Social networks and alcohol consumption among first generation Chinese and Korean immigrants in the Los Angeles metropolitan area

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Abstract

Aims: To test hypotheses involving mechanisms of reinforcement of alcohol behaviors operating in social networks.

Design: Telephone interviews conducted by professional interviewers in Mandarin or Korean or English with first generation Chinese (from Mainland or Taiwan) and Korean immigrants residing using a dual frame stratified sampling design. Combined probability and non-probability approaches for sampling due to the widespread use of cell phones. Interviews were conducted in language of preferences with over 95% of interviews in Korean or Mandarin.

Setting: Residents of three counties with the largest proportions of eligible residents (Los Angeles, Orange, and San Bernardino) were included.

Participants: Adult residents (21 and over) stratified by gender who could be reached by telephone constituted the sample.

Measures: Measures included frequency/amount alcohol consumption drawn from NIAAA standard, a "relax, socialize, have fun with" name generator was used to identify alters. Reinforcers within networks were measured by participant reports of amount of alter drinking, drunkenness, and encouragement to drink, acculturation, and demographic variables were measured by self report.

Findings: Using a random effects approach and controlling for other variables, including drinking in the network, acculturation, Korean/Chinese origin, and demographics, source of immigration, network context, as was and sampling frame, encouragement to drink in the network was related to drinking (*P*<.05).

Conclusions: Studies of social networks in relation to health behaviors should include measures of actions within networks, especially reinforcers of behaviors, in order to understand the functioning and consequences of networks.

Excessive alcohol consumption has been positively associated with a host of serious health issues, including cancers, cardiovascular disease, damage to specific organs, physical injuries (Cargiulo, 2007), and premature death (Corrao, Bagnardi, Zambon, & La Vecchia, 2004; Parry, Patra, & Rehm, 2011). In the U.S., excessive alcohol use is estimated to be responsible for 79,000 deaths annually, and

alcohol-related problems cost Americans billions of dollars annually through healthcare costs, lost productivity, and crime—an estimated $746 per capita in 2006 (Bouchery et. al., 2011).

Understanding the epidemiology of alcohol use is important for both prevention and public policy planning. .

The dynamic nature of immigrant populations presents a unique challenge for alcohol researchers interested in understanding the epidemiology and etiology of heavy alcohol use. Earlier studies have reported drinking to be common among Chinese and Koreans in the United States, especially among men (Caetano, Clark, & Tam, 1998; Lum, Corliss, Mays, Cochran, & Lui, 2009; Makimoto, 1998). Our study is based on the assumption that first-generation immigrants would be partially reliant on social networks to assist with the challenges they face in their new environment (Deri, 2005; Ryan, Sales, Tilki, & Siara, 2008).

According to the 2000 U.S. Census, immigrants are the fastest-growing segment of the U.S. population, and are expected to comprise 12% of the total population (33 million) by 2030. Chinese and Korean Americans represent the largest and fourth largest Asian-American populations in the U.S., and increased by 43% between 2000 and 2010 (Hoeffel. Rastogi, Kim, & Shahid, 2012). More recently, the 2007 American Community Survey estimated a population of over 4.0 million Chinese and Chinese with other groups (constituting 24% of Asians in the U.S.) and 1.7 million Koreans and Koreans with other groups (Hoeffel et al., 2012). About 63% were foreign born and 42% had limited English proficiency (Kelly, 2010; Kwong & Wen-Chu Chen, 2010). Several reports suggest that certain Asian groups tend to drink less than Caucasians in the U.S., but that drinking increases with acculturation; however, variance is clear among Asian groups in drinking behavior. For example, Chi and coauthors reported that 14.2% of Chinese men and 25.8% of Korean men were "heavy" drinkers, and that drinking was less common among Chinese and Korean females than males (1989, p. 18).

One problem with the extant literature on Asian drinking behavior is its tendency to lump "Asians" into a single group, ignoring the diversity of Asian cultures, a practice which can lead to erroneous conclusions (Unger, 2012). Another has been to conduct interviews in English, despite the fact that many subjects are recent immigrants from non-English speaking societies, and English language skills are highly associated with acculturation.

Immigration is a stress-inducing experience, with some immigrants turning to alcohol in order to cope (Gil, Wagner, & Vega, 2000; Sinha et al., 2008). Once in the U.S., immigrants tend to live in ethnic enclaves, where social networks may be dense. A social network is typically defined as a set of individuals who are linked by one or more relationships (Hanneman & Riddle, 2005; Wassermand & Faust, 1994). Evidence suggests social network characteristics are associated with adoption, continuation, and cessation of health behaviors (Smith & Christakis, 2008), including health risks, such as alcohol consumption (Rosenquist, Murabito, Fowler, & Christakis, 2010). However, the mechanisms by which such association might be causal are rarely measured or discussed—an issue that this study addresses.

Research suggests that social network strategies for health promotion may be more efficient than individual-level strategies (Valente, 2010; Valente, Gallaher, & Mouttapa, 2004); studies often emphasize the structures of networks, as well as the health behaviors associated with these structures (Calafatt et al., 2010; Smith & Christakis, 2008). A limitation of previous research is that it has not tested the specific mechanisms involved in reinforcing the health risk behaviors that are associated with interaction in network structures (Christakis & Fowler, 2010).

This study focused on how social networks may exacerbate or ameliorate alcohol consumption among persons subject to the stresses of immigration. Social networks involve regular interaction among individuals, and are defined in terms of the purposes of the interaction—for example, relaxation and fun, gaining advice about specific issues, obtaining information from trusted sources, social support, and so on. Persons bring social norms to their networks and are influenced by social norms learned from others in these networks (Valente, 2010). This study hypothesizes that social interactions, especially modeling and social reinforcement of specific health behaviors, are powerful influences of alcohol risks within social network structures. Socially reinforcing contingencies are technically defined as consequences that subsequently lead to an increase in the same class of behavior. Based on this greater specification of possible mechanisms of social support, the following hypotheses were examined:

1) Amount of alcohol consumption is a function of drinking behaviors of others in one's social networks.

2) Amount of alcohol consumption is a function of encouragement as a reinforcer in one's social networks.

Materials and Methods

The sample

A dual sampling frame was used to sample first-generation Korean and Mandarin-speaking Chinese in Los Angeles, Orange, and San Bernardino counties, the three counties with the largest numbers of first-generation Chinese and Korean persons in California. Two major problems were encountered in sampling first-generation Chinese and Korean groups in the greater Los Angeles area. First, each group is dispersed so that they constitute relatively small proportions of the populations within telephone exchanges, meaning that random digit dialing (RDD) is not cost effective in sampling. Second, many persons, especially younger immigrants, are increasingly dependent on cell phones (Blumberg et al., 2011, pp. 11, 13, 17; Blyth, 2008; Couper, 2005; Lynn & Kaminska, 2010), for which there are no publicly accessible directories available for purposes of sampling.

The first sampling frame was based on random surname samples of listed numbers for Chinese and Korean groups that were purchased for the three counties. The lists of approximately 300 Korean and 300 Chinese surnames encompassed 95% of all Korean and over 85% of all Chinese surnames (Lauderdale & Kestenbaum, 2000;

Myung, McDonnell, Kazinets, Seo, & Moskowitz, 2010; Quan et al., 2006; Wong, Palaniappan, & Lauderdale, 2010). Probability samples of *N* = 774 Chinese and *N* = 861 Koreans were successfully interviewed using the two probability frames.

It was clear, once interviewing had commenced, that the above samples were skewed toward older persons whose lifestyles, including levels of alcohol consumption, were not representative of younger Chinese and Koreans. In other populations, cell phone use and alcohol consumption, especially alcohol abuse, are concentrated among youthful populations, and our data also revealed these tendencies. Another problem is that Chinese and Korean immigrants initially settle in areas of ethnic concentration but then rapidly move to other areas, often in a pattern of upward mobility, and large numbers of other groups are present in these areas (Zhou, 2009).

These considerations led to supplemental non-probability recruitment that included contacts with language schools prominent in Asian communities; radio solicitations; endorsements by ethnic organizations; attendance at ethnic fairs and celebrations, recreation facilities, and educational institutions; solicitations outside Asian grocery stores in Asian shopping centers and Asian shops frequented by Chinese and Koreans; and referrals from would-be survey participants who fell outside the age stratum. Interviews were completed with 410 Chinese and 672 Korean immigrants in the non-probability frame. While non-probability procedures do not permit estimating population parameters accurately, the data do permit testing hypotheses and controlling statistically for the nature of sampling.

The survey
Questionnaires designed to measure alcohol consumption and related variables, which had been used successfully in prior studies, were adapted for telephone interviewing. A multistage translation procedure was employed, whereby questions were developed in English, then translated into Mandarin and Korean by bilingual native speakers. An iterative process of focus groups, back translation, and instrument modification was used until accurate meanings of concepts were agreed upon. English, Mandarin, and Korean translations are available on request from the senior author.

Interviewing was conducted by two teams of professional bilingual interviewers, one fluent in Mandarin and English and the other in Korean and English. Both were trained for the questionnaire using role playing and continuing feedback, and were closely supervised by bilingual team leaders. Cooperation rates (percent of eligible participants contacted who completed interviews) were about 55.0% among Chinese and 65.0% among Koreans. A project 800 number was installed to answer questions and permit potential respondents to contact project interviewers. All but six interviews were conducted in Korean or Mandarin, as determined by participants' preferences.

All study procedures were approved by the San Diego State University Institutional Review Board.

Measures
NIAAA Standard. A wide variety of measures of quantity-frequency of alcohol consumption have been used in published studies. This study used two questions taken from the NIAAA gold standard (National Council on Alcohol Abuse and Alcoholism, October 15–16, 2003) and based on prior research (Rosenquist et al., 2010): "In the last 12 months, how many alcoholic beverages did you drink per week?" and "During the last 12 months, how many alcoholic drinks did you have on a typical day when you drank alcohol?" An ordinal composite scale was coded from the responses: (1) Abstainers (39.1%) were those who reported not drinking within the prior year. (2) Light drinkers (29.5%) were those who reported drinking one or two times during the past year and drinking one or two drinks when they drank; or drinking three to 12 times during the last year and drinking one drink when they drank; or drinking monthly to twice a week or less and drinking two drinks when drinking; or drinking twice a week and drinking one or two drinks when drinking. (3) Moderate drinkers (22.2%) were those who reported drinking three to 12 times in the last year and one to four drinks when drinking; or drinking three to 12 times in the last year and twice a month to twice a week and one to four drinks when drinking; or drinking twice a week to every day and one to four drinks when drinking. (4) Heavy drinkers (9.2%) were those who reported drinking three to 12 times in the last year and five or more drinks when drinking; or drinking twice a month to twice a week and five or more drinks when drinking; or drinking from five or six times a week to every day and five or more drinks when drinking. Chinese and Korean translations are available from the senior author on request.

Network Behaviors. Network linkages (number of alters and frequency of meetings) were measured by responses to two questions: (1) "People sometimes get together with others just to relax, have fun, or socialize. Now, think about all the people you have socialized with, or gotten together with to have fun or relax, during the most recent month [network "alters"]. Just tell me their first name and last initial," and (2) "About how many times have you gotten together with [each alter] during the last six months?" Survey participants (egos) were then asked about the behaviors listed for each alter at each interaction. The total number of alters in a participant's social network was coded zero to four, for up to four mentions. The procedure assumes that the first four mentioned were the most frequent alters, although there may have been additional mentions that were beyond the scope of the project to collect. The final measure was computed by summing the number of meetings each alter reported, where frequency of meetings was capped at 240 for each alter (10 meetings a month for up to four alters), which encompassed over 95% of participants. The result was then squared to constrain left skewness.

The content of network behaviors regarding alcohol was coded by participants' responses to questions concept-

ualized as measures of rates of exposure to network variables facilitating alcohol consumption.

a. Percentage of meetings when ego and alter drank together: "On occasions when you got together, did you and [alter] drink alcohol all the time, most of the time, some of the time, or never?" Responses were coded (0 to 4). The measure was computed by multiplying the frequency measure by the number of times reported as drinking (1 = never; 2 = some times; 3 = most times; 4 = all times), and then summing for alters to form a score for each participant. The percentage of total network meetings that involved drinking was then found by dividing times drinking by total number of network meetings, and multiplying the result by 100. This result was transformed by computing the natural logarithm of the percentage plus 1 to constrain skewness. The higher the percentage, the greater the "dose" of drinking in the network.

b. Percentage of meetings when alter was drunk: "On occasions when you got together, did [alter] become drunk nearly all the time, most of the time, sometimes, or never?" Responses were coded 1 if alter and ego did not drink together, otherwise 2 to 4 for some times, most times, or all times. The measure was computed by multiplying the frequency with which each alter was reported to be drunk by the frequency of meetings. Results were then summed for the number of alters. The percentage of total meetings in which the alters were drunk was found by dividing the number of times drunkenness occurred by the total number of meetings and multiplying the result by 100, then computing the natural logarithm of the result plus 1 to constrain skewness.

c. Encouragement to drink: "When you were together, did [alter] encourage you to drink, discourage you from drinking, both, or neither?" If the participant chose one of the first two responses (alter had encouraged or discouraged drinking), a follow-up question was asked: "Did [alter] do this nearly always, often, sometimes, or just a few times?" These responses were coded 3, 2, 1, or 0. The measure was computed by multiplying the frequency of encouragement to drink by the frequency with which the participant drank, and then summed to measure total encouragement for each alter. The procedure was repeated and summed across alters to measure total discouragement. The summed discouragement score was subtracted from the summed encouragement score across alters, producing a scale running from negative to positive numbers (positive meaning drinking was encouraged, and negative meaning it was discouraged). The sums were then divided by the total meetings, and the result multiplied by 100 and then transformed by computing the natural logarithm of the result plus 1 to constrain skewness.

Acculturation. The Suinn-Lew scale was developed to measure acculturation among Asians in the U.S. and has been used in numerous studies (Suinn, Khoo, & Ahuna, 1995; Suinn, Rickard-Figueroa, Lew, & Vigil, 1987). Items were first recoded in an ordinal direction, so that acculturated responses were the numerically largest code. Then, items were standardized (mean = 0, $SD = 1$) so that all had the same variance, and summed to form a composite ($\alpha = .76$, mean = -0.00, $SD = .59$). The validity of the composite set of items is supported by its use in a series of earlier studies (e.g., Hofstetter et al., 2004, 2010). The higher the number, the more acculturated the respondents. The wording of items can be found in the methodological appendix.

Demographics. Participants' identification as Chinese or Korean, age, gender, household income and education were measured by self report. Subsample (probability or non-probability) was coded for each participant. Education was calculated as the total years of education in the U.S. plus the non-overlapping years in China or Korea.

Analysis

All analyses were conducted using STATA (13.1). Distributions of continuous variables were transformed to constrain skewness. Item wording, distributions, and transformations are reported in Tables 1 and 2. Hypotheses were tested by regressing the drinking scale based on two questions from the NIAAA standard six items (National Council on Alcohol Abuse and Alcoholism, 2003) measuring frequency and number of drinks consumed. Controls for the number of network linkages, age, gender, education, acculturation, ethnicity (Chinese or Korean), and subsample (probability or non-probability) were included using ordinal logistic regression in the analysis. Analyses were replicated using the missing data imputation, using the STATA MI procedure with a normal distribution of error assumption (MVN) and 100 imputations based on the covariance structure of the data and random assignment of error (StataCorp, 2013).

Results

Demographics

All study participants were born in Korea, mainland China, or Taiwan. Of the Chinese participants, 56.6% were born in mainland China, and 43.1% were born in Taiwan. About 95.7% of Chinese and 96.4% of Korean participants were interviewed in Mandarin and in Korean, respectively, by personal preference, while four Chinese and five Koreans were interviewed partially in Mandarin or Korean and partially in English, according to their preferences. About 4.3% of Chinese and 3.6% of Koreans preferred to be interviewed in English. Only 10.2% of Chinese and 22.0% of Koreans reported having been born in rural places in mainland China, Taiwan, or Korea.

According to data in Table 1, there were no statistically significant differences ($P > .05$) between Chinese and Korean immigrants in gender (50.1% vs. 53.2%), age (43.6 years vs. 42.9 years), age at time of immigration (28.0 years vs. 29.0 years), being married or cohabiting (66.6%

Table 1

Sample characteristics by total sample, national origin, and sample frame

Demographics	Chinese		Korean		Differences	
	Mean/%	SD	Mean/%	SD	t	P<
Male	50.1%		53.2%		-1.19	0.233
Age	43.6	14.2	42.9	14.8	1.23	0.217
Education	15.3	3.2	15.5	2.8	-2.06	0.040
Age at immigration	28.0	12.7	29.0	52.8	-0.668	0.504
Married	66.6%		64.8%		0.971	0.332
U.S. citizen	65.4%		43.9%		11.39	0.001
Probability sample	65.3%		56.2%		4.84	0.001
Acculturation	-0.03	1.00	0.02	1.00	-1.37	0.172
Network Measures:						
Network links	174.3	204.6	275.6	239.7	-11.6	0.000
Percent links both drinking	12.2	19.6	19.7	30.8	-6.6	0.000
Percent links alter drunk	2.6	6.4	7.7	14.5	-10.0	0.000
Percent links encourage drinking	0.06	0.40	0.58	1.34	-12.9	0.000
	Non-Probability		**Probability**		**Differences**	
	Mean/%	SD	Mean/%	SD	t	P<
Male	60.6%	48.9	46.7	50.0	7.19	0.001
Age	36.8	10.8	47.4	15.1	-20.06	0.001
Education	15.8	2.3	15.2	3.3	5.28	0.001
Age at immigration	24.9	9.7	30.9	51.6	-3.76	0.001
Married	53.0%		73.9%		-11.51	0.001
U.S. citizen	39.0%		62.7%		-12.40	0.001
Acculturation	0.2	0.9	-1.0	1.1	6.56	0.001
Network Measures:						
Network links	271.3	246.0	199.0	213.6	9.24	0.001
Percent links both drinking	17.6	26.9	16.1	27.4	1.32	0.907
Percent links alter drunk	7.0	13.0	4.5	11.4	4.98	0.001
Percent links encourage drinking	0.6	1.3	0.2	0.9	7.87	0.001

vs. 64.8%), and acculturation (-.03 vs. .02). Statistically significant differences existed between the probability and non-probability samples for all demographic variables (*P* < .05): more males were included in the non-probability sample (60.6% vs. 46.7%), fewer were married (53.0% vs. 73.9%), and fewer were U.S. citizens (39.0% vs. 62.7%). Participants in the non-probability sample were also younger (36.8 years vs. 47.4 years), better educated (15.8 years vs. 15.3 years), younger at time of immigration (24.9 years vs. 30.9 years), and less acculturated (0.2 vs. 1.1).

Network Linkages

Chinese immigrants reported fewer network linkages than Koreans (174.3 vs. 275.6), and lower rates of network linkages in which both persons drank alcohol (12.2% vs. 19.7%), the alter became drunk (2.6% vs. 7.7%), and/or the alter encouraged drinking (.06% vs. .58%). In comparison to persons in the probability sample, persons in the non-

probability sample reported more network linkages (271.3 vs. 199.0), and a larger rate of linkages in which alters were drunk (7.0 vs. 4.5) and alters encouraged the survey participant to drink (0.6 vs. 0.2). There was no statistically significant (*P* > .05) association between sampling frames in the rate of occasions in which both persons drank alcohol (17.6 vs. 16.1).

Origin of Immigration

Results in Table 1 suggest that it is important to assess alcohol consumption by origin of immigration (Chinese vs. Korean) and sample frame (non-probability vs. probability). It is also useful to determine any significant alcohol consumption differences among Chinese from Mainland China and those from Taiwan, given the differences in living conditions between the two groups. Table 2 presents differences in alcohol consumption by nation of origin, and differences by sampling frame within

nationalities, which were statistically significant ($P < .001$ by Fisher's exact tests).

In general, Korean immigrants were less likely to be abstainers and more likely to be moderate or heavy drinkers than Chinese in each group ($P < .001$). Among Chinese, 52.7% were abstainers and 1.9% were heavy drinkers, compared to 28.4% of Koreans who were abstainers and 9.2% who were heavy drinkers. Similar differentials between Chinese and Koreans were reported in the non-probability analysis (38.4% vs. 15.2% abstainers, and 3.1% vs. 22.8% heavy drinkers, respectively, $P < .001$) and the probability analysis (59.8% vs. 38.2% abstainers and 1.3% vs. 9.2% heavy drinkers, respectively, $P < .001$). However, the non-probability sample reported fewer abstainers and more heavy drinkers than the probability sample ($P < .001$). Among Chinese, slightly fewer of those from Taiwan than those from the Mainland reported abstention (50.0% vs. 54.7%) or heavy drinking (2.4% vs. 1.5%), although the differences were not statistically significant ($P > .05$).

Bivariate and Multivariate Analyses of Drinking

Multivariate ordinal analysis procedures and bivariate analyses were used to evaluate hypotheses and are presented in Table 3, below. Data in Table 2 suggest the need to pay particular attention to the origin (Chinese vs. Korean) of immigrants as well as the sampling frame (probability vs. non-probability). For this reason, sample (probability vs. non-probability) was controlled by including the sample frame as a covariate in analyses, and analyses were also replicated by subsetting for sampling frame.

Bivariate analysis in Table 3 provides support for each of the hypotheses ($P < .05$). The odds of drinking increase with the number of network linkages, the rate of both ego (survey participant) and alter (person reported about) drinking, the rate that alter is intoxicated in linkages, and the rate that alter encouraged ego to drink in network linkages. Data in Table 1 suggested that alter and ego drinking together, alter intoxication, and encouragement of ego drinking occur infrequently, but also that these behaviors are associated with increased drinking by survey participants. These data also suggest that male gender, education, acculturation and being Korean is associated with increased drinking, while older age and being in the probability sample is associated with decreasing drinking.

The multivariate analysis generally supports the bivariate analyses, although the effects of collinearity are clear. Most importantly, two of the network variables—alter and ego both drinking, and ego being encouraged by alter to drink—were associated with drinking in the predicted direction, after network size, rate of alter drunkenness, and other covariates were controlled, supporting hypotheses 1 and 2. Being male, in the probability sample, and Korean were associated with increased drinking, while being older and in the probability sample were associated with diminished drinking. Education and acculturation were no longer related to drinking in a statistically significant way ($P > .05$). The rate of alter drunkenness was associated with diminished drinking in the multivariate analyses, possibly due to collinearity with the other network drinking behaviors.

Table 3 also presents logistic regressions by nationality. With several exceptions, the two sets of analysis replicate the preceding results. Size of network, drinking together in networks, and encouragement to drink (among Koreans, but not statistically significantly among Chinese, $P <. 05$) are associated with drinking, as is male gender. Alter drunkenness, being older, and probability sample frame were all associated with diminished drinking, controlling for other covariates among both Koreans and Chinese. Slight differences appeared between Chinese and Koreans. Education was associated positively with drinking among Chinese and negatively among Koreans (non-significant, $P > .05$), although the odds ratios were small. Acculturation was not statistically significantly associated with drinking among Chinese ($P > .05$) but was associated negatively with drinking among Koreans ($P < .05$).

Table 2

Distribution of alcohol use by nationality, sampling frame, and mainland vs. Taiwanese-Chinese origin[a]

| | Type of Sample | | | | | | | |
| Alcohol Consumption | Nationality Samples | | Non-Probability Samples Nationality | | Probability Samples Nationality | | Chinese Origin Samples | |
	Chinese	Korean	Chinese	Korean	Chinese	Korean	Taiwan	Mainland
Abstain	52.7%	28.4%	38.4%	15.2%	59.8%	38.2%	50.0%	54.7%
Light use	31.6	29.5	36.5	25.3	29.1	29.7	31.0	32.0
Moderate use	13.9	22.2	22.0	36.7	9.8	22.9	16.7	11.8
Heavy use	1.9	9.2	3.1	22.8	1.3	9.2	2.4	1.5
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(*N*)	(1071)	(1362)	(359)	(580)	(712)	(781)	(462)	(609)
	Fisher's Exact $P<.001$		Fisher's Exact $P<.001$		Fisher's Exact $P<.001$		Fisher's Exact $P<.079$	

[a] Numbers are percentages of alcohol consumption by nationality, sample frame, and origin of Chinese immigrants. Missing data were deleted.

Table 3

Ordinal regression of alcohol consumption on network and selected variables among First-Generation Korean- and Mandarin-speaking Chinese immigrants in Greater Los Angeles by combined nationalities, nationalities, sampling frame, and bivariate associations[a]

Predictor	OR	Total Sample Multivariable Analysis 95% CI Lower	Upper	OR	Total Sample Bivariate Analysis 95% CI Lower	Upper
Number network links	1.025	1.012	1.039	1.053	1.044	1.063
Percent of both drink when together	3.168	2.410	4.165	2.174	2.045	2.316
Percent times alter drunk	0.476	0.347	0.654	2.254	2.092	2.428
Percent times encourage ego to drink	1.222	1.146	1.303	1.588	1.498	1.683
Gender (male)	2.179	1.815	2.615	3.437	2.951	4.003
Years education	1.000	0.999	1.002	1.003	1.002	1.004
Age	0.335	0.247	0.454	0.146	0.116	0.185
Acculturation	0.946	0.859	1.043	1.446	1.343	1.558
Sample (probability)	0.697	0.582	0.836	0.331	0.284	0.386
Nationality (Korean)	1.894	1.570	2.284	3.372	2.893	2.933
Cut Points:	-2.467	-3.657	-1.277			
	-0.591	-1.774	0.590			
	1.638	0.447	2.830			
	Pseudo R^2=.20, Wald Chi Square =828.82, P<.001					

Predictor	OR	Chinese 95% CI Lower	Upper	OR	Korean 95% CI Lower	Upper
Number network links	1.022	1.000	1.045	1.026	1.008	1.044
Percent of both drink when together	6.273	2.902	13.561	2.786	2.100	3.697
Percent times alter drunk	0.223	0.093	0.534	0.551	0.396	0.767
Percent times encourage ego to drink	1.140	0.909	1.429	1.221	1.143	1.303
Gender (male)	2.674	2.011	3.555	1.885	1.487	2.390
Years education	1.002	1.000	1.003	0.999	0.998	1.001
Age	0.340	0.212	0.544	0.319	0.210	0.484
Acculturation	1.049	0.886	1.243	0.876	0.775	0.990
Sample (probability)	0.644	0.475	0.872	0.697	0.553	0.878
Cut Points:	-2.828	-4.623	-1.032	-4.149	-5.841	-2.458
	-0.619	-2.413	1.174	-2.459	-4.136	-0.782
	2.145	0.235	4.055	-0.339	-2.007	1.329
	Pseudo R^2=.16, Wald Chi Square =220.21, P<.001			Pseudo R^2=.15, Wald Chi Square =479.24, P<.001		

Predictor	OR	Probability Sampling Frame 95% CI Lower	Upper	OR	Non-Probability Sampling Frame 95% CI Lower	Upper
Number network links	1.016	0.998	1.034	1.035	1.015	1.056
Percent of both drink when together	3.514	2.305	5.358	3.015	2.095	4.340
Percent times alter drunk	0.441	0.270	0.717	0.488	0.319	0.746
Percent times encourage ego to drink	1.204	1.088	1.332	1.225	1.126	1.332
Gender (male)	2.017	1.569	2.591	2.435	1.857	3.195
Years education	1.000	0.999	1.002	1.001	0.999	1.003
Age	0.303	0.201	0.458	0.379	0.241	0.598
Acculturation	0.881	0.776	1.001	1.050	0.897	1.229
Nationality (Korean)	1.829	1.422	2.352	1.889	1.415	2.523
Cut Points:	-2.716	-4.369	-1.063	-1.683	-3.439	0.072
	-0.836	-2.475	0.802	0.213	-1.544	1.970
	1.316	-0.339	2.972	2.509	0.739	4.279
	Pseudo R^2=.16, Wald Chi Square = 400.87, P<.001			Pseudo R^2=.18, Wald Chi Square = 364.35, P<.001		

[a] Numbers in cells are OLS regression coefficients and associated 95% confidence intervals from regressing social network and other predictors on the multivariate ordinal drinking measure for the total sample, the Chinese and Korean immigrant groups, sampling frames, and bivariate associations between predictors and drinking. The drinking measure is a scale drawn from two items in the NIAAA six-item standard (National Institute of Alcohol Abuse and Alcoholism, October 15–16, 2003). Percent of network links in which both drink, percent links in which the alter was drunk, percent links in which alter encouraged drinking, and age were transformed using the natural log to constrain right skewness. Number of network links and years of formal education were transformed by squaring the raw scores to constrain left skews.

Evidence that findings are not simply a function of artifacts generated by different groups and different sampling frames is presented in the bottom section of Table 3. Ordinal regressions showed that network rates were related to drinking, as in the proceeding sections of Table 3, regardless of sample frame. The partial associations between education and acculturation and drinking were not statistically significant ($P > .05$) in either sampling frame. Male Koreans drank more in both sample frames than female Koreans ($P < .05$).

Adjusted odds ratios are not identical from one subset of data to another, but the signs of the odds ratios are identical in every set of regressions involving networking variables, although differences between the bivariate and multivariate analyses suggest that multicollinearity is at work, an assumption supported by bivariate correlations among the network variables. These results support the conclusion that the mechanisms involved in the network reinforcement of drinking and other predictors are not simply due to artifacts of origin of immigration or either of the dual sampling frames. The consistency of associations between network variables and drinking in the several subsamples in Table 3 increase confirmation of the hypotheses.

Finally, missing data were imputed using the MI procedure in STATA 13 using 100 imputations in each analysis. Results are not reported here, but replication of analyses suggests that results are not due to patterns of missing data.

Discussion

This study demonstrated the importance of considering social networks when seeking to understand alcohol consumption among two rapidly growing first-generation immigrant populations. Bivariate and multivariate partial associations demonstrate that positive reinforcement, sharing drinks, and encouragement to drink were consistently associated with alcohol consumption, after covariates were controlled, in large population-based surveys of immigrants from China and Korea. Findings were replicated when data were subset by nationality groups and sample frames. Encouragement to drink by others, assumed to be a key mechanism, was statistically significantly associated with drinking in a bivariate analysis and multivariate analyses, with one exception (the multivariate analysis of the Chinese subsample, where the non-significant finding involved an odds ratio in the hypothesized direction). Similarly, drunkenness of alters was strongly associated with drinking in bivariate analyses, but reversed direction in the multivariate analyses, a reversal likely due to collinearity with other network measures.

Beyond network variables, nationality, gender, and age were strongly and consistently related to alcohol behavior. First-generation immigrants undergo rapid changes in their social environments and in their social networks. Using two indicators from NIAAA-endorsed measures which focus on the frequency and amount of alcohol consumption, the study controlled for cultural differences, and the results suggest how environmental variables may influence individual alcohol behavior.

Comparisons with odds ratios indicated general agreement in direction of associations between drinking and network and other predictors, regardless of group, with only one minor deviation of sign (between acculturation and drinking among the probability sample, and education and drinking among the Korean subsample, but neither deviation was statistically significant). Although odds ratios varied somewhat, the direction of associations were consistent between the total sample, Chinese and Korean subsamples, and probability and non-probability subsamples.

First-generation Chinese and Koreans were selected for analysis because both are rapidly growing populations, and disruptions of existing social networks by immigration permitted collection of data from persons undergoing dramatic change and consequent disruptions in their lives (Hoeffel et al., 2012; Zhou, 2009, p. 223–235). These types of life events are associated with greater alcohol consumption among general populations in numerous studies, although the associations with alcohol may be mitigated by buffering factors, such as social support and coping resources (Veenstra et al., 2006) or exacerbated by poverty, racism, and other hardships (Gee, Spencer, Chen, Yip, & Takeuchi, 2007; Stockdale et al., 2007). Mulia and co-authors (2008a, b) reported that adverse experiences, such as poverty, racism, and other disadvantages, were associated with at-risk drinking and problem drinking among both minorities and whites. No association between stress and drinking was found in our data, so that measure was dropped. It is likely that collinearity with other predictors, especially education, income, and acculturation, was responsible for this finding.

These data contribute to idea that a "social contagion" effect is involved in network public-health risk behaviors (Christakis & Fowler, 2010) and suggest how social norms in broader cultures may influence individual health behaviors, and may also be susceptible to influence by public policy at a higher level of aggregation (Glass & McAtee, 2006; Hovell, Wahlgren, & Adams, 2009). The data support the hypothesis that widespread norms in societies, which may be influenced by public policy, in turn influence behaviors within social networks. The greater familiarity, trust, and intimacy that develop within social networks may enhance the extent of influence that network interaction has in shaping health behaviors involving alcohol, smoking, or other hazards.

While social networks are not the only influence on behavior, they are important, as other research has suggested. So, too, are the more direct influences of public policy, such as enforcement of laws at the various levels of government; group subcultures and experiences; and many other aspects of the environment that influence individuals and may be carried into a social network (Valente, 2010).

Limitations

One unresolved problem with social network analysis is that of homophily (Aral, Muchnik, & Sundararajan, 2009; McPherson, Smith-Lovin, & Cook, 2001, Simons-Morton & Farhat, 2010; Van der Weele, 2011); that is, do drinkers associate with other drinkers, or do people who join social networks acquire the behaviors of others in the network through interaction? While no cross-sectional analysis can bring rigorous evidence to bear on this issue, our data show that persons who report network behaviors that encourage use of alcohol increase their consumption of alcohol to a greater degree than those who do not, after controlling for other network variables including network size and drinking with others. However, network reinforcer associations were controlled, using the number of network linkages, and behaviors that were assumed to reinforce drinking were consistently associated with alcohol consumption. Acculturation, age, gender, and education, as well as national origin and sampling frames, were controlled statistically. Data were collected by survey interviewing by telephone and therefore relied on self-report, which is the basis of much alcohol research but is subject to a variety of biases.

Future Studies

Future studies should explore the association between changes in network behaviors and in alcohol consumption, using a longitudinal approach. Circumstances of immigration vary in many ways, so that conclusions would be bolstered by including more diverse groups of immigrants who face more varied types of problems in American society. Refocusing research to smaller, more narrowly defined and spatially constrained groups may be productive in future studies involving social networks and alcohol consumption, although this study has provided initial evidence that focusing on network mechanisms among two immigrant groups further specifies the way networks function, in a broader, societal-level context, to influence alcohol behaviors. Studying immigrant population requires using appropriate languages according to the preference of respondents, as well as consideration of problems with sampling for surveys likely to be at least partially conducted using cell phones.

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