California Center for Population Research
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Gilbert C. Gee
Jersey Liang
Joan Bennett
Neal Krause
Erika Kobayashi
Taro Fukaya
Yuko Sugihara

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Gilbert C. Gee
Jersey Liang
Joan Bennett
Neal Krause
University of Michigan
Erika Kobayashi
Taro Fukaya
Yuko Sugihara
Tokyo Metropolitan Institute of Gerontology

This study examined the longitudinal changes in alcohol consumption among elderly Japanese, characterized the subtrajectories within the aggregate trend, and examined potential predictors of these trajectories. Data come from a nationally representative survey of 2,566 persons in Japan, ages 60 to 96, followed over five waves between 1987–1999. Hierarchical linear modeling and cluster analysis were used to uncover trajectories of alcohol use. Multinomial logistic regression was employed to examine the predictors of trajectory association at baseline. Alcohol use appears relatively stable between ages 60 and 70, but declines thereafter. Further, there are three subtrajectories: stable, declining, and curvilinear (in addition to abstainers). Predictors of these trajectories varied by trajectory. Alcohol use may continue to be an important part of life at older ages. However, older drinkers appear to follow four drinking trajectories. Demographic characteristics and stressors may be associated with these trajectories. Knowledge of these trajectories may aid in targeting of interventions.

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Alcohol use varies cross-culturally, but these variations may diminish with increasing globalization of the alcohol industry (Jernigan et al. 2000; World Health Organization 2004). Although these comparative patterns are of interest, much of what is known about alcohol consumption has focused on Western countries and younger populations; relatively little is known about alcohol in other contexts and among older populations. In this study, we focus on alcohol consumption among older persons in Japan. Hayashida (1998:162S) notes that Japanese "rank already among the highest alcohol consumers in the world. In Japan, nevertheless, it appears that no serious efforts have ever been made to control her own alcohol consumption."

Although several studies have examined drinking in Japan, most have not focused on population-based samples of older adults (Hashimoto et al. 2001; Mori and Shirasaka 1995; Nagoshi et al. 1994; Otani et al. 2003; Sobue, Yamamoto, and Watanabe 2001) To fill a gap, our study examines trajectories of drinking among a representative sample of Japanese elderly. In addition to providing relevant information for Japan, our analysis provides a point of comparison for Western populations. A study of trajectories of alcohol use will provide a necessary first step for the identification of older Japanese at higher risk. In particular, those with high, sustained drinking or those with increasing patterns of alcohol consumption over time would be likely intervention targets. Yet, these groups cannot be identified properly with data gathered at only one point in time. Instead, only by studying trajectories of change in alcohol consumption can more accurate assessments of vulnerability be determined.

Japan presents an interesting contrast to the United States. Both nations have similarities, including rapid population aging, economic development (Liang et al. 2003), high burden of alcohol-related problems (Hashimoto et al. 2001), and higher drinking rates among men, but greater increase among women (Kono and Takano 1992; Wilsnack 1996).

Nonetheless, there are some important differences in drinking between the two countries (Higuchi and Kono 1994; Nagoshi et al. 1994). In the United States, alcohol consumption apexes in early adulthood, whereas in Japan it peaks in the middle ages (Dufour and Fuller 1995; Higuchi and Kono 1994). The later peak in Japan likely reflects the greater social acceptance of alcohol use as a part of business culture in Japan (Hayashida 1998). Further, Japan appears to tolerate a higher level of alcohol consumption and public drunkenness (Higuchi and Kono 1994).

Alcohol Use among Older Persons

In this section, our review focuses on alcohol consumption among older adults. Granted limited information elsewhere, much of this review derives from Western countries, primarily the United States.

In the United States, alcohol use among older persons remains a significant issue. (Dufour and Fuller 1995; Rigler 2000). An estimated 20.6 million individuals above age 55 have used alcohol in the last month in the United States (Substance Abuse and Mental Health Services Administration 2001). The prevalence is likely to rise with the aging of the population (Breslow, Faden, and Smother 2003).

Most studies stress that alcohol consumption is generally low and declines for older populations (Perreira and Sloan 2001; Thun et al. 1997) Others have argued that alcohol-related problems among the elderly are underreported and may increase under certain circumstances (Adams and Cox 1995). Regardless, it is important to examine all levels of adult drinking because of potential benefits and dangers associated with alcohol. For example, although modest levels of drinking may reduce the risk of heart disease, alcohol itself may interact with medications taken by older persons and may contribute to falls (Council on Scientific Affairs 1996; Kahn et al. 2002; Mukamal et al. 2004).

Investigators have long noted subtypes of drinkers, such as Type A and Type B (Babor 1996). These typologies use time mainly to refer to age of drinking onset. However, the relationship between time and alcohol use is more complex than just age of onset, including duration and timing of increase and decrease. These considerations are captured by *trajectories*—patterns of consumption that vary with respect to age (Casswell, Pledger, and Pratap 2002; Johnson et al. 1998; Li, Duncan, and Hoops 2001). Trajectories are important because they highlight heterogeneity in development and mirror clinical practice. Clinical practice considers both an individual's status at time of assessment and the prognosis (a trajectory) in determining treatment options. More generally, any "intervention" (e.g., widowhood) has the potential to deflect individuals into different trajectories.

Alcohol trajectories research has focused on younger persons (Muthen and Shedden 1999; Nagin 1999; Schulenberg et al. 1996). These studies report between 4 and 7 distinct trajectories that include patterns of acceleration, stability, and deceleration. There is little reason to suspect that these trajectories converge into a single pattern in older ages. Yet, despite a body of knowledge on adult drinking, little research has examined how adult drinking can be modeled as heterogeneous trajectories.

Further, much of the extant research on alcohol and aging has relied upon cross-sectional and/or nonrepresentative samples (Brennan, Schutte, and Moos 1999; Ekerdt et al. 1989; Krause 1995; Mirand and Welte 1996; Sobue et al. 2001). With a few exceptions (Brennan et al. 1999; Perreira and Sloan 2001; Vaillant 2003), most longitudinal studies of drinking in older adults have been limited to analyses of two waves of data collection, preventing the examination of potential nonlinear trajectories (Gallo et al. 2001). Understanding the relationship between alcohol and age requires data with multiple observations over an extended period of time. Studies with two waves of information assume that the relationship between age and alcohol is linear, but this assumption may not always be tenable.

These observations motivate the research questions for this investigation. What is the relationship between age and alcohol consumption? Based on prior research, we expect that alcohol use among older persons should decline and be relatively stable (Dufour and Fuller 1995).

Further, to what extent do people deviate from the overall trend and what is the nature of this deviation? We hypothesize that there will be at least four trajectories of alcohol consumption: abstinence, decline, stable use, and increase. These four patterns have been observed in studies of adult drinking (Brennan et al. 1999; Vaillant 2003). Among men, moderate drinkers remain stable over age, whereas heavier drinkers decline; among women, moderate drinking decreases with age, whereas heavy drinkers remain stable (Breslow et al. 2003). Some research has reported on subgroups of new drinkers as well as increases in drinking levels in adulthood (Liberto and Oslin 1995). One study of older persons noted that over the period of six years, about a tenth of their sample increased the amount they drank (Perreira and Sloan 2001).

Predictors of Alcohol Trajectories

In addition to describing the age norm of alcohol use and its underlying heterogeneity, we examine several predictors of these trajectories. We focus on stressors, illness, and gender.

Many studies suggest that individuals drink in order to reduce stress (Cappell and Herman 1972; Sloan, Roache, Johnson 2003). The intuitive appeal of this hypothesis has sparked numerous studies on life events (e.g., widowhood) and alcohol use. However, findings are generally inconclusive, with some studies finding positive results (Gallo et al. 2001; Glass et al. 1995); negative results (Brennan et al. 1999); and others reporting mixed or no results (Brennan et al. 1999). Granted the divergent directions, some of the null findings may be due to a nonlinear relationship between stressors and alcohol use. Accordingly, we hypothesize that stressors will be associated with trajectories of increased consumption and with trajectories that show a rise and fall. Also, we hypothesize that stressors should not be associated with stable or initially declining trajectories.

Although there are numerous stressors, we focus on three that may be particularly relevant for alcohol use among older persons: loss of a loved one, financial strain, and illness. Loss of a spouse, friends, and family members may induce grief and sorrow, induce other stressors, and represent the degradation of one's support network. This loss may be especially pertinent to the longitudinal study of older adults because the effects of death may persist over 14 years (Wortman, Silver, and Kessler 1993). Death of a loved one has been associated with increased drinking (Glass et al. 1995; Romelsjo et al. 1991). However, this increase may be short-lived. Perreira and Sloan (2001) found a spike in drinking over a two-year period after widowhood, followed by a marked decline. Therefore, we anticipate that loss of a loved one may be associated with trajectories of increasing use and with trajectories of initial increase, then decline.

Financial strain may be a stressor that leads to negative affect and prompt individuals to consume alcohol to regulate this undesired state (Peirce et al. 1994). Some studies report that financial strain is associated with increased drinking (Krause 1991; Peirce et al. 1996). However, others find that financial stressors are associated with abstinence (San Jose et al. 2000) and decreased consumption (Brennan et al. 1999). It may be that persons who are financially strained have less discretionary income to spend on alcohol (Krause 1991). Taken together, these findings suggest that financial strain would be associated with trajectories of abstinence or with trajectories of change (i.e., increased or decreased consumption), but also that financial strain will not be associated with trajectories of relatively stable consumption.

We also anticipate that illness will be associated with alcohol trajectories. Although alcohol use can influence health, health may affect alcohol consumption for two major reasons. First, changes in health status may represent life events that can modify drinking behavior. Individuals who become ill may disengage from settings where alcohol is consumed.

Further, individuals who are ill may not tolerate alcohol well, take medications contraindicated with alcohol, and receive advice from medical professionals to decrease their drinking (Krause 1995). Second, there may be a direct (nonstress) relationship between alcohol and health. Although heavy drinking can cause illness (e.g., cirrhosis and injuries) (Thun et al. 1997), abstinence may also place individuals at risk for illness relative to light and moderate drinking. Several cross-sectional studies from Western countries find that individuals consuming light to moderate amounts of alcohol report better health than individuals drinking little to no alcohol (Gronbaek et al. 1999; Theobald, Johansson, and Engfeldt 2003), a finding echoed by a few longitudinal studies in China (Woo, Ho, and Yu 2002) and Japan (Tsugane et al. 1999). Hence, although most people probably do not drink moderately for the express purpose of health promotion, it is possible that an unanticipated consequence of moderate drinking is improved health. Taken together, these observations lead to the hypothesis that healthier individuals will be more likely to be in light/moderate drinking trajectories, compared to abstinence. We also hypothesize that persons who are ill will be in trajectories of decreasing consumption.

We also expect that gender will be an important predictor. Prior studies have clearly demonstrated that in the United States and Japan, women are more likely to abstain and drink less heavily compared to men (Mori and Shirasaka 1995; Perreira and Sloan 2001). Alcohol consumption among women in the general population in Japan appears to be rising (Kono and Takano 1992), although it is unclear whether this extends to women in the older age groups. Accordingly, we hypothesize that women will be more likely to abstain than to be in any drinking trajectory and we explore whether women are more likely to be in trajectories of rising consumption.

Methodology

Sample

The data come from two cohorts of a national longitudinal study of health and aging in Japan (Liang et al. 2003). The initial cohort ($n = 2{,}200$) entered in 1987 and was interviewed in 1987, 1990, 1993, 1996, and 1999. The second cohort ($n = 366$) entered in 1990 and was interviewed in 1990, 1993, 1996, and 1999. For the analyses of baseline factors (see below), we used predictors assessed in 1987 for the first cohort and 1990 for the second cohort. From 1990 to 1999, there were 167, 207, 228, and 238 deaths per wave, respectively. Also within that same time period there were 210, 160, 217, and 224 persons otherwise lost to follow-up, respectively.

Measures

The dependent variable was a quantity-frequency measure of the typical number of drinks per week (Rehm 1998). One drink was equivalent to one "go," the Japanese standard drink (19.75 grams of ethanol). We applied a log transformation to account for a skewed distribution.

Loss of a loved one was measured with a count of the number of close relatives and friends who died within the past year. A larger number indicates greater loss.

Financial strain consisted of four items that ask about respondent's satisfaction with their financial situation, the adequacy of their financial situation, their financial situation compared to others, and whether respondents felt they had enough pocket money. These four items were summed; higher values indicate greater financial strain. Inter-item reliability (Cronbach's alpha) was 0.75.

Health was measured with several indicators that included self-rated health, functional status, serious conditions, and chronic conditions. *Self-rated health* was a composite of three indicators asking the respondent's rating of physical health, health compared to other persons their age, and overall satisfaction with their health (alpha = 0.85); higher scores indicate improved health.

Functional status was measured with a six-item composite of activities of daily living (e.g., walking a half mile, shopping), with higher scores indicating greater difficulty. *Serious conditions* were measured with a checklist of the number of health problems including diabetes, heart disease, hypertension and stroke. *Chronic conditions* was the number of recurring problems such as arthritis and liver disease from a checklist of 11 items (Ferraro and Farmer 1999).

Other covariates include cognitive impairment, social support, depression and demographics.

Cognitive impairment was measured with the Short Portable Mental Health Status Questionnaire, with higher scores indicating greater impairment (Pfeiffer 1975). *Depressive symptoms* were measured with a shortened form of the Center for Epidemiologic Studies Depression Scale (CES-D) (Kohout et al. 1993). This seven-item scale (alpha = 0.83) included the following: (1) appetite was poor; (2) sleep was restless; (3) could not get going; (4) everything I did was an effort; (5) felt depressed; (6) felt lonely; (7) felt sad. The shortened CES-D appears to measure the same symptom dimensions as the original CES-D with little decrement in precision (Kohout et al. 1993).

Social relationships were measured with three indicators. *Emotional support received* was a composite of two items asking how often the respondent felt someone "listened to them" and "made them feel cared for" ($r = 0.75$). *Instrumental support received* was a composite of two items asking how often a network tie provided assistance when the respondent was sick and needed financial assistance ($r = 0.41$). Higher scores indicated greater received support. *Negative interactions* were measured with four indicators (alpha = 0.57) and address the extent to which social relationships provide discord (e.g., "How often are people too critical of you?").

Additional covariates included *education*, a continuous measure of the years of total education; *work status*, a dummy variable with a 1 indicating current full- or part-time employment; and *gender*, with a 1 indicating female. Table 1 summarizes these measures.

Analyses

The analyses took three stages, following the analytic approach outlined by Liang and colleagues (2003). The first step employed hierarchical linear modeling (HLM) to estimate individual growth curves and random effects (Raudenbush and Bryk 2002). Significant random effects would suggest that multiple trajectories exist in the population, whereas nonsignificance suggests a single trajectory.

The number of drinks consumed by individual, $i(Y_{ti})$, can be specified as a function of this person's age, a, at a given survey (t) in a level-1 or repeated observation model (Raudenbush and Bryk 2002).

$$Y_{ti} = \pi_{0i} + \pi_{1i} a_{ti} + e_{ti} \tag{1}$$

The error e_{ti} is assumed normally distributed with a mean of 0 and variance Φ^2. The intercept of alcohol use for person i, (π_{0i}) is their baseline alcohol consumption and the parameter (π_{1i}) is the rate of change in consumption for person i across age. Because the growth parameters (π_{0i} and π_{1i}) may vary across individuals, we can specify them in a Level-2 model:

$$\pi_{0i} = \beta_{00} + \Sigma\beta_{0q} X_{qi} + r_{0i} \quad \text{and} \quad \pi_{1i} = \beta_{10} + \Sigma\beta_{1q} X_{qi} + r_{1i} \tag{2}$$

Table 1
Characteristics of Respondents at Baseline

Measure	Statistic	Min	Max
N	2,566		
Age			
Mean	68.01	60	93
Standard Deviation (*SD*)	6.87		
Years of Education			
Mean	8.75	0	17
SD	2.76		
Gender			
Percent Female	54.36%		
Work Status			
Percent Working	29.54%		
Negative Interaction			
Mean	8.14	4	19
SD	3.04		
Emotional Support Received			
Mean	8.24	2	10
SD	1.81		
Instrumental Support Received			
Mean	7.31	2	10
SD	2.07		
CES-D			
Mean	1.13	1	3
SD	0.39		
Self-Rated Health			z
Mean	23.11	11	45
SD	8.73		
Serious Conditions			
Mean	0.42	0	4
SD	0.63		
Chronic Conditions			
Mean	0.65	0	12
SD	0.99		
Functional Status			
Mean	0.75	0	24
SD	2.75		
Loss of loved one			
Mean	0.47	0	9
SD	0.81		
Functional status			
Mean	7.22	4	15
SD	2.13		
Drinks per Week			
Mean	1.87	0	37.5
SD	4.4		

where the random effects of r_{0i} and r_{1i} are assumed to have variances ϑ_{00} and ϑ_{11}, respectively, with covariance ϑ_{01}. X_{qi} is a covariate (e.g., gender) associated with individual i and π represents the effects of X on the growth parameter. We investigated successively more complex models of growth of alcohol consumption: linear, quadratic, and cubic polynomials of age. Abstainers ($n = 973$)—individuals who did not drink in any period of observation—were defined as a trajectory *a priori* and removed from this analysis. Therefore, the HLM analysis includes only individuals who drank at least once during any period of observation.

In the second stage, the empirical Bayes estimates of the random effects from the HLM analyses were analyzed with K-means cluster analyses (Liang et al. 2005; Liang et al. 2003). This procedure identifies alcohol trajectories by uncovering homogeneous groupings within the sample. We examined models with 2 to 11 clusters and identified the most parsimonious cluster solution. Individuals were then assigned to their respective clusters (trajectories). Abstainers were reintroduced into the dataset as a trajectory.

The third stage investigated predictors of trajectory membership. We used multinomial logistic regression, with the trajectories as the dependent variable, to examine the predictors of trajectory membership at baseline. As a check on the cluster assignments, we also reran growth models to determine if the trajectories were significant predictors of the growth curve parameters.

Covariates were centered to facilitate interpretation and address multicollinearity (Aiken and West 1991). Multiple imputation was used to minimize loss of participants due to missing data and attrition (Rubin 1996; Shafer 1999). We imputed missing data on alcohol consumption for all respondents at baseline and for participating respondents at a given wave (e.g., information for dead respondents was not imputed). Using the *NORM* software (Schafer 1997), four complete datasets were imputed. Analyses were replicated across all datasets and the estimates were averaged. Standard errors were also averaged using a formula that combines the average of the squared errors of the estimates and variance of the parameter estimates across the datasets (Schafer and Olsen 1998).

Results

Age Norm of Alcohol Consumption

Table 2 displays mean alcohol consumption for age groups across the five waves of the study. Although consumption levels are quite low, respondents do appear to drink even in their nineties.

Table 2
Mean Weekly Alcohol Consumption for Age Groups, by Survey Year

	Year											
	1987		1990		1993		1996		1999		Total	
Age Group	mean	*n*	mean	*n*	mean	*n*	mean	*n*	mean	*n*	mean	*n*
60–62	2.05	439	2.52	365	3.2	6					2.27	810
63–65	1.65	381	2.22	369	2.91	328	0	1			2.23	1079
66–68	1.66	300	1.62	319	2.1	360	2.75	297	1.88	3	2.03	1279
69–71	1.55	283	1.53	241	1.94	311	2.24	319	2.33	280	1.94	1434
72–74	1.28	304	1.57	220	1.53	232	2.07	277	1.79	279	1.65	1312
75–77	1.00	215	1.61	238	1.59	202	1.37	198	1.76	246	1.48	1099
78–80	0.93	138	1.17	144	1.26	200	1.21	181	1.16	166	1.16	829
81–83	1.36	81	0.73	81	1.2	127	1.38	153	0.94	132	1.14	574
84–86	1.21	38	1.24	36	0.54	64	1.22	74	0.86	109	0.96	321
87–89	1.1	15	1.86	18	0.49	20	0.45	36	1.04	53	0.93	142
90–92	1.69	4	0.81	5	2.03	10	0.51	11	0.42	16	0.95	46
93–95	0	2	0	1	2.17	3	0	2	0	2	0.65	10
96–98					0	1			0	1	0	2
99–101												
Total	1.54	2,200	1.8	2,037	1.87	1,864	1.88	1,549	1.6	1,287	1.74	8,937

As seen cross-sectionally and longitudinally, there is a trend toward decreased consumption as individuals age. For example, respondents aged 60 to 62 in 1987 drank 2.05 go per week. Thereafter, their consumption was 2.22 (1990), 2.10 (1993), 2.24 (1996), and 1.79 go per week (1999). As seen in this example, there was also a slight increase in drinking between 1993 to 1996 and a decline in 1999. In addition, there are a few groups for which there seems to be a slight increase in consumption over time, such as among those who were age 63 to 65 in 1987. These perturbations in the general trend of decline motivate our desire to further examine potentially heterogeneous trajectories of alcohol use.

We then employ growth curve modeling to more formally summarize these descriptive observations. This analysis found a quadratic relationship between alcohol use and age ($\pi_{1i} = -0.004$, $p > 0.05$ and $\pi_{2i} = -0.0005$, $p \leq 0.01$). The average 60-year-old and 70-year-old are predicted to drink 1.3 drinks per week, the average 80-year-old is predicted to drink 1.1 drinks per week, and the average 90-year-old is predicted to drink 0.72 drinks per week.

The unconditional growth model suggested that there were heterogeneous groups of drinkers in the sample, both in terms of initial drinking status (variance of intercept = 0.72, $p < 0.001$) as well as in their change over time (variance of growth rate age = 0.002, and age$^2 > 0.001$; $p < 0.001$ for both growth rates). Therefore, we used cluster analysis to uncover the major trajectories within the sample. Three clusters were uncovered, with subsequent clusters being derivations of these three. Abstainers were defined *a priori* as a fourth trajectory. Table 3 (columns 2–5) presents the growth curve estimates for the three empirical trajectories and Table 4 lists the predicted drinks. The analyses find that age was best modeled with a quadratic term for all three subtrajectories.

To facilitate discussion, the trajectories are labeled as follows:

- *Abstainers (37.9% of sample).* Individuals who reported no alcohol use over all periods of observation were defined as abstainers.
- *Decline* (10.6%). Persons in this trajectory drank the most and had the sharpest decline. At age 60, they were predicted to imbibe about 12.0 drinks per week, or just under two drinks per day. By age 90, this declined to less than 0.06 drinks per week.
- *Stable* (37.8%). This trajectory included individuals who drank very little. There was some fluctuation, but their drinking was the most stable. At age 60, they were predicted to imbibe 0.38 drinks per week, with a drop to 0.15 drinks/week at age 75, but at age 90 they were still predicted to imbibe 0.37 drinks per week.

Table 3
Growth Curve Estimates of Logged Alcohol Consumption for the Total Sample and Individual Trajectories, 1987–1999[a]

	Total ($n = 1{,}593$)	Decline ($n = 272$)	Stable ($n = 969$)	Curvilinear ($n = 352$)
Fixed Effects				
Intercept	0.82835	1.88939	0.16434	1.71165
SE	(0.025171)***	(0.038749)***	(0.009433)***	(0.038953)***
Age	−0.00399	−0.077845	−0.009511	0.08480
SE	(0.002168) +	(0.004121)***	(0.001509)***	(0.003689)***
Age^2	−0.000471	−0.003245	0.00080	−0.005328
SE	(0.000182)**	(0.000494)***	(0.000136)***	(0.000386)***
Random Component				
Intercept	0.74208***	0.18793***	0.02352	0.28879
SE	(0.86144)***	(0.43351)***	(0.15337)***	(0.53739)***
Age	0.00242***	0.00013***	0.00036	0.00006
SE	0.04923	0.01153	−0.01908	0.00742
Age^2	0.0000***	0.0000**	0.0000*	0.00001
SE	0.00206	0.00151	0.00172	(0.00237)**

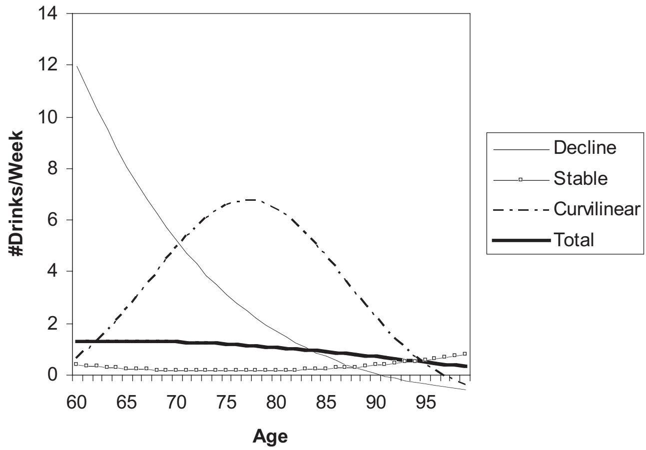
$+p \leq .10$; $*p \leq 0.05$; $**p \leq 0.01$; $***p \leq 0.001$
a. Abstainers omitted from analysis.

Table 4
Predicted Number of Drinks per Week by Age and Trajectory

Age	Trajectory Decline	Stable	Curvilinear	Total
60	11.97	0.38	0.63	1.28
65	8.07	0.24	2.55	1.31
70	5.19	0.17	4.92	1.28
75	3.13	0.15	6.58	1.20
80	1.69	0.17	6.42	1.07
85	0.71	0.24	4.57	0.91
90	0.06	0.37	2.21	0.72

- *Curvilinear* (13.7%). Although the age norm and the stable and declining drinkers all had a polynomial function of age, the last trajectory, called *curvilinear*, had the sharpest departure from linearity (an inverted-U shape). At age 60, they were predicted to imbibe 0.63 drinks per week, rising to 6.58 at age 75, then dropping to 2.21 at age 90.

Figure 1
Trajectories of Alcohol Consumption among Japanese Elderly, 1987–1999



These trajectories are displayed in Figure 1.

Predictors of the Age Norm

Table 5 examines predictors of the age norm (overall trajectory) of alcohol use. Female gender is a significant predictor of initial status ($\beta = -0.14$, $p < 0.001$) and of the growth curve ($\beta = -0.14$, $p < 0.001$; $\beta = -0.004$, $p = 0.05$). Functional limitations is associated with the growth curve ($\beta = 0.002$, $p < 0.001$; $\beta = -0.00009$, $p = 0.001$). None of the other factors were significant predictors.

These models also included trajectory membership as a predictor of the intercept and the age slope, simultaneously controlling for all covariates (Table 5, Model 2). If the identified trajectories of alcohol consumption are valid, then we can expect that they will be associated with the growth curve parameters. There is evidence in support of this. All trajectories were significantly associated with the age norm. For example, the decline trajectory was associated with initial drinking status ($\beta = 1.78$, $p < 0.001$) and with the growth curves ($\beta = -0.07$, $p < 0.001$; $\beta = -0.003$; $p = 0.001$).

Although the trajectories and a few factors are associated with the growth curve, the random effects associated with the intercept and age slopes

Table 5
Predictors of Growth Curve Parameters for the Age Norm of Alcohol Consumption

	Intercept		Linear Age Effect		Quadratic Age Effect	
	Coeff	*SE*	Coeff	*SE*	Coeff	*SE*
Intercept	0.1480	0.0822	−0.0036	0.0098	0.0004	0.0009
Female	−0.1473	0.0179***	0.0093	0.0024***	−0.0004	0.0002
Functional status	−0.0031	0.0033	0.0015	0.0006**	−0.0001	0.0000*
Trajectory – Decline[a]	1.7774	0.0405***	−0.0691	0.0044***	−0.0030	0.0005***
Trajectory – Stable[a]	0.1571	0.0096***	−0.0073	0.0015***	0.0006	0.0001***
Trajectory – Curvilinear[a]	1.6132	0.0393***	0.0895	0.0038***	−0.0051	0.0004***

$*p \leq 0.05$; $**p \leq 0.01$; $***p \leq 0.001$
Note: Predictors include work status, education, loss of a loved one, negative interactions, instrumental social support, emotional social support, CES-D, cognitive impairment, self-rated health, serious conditions, and chronic conditions. Show above are predictors that are significant for at least one of the growth parameters.
a. Comparison category is the Abstinence trajectory.

remained significant. This indicates that additional unmeasured factors may be associated with the age norm.

Baseline Predictors of Trajectory Membership

We used multinomial logistic regression to examine the factors that predict trajectory membership at baseline (Table 6). To account for competing risk of mortality and loss to follow-up, we include into the dependent variable categories of “deceased” (died after the first wave, $n = 578$) and “other loss to follow-up” ($n = 110$). Thus, the multinomial analysis considers stable, decline, curvilinear, deceased, and other loss-to-follow-up, all compared to the reference category of abstainers.

Loss of loved ones was associated with an increased likelihood of being in the curvilinear trajectory compared to abstinence at baseline (RRR = 1.47, $p < 0.05$). Respondents with functional limitations were more likely to abstain be than in the stable trajectory (RRR = 0.91, $p = 0.01$). Respondents reporting better health at baseline were more likely to be in the

Table 6
Predictors of Trajectory Membership at Baseline, Multinomial Logistic Regression

	Decline		Stable		Curvilinear		Other Loss to Follow Up		Dead	
	RRR	*SE*	RRR	*SE*	RRR	*SE*	RRR	*SE*	RRR	*SE*
Gender (1 = female)	0.05	0.01***	0.60	0.08***	0.06	0.01***	0.44	0.11**	0.13	0.02
Work status (1 = working)	1.65	0.31**	1.14	0.15	1.20	0.21	2.34	0.55***	0.59	0.10***
Education (years)	1.01	0.03	1.02	0.02	1.01	0.03	1.04	0.04	0.96	0.02
Financial Strain	1.05	0.04	1.03	0.03	1.00	0.04	1.09	0.05	0.98	0.03
Loss of Loved One	1.05	0.23	1.23	0.17	1.47	0.27*	1.14	0.29	1.42	0.21*
Negative Interaction	0.99	0.03	1.02	0.02	1.03	0.03	0.99	0.04	0.95	0.02*
Emotional Support Received	1.08	0.06	1.02	0.03	0.99	0.05	1.08	0.07	0.98	0.04
Instrumental Support Received	1.04	0.05	1.01	0.03	0.99	0.04	1.01	0.06	1.04	0.03
CES-D	1.06	0.29	0.79	0.12	0.77	0.20	1.06	0.29	1.12	0.18
Cognitive Impairment	0.90	0.10	1.04	0.06	1.03	0.10	1.21	0.12	1.37	0.08***
Self-Rated Health	1.40	0.17**	1.04	0.07	1.19	0.13	0.91	0.12	0.88	0.07
Serious Conditions	0.82	0.13	0.90	0.08	0.78	0.11	0.91	0.16	1.03	0.10
Chronic Conditions	0.88	0.10	1.03	0.06	0.92	0.09	0.94	0.11	0.94	0.06
Functional Status	1.02	0.06	0.91	0.03**	0.89	0.07	1.00	0.05	1.10	0.03***

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$
Note: Abstainers are the reference group for the dependent variable.
RRR = Relative Risk Ratio. *SE* = Standard Error.

decline trajectory than to abstain (RRR = 1.40; $p < 0.001$). Gender was the most consistent predictor of trajectory membership. Women were more likely than men to abstain than in any drinking trajectories. For example, women were much less likely (RRR = 0.048, $p < 0.001$) to be in the decline trajectory than to be abstainers. Individuals who were employed were more likely to be in the decline trajectory than abstaining (RRR = 1.65, $p < 0.01$).

Individuals who died were more likely to be male, unemployed, and more likely to report having lost a loved one, cognitive impairment, and functional limitations. They were also less likely to report a negative interaction. Individuals otherwise lost to follow-up were more likely to be male and employed.

In supplemental analyses, we considered whether the individual measures of financial strain (disaggregated from our composite measure) or income might predict trajectory membership, but none of these items was statistically significant.

Discussion

A major contribution of this descriptive study lies in a quantitative depiction of the age norm of alcohol use after age 60 and the heterogeneity associated with this trend. According to our findings, the majority of Japanese elderly do drink, albeit relatively little. Drinking is relatively stable between ages 60 to 70, but declines thereafter. To our knowledge, this is the first empirical study to examine alcohol consumption trajectories among Japanese elderly and may provide a point of comparison with other populations. These findings add to U.S. studies showing a decline in alcohol use among older ages, as well as continued use of alcohol among older persons (Dufour and Fuller 1995).

Aggregate trends, however, mask heterogeneity. Our analyses find four major trajectories characterized as abstainers, decline, stable, and curvilinear. These trajectories differ significantly with respect to their initial levels at age 60 and their patterns of growth as persons age. The prevalence of abstainers (38%) in this sample of Japanese older adults is slightly higher than estimates of abstinence among Japanese American older adults (28–35%), but are reasonably close (Galanis et al. 2000).

The *decline* trajectory represented those who drank the most at age 60, but also exhibited the sharpest decline over age. These drinkers, compared to abstainers, were more likely to be employed, healthy, and male. The use of alcohol as a "social lubricant" within Japanese work culture is well known

(Ames, Grube, and Moore 2000; Hayashida 1998). It is possible that this trajectory represents those whose drinking behavior is motivated by their work lives. As they exit the workforce, drinking drops rapidly. It is also noteworthy that health appraisals were significantly associated with alcohol consumption, even after controlling for more "objective" measures of serious and chronic health conditions and for functional status. Health appraisals are sometimes more predictive of mortality and morbidity than direct measures of health conditions, possibly because these appraisals represent an individual's holistic view of their health over their lifecourse (Idler and Bernyamini 1997; Idler et al. 1999). If this were the case, it is not surprising that health appraisals may be strongly linked to trajectories of health and health behavior. The association between health and a trajectory of declining alcohol use might indicate that although there is relative health benefit for moderate alcohol use near age 60, these benefits may decrease as individuals age. However, it should be repeated that our analyses only focus on how health appraisal predicts trajectory membership at baseline and, further, that health was associated with only one of three alcohol trajectories. Future studies should examine how and to what extent alcohol trajectories may shape health trajectories.

The *stable* trajectory drank very little. Although there were some fluctuations, these individuals drank the same at age 60 and at age 90. Compared to abstainers, persons in this trajectory were more likely to be male and less likely to have functional limitations at baseline. A recent prospective study of Japanese elderly also noted that, compared to abstainers, current drinkers had lower decline of instrumental activities of daily living (Suzuki and Miyagi 2000). These findings from Japan support observations made in other countries that light/moderate levels of drinking, compared to abstinence, may be protective against functional status decline (Stuck et al. 1999).

Finally, the *curvilinear* trajectory began with relatively low levels of drinking, peaked near age 75, then declined. This trajectory might be partially explained by the tension reduction hypothesis, which posits that individuals drink in order to reduce stress. Financial strain did not predict this trajectory, suggesting that the tension reduction hypothesis may not apply with all stressors. However, loss of a loved one was a significant predictor of this trajectory. The initial rise in drinking might occur because individuals drink to cope with the loss of a network member. With time, this drinking may decline as individuals adapt to their new situations. Similarly, Perreira and Sloan (2001) found a spike in drinking over a two-year period after widowhood, followed by a marked decrease.

Our findings share some other similarities with the Health and Retirement Study reported by Perreira and Sloan (2001). They reported that participants were also heterogeneous in their drinking patterns. Over the period of six years, most respondents (68%) did not change alcohol consumption between their first and fourth wave of observation. Further, they found that 23% of their sample decreased consumption and that 9% increased consumption. Thus, our results are similar in observing that adult drinkers are composed of heterogeneous groups. However, the specific patterns and the relative prevalence of each group were dissimilar.

There are several potential reasons for these divergences. Most obvious are the potential cultural differences in drinking between Japan and the United States, but the methodological differences are likely important, too. Most strikingly, Perreira and Sloan (2001) examined changes by time (observation waves), whereas we examined changes by age. Also, we used a Japanese standard drink, which differs in the concentration of ethanol compared to a U.S. standard drink. Further, our analysis used more information by considering all waves of observation simultaneously, rather than changes between pairs of observations (i.e., between waves 1 to waves 4). Finally, our analysis examines 12 years of data, whereas theirs spans six.

Consistent with other work, women were more likely to abstain and were less likely to represent the trajectories of higher consumption (Glass et al. 1995; Moore et al. 1999). Gender differences in consumption might represent cultural norms in drinking learned at much earlier ages (Sobue et al. 2001).

As with all research, caveats apply. First, although our analyses were longitudinal, we focused on persons aged 60 and older. Thus, we are unable to comment on the trajectories of alcohol use across the entire lifespan. It is quite likely that alcohol use in older age represents a continuation of behavior that begins at a much earlier age. However, our work provides information on older adulthood that is unavailable from extant studies of younger adults. Second, the HLM analyses omit abstainers and assumes that the drinking patterns of these individuals are known. Because abstainers are defined as individuals who did not drink for any period from which we have data, this appears to be a reasonable assumption. However, if individuals self-select into abstinence due to unobserved characteristics, then the censoring of our sample may potentially bias the results. Third, we cannot distinguish between age and cohort effects with this longitudinal data. The trajectories of other cohorts may differ from those reported here. Fourth, alcohol use measures were based on self-report and are potentially subject to response biases, such as recall and social desirability (Rehm 1998). Recall biases are tempered by controls for cognitive functioning, but remains a limitation of this approach (Sobell et al. 1988). Fifth, our multinomial analyses of baseline predictors of these trajectory groups assumes that the values of the predictors are fixed throughout the observation period. This approach is useful for preliminary inquiry. However, future research should examine how time-varying covariates may be associated with the use of alcohol in older age.

Several unresolved questions await future research. First, it may be that trajectories are tied to specific beverages. For example, declining drinkers might be most apt to imbibe sake. Beverage type may be especially important in studies attempting to link alcohol consumption to health outcomes. Increasing evidence suggests that certain kinds of alcohol (e.g., red wine) may ameliorate heart disease (Di Castelnuovo et al. 2002). Second, future work should consider how trajectories in older age may represent developmental patterns formed earlier in life. Vaillant (2003) has illustrated how alcohol abusers wax and wane in their use of alcohol over the life course. It would be of interest to see how early life initiation of alcohol use maps onto adult alcohol use. Third, future research should examine how trajectories interweave together. This extends the concept that not only do time-varying covariates influence behavioral patterns, but also that trajectories themselves are mutually dependent. For example, trajectories of cognitive decline may determine and be determined by alcohol trajectories.

In closing, Japanese elderly appear to drink well into old age, with general stability in their patterns of consumption. Overall, drinking decreases among this population but there are important subgroup differences. These differences, in part, appear to be influenced by life events, health conditions, gender, and employment. Future studies should continue to examine the heterogeneity within adult drinkers and also to examine the factors that may distinguish these trajectories. By better understanding these trajectories, public health resources may be better used to target specific at-risk populations.

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Gilbert C. Gee is an Assistant Professor in the Department of Health Behavior and Health Education in the School of Public Health at the University of Michigan. His research examines how stressors at multiple levels may influence health and health disparities among diverse populations.

Jersey Liang is a Professor in the Department of Health Management and Policy in the School of Public Health at the University of Michigan and a Research Professor in the Institute of Gerontology. His current research centers around: (a) quality of life at the individual and population levels, (b) dynamic models of health and health care in old age, and (c) comparative analysis of geriatric care management and policy.

Joan Bennett is a Research Area Specialist Lead in the Department of Health Management and Policy in the School of Public Health at the University of Michigan. She is part of a research team investigating comparative health and aging in the United States, Japan, Taiwan, and mainland China.

Neal Krause is a Professor in the Department of Health Behavior and Health Education in the School of Public Health at the University of Michigan and a Research Professor in the Institute of Gerontology. His work focuses on factors the influence the health of older people, including stress, social support, and religion. This work has been funded by the National Institute on Aging.

Erika Kobayashi is a Senior Research Scientist in the Research Team for Social Participation and Health Promotion at Tokyo Metropolitan Institute of Gerontology. Her work focuses on social networks among the Japanese elderly, including how health decline may affect family and nonfamily relations.

Taro Fukaya is a Research Associate in the Research Team for Social Participation and Health Promotion in the Tokyo Metropolitan Institute of Gerontology. His research examines how information about personal social services may influence health and social participation among elderly.

Yoko Sugihara is a Senior Research Scientist in the Human Care Research Team at the Tokyo Metropolitan Institute of Gerontology, where she is involved in several longitudinal studies of health and aging in Japan. Her research examines longitudinal changes in caregiver health and social support.