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Alcohol Consumption and Health Status in Older Adults

A Longitudinal Analysis

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Objective: This longitudinal study examines the relationship of alcohol consumption to mortality and changes in mental and functional health in older adults. **Method:** In a national population health survey, 4,187 participants aged 50 and older at baseline provided information on alcohol consumption, potential confounders, and follow-up vital status. Logistic regression estimated the odds ratio for mortality, increase in psychological distress, and decline in functional health 10 years later. **Results:** Compared with lifelong abstainers, light and moderate drinkers were at nonsignificantly lower risk of mortality. Among survivors, alcohol consumption showed no consistent relationship with increases in psychological distress. Occasional and light drinkers had significantly reduced risk of a substantial functional health decline, whereas moderate drinkers had nonsignificantly reduced risk. **Discussion:** Findings suggest that light-to-moderate alcohol consumption reduces the risk of substantial functional health decline in older middle-aged drinkers.

Keywords: *alcohol consumption; older adults; health status; longitudinal study*

Epidemiologic studies have suggested that people who consume moderate doses of alcohol experience lower all-cause mortality rates than abstainers and heavy drinkers (Klatsky, Friedman, & Siegelaub, 1981; Marmot, Rose, Shipley, & Thomas, 1981; White, 1999). This relationship has been described with a U- or J-shaped curve, which is thought to be a balance between the beneficial effects of alcohol consumption on coronary heart disease and the detrimental effects on other health conditions, such as some cancers, cirrhosis, and accidental injuries (Rehm, 2000). The existence of a U-shaped relationship between alcohol use and CHD or total

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mortality has been well established in middle-aged men (Poikolainen, 1995; Scherr et al., 1992). In contrast, few longitudinal studies have confirmed this relationship in older adults. Even less is known about the effect of alcohol consumption on other overall measures of health. The purpose of this study is therefore to examine whether alcohol consumption is associated with three indicators of overall health status—mortality, changes in mental health, and changes in functional health.

Alcohol Consumption and Mortality

Although there is still controversy as to whether the association represents causation (e.g., Fillmore, Kerr, Stockwell, Chikritzhs, & Bostrom, 2006; Rehm, 2000; Shaper, Wannamethee, & Walker, 1988; Skog, 1996), a U-shaped relationship between alcohol use and mortality has been repeatedly observed in middle-aged men. In older adults, some studies have confirmed this relationship (Doll, Peto, Boreham, & Sutherland, 2005; Goldberg, Burchfiel, Reed, Wergowske, & Chiu, 1994; Scherr et al., 1992; Simon, McCallum, Friedlander, Ortiz, & Simons, 2000). For example, a 23-year prospective study of male British doctors aged 48 to 78 found that overall mortality rate was significantly lower in the group consuming an average of 2 to 3 units (units ≈ 8 g) per day than in nondrinkers (Doll et al., 2005). To address the concern that the higher abstainer risk was caused by the termination of drinking due to morbidity, recent ex-drinkers were separated from never-drinkers. It was found that when recent ex-drinkers were combined with the current drinkers, the combined group still had a significantly reduced overall mortality rate compared to the combined group of never-drinkers and long-term ex-drinkers.

Some studies, however, have failed to observe increased risk in abstainers, heavy drinkers, or both (Fillmore, Kerr, & Bostrom, 2003; Klatsky et al., 1981; Moore et al., 2006; Scherr et al., 1992). Some investigators have argued that the protective effect of alcohol consumption would be relatively

weak in elderly people (Poikolainen, 1995; Simon et al., 2000). Besides, based on findings of age-related physiological changes in older persons, the U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA) recommends the elderly to limit their daily alcohol intake to no more than one drink (Dufour & Fuller, 1995). Alternatively, moderate alcohol consumption may confer greater benefit to older people, who have the highest rate of CHD (Rehm, 2000; Rimm & Moats, 2007), with the nadir of the U increasing in this population (White, 1999). There are studies supporting both views (Klatsky et al., 1981; Rehm & Sempos, 1995; White, Altmann, & Nanchahal, 2002). Thus, it is worth exploring further the net balance of benefits and harms in older people.

Alcohol Consumption, Mental Health, and Functional Health

Most prospective studies have focused on mortality; less is known about other overall health status indicators in older adults. General functioning is a more meaningful measure of the burden of disease in the population because alcohol consumption may be more strongly related to functioning or disability and quality of life, than to mortality (Rehm, 2000). Recently, an increasing number of studies have examined the relationship between alcohol consumption and cognitive functioning in older adults, with mixed results (Anttila et al., 2004; Bond et al., 2004; Broe et al., 1998; Ganguli, Bilt, Saxton, Shen, & Dodge, 2005; Herbert et al., 1993; Leibovici, Ritchie, Ledesert, & Touchon, 1999; Stampfer, Kang, Chen, Cherry, & Grodstein, 2005). In contrast, studies linking alcohol use to other aspects of general functioning remain scarce.

The purpose of the present study is to examine the association of alcohol consumption to other summary measures of health status, namely overall mental and functional health. In this study, mental health was indicated by a measure of the level of psychological distress. To our knowledge, no longitudinal studies have examined the effect of alcohol consumption on nonspecific psychological distress, as compared to disorder-specific diagnostic measures. Several previous studies, however, have linked alcohol consumption to anxiety and depression. A meta-analysis of eight longitudinal studies suggests that alcohol use was associated with depressive symptoms (Hartka et al., 1991), but more recent longitudinal studies have failed to confirm an association (Moscato et al., 1997; Wang & Patten, 2001). In older adults, a prospective study of persons aged 50 and above found that

alcohol consumption was associated with fewer depressive symptoms compared to abstinence (Lang, Wallace, Huppert, & Melzer, 2007b).

Another health outcome examined in the present study is functional health decline. In a prospective study of predictors of functional change, Wang, van Belle, Kukull, and Larson (2002) found that people aged 65 and older who consumed five drinks or more a year without any alcohol-related problem had reduced rates of functional decline compared to those who consumed less as well as to problem drinkers. Another prospective study of people aged 65 and older reported an association between no consumption and poorer everyday functioning or disability (Lang, Guralnik, Wallace, & Melzer, 2007a).

In the present study, we examined whether level of alcohol consumption is associated with mortality and changes in mental and functional health over a 10-year period in older adults from the National Population Health Survey (NPHS). Because everyday functioning is crucial to the quality of life and care of older adults (Friedmann et al., 1999; Wang et al., 2002), it is important to understand the potential impact of alcohol intake on general functional outcomes. We could not make specific hypotheses about the pattern of associations between alcohol use and these health outcomes due to the paucity of previous studies. Although alcohol consumption has shown a U-shaped relationship with mortality, a recent meta-analysis has again raised doubt as to whether the association is causal (Fillmore et al., 2006). In short, this meta-analysis showed that the small number of studies that separated people who reduced or stopped drinking from complete abstainers have found no significant effects of alcohol use, supporting the "sick quitter" hypothesis (Shaper, Wannamethee, & Walker, 1988). The NPHS is well placed to address this methodological issue, with measurement of past drinking that allows assessing the effects of consumption in relationship to lifetime abstinence.

Method

Data and Sample

Data came from the NPHS, a longitudinal population health survey conducted by Statistics Canada. The NPHS used a multistage, stratified, probability sampling procedure to select household residents in the 10 Canadian provinces, excluding persons living in Indian reserves, military bases, institutions, and some remote areas in Ontario and Quebec. The longitudinal respondents were selected in 1994/1995 (Cycle 1) and are followed-up

every 2 years (Cycles 2 to 6). Detailed descriptions of the NPHS methodology have been published elsewhere (Statistics Canada, 2006).

In 1994/1995, 5,404 of these longitudinal respondents were 50 years and older. For the mortality analysis, only the respondents with data on all the baseline covariates and known vital status at 10-year follow-up (2004/2005) were included. The analyses of functional health and psychological distress were based on surviving respondents who had data on all baseline covariates and scores on both functional health and psychological distress at follow-up.

Measures

Alcohol consumption. The NPHS asked a series of questions related to past and current alcohol consumption. Respondents who answered negative to the question "Did you ever have a drink?" were lifelong abstainers. Respondents who had at least one drink in the past 12 months (current drinkers) were asked how many drinks they had, on each day, in the week prior. Respondents were classified as lifelong abstainer, former drinker (drank previously but not in the past year), occasional drinker (0 drinks/week), light drinker (1-7 drinks/week), moderate drinker (8-14 drinks/week), and heavy drinker (≥15 drinks/week). A drink is 13.6 g of alcohol.

Stability of Alcohol Consumption

Most studies of the effects of alcohol on health outcomes have been based on a single assessment of alcohol intake at a particular time point. Some studies have noted that the percentage of people who were in the same or an adjacent consumption category at baseline and follow-up was high (Byles, Young, Furuya, & Parkinson, 2006; Thun et al., 1997). Other studies have examined the effects of changes in drinking and found that certain types of changes were associated with changes in risks, although the results were mixed (e.g., Fillmore et al., 2003; Goldberg et al., 1994; Grønbæk et al., 2004; Lazarus, Kaplan, Cohen, & Leu, 1991; Paganini-Hill, Kawas, & Corrada, 2007).

In the present study, we were unable to assess the effects of changes in drinking over time due to the small number of respondents in most categories of change. Of the 2,438 surviving respondents, 2,396 had data on alcohol consumption at both Cycle 1 (1994/1995) and Cycle 2 (1996/1997) and 2,360 had data on alcohol consumption at both Cycle 1 and Cycle 6 (2004/2005). To give a rough idea of the stability in alcohol consumption, 54.3% of the 2,396 respondents remained in the same drinking category

and 92.7% in the same or an adjacent drinking category over a 2-year period, whereas 51.3% of the 2,360 respondents remained in the same drinking category and 88.5% in the same or an adjacent drinking category over a 10-year period.

Measures of Health Outcomes

Mortality. Over the 10-year period, 1,474 deaths occurred among respondents aged 50 years and older. Eighty-five percent were confirmed against the Canadian Vital Statistics Death Database.

Psychological distress. Mental health was indicated by the Kessler 6-item Psychological Distress Scale (K6). The K6 was developed by Kessler and colleagues (2002) using general population samples, with the goal of creating a short dimensional measure of nonspecific psychological distress. Respondents rate the frequency in the last 30 days ("none of the time" to "all of the time") of six symptoms ("so sad that nothing could cheer you up," "nervous," "restless or fidgety," "hopeless," "that everything was an effort," and "worthless"). Total scores range from 0 to 24, with 0 reflecting no distress and 24 reflecting the most distress. Scores 13 and above reflect significant psychological distress (Kessler et al., 2003) and are associated with considerable dysfunction and disability (Pratt, Dey, & Cohen, 2007). The K6 has been shown to have good psychometric properties (Cairney, Veldhuizen, Wade, Kurdyak, & Streiner, 2007; Kessler et al., 2002).

Functional health. Functional health status was assessed by the Health Utility Index Mark III (HUI3), a generic health status or health-related quality-of-life measure that synthesizes both quantitative and qualitative aspects of health. The HUI3 describes the respondent's overall functional health on eight selected attributes: vision, hearing, speech, mobility/ambulation, dexterity, cognition, emotion, and pain, with five or six levels of functioning per attribute (Feeny et al., 2002). Each of all the possible combinations of levels, one from each attribute, represents a unique health state. The scores range from –.360 (a state deemed worse than death), to 0.00 (dead), to 1.00 (fully healthy state). Scores of .83 and below reflect dysfunction, whereas scores of .946 and above reflect a healthy state (Kopec, Williams, To, & Austin, 2000). Studies have demonstrated good reliability and validity of the HUI3 (Asakawa, Rolfson, Senthilselvan, Feeny, & Johnson, 2008; Boyle, Furlong, Feeny, Torrance, & Hatcher, 1995; Kopec et al., 2000; Kopec, Schultz, Goel, & Williams, 2001).

Other baseline covariates. Other covariates included age (continuous), sex, marital status (alone, married/living with partner), education (<secondary graduation, ≥secondary graduation), self-rated general health (poor/fair, good/very good/excellent), chronic condition (yes, no), smoking (current, never/former), and social support (low, high). The dichotomous measure of chronic condition was created based on whether the respondents had been diagnosed with any one or more of the following conditions: high blood pressure, diabetes, heart disease, cancer, stroke effects, or dementia. Social support was assessed using the 4-item perceived social support index (have someone: they can confide in; they can count on; who can give them advice; and who makes them feel loved; Statistics Canada, 2008), defined as low if the respondent answered negative to one or more of these items. Baseline scores on psychological distress and functional health were also included as covariates in multivariate analyses. Many of these variables have been shown to be associated with health outcomes in the NPHS (Shields & Martel, 2006) and considered as potential confounders in the literature.

Analyses

Baseline characteristics. Analysis of variance (ANOVA) or the second order Rao-Scott adjusted chi-square test were used to examine baseline differences in the covariates between respondents with missing data and those with complete data, and among the six drinking categories. Because the significance levels of the Pearson chi-square test are usually inflated under cluster sampling, the Pearson chi-square statistic was modified based on a procedure developed by Rao and Scott (1981, 1984).

Health outcomes. The relationship between alcohol consumption and mortality was examined using logistic regression. Using lifelong abstainers as the reference, odds ratios (OR) and 95% confidence intervals (CI) for mortality were calculated. The regression models included age, sex, marital status, education, general health, chronic condition, smoking, social support, psychological distress, and functional health as covariates. To explore possible effect modification, analyses were repeated separately for the middle-aged (50-64 years) and the elderly (≥65 years).

Analyses of change in psychological distress and functional health were conducted by dichotomizing the sample based on the extent of change that occurred between Cycle 1 (1994/1995) and Cycle 6 (2004/2005), following the method used by Stampfer and colleagues (2005). For analyses examining predictors of increases in psychological distress, the sample was

dichotomized according to whether respondents showed an increase in psychological distress from Cycle 1 to Cycle 6. The 10% of the sample ($n = 267$) that experienced the largest increase in psychological distress was identified by subtracting K6 scores at Cycle 6 from K6 scores at Cycle 1. The mean change score for the 10% showing the most increase in distress was –5.22, and 90% of this group's change scores fell between –3.2 and –10.0, reflecting a substantial increase in psychological distress from Cycle 1 to Cycle 6. At Cycle 6, 90% of this group's K6 scores fell between 3.0 and 13.4, with a mean of 7.0. Most members of the group were not experiencing severe psychological distress (defined as a K6 score of 13 or above; Kessler et al., 2003) at Cycle 6, although a small number were. Thus, the group showing substantial increases in distress can be characterized as psychologically distressed but not disabled at Cycle 6. The respondents showing substantial increases were contrasted with the 90% of respondents who did not experience substantial increases in psychological distress from Cycle 1 to Cycle 6.

For analyses examining predictors of decreases in functional health, the sample was dichotomized according to whether respondents showed a decrease in functional health from Cycle 1 to Cycle 6. The 10% of the sample ($n = 240$) that experienced the largest decrease in functional health was identified by subtracting HUI3 scores at Cycle 6 from HUI3 scores at Cycle 1. The mean change score for the 10% showing the largest decrease in functional health was 0.5, and 90% of this group's change scores fell between 0.3 and 0.8. Given a change of .05 on the HUI3 reflects a clinically important change in functional health (Horsman, Furlong, Feeny, & Torrance, 2003), these values reflect substantial decline in respondents' functional health from Cycle 1 to Cycle 6. At Cycle 6, this group's HUI3 scores fell between 0.04 (5th percentile) and 0.6 (95th percentile), with a mean of 0.4. Scores of 0.83 and below reflect dysfunction, and scores less than 0.60 correspond to self-ratings of health as poor (Kopec et al., 2000, 2001). Thus, this group can be characterized as having very poor health at Cycle 6. The group showing substantial decline in functional health was contrasted with the 90% of the sample who did not experience decreases in functional health from Cycle 1 to Cycle 6.

Logistic regression estimated the OR and 95% CI for substantial increase in psychological distress and substantial decline in functional health for each drinking category in relationship to lifelong abstainers. Predictors of decreases in psychological distress and increases in functional health were not examined. The regression models included all covariates, including baseline scores. Baseline scores were included as covariates because those

with perfect baseline scores had no room for improvement and may change more due to regression to the mean (Ganguli et al., 2005; Stampfer et al., 2005). Analyses were repeated in separate age strata. Given the limited power of the study and to facilitate cross-study comparisons, odds ratios were interpreted whether they were significant at the conventional .05 level, as was done in some previous studies (Goldberg et al., 1994; Rehm & Sempos, 1995).

Recoding and computation of variables were done in SPSS, version 15 (SPSS Inc., Chicago). Because the NPHS used a complex sampling design, all analyses were performed in WesVar, version 4.3 (Westat Inc., Rockville, MD) using bootstrap weight variables provided by the NPHS to account for the survey design effects. Statistics Canada recommends researchers verify the quality of total or proportion estimates with the coefficient of variation (CV = standard deviation of estimate/estimate). The proportion estimates marked with a superscript "c" in Table 1 and Table 3 and "b" in Table 2 had a CV between 16.6% and 33.3%, indicating high sampling variability associated with the estimate. Odds ratios were not reported if the bootstrap estimate of the standard error of the coefficient, B, was unstable.

Results

Baseline Characteristics

Of the 5,405 longitudinal respondents selected in 1994/1995, 4,595 completed the baseline interview and had known vital status at 10-year follow-up. A total of 4,187 had complete data on all baseline covariates. Table 1 shows that, compared with respondents with complete data, those who dropped out or had missing data on baseline covariates were younger, were more likely to be men, and had poorer self-rated general health. Baseline mental and functional health scores and the distribution of marital status, education, chronic condition, smoking status, social support, and alcohol consumption did not differ between the two groups.

At baseline, the mean age of persons with complete data was 64.5 years ($SE = 0.2$). The majority were women (55.6%), were married or living with a partner (69.1%), had a secondary school education or more (56.8%), had good to excellent self-rated general health (80.3%), had no chronic condition (64.1%), were nonsmokers (79.0%), and had high level of social support (79.2%). On the K6, the mean score was 2.8 ($SE = 0.1$), reflecting low levels of psychological distress at Cycle 1. On the HUI3, the mean score was 0.80 ($SE = 0.01$). Prior research with this NPHS sample (Kopec et al.,

Table 1
Baseline Characteristics of Respondents
According to Missing Status

Characteristics (No. of Cases)	Complete ($n = 4,187$)	Missing[a]	p[b]
Age (1,217)	64.5 (0.2)	62.7 (0.3)	<.001
Sex (1,217)			.01
Women	55.6 (0.7)	49.7 (1.8)	
Men	44.4 (0.7)	50.3 (1.8)	
Marital status (1,215)			.23
Married/with partner	69.1 (0.9)	71.3 (1.6)	
Alone	30.9 (0.9)	28.7 (1.6)	
Education (1,199)			.08
≥secondary graduation	56.8 (1.0)	52.8 (2.0)	
<secondary graduation	43.2 (1.0)	47.3 (2.0)	
General health (1,077)			.02
Good/very good/excellent	80.3 (0.8)	76.0 (1.7)	
Poor/fair	19.7 (0.8)	24.0 (1.7)	
Chronic condition (1,206)			.64
No	64.1 (1.0)	63.2 (1.9)	
Yes	35.9 (1.0)	36.9 (1.9)	
Smoking (1,072)			.22
Never/former	79.0 (0.8)	76.7 (1.7)	
Current	21.0 (0.8)	23.3 (1.7)	
Social support (788)			.08
High	79.2 (0.8)	74.8 (2.2)	
Low	20.8 (0.8)	25.2 (2.2)	
Psychological distress (786)	2.8 (0.1)	2.8 (0.2)	.78
Functional health (1,003)	0.80 (0.01)	0.81 (0.01)	.40
Alcohol consumption (1,049)			.29
Lifelong abstainer	11.2 (0.6)	14.5 (1.6)	
Former drinker	19.0 (0.7)	17.8 (1.6)	
Occasional drinker	30.0 (0.9)	30.6 (1.9)	
Light drinker	29.2 (0.9)	26.3 (1.7)	
Moderate drinker	7.2 (0.5)	7.1 (1.1)	
Heavy drinker	3.4 (0.4)	3.7 (0.7)[c]	

Note: Means (standard errors) are shown for continuous variables and proportions (standard errors) for categorical variables.
a. Number of respondents with some missing data for whom data on the characteristic were available is indicated by the number of cases in parentheses in the first column.
b. Derived from one-way ANOVA for continuous variables and χ^2 test for categorical variables.
c. Coefficient of variation 16.6% to 33.3%.

2001) indicated HUI3 scores of .788 correspond to self-ratings of health as fair or better. Nondrinkers were 30.2% of the population.

Table 2
Baseline Characteristics of 4,187 Respondents
According to Alcohol Consumption

			Current Drinker (Drinks per Week)				
Characteristics	Lifelong Abstainer	Former Drinker	Occasional (0)	Light (1-7)	Moderate (8-14)	Heavy (≥15)	p^a
No. of cases	551	913	1,250	1,075	264	134	
Age	68.1 (0.7)	67.0 (0.4)	64.7 (0.3)	62.3 (0.3)	61.2 (0.6)	62.2 (0.7)	<.001
Sex							<.001
Women	77.8 (2.5)	62.0 (2.1)	57.7 (1.7)	51.2 (1.9)	32.2 (3.3)	16.7 (3.9)^b	
Men	22.2 (2.5)	38.0 (2.1)	42.3 (1.7)	48.8 (1.9)	67.8 (3.3)	83.3 (3.9)	
Marital status							<.001
Married/with partner	60.3 (2.8)	62.4 (2.2)	66.0 (1.7)	75.8 (1.5)	84.1 (2.2)	72.7 (4.3)	
Alone	39.7 (2.8)	37.6 (2.2)	34.0 (1.7)	24.2 (1.5)	15.9 (2.2)	27.3 (4.3)	
Education							<.001
≥secondary graduation	43.9 (3.3)	45.2 (2.3)	53.3 (1.8)	69.5 (1.8)	68.9 (3.4)	60.3 (5.1)	
<secondary graduation	56.1 (3.3)	54.9 (2.3)	46.7 (1.8)	30.5 (1.8)	31.1 (3.4)	39.7 (5.1)	
General health							<.001
Good/very good/ excellent	73.6 (2.5)	68.4 (2.0)	81.2 (1.3)	87.6 (1.3)	87.5 (2.4)	82.2 (4.1)	
Poor/fair	26.4 (2.5)	31.6 (2.0)	18.8 (1.3)	12.4 (1.3)	12.5 (2.4)^b	17.8 (4.1)^b	
Chronic condition							<.001
No	57.0 (3.0)	55.5 (2.3)	65.3 (1.6)	70.3 (1.8)	64.4 (3.4)	71.6 (4.6)	
Yes	43.0 (3.0)	44.5 (2.3)	34.7 (1.6)	29.7 (1.8)	35.6 (3.4)	28.4 (4.6)	
Smoking							<.001
Never/former	89.4 (1.7)	78.5 (2.0)	79.3 (1.5)	78.6 (1.6)	71.0 (3.3)	64.8 (5.2)	
Current	10.6 (1.7)	21.5 (2.0)	20.7 (1.5)	21.5 (1.6)	29.0 (3.3)	35.2 (5.2)	
Social support							.06
High	84.5 (2.2)	77.4 (1.9)	77.2 (1.4)	79.6 (1.7)	83.7 (2.8)	75.9 (4.5)	
Low	15.5 (2.2)	22.6 (1.9)	22.8 (1.4)	20.4 (1.7)	16.3 (2.8)	24.1 (4.5)	
Psychological distress	3.0 (0.2)	3.5 (0.2)	2.9 (0.1)	2.5 (0.1)	2.3 (0.2)	2.3 (0.3)	<.001
Functional health	0.78 (0.01)	0.73 (0.01)	0.81 (0.01)	0.85 (0.01)	0.87 (0.01)	0.82 (0.02)	<.001

Note: Means (standard errors) are shown for continuous variables and proportions (standard errors) for categorical variables.
a. Derived from one-way ANOVA for continuous variables and χ^2 test for categorical variables.
b. Coefficient of variation 16.6% to 33.3%.

Table 2 shows that on average, current consumption was associated with younger age, being male, a greater likelihood of being married/with partner, an absence of selected chronic conditions, and less psychological

Table 3
Baseline Characteristics of Surviving
Respondents According to Missing Status

Characteristics (No. of Cases)	Complete (*n* = 2,438)	Missing[a]	*p*[b]
Age (683)	60.7 (0.2)	65.6 (0.5)	<.001
Sex (683)			.003
Women	58.9 (1.0)	50.5 (2.4)	
Men	41.1 (1.0)	49.5 (2.4)	
Marital status (682)			.54
Married/with partner	74.8 (1.0)	73.2 (2.4)	
Alone	25.2 (1.0)	26.8 (2.4)	
Education (675)			<.001
≥secondary graduation	63.8 (1.2)	48.3 (2.7)	
<secondary graduation	36.2 (1.2)	51.7 (2.7)	
General health (615)			.01
Good/very good/excellent	86.2 (0.9)	79.9 (2.1)	
Poor/fair	13.8 (0.9)	20.1 (2.1)	
Chronic condition (676)			.08
No	71.5 (1.1)	66.5 (2.6)	
Yes	28.5 (1.1)	33.5 (2.6)	
Smoking (612)			.90
Never/former	80.3 (1.0)	80.0 (2.1)	
Current	19.7 (1.0)	20.0 (2.1)	
Social support (483)			.20
High	81.4 (1.0)	78.1 (2.4)	
Low	18.6 (1.0)	21.9 (2.4)	
Psychological distress (486)	2.6 (0.1)	2.9 (0.2)	.22
Functional health (585)	0.86 (0.01)	0.79 (0.01)	<.001
Alcohol consumption (598)			<.001
Lifelong abstainer	8.7 (0.8)	18.8 (2.4)	
Former drinker	15.8 (0.8)	19.0 (2.1)	
Occasional drinker	30.6 (1.1)	27.9 (2.5)	
Light drinker	33.2 (1.2)	27.7 (2.6)	
Moderate drinker	8.5 (0.7)	4.6 (1.1)[c]	
Heavy drinker	3.2 (0.5)	2.0 (0.6)[c]	

Note: Means (standard errors) are shown for continuous variables and proportions (standard errors) for categorical variables.
a. Number of respondents with some missing data for whom data on the characteristic was available is indicated by the number of cases in bracket in the first column.
b. Derived from one-way ANOVA for continuous variables and χ^2 test for categorical variables.
c. Coefficient of variation 16.6% to 33.3%.

distress, and positively related to education, general health, smoking, and functional health. Level of social support did not differ significantly across drinking categories.

Of the surviving respondents, 2,438 had complete data on psychological distress and functional health at follow-up. Table 3 shows at baseline, surviving respondents with missing data were older, more likely to be men, less likely to have more than secondary education, had poorer self-rated general health, had poorer functional health, and more likely to be non-drinkers, compared with those with complete data. The two groups were not different in baseline mental health score and the distribution of marital status, chronic condition, smoking status, and social support.

Alcohol Consumption and Health Outcomes

During the 10 years of follow-up, 1,307 of the 4,187 respondents died. Table 4 shows the results from unadjusted, age-adjusted, and multivariate-adjusted logistic regression analyses of mortality risk. In the unadjusted analysis, occasional, light, and moderate drinkers had significantly reduced mortality risk compared with lifelong abstainers. In the age-adjusted analysis, heavy drinkers had a significantly increased mortality risk. In the multivariate-adjusted model, the risks for occasional, light, and moderate drinkers were nonsignificantly reduced, with OR = 0.79 (95% CI = 0.55-1.12) for light drinkers; however, heavy drinkers had an elevated risk, albeit nonsignificantly (OR = 1.63, 95% CI = 0.91-2.92). Former drinkers were not at a higher risk for mortality. In age-stratified, multivariate-adjusted analyses, in middle-aged persons, the lowest risk was observed among moderate drinkers (OR = 0.74, 95% CI = 0.28-1.98). In contrast, in elderly persons, risk was lowest among light drinkers (OR = 0.73, 95% CI = 0.46-1.14). In all cases, however, the multivariate-adjusted OR had corresponding CI that contained one.

Among the surviving respondents, 2,438 had complete data on psychological distress and functional health at follow-up. The risk could not be modeled for heavy drinkers and elderly moderate drinkers due to small sample sizes. Table 5 presents results from the unadjusted and multivariate-adjusted analyses of the risk of a substantial increase in psychological distress. In general, adjusting for the covariates did not substantially change the magnitude of the OR. In the multivariate-adjusted analysis, former and current drinkers were at nonsignificantly lowered risk of an increase in psychological distress, as compared with lifelong abstainers. In age-stratified, multivariate-adjusted analyses, similar results were observed in middle-aged persons. In contrast, in elderly persons, former and current drinkers had higher risk than abstainers. Again, all OR had corresponding CI that overlapped one.

The magnitude of the risks for a substantial decline in functional health was similar in unadjusted and multivariate-adjusted models (Table 6). The

Table 4
Odds Ratios (95% Confidence Intervals)
for 10-Year Mortality According to Alcohol Consumption

Respondents (n = 4,187)	Lifelong Abstainer	Former Drinker	Current Drinker (Drinks per Week/Mean for Total Sample)			
			Occasional (0)	Light (1-7/3.2)	Moderate (8-14/10.6)	Heavy (≥15/24.5)
Total						
No. of cases	551	913	1,250	1,075	264	134
Crude	1.0	1.15 (0.86-1.53)	0.74 (0.55-0.98)	0.49 (0.37-0.65)	0.51 (0.35-0.76)	1.13 (0.67-1.93)
Age-adjusted	1.0	1.40 (1.01-1.94)	1.07 (0.77-1.49)	0.87 (0.63-1.21)	1.08 (0.68-1.71)	2.52 (1.41-4.51)
Multivariate-adjusted[a]	1.0	1.01 (0.70-1.47)	0.89 (0.63-1.28)	0.79 (0.55-1.12)	0.85 (0.52-1.40)	1.63 (0.91-2.92)
Middle-aged						
No. of cases	158	342	608	619	167	80
Crude	1.0	1.44 (0.65-3.19)	1.26 (0.60-2.66)	1.15 (0.53-2.50)	1.15 (0.47-2.80)	3.19 (1.35-7.57)
Age-adjusted	1.0	1.41 (0.62-3.20)	1.28 (0.59-2.77)	1.22 (0.55-2.73)	1.21 (0.48-3.02)	3.10 (1.28-7.48)
Multivariate-adjusted[a]	1.0	0.88 (0.35-2.27)	0.91 (0.39-2.14)	0.93 (0.40-2.18)	0.74 (0.28-1.98)	1.55 (0.59-4.11)
Elderly						
No. of cases	383	571	642	456	97	54
Crude	1.0	1.17 (0.84-1.63)	0.75 (0.53-1.06)	0.52 (0.37-0.72)	0.66 (0.39-1.13)	1.14 (0.47-2.72)
Age-adjusted	1.0	1.47 (1.02-2.13)	1.06 (0.73-1.55)	0.74 (0.50-1.10)	1.13 (0.61-2.08)	2.50 (1.04-6.04)
Multivariate-adjusted[a]	1.0	1.13 (0.75-1.71)	0.97 (0.64-1.46)	0.73 (0.46-1.14)	0.99 (0.51-1.90)	1.90 (0.81-4.45)

a. Adjusted for age, sex, marital status, education, general health, chronic condition, smoking, social support, psychological distress, and functional health.

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Table 5

Odds Ratios (95% Confidence Intervals) for a Substantial Increase in Psychological Distress According to Alcohol Consumption

Respondents (n = 2,438)	Lifelong Abstainer	Former Drinker	Current Drinker (Drinks per Week/Mean for Total Sample)			
			Occasional (0)	Light (1-7/3.2)	Moderate (8-14/10.3)	Heavy (≥15/24.5)
Total						
No. of cases	234	434	770	745	186	69
Crude	1.0	0.54 (0.27-1.06)	0.75 (0.40-1.42)	0.60 (0.33-1.89)	0.79 (0.33-1.89)	—
Multivariate-adjusted[a]	1.0	0.52 (0.26-1.03)	0.79 (0.41-1.51)	0.68 (0.36-1.28)	0.89 (0.36-2.24)	—
Middle-aged						
No. of cases	121	269	490	527	139	53
Crude	1.0	0.54 (0.25-1.17)	0.69 (0.34-1.40)	0.58 (0.31-1.10)	0.62 (0.24-1.59)	—
Multivariate-adjusted[a]	1.0	0.51 (0.23-1.14)	0.70 (0.35-1.45)	0.57 (0.29-1.13)	0.56 (0.21-1.46)	—
Elderly						
No. of cases	113	165	280	218	47	16
Crude	1.0	1.05 (0.29-3.78)	1.80 (0.55-5.88)	1.35 (0.40-4.55)	—	—
Multivariate-adjusted[a]	1.0	1.19 (0.31-4.62)	2.02 (0.55-7.43)	1.61 (0.42-6.25)	—	—

Note: Blank indicates unstable standard error associated with the estimate.

a. Adjusted for age, sex, marital status, education, general health, chronic condition, smoking, social support, psychological distress, and functional health.

Table 6

Odds Ratios (95% Confidence Intervals) for a Substantial Decline in Functional Health According to Alcohol Consumption

Respondents (n = 2,438)	Lifelong Abstainer	Former Drinker	Current Drinker (Drinks per Week/Mean)			
			Occasional (0)	Light (1-7/3.2)	Moderate (8-14/10.3)	Heavy (≥15/24.5)
Total						
No. of cases	234	434	770	745	186	69
Crude	1.0	0.72 (0.36-1.42)	0.45 (0.25-0.80)	0.25 (0.13-0.47)	0.36 (0.13-1.01)	—
Multivariate-adjusted[a]	1.0	0.72 (0.35-1.48)	0.45 (0.24-0.85)	0.26 (0.13-0.52)	0.38 (0.13-1.12)	—
Middle-aged						
No. of cases	121	269	490	527	139	53
Crude	1.0	0.61 (0.26-1.45)	0.30 (0.14-0.66)	0.25 (0.12-0.54)	0.29 (0.08-1.06)	—
Multivariate-adjusted[a]	1.0	0.57 (0.23-1.46)	0.27 (0.12-0.63)	0.23 (0.10-0.52)	0.23 (0.07-0.83)	—
Elderly						
No. of cases	113	165	280	218	47	16
Crude	1.0	0.41 (0.15-1.16)	0.39 (0.15-1.02)	0.44 (0.16-1.18)	—	—
Multivariate-adjusted[a]	1.0	0.48 (0.14-1.63)	0.49 (0.14-1.67)	0.59 (0.15-2.24)	—	—

Note: Blank indicates unstable standard error associated with the estimate.

a. Adjusted for age, sex, marital status, education, general health, chronic condition, smoking, social support, psychological distress, and functional health.

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multivariate-adjusted analysis showed that the risks were lower among former and current drinkers. This reduction in risk was significant in occasional (OR = 0.45, 95% CI = 0.24-0.85) and light drinkers (OR = 0.26, 95% CI = 0.13-0.52). Age-stratified, multivariate-adjusted analyses showed that in middle-aged persons, the lowest risk was found in light drinkers (OR = 0.23, 95% CI = 0.10-0.52) and moderate drinkers (OR = 0.23, 95% CI = 0.07-0.83). Occasional drinkers also had significantly reduced risk (OR = 0.27, 95% CI = 0.12-0.63). In contrast, in elderly persons, occasional drinkers had the lowest risk (OR = 0.49, 95% CI = 0.14-1.67) among current drinkers, although the risk reduction was not significant.

Sensitivity Analyses

Sensitivity analyses were performed to test the robustness of the findings. To account for individual variation in alcohol intake, alcohol intake was averaged over Cycle 1 (1994/1995) and Cycle 2 (1996/1997) for current drinkers, who were then recategorized according to average intake (Emberson, Shaper, Wannamethee, Morris, & Whincup, 2005; Lang et al., 2007a). Lifelong abstainers and former drinkers were those who remained in the same category at both cycles. Multivariate-adjusted analyses of risk according to this new classification were repeated for the total sample (*n* = 1,898). The OR for a substantial increase in psychological distress were different from those in the main analysis (OR and 95% CI, respectively, for former drinker: 0.85, 0.29-2.47; occasional drinker: 0.70, 0.23-2.09; light drinker: 1.11, 0.40-3.04; and moderate drinker: 1.73, 0.52-5.74), with light and moderate drinkers now at increased risk, indicating no consistent pattern of association between alcohol consumption and increase in psychological distress. The new model of risks for functional health decline produced results for current drinkers similar to those in the main analysis (OR and 95% CI, respectively, for former drinker: 0.44, 0.17-1.12; occasional drinker: 0.31, 0.12-0.80; light drinker: 0.23, 0.09-0.57; and moderate drinker: 0.21, 0.07-0.65).

Discussion

Association With Mortality

This study assessed the relationship of alcohol consumption to mortality and changes in psychological distress and functional health status in a population-based sample of older adults. In mortality analyses, there was a nonsignificant overall protective effect of light-to-moderate drinking and

harmful effect of heavier drinking on mortality, compared with lifetime abstinence. Specifically, the analyses revealed a nonsignificant beneficial effect of moderate drinking in middle-aged persons and of light drinking in elderly persons. On average, former drinkers had no higher risk for mortality than lifelong abstainers.

Few studies linking alcohol consumption to mortality have separated former or occasional drinkers from lifelong abstainers, making comparisons with this study difficult. However, in this study, neither former drinkers nor occasional drinkers were at increased risk compared with lifelong abstainers. The few previous studies that have stratified by age have revealed similarities as well as some inconsistencies. A study of U.S. male civil servants found a protective effect of light-to-moderate drinking on 10-year mortality in those aged 50 to 59 and 60 to 64 (Marmot et al., 1981). Another U.S. study found this relationship to be stronger among those younger than 50 years and relatively weak among those aged 60 and above (Klatsky et al., 1981). In a Danish population study, a protective effect of light-to-moderate drinking was found in both middle-aged (50-64 years) and elderly (>64 years) persons (Grønbæk et al., 1998). In a large U.S. representative cohort, alcohol consumption exhibited a positive linear relationship with mortality for those aged 25 to 59 and a nonsignificant U-shape for those aged 60 and above (Rehm & Sempos, 1995).

A study of Japanese American men aged 51 to 75 years revealed a nonsignificant J-shaped relationship between alcohol consumption and mortality rates over 15 years in both middle-aged and elderly men. However, in middle-aged men, the protective effect on total mortality was associated with light drinking (1-14 ml per day), whereas in elderly men it was associated with moderate drinking (15-39 ml per day; Goldberg et al., 1994). In contrast, in the present study the nadir of the J was lower in the elderly than in the middle-aged. Unfortunately, in many of these studies, including the present, the relatively small number of moderate and heavy drinkers increased the scope for random variation in observed rates and the risk estimates for total mortality were not significantly different from 1. Future studies with larger sample size are needed to confirm the findings of protective effects of alcohol consumption on mortality in older adults.

Association With Increase in Psychological Distress

This study also examined whether alcohol consumption is related to two other summary measures of health status. Among the surviving respondents, it was found that former, occasional, light, and moderate drinking

were nonsignificantly associated with lower rates of a substantial increase in psychological distress 10 years later than lifelong abstinence. Stratified analyses showed that this relationship only held in middle-aged persons, whereas in elderly persons, former and current drinkers had greater risk of a substantial increase in psychological distress.

In contrast, a previous prospective study of older adults aged 50 and above found that those consuming one to two drinks per day had significantly fewer depressive symptoms, whereas abstinence was associated with significantly more depressive symptoms, compared to those consuming no more than one drink per day (Lang et al., 2007b). In addition, never drinkers and ex-drinkers were not significantly different in the number of depressive symptoms.

In the present study, although baseline level of psychological distress differed significantly across the drinking groups, the multivariate analyses suggested that changes in distress over time have a complex relationship with alcohol consumption and other measured or unmeasured variables. In the multivariate analysis, the only significant predictors of a substantial increase in distress were smoking and baseline distress score (data not shown). More studies are thus needed to identify determinants of changes in distress over time.

Association With Functional Health Decline

This study found that occasional and light drinkers were significantly less likely to have a substantial decline in functional health status than lifelong abstainers. Former and moderate drinkers were also at reduced risk of functional health decline, although nonsignificantly. When the analyses were stratified for age, occasional-to-moderate alcohol consumption significantly protected against functional health decline in middle-aged persons. There were also trends for a protective effect of alcohol consumption in elderly persons. In both age groups, former drinkers were at nonsignificantly reduced risk of a substantial decline in functional health.

In the few prospective studies linking functional health outcomes to alcohol consumption in older adults, excessive (Perreira & Sloan, 2002), no, and rare consumption (Byles et al., 2006; Lang et al., 2007b; Wang et al., 2002) have all been associated with poorer functional outcomes, supporting a protective effect of moderate alcohol consumption on functional status. However, none of these studies have separated former drinkers from lifelong abstainers. In the present study, former drinkers had nonsignificantly lowered risk of functional health decline. Whether this is a result of former drinkers having the poorest functional health at baseline is unclear.

Limitations

This study had several limitations. The first relates to potential imprecision in the measurement of alcohol consumption. The NPHS uses an actual intake approach that asks the respondent to recall actual day-to-day alcohol intake for the past week. This approach generally gives more accurate estimates of actual intake over the short specified period than the usual intake approach that asks the respondent to estimate his or her usual intake over a long period (Poikolainen, 1995; see also Feunekes, Van't Veer, van Staveren, & Kok, 1999). However, because of variation in intake over time, this actual intake approach may result in relatively more misclassifications and random errors (Poikolainen, 1995). Misclassifications leading to random errors may have weakened the observed association between alcohol consumption and health outcomes in this study.

Second, as with all observational studies, there is always the possibility of residual or unmeasured confounding. Many of the covariates included in this study were crude measures of the variables, dichotomized to increase stability of estimate. It is also possible that uncontrolled confounding has contributed to the observed results. In particular, unmeasured confounding by lifestyle factors, such as dietary habits, has been a concern in literature linking alcohol use to health outcomes (Andréasson, 1998). Unfortunately, information on diet was not collected until Cycle 2 of the NPHS. However, there may have been overadjustment for some covariates that lie in the causal pathway between alcohol consumption and health outcomes. These may include hypertension and heart diseases, two of the selected chronic conditions controlled for in this study. Nevertheless, the concern that lifelong abstainers include individuals who never started drinking due to illnesses warrants this conservative approach.

Third, although the NPHS is a population-based study, the respondents were community-dwelling, noninstitutionalized older persons. The NPHS also excluded persons living in reserves. Studies have found Aboriginals to be less likely to drink regularly but more likely to binge drink compared to the general population (Anderson, 2007; MacMillan et al., 2008). Consequently, the results of this study should be generalized with caution. Future studies should include Aboriginal populations, who have a different disease distribution, and examine detailed patterns of drinking as opposed to average consumption level, to further clarify the effects of alcohol consumption on health.

Finally, this study had limited power to detect associations, as indicated by a lack of stability in the estimates of odds and the wide confidence intervals. Due to small sample sizes, we could not perform subgroup analyses

that examine the effects of gender, changes in drinking over time, or frequency of binge drinking.

In conclusion, results from this national population study suggest a protective effect of alcohol consumption on functional health decline over 10 years in older persons. Alcohol consumption was nonsignificantly associated with reduced mortality, and showed a nonsignificant, inconsistent pattern of relationship with increases in psychological distress. Given the observational nature and limited power, the findings should be extrapolated with great caution. As many investigators have noted, moderate drinking should not be recommended to nondrinkers based on positive findings because the optimal level for aggregate consumption is likely to be lower than that for individual consumption (Skog, 1996). In addition, few studies have examined the effects of nondrinkers taking up moderate drinking in older age (Fillmore et al., 2003; Goldberg et al., 1994; Grønbæk et al., 2004; Lazarus et al., 1991; Paganini-Hill et al., 2007). Nevertheless, the available evidence suggests that clinicians should advise current light-to-moderate drinkers to reduce consumption only when they have characteristics that predispose them to risk. Individuals should also consider their own medical conditions and medication use before making a decision about continuing or changing their usual consumption level.

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