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A person-centered examination of adverse childhood experiences and associated distal health, mental health, and behavioral outcomes in the United Arab Emirates

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Abstract

Background An increasing body of evidence highlights the utility of examining adverse childhood experiences (ACEs) utilizing person-centered analytical approaches, particularly for understanding the organization and co-occurrence of ACEs, and their contributions to risk, vulnerability, and the development of intervention efforts.

Methods In the first study of its kind, this paper uses Latent Class Analysis, to assess ACEs among a large community sample in Abu Dhabi, capital city of the United Arab Emirates, by examining patterns of ACEs and their associated impact on health, mental health, behavioral risk, and adult psychological function in a cross-sectional sample of 922 members of the Abu Dhabi community.

Results Findings support a 3-class solution, representing low-to-no ACEs, Household ACEs, and Violence ACEs among this sample, with variability in the age, sex, and nationality status reflected across classes. ACE categories notably differentiated later adult risk for a suite of diagnoses of health and mental health disorders, risk for elevated screening values for depression, anxiety and stress, and a range of adult risk-related behaviors.

Conclusion These findings are considered in line with the extant literature and form the basis of considerable public health policy and intervention planning in Abu Dhabi, the United Arab Emirates, and the Arab region.

Keywords Child protection, Child abuse, Adverse childhood experiences, Latent class analysis, Person-centered, United Arab Emirates

Background

Recognized as traumatic occurrences during the formative period of childhood, prior to reaching the age of 18, adverse childhood experiences (ACEs) encompass a spectrum of adverse situations, including maltreatment, neglect, abuse, and trauma [1]. The empirical linkage between ACEs and a myriad of detrimental consequences across the lifespan is well-established, manifesting notably in cascading adverse impacts on both mental and physical health [2, 3]. This association is compounded by the tendency for ACEs to seldom transpire in isolation,

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as evidenced consistently in the extant literature [4–6], where a dose–response association is frequently evidenced. The results of which reflect an estimated 3–6% of a country's GDP as the financial cost attributable to ACEs [7]. Consequently, concerted efforts persist in comprehending the nature, scope, and sequelae of ACEs on a global scale. Recent evidence from Madigan and colleagues [6], based on data from half a million adults in a global meta-analysis, provides further support for the risks of compounding ACEs, further underscoring its significance as a considerable global public health concern, grounded in culture and context [8], of pressing social consequence [6] at significant public cost [7].

Traditional assessments of ACEs and their consequences have historically employed a cumulative approach, treating ACEs as categorical, unitary entities with equal weighting [3, 9]. The trajectory of this expanding body of knowledge has emphasized the utility of understanding the compounding effects of ACEs at a general level, albeit offering limited insights into the specific nature of individual ACEs, their co-occurrence patterns, and disparate impacts [10–12]. Recent scholarship, however, has presented compelling evidence supporting the examination of ACE co-occurrence and clustering, particularly due to its implications for preventive and therapeutic interventions [11, 13]. This approach involves identifying cohorts with shared experiences, risks, and outcome profiles, thereby advancing our understanding of the nuanced interplay between ACEs and facilitating more targeted and effective interventions [12, 14, 15].

In the United Arab Emirates (UAE), the existing evidence does not diverge significantly from global patterns in child maltreatment. Recent research by Shah and colleagues [16] reveals that 33.9% of respondents experienced emotional abuse, 12.6% experienced physical abuse, and 12.1% had experienced neglect, suggesting these are the most prevalent types of maltreatment experiences among the UAE sample. The repercussions of such maltreatment include an elevated risk of substantial depressive symptomatology, diminished self-esteem, extended screen-time, and an upsurge in smoking and tobacco usage [16]. Despite earnest endeavors to establish robust reporting mechanisms for child abuse, as mandated by legislation in the UAE, Sachdeva [17] suggests that a substantial majority of abuse and neglect cases remain unreported to authorities. This underscores the importance of self-report measures as a pivotal tool in comprehending the intricacies of sensitive issues within the UAE sample [16]. More recently Long and Colleagues [18] provide an initial view of the ACEs landscape in the UAE, ascertaining that the average number of ACEs in a cross-sectional community sample from Abu Dhabi is approximately 1.74, and that when

considered cumulatively, ACEs are predictive of a suite of adult-onset health and risk concerns, while Murphy and colleagues [19] elicit the long-term impact cumulative ACEs have on depression, anxiety, and stress when controlling for demographics, presence of disease diagnoses, and lifestyle factors, the understanding of the extent and nature of ACEs remains embryonic in the UAE. Concurrently, specific health concerns pertaining to chronic diseases are noteworthy in the UAE. Nationally, elevated levels of cancer, cardiovascular disease, diabetes, health issues associated with high body mass index (BMI), and heightened rates of smoking are documented [20]. The burden of cardiovascular disease is particularly salient [21], and mental health issues, most notably depressive disorders, exhibit prevalence estimates surpassing the global average. In Abu Dhabi specifically, prevalence rates range from 12.5% to 28.6%, with acknowledged inherent challenges related to underdiagnosis, casting doubt on the reliability of diagnosis figures and indeed self-report awareness of a diagnosis as an analogue for prevalence [22].

Despite the recognized imperative relating to child trauma, along with the association with long-term sequelae, there exists a conspicuous dearth of empirical research into the ramifications of adverse childhood experiences (ACEs) and their longitudinal effects in the United Arab Emirates (UAE), particularly the relative risk associated with differential ACEs accumulation patterns. The present study aims to apply person-centered analyses to adult retrospective accounts of ACEs among a large-scale UAE sample. Thereby enhancing insight into the presence, structure, and nature of ACEs at a community level. Furthermore, this study will assess ACEs with health, mental health, and risk-based behaviors, in addition to a validated assessment of current adult emotional distress through the distal measures of depression, anxiety, and stress using a validated screening tool.

Methods

Design & participants

This study was conducted in Abu Dhabi as part of a broader cross-sectional collection of research into communities, health, wellbeing, and behaviors in Abu Dhabi. 922 Individuals over the age of 18 living in Abu Dhabi were recruited for participants in this study, using multi-channel convenience sampling, including in-person and targeted media campaigns ensuring the breadth of outreach to communities across Abu Dhabi. Individuals were excluded if they were under the age of 18 years or not living in the Emirate of Abu Dhabi. Additionally, by virtue of being conducted in Arabic (native language) and English (business language and lingua franca of the UAE), participants were excluded if they were unable to read or

express themselves in either of these languages, however, to enhance accessibility based on reading levels, participants were offered interview-based data collection. This was not taken up in any case.

Materials

Demographics

The survey included a demographic component detailing the nature of the sample and screening for against inclusion and exclusion criteria. Participants' age, sex, nationality, residency status, level of educational attainment, marriage status, child status, and employment status were collected as continuous (e.g., age) or categorical responses (e.g., have you ever been married).

Adverse childhood experiences international questionnaire

Participants' adverse childhood experiences were assessed using the WHO's Adverse Childhood Experiences Questionnaire (ACE-IQ) developed by the World Health Organization [23]. The ACE-IQ was created as a standard for all countries for measuring the prevalence of ACEs and their association with risky behaviors later in life. Our study used the ACE-IQ to determine the exposure to different types of ACEs, including physical, sexual, and emotional abuse, family dysfunction, peer, community, and collective violence, and neglect by parents or caregivers.

The English [23] and Arabic [24] versions of the ACE-IQ were utilized for the purposes of the study after multi-faceted stakeholder engagement on the translation, back-translation, and cultural coherence of both versions. Participants provided informed consent and were made aware of their right to curtail the survey at any point without reason. Questions include items relating to the experiences of children, such as "When you were growing up, during the first 18-years of your life, how often did your parents not give you enough food even when they could easily have done so?" In accordance with ACE-IQ procedures, participants respond to questions based on their retrospective understanding with "Always", "Most of the time", "Sometimes", "Rarely", "Never", "Refused". Scores are then calculated based on the 'frequency' scoring procedures commensurate with ACE-IQ instructions [23].

Health survey

In addition to the ACE-IQ, participants were asked about any formal health diagnoses and current lifestyle factors. This survey consisted of yes/no responses to questions such as "Have you ever been formally diagnosed with, or told by a medical professional that you are at risk of, type 2 diabetes?" Participants gave a binary response to these

questions, which were coded as 0=no, 1=yes, 88=no response.

Depression, anxiety, and stress scale

(DASS-21) questionnaire is a validated instrument that rates these three dimensions of mental health in adults (validated in both clinical patients and non-patients), on a single, clear, and systematic scale [25, 26]. The scale benefits from being validated in Arabic [27] and has been extensively used in the UAE [18, 19].

Procedure and ethical considerations

The survey was conducted exclusively in Arabic and English, Arabic being the native language of the UAE and English the business language of the UAE. The questionnaire was distributed via an online survey distribution platform to the community at scale, using professional networks, gatekeepers, and collaborative partners. Additionally, social media penetration of the UAE is approximately 98% [28], accordingly, a social media campaign was utilized.

Trained research assistants were available to perform face-to-face interviews at the request of participants due to the sensitive nature of the ACE-IQ scale and was a response to stakeholder feedback relating to cultural sensitivity. Despite being made fully aware of this service, no participants opted for this support.

Participants were informed of their rights, a time commitment range for completion of the survey, and given a suite of physical/mental health referral contacts in the event of participation leading to distress. Participants were informed of their right to refrain from answering any question they were not comfortable answering and provided with a unique participant ID and given the right to remove their data within 2 weeks of data collection. This was exercised by 0 participants. The research was approved by the Institutional Review Boards of Georgetown University Medical Center (STUDY00004558), and the Abu Dhabi Department of Health (DOH/CVDC/2022/1029). The public were consulted throughout the design of the study to ensure appropriate accessibility of language, particularly given Arabic translation dialect considerations. Measures were implemented and piloted with a small, cross-sectional community sample and their feedback was pivotal in framing the survey, as well as in the briefing and debriefing materials (e.g., in relation to the trauma that may be experienced due to considerations of previous adverse childhood experiences). Findings will form the basis of public awareness, policy documentation, and white papers to inform practice, strategic priorities, and intervention efforts.

Data analysis

Data included between 0.1% and 2.6% missing values per variable, which had a random distribution (Little’s MCAR $\chi^2_{(95)}=97.935, p=0.398$), and were imputed using the expectation maximization algorithm. The distribution of observed variables was examined by calculating frequency distributions for binary variables and means and descriptive statistics for continuous variables. All analyses were conducted using M-Plus [29]. A-priori power analyses were conducted to verify an adequate sample size, where Cohen’s $f^2=0.20$, corresponding to a medium-to-large effect size, with a target power of 0.80, predicting three groups [11], sample of 474 participants was calculated as adequate. Further, in keeping with broad methodological considerations, where LCA is considered a large sample modelling technique, sample sizes of greater than 500 are recommended [30], therefore 500 was considered a baseline minimum. For consistency and ease of interpretation, decimal precision has been standardized across all tables. Chi-square results and descriptive statistics now reflect two decimal places unless three are necessary for interpreting values below 1.

Latent class analysis

The thirteen ACE variables were used as observed variables measuring a latent categorical variable (C). To identify an optimal model, models with two, three, and four latent classes were evaluated, considering several measures of goodness of fit, classification precision, and interpretability of the latent classes. Our evaluation involved the use of various indices of model fit, including the Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and sample size-adjusted BIC, which measure model parsimony and indicate better fit with lower values [29]. Lo-Mendell Rubin adjusted likelihood ratio (LRT) test was conducted to determine whether adding one more latent profile significantly improves model fit [30]. To assess classification precision, measures including average latent profile probabilities for most likely latent profile membership, classification probabilities for most likely latent profile membership, and entropy were assessed. The average latent profile probabilities and classification probabilities reflect the proportions of correctly classified cases in each group, while entropy, which ranges from 0 to 1, indicates the overall level of classification certainty [31].

Latent profiles were described by examining ACE probabilities for each group. Further, demographic information (sex and national status as an expatriate resident or a UAE national), physical health and mental health diagnoses, and behavioral risk factors across groups were examined. Chi-square tests examined the distribution

of categorical variables, and the independent-samples Kruskal–Wallis test to compare quantitative variables by latent class.

LCA with covariates and a distal outcome

Covariates were chosen based on guidance from a recent and comprehensive meta-analysis of prevalence and mediators of ACEs [6], while this study highlights marginal benefit from the incorporation of age, the recency and diversity of the UAE’s migrant population growth, along with the sample size achieved allow for a more exploratory approach to the incorporation of covariates. The latent class model included sex, age, and nationality as covariates of the latent categorical variable C. Additionally, we specified DASS_D (depression), DASS_A (anxiety), and DASS_S (stress) as distal outcomes of the latent categorical variable C. To minimize classification error, we employed a three-step approach to estimate the mixture model with covariates and a distal outcome, as outlined by [32]. The first step involved estimating the latent categorical variable C, followed by creating a nominal variable N that stored the most likely profile memberships. Finally, an estimation of the mixture model with the distal outcome, where N was used as an indicator of C, and the measurement error was set equal to the misclassification proportion estimated in the first step is established [33].

Results

A descriptive account of the continuous variables is illustrated below in Table 1. Here it can be seen that the average age of the sample was 38.33 years, with a range from 18–72 years. ACEs range from 0 (the lowest possible score on the tool used) to 13 (the highest possible score on the tool used), with an average ACE value of 1.74, a value similar to that seen internationally, including in North America [34].

Descriptive analyses

Latent class analysis

Models with two (Model 2), three (Model 3), and four (Model 4) classes were compared. Model 2 included a

Table 1 Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
DAS_D	921	.00	42.00	8.87	10.81
DAS_A	922	.00	42.00	7.19	9.09
DAS_S	922	.00	42.00	9.94	10.52
Overall ACEs	918	.00	13.00	1.74	2.22
Age	910	18	72	38.33	10.12
Valid N (listwise)	905				

group without ACEs and a group with multiple ACEs. Although this solution had higher entropy, it was not particularly informative, given that it only differentiated between ACEs present and ACEs absent. Model 3 was informative and described distinct ACE patterns. It had a significant Lo-Mendell-Rubin (LMR) test statistic, and a high level of classification precision. Model 4 included two groups with similar ACE patterns. Further, the inclusion of an additional class did not bring a significant improvement in model fit compared to Model 3, as shown by the non-significant LMR test statistic. Based on these considerations, a three-class model was considered optimal. The inclusion of covariates and distal outcomes in the three-class model (Model 3*) further improved the classification precision and fit to the data (Table 2).

The largest latent class ($n=717$, 77.77%) had low probability estimates on all ACEs, and was labeled Low-to-No-ACEs. The second largest group ($n=159$, 17.24%) had high probabilities on household member violence, sexual abuse, and parental death or divorce. This group was labeled Household-ACEs. The smallest group included 46 individuals (4.99%) who had extremely high probabilities of physical abuse, household member violence, and community violence. This group was labeled Violence-ACEs. Table 3 lists ACE probabilities and corresponding standard errors (*S.E.*), *t* statistics and two-tailed *p* values for each group. Figure 1 illustrates ACE probabilities by latent class. Average latent class probabilities and classification probabilities for the three latent classes ranged between 0.83 and 0.98 (Table 4 in the supplementary materials).

Comparisons by latent class

The Kruskal–Wallis test did not identify distributional age differences across latent classes and could not calculate a test statistic; however, the Low-to-No ACEs latent class had a higher average age, followed by Household ACEs and Violence ACEs latent classes (Table 5). The chi-square test showed that the

Violence ACEs latent class included a significantly larger proportion of individuals identifying as Emirati ($\chi^2_{(2)}=35.15$, $p<0.001$). Further, the Violence ACEs and Household ACEs latent classes included significantly lower than expected proportion of males, whereas the Household ACEs class included a larger than expected proportion of females ($\chi^2_{(2)}=29.78$, $p<0.001$).

Results from chi-square tests yielded significantly higher prevalence in the Violence ACEs and Household ACEs latent classes, and lower prevalence in the Low-to-No ACEs latent class of chronic respiratory problems ($\chi^2_{(2)}=34.75$, $p<0.001$), sexually transmitted diseases ($\chi^2_{(2)}=37.15$, $p<0.001$), cancer ($\chi^2_{(2)}=24.35$, $p<0.001$), depression ($\chi^2_{(2)}=151.99$, $p<0.001$), anxiety ($\chi^2_{(2)}=143.77$, $p<0.001$), other mental illnesses ($\chi^2_{(2)}=71.57$, $p<0.001$), usage of illicit drugs ($\chi^2_{(2)}=54.24$, $p<0.001$), and engagement in risky sexual behavior ($\chi^2_{(2)}=85.87$, $p<0.001$).

Additionally, the Violence ACEs latent class had a significantly higher prevalence of individuals with Type 2 diabetes ($\chi^2_{(2)}=11.65$, $p=0.003$) and obesity ($\chi^2_{(2)}=23.39$, $p<0.001$); the Household ACEs latent class had significantly higher proportions of individuals diagnosed with coronary heart disease ($\chi^2_{(2)}=18.75$, $p<0.001$), liver disease ($\chi^2_{(2)}=26.33$, $p<0.001$), fibromyalgia/chronic pain or fatigue ($\chi^2_{(2)}=25.29$, $p<0.001$), and individuals who reported smoking ($\chi^2_{(2)}=12.22$, $p<0.002$) or consuming alcohol on a regular basis ($\chi^2_{(2)}=61.89$, $p<0.001$). Table 5, in the supplementary material, reports the chi-square tests results for variable comparisons across latent classes.

The average DASS_D (depression) score was 6.54 ($SD=8.87$) for the Low-to-No ACEs latent class, 14.89 ($SD=11.81$) for the Household ACEs latent class, and 24.48 ($SD=13.62$) for the Violence ACEs latent class. DASS_A (anxiety) scores had an average of 5.33 ($SD=7.28$) for the Low-to-No ACEs group, 12.17 ($SD=10.69$) for the Household ACEs group, and 19.00 ($SD=12.74$) for the Violence ACEs group. Similarly, DASS_S (stress) scores had an average of 7.72 ($SD=8.38$) for the Low-to-No ACEs group, 15.80 ($SD=11.16$) for the Household ACEs group, and 24.48 ($SD=11.20$) for the Violence ACEs group. Results of independent-samples Kruskal–Wallis tests showed DASS_D (test statistic₍₂₎=142.679, asymptotic $p<0.001$) DASS_A (test statistic₍₂₎=118.750, asymptotic $p<0.001$), and DASS_S (test statistic₍₂₎=138.979, asymptotic $p<0.001$) scores differed significantly across latent classes, and follow-up pairwise comparisons showed that significant differences occurred between each pair of latent classes (Table 6).

Table 2 Entropy and model fit indices by latent class model

	Model 2	Model 3	Model 3*	Model 4
Entropy:	0.89	0.87	0.88	0.86
AIC:	7921.35	7818.22	7775.615	7797.78
BIC:	8051.66	8016.11	8002.463	8063.24
Sample Adjusted BIC:	7965.91	7885.89	7853.196	7888.56
Lo-Mendell-Rubin adjusted LRT test	1136.80	129.77	149.736	47.93
Value				
<i>p</i> -value	0.0000*	0.0007*	0.0005*	0.4642

* $p<0.001$

Table 3 Three-class model results in probability scale

Latent Class	ACE	Estimate	S.E	Est./S.E	Two-Tailed <i>p</i> -Value
Low-to-no ACEs (<i>n</i> = 717, 77.77%)	Physical abuse	0.002	0.002	0.908	0.36
	Emotional abuse	0.005	0.005	1.046	0.29
	Sexual abuse	0.069	0.012	5.695	< 0.001
	Alcohol/drugs	0.025	0.007	3.629	0.000
	Incarcerated household member	0.005	0.003	1.463	0.14
	Household mental illness	0.012	0.005	2.266	0.02
	Household member violence	0.118	0.016	7.503	< 0.001
	Parental death	0.142	0.015	9.736	< 0.001
	Emotional neglect	0.052	0.009	5.443	< 0.001
	Physical neglect	0.061	0.010	6.402	< 0.001
	Bullying	0.063	0.010	6.236	< 0.001
	Community violence	0.115	0.013	9.152	< 0.001
	Collective violence	0.091	0.012	7.881	< 0.001
Violence -ACEs (<i>n</i> = 46, 4.99%)	Physical abuse	1.000	0.000	0.000	1.000
	Emotional abuse	0.964	0.062	15.473	< 0.001
	Sexual abuse	0.541	0.079	6.869	< 0.001
	Alcohol/drugs	0.296	0.075	3.964	< 0.001
	Incarcerated household member	0.286	0.075	3.785	< 0.001
	Household mental illness	0.303	0.079	3.842	< 0.001
	Household member violence	1.000	0.000	0.000	1.00
	Parental death	0.405	0.080	5.066	< 0.001
	Emotional neglect	0.744	0.086	8.621	< 0.001
	Physical neglect	0.117	0.053	2.210	0.02
	Bullying	0.751	0.082	9.218	< 0.001
	Community violence	0.899	0.071	12.743	< 0.001
	Collective violence	0.313	0.076	4.097	< 0.001
Household ACEs (<i>n</i> = 159, 17.24%)	Physical abuse	0.149	0.042	3.560	< 0.001
	Emotional abuse	0.306	0.045	6.753	< 0.001
	Sexual abuse	0.538	0.048	11.151	< 0.001
	Alcohol/drugs	0.253	0.040	6.272	< 0.001
	Incarcerated household member	0.159	0.034	4.739	< 0.001
	Household mental illness	0.254	0.040	6.353	< 0.001
	Household member violence	0.718	0.047	15.336	< 0.001
	Parental death	0.443	0.046	9.560	< 0.001
	Emotional neglect	0.333	0.042	8.023	< 0.001
	Physical neglect	0.131	0.029	4.447	< 0.001
	Bullying	0.243	0.041	5.946	< 0.001
	Community violence	0.288	0.044	6.540	< 0.001
	Collective violence	0.327	0.046	7.093	< 0.001

Relationships between latent classes, covariates, and distal outcomes

Holding Low-to-No ACEs as a reference latent class, identifying as Emirati predicted a significantly higher probability of membership to the Violence ACEs class. Identifying as a female predicted an increased probability of membership to the Household ACEs latent profile, whereas a higher age predicted a significantly lower

probability of membership to the Household ACEs latent profile. In reference to the Violence ACEs class, identification as Emirati reduced the probability of membership to the Low-to-No ACEs and Household ACEs groups.

Compared to the Household ACEs latent profile, identifying as Emirati predicted a higher probability of membership to the Violence ACEs latent profile, whereas a higher age and identifying as male predicted

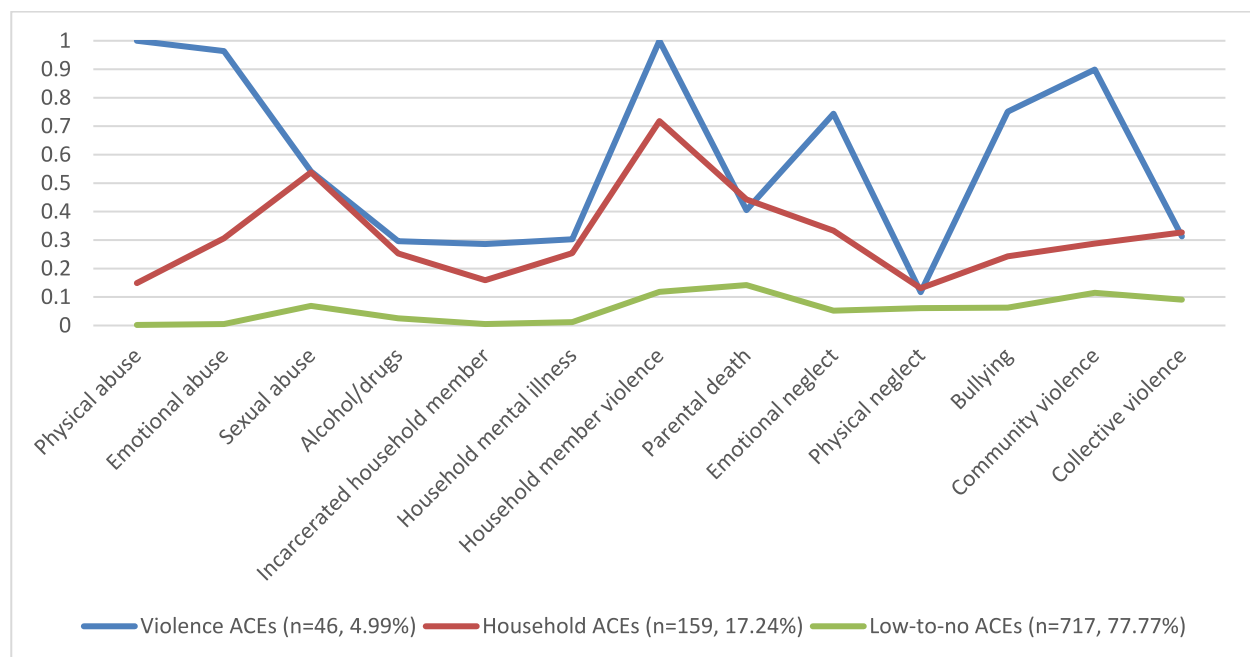


Fig. 1 ACE probabilities by latent class

Table 4 Three-class model average latent class probabilities and classification probabilities for most likely latent class membership

	Latent Profile		
	Violence ACEs (n = 46, 4.99%)	Household ACEs (n = 159, 17.24%)	Low-to-no ACEs (n = 717, 77.77%)
Average Latent Class Probability	0.95	0.05	0.00
Classification Probability	0.95	0.05	0.00
Average Latent Class Probability	0.01	0.90	0.08
Classification Probability	0.01	0.83	0.16
Average Latent Class Probability	0.00	0.04	0.96
Classification Probability	0.00	0.02	0.98

a significantly higher probability of membership to the Low-to-No ACEs latent profiles.

In reference to the Low-to-No ACEs latent class, membership to the other two latent classes predicted significantly higher DASS_D and DASS_A scores. By contrast, in reference to the Violence ACEs latent class, membership of the Low-to-No ACEs or Household ACEs latent classes predicted significantly lower DASS_D and DASS_A scores. Compared to the Household ACEs latent profile, membership to the Low-to-No ACEs predicted lower DASS_D and DASS_A scores, whereas membership to the Violence ACEs latent profile predicted higher DASS_D and DASS_A scores. Table 7 lists parameter estimates, standard errors, *t* statistics and *p* values for the relationships

between covariates, latent class memberships, and distal outcomes.

Discussion

With a view to contribute substantially to the largely neglected assessment of ACEs of populations in Arab states generally, the UAE and Abu Dhabi more specifically; and to inform early and downstream interventions, we investigated the co-occurring patterns of ACE exposure among an adult community sample in Abu Dhabi. The aim of which was to investigate the relationships between latent classes of retrospective ACEs, multiple domains of adult health, mental health, and risk-related behavioral vulnerability, and distal adult emotional function outcomes.

Table 5 Age, nationality, sex, physical and mental health diagnoses, and behavioral risk factors by latent class

			Latent Class		
			Violence ACEs (n = 46, 4.99%)	Household ACEs (n = 160, 17.35%)	Low-to-No ACEs (n = 716, 77.66%)
Age		M	34.67	35.52	39.15
		SD	8.829	10.785	9.910
		Minimum	20	18	18
		Maximum	40	66	72
Nationality status ($\chi^2(2) = 35.15, p < .001$)	Expatriate	Count	12	111	488
		% within total	2.0%	18.2%	79.9%
		% within latent class	26.1%	69.8%	68.1%
		Standardized residual	-3.3	.5	.6
	Emirati	Count	34	48	229
		% within total	10.9%	15.4%	73.6%
		% within latent class	73.9%	30.2%	31.9%
		Standardized residual	4.7	-.8	-.8
Sex ($\chi^2(2) = 29.78, p < .001$)	Male	Count	11	44	343
		% within total	2.8%	11.1%	86.2%
		% within latent class	23.9%	27.8%	48.4%
		Standardized residual	-2.0	-3.0	1.9
	Female	Count	35	114	366
		% within total	6.8%	22.1%	71.1%
		% within latent class	76.1%	72.2%	51.6%
		Standardized residual	1.8	2.6	-1.7
Diabetes Type 2 ($\chi^2(2) = 11.65, p = .003$)	No	Count	30	122	602
		% within total	4.0%	16.2%	79.8%
		% within latent class	68.2%	79.2%	85.5%
		Standardized residual	-1.1	-.6	.6
	Yes	Count	14	32	102
		% within total	9.5%	21.6%	68.9%
		% within latent class	31.8%	20.8%	14.5%
		Standardized residual	2.5	1.3	-1.3
High Blood pressure ($\chi^2(2) = 3.64, p = .162$)	No	Count	33	123	582
		% within total	4.5%	16.7%	78.9%
		% within latent class	73.3%	78.8%	82.9%
		Standardized residual	-.6	-.4	.3
	Yes	Count	12	33	120
		% within total	7.3%	20.0%	72.7%
		% within latent class	26.7%	21.2%	17.1%
		Standardized residual	1.3	.8	-.7
Coronary heart disease ($\chi^2(2) = 18.75, p < .001$)	No	Count	41	140	687
		% within total	4.7%	16.1%	79.1%
		% within latent class	91.1%	91.5%	97.9%
		Standardized residual	-.4	-.6	.4
	Yes	Count	4	13	15
		% within total	12.5%	40.6%	46.9%
		% within latent class	8.9%	8.5%	2.1%
		Standardized residual	1.9	3.2	-2.0

Table 5 (continued)

			Latent Class		
			Violence ACEs (n = 46, 4.99%)	Household ACEs (n = 160, 17.35%)	Low-to-No ACEs (n = 716, 77.66%)
Chronic respiratory problems ($\chi^2_{(2)} = 34.75, p < .001$)	No	Count	36	135	676
		% within total	4.3%	15.9%	79.8%
		% within latent class	80.0%	87.1%	96.3%
		Standardized residual	-1.0	-.9	.7
	Yes	Count	9	20	26
		% within total	16.4%	36.4%	47.3%
		% within latent class	20.0%	12.9%	3.7%
		Standardized residual	3.8	3.4	-2.6
Liver disease ($\chi^2_{(2)} = 26.33, p < .001$)	No	Count	44	140	694
		% within total	5.0%	15.9%	79.0%
		% within latent class	97.8%	91.5%	98.7%
		Standardized residual	.0	-.7	.3
	Yes	Count	1	13	9
		% within total	4.3%	56.5%	39.1%
		% within latent class	2.2%	8.5%	1.3%
		Standardized residual	-.1	4.6	-2.1
Any sexually transmitted disease ($\chi^2_{(2)} = 37.15, p < .001$)	No	Count	41	141	700
		% within total	4.6%	16.0%	79.4%
		% within latent class	91.1%	92.2%	99.3%
		Standardized residual	-.4	-.7	.4
	Yes	Count	4	12	5
		% within total	19.0%	57.1%	23.8%
		% within latent class	8.9%	7.8%	0.7%
		Standardized residual	2.9	4.5	-2.8
Obesity ($\chi^2_{(2)} = 23.39, p < .001$)	No	Count	25	111	579
		% within total	3.5%	15.5%	81.0%
		% within latent class	55.6%	72.5%	82.2%
		Standardized residual	-1.8	-.9	.9
	Yes	Count	20	42	125
		% within total	10.7%	22.5%	66.8%
		% within latent class	44.4%	27.5%	17.8%
		Standardized residual	3.5	1.8	-1.7
Cancer ($\chi^2_{(2)} = 24.35, p < .001$)	No	Count	38	139	682
		% within total	4.4%	16.2%	79.4%
		% within latent class	88.4%	88.5%	97.0%
		Standardized residual	-.5	-.8	.5
	Yes	Count	5	18	21
		% within total	11.4%	40.9%	47.7%
		% within latent class	11.6%	11.5%	3.0%
		Standardized residual	2.0	3.7	-2.3

Table 5 (continued)

			Latent Class		
			Violence ACEs (<i>n</i> = 46, 4.99%)	Household ACEs (<i>n</i> = 160, 17.35%)	Low-to-No ACEs (<i>n</i> = 716, 77.66%)
Depression ($\chi^2(2) = 151.99, p < .001$)	No	Count	21	107	665
		% within total	2.6%	13.5%	83.9%
		% within latent class	46.7%	70.4%	94.9%
		Standardized residual	−3.0	−2.4	1.8
	Yes	Count	24	45	36
		% within total	22.9%	42.9%	34.3%
		% within latent class	53.3%	29.6%	5.1%
		Standardized residual	8.2	6.5	−5.1
Anxiety ($\chi^2(2) = 143.77, p < .001$)	No	Count	17	97	641
		% within total	2.3%	12.8%	84.9%
		% within latent class	37.8%	63.8%	91.2%
		Standardized residual	−3.4	−2.7	2.1
	Yes	Count	28	55	62
		% within total	19.3%	37.9%	42.8%
		% within latent class	62.2%	36.2%	8.8%
		Standardized residual	7.7	6.2	−4.8
Diagnosed with any other types of mental illnesses/disease ($\chi^2(2) = 71.57, p < .001$)	No	Count	35	136	699
		% within total	4.0%	15.6%	80.3%
		% within latent class	83.3%	88.3%	99.3%
		Standardized residual	−.9	−1.1	.7
	Yes	Count	7	18	5
		% within total	23.3%	60.0%	16.7%
		% within latent class	16.7%	11.7%	0.7%
		Standardized residual	4.7	5.7	−3.8
Fibromyalgia/chronic pain or fatigue ($\chi^2(2) = 25.29, p < .001$)	No	Count	40	124	685
		% within total	4.7%	14.6%	80.7%
		% within latent class	90.9%	89.2%	97.7%
		Standardized residual	−.3	−.8	.5
	Yes	Count	4	15	16
		% within total	11.4%	42.9%	45.7%
		% within latent class	9.1%	10.8%	2.3%
		Standardized residual	1.7	4.0	−2.2
Ever smoked (cigarettes, shisha, cigars, or other types of tobacco)? ($\chi^2(2) = 12.22, p < .005$)	No	Count	24	74	440
		% within total	4.5%	13.8%	81.8%
		% within latent class	52.2%	47.7%	62.3%
		Standardized residual	−.6	−1.9	1.0
	Yes	Count	22	81	266
		% within total	6.0%	22.0%	72.1%
		% within latent class	47.8%	52.3%	37.7%
		Standardized residual	.8	2.3	−1.3

Table 5 (continued)

			Latent Class		
			Violence ACEs (<i>n</i> = 46, 4.99%)	Household ACEs (<i>n</i> = 160, 17.35%)	Low-to-No ACEs (<i>n</i> = 716, 77.66%)
Ever consumed alcohol or other intoxicants on a regular basis ($\chi^2(2) = 61.89, p < .001$)	No	Count	35	111	661
		% within total	4.3%	13.8%	81.9%
		% within latent class	79.5%	72.1%	93.2%
		Standardized residual	-.7	-2.2	1.2
	Yes	Count	9	43	48
		% within total	9.0%	43.0%	48.0%
		% within latent class	20.5%	27.9%	6.8%
		Standardized residual	1.9	6.3	-3.4
Ever used illicit/illegal drugs (hashish, pills, stimulants, narcotics, or any other types of drug?) ($\chi^2(2) = 54.24, p < .001$)	No	Count	37	131	702
		% within total	4.3%	15.1%	80.7%
		% within latent class	88.1%	87.3%	98.7%
		Standardized residual	-.5	-1.1	.6
	Yes	Count	5	19	9
		% within total	15.2%	57.6%	27.3%
		% within latent class	11.9%	12.7%	1.3%
		Standardized residual	2.8	5.8	-3.3
Ever used any prescription drugs beyond the recommended dosage (e.g., painkillers?) ($\chi^2(2) = 1.11, p = .573$)	No	Count	31	120	550
		% within total	4.4%	17.1%	78.5%
		% within latent class	70.5%	76.9%	77.4%
		Standardized residual	-.5	.0	.1
	Yes	Count	13	36	161
		% within total	6.2%	17.1%	76.7%
		% within latent class	29.5%	23.1%	22.6%
		Standardized residual	.9	.0	-.2
Do you exercise on a regular basis (at least 3 times per week)? ($\chi^2(2) = 5.98, p = .050$)	No	Count	31	94	381
		% within total	6.1%	18.6%	75.3%
		% within latent class	67.4%	61.8%	53.7%
		Standardized residual	1.1	1.0	-.7
	Yes	Count	15	58	328
		% within total	3.7%	14.5%	81.8%
		% within latent class	32.6%	38.2%	46.3%
		Standardized residual	-1.2	-1.1	.8
Ever engaged in risky sexual behavior? ($\chi^2(2) = 85.87, p < .001$)	No	Count	29	118	680
		% within total	3.5%	14.3%	82.2%
		% within latent class	65.9%	80.3%	96.2%
		Standardized residual	-1.8	-1.5	1.1
	Yes	Count	15	29	27
		% within total	21.1%	40.8%	38.0%
		% within latent class	34.1%	19.7%	3.8%
		Standardized residual	6.2	5.1	-3.9

This community sample demonstrated an average of 1.74 ACEs, with 64% reporting at least one ACE, a level comparable with the United States, where the impact

of ACEs on individuals is more widely understood and informs discourses around public health and interventions more comprehensively [34]. We identified three

Table 6 DASS_D, DASS_A, and DASS_S pairwise comparisons

	Test Statistic	Std. Error	Std. Test Statistic	Asymptotic (two-sided) p ^a	Adjusted p ^b
DASS_D					
Low-to-No ACEs-Household ACEs	208.23	22.74	9.16	< .001	< .001
Low-to-No ACEs-Violence ACEs	338.66	39.45	8.59	< .001	< .001
Household ACEs-Violence ACEs	130.43	43.42	3.004	.003	.008
DASS_A					
Low-to-No ACEs-Household ACEs	189.23	22.73	8.33	< .001	< .001
Low-to-No ACEs-Violence ACEs	310.10	39.44	7.86	< .001	< .001
Household ACEs-Violence ACEs	120.88	43.41	2.79	.005	.016
DASS_S					
Low-to-No ACEs-Household ACEs	199.15	22.95	8.68	< .001	< .001
Low-to-No ACEs-Violence ACEs	352.14	39.82	8.84	< .001	< .001
Household ACEs-Violence ACEs	152.99	43.83	3.49	< .001	.001

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same

^a The significance level is .050

^b Significance values have been adjusted by the Bonferroni correction for multiple tests

distinct ACE clusters among the Abu Dhabi sample. These clusters are varied with respect to extent and nature of exposure to ACEs. The vast majority of the sample were situated within the low-to-no ACE category, followed by a 17.24% sample representation in the household ACE category, where higher probabilities of poly-victimization around household violence, sexual abuse, and parental death/divorce/separation were prevalent; and finally, we saw 5% sample representation in the violence ACEs, where higher probabilities of physical abuse, household violence, and community violence were noted. These patterns are somewhat reflective of previous research on clustering of types of adversity [10, 35], further supporting the idea that ACE distribution and categorizations are unremarkable by international comparison and in respect to the extant literature.

The present findings illustrate significant demographic distinctions in ACE profiles based on age, with likelihood of membership to the low-to-no ACEs class increasing with age in reference to the household ACEs class; between male and female participants; as well as between UAE citizens and expatriates. Sex disparities observed here align with international evidence indicating that women are often disproportionately represented in categories associated with household ACEs, possibly due to socio-cultural factors that influence caregiving roles and experiences of domestic environments [8]. Additionally, the overrepresentation of Emirati nationals in the violence ACE category may reflect broader socio-environmental and economic dynamics that differ between citizens and expatriates, for example cultural norms around familial privacy and reporting, which may

nuance levels of community cohesion and social support networks [16]. Understanding these demographic distinctions is crucial for informing culturally nuanced intervention and prevention strategies. For example, these findings provide an impetus for the development of culturally grounded strategies for targeting the reduction of women's experiences of violence in the home, working towards an evidence-based series of preventative measures. Additionally, support is provided for the development of mechanisms for the mitigation of the negative consequences of the association between sex and household ACEs, by promoting mental health resources targeted at women and children in family-centric contexts. Such efforts may include family counseling and resilience-building programs. Such efforts may include family counseling and resilience-building programs. More broadly, differential health outcomes evident in violence and household ACE classes may reflect differences in the nature and/or the intensity of ACE exposures in each class, demonstrating variation in likely outcome risks [36, 37]. For example, violence-related ACEs often encompass direct physical harm or threat with associated heightened chronic stress responses, whereas household ACEs may involve similar ACEs in different intensities or frequencies, manifesting in lower-level chronic stress response, associated with more internalizing outcomes, such as depression and anxiety [36]. Future studies should explore these mechanistic pathways to refine intervention targeting.

The influence of rapid social transitions in the UAE—driven by economic modernization and increased expatriate integration—highlights the need for policy

Table 7 Relationships between Covariates, latent class memberships, and distal outcomes

	Estimate	S.E	Estimate/S.E	Two-Tailed <i>p</i> Value
<i>Reference Class: Low-to-No ACEs</i>				
Age—> Violence ACEs	−0.042	0.023	−1.828	0.067
SEX- > Violence ACEs	0.534	0.397	1.346	0.178
BI_NAT- > Violence ACEs	1.515	0.399	3.794	<0.001
Age—> Household ACEs	−0.027	0.012	−2.197	0.028
SEX- > Household ACEs	0.800	0.236	3.385	0.001
BI_NAT- > Household ACEs	−0.173	0.248	−0.696	0.486
<i>Reference Class: Violence ACEs</i>				
Age—> Low-to-No ACEs	0.042	0.023	1.828	0.067
SEX- > Low-to-No ACEs	−0.534	0.397	−1.346	0.178
BI_NAT- > Low-to-No ACEs	−1.515	0.399	−3.794	<0.001
Age- > Household ACEs	0.015	0.027	0.542	0.588
SEX- > Household ACEs	0.266	0.457	0.583	0.560
BI_NAT- > Household ACEs	−1.688	0.463	−3.643	<0.001
<i>Reference Class: Household ACEs</i>				
Age—> Violence ACEs	−0.015	0.027	−0.542	0.588
SEX- > Violence ACEs	−0.266	0.457	−0.583	0.560
BI_NAT- > Violence ACEs	1.688	0.463	3.643	<0.001
Age—> Low-to-No ACEs	0.027	0.012	2.197	0.028
SEX- > Low-to-No ACEs	−0.800	0.236	−3.385	0.001
BI_NAT- > Low-to-No ACEs	0.173	0.248	0.696	0.486
<i>Reference Class: Low-to-No ACEs</i>				
Violence ACEs—> DASS_D	0.137	0.016	8.619	<0.001
Violence ACEs—> DASS_A	0.143	0.016	8.704	<0.001
Violence ACEs—> DASS_S	1.160	0.019	1.123	1.198
Household ACEs—> DASS_D	0.085	0.011	7.638	<0.001
Household ACEs—> DASS_A	0.096	0.012	7.850	<0.001
Household ACEs—> DASS_S	1.091	0.012	1.068	1.115
<i>Reference Class: Violence ACEs</i>				
Low-to-No ACEs—> DASS_D	−0.137	0.016	−8.619	<0.001
Low-to-No ACEs—> DASS_A	−0.143	0.016	−8.704	<0.001
Low-to-No ACEs—> DASS_S	0.862	0.014	0.835	0.891
Household ACEs—> DASS_D	−0.052	0.014	−3.687	<0.001
Household ACEs—> DASS_A	−0.047	0.015	−3.054	0.002
Household ACEs—> DASS_S	0.941	0.015	0.912	0.971
<i>Reference Class: Household ACEs</i>				
Low-to-No ACEs—> DASS_D	−0.085	0.011	−7.638	<0.001
Low-to-No ACEs—> DASS_A	−0.096	0.012	−7.850	<0.001
Low-to-No ACEs—> DASS_S	0.916	0.010	0.897	0.936
Violence ACEs—> DASS_D	0.052	0.014	3.687	<0.001
Violence ACEs—> DASS_A	0.047	0.015	3.054	0.002
Violence ACEs—> DASS_S	1.063	0.017	1.030	1.096

frameworks that address both traditional and emergent risk factors. Additionally, the UAE's healthcare system could benefit from integrating ACE screening and culturally adapted preventive programs into primary care settings, specifically targeting high-risk groups such as

young adults and expatriates who may be underrepresented in mental health service utilization due to stigma or lack of awareness [17]. These insights inform a targeted approach in public health policies, suggesting that tailored interventions—such as early screening programs

and gender-responsive services—could help reduce the long-term burden of ACEs on physical and mental health in the UAE. Future policy efforts could focus on preventative measures within schools and communities, potentially reducing the incidence of chronic health issues and supporting a resilient society amidst ongoing socioeconomic changes. We also provide further insights into the role of ACE clusters in increasing vulnerabilities and risks to health, mental health, and adult risk related behaviors, with all but high blood pressure and over-use of prescription drugs exhibiting differential propensities for risk across ACE classes.

Violence and household ACE subtypes appear to increase risk of chronic respiratory problems, sexually transmitted disease, cancer, depression, anxiety, other mental illness, and use of illicit drugs, as well as risky sexual behavior, when self-reported as having ever been diagnosed (health or mental health outcomes) or as ever having been engaged in (risk-related adult behaviors). Additionally, the violence ACE cluster appears to be associated with a considerably greater risk for obesity and type-2 diabetes; and finally, the household ACE cluster appears to be implicated in greater risk for coronary heart disease, liver disease, fibromyalgia, and the consumption of alcohol on a regular basis [3, 38]. This added layer of nuance allows policy makers, healthcare providers, and intervention programs to consider the relative risks of ACEs among specific demographic strata of the population of Abu Dhabi, and to align resources and intervention strategies specific to the ACE history of individuals, based on specific outcome risks, to inform a more targeted, efficient, and efficacious appropriation of intervention efforts and funding allocation.

Finally, in acknowledging the limitation of relying on formal diagnoses of mental illnesses, and indeed their insight among respondents [22], a further meaningful contribution of this study stems from its investigation of depression, anxiety, and stress at a community level, based on a widely used, validated screening tool. The findings of which provide tangible support for the idea that, at a community level, levels of depression, anxiety, and stress can be differentiated by ACE classes. Depression scores appear to increase exponentially across ACE classes, with average scores being significantly higher for household ACEs compared to low-to-no ACEs, and significantly higher still among the violence ACEs category, a pattern which holds for anxiety and stress scores also [39, 40]. Kim and colleagues [39] suggest that adverse experiences during childhood may not only directly impact mental health outcomes but also influence an individual's self-esteem which mediates the negative association of child maltreatment with depressive symptoms. Elmore and Crouch [40] suggested that the

critical periods and age of certain ACEs can exert a profound influence on mental health outcomes. Both studies observed an increase in depression scores across ACE classes suggesting a dose–response relationship, reinforcing the notion that the accumulation of ACEs may amplify the risk of mental health challenges.

With the complex socio-cultural context of the UAE, the identification of three distinct ACE clusters within the Abu Dhabi sample provides early momentum in a more nuanced understanding of the nature and extent of exposure to adversity and the associated risks for later morbidities and risks. Moreover, the health priorities that are shaping the UAE health care system, in particular, the importance of early interventions on chronic disease levels including prevention of mental health disorders [41], thereby informing public health and systems-level approaches to early intervention justifications and strategies. The findings suggest that ACEs can vary widely, and individuals may experience a combination of adverse events that cluster together. Understanding these distinct clusters is important for the development of targeted early interventions as well as downstream interventions. Such efforts should address the family dynamics and the support for those affected by parental separation or violence within the home. Meanwhile, those encompassed by the Violence ACEs category may require interventions focused on community-based violence prevention and trauma support. Prevention strategies should address the specific needs of individuals within each cluster, ultimately contributing to more effective and culturally sensitive approaches to promoting health, well-being, and the diversion away from long-term adult risk-related behaviors.

Building on the insights from this study, future research could enhance the reliability and applicability of these findings by incorporating longitudinal methods to track the long-term impacts of distinct ACE classes on health outcomes over time. Such studies could elucidate causal relationships between ACE clusters and adult outcomes, as well as identify potential mediating factors, such as frequency and intensity of exposures, social support, and wide resilience factors, which could clarify how certain individuals within the UAE context manage to maintain positive health despite ACE exposure.

Future studies should also aim to replicate these findings across diverse regions and cultural settings within the UAE to increase generalizability. Integrating ACE assessment into national health monitoring can inform culturally tailored interventions and provide a foundation for preventive strategies that address both individual and community-level resilience. These research efforts would be invaluable in informing public health policy, supporting targeted mental health services and early intervention

programs that align with the UAE's unique socio-cultural context, and address the specific needs of ACE-affected populations. Globally, such research has implications for countries with similar sociocultural dynamics, offering guidance on implementing effective, context-sensitive ACE interventions in varied public health systems.

Conclusions

This study provides critical insights into the varied impacts of adverse childhood experiences (ACEs) on health, mental health, and risk-related behaviors within a large, community-based sample in Abu Dhabi. Using a person-centered approach with Latent Class Analysis (LCA), we identified three distinct ACE profiles: Low-to-No ACEs, Household ACEs, and Violence ACEs. These profiles underscore the nuanced ways in which different types and intensities of childhood adversity contribute to later-life outcomes, revealing significant differences in the prevalence of chronic conditions, mental health disorders, and behavioral risks. Notably, individuals in the Violence ACEs class displayed heightened risk across nearly all outcomes, while those in the Household ACEs class faced unique vulnerabilities related to family-related adversity.

The findings also highlight the demographic variations in ACE profiles, with significant differences associated with sex and nationality status. This underscores the importance of culturally tailored public health interventions that address the unique social and familial contexts influencing adverse childhood experiences in the UAE. The study's results align with international evidence on the clustering of ACEs and their differential impacts, providing a foundation for local and regional efforts to mitigate the long-term health impacts of childhood adversity. Public health strategies could incorporate targeted screenings and interventions within primary care settings, focusing on high-risk groups, such as young adults, expatriates, and women, to enhance preventative care and support resilience-building.

In conclusion, this study's identification of distinct ACE profiles within the Abu Dhabi sample offers a foundational understanding of the complex interplay between childhood adversity and adult health outcomes in the UAE. By illuminating the specific ACE patterns and their associations with adverse health and behavioral consequences, the findings provide actionable insights for public health policy, suggesting the potential for culturally sensitive intervention strategies. These insights serve as a crucial step toward enhancing mental health resources and addressing childhood adversity within the UAE, ultimately informing a more resilient and health-conscious society.

Abbreviations

ACE(s)	Adverse Childhood Experiences
ACE-IQ	Adverse Childhood Experiences International Questionnaire
DASS-21	Depression Anxiety and Stress Scale – 21 item version
LCA	Latent Class Analysis
UAE	United Arab Emirates

Authors' contributions

AM, IE, NH, ZA, LT, & CA all contributed to the design and development of this body of work; AM, IE, & CA substantially contributed to the acquisition of data; AM, AMcN, and DE contributed to the analysis and interpretation of the data, AM drafted the work and all authors contributed to the substantial revision and review of the manuscript.

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Data availability

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

Declarations

Ethics approval and consent to participate.

Ethical approval was sought by Review Boards of Georgetown University Medical Center (STUDY00004558), and the Abu Dhabi Department of Health (DOH/CVDC/2022/1029). Informed consent was provided by all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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