused some of them to lose their employment and subsequently die of ALD. As with many health-related problems, more research is needed on understanding the causal directions involving risk factors and morbidity. However, there is strong evidence that disability is related to alcohol abuse and may be the primary cause of self-medication and coping,<sup>27,28</sup> and if some employed persons with alcohol-related morbidity died of ALD by the end of the study that suggests our results for the unemployed, disabled and those not otherwise unemployed may be conservative and underestimate the hazard for these factors.

Research has suggested caution in drawing causal inferences based on estimates from a multivariate model.<sup>29</sup> For example, it is quite plausible that structural racism impacts employment status, housing tenure, educational attainment, income, and other related variables not in our models as it limits the employment status of minorities, reduces education and income, and prevents minority members from owning homes. Including these covariates in models tends to ignore the overall macro effect of structural racism. However, this study concerns individual level micro variables, and the NLMS does not include macro-level covariates. It is also not possible to draw conclusions on factors that are at a higher level of aggregation when they are not in the analysis. Nevertheless, findings from this study and others<sup>14,30</sup> suggest that strong racial differences exist even after taking into account other variables in the equation, and macro-level structural racism is not excluded in this or similar research.

**Table 3** Minority Women and Non-Hispanic White Women: Alcohol-Related Liver Disease Mortality

Variable	Minority Women					Non-Hispanic White Women				
	Event	Pop.	$\beta$	HR	95% CI	Event	Pop.	$\beta$	HR	95% CI
<b>Employment Status</b>										
Employed	62	89,284	Ref.	1.00	Ref	159	297,895	Ref.	1.00	Ref.
Unemployed	9	9357	0.46	1.58	0.77, 3.19	14	15,554	0.57*	1.76	1.07, 3.05
Disabled	26	5370	1.201***	3.34	2.05, 5.43	39	9117	1.48***	4.37	3.04, 6.28
Not in the Labor Force	166	70,703	0.76***	2.13	1.54, 2.96	513	235,268	0.92**	2.50	2.04, 3.06
<b>Place of Residence</b>										
Outside Central City in SMSA	64	54,923	Ref.	1.00	Ref	290	12,677	Ref	1.00	Ref
Central City of SMSA	142	82,899	0.21	1.23	0.91, 1.66	200	126,779	0.11	1.12	0.92, 1.33
Rural Area	57	36,892	0.05	1.05	0.72, 1.50	235	195,774	-0.18*	0.83	0.69, 0.99
<b>Housing Tenure</b>										
Own Home	140	92,948	Ref.	1.00	Ref	531	411,057	Ref	1.00	Ref
Rents	123	81,766	0.07	1.07	0.81, 1.39	194	146,777	0.04	1.04	0.87, 1.24
<b>Marital Status</b>										
Married	105	86,442	Ref.	1.00	Ref	347	344,973	Ref.	1.00	Ref
Divorced/Separated	51	27,353	0.27	1.31	0.91, 1.86	99	57,751	0.56***	1.74	1.36, 2.22
Single/never Married	32	43,079	-0.10	0.90	0.59, 1.38	51	87,072	0.07	1.07	0.78, 1.46
Widowed	75	17,840	0.35*	1.43	1.01, 2.00	228	68,038	0.41***	1.51	1.23, 1.83
<b>Educational Attainment</b>										
Some College	43	51,246	Ref.	1.00	Ref	188	212,398	Ref	1.00	Ref
Less High School	150	65,108	0.15	1.16	0.80, 1.68	257	113,179	0.03	1.03	0.84, 1.26
High School Graduate	70	58,360	0.09	1.10	0.74, 1.61	280	232,257	-0.03	0.97	0.80, 1.17
<b>Family Income</b>										
\$40,000–49,999	13	11,413	Ref.	1.00	Ref	33	44,762	Ref	1.00	Ref
< \$20,000	174	82,517	0.11	1.11	0.61, 2.00	397	174,660	0.501**	1.66	1.14, 2.40
\$20,000–29,999	31	30,956	-0.27	0.77	0.39, 1.46	111	101,238	0.18	1.20	0.81, 1.77
\$30,000–39,999	22	20,026	-0.09	0.92	0.46, 1.81	78	77,698	0.23	1.26	0.83, 1.89
\$50,000–59,999	10	11,955	-0.25	0.78	0.31, 1.77	55	66,540	0.16	1.17	0.76, 1.80
\$60,000+	11	15,725	-0.47	0.62	0.27, 1.39	39	81,897	-0.45	0.64	0.39, 1.01
Income Missing	2	2122	-0.57	0.57	0.12, 2.51	12	11,039	-0.13	0.88	0.45, 1.70
<b>Age</b>										
18–44	64	110,731	Ref	1.00	Ref	106	296,421	Ref	1.00	Ref
45–64	109	42,855	1.34***	3.82	2.71, 5.37	294	154,668	1.56***	4.73	3.73, 5.99
65+	90	21,128	1.55***	4.72	3.14, 7.06	325	106,745	1.58***	4.84	3.70, 6.30
LRS			277.05***					842.29***		
Df			19					19		
R <sup>2</sup>			0.028					0.151		
Events			263					725		
Population at Risk			174,714					557,834		

Notes: \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001.

Prior research indicates males, minorities, marital statuses other than marriage, and socioeconomic status are related to ALD mortality. Among socioeconomic variables,

employment and employment categories other than unemployment have received less attention. As noted, in one US study, unemployment was among the highest risk factors for



ALD mortality.<sup>14</sup> And while disability status has been the subject of research, large sample longitudinal studies of ALD mortality have been lacking.<sup>15–18</sup> The current paper analyzed a sample of 1.4 million individuals and 167,000 mortality events with a set of relevant covariates including expanded socioeconomic variables, including disabled status and those otherwise not working, notably the retired, housekeepers and students. Among other factors, results show a strong relationship between unemployment (those looking for work), disability status (unable to work), and those otherwise not looking for work. Stratifying the results for gender and race and ethnic groups did not reduce these findings.

These results have obvious clinical importance. For both men and women, minority and non-Hispanic whites who were not employed or looking for employment, as in the case of disabled status, the risks for alcohol consumption (the cause of ALD morbidity and mortality) were quite high, independent of other covariates often thought to be more important. Health care professionals should be aware that alcohol use may not only contribute to employment loss and reductions in employment chances, but the lack of employment and disability status is strongly related to subsequent ALD mortality.

## Conclusion

Gender, minority status, marital statuses other than marriage, and socioeconomic variables have been found to be important in the ALD mortality literature. Unemployment and other employment factors have been less studied. In this large sample longitudinal study with expanded employment status factors, disability (HR=3.76, CI 3.22, 4.39), unemployment (HR=1.90, CI 1.56, 2.31), and those not otherwise in the labor force (HR=2.31, CI 2.08, 2.56), were strongly related to ALD mortality compared to the employed. Gender, minority status and other covariates shown to be related to ALD mortality in the research literature were similarly associated but generally did not modify the relationships between the non-employment factors and ALD mortality. Those who are not employed and not looking for work, including the disabled, have high risk for ALD mortality. Health professionals should consider these findings and guide health care directives accordingly.

## Ethical Approval and Informed Consent

An institutional review board (IRB) or ethics committee was not required for this research. The IRB guidelines for research at the University of California, Riverside, Ca

states that in order to be exempt, data must be publicly available, such as census data, public use data, labor statistics, vital statistics, and similar statistics that are published by federal agencies. These data must have been de-identified and are anonymous. The NLMS data used in this study come from US federal agencies and are anonymized prior to release to researchers, and they are publicly available on the World Wide Web.

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## Disclosure

The authors report no conflicts of interest in this study.

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