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A Person-Centered Approach to Understanding Firearm Injury Risk Among Asian Americans

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Abstract

Background: Firearm mortality has risen sharply in the United States, with firearm homicide and suicide rates increasing by 16% and 28%, respectively, between 2019 and 2023. Firearm ownership among Asian Americans has grown amid rising exposure to violence and mistreatment in recent years, yet this population remains understudied. This study used a person-centered approach to identify patterns of psychological and behavioral indicators of firearm injury risk among Asian American household firearm owners and examined whether two contextual stressors, exposure to violence and interpersonal and cultural mistreatment, predicted higher-risk profile membership.

Methods: This study used national survey data collected in 2024 from a probability-based sample of U.S. Asian adults. Latent profile analysis was conducted among a subsample of household firearm owners (N=386) using four indicators: firearm carrying, firearm storage practices, heavy alcohol use, and mental distress. Models were estimated with full-information maximum likelihood and poststratification weights; profile solution was selected using fit indices and entropy. We ran multinomial logistic regressions to examine associations between exposure to violence and interpersonal and cultural mistreatment, respectively, and profile membership, adjusting for age, gender, and education.

Results: A three-profile solution balanced fit and interpretability. The *compound-risk* profile (9.5% of owners) showed the highest probability of firearm carrying, lowest rates of secure firearm storage, and elevated alcohol use and mental distress. The *distress-dominant* profile (10.4%) showed the highest mental distress but low alcohol use and the highest rate of secure storage. Remaining owners (80.1%) fell into a *lower-risk* profile, with the lowest probability of firearm carrying and lowest mental distress. Relative to the lower-risk profile, greater violence exposure was associated with higher odds of classifying into the distress-dominant (aOR=1.42) and compound-risk profiles (aOR=1.65). Greater exposure to interpersonal and cultural

mistreatment was also associated with higher odds of classifying into the distress-dominant (aOR=1.22) and compound-risk profiles (aOR=1.30).

Conclusions: Asian American firearm owners differ in their patterns of firearm injury risk. Moreover, exposure to violence and interpersonal and cultural mistreatment were associated with membership in profiles marked by greater firearm injury risk. Firearm injury prevention for this population should pair individual-level strategies, such as secure storage promotion, with efforts to address upstream contextual stressors.

Keywords: Latent profile analysis; Firearm storage; Firearm carrying; Firearm ownership; Alcohol use; Psychological distress; Exposure to violence; Asian Americans

Background

Firearm deaths have been steadily increasing in recent years, with firearm homicide and suicide rates increasing by 16% and 28%, respectively, between 2019 and 2023 [1]. Scholars have identified risk factors driving these alarming increases [2–8]. However, researchers usually examine these indicators independently even though they occur simultaneously in reality [9]. As a result, prevention efforts often focus on addressing independent risk factors despite the fact that clustering patterns may have the greatest implications for prevention [10]. Researchers have, for example, highlighted that heavy alcohol use and heightened psychological distress often coincide with risky firearm behaviors, such as unsafe storage and increased carrying [11–13]. As such, individuals experiencing multiple psychological and/or behavioral indicators of firearm injury risk (e.g., alcohol use and unsecured firearm storage,) may face greater risk compared to those experiencing a single indicator or no indicators.

Firearm Storage, Carrying, and Other Co-occurring Risk Indicators

Firearm injury risk is shaped by both firearm access and how access clusters with other risk factors. Specifically, unsecure storage is associated with elevated risk of intentional and unintentional firearm injury [14,15], and carrying outside the home is associated with elevated risk of interpersonal violence, in part because it increases exposure to situations in which conflict can escalate to a firearm assault injury [16,17].

Unsecure storage and carriage may be especially consequential for individuals with higher levels of mental health symptoms and alcohol use [18]. Firearms have an approximately 90% case-fatality rate in suicide attempts [19], making immediate access to a firearm particularly consequential for individuals experiencing high levels of psychological distress, including suicidal ideation. To this end, researchers have found unsecure firearm storage as an important

modifiable risk factor for firearm suicide and firearm injury [20,21]. Alcohol use may create a parallel vulnerability to firearm injury through acute intoxication and impaired judgment. While alcohol use is a common coping response to psychological distress [22], reviews find substantial associations between alcohol use and both self-directed and interpersonal firearm violence, and acute alcohol use is common among firearm-violence decedents [17,23,24]. Moreover, a recent scoping review of 42 studies published between 2015 and 2023 shows that both alcohol use and alcohol use disorder are consistently linked to increased firearm ownership, unsafe storage, and carrying [11]. Thus, rather than considering psychological distress, alcohol use, firearm carriage, and unsecured storage as independent risk factors, examining how they cluster may better identify circumstances in which firearm access is most likely to result in injury.

Taken together, firearm injury risk is rarely the product of a single indicator; rather, it emerges from the intersection of multiple psychological and behavioral factors which can interact in ways that produce synergistic rather than merely additive effects [25–27]. Yet, there is limited understanding of clustering patterns among firearm owners and which social and environmental factors predict the patterns. Further, recent research has demonstrated heterogeneity among firearm owners in terms of both risk exposure and the psychological and behavioral indicators associated with firearm injury risks [28,29]. Using a person-centered analytic approach to better understand such differences can have important implications for prevention practices.

Contextual Stressors Experienced by Asian Americans

The clustering of these risk factors is especially pronounced in marginalized communities, as they can be shaped by prolonged stress and trauma such as exposure to violence and racial discrimination [30–32]. This may be particularly relevant for Asian Americans who have

experienced substantial increases in anti-Asian discrimination and violence since the COVID-19 pandemic [32,33]. For example, police-reported anti-Asian hate crimes across 15 major U.S. cities rose 169% in the first quarter of 2021 compared with the first quarter of 2020 [33], and community-based reporting systems documented thousands of self-reported anti-Asian hate incidents since the start of the pandemic [34]. These experiences, documented in separate studies, have been associated with elevated levels of psychological distress [32,35–38], alcohol and substance use as a form of self-medication [39–42], and firearm acquisition among Asian Americans, suggesting that these contextual stressors may contribute to multiple, co-occurring pathways of firearm injury risk [32].

Moreover, Asian Americans are diverse in cultural, historical, and socioeconomic backgrounds, leading to important differences in both exposure to contextual stressors as well as how mental health symptoms, substance use, and firearm injury risk behaviors may interact and cluster across individuals [27,43–45]. A recent study examining the correlates of firearm ownership and storage practices among Asian Americans, for example, has found significant subgroup differences in both risk exposures and firearm-related behavioral outcomes [30], suggesting that a variable-centered approach with aggregated data may not capture distinct profiles of injury risk within this population. To this end, person-centered approaches such as latent profile analysis can identify multiple, distinct patterns of co-occurring risk factors [46,47], which can shed light on more precise prevention efforts for individuals with different risk patterns.

Current Study

To our knowledge, no research has examined the concurrent patterns of firearm-related behaviors, alcohol use, and psychological distress, or how contextual stressors relate to these patterns [12,13]. To address these gaps, this study 1) uses a person-centered approach to

identify distinct patterns of risk indicators associated with firearm injury among Asian American household firearm owners, including firearm behavior, alcohol use, and mental distress, and 2) examines the separate associations of exposure to violence and interpersonal and cultural mistreatment with risk profile membership.

Methods

Study Design

Data were drawn from the Study of Asian Firearm Exposure Risk and Resilience (SAFER) National Survey, a probability-based survey of U.S. Asian adults launched between April and June 2024. In partnership with Gallup, participants were recruited utilizing a dual-frame probability sampling design to ensure national representation and enhance coverage of hard-to-reach subgroups. The frames included: (1) an address-based sample (ABS) drawn from the U.S. Postal Service Delivery Sequence File, utilizing the next-birthday method for household selection; and (2) the probability-based Gallup Panel™. To maximize accessibility, surveys were administered via web or paper in English and six Asian languages (Simplified & Traditional Chinese, Korean, Vietnamese, Filipino/Tagalog, Urdu, and Hindi). Eligible participants self-identified as Asian, were 18 years of age or older, and resided in the United States. The study protocol was reviewed and approved by the Institutional Review Boards of The University of Michigan and Gallup, Inc. The full SAFER survey recruitment yielded a total sample of 1,806 eligible Asian adults. Overall, 386 (21.4%) lived in a household with one or more firearms: 247 (13.7%) personally owned a firearm and 139 (7.7%) lived with a firearm owner but did not personally own one.

Analytic Sample

The current study seeks to identify patterns of firearm storage, carrying, alcohol use, and mental distress as risk indicators of firearm injury and examine associated risk exposures. Hence, our

analyses focus on participants who reported having access to firearms (i.e., either personal firearm owners or living in a household with at least one firearm) (n=386).

Measures

Indicators for Latent Profile Analyses

Firearm carrying was measured using an item adapted from the National Firearm Survey [48]: “What were all the reasons that you carried a gun in the PAST 12 MONTHS? Please select all that apply.” Response options included: for protection against people; for protection against animals; for work; for hunting, target shooting, or at a gun range; other reason; and "I did not carry a gun in the past 12 months." To focus on carrying behaviors most relevant to personal defense and violence risk, we excluded responses for carrying exclusively for hunting, sport shooting, or work-related reasons. Participants who selected "other reason" were manually reviewed and recoded to ensure validity. The final measure was dichotomized: respondents were coded as 1 (carrying in the past 12 months) if they endorsed at least one non-occupational/non-recreational reason for carrying a firearm. We coded this variable as 0 (no carrying) if they did not carry a gun in the past 12 months or only carried for the excluded reasons.

Firearm storage was assessed with two questions: “Are any of the guns on your property stored loaded?” and “Are any of the guns on your property stored unlocked?” Items were adapted from national firearm surveys [49]. Consistent with prior research for secure storage [47,50], valid responses were used to derive a three-level storage score, Responses were recoded to 0 (all guns locked & unloaded; responded “no” to both questions), 1 (somewhat unsecure; responded “yes” to either question), and 2 (least secure; responded “yes” to both questions). Respondents who selected “unsure”, “prefer not to answer” or skipped either storage question were treated as missing.

Heavy Alcohol Use. We measured heavy alcohol use using a composite of three frequency items: 1) past-30–day alcohol use (0 = never to 7 = 40+ times); 2) past–2-week heavy episodic drinking (frequency of consuming ≥4 drinks for females or ≥5 drinks for males on one occasion; 0 = none to 6 = 10+ times); and (3) frequency of drinking to get drunk (0 = never to 5 = on all occasions). We conducted a principal component analysis (PCA) on the three items and extracted the first principal component score (captures 73.1% of the variance) to represent levels of heavy alcohol use.

Mental Distress. We measured mental distress symptoms using three validated scales. Anxiety symptoms are assessed with an 8-item scale (Ω = 0.94) originally developed by Spitzer et al. [51]. Depressive symptoms are evaluated using a 7-item scale (Ω = 0.89) from Kroenke et al. [52] as part of the PHQ-9. Both are on a 4-point frequency scale ranging from 1= not during the past two weeks to 4= five or more times in the past two weeks. PTSD symptoms are assessed using the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5, KR-20 = 0.79) developed by Prins et al. [53]. PTSD was coded by summing five binary 1=yes/0=no items for PTSD symptoms, with those without trauma coded as 0. Finally, given prior study showed good reliability and validity with composite scores of mental distress scales [52], we conducted a principal components analysis (PCA) using the three scales and retained the first principal component, which accounted for 69.4% of the variance.

Independent Variables

Exposure to Violence. We measured exposure to violence (ETV) with three separate measures assessing frequency of experiences in the past 12 months on a 6-point scale (1 = never to 6 = almost every day). Firearm violence exposure was assessed with two items: hearing gunfire or

witnessing a shooting; having someone close been shot [54]. Violent victimization was measured using three items (Ω = 0.80): being threatened, physically assaulted, or having something taken using physical force [55]. Observing violence was assessed with three items (Ω = 0.85): seeing a violent crime, someone stabbed or beaten up, or shot) [55]. We conducted a PCA with the three scales and extracted the first principal component score (captures 54.3% of the variance), supporting its use as a parsimonious summary measure of exposure to violence and consistent with prior work combining similarly structured violence-exposure subscales into a single composite score [55,56].

Interpersonal and Cultural Mistreatment. Interpersonal and cultural mistreatment was measured using a brief 6-item scale [57] (Ω = 0.87) assessing experiences in the past 12 months attributed to being Asian, including subtle (3 items) and blatant (2 items) discrimination rated on a 6-point frequency scale (1 = 0 times in the past 12 months to 6 = almost every day) and cultural racism (1 item) rated on a 5-point scale (1 = mostly negative to 5 = mostly positive) and reverse-coded so that higher scores indicate more negative portrayals. The brief scale was adapted from previously established scales measuring subtle, blatant, and cultural anti-Asian discrimination [57–60] and tested among an Asian American sample as a unidimensional scale for high reliability and concurrent validity with mental distress symptoms and firearm purchase behaviors [57]. Item scores were standardized and summed to create a composite score of interpersonal and cultural mistreatment, with higher scores reflecting more frequent mistreatment.

Analytic Approach

Analyses proceeded in three steps. First, we examined the extent and patterns of item-level missingness to inform how missing data were handled. Second, we used latent profile analysis (LPA), a person-centered approach that identifies unobserved subgroups of individuals who share similar configurations of indicators, to classify

firearm owners by their patterns of firearm carrying, firearm storage, heavy alcohol use, and mental distress. Third, we examined the associations of exposure to violence and interpersonal and cultural mistreatment with profile membership while accounting for uncertainty in profile classification.

Missingness Analysis

Item-level missingness (Supplementary Table S1) was low to moderate across analytic variables, from 0% for multiple variables to 12.7% (n=49) for firearm storage. Because firearm storage is an LPA indicator, we compared owners with valid vs. missing storage data on the other study variables to evaluate whether this missingness was related to key risk indicators, exposures, or demographics. Owners missing storage data were less likely to be male or to report firearm carrying and reported lower exposure to firearm violence than owners with valid storage practice data (all $p<.05$), with no other significant differences (Supplementary Table S2). Given the missing completely at random (MCAR) assumption not met, we decided to proceed with the FIML approach that only requires missing at random (MAR) for the latent profile analysis, retaining all partially missing data [61,62]. Because the R3STEP approach requires complete data on the predictor and covariates [63,64], the mistreatment and ETV models retained 351 (90.9%) and 366 (94.8%) of the 386 owners, respectively. Owners dropped from the mistreatment model reported lower blatant ($M=1.24$ vs. 1.50 among retained owners, $t(79)=3.69$, $p<0.001$) and subtle ($M=1.36$ vs. 1.68, $t(60)=3.37$, $p=0.001$) discrimination, and lower alcohol use ($M=-0.29$ vs. 0.32, $t(40)=2.59$, $p=0.013$), than retained owners. Owners dropped from the ETV model reported higher levels of observed violence ($M=1.79$ vs. 1.22 among retained owners, $t(12)=-2.39$, $p=0.034$) than retained owners. No other significant differences were observed in either model (Supplementary Tables S3-S4).

Identifying Distinct Latent Profiles

The analytic sample for the latent profile analysis includes Asian American firearm owners (n = 386) and incorporates firearm behavior indicators, including firearm carrying (binary) and a three-level categorical measure of firearm storage practices (secure, somewhat unsecure, least secure), and a composite score of mental distress and heavy alcohol use (treated as continuous variables). All models incorporated poststratification weights to align the sample with the Asian adult population residing in U.S. of the parent study [30]. Models were estimated in Mplus Version 8 using full-information maximum-likelihood estimation (FIML) with robust standard errors (MLR) [61,62]. To determine the optimal number of latent profiles, we compared models with different numbers of profiles using several fit indices, including Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), sample-size adjusted BIC (saBIC), and entropy. Finally, to ensure we select a parsimonious latent profile solution, our model selection balanced statistical fit (i.e., model fit, entropy) and substantive interpretation (i.e., the meaningfulness and distinctiveness of each profile).

Predictors of Latent Profile Membership

To evaluate the independent effects of contextual stressors on latent profile membership across both analytic phases, we estimated multinomial logistic regression models using the Vermunt three-step approach (R3STEP) [63,64]. This procedure was utilized to account for classification uncertainty in latent class assignment while preserving the original latent profile solution after predictors are introduced. Because of smaller profile size and that mistreatment and violence exposure were highly correlated (r = 0.451), we estimated a separate multivariable model for both stressors. All models were adjusted for age, gender, and educational attainment. We report the adjusted Odds Ratios (aORs) and 95% Confidence Intervals (CIs) using the largest class (also the lowest injury risk group) as the reference group.

Results

Descriptive Results

Table 1 presents weighted descriptive characteristics of the analytic sample of Asian American household firearm owners (N=386). Most owners self-identified as male (58.1%), and age was broadly distributed across adulthood, from 14.8% aged 18–29 to 13.0% aged 70 or older, with the largest share in their 30s (22.0%). Just over half held a bachelor's degree or higher (51.1%), and half were U.S.-born (50.4%). The sample reflected the ethnic diversity of the Asian American population, including Chinese (24.9%), Filipino (17.7%), Vietnamese (14.1%), Korean (7.4%), Japanese (6.2%), and Indian (6.1%) owners, along with 23.7% identifying with another Asian ethnicity. With respect to the indicators of firearm injury risk, most owners reported carrying a firearm in the past 12 months (55.7%), with others reported either no carrying or carrying exclusively for hunting, sport shooting, or work-related reasons. Firearm storage practices varied: 48.5% stored all firearms in the most secure manner (locked and unloaded), 29.5% stored at least one firearm somewhat unsecured (unlocked and unloaded **or** locked and loaded), and 22.0% stored at least one firearm least securely (at least one firearm loaded and unlocked). Weighted mean scores for the composite indicators were 0.40 (SD=1.81) for heavy alcohol use, 0.11 (SD=1.53) for mental distress, and 0.27 (SD=1.52) for exposure to violence; each was the first principal component score used in the analyses that follow. Because the interpersonal and cultural mistreatment items were rated on different response scales, items were standardized before summing; the resulting sum score, used in the profile-membership regression models, averaged 0.49 (SD=5.28).

Table 1

Demographic and Descriptive Statistics of Key Study Variables Among Household Firearm Owners (N = 386) of a National Sample of Asian Americans: United States, April-June 2024

Characteristic	**Overall** (N = 386)[1]
Gender	
Female and Other*	41.88% (34%, 51%)

Characteristic	**Overall** (N = 386)[1]
Male	58.12% (49%, 66%)
Age	
18-29	14.83% (8.9%, 24%)
30-39	22.01% (16%, 30%)
40-49	18.22% (13%, 25%)
50-59	19.40% (14%, 27%)
60-69	12.54% (8.7%, 18%)
70 years old or older	13.00% (7.7%, 21%)
Education	
Less than bachelor's	48.86% (40%, 58%)
Bachelor's and above	51.14% (42%, 60%)
Ethnicity	
Chinese	24.92% (19%, 31%)
Filipino	17.66% (12%, 26%)
Indian	6.09% (3.6%, 10%)
Japanese	6.17% (3.8%, 9.8%)
Korean	7.39% (4.6%, 12%)
Vietnamese	14.12% (8.3%, 23%)
Other	23.65% (16%, 33%)
US Born	50.38% (42%, 59%)
Interpersonal and Cultural Mistreatment (standardized sum score)	0.491 (5.283)
Exposure to violence (PC1)	0.267 (1.518)
Exposure to firearm violence	3.201 (0.987)
Violent victimization	1.142 (0.358)
Observing violence	1.261 (0.587)
Firearm storage	
Least secure	22.03% (15%, 32%)

Characteristic	**Overall** (N = 386)[1]
Somewhat unsecure	29.46% (22%, 38%)
Most secure	48.51% (39%, 58%)
Firearm carrying	55.72% (47%, 64%)
Heavy alcohol use (PC1)	0.403 (1.808)
Mental distress (PC1)	0.114 (1.527)

[1]%; Mean (SD)

Abbreviation: CI = Confidence Interval

Note. Results are weighted % (95% CI) for categorical measures and weighted mean (SD) for continuous measures. Ns vary by variable due to item missingness; item-level missingness is reported in Table S1. * Participants self-reported their gender identity; other includes nonbinary and an identity not listed.

Distinct Profiles of Firearm Injury Risks

LPAs were conducted among firearm owners (N = 386) using four indicators of firearm injury risk: unsafe firearm storage, firearm carrying, alcohol use, and mental distress. Models with 1 to 6 classes were estimated and compared using a combination of fit indices, classification accuracy, and theoretical interpretability (Table 2).

The 3-class solution was selected as the optimal model. The AIC, BIC, and saBIC decreased substantially from the 1-profile to the 3-profile model, indicating improved fit. Although the 4-profile solution yielded lower information criterion values, it resulted in a profile comprising only 3.2% of the sample (n=12), limiting stability for subsequent regression analyses. Moreover, the additional profile was not conceptually distinct and reflected an incremental difference in mental distress severity relative to an existing profile. In contrast, the 3-profile solution maintained conceptually distinct profiles with sufficient class sizes (smallest class 9.5%) and demonstrated high classification accuracy (entropy = 0.91). Thus, the 3-profile solution provided the optimal balance of parsimony, fit, and interpretability (as shown in Table 2).

Table 2

Fit Indices for Latent Profile Analysis Models (1-6 Classes), Firearm Owners

Model	npar	AIC	BIC	saBIC	VLMR (p)	Entropy	Smallest Class %
1 Class	7	4026.49	4054.18	4031.97	--	--	100.00
2 Classes	13	3812.89	3864.32	3823.07	.320	.916	18.26
3 Classes	**19**	**3745.49**	**3820.65**	**3760.36**	**.567**	**.911**	**9.48**
4 Classes	25	3666.16	3765.06	3685.74	.472	.912	3.25
5 Classes	31	3591.03	3713.66	3615.30	.552	.916	3.55
6 Classes	37	3553.90	3700.27	3582.87	.520	.897	3.55

Note. N = 386 firearm owners. npar = number of free parameters; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; saBIC = sample-size adjusted BIC; VLMR = Vuong-Lo-Mendell-Rubin likelihood ratio test against the k - 1 class model. Smallest class % uses model-estimated class proportions. The bootstrapped likelihood ratio test is unavailable for weighted mixture models. The retained 3-class solution is shown in bold.

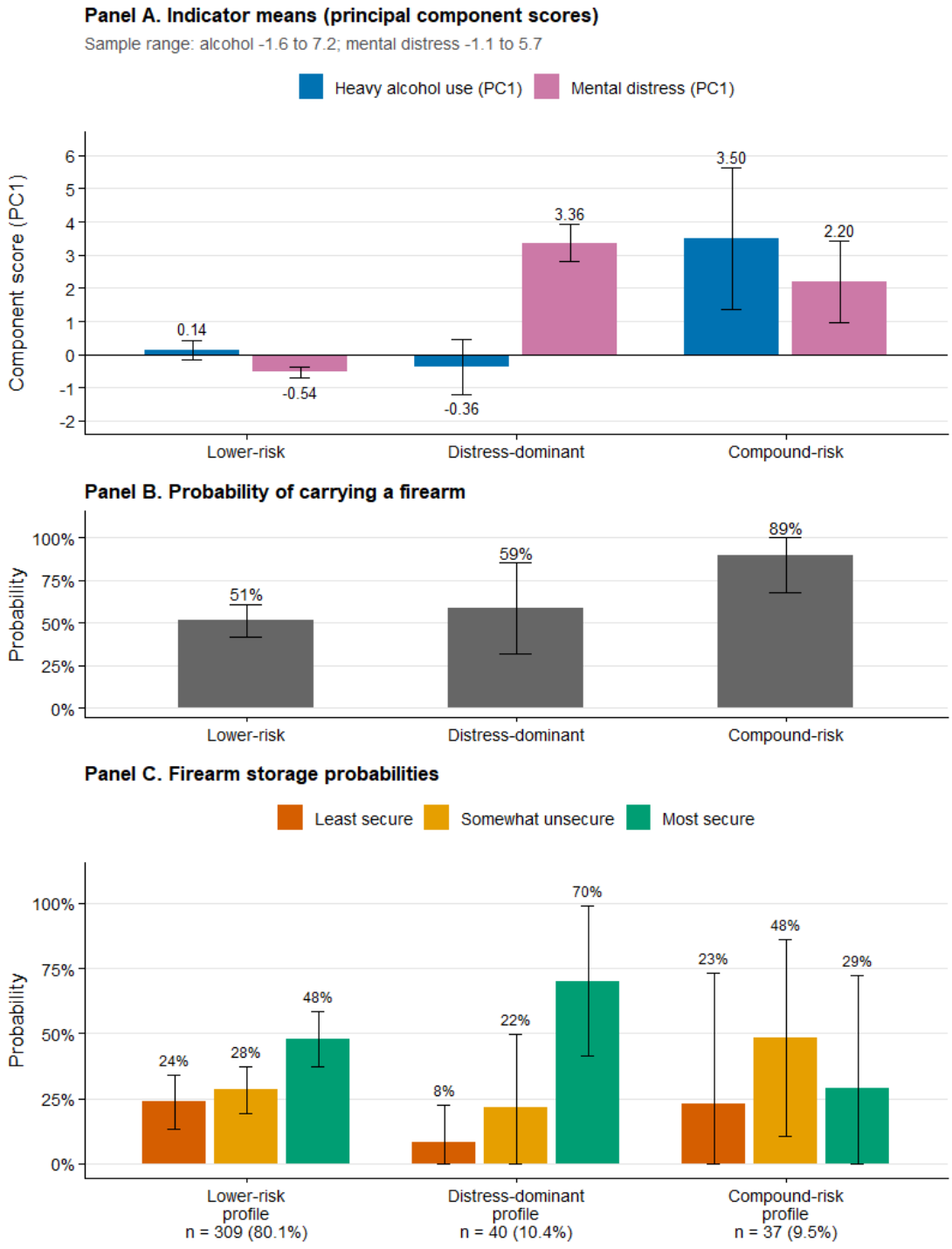
Figure 1 and Table 3 represent the estimated probabilities or mean levels of indicators across the three latent profiles. The compound-risk profile (Class 3; n = 37, 9.5%), was characterized by the highest involvement of risk behaviors, including elevated probabilities of firearm carrying (89.4%), the lowest probability of most secure storage (28.9%), alcohol use (Mean = 3.50), and mental distress (Mean = 2.20). The distress-dominant profile (Class 2; n = 40, 10.4%), was characterized by the highest levels of mental distress in the sample (Mean = 3.36) but relatively low alcohol use (Mean = -0.36), distinguishing it as a group driven primarily by psychological distress rather than substance use or carrying behaviors. This group is also characterized as having the highest probability of engaging in the most secure firearm storage (all guns locked and unloaded, 70.1%). Finally, the lower-risk profile (Class 1; n = 309, 80.1%), represents the largest group, characterized by the lowest probability of firearm carrying (51.4%) and lowest mental distress (Mean = -0.54), with low alcohol use (Mean = 0.14); its probability of least secure storage (23.7%) was comparable to that of the compound-risk profile (22.9%).

Figure 1

Indicator Means and Firearm Behavior Probabilities for the 3-Class Solution

Figure 1

Indicator Means and Firearm Behavior Probabilities for the 3-Class Solution



Note. N = 386 firearm owners. Bars are model estimates from the 3-class solution; whiskers are 95% confidence intervals computed from the model standard errors, truncated at 0 and 1 for probabilities. Class sizes are based on model-estimated class proportions (weighted counts rounded to integers).

Table 3

Estimated Probabilities and Means for the 3-Class Solution (n = 386), Class Size from Model-Estimated Proportions

	Class 1 Lower-Risk Profile n = 309 (80.1%)	Class 2 Distress-Dominant Profile n = 40 (10.4%)	Class 3 Compound-Risk Profile n = 37 (9.5%)
Probability of firearm behavior			
Firearm Carrying in the past 12m	51.4%	58.6%	89.4%
Storage practices			
Least secure (≥1 gun unlocked & loaded)	23.7%	8.4%	22.9%
Somewhat unsecure	28.3%	21.6%	48.2%
Most Secure (all guns locked & unloaded)	48.0%	70.1%	28.9%
Indicator means			
Heavy Alcohol Use	0.14	-0.36	3.50
Mental Distress	-0.54	3.36	2.20

Note. N = 386 firearm owners. Class sizes are the model-estimated class proportions, the prevalence parameters of the solution; the ns shown are the corresponding weighted counts rounded to integers (309.3, 40.1, and 36.6 unrounded) and are not respondent headcounts. This basis matches the smallest class percentage reported in Table 2. Probabilities are model-estimated item probabilities; storage categories are mutually exclusive and sum to 100% within class. Firearm carrying is the probability of carrying in at least one location. Heavy Alcohol Use and Mental Distress are class means of the alcohol and mental distress principal component scores (PC1), centered near zero.

Multivariable Associations

Unadjusted bivariate models (Table 4, Models 1 to 3) showed that male gender and older age were each associated with lower odds of distress-dominant profile membership relative to the lower-risk profile (OR=0.26, 95% CI=0.07–0.96; OR=0.72, 95% CI=0.55–0.94, respectively), and that holding a bachelor's degree or higher was associated with lower odds of compound-risk profile membership relative to both the lower-risk (OR=0.13, 95% CI=0.02–0.75) and distress-dominant (OR=0.07, 95% CI=0.01–0.78) profiles.

After adjusting for gender, educational attainment, and age, more frequent interpersonal and cultural mistreatment was associated with higher odds of classification into the distress-dominant profile (aOR = 1.22, C.I. = [1.06, 1.40]) and the compound-risk profile (aOR = 1.30, C.I. = [1.08, 1.55]), relative to the lower-risk profile (Table 4, Model 4). Older age was associated with lower odds of classification into the distress-dominant profile (aOR = 0.67, C.I. = [0.47, 0.96]), while education and gender were not significant. Likewise, in a separate model (Table 4, Model 5), higher exposure to violence was associated with greater odds of classification into the distress-dominant profile (aOR = 1.42, C.I. = [1.01, 2.00]) and the compound-risk profile (aOR = 1.65, C.I. = [1.04, 2.61]), relative to the lower-risk profile, net of age, education, and gender. Notably, because the mistreatment (standardized sum score, SD = 5.28) and ETV (first principal component, SD = 1.52) predictors are scaled differently, a 1-unit increase does not represent an equivalent magnitude of exposure across the two models. The aORs above should therefore be interpreted within, rather than compared across, each model.

Table 4

Unadjusted and Adjusted Multinomial Logistic Regression Results Predicting Latent Class Membership Among Asian American Firearm Owners

Predictor	Comparison	*B*	*SE*	OR	95% CI	*p*
Model 1: Gender (unadjusted), N = 376						
Male	Class 2 vs. Class 1	-1.34	0.66	0.26*	[0.07, 0.96]	.043
Male	Class 3 vs. Class 1	-0.49	0.84	0.61	[0.12, 3.17]	.560
Male	Class 3 vs. Class 2	0.85	1.07	2.34	[0.29, 19.19]	.427
Model 2: Education (unadjusted), N = 385						
Bachelor's or above	Class 2 vs. Class 1	0.66	0.84	1.93	[0.38, 9.96]	.431
Bachelor's or above	Class 3 vs. Class 1	-2.04	0.89	0.13*	[0.02, 0.75]	.022
Bachelor's or above	Class 3 vs. Class 2	-2.69	1.25	0.07*	[0.01, 0.78]	.031
Model 3: Age (unadjusted), N = 386						
Age category	Class 2 vs. Class 1	-0.33	0.14	0.72*	[0.55, 0.94]	.017
Age category	Class 3 vs. Class 1	-0.26	0.41	0.77	[0.34, 1.72]	.525
Age category	Class 3 vs. Class 2	0.07	0.43	1.07	[0.46, 2.50]	.868

Predictor	Comparison	*B*	*SE*	OR	95% CI	*p*
Model 4: Interpersonal and cultural mistreatment (adjusted for gender, education, and age), N = 351						
Interpersonal and cultural mistreatment	Class 2 vs. Class 1	0.20	0.07	1.22**	[1.06, 1.40]	.005
Interpersonal and cultural mistreatment	Class 3 vs. Class 1	0.26	0.09	1.30**	[1.08, 1.55]	.005
Interpersonal and cultural mistreatment	Class 3 vs. Class 2	0.06	0.11	1.06	[0.86, 1.31]	.582
Model 5: Exposure to Violence (adjusted for gender, education, and age), N = 366						
ETV	Class 2 vs. Class 1	0.35	0.17	1.42*	[1.01, 2.00]	.042
ETV	Class 3 vs. Class 1	0.50	0.23	1.65*	[1.04, 2.61]	.034
ETV	Class 3 vs. Class 2	0.14	0.22	1.15	[0.76, 1.76]	.505

Note. N = 386 firearm owners; Ns vary by model due to listwise deletion on the auxiliary variables. B = log-odds; SE = standard error; OR = odds ratio; CI = 95% confidence interval. Class 1 (lower-risk profile) is the reference for the first two comparisons; Class 3 vs. Class 2 uses Class 2 as the reference. Class 2 is the distress-dominant profile and Class 3 the compound-risk profile. Estimates are from the 3-step procedure (R3STEP) with survey weights. Interpersonal and cultural mistreatment is the six-item standardized sum score and ETV the first principal component; ORs are per 1-unit increase. Models 4 and 5 adjust for gender, education, and age. * p < .05. ** p < .01. *** p < .001.

Discussion

The three profiles of psychological and behavioral risk that we identified suggest significant within-group variation among Asian American firearm owners. The two risk profiles (i.e., compound-risk and distress-dominant) may reflect meaningfully different configurations of coping and firearm-related behaviors. The compound-risk profile represents an especially concerning configuration because firearm carrying, less secure storage, and alcohol use have each been linked with greater firearm injury risk [27,44,65–67]. Moreover, the clustering of these risk factors may be interpreted through the stress and coping framework [68], whereby individuals experiencing elevated distress may rely on maladaptive coping resources such as alcohol use and firearm carrying, which heighten risk for firearm injury. In contrast, the distress-dominant profile may reflect a different response to stress. Although these individuals reported the highest mental distress and more than half still carried firearms, they reported low levels of alcohol use and were more likely than individuals in the compound-risk profile to securely store

their firearms. This pattern may reflect a more safety-oriented response in which firearm access is maintained, potentially for protection, while other behaviors that increase immediate risk for firearm injury are minimized. Together, these profiles suggest that mental distress alone may be insufficient for identifying firearm injury risk; rather, risk may be conditional on whether distress co-occurs with other risk factors such as alcohol use, firearm carrying, and unsecured storage.

Our finding that exposure to violence and interpersonal and cultural mistreatment was associated with membership in the compound-risk profile suggests that psychological and behavioral risk indicators defining this profile are not simply individual-level characteristics but are shaped by contextual and interpersonal factors. This is consistent with a stress-mediated pathway in which exposure to anti-Asian discrimination and violence dysregulates psychological functioning [35–38], increases reliance on alcohol as a maladaptive coping mechanism and motivates both firearm acquisition and active carrying due to heightened safety concerns [43,69–72]. In this sense, the compound-risk profile reflects the embodiment of structural adversity in individual behavior. Prior studies have demonstrated that limiting access to lethal means such as secure firearm storage or temporary removal of firearms, can be powerful approaches to prevent firearm injury and deaths when individuals are at heightened risk of mental crisis [73,74]. However, such prevention approaches may be insufficient if the upstream factors driving harmful behaviors remain unaddressed. Sustainably reducing the associated firearm injury and mortality, therefore, requires multilevel approaches that address both individual outcomes and the structural and community conditions that fundamentally drive the safety concerns, stress, and subsequent health outcomes [75,76].

Interestingly, while our analysis indicated that the association between the distress-dominant profile and exposure to violence and interpersonal and cultural mistreatment is somewhat

attenuated compared to the compound-risk profile, the psychological consequences of interpersonal and cultural mistreatment and violence exposure are concerning because Asian Americans remain the group least likely to access mental health care compared with any other race/ethnicity groups in the U.S. [77–80]. Frequent exposure to interpersonal and cultural mistreatment and violence can increase the unmet need for mental health care, heightening the risk of potential harm. Therefore, prevention efforts targeting this profile should consider components addressing the underlying distress and its drivers as a primary concern.

Limitations

Some limitations of this study are to be noted. First, the cross-sectional design precludes causal inference between violence exposure and mistreatment experienced by Asian Americans and the risk factors of firearm injury. Similarly, the relatively small highest-risk latent profiles limited the number of control variables that could be included because of statistical power issues. Future research that includes longitudinal data in a larger sample of Asian American firearm owners would be a useful direction for future research. Nevertheless, we provide a first look at the association between systemic trauma and a compounding injury risk pattern. A second limitation is that we did not examine differences in the configuration of risks across different Asian ethnic groups, despite the substantial heterogeneity in culture, history (e.g., migration experiences), and assets and resources. Yet, identifying clustered risk patterns is an essential first step to identifying at-risk populations and informing public health preventive efforts. Third, while the latent profile analysis accommodated partially missing data through full-information maximum likelihood estimation, the R3STEP models required complete data on each predictor and covariate. Our missing data analysis indicated that the dropped sample may differ in some variables from the analytic sample for both models. In particular, owners dropped from the

mistreatment model had lower mistreatment and alcohol use than those retained; owners dropped from the ETV model had higher observed violence than those retained. For the ETV model in particular, missing higher-exposure owners means the retained sample may under-represent these owners experiencing higher levels of violence, and this would more likely underestimate than inflate the association between ETV and higher-risk profile membership. The direction of potential bias in the mistreatment model is less clear, as dropped owners reported both lower mistreatment and lower alcohol use. Nevertheless, the proportion of owners excluded was small (5.2% for the ETV model and 9.1% for the mistreatment model), and dropped owners did not differ from retained owners in firearm carrying or mental distress in either model, making it unlikely that listwise deletion substantively altered the findings.

While using this person-centered approach in examining the injury risk indicator variables allows us to capture unobserved heterogeneity in firearm behaviors, mental distress and alcohol use, our inclusion of systemic stressors as predictors relied on a traditional variable-centered approach. This mean-level approach assumes a log-linear relationship between systemic stressors and outcome and precludes the examination of exposure heterogeneity. It is plausible that systemic stressors themselves cluster into distinct typologies of trauma (e.g., profiles of exclusively subtle mistreatment versus multi-contextual victimization) that may interact to drive firearm behaviors. Even so, our findings demonstrated a significant dose-response relationship between the magnitude of systemic stressors and injury risk profile membership, building the foundation of evidence on the shared risk factors shouldering Asian Americans. Future research could consider fully person-centered mixture models for both exposure and outcome variables to simultaneously identify profiles of systemic stress exposure and evaluate how these exposure typologies could link to high-risk patterns. Lastly, our objective was to assess the association of violence exposure and interpersonal and cultural mistreatment with risk-profile membership separately, without conditioning either association on the other exposure. Nevertheless, the

smaller-than-anticipated profiles and moderate correlation between exposures (r=0.45) would limit the precision of estimates from a joint model. Future studies could oversample Asian American firearm owners to examine how violence exposure, interpersonal and cultural mistreatment, and other contextual risks jointly relate to firearm injury risk.

Conclusions

These limitations notwithstanding, this is the first study to apply a person-centered approach to examine how psychological and behavioral risk factors cluster among Asian American firearm owners and how structural factors relate to at-risk profiles. Our results suggest that exposure to both violence and interpersonal and cultural mistreatment is associated with heightened firearm injury risk across multiple psychological and behavioral domains. While researchers have identified distinct constellations of risk patterns among firearm owners [29,47], youth firearm suicide [81], and youth presenting to emergency departments [28], this approach has not been applied to Asian American firearm owners. This omission is important because Asian Americans experience high levels of violence and anti-Asian discrimination, which in separate studies, have been linked with psychological distress, alcohol use, and firearm injury-related risk behaviors such as acquisition and carrying [30,32]. Examining how these risks co-occur may, therefore, reveal subgroups of Asian American firearm owners with distinct constellations of risk that may be especially relevant for firearm injury prevention. This is particularly valuable for prevention research because it identifies vulnerable subgroups defined by the simultaneous presence of multiple risk factors, enabling interventions to be targeted to those who need them most rather than applied uniformly across a population with heterogeneous risk profiles.

Abbreviations

ABS: address-based sample

AIC: Akaike's Information Criterion

aOR: Adjusted Odds Ratio

BIC: Bayesian Information Criterion

CI: Confidence Interval

DSM-5: Diagnostic and Statistical Manual of Mental Disorders, 5th Edition

ETV: exposure to violence

FIML: full-information maximum likelihood

LPA: latent profile analysis

MAR: missing at random

MCAR: missing completely at random

MLR: maximum likelihood with robust standard errors

OR: Odds Ratio

PCA: principal component analysis

PHQ-9: Patient Health Questionnaire 9

PTSD: Post Traumatic Stress Disorder

R3STEP: Vermunt three-step approach

saBIC: sample-size adjusted BIC

SAFER: Study of Asian Firearm Exposure Risk and Resilience

SD: Standard deviation

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Declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by The University of Michigan Institutional Review Board (HUM00233679) and Gallup, Inc. Institutional Review Board (202602-17). Participants consented to participate in the project in compliance with 45 CFR §46.

Consent for publication

Not Applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests.

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Authors' contributions

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DBL: Formal analysis, Methodology, Validation, Writing – original draft.

ZH: Conceptualization, Writing – original draft.

EGH: Project administration, Writing – original draft.

AC: Conceptualization, Formal analysis, Methodology, Validation, Writing – original draft.

JEH: Writing – review & editing.

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