Excess Mortality of Alcohol-Dependent Individuals After 14 Years and Mortality Predictors Based on Treatment Participation and Severity of Alcohol Dependence

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Background: Little is known about excess mortality and its predictors among alcohol-dependent individuals in the general population. We sought to estimate excess mortality and to determine whether alcohol dependence treatment utilization, alcohol dependence severity, alcohol-related problems, and self-rated health may predict mortality over 14 years.

Methods: A random sample of the general population between the ages of 18 and 64 in 1 region in Germany was drawn. Among 4,070 respondents with valid data, 153 alcohol-dependent individuals were identified. For 149 of these 153, vital status information was provided 14 years later. Baseline data from the Composite International Diagnostic Interview (German version M-CIDI) included a diagnosis of alcohol dependence according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) of the American Psychiatric Association, alcohol dependence treatment utilization, alcohol dependence severity based on the number of DSM-IV alcohol dependence diagnostic criteria fulfilled and a symptom frequency questionnaire, alcohol-related problems, self-rated general health, cigarettes smoked per day, and the number of psychiatric disorders according to the DSM-IV at baseline.

Results: Annualized death rates were 4.6-fold higher for women and 1.9-fold higher for men compared to the age- and sex-specific general population. Having participated in inpatient specialized alcohol dependence treatment was not related with longer survival than not having taken part in the treatment. Utilization of inpatient detoxification treatment predicted the hazard rate ratio of mortality (unadjusted: 4.2, 90% confidence interval 1.8 to 9.8). The severity of alcohol dependence was associated with the use of detoxification treatment. Alcohol-related problems and poor self-rated health predicted mortality.

Conclusions: According to the high excess mortality, a particular focus should be placed on women. Inpatient specialized alcohol dependence treatment did not seem to have a sufficient protective effect against dying prematurely. Having been in detoxification treatment only, the severity of alcohol dependence, alcohol-related problems, and self-rated health may be predictors of time-to-death among this general population sample.

Key Words: Mortality Alcohol Dependence, Alcohol Dependence Severity, Treatment Utilization, Self-Rated General Health, Smoking.

A HIGH DEATH rate among alcohol-dependent individuals is well known (Campos et al., 2011; Markkula et al., 2012; Timko et al., 2006). However, to estimate excess mortality, general population samples are needed. To date, there is only 1 adult population sample with a mortality follow-up after 8 years (Markkula et al., 2012). A random sample (*n* = 6,372) of the general population of Finland aged between 20 and 69 years was interviewed using the Munic Composite International Diagnostic Interview (M-CIDI) (Wittchen et al., 1995, 1998), which generates a diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) of the American Psychiatric Association (2000). Among the alcohol-dependent study participants, 19 (8.7%) were deceased at follow-up. Alcohol use disorders were 1 of 2 diagnoses that revealed an excess mortality after controlling for psychiatric comorbidity (hazard rate ratio [HRR], 2.34, 95% confidence interval [CI] 1.53 to 3.57). According to data from 2 nonclinical male samples, among those with alcohol dependence, according to the DSM-III, death rates were 2- to 3-fold higher than the expected rate among the general population (Vaillant, 2003). Clinical sample data also revealed excess mortality of alcohol-dependent patients (Campos et al., 2011; Mann et al., 2005). Annualized death rates, that is, the mortality proportion divided by the number of years under examination, of 1.2 to 3.7% have been reported (Campos et al., 2011; Finney and Moos, 1991;

Mann et al., 2005; Timko et al., 2006). While sex-specific data are rare, 1 study found an annualized death rate of 1.4% among men and 1.0% among women (Timko et al., 2006). However, death rates have not been sufficiently adjusted to age-period-cohort effects.

One main factor that should be assumed to lower excess mortality is alcohol dependence treatment. First, it may be expected that treatment decreases the risks of dying prematurely. Second, treatment self-selection may occur such that higher alcohol dependence severity or more alcohol-related problems are associated with treatment use (Moos and Moos, 2004) and mortality with treatment use being a mediator. Among alcohol-dependent individuals who had been identified in a general population sample in the United States, 22.7% had participated in formal treatment including detoxification or specialized alcohol dependence treatment or both (Dawson et al., 2006). Among those who had ever sought help, more had recovered with abstinence than among those who had never sought help. Furthermore, a trend was found toward more alcohol dependence symptoms and a higher proportion of individuals with multiple episodes of dependence compared to those who had never sought help (Dawson et al., 2006).

Alcohol dependence severity might be 1 driving force in the known relationship between alcohol consumption and death (Breslow and Graubard, 2008; Poikolainen et al., 2011; Thun et al., 1997). Alcohol dependence severity can be determined through 2 approaches. The first considers the number of alcohol syndrome criteria (Dawson et al., 2010), and the second considers the frequency of alcohol dependence symptoms (Dawson and Grant, 2010). Each of these 2 approaches has its own advantages, such as a diagnosis provided by an expert or a diagnosis at low cost. For the purpose of measuring symptom frequency, questionnaires have been developed including the short alcohol dependence data (SADD) (Davidson and Raistrick, 1986), the Severity of Alcohol Dependence Questionnaire (SADQ) (Stockwell et al., 1983), the Alcohol Dependence Scale (ADS) (Skinner and Allen, 1982), and the severity scale of alcohol dependence (SESA) (John et al., 2003). However, few general population studies provided follow-up data about alcohol dependence severity and mortality years later. In one such example, based on a Korean community, the SADQ was found to be a predictor of mortality (Min et al., 2008). In another case that examined first-contact treatment seekers, the severity of alcohol dependence as assessed by the ADS was found to be related to mortality (Timko et al., 2006). Limitations of the research include that no evidence exists about the relationship of alcohol dependence severity with mortality from general population samples where dependence severity is based on the number of dependence criteria and on standardized questionnaires according to the frequency of symptoms.

Alcohol-related problems predicted relapses to drinking after 16 years among individuals who had sought treatment for their alcohol use disorder (Moos and Moos, 2006). Stud-

ies have also revealed that self-reported general health is associated with the number of health disorders (Galenkamp et al., 2011) and with mortality (Jylha, 2009). However, little is known about this relationship in alcohol-dependent individuals among the general population. The data further indicate that additional characteristics of alcohol dependence, such as psychiatric comorbidity and a higher prevalence of smoking (Lawrence et al., 2010), are related to mortality (Campos et al., 2011). The number of psychiatric diagnoses may be considered an indicator of disease burden in addition to the severity of alcohol dependence. Of particular importance is tobacco-attributable mortality because the general population data revealed that the majority of alcohol-dependent individuals also engage in cigarette smoking (Falk et al., 2006). As a consequence of this finding, alcohol-dependent individuals are at risk of death from both alcohol-attributable and tobacco-attributable causes (Hurt et al., 1996).

Limitations of the evidence include that samples have, for the most part, not been drawn at random from the general population, with alcohol dependence diagnoses being provided according to the standards of the DSM or the International Classification of Diseases. Additionally, clinical samples are subject to the limitation that only a minority of the alcohol-dependent subpopulations participate in or seek treatment. Furthermore, there is reason to assume that alcohol-dependent subpopulations that do not seek treatment differ from those who do. According to mortality, particularly little is known about the majority of alcohol-dependent subpopulations. Studies on alcohol-dependent individuals who did not seek treatment did not include random general population samples and demonstrated selection bias. Studies with vital status follow-up did not include proper assessments of alcohol dependence severity and alcohol-related problems among alcohol-dependent populations.

The aim of the present paper is to estimate excess mortality and to analyze whether alcohol dependence treatment, alcohol dependence severity, alcohol-related problems, and self-rated health may predict the time-to-death 14 years after baseline among individuals who had received a diagnosis of alcohol dependence based on the DSM-IV criteria in a random adult general population survey. We also analyzed whether more individuals with more intense alcohol dependence severity or alcohol-related problems participated in treatment than those alcohol-dependent individuals with less intense severity or alcohol-related problems. Because the sample included individuals who had never participated in alcohol dependence treatment, it may be expected that excess mortality compared to the age- and sex-adjusted general population is present, though it may be lower than that found in previous treatment samples.

MATERIALS AND METHODS

Sample

In a northern German area, a random sample of adults aged between 18 and 64 years was selected, and 4,093 interviews were

completed, which accounts for 70.2% of those who were eligible to participate (Meyer et al., 2000a). Among the interviews, 4,075 were valid and could be analyzed. Among the sample, 3.8% demonstrated a lifetime prevalence of alcohol dependence (Meyer et al., 2000a), which corresponds to 153 individuals. The baseline survey was conducted between July 1996 and March 1997 in the city of Lübeck and 46 surrounding communities. The general population of this area between the ages of 18 and 64 and with German nationality was 193,452 (Meyer et al., 2000a). All study participants were selected using the residents' registration files. By law, every resident in Germany must be registered in these files.

From June 6, 2010 to December 15, 2010, the vital status of the 153 alcohol-dependent individuals was verified. Four individuals could not be located in the follow-up because of either having moved to a foreign country or having no fixed address. Our final sample included 149 individuals with a diagnosis of alcohol dependence in the year 1996/1997 and with known vital status in the year 2010.

Assessments

According to premature mortality, vital status information (alive and current living address or date of death) was provided by the local residence registration offices for all 149 individuals in the final sample upon our request. Premature death was defined as having been deceased before the gender-specific age of life expectancy in Germany in the year 2009, which was the most recent year available at the time of the data analysis. For women, life expectancy at birth was 82.5 years, and for men, it was 77.3 years (Statistisches Bundesamt, 2011b). All other assessments were based on baseline interviews of study participants (Meyer et al., 2000b), which included the Composite International Diagnostic Interview (CIDI) in its version M-CIDI (Wittchen et al., 1995). The M-CIDI provided the diagnoses of alcohol dependence (current: past 12 months; remitted: lifetime but not in the past 12 months) and of affective, anxiety, eating, somatoform, and other substance use disorders based on the DSM-IV criteria (Meyer et al., 2000b).

According to alcohol dependence therapy, we assessed whether the individual had participated in inpatient specialized alcohol dependence treatment, inpatient detoxification or outpatient alcohol dependence treatment. Inpatient specialized alcohol dependence treatment in Germany includes group treatment of problems related to alcohol dependence with the focus on supporting the patient to live alcohol-free. Patients must apply for specialized alcohol dependence treatment, a program financed by pension insurance with the aim to reestablish the ability to work and avoid premature pension. Usually, an addiction counseling service assists in preparing the application. The patient must be motivated to live abstinently, and there is a waiting time before treatment is provided. The pension insurance agency decides whether the individual receives treatment or not. Nationwide, participation in such treatment for men was 122 days (the mean) and 121 days for women in the year 1996 (Hüllinghorst, 1997). In contrast, detoxification treatment admission may occur immediately. It is limited to medical treatment and usually lasts only until the withdrawal symptoms have disappeared. Unsystematic counseling may be provided. Intake occurs by emergency, by referral through a physician or through some other referring agency or individual. Every patient who is in need of treatment must be admitted. Detoxification inpatient treatment is usually provided by psychiatric or general hospitals. In addition to the aforementioned programs, we also assessed whether the individuals had participated in alcohol dependence self-help groups.

Alcohol dependence severity was estimated using 2 approaches. In the first approach, we used the number of alcohol dependence criteria according to the DSM-IV. The range of the number of criteria fulfilled during a lifetime was 3 to 7. The second approach is based on the frequency of alcohol dependence symptoms as stated by the alcohol-dependent individual. We used the SESA (John et al., 2003) that was completed during the computer-assisted interview. The SESA was developed as a psychometrically sound measure based on self-reporting of the study participants. It is based on items from earlier established questionnaires about alcohol dependence severity: the SADQ, the SADD, and the ADS (John et al., 2003). We used the SESA with the subscales narrowing of drinking repertoire, somatic withdrawal symptoms, alcohol consumption to avoid symptoms, craving, increase in tolerance, extreme increase in tolerance, and decrease in tolerance (John et al., 2003). The SESA sum score in our final sample included 28 items with 62 ranks and an empirical value ranging from 0 to 79.

To estimate alcohol-related problems associated with alcohol consumption, we applied the 9-item Adverse Consequences from Drinking scale (ACD) (Moos et al., 1985), which covers problems from drinking in the past 6 months prior to the interview according to health; work; financial resources; family; fighting; issues with neighbors, police, and friends; and driving while intoxicated. The ACD used a 5-point Likert scale ranging from "never" to "often" for each item (Moos et al., 1985). The ACD sum score included 18 ranks that were empirically identified in our final sample with a value ranging from 9 to 32.

To estimate self-rated general health, we used the item, "How is your health in general?" with a 5-point scale ranging from 1 (poor) to 5 (excellent). The total number of psychiatric disorders was calculated according to the diagnoses provided by the M-CIDI. We assessed daily tobacco smoking according to the M-CIDI. This includes cigarettes smoked per day (cpd) during the time in life when cigarette consumption was highest, the age at onset of daily smoking, and the age at termination of smoking. We calculated pack-years of cigarette smoking by the number of cpd smoked at the time when cpd was highest divided by 20 times the number of years smoked in life and considered "never smokers" as 0.

Data Analysis

Data analysis was performed in 5 steps using STATA/MP 11.1 (Stata Corp. LP, College Station, TX). First, descriptive data including proportions of deceased study participants were provided (Table 1). Second, for comparisons with earlier evidence, the annualized death rates were calculated by dividing the proportion of deceased individuals in our sample by the number of follow-up years (Finney and Moos, 1991; Timko et al., 2006). For comparisons with the equivalent annual death rate in the general population of Germany, we used the proportions of deceased residents of Germany each year from 1997 to 2010 among the population aged 18 to 64 in 1997 and for each following year among the population that was 1 year older than that of the year before. The mean annualized death rates of these 14 proportions of deceased residents were 0.36% of the age-specified female population, 0.66% of the age-specified male population, and 0.51% of the age-specified total population (Statistisches Bundesamt, 2011a). Third, we calculated the HRR according to the Cox proportional hazard model using univariate analysis. Fourth, a multivariate analysis was performed (Table 2). We fitted 2 models. In model 1, we used specialized alcohol dependence treatment and detoxification treatment participation, alcohol dependence severity, and the rank sum score of alcohol-related problems, self-rated health, and adjusted for pack-years of smoking, age, and sex. Alcohol dependence severity according to each of the 2 assessment approaches was included. We used quintiles of the SESA sum score to ease comparisons with the number of criteria of alcohol dependence. In model 2, the number of psychiatric disorders was added to the variables of model 1. Fifth, according to alcohol dependence treatment, we tested a mediation effect of treatment. Severity should have been associated with treatment at baseline (Table 3), and treatment should predict mortality risk. After adding treatment participation to the multivariate model

Table 1. Sample Characteristics at Baseline and Follow-Up by Vital Status at Follow-Up N = 149

	Follow-up		
Baseline	Alive	Dead	Total
Total	121 (81.2)	28 (18.8)	149 (100.0)
Female	23 (76.7)	7 (23.3)	30 (100.0)
Male	98 (82.4)	21 (17.6)	119 (100.0)
Age mean (SD)	41.2 (11.4)	50.8 (10.4)	43.0 (11.8)
Alcohol dependence inpatient treatment			
Never	90 (85.7)	15 (14.3)	105 (100.0)
Specialized treatment	26 (76.5)	8 (23.5)	34 (100.0)
Detoxification only	5 (50.0)	5 (50.0)	10 (100.0)
Alcohol dependence number DSM-IV criteria			
Mean (SD)	4.4 (1.4)	5.0 (1.3)	4.6 (1.4)
3 criteria	42 (89.4)	5 (10.6)	47 (100.0)
4 criteria	26 (83.9)	5 (16.1)	31 (100.0)
5 criteria	21 (77.8)	6 (22.2)	27 (100.0)
6 criteria	21 (72.4)	8 (27.6)	29 (100.0)
7 criteria	11 (73.3)	4 (26.7)	15 (100.0)
Severity scale of alcohol dependence (SESA)			
Mean (SD)	23.8 (23.9)	36.6 (26.3)	25.0 (24.6)
0–2	19 (82.6)	4 (17.4)	23 (100.0)
3–9	34 (97.1)	1 (2.9)	35 (100.0)
10–26	22 (73.3)	8 (26.7)	30 (100.0)
27–52	25 (83.3)	5 (16.7)	30 (100.0)
53–79	21 (67.7)	10 (32.3)	31 (100.0)
Alcohol dependence			
Current	44 (83.0)	9 (17.0)	53 (100.0)
Remitted	77 (80.2)	19 (19.8)	96 (100.0)
Alcohol-related problems sum score mean (SD)	11.6 (4.2)	13.0 (6.4)	11.8 (4.7)
Self-rated health mean (SD)	3.1 (1.0)	2.5 (0.9)	3.0 (1.0)
Number of psychiatric disorders lifetime mean (SD)	2.6 (1.9)	2.7 (1.8)	2.6 (1.8)
Cigarette pack-years mean (SD)	33.6 (30.8)	50.6 (30.1)	36.8 (31.3)

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; SD, standard deviation. Numbers (percentage); Means (SD).

with alcohol dependence severity as a predictor of mortality risk, the relationship between severity and mortality should be attenuated (Vittinghoff et al., 2005). We used Sobel–Goodman mediation tests (sgmediation in STATA), and we performed all data analyses with the final sample. Six missing values were present in each of 22 of the SESA items, and 1 missing value was present in the age of onset of daily smoking. These missing values were substituted by means of sex-specific age groups. We focused on the estimation of effects and included 90% CI. We also provided p-values that correspond to 95% CI.

RESULTS

Among the 149 alcohol-dependent individuals of the final sample, 28 (18.8%) were deceased during the follow-up time frame of 14 years from baseline (Table 1). In the total sample, an annualized death rate of 1.34% was found. Among female alcohol-dependent individuals, 23.3% had died, and among male alcohol-dependent individuals, 17.6% had died, which equals annualized death rates of 1.67% for women and 1.26% for men. Age at death ranged from 35 to 71 years with a mean of 60 years (standard deviation [SD]: 12) for women and 58 years (SD: 11) for men, the median being 60 years for women and 62 years for men. The mean number of years from baseline until death was 7.2 (SD: 3.2; median: 7.1).

Among the age- and sex-equivalent national general population in the years from baseline to follow-up, the annualized death rate for female alcohol-dependent individuals was 4.6-fold, and for male participants was 1.9-fold. Death for all 28 alcohol-dependent individuals occurred prematurely; that is, none of the deceased had reached the age of life expectancy for the German national population.

Of the study participants, 34 (22.8%) had utilized inpatient specialized alcohol dependence treatment, and 10 (6.7%) had utilized only inpatient detoxification. Outpatient treatment only, that is, without additional inpatient treatment, had not been used, and there were 5 respondents (3.4%) who had participated in alcohol dependence self-help groups, but not in treatment programs. The data revealed that 5 of the 10 individuals who had been inpatients in detoxification treatment only were deceased 14 years after

Table 2. Survival Analysis—Hazard Rate Ratios (90% Confidence Intervals) N = 149

		Multivariate			
		Model 1		Model 2	
Baseline	Univariate				
Inpatient alcohol dependence treatment					
Never	Ref	Ref	Ref	Ref	Ref
Specialized alcohol dependence treatment	1.71 (0.83–3.51)	0.69 (0.27–1.76)	0.83 (0.38–1.82)	0.60 (0.23–1.60)	0.81 (0.37–1.77)
Detoxification	4.18 (1.79–9.79)†	3.16 (1.10–9.11)	3.85 (1.44–10.31)*	3.06 (1.05–8.89)	4.07 (1.54–10.74)*
Number of alcohol dependence criteria DSM-IV	1.31 (1.05–1.64)*	1.08 (0.76–1.53)	–	1.14 (0.79–1.65)	–
Severity scale of alcohol dependence (SESA)	1.33 (1.05–1.69)*	–	0.92 (0.69–1.23)	–	0.91 (0.68–1.21)
Alcohol-related problems	1.05 (0.99956–1.11)	1.08 (1.01–1.15)*	1.09 (1.02–1.17)*	1.07 (1.01–1.14)	1.09 (1.02–1.16)*
Self-rated health	0.57 (0.41–0.79)†	0.59 (0.42–0.82)†	0.59 (0.42–0.82)†	0.52 (0.35–0.77)†	0.53 (0.36–0.78)†
Number of psychiatric disorders lifetime	1.03 (0.87–1.21)	–	–	0.89 (0.72–1.09)	0.90 (0.73–1.11)
Pack-years smoked	1.01 (1.005–1.02)†	1.01 (0.996–1.02)	1.01 (0.997–1.02)	1.01 (0.997–1.02)	1.01 (0.998–1.02)
Age	1.08 (1.04–1.11)‡	1.08 (1.04–1.12)†	1.08 (1.04–1.13)†	1.07 (1.03–1.12)*	1.08 (1.03–1.12)†
Female	1.36 (0.66–2.78)	1.22 (0.50–2.96)	1.36 (0.59–3.14)	1.45 (0.57–3.71)	1.71 (0.67–4.36)

*p < 0.05, †p < 0.01, ‡p < 0.001 (corresponding to 95% confidence interval).
DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition. SESA: quintiles.

Table 3. Alcohol Dependence Severity and Treatment at Baseline N = 149; Multinomial Logistic Regression (95% Confidence Interval)

Predictor	Treatment		Pseudo R
	Alcohol dependence treatment relative risk ratio	Detoxification relative risk ratio	
Unadjusted			
Number of alcohol dependence criteria DSM-IV	3.86 (2.43–6.11)	3.57 (1.84–6.93)	0.28
Severity scale of alcohol dependence (SESA)	3.55 (2.24–5.64)	2.01 (1.15–3.52)	0.22
Adjusted			
Number of alcohol dependence criteria DSM-IV	3.90 (2.44–6.24)	3.64 (1.86–7.12)	0.28
Alcohol-related problems	0.99 (0.90–1.08)	0.98 (0.85–1.12)	
SESA	3.64 (2.25–5.88)	2.03 (1.13–3.63)	0.22
Alcohol-related problems	0.98 (0.90–1.07)	0.99 (0.87–1.13)	

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.

baseline. Further analysis, which is not presented in Table 1, revealed that of those who had met 5 or more alcohol dependence criteria and who had participated in any alcohol dependence inpatient treatment, 32.5% died, whereas among those who had met 5 or more alcohol dependence criteria but who had not undergone inpatient alcohol dependence treatment, 16.1% died during the 14 year follow-up time.

Study participants who had been in inpatient detoxification treatment only had an HRR of 4.2 (90% CI 1.8 to 9.8) for mortality compared to those who had never been in inpatient alcohol dependence treatment, according to the univariate survival analysis (Table 2). With respect to survival, there was no difference between participating in inpatient specialized alcohol dependence treatment and not participating in any inpatient alcohol dependence treatment. In a multivariate survival analysis, detoxification treatment and alcohol-related problems were found to be predictors of time-to-death after adjusting for pack-years smoked, age, and sex (Table 2). The HRR was 3- to 4-fold for individuals who had been in inpatient detoxification, but not in specialized alcohol dependence treatment compared to those who had never participated in any inpatient alcohol dependence treatment.

The severity of alcohol dependence was found to be inversely related to survival independent of the approach chosen to estimate alcohol dependence severity. With each additional dependence criterion, the hazard for mortality was 31% higher than among those who only met the minimum number of 3 criteria. A 33% higher mortality risk was found for each of the second to the fifth quintile of alcohol dependence symptom frequency according to the SESA, the lowest quintile being the reference. While the severity of alcohol dependence was insignificant in both multivariate models, mortality risk increased by 7 to 9% with each of the 18 ranks according to the ACD sum score. Self-rated health also predicted survival time. With each ranking above "poor health," the mortality risk decreased by 52 to 59%. The number of psychiatric disorders other than alcohol dependence was found not to be related to mortality risk.

We explored whether detoxification treatment participation may have mediated an effect of alcohol dependence severity on mortality. At baseline, detoxification treatment participation was associated with severity (Table 3) with respect to the number of alcohol dependence criteria and the frequency of alcohol symptoms, and after adjustment for alcohol-related problems. Detoxification treatment participation predicted mortality risk. The Sobel–Goodman mediation test coefficients were significant ($p < 0.05$).

DISCUSSION

Using a random adult general population sample that included individuals who never had and had not been in alcohol dependence treatment, this study revealed 3 main findings. First, the data revealed excess mortality for general population recruited alcohol-dependent individuals compared to the age- and sex-adjusted general population. Second, having participated in inpatient specialized alcohol dependence treatment is not related to longer survival than never having been in inpatient treatment. Third, detoxification treatment, alcohol dependence severity, alcohol-related problems, and self-rated health predicted time-to-death.

Excess mortality is clearly revealed by the data, as all noted deaths occurred prematurely. The annualized death rate was 4.6-fold the annualized death rate of the age-equivalent national female population. It is higher than that for men, which was 1.9-fold the age-equivalent national male population. These findings support evidence that seems to reveal higher relative risks for several alcohol-attributable causes of death among severely drinking women than among severely drinking men (Zaridze et al., 2009). These differences between the sexes are in contrast to the sex-specific findings from a clinical sample (Timko et al., 2006). Our findings suggest that women with alcohol dependence should be considered at higher risk of premature death than alcohol-dependent men.

We have minimized age-period-cohort effects by using annual mortality rates of the national population that corresponded precisely to age and sex in our sample during each of the 14 years of follow-up. Our results support evidence that revealed excess mortality among alcohol-dependent individuals from the general population (Markkula et al., 2012) and from 2 socially different male samples with a 2- to

3-fold mortality compared to the general population (Vaillant, 2003).

Our findings correspond also to excess death rates found in clinical samples (Finney and Moos, 1991; Mann et al., 2005; Timko et al., 2006), including former treatment participants over 16 years after treatment (Mann et al., 2005). The present results do not confirm the assumption that among alcohol-dependent individuals in the general population, mortality excess is lower than in alcohol-dependent individuals from clinical samples.

In addition to excess mortality, it should be considered that among the survivors, there remains a high risk of death because of tobacco smoking. Those individuals who were alive at the time of follow-up had smoked 33.6 (SD 30.8) pack-years at the mean age of 41.2 (SD 11.4) years. Because of this particularly high exposition, further excess mortality attributable to smoking must be expected (Hurt et al., 1996).

Participation in specialized alcohol dependence treatment should be expected to increase the probability of living without drinking alcohol and hence increase life expectancy, even if the individuals have a higher alcohol dependence severity than those who did not participate in treatment. However, our data do not support this expectation. Participation in inpatient specialized alcohol dependence treatment was not related to longer survival than never having participated in inpatient treatment. Among the potential reasons for this finding, it seems important to consider alcohol dependence itself and the co-occurring health risk behaviors. On the basis of alcohol dependence itself, the general condition of patients when they finally admit to need help and thus participate in treatment may be so compromised that survival time may no longer be affected by abstinence from alcohol. Additionally, the minority of patients who stay sober until death may be so small that abstinence among all alcohol-dependent individuals after treatment does not affect life expectancy. Co-occurring health risk behaviors may mask treatment effects to such a degree that they become undetectable with respect to survival time. The main co-occurring risk behavior is tobacco smoking, which has been revealed by the data to be prevalent in the majority of alcohol-dependent individuals among the general population (Falk et al., 2006). In our sample, those who were deceased at follow-up had smoked a mean of 50.6 (SD 30.1) pack-years at a mean age of 50.8 (SD 10.4) years at baseline. Among the survivors, the mean pack-years related to mean age seemed to be lower than among those who had been deceased at follow-up. Adjusted survival analysis did not reveal that smoking was a predictor of short survival time, although there was a trend.

Our results provide evidence that only a minority of an alcohol-dependent subpopulation among the general population participates in alcohol dependence treatment (Dawson et al., 2006). The treatment system did not seem to be efficacious enough to sufficiently prevent alcohol-dependent subpopulations from premature death. Hence, the challenges may be to reach more alcohol-dependent individuals earlier in their lives. Second, the treatment should focus more on

smoking cessation than it has in the past. The findings support the assumption that such approaches may help to curb mortality among alcohol-dependent individuals.

Inpatient detoxification treatment participation was related to higher mortality risk compared to those who had never participated in alcohol dependence treatment, and alcohol dependence severity was related to participation in inpatient detoxification treatment. A mediation effect of detoxification treatment participation is suggested by the Sobel–Goodman test scores of mediation. Those who had a higher severity of alcohol dependence were more likely to have participated in detoxification treatment. Thus, alcohol dependence severity may be a predictor of mortality mediated by detoxification treatment. Furthermore, alcohol-related problems predicted time-to-death. This is plausible considering that data revealed lower abstinence rates among those alcohol-dependent individuals after treatment who had more lifetime alcohol-related problems compared to those with fewer alcohol-related problems (Moos and Moos, 2006). Our data confirm findings that self-rated health, assessed with just 1 question, predicts mortality (Galenkamp et al., 2011; Jylha, 2009).

Both approaches to assess dependence severity seemed to be predictive largely to the same extent. Both approaches are based on the number of alcohol dependence symptoms, but the SESA questionnaire provides additional self-statement information about the frequency of the symptoms, and it is probably the more cost-saving way to gather data about alcohol dependence symptoms. The results support other general population data about the associations between symptom frequency and treatment use (Dawson and Grant, 2010; Dawson et al., 2010) and the relationship between alcohol dependence according to the SADQ and mortality (Min et al., 2008).

The number of psychiatric disorders did not improve the prediction of mortality within the follow-up time. Reasons for this finding may be that only specific psychiatric comorbidity, such as major depressive disorder, may have an effect (Markkula et al., 2012). To provide evidence of such a hypothesis, the number of cases may have been too low.

Strengths of this study include that alcohol-dependent individuals were recruited as part of a random general population sampling. Second, annualized death rates that have been used provided comparability of findings with other studies and with mortality data from the general population. Third, the diagnosis of alcohol dependence according to the DSM-IV was generated from a standardized psychiatric interview of the entire sample. Fourth, the severity of dependence rating based on the alcohol dependence syndrome was used. In contrast, 4 limitations of our study should be considered. First, the number of death cases is only 28. This low number may conceal effects in subgroups, such as individuals with specific psychiatric comorbidity. However, general population data revealed that alcohol dependence belonged to 1 of only 2 diagnostic groups that predicted mortality after adjustment for further psychiatric comorbidity (Markkula

et al., 2012). Second, our study did not include causes of death. This limitation made it impossible to analyze subgroups of alcohol-attributable, tobacco-attributable, and other causes of death. However, data revealed that excess death rates among alcohol-dependent individuals were present for each of these subgroups (Hurt et al., 1996). Third, our results relate to 1 region of Germany only. Fourth, we have no data about individual help-seeking that may have occurred after the initial survey during the follow-up period.

It may be concluded from our findings that there was significant excess mortality, particularly for women, in this general population-derived sample of alcohol-dependent individuals. Our study determined that inpatient treatment participation may not have had a sufficiently protective effect against premature death. Main predictors of premature death among the population of alcohol-dependent individuals under study include participation in inpatient detoxification treatment, severity of alcohol dependence, alcohol-related problems, and poor self-rated general health.

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