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Latent classes of alcohol problems in Mauritian men: results from the Joint Child Health Project

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Abstract

Introduction and Aims—The purpose of this study was to identify latent classes of alcohol problems and their sociodemographic correlates in the east African nation of Mauritius.

Design and Methods—Participants were from the Joint Child Health Project, a longitudinal study of a 1969–1970 birth cohort of 1795 individuals. In mid-adulthood ($M = 37$ years), all available participants ($n = 1206$; 67% of the original cohort) were assessed for demographic characteristics, and lifetime drinkers were assessed for alcohol-related problems. Given the low endorsement of problems by women, only male lifetime drinkers ($n = 520$) were included in the latent class analyses.

Results—Analyses indicated the best-fitting model contained four classes of drinkers: non-problematic (66%), moderate (16%), hazardous (11%) and severe (6%). Lower education and occupation were associated with moderate and severe problem classes, whereas higher education and occupation were associated with the hazardous class. Being Hindu, Tamil and Creole were differentially predictive of class membership, but being Muslim was not.

Discussion and Conclusions—Our findings provide evidence of a distinct hazardous drinking class that has unique demographic correlates and may represent a cluster of problems that is more bound by cultural factors. We also found problem classes on a severity continuum from none to moderate to severe problems. This study highlights the importance of examining societal, subgroup, and person-level factors to produce a more nuanced understanding of distinct classes of alcohol-related problems.

Keywords

alcohol use disorder symptoms; alcohol problems; latent class analysis; religion; ethnicity; Mauritius; Africa

Classification of Alcohol Problems

Researchers have long debated whether alcohol problems should be viewed along a spectrum of severity [1] or as a disorder with distinctive subtypes [2,3]. Recent revisions to the *Diagnostic Statistical Manual of Mental Disorders* (DSM) have adjusted alcohol use disorders (AUD) from subtypes (abuse, dependence) in DSM-IV [4] to along a severity continuum (mild, moderate, severe) in DSM-5 [5]. To examine alcohol problem subtypes, several studies have employed latent class analysis (LCA) [6]. LCA is a type of mixture model that theorizes multiple subgroups or types of people exist, but group membership is not known (i.e. is latent). These subgroups are classified in LCA according to their patterns of responses on a collection of indicators related to the outcome of interest (e.g. alcohol problems).

LCA studies examining alcohol problem symptoms in Western samples have found evidence of classes existing along a continuum. Using data from the Collaborative Study of the Genetics of Alcoholism, Bucholz and colleagues [7] examined 37 lifetime symptoms of alcohol problems in adult relatives of alcoholic probands and found four latent classes of drinkers, including non-problematic drinkers and those with mild, moderate and severe alcohol problems. The number of classes and pattern of increasing symptom endorsements in successive classes was consistent across men and women, with some gender differences in symptom endorsements within each class. Two additional LCA studies have examined alcohol problem symptoms by gender. In an Australian male twin sample, Heath and colleagues [8] found support for five latent classes of alcohol problems also along a latent dimension of severity. In a nationally representative sample of US adults, the number and nature of latent classes were found to vary when splitting the sample by gender and when using 34 disaggregated symptom items versus 11 aggregated DSM AUD criteria items [9]. In the aggregated analyses, a four-class, severity-graded structure was the best-fitting model, but the disaggregated analyses revealed more qualitative differences in classes with unique configurations among the indicators. In men, the best fitting model for the disaggregated symptoms had nine classes, including subtypes with distinct symptom patterns that were obscured in the aggregated analyses. Based on these findings, Shireman and colleagues recommended using disaggregated symptom items and examining men and women separately when conducting LCAs on alcohol problems. They also noted a lack of research cross-culturally and the need for replication of findings across societies [10] and set of symptoms [11,12].

Study Purpose

The purpose of this study is to determine the number and nature of latent alcohol problem classes and their demographic correlates in a birth cohort sample from the island of Mauritius, a middle-income east African nation. Examining LCAs of alcohol problems in societies such as Mauritius can provide evidence of the cross-cultural generalisability of alcohol problem classes found in Western societies. To our knowledge, this is the first study to examine LCA alcohol problem subtypes in a non-Western sample (see 2015 review in [9]). After deriving latent classes of alcohol problems, we then examined demographic correlates of class membership, including education, occupation and religioethnicity, as

within-culture variables to better understand how these variations are associated with alcohol problem classes. In LCA studies of Western samples, lower education and occupation have been found in more severe drinker classes [13–15]. Whether these associations are seen in a middle-income nation sample, however, remains to be determined. Such information can provide insight into the commonality and uniqueness of how alcohol problems manifest within and across societies to better understand both cultural- and individual-level factors associated with alcohol problem classes.

Mauritian Drinking Context

In 2011, the World Health Organization (WHO) rated Mauritius a 3 out of 5 on risky drinking pattern scale, indicating moderate risk for consumption patterns linked to alcohol-attributable burden of disease [16]. With large tourism and sugar cane industries, alcohol (including local rum) is readily available on the island at a range of quality and price (see [17] for review). Mauritian culture has been referred to as a “mosaic” or “rainbow” culture [18,19], with distinct subgroups within its broader culture that have differing views on the appropriate use and heavy use of alcohol (see [20]). The Mauritian population is comprised of Hindus (52%) and Muslims (19%) of primarily of Indian heritage, and Creoles (26%; of east African descent), Chinese (4%), and French (2%) who are predominantly Catholic [18]. In these three main religions, Islam has strong proscriptions against any alcohol use [21], Hinduism is generally accepting of moderate alcohol use but not heavy drinking [22], and Catholicism (originated from French Catholicism) is tolerant of a range of drinking, perhaps even heavy drinking [23]. In addition, within Hinduism, the Tamil sect is further noted to have rituals that push one’s body to the extreme, such that heavier drinking may be more acceptable in Tamils than in other Mauritian Hindus (see [20]). Thus, Mauritius provides a unique opportunity to examine subgroups that have differing views on the appropriate use of alcohol within a society with relatively easy access to alcohol.

Using the current study sample, we previously showed that being Catholic was associated with increased likelihood of having a lifetime AUD compared with Hindus and Muslims but not Tamils. In addition, being Muslim was associated with reduced likelihood of being a lifetime drinker, but did not provide additional protection from developing a lifetime AUD within drinkers [20]. Given that Islam does not consider any level of drinking to be acceptable, it is also possible that the likelihood of having certain alcohol problem subtypes differs for Muslims compared with other religioethnic groups [24]; for example, Muslim drinkers may be more likely to be in alcohol problem classes than non-problem classes, or in classes indicative of psychosocial problems (e.g., guilt, social problems, failure to fulfill role obligations). Given this, we expected varying likelihoods of membership in the latent alcohol problem classes that emerge in our analyses across the four main Mauritian religioethnic groups.

Methods

Sample

The original Joint Child Health Project (JCHP) cohort ($N=1795$) comprised almost the entire population of children born in a one-year period between 1969 and 1970 in two

Mauritian towns (see [25] for JCHP study overview). The religioethnic breakdown was representative of the island and included 52% Hindu, 26% Creole, 19% Muslim, 4% Chinese and 2% other; 48% of the sample was female.

The current sample included all available JCHP participants ($n = 1209$; 67% of the original cohort) assessed in mid-adulthood (see [20] for details). The sample assessed in mid-adulthood had a higher proportion of males than the original cohort (55% vs. 52%), but did not differ from the age 3 sample on ethnic distribution or psychosocial adversity when examined in total or when split by gender. Given the low levels of alcohol-related problems endorsed by the female drinkers (details available upon request), we concentrated our analyses on the 520 male lifetime drinkers (79% of 662 males assessed; age $M = 36.6$ years old, $SD = 1.33$). Of these, 234 (45%) were Hindu, 138 (27%) were Creole, 76 (15%) were Tamil, 37 (7%) were Muslim, and 35 (7%) were Chinese/French/other.

Measures and Variables

All data were obtained during in-person interviews conducted in Kreol, the common spoken language of all Mauritians. Open-ended items obtained years of education and current occupation, with occupational level then coded on a 7-point scale using the Hollingshead Index of Social Status [26]. All participants also were assessed for lifetime alcohol behaviors. Individuals who reported having consumed a full drink in their lives were administered an interview, which was based on the Alcohol Use Disorder module of the Structured Clinical Interview for DSM-IV Axis I Disorders [12], and included components of the Semi-Structured Interview for the Assessment of the Genetics of Alcoholism [11] and the Alcohol Use Inventory [27] (available in English and Kreol upon request). From the interview, 27 indicators of lifetime alcohol-related problems that mapped onto items in Bucholz *et al.* [7] were entered into the LCAs. All response options were coded to be dichotomous. There was less than 1% missing on these indicators; for missing scores we imputed a value logically determined when possible (e.g. if never married, then no marital problems were caused by drinking) or assigned a value of 0.

Analyses

LCA unconditional models—LCA models were estimated in Mplus Version 7 [28]. Because our indicators were dichotomous, we used maximum likelihood with robust standard errors as the estimation method and the relationships between the latent class variable and the indicators are described with a set of logistic regression equations. Thresholds marking proportions of persons in each class that endorse each indicator differ across levels of the latent class variable, helping to define the classes. With clinical outcomes such as alcohol problems, these proportions are referred to as *symptom endorsement probabilities* (SEP) for each class [7].

To determine the most appropriate number of classes, solutions were compared on relative fit statistics including: (i) -2 loglikelihood (-2LL) and the Akaike Information Criterion [29], with lower scores indicating a better-fitting model for each; (ii) the fit of a k class model was compared with the fit of a $k-1$ class model using the χ^2 Likelihood Ratio Test (LRT) and the Lo-Mendell-Rubin Likelihood Ratio Test (LMR LRT) [30]. We also examined entropy

statistics, with values close to 0 and 1 edges of the range of values indicating clear classifications with good distinguishability between classes [31]. Lastly, we required sufficient proportions of the sample to be classified into each class and that each class had face validity.

LCA conditional models—After selecting the number of classes, we used the Mplus AUXILIARY function with the R3STEP option to examine correlates of the latent classes using a three-step estimation approach [32,33]. In these models, correlates are referred to as “auxiliary” variables to specify they are “outside of the measurement model” and are not indicators used to derive the latent classes. These tests are expressed as omnibus tests of equality of means across all classes, followed by posthoc tests of equality of means between specific classes. Multinomial logistic regressions examined the likelihood of being in each class within each religioethnic group. To adjust for multiple comparisons, significance was accepted at <0.01 .

Results

LCA Unconditional Models

Table 2 compares the fit, classification quality, and class proportions for the two- through five-class LCAs. The addition of each class improved the -2LL and Akaike Information Criterion statistics and LRTs, but adding a fifth class, which split the second (moderate) class (16%) into two classes (11% and 5% of the sample), did not significantly improve the LMR LRT and resulted in less clearly interpretable SEPs. Based on these findings, the four-class solution was considered the most appropriate model.

Figure 1 shows the SEPs for the four-class solution. Class 1 (66%) was indicative of Non-problematic drinking, with very low endorsement of most items (0%–4%) plus Can't Control Drinking (5%) and Cravings (6%). Class 2 (16%) had SEPs characteristic of moderate drinking problems. In this class, all but four items (blackouts, seizures, received help, drank non-beverage alcohol) were endorsed, with high endorsement of two items, tolerance (85%) and time spent drinking/recovering (68%). Class 3 (11%) was slightly smaller in size than Class 2 and had higher endorsement of items related to risky or hazardous use of alcohol (hazardous use, 100%; drunk driving, 92%; physical fights, 16%), which were relatively low in other classes. Due to this selective pattern of SEPs, we characterised this class as a Hazardous drinking class. Finally, Class 4 (7%) was the smallest in size and had SEPs indicative of Severe drinking problems. This was the only class with all items endorsed.

LCA Conditional Models

Table 3 shows mean scores of years of education and occupational level for each class. The more problematic drinking classes, moderate and severe, had lower mean scores on occupational level than the non-problematic class, with the hazardous class in between. The moderate and severe classes also had lower years of education than the hazardous and non-problematic classes.

Table 4 shows the results of the four multinomial logistic regressions entering each religioethnicity group separately as a predictor of drinking class. Hindus were less likely to be in the hazardous drinking class than in the other three classes, whereas Tamils were more likely to be in the hazardous drinking class than in the other three classes. Creoles were more likely to be in the Moderate drinker class than in the Non-problematic drinker class. We found no significant associations between being Muslim and being in a particular drinking class.

Discussion

The three aims of this study were: (i) to determine the number and nature of latent alcohol problem classes in a sample of Mauritians; (ii) to compare these classes to those previously found in other societies; and (iii) to assess the associations of these classes with sociodemographic variables within Mauritian society. Analyses were limited to men, given the low endorsement of alcohol problem symptoms among women in this sample. Our results indicated varying patterns of symptom endorsement across four latent classes that are indicative of a unique hazardous subtype of alcohol problems, as well as a severity continuum from non-problematic to moderate to severe problems.

The most novel finding from this study is that the Hazardous latent class emerged as a distinct subtype in our Mauritian male cohort. All members of this class endorsed hazardous drinking, an item that includes participating in risky behaviours such as driving, operating heavy machinery, swimming and crossing against traffic while under the influence of alcohol; for most of this class (92%), this hazardous behaviour included driving while under the influence of alcohol. These two items had relatively low endorsement in the other classes. Moreover, the Hazardous class was associated with higher education and occupational level, whereas the moderate and severe problem classes were associated with lower education and occupational level, providing additional evidence for this being a distinct subtype of problems. Driving while under the influence of alcohol is only possible to do if a person has access to a vehicle to drive; thus, the likelihood of being in the hazardous drinking class increases when economic resources permit engagement in the risky activities that are symptomatic of this class. Numerous researchers have recognized the sociodemographic bias of this item [34–36], and drinking and driving has been associated with higher education and lower rates of unemployment in some, but not all studies of Western samples [37–39]. Thus, the items primarily constituting this subtype of alcohol problems, which in DSM-IV would be part of alcohol abuse, may be particularly susceptible to variation across cultural contexts. Additional studies in low- and middle-income nations would help determine whether similar hazardous drinking classes are found when resources, rates of driving, and alcohol accessibility have greater variability within the society than are typically found in Western societies.

We also found a relationship of hazardous drinking with religioethnicity in our Mauritian sample. Tamils were at greater risk of being hazardous drinkers, whereas other Hindus were at lower risk of being Hazardous drinkers compared to their membership in other drinking classes. The reason for this difference is not clear. Although Hindu and Tamil male drinkers do not significantly differ in years of education or occupational level, there is some

indication that Tamils are more likely in the lowest occupational category (29% vs. 14% of Hindu coded as unskilled labourers), which is not consistent with our finding that Hazardous drinking is linked to higher education and occupation levels and perhaps more opportunities for risky drinking behaviours. These differences in likelihood of being in the Hazardous class may be related to Hindu teachings of moderation versus Tamil traditions of challenging oneself in physically risky situations (see [20]). Additional research is needed to understand these group differences, but these results provide further evidence of the importance of disaggregating groups to better understand how cultural factors may play a role in the manifestation of alcohol problems.

Our finding that three of the four latent classes of alcohol problems were along a severity continuum is consistent with results of some prior LCAs on Western samples of men [7,8] and with the framework of DSM-5 AUDs. Our severe problem class contained a relatively similar proportion of the male drinkers (7%) as found in the four-class model by Bucholz *et al.* [7] using the Collaborative Study of the Genetics of Alcoholism sample of adult male relatives of alcoholic probands (10%). In both severe classes, every symptom was endorsed, but only in Bucholz *et al.* did the severe class have the highest endorsement probability for all items, indicating a clear pattern of escalation of all symptoms across classes. In addition to hazardous and driving drunk being lower in our severe class than in our hazardous class, tolerance was also lower in our severe class than in our moderate class. In Shireman *et al.* [9], a class that was indicative solely of tolerance emerged for men when using the disaggregated symptom items. In the Mauritian sample, our moderate class had high endorsement of both tolerance and time spent drinking. These are two primarily behavioural indicators of alcohol problems—they are not very stigmatising symptoms and do not require admitting to problems or wanting to control or reduce drinking. Among religioethnic groups, Creoles were more likely to be in the moderate class than in the non-problematic class. The idea of “saving face,” or not admitting to having problems so as to not embarrass ones family, is a concept typically associated with Asian cultures [40], which would include the Indian heritage of the Hindu, Tamil and Muslim Mauritians. In a previous study of the JCHP sample assessed during childhood [41], we found Creole parents endorsed higher levels of problems in their children that were more similar to rates in the US than did Hindu and Muslim parents. Additional research is needed to better understand why Creoles are more likely to be in the Moderate class; examining alcohol consumption levels in relation to problems may help shed light on these differences [42].

Finally, unlike predicted, we did not find Muslim religioethnicity was associated with greater probability of being in any particular class of drinkers. Power may be an issue, as indicated by wide confidence intervals and only 7% of the male drinkers being Muslim. However, the effect sizes do not suggest any support for our hypothesis that Muslims would experience more problems from being drinkers (i.e. be less likely to be in the non-problematic class) or be more likely to be in classes indicative of psychosocial problems. This may also be due to hiding drinking from family members and instead drinking with friends or co-workers. A better understanding of drinking contexts may provide insight into differences in the drinking patterns of Mauritian Muslim men compared with Mauritian men from other religioethnic groups.

Limitations

Results of this study should be interpreted within the context of the study limitations. First, alcohol symptom data were self-reported, retrospective measures of lifetime problems. Self-report, however, may be the most valid way to collect these data given certain behaviours occur when the participant is likely alone (e.g. drinking non-beverage alcohol) or require introspection (e.g. feeling guilty, thinking you have a problem). Second, our sample was limited to a cohort of Mauritians all born in 1969–1970 assessed in mid-adulthood, thereby reducing the breadth of our results to other age groups. Third, reporting biases may differ across religioethnic groups given we expect varying degrees of stigma attached to alcohol use and problems across these groups [43]. Our findings for class membership by religioethnic group, however, were not consistent with what we would expect based on religioethnic group views on alcohol use; it is possible reporting bias may be more related to denying drinking at all rather than denying problems once admitting to being a drinker. Fourth, we were not able to map our data onto all of the items in prior LCA studies of alcohol problems, which limits our ability to directly compare our results to findings from these studies. In addition, slight differences in wording and coding of items may affect endorsement rates [44]. Additional data collection that is underway will enable us to better capture drinking contexts, consumption patterns, access to driving, and a broader ranges of problems in future work with the JCHP sample.

Conclusions

In summary, this study revealed similarities and differences between drinking typologies in Western societies and those in Mauritius. The nature of the non-problematic, moderate and severe drinking classes were similar to those found using Western samples, including the relationship of these classes with socioeconomic factors. The hazardous drinking class was qualitatively unique from the other classes of problematic drinkers and may represent a cluster of problems that is more bound by cultural factors. Other studies have found other unique classes of alcohol problems when disaggregating both sample and symptom items, and this study further highlights the importance of examining subgroups within a society to produce a more nuanced understanding of alcohol problem subtypes. This study increases our understanding of the universality of alcohol problems as well as the environmental- and person-level factors that contribute to the development of distinct classes of alcohol-related problems.

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Figure 1.

Symptom Endorsement Probabilities for Four Latent Classes

Note. $n = 342$ for Non-problematic, 83 for Moderate, 60 for Hazardous, and 35 for Severe class.

Table 1

Endorsement of alcohol-related problems in men

Alcohol problem	Endorsed, % (<i>n</i> = 662)
Tolerance	22.4
Time spent drinking and recovering	19.6
Can't control drinking	14.1
Social problems	13.8
Larger/longer than intended	13.4
Hazardous use	13.3
Role problems	12.5
Cravings	12.2
Drive drunk	11.0
Fell off wagon	8.7
Felt guilty	8.5
Can't cut down	7.0
Use despite problems	6.7
Have drinking problem	5.6
Withdrawal	5.6
Marriage difficulties	4.7
Physical fights	4.2
Social activities given up	4.1
Benders	3.3
Morning drinking	2.7
Delirium tremens	2.1
Relief drinking	1.8
Blackouts	1.7
Received help	1.4
Legal problems	1.2
Seizures	1.1
Drank non-beverage alcohol	0.3

Table 2

Comparison of Latent Class Models

Model	df	-2LL	-2LL	Model comparisons				LMR LRT (P)	Entropy
				AIC	Bootstrapped LRT P	LRT P			
2 Classes	55	-3031.0	-	6172.0	<0.001			<0.001	0.95
3 Classes	83	-2818.7	-212.3	5803.4	<0.001			<0.001	0.94
4 Classes	111	-2751.1	-67.6	5724.2	<0.001			<0.05	0.95
5 Classes	139	-2694.6	-56.5	5667.3	<0.001			0.08	0.96

Class prevalence (proportion)					
	1	2	3	4	5
2 Classes	0.72	0.28	-	-	-
3 Classes	0.65	0.28	0.06	-	-
4 Classes	0.66	0.16	0.12	0.07	-
5 Classes	0.66	0.11	0.05	0.12	0.05

Note. N = 520.

LMR, Lo-Mendell-Rubin; LRT, likelihood ratio test. P values for LRTs are the significance level for fit of the current model with k classes over a model with k-1 classes.

Table 3

Means and standard errors of demographic covariates for the four-latent class solution

	Class 1 (66%) Non-problematic (<i>n</i> = 342)	Class 2 (16%) Moderate (<i>n</i> = 83)	Class 3 (12%) Hazardous (<i>n</i> = 60)	Class 4 (7%) Severe <i>n</i> = 35)
	<i>M</i> (<i>SE</i>)	<i>M</i> (<i>SE</i>)	<i>M</i> (<i>SE</i>)	<i>M</i> (<i>SE</i>)
Years of education	10.91 ^a (0.21)	9.44 ^b (0.35)	11.34 ^a (0.48).	7.92 ^b (0.54)
Occupational level	3.58 ^a (0.09)	2.99 ^b (0.14)	3.31 ^{ab} (0.21)	2.68 ^b (0.18)

Note. Class means on auxiliary variables that do not share the same subscript differ at $P < 0.01$.

Table 4

Multinomial logistic regressions of class membership on religioethnicity

	Odds ratio (95% CI), Predicted Class/Reference Class						
Religioethnicity	Haz / Non	Mod / Non	Sev / Non	Mod / Haz	Sev / Haz	Sev / Mod	
Hindu (<i>n</i> = 234)	0.39* (0.21–0.74)	0.63 (0.37–1.09)	1.09 (0.53–2.27)	0.30* (0.14–0.66)	2.78 (1.11 – 6.94)	1.73 (0.73–4.07)	
Creole (<i>n</i> = 138)	1.53 (0.81–2.90)	2.54** (1.46–4.44)	1.18 (0.52–2.70)	1.66 (0.77–3.58)	0.77 (0.29–2.05)	0.46 (0.18–1.17)	
Tamil (<i>n</i> = 76)	2.90* (1.49–5.62)	0.87 (0.38–1.96)	0.84 (0.28–2.58)	0.30 (0.12–0.78)	0.29 (0.09–0.98)	0.97 (0.26–3.60)	
Muslim (<i>n</i> = 37)	0.52 (0.15–1.84)	0.20 (0.03–1.35)	0.61 (0.14–2.71)	0.38 (0.04–3.66)	1.18 (0.18–7.77)	3.10 (0.29–33.50)	

CI, confidence interval; Haz, hazardous, Mod, moderate; Non, non-problematic; Sev = severe.

All models have 111 *df*.* $P < 0.01$.** $P < 0.001$.