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# Predictors of transitions across stages of alcohol use and disorders in an adult population with heterogeneous ethnic restrictions regarding drinking

**Faith Cole[1], Corina Benjet[2], Dirgha J. Ghimire[1] & William G. Axinn[1]**

Institute for Social Research, University of Michigan, MI, USA[1] and Epidemiology and Psychosocial Research, National Institute of Psychiatry Ramón de la Fuente Muñiz, Mexico City, Mexico[2]

## ABSTRACT

**Aims** To disaggregate associations with alcohol use disorder relative to those with early alcohol use stages in an adult population. We estimated prevalence rates and socio-demographic correlates for the opportunity to drink and transitions into life-time alcohol use, regular use and alcohol use disorder. **Design** A retrospective, cross-sectional population survey within a family panel study. **Setting** Chitwan in Nepal, an ethnically diverse setting with heterogeneous ethnic restrictions regarding alcohol. **Participants** A total of 10714 individuals aged 15–59 years (response rate = 93%). **Measurements** The Nepal-specific Composite International Diagnostic Interview assessed life-time alcohol use opportunity, any use, regular use, disorder and socio-demographic characteristics. **Findings** Seventy per cent [95% confidence interval (CI) = 69.08–70.82%] of the population had the opportunity to drink, 38.06% (95% CI = 37.14–38.99%) had life-time alcohol use, 32.37% (95% CI = 31.48–33.27%) had regular alcohol use and 6.04% (95% CI = 5.60–6.50%) developed an alcohol use disorder. Compared with high-caste Hindus, all other ethnicities had greater odds of early stage transitions [odds ratios (OR) ranged from 1.31, 95% CI = 1.16–1.47 to 1.98, 95% CI = 1.81–2.18)], but not of development of disorder. Male sex was associated with greater odds of all transitions, from opportunity (OR = 5.71, 95% CI = 5.41–6.03) to development of disorder (OR = 1.95, 95% CI = 1.35–2.81). The youngest cohort had higher odds of all transitions, from opportunity (OR = 4.86, 95% CI = 4.47–5.29) to development of disorder (OR = 9.34, 95% CI = 6.88–12.70). Higher education was associated with lower odds of all transitions except opportunity [from use (OR = 0.77, 95% CI = 0.71–0.83) to the development of disorder (OR = 0.73, 95% CI = 0.59–0.89)]. **Conclusions** The prevalence of life-time alcohol use among adults in Nepal appears to be low, but the overall prevalence of disorder is similar to other countries. Socio-demographic correlates of early alcohol use transitions differ from those associated with later transitions; while sex and age cohort were associated with all transitions, ethnicity was associated with early transitions (opportunity, life-time use, regular use), but not later transitions (use and regular use to disorder).

**Keywords** Alcohol use disorders, alcohol use transitions, epidemiology, general population, opportunity to drink, south Asia.

*Correspondence to:* Faith Cole, Institute for Social Research, University of Michigan, 426 Thompson St, Ann Arbor, MI, 48104-2321, USA.
E-mail: faithco@umich.edu
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## INTRODUCTION

Alcohol use disorders (AUD) are formidable threats to health. They have been causally linked to more than 60 diseases [1], and there were more than 3 million deaths from harmful alcohol use in 2016 [2]. Thus, understanding the processes leading to AUD is a high scientific priority. Here we analyze new data from Nepal to provide important insights into the development of AUD.

Alcohol consumption is low in South Asia relative to European settings [2,3]. In Nepal, until 1960, the legalized Hindu caste system prohibited certain caste/ethnic groups from drinking on religious grounds [4–8]. Before the 1960s there was no industrial production of alcohol in Nepal [9]. Thus, Nepali society is historically divided between groups for whom alcohol use is socially acceptable (Matwali), many of whom produce alcohol within the home [9,10], and groups (non-Matwali) that are subjected to restrictions

on drinking [6,8,9]. Even as commercial production and availability of alcohol has grown, this history results in groups who have less opportunity to drink living next door to members of groups who have the opportunity to use alcohol regularly. This heterogeneity of alcohol use provides important comparison groups for understanding the association between exposure to alcohol and the development of AUD.

Exposure to the opportunity to drink is the first transition into alcohol use—one cannot be at risk for alcohol use or AUD without an opportunity to drink. Thus, understanding the risk factors associated with the opportunity to drink and the commencement of alcohol use is crucial for understanding the transitions into AUD. Research has shown that the socio-demographic factors associated with early stages of alcohol involvement differ from those associated with the onset of AUD, suggesting that contextual factors may have a relatively greater influence on earlier alcohol use stages than later stages [11–14].

Despite evidence demonstrating the importance of distinguishing risk factors associated with early alcohol use from those associated with disorders, the understanding of transitions into early alcohol use is limited by the relative scarcity of information from settings outside the European diaspora. Almost all the studies predicting transitions into early alcohol use have been conducted in settings where use is widely accepted and practiced, limiting the study of factors associated with exposure to alcohol use because opportunity to drink is almost universal among adults. This limitation has led most studies to either exclude investigation of factors associated with opportunity or investigate opportunity and initial use among adolescents.

The only study that investigated factors associated with exposure to opportunity in an adult population examined sex differences only [15]. Wells and co-authors [15] found that sex differences in the opportunity for substance use and the commencement of use vary greatly across countries, providing evidence that contextual factors may be especially important in determining opportunity to drink. Although norms surrounding alcohol are contextual factors that affect who has an opportunity [15], few studies have investigated settings with social restrictions against use. Therefore, the scientific understanding of how social factors differentially affect characteristics associated with opportunity to drink, commencement of use and subsequent AUD is limited.

The present study uses the first large, general population study of AUD in Nepal to address this important gap and identify social factors likely to produce heterogeneity in exposure to opportunity to drink, onset of alcohol use and regular use and development of AUD. By studying these transitions in a setting of ethnic variations in restrictions against alcohol use, we have a population with heterogeneity in exposure to and consumption of alcohol. We use this heterogeneity to distinguish associations with opportunity to drink and alcohol consumption from associations with AUD in an adult population. To conduct this, we estimated the total prevalence rates, conditional prevalence rates and risk of transition by ethnicity, sex, birth cohort and educational level.

## METHODS

### Design

This is a retrospective, cross-sectional survey that was conducted from 2016 to 2018 among participants in the Chitwan Valley Family Study (CVFS), a 25-year longitudinal panel study that is representative of the general population in western Chitwan, Nepal [16]. The region makes up approximately 2% of Nepal's population and is known to be particularly diverse by ethnicity [17,18]. Age and gender distributions are similar to the national population [17]. Respondents had experience of CVFS confidentiality protections before they reported alcohol use behavior to the ethnically diverse, professionally trained interviewers. All analyses are based on reports of alcohol use behaviors during the respondents' life-time until the age of interview. The survey used computer-assisted personal interviewing (CAPI) and a life history calendar (LHC) [17,19].

### Sample

Respondents were 10714 individuals aged 15–59 years in western Chitwan, Nepal. The response rate was 93%. Respondents were recruited via an in-person visit or telephone call, depending on the respondent's location at the time of recruitment. CVFS sampling procedures are described in previous publications [16,20]. See Table 1 for the sample description and Supporting information, Table S1 for the sample description stratified by sex.

### Measures

Alcohol use and AUD were retrospectively measured using the Nepal-specific version of the World Mental Health–Composite International Diagnostic Interview (CIDI) version 3.0. The CIDI is a fully structured diagnostic interview that evaluates psychiatric disorders during the respondent's life-time [21,22], including AUD, according to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) [23].

#### *Alcohol use disorders*

For AUD, the instrument measures whether the respondent met diagnostic criteria for alcohol abuse (ALA) and alcohol dependence (ALD) at any point in their life-time and the age at which respondents first met diagnostic criteria, which we refer to as age-of-onset. We combined ALA and ALD into

**Table 1** Sample description.

| | *CVFS sample 2016–18 (N = 10623)*[a] | |
|---|---|---|
| *Total* | *n* | *%* |
| Sex | | |
| Male | 4878 | 45.92 |
| Female | 5745 | 54.08 |
| Birth cohort | | |
| 1992–2004 | 3441 | 32.39 |
| 1982–91 | 3001 | 28.25 |
| 1972–81 | 2135 | 20.10 |
| Before 1972 | 2046 | 19.26 |
| Ethnicity | | |
| Brahmin/Chhetri | 4634 | 43.62 |
| Hill Janajati | 2106 | 19.82 |
| Dalit | 1301 | 12.25 |
| Newar | 640 | 6.02 |
| Terai Janajati | 1942 | 18.28 |
| Level of education | | |
| SLC or more[b] | 4066 | 38.28 |
| Below SLC | 6556 | 61.72 |
| Missing | 1 | 0.01 |

[a]Ninety-one respondents of 'other' ethnicity were excluded from our analyses due to low cell counts; [b]SLC = School Leaving Certificate.

alcohol use disorders (AUD), defined as any life-time ALA or ALD. The Nepal CIDI integrated an LHC to improve retrospective reporting of alcohol use and disorder symptoms [19]. The Nepal-specific LHC-CIDI was translated through a multi-step iterative process to insure validity within the local context [19,24]. Clinical validation of the Nepal LHC-CIDI against the clinician-administered Structured Clinical Interview for DSM-IV (SCID-IV) demonstrated high concordance, comparable to validation studies of US and European CIDI instruments [19].

*Alcohol use*

Measures of alcohol use include indicators of life-time opportunity to drink, alcohol use and regular alcohol use. For opportunity to drink, we used responses to the CIDI item: 'About how old were you the very first time you had an opportunity to drink alcohol?'. Opportunity to drink is defined as: 'anytime someone either offered you alcohol or you were present when others were drinking and could have drunk if you wanted to'. For life-time alcohol use, we used responses to: 'How old were you the very first time you ever drank an alcoholic beverage?'. The definition of alcoholic beverages included local alcoholic beverages (jad and rakshy), beer, wine and hard liquors such as vodka, gin or whisky. For regular alcohol use, we used responses to: 'How old were you when you first started drinking at least 12 drinks in a year?'. Respondents were given examples of the quantity considered one drink for each beverage type. All alcohol use indicators were coded as a dichotomous measure, 0 if the answer was 'never' and 1 if the respondent reported an age of onset for that outcome.[1] These questions to measure opportunity, first use and regular use are standard indicators used in multiple studies and settings [11–15,25–27].

*Socio-demographic measures*

Although Nepal has more than 100 recognized ethnic groups [28], scholars generally simplify discussion of ethnicity in Nepal using five broad categories: Brahmin/Chhetri (high-caste Hindu), Hill Janajati (multiple ethnicities of Tibetan origin), Dalits (low-caste Hindus), Newar (heterogeneous in terms of caste and religion) and Terai Janajati (multiple plains ethnicities, primarily of Burmese decent). This categorization has been shown to capture sufficient variation in ethnicity in the study area [29]. We use these five ethnic categories. The 91 respondents who identified as an 'other' ethnicity were excluded. Respondents of Brahmin/Chhetri ethnicity were considered non-Matwali by the caste system legalized until 1960 [6], and were therefore subjected to legal sanctions against alcohol consumption until 1960 and still face social restrictions against use [6–8]. The other ethnicities included were all considered Matwali, and therefore do not face the same restrictions; rather, many Matwali produce alcohol in their homes [9,30].

Additional socio-demographic measures included sex, birth cohort and education. Birth cohort was categorized into four groups: 1992–2004, 1982–91, 1972–81 and before 1972. We measured education with a dichotomy indicating whether or not the respondent received their School Leaving Certificate (SLC), awarded to students who pass a national examination offered after completing 10th grade.

## Analyses

We estimated the total prevalence, conditional prevalence and socio-demographic correlates of transitions into four alcohol use stages (opportunity to drink, life-time alcohol use, regular use and AUD). The overall prevalence of each was estimated as the proportion of respondents who transitioned into that alcohol use stage at any point prior to the interview. We used the full sample for overall prevalence rates ($n$ = 10623). Conditional prevalence of each alcohol use stage was calculated as the proportion of respondents who had transitioned into that stage if they met criteria for the prior stage. The conditional prevalence of AUD was calculated among life-time alcohol users ($n$ = 4043).

[1]207 individuals who reported alcohol use but no opportunity were recoded from 0 to 1 for opportunity; 9 individuals who met diagnostic criteria for AUD but reported no regular alcohol use were recoded from 0 to 1 for regular alcohol use.

We estimated associations between socio-demographic correlates and the odds of transition into alcohol use stages. Using the full life histories, we began the analyses at age 10 and examined the annual rate of transition to each subsequent alcohol use stage. The CVFS LHC instruments were designed to enable discrete-time survival (event history) models, using person-years as the unit of analysis [31]. The discrete-time approach has many advantages, eliminating parametric assumptions in the baseline survival function, such as proportionality [32,33]. Respondents were considered at risk of transitioning if they met criteria for the prior alcohol use stage. A dichotomous variable was created for each transition, where the year of transition was coded 1 and previous years were coded 0. Transitions included: onset of opportunity, commencing use, use to regular use, use to AUD and regular use to AUD. We present survival coefficients as odds ratios (OR) adjusted for all covariates and 95% confidence intervals (95% CI). Age was the only variable treated as a time-varying predictor. All significance tests were evaluated at $P < 0.05$ with two-sided tests. Analyses were conducted in Stata version 15 [34] using the 'logistic' command. We also ran all analyses stratified by sex. The analysis in the study was not pre-registered and should be considered exploratory.

### Ethics and consent

All respondents provided written or verbal informed consent prior to the interview. Verbal consent was witnessed and formally recorded. The survey was conducted in a private setting. Procedures involving human subjects were approved by the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board and the Nepal Health Research Council.

## RESULTS

Table 2 presents the prevalence of alcohol use stages in the total population by socio-demographic correlates; Supporting information, Tables S2 and S3 show these same estimates stratified by sex; 69.95% of the population had the opportunity to drink. Although opportunity was almost ubiquitous in males (94.48%), fewer than half of females (49.12%) had an opportunity to drink. The ethnic group with the highest prevalence of opportunity were the Hill Janajati (79.91%). The Brahmin/Chhetri had the least opportunity (61.22%). Life-time alcohol use (38.06%) and regular alcohol use (32.37%) were low, due in part to low rates of life-time and regular alcohol use in females (8.39 and 4.56%, respectively) compared to males (73.02 and 65.13%, respectively). The Brahmin/Chhetri had the lowest rates of life-time (29.91%) and regular (25.05%) alcohol use. AUD was 6.04% in the total population (12.53% among males and 0.54% among females). Both the Brahmin/Chhetri and Newar ethnic groups had the lowest prevalence of AUD (4.29 and 5.00%, respectively). The youngest birth cohort (1992–2004) had the lowest prevalence of AUD (3.52%) compared to 8.21% for the oldest birth cohort (before 1972), as did those with an SLC (4.06%), compared to those without an SLC (7.28%).

Table 3 shows conditional prevalence rates of alcohol use stages (see Supporting information, Tables S4 and S5 for estimates stratified by sex). Slightly more than half of those with the opportunity to drink have done so (54.41%), and a majority of those who have had a drink (85.06%) had regular alcohol use. Among those with life-time alcohol use, the prevalence of AUD was 15.88%. Although the Brahmin/Chhetri had the lowest prevalence of life-time alcohol use among those with an opportunity (48.85%), the differences between ethnic groups for all other conditional transition prevalence rates were attenuated. Those born before 1972 had the highest prevalence of life-time use given opportunity (68.47%), and regular use given life-time use (90.97%). The youngest cohort had the lowest prevalence of AUD given life-time use (12.41%).

We present the results of the discrete-time survival models for the association of socio-demographic factors with transitions into alcohol use stages in Table 4. Male sex was associated with increased odds of all transitions between alcohol stages; males were more than five times more likely than females to have an opportunity, 11 times more likely to drink given the opportunity, four times more likely to transition to regular use, three times more likely to transition to AUD from life-time use and nearly twice as likely to transition from regular use to AUD. Non-Brahmin/Chhetri ethnicity was associated with 58–87% higher odds of opportunity to drink, 77–98% higher odds of commencing drinking and 31–49% higher odds of transitioning to regular use, but was not associated with developing AUD either from life-time or regular use.[2] Overall, younger cohorts had higher odds of all transitions between alcohol stages, with greater magnitude of ORs in later stages. Although the prevalence rates of the older cohorts were higher than those of the youngest cohort (shown in Table 2), the higher ORs for the younger cohorts can be explained by the younger ages of onset of all alcohol use stages. For example, the median ages of onset for the youngest cohort ranged from 17 for opportunity to 19 for AUD, whereas the mean ages of onset for the oldest cohort ranged from 23 for opportunity to 35 for AUD (results not shown in Table 2). Education was not associated with opportunity to drink, but having SLC was associated with

[2]When compared to Newar ethnicity, there was one exception to this result: Dalit had 52 and 54% greater odds than Newar to develop AUD from life-time use and regular use, respectively (this result is not shown in the tables).

**Table 2** Overall life-time prevalence of alcohol use stages by socio-demographic correlates ($n$ = 10623[a]).

| | *Life-time opportunity to drink (N = 10623)* | | | *Life-time alcohol use (N = 10623)* | | | *Regular alcohol use (N = 10623)* | | | *Alcohol use disorder[b] (N = 10623)* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | *%* | *(95% CIs)* | *n* | *%* | *(95% CIs)* | *n* | *%* | *(95% CIs)* | *n* | *%* | *(95% CIs)* |
| Total | 7430 | 69.95 | (69.08, 70.82) | 4043 | 38.06 | (37.14, 38.99) | 3439 | 32.37 | (31.48, 33.27) | 642 | 6.04 | (5.60, 6.50) |
| Sex | | | | | | | | | | | | |
| Male | 4608 | 94.48 | (93.84, 95.13) | 3561 | 73.02 | (71.77, 74.26) | 3177 | 65.13 | (63.80, 66.48) | 611 | 12.53 | (11.60, 13.45) |
| Female | 2822 | 49.12 | (47.83, 50.41) | 482 | 8.39 | (7.67, 9.11) | 262 | 4.56 | (4.02, 5.10) | 31 | 0.54 | (0.35, 0.73) |
| Ethnicity | | | | | | | | | | | | |
| Brahmin/Chhetri | 2837 | 61.22 | (59.82, 62.62) | 1386 | 29.91 | (28.59, 31.23) | 1161 | 25.05 | (23.81, 26.30) | 199 | 4.29 | (3.71, 4.88) |
| Hill Janajati | 1683 | 79.91 | (78.20, 81.63) | 955 | 45.35 | (43.22, 47.47) | 812 | 38.56 | (36.48, 40.64) | 155 | 7.36 | (6.24, 8.48) |
| Dalit | 952 | 73.17 | (70.76, 75.59) | 559 | 42.97 | (40.27, 45.66) | 486 | 37.36 | (34.72, 39.99) | 107 | 8.22 | (6.73, 9.72) |
| Newar | 475 | 74.33 | (70.94, 77.73) | 268 | 41.94 | (38.10, 45.78) | 225 | 35.16 | (31.45, 38.87) | 32 | 5.00 | (3.31, 6.70) |
| Terai Janajati | 1483 | 76.36 | (74.47, 78.26) | 875 | 45.06 | (42.84, 47.27) | 755 | 38.88 | (36.71, 41.05) | 149 | 7.67 | (6.49, 8.86) |
| Birth cohort | | | | | | | | | | | | |
| 1992–2004 | 2284 | 66.38 | (64.80, 67.96) | 975 | 28.33 | (26.83, 29.84) | 738 | 21.45 | (20.08, 22.82) | 121 | 3.52 | (2.90, 4.13) |
| 1982–91 | 2157 | 71.90 | (70.29, 73.51) | 1111 | 37.03 | (35.30, 38.76) | 939 | 31.29 | (29.63, 32.95) | 192 | 6.40 | (5.52, 7.27) |
| 1972–81 | 1565 | 73.30 | (71.42, 75.18) | 982 | 46.00 | (43.88, 48.11) | 875 | 40.98 | (38.90, 43.07) | 161 | 7.54 | (6.42, 8.66) |
| Before 1972 | 1424 | 69.60 | (67.60, 71.59) | 975 | 47.65 | (45.49, 49.82) | 887 | 43.35 | (41.20, 45.50) | 168 | 8.21 | (7.02, 9.40) |
| Level of education | | | | | | | | | | | | |
| SLC or more[c] | 2923 | 71.89 | (70.51, 73.27) | 1399 | 34.41 | (32.95, 35.87) | 1103 | 27.13 | (25.76, 28.49) | 165 | 4.06 | (3.45, 4.66) |
| Below SLC | 4507 | 68.75 | (67.62, 69.87) | 2644 | 40.33 | (39.14, 41.52) | 2336 | 35.63 | (34.47, 36.79) | 477 | 7.28 | (6.65, 7.90) |

[a]Ninety-one respondents of 'other' ethnicity were excluded from our analyses due to low cell counts; [b]alcohol use disorder (AUD) refers to any life-time AUD, including abuse (ALA) or dependence (ALD); [c]SLC = Schooling Leaving Certificate. CI = confidence interval.

**Table 3** Conditional life-time prevalence of alcohol use stages.

| | *Life-time alcohol use among those with life-time opportunity (N = 7430)* | | | *Regular alcohol use among life-time alcohol users (N = 4043)* | | | *AUD[a] among life-time alcohol users (N = 4043)* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *n* | *%* | *(95% CIs)* | *n* | *%* | *(95 CIs)* | *n* | *%* | *(95% CIs)* |
| Total | 4043 | 54.41 | (53.28, 55.55) | 3439 | 85.06 | (83.96, 86.16) | 642 | 15.88 | (14.75, 17.01) |
| Sex | | | | | | | | | |
| Male | 3561 | 77.28 | (76.07, 78.49) | 3177 | 89.22 | (88.20, 90.24) | 611 | 17.16 | (15.92, 18.40) |
| Female | 482 | 17.08 | (15.69, 18.47) | 262 | 54.36 | (49.89, 58.82) | 31 | 6.43 | (4.23, 8.63) |
| Ethnicity | | | | | | | | | |
| Brahmin/Chhetri | 1386 | 48.85 | (47.01, 50.69) | 1161 | 83.77 | (81.82, 85.71) | 199 | 14.36 | (12.51, 16.21) |
| Hill Janajati | 955 | 56.74 | (54.37, 59.11) | 812 | 85.03 | (82.76, 87.29) | 155 | 16.23 | (13.89, 18.57) |
| Dalit | 559 | 58.72 | (55.59, 61.85) | 486 | 86.94 | (84.14, 89.74) | 107 | 19.14 | (15.87, 22.41) |
| Newar | 268 | 56.42 | (51.95, 60.90) | 225 | 83.96 | (79.53, 88.38) | 32 | 11.94 | (8.03, 15.85) |
| Terai Janajati | 875 | 59.00 | (56.50, 61.51) | 755 | 86.29 | (84.00, 88.57) | 149 | 17.03 | (14.53, 19.52) |
| Birth cohort | | | | | | | | | |
| 1992–2004 | 975 | 42.69 | (40.66, 44.72) | 738 | 75.69 | (73.00, 78.39) | 121 | 12.41 | (10.34, 14.48) |
| 1982–91 | 1111 | 51.51 | (49.40, 5362) | 939 | 84.52 | (82.39, 86.65) | 192 | 17.28 | (15.06, 19.51) |
| 1972–81 | 982 | 62.75 | (60.35, 65.15) | 875 | 89.10 | (87.15, 91.06) | 161 | 16.40 | (14.08, 18.71) |
| Before 1972 | 975 | 68.47 | (66.05, 70.89) | 887 | 90.97 | (89.17, 92.78) | 168 | 17.23 | (14.86, 19.61) |
| Level of education | | | | | | | | | |
| SLC or more[b] | 1399 | 47.86 | (46.05, 49.67) | 1103 | 78.84 | (76.70, 80.98) | 165 | 11.79 | (10.10, 13.49) |
| Below SLC | 2644 | 58.66 | (57.23, 60.10) | 2336 | 88.35 | (87.13, 89.57) | 477 | 18.04 | (16.57, 19.51) |

[a]Alcohol use disorder (AUD) refers to any life-time AUD, including abuse (ALA) or dependence (ALD); [b]SLC = Schooling Leaving Certificate. CI = confidence interval.

**Table 4** Socio-demographic correlates of transitions into alcohol use stages.[a]

| | *Opportunity (n = 10623[b])* | | *Commencing use (n = 7430)* | | *Life-time use to regular use (n = 4043)* | | *Life-time use to AUD[c] (n = 4043)* | | *Regular use to AUD (n = 3439)* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *OR* | *(95% CI)* | *OR* | *(95% CI)* | *OR* | *(95% CI)* | *OR* | *(95% CI)* | *OR* | *(95% CI)* |
| Sex | | | | | | | | | | |
| Male | 5.71*** | (5.41, 6.03) | 11.19*** | (10.11,12.39) | 4.37*** | (3.82, 5.00) | 3.13*** | (2.18,4.51) | 1.95*** | (1.35, 2.81) |
| Female (ref.) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) |
| Ethnicity | | | | | | | | | | |
| Brahmin/Chhetri (ref.) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) |
| Hill Janajati | 1.87*** | (1.75, 2.00) | 1.91*** | (1.74, 2.09) | 1.44*** | (1.30, 1.59) | 1.15 | (0.92, 1.43) | 1.10 | (0.88, 1.38) |
| Dalit | 1.58*** | (1.45, 1.71) | 1.77*** | (1.59, 1.97) | 1.31*** | (1.16, 1.47) | 1.27 | (0.99, 1.63) | 1.24 | (0.97, 1.59) |
| Newar | 1.62*** | (1.46, 1.80) | 1.86*** | (1.61, 2.14) | 1.49*** | (1.28,1.74) | 0.84 | (0.57, 1.22) | 0.81 | (0.55, 1.17) |
| Terai Janajati | 1.80*** | (1.68, 1.94) | 1.98*** | (1.81, 2.18) | 1.46*** | (1.32, 1.62) | 1.19 | (0.95, 1.49) | 1.13 | (0.90, 1.42) |
| Birth cohort | | | | | | | | | | |
| 1992–2004 | 4.86*** | (4.47, 5.29) | 2.15*** | (1.94, 2.39) | 3.96*** | (3.51, 4.47) | 8.39*** | (6.17,11.41) | 9.34*** | (6.88,12.70) |
| 1982–91 | 2.17*** | (2.01, 2.34) | 1.29*** | (1.17, 1.42) | 1.68*** | (1.52, 1.86) | 3.21*** | (2.51, 4.10) | 3.39*** | (2.65,4.33) |
| 1972–81 | 1.32*** | (1.23, 1.43) | 1.06 | (0.96, 1.16) | 1.11* | (1.01, 1.23) | 1.35** | (1.08, 1.70) | 1.39** | (1.11,1.75) |
| Before 1972 (ref). | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) |
| Level of education | | | | | | | | | | |
| SLC or more | 1.04 | (0.99, 1.11) | 0.77*** | (0.71, 0.83) | 0.69*** | (0.64, 0.75) | 0.67*** | (0.55,0.81) | 0.73** | (0.59,0.89) |
| Below SLC (ref.)[d] | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) | 1.00 | (1.00, 1.00) |
| Age (years) | 1.64*** | (1.60, 1.67) | 1.58*** | (1.53, 1.62) | 1.70*** | (1.64, 1.75) | 1.36*** | (1.30,1.43) | 1.36*** | (1.29,1.42) |
| Age squared (age decay)[e] | 0.99*** | (0.99, 0.99) | 0.99*** | (0.99, 0.99) | 0.99*** | (0.99, 0.99) | 1.00*** | (0.99, 1.00) | 1.00*** | (1.00,1.00) |
| Constant | 0.00*** | (0.00, 0.00) | 0.00*** | (0.00,0.00) | 0.00*** | (0.00, 0.00) | 0.00*** | (0.00, 0.00) | 0.00*** | (0.00, 0.00) |
| *n* | 10623 | | 7430 | | 4043 | | 4043 | | 3439 | |
| Person-years | 156727 | | 116964 | | 57101 | | 101430 | | 88269 | |
| –2 Log-likelihood | | | | | | | | | | |
| | −25613.02 | | −14918.76 | | −11516.20 | | −3663.50 | | −3586.53 | |

Exponentiated coefficients; 95% confidence intervals in parentheses; *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$. [a]Models are adjusted for all covariates; [b]91 respondents of 'other' ethnicity were excluded from our analyses due to low cell counts; [c]alcohol use disorder (AUD) refers to any life-time AUD, including abuse (ALA) or dependence (ALD); [d]SLC = School Leaving Certificate; [e]age squared is an indicator of the decaying effect of age. OR = odds ratio; CI = confidence interval.

23–31% lower odds of all other transitions. Although age was positively associated with all transitions, age squared was negatively associated with onset of opportunity, commencing use and regular use (although the ORs were close to 1.00); in other words, as time passes, those who did not previously transition have reduced odds of doing so with each additional year.

Supporting information, Tables S6 and S7 show the results stratified by sex, annotated to indicate which correlates displayed a statistically significant interaction with gender. The observed gender difference in the hazard of opportunity to drink was statistically significant for all ethnic groups, indicating that all groups increased the odds of opportunity for females more than males. Gender differences were significant for commencing use for Hill Janajati and Terai Janajati, but were not significant for later transitions. Significant gender differences were also found in early transitions for birth cohort, SLC, age and age squared (see Supporting information, Tables S6 and S7).

## DISCUSSION

South Asia is home to nearly 2 billion people, approximately one-quarter of humanity. Although there is some information about prevalence and correlates of AUD in this important population [35–40], rarely do those studies feature clinically validated measurements conducted with rigorous survey methodology among a large, general population sample [17,19]. An important exception is a study in Sri Lanka, which documented 63.1% life-time alcohol use and 6.2% prevalence of AUD [3]. Thus, one key contribution of this study is to provide a rigorous and detailed view of AUD prevalence and correlates in a large, South Asian sample. A further contribution is that some South Asian ethnic groups have restrictions on alcohol consumption, resulting in heterogeneity within a controlled comparison that provides a special window into the development of AUD.

We found that male sex and younger cohorts had greater odds of transitioning to every alcohol use stage relative to female sex and the oldest cohort. Respondents with higher education had decreased odds of every transition (except opportunity, for which those with and SLC had increased odds for females but decreased odds for males). These findings for sex, cohort and education are similar to those from other settings, such as the United States [13], Brazil [12], South Africa [11,25], China [14], New Zealand [15,26] and Northern Ireland [27]; the new data from Nepal provide more evidence that these associations may be consistent across diverse settings.

Nepal's heterogeneous ethnic groups, however, demonstrate a setting-specific story. Groups without ethnic restrictions on alcohol use had higher odds of opportunity, life-time use and regular use, but these same ethnic differences produced no statistically significant differences in the transitions from either life-time or regular use to AUD. That is, widespread adult restrictions on alcohol use are consequential for alcohol use, but have relatively no bearing on who makes the transition from life-time or regular use to AUD among those who drink. This contributes to growing evidence that contextual factors, such as accessibility and tolerance, contribute to earlier but not later stages of alcohol involvement. This is particularly relevant, because many public policies that aim to reduce accessibility or influence norms may have little impact upon AUD beyond reduction of alcohol use in general (which in and of itself may be important).

Although the overall prevalence of any life-time alcohol use in Nepal (38.06%) was lower than the mean prevalence of life-time alcohol use (80%) in 29 WMH countries, most of which are higher-income and westernized [41], overall prevalence of AUD in Nepal (6.04%) is only a little lower than the mean prevalence in these same countries (8.6%). Further, conditional prevalence of AUD among those with life-time use is twice as high in Nepal (15.88%) as the mean in these WMH countries (7.1%) [41]. As alcohol becomes more available and alcohol consumption increases in South Asia and the western Pacific [2] and in populations with social restrictions against use [9,30,42], the treatment needs for alcohol use disorder may increase.

Readers should consider our findings within the context of the following limitations. First is the retrospective assessment of AUD: recall bias may have led to under-reporting of AUD or bias in accuracy in reported ages of onset [43]. We minimized this bias with the LHC approach, which has been shown to improve retrospective measurement of disorder prevalence and timing [19]. Secondly, social restrictions surrounding alcohol use may have led to ethnic bias in willingness to report alcohol use, which could account for ethnic differences in early stages of alcohol use. However, if ethnic bias in reporting alcohol use played an important role in these findings, we would also have expected to see ethnic differences in transitions to later stages of alcohol involvement, which we did not. Thirdly, our measure of opportunity does not explicitly address community-level availability. Fourthly, individuals with AUD could have more frequently refused to participate in the survey. Although response rate for this survey is exceptionally high (93%), it is plausible that our results were biased, because individuals with AUD might have been less likely to participate [44]. Finally, because people with AUD may experience cognitive impairment as symptoms, we might have excluded subthreshold or atypical cases of AUD that could have qualified for treatment in a clinical setting. Despite these limitations, this large representative sample from an understudied region of the world provides important insights into the predictors of transitions through stages of alcohol involvement and has implications for public policy.

Globalization means that subpopulations with restrictions on alcohol use who were once mainly in a single place, such as Hindus in South Asia, are now settled world-wide. As a result, treatment of AUD globally faces challenges of tailoring interventions to prevent and treat differently those who are exposed to alcohol from early childhood versus those who are restricted from drinking but may do so anyway. Careful study of the differences across such subpopulations has the potential to reveal more specific and effective strategies for prevention of transitions throughout alcohol use stages. Furthermore, as access to alcohol and restriction on use change over time, potentially increasing use in some world regions [2,9,30,42], the risk of AUDs may drastically increase. This is most likely in younger cohorts. Thus, treatment needs and adverse health consequences of alcohol can be expected to increase in these regions.

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### Declaration of interests

W.G.A. and D.J.G. report support from the National Institute of Mental Health (grant number R01MH110872) and the Eunice Kennedy Shriver National Institute of Child Health and Human Development (grant number P2CHD041028) during the conduct of the study. D.J.G. is also the Director of the Institute for Social and Environmental Research in Nepal (ISER-N) that collected the data for the research reported here. D.J.G.'s conflict of interest management plan is approved and monitored by the Regents of the University of Michigan. F.C. and C.B. have no conflicts of interest to report.

### Author contributions

**Faith Cole:** Conceptualization; data curation; formal analysis. **Corina Benjet:** Conceptualization. **Dirgha J. Ghimire:** Conceptualization; data curation; formal analysis; funding acquisition; methodology; project administration; supervision. **William G. Axinn:** Conceptualization; data curation; formal analysis; funding acquisition; methodology; project administration; supervision.

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## Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**Table S1** Sample description by sex
**Table S2** Overall lifetime prevalence of alcohol use stages by sociodemographic correlates among females ($N = 5745$)
**Table S3** Overall lifetime prevalence of alcohol use stages by sociodemographic correlates among males ($N = 4878$)
**Table S4** Conditional lifetime prevalence of alcohol use stages among females
**Table S5** Conditional lifetime prevalence of alcohol use stages among males
**Table S6** Sociodemographic correlates of transitions into alcohol use stages among females[1]
**Table S7** Sociodemographic correlates of transitions into alcohol use stages among males[1]