



Adverse childhood experiences and risky behaviors in Oman: A cross-sectional study

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ABSTRACT

Objective: Adverse childhood experiences (ACEs), which refer to potentially traumatic events occurring during childhood, have been consistently linked to detrimental effects on high-risk behaviors through various studies. Nonetheless, such an association has rarely been examined in the context of Arab culture. This study aimed to investigate the association between ACE levels and high-risk behaviors (e.g., smoking, alcohol consumption, drug use, high-risk sexual behavior, and physical inactivity) among Omani adults.

Methods: This was a cross-sectional study with convenience sampling. The participants were recruited from a university-affiliated medical facility in Oman. Data were collected in 2022. They were asked to complete the Adverse Childhood Experience International Questionnaire (ACE-IQ)

Results: The study included 1648 Omani adults. Analyses revealed that the adjusted odds ratios (ORs) for engaging in some of the identified high-risk behaviors increased as the level of ACEs increased. Specifically, individuals with an ACE level of 4 exhibited higher odds of smoking (OR: 2.6), alcohol consumption (OR: 2.9), and risky sexual behavior (OR: 32) than those without ACEs.

Conclusion: The findings of this study underscore a notable association between ACEs and high-risk behaviors among Omani adults. Consequently, there is a pressing need for intensified efforts to prevent ACEs when possible and to alleviate their adverse effects, emphasizing the importance of public health initiatives and interventions in Oman.

1. Introduction

Examination of high-risk behaviors and their underlying risk factors presents an opportunity to address and diminish them, thereby diminishing the incidence of non-communicable diseases (NCDs). It is widely recognized that engaging in high-risk behaviors, such as smoking, alcohol abuse, and insufficient physical activity, substantially contributes to the onset of NCDs (Oduro et al., 2023). Globally, adverse childhood experiences (ACEs) have been recognized as risk factors for high-risk behaviors. Adverse childhood experiences are a spectrum of intense stressors or traumatic events that are known to significantly impact children's development (Anda et al., 2010). These events include but are not confined to emotional, physical, and sexual abuse; emotional and physical neglect; growing up in a home or community where domestic violence is witnessed; members abusing drugs or alcohol; having mental health issues; there is a stressful relationship (such as separation

or divorce); or where members engage in criminal activity (Anda et al., 2010; Hughes et al., 2017). Indeed, exposure to multiple ACE is a significant risk factor for various high-risk behaviors, including smoking, alcohol use, and drug abuse (Al Mamun et al., 2007; Chung et al., 2010; Nelson et al., 2006; Struck et al., 2021).

The outcomes of previous studies have elucidated a discernible dose-response relationship between the extent of exposure to ACEs and the probability of engaging in high-risk behaviors during adulthood. This suggests that the accumulation of ACEs increases the risk of engaging in such behaviors during adulthood (Merrick et al., 2017; Van der Feltz-Cornelis et al., 2019). Notably, individuals who have experienced four or more ACEs, according to data from the Behavioral Risk Factor Surveillance System survey involving 48,526 U.S. adults, exhibited a heightened likelihood of engaging in risky behaviors, such as binge drinking, heavy drinking, and smoking (Campbell et al., 2016). Another study emphasized that experiencing four or more ACEs

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substantially increased the likelihood of illegal drug use (OR = 7.0) (Ramiro et al., 2010). Early initiation of smoking (OR = 3.7) and risky sexual behavior (OR = 3.6) displayed similar trends (Ramiro et al., 2010).

Remarkably, most of these studies have been conducted in Western countries, with only a limited number of studies conducted in developing countries such as the Middle East, where resources are scarce and support systems are insufficient (Almuneef et al., 2016; Ramiro et al., 2010). It is reported that ACEs are prevalent in underdeveloped countries (Crouch et al., 2019; Merrick et al., 2018; Mersky et al., 2021; Petruccioli et al., 2019; Walsh et al., 2019). A study in Saudi Arabia revealed that 80.3 % of the participants had experienced at least one ACE during their childhood (Almuneef et al., 2016). Social stigmatization of reporting child abuse and other traumatic events in these countries, especially sexual abuse, could further exacerbate the negative impact of ACEs, thereby impeding victims from accessing essential treatment and support (Attrash-Najjar & Katz, 2022).

Given the distinctive characteristics of Arab culture and communities, caution must be exercised when extrapolating evidence established in different cultural contexts regarding the magnitude of the impact of ACEs on risky behaviors in Arab countries. Therefore, it is crucial to assess the magnitude of the impact of ACEs on risky health behaviors in Arabic and Islamic cultures. To the best of the author's knowledge, no previous research has explored the association between ACEs and risky health behaviors in Oman, an Arab country. Therefore, the objective of this study was to assess the association between ACEs and high-risk behaviors among Omani adults.

2. Methods

2.1. Design & participants

A cross-sectional survey was used. This study was conducted at a university-affiliated medical facility in Oman. This facility is a tertiary hospital that receives referrals across the country. It includes various outpatient medical specialties and clinics.

Participants in this study were Omani patients and their accompanying family members. Participants who visited the outpatient clinics within the selected hospital, demonstrated literacy, indicating proficiency in both Arabic reading and writing, and aged between 18 and 60 years were conveniently recruited.

The sample size was determined using nMaster software, based on the assumption that 80 % of the participants had experienced at least one ACE, a premise derived from the outcomes of a study conducted in Saudi Arabia (Almuneef et al., 2016). To achieve a 95 % confidence level and 2 % absolute precision, 1537 patients were found to be a sufficient sample size for the purpose of this study. However, we gathered data from a larger cohort of approximately 1690 participants to allow for missing or insufficient data completion.

2.2. Measurements

The Arabic version of the Adverse Childhood Experience International Questionnaire (ACE-IQ) was used. This questionnaire was adapted from the World Health Organization (WHO) and translated and validated in Saudi Arabia by Almuneef et al. (2014). The questionnaire comprises three sections. The first section focused on demographic variables, including age, occupation, gender, educational level, and place of residence.

2.2.1. Adverse childhood experiences

The second section of the ACE-IQ measures ACEs. The specific ACEs under investigation encompassed 13 instances of physical and emotional neglect, family dysfunction (e.g., mental illness, alcohol consumption, drug abuse, divorce, or death of a parent), and three categories of child abuse (physical, emotional, sexual), witnessing community violence,

witnessing peer violence, and witnessing collective violence. All inquiries concerning ACEs pertained to respondents' initial 18 years of life. Each ACE was assigned a binary code (yes/no), indicating whether the criteria for that category were fulfilled. Additionally, the cumulative totals of the subcategories were utilized to denote the severity of ACE exposure, thereby facilitating a scoring spectrum ranging from 0 (no categories met) to 13 (all categories met). ACE scores were further categorized into five distinct levels: level 0 indicated that there were no ACEs, whereas levels 1, 2, 3, and 4 indicated that there were one, two, three, and four or more ACEs, respectively (Alhowaymel et al., 2023).

2.2.2. High risky behaviors

The Arabic ACE-IQ also incorporated the CDC Health Appraisal Questionnaire (HAQ), which encompasses inquiries about addictive behaviors, such as smoking, tobacco, alcohol consumption, illicit drug use, and engaging in high risky sexual behavior. Participants were prompted on the HAQ to specify whether they had ever engaged in smoking, alcohol consumption, the use of illicit drugs, or engaged in high-risk sexual behavior by response of yes or no.

2.3. Data collection procedure

Four research assistants (RAs) were recruited to collect data. The principal investigator provided a day of training to the RAs on the methods for approaching potential participants, eligibility, and enrollment procedures, as well as ethical issues. The RAs located themselves in the vital signs checking room where they approached every patient and accompanying family member, providing an in-depth description of the study. All participants who met the eligibility criteria were provided information about the study in a designated private room near the waiting area. They were asked to provide informed consent and complete the questionnaire. The RAs were explicitly instructed to monitor and maintain an equitable representation of both male and female participants to ensure gender balance.

2.4. Ethical considerations

Ethical approval was obtained from the Medical Research Ethics Committee (MREC) of the College of Medicine and Health Sciences, Sultan Qaboos University (SQU-EC/ 169/2022). The study adhered to the institution's guidelines for the protection of human subjects, ensuring both their safety and privacy. The questionnaire was self-administered. No identifiable data was collected from the participants. Participants were well informed about their right to voluntarily withdraw their involvement in the study at any time. The questionnaires were safely held in a locked cabinet accessible only to the designated members of the research team.

2.5. Data analysis

Statistical Package for the Social Sciences (SPSS-26) was used for data analysis. Categorical variables are presented as frequencies and percentages, while continuous variables are presented as means and standard deviations. To answer the study's aim, which is to examine the association between ACEs and high-risk behaviors, logistic regression was used. In bivariate analysis, associations were evaluated using the chi-square test. Subsequently, for a more nuanced multivariate examination, the logistic regression method was employed, yielding adjusted odds ratios (OR).

In the logistic regression analysis for each high-risk behavior outcome, variables demonstrating a conservative p-value ≤ 0.25 in the bivariate analysis were included. However, outcomes characterized by exceptionally low prevalence were precluded from the regression analysis due to an insufficient number of positive cases. A p-value of 0.05 was used in logistic regression.

3. Results

3.1. Sample characteristics

In this study, 1684 Omani participants were enrolled; 52.7 % of them were male. The mean age of the participants was 36 years (SD = 10.4), ranging from 18 to 60 years. Most participants (58 %) resided in urban areas, while 42 % lived in villages. Nearly two-thirds of the participants were employed, and a significant proportion were married (74.9 %). Educational attainment varied, with the majority having completed high school (37.2 %) or held a bachelor’s degree (43.5 %).

3.2. Prevalence of adverse childhood experience

The participants’ adverse childhood experience (ACE) scores ranged from 0 to 13, with mean of 3.0 (SD = 2.1). Categorized by ACE levels, 38.2 % of the participants reported experiencing four or more ACEs (ACE level 4). A substantial majority (88 %) had encountered at least one type of ACE, and more than half (52.8 %) reported experiencing three or more ACEs. [Table 1](#) provides the details of the sample characteristics and ACE prevalence.

3.3. Prevalence of high-risk behaviors

In the context of high-risk behaviors, physical inactivity emerged as the most prevalent behavior, reported by 55 % of the participants, followed by smoking 11.5 %. The least prevalent high-risk behavior was the use of illicit drugs, as reported by 1.0 % of the participants. [Table 2](#) provides details of the prevalence of the outcomes.

3.4. Associations between ACEs and high risky behaviors outcomes

Chi-square analyses showed that ACEs were significantly associated with smoking $X^2(4, N = 1643) = 26.01, p < 0.01$; alcohol consumption $X^2(4, N = 1643) = 27.23, p < 0.01$; illicit drug use $X^2(4, N = 1643) = 11.23, p < 0.01$; high-risk sexual behavior $X^2(4, N = 1643) = 63.98, p < 0.01$, and physical inactivity $X^2(4, N = 1643) = 9.17, p = 0.05$. [Table 3](#) shows the bivariate analysis findings.

Logistic regression analysis showed that smoking was significantly associated with ACE, sex, age group, and marital status. Similarly, alcohol consumption and risky sexual behavior were significantly associated with ACE levels and sex. Conversely, physical inactivity was significantly associated with sex and education status, but not with ACE

Table 1
Characteristics of Omani adult Sample, 2022 (n = 1684).

Characteristics	Subgroups	n (%)
Gender	Male	888 (52.7)
	Female	796 (47.3)
Age groups	< 30 years	395 (27.2)
	30–40	515 (35.5)
	≥ 40	541 (37.3)
Education status	Less than high school	143 (8.5)
	High school	622 (73.2)
	Bachelor	728 (43.5)
	Postgraduate	180 (10.8)
Occupation status	Working	987 (59.2)
	Not working	674 (40.8)
Marital status	Married	1249 (74.9)
	Single	374 (22.4)
	Separated	45 (2.7)
Living place	Village (rural)	707 (42.0)
	City (urban)	977 (58.0)
ACE levels	ACE 0	197 (12.0)
	ACE 1	290 (17.7)
	ACE 2	289 (17.6)
	ACE 3	240 (14.6)
	ACE 4	627 (38.2)

Table 2

Prevalence of High-Risk Behaviors among Omani Sample, 2022 (n = 1684).

Outcome	Subgroups	n (%)
Smoking	Yes	194 (11.5)
	No	1490 (88.5)
Alcohol drinking	Yes	42 (2.5)
	No	1642 (97.5)
Drugs	Yes	16 (1.0)
	No	1668 (99.0)
Sexual activity	Yes	143 (8.5)
	No	1541 (91.5)
Physical inactivity	Yes	926 (55.0)
	No	758 (45.0)

Table 3

Bivariate analysis findings about the association between demographic variables, ACEs and smoking, alcohol drinking, physical inactivity, and Illicit drug use among Omani Sample, 2022.

		N	X ²	df	P value
Smoking	Gender	1684	144.76	1	0.00
	Age	1451	9.73	2	0.00
	ACEs	1643	26.01	4	0.00
	Living Place	1684	0.71	1	0.44
	Marital status	1668	8.36	2	0.02
	Education	1673	16.71	3	0.00
	Occupation	1679	24.53	1	0.00
Alcohol drinking	Gender	1684	24.82	1	0.00
	Age	1451	10.46	2	0.00
	ACEs	1643	27.23	4	0.00
	Living Places	1684	5.84	1	0.02
	Marital status	1668	0.78	2	0.76
	Occupation	1673	1.25	1	0.27
	Education	1679	14.12	3	0.00
Illicit drug use	Gender	1684	7.83	1	0.00
	Age	1451	2.10	2	0.35
	ACEs	1643	11.23	4	0.02
	Living place	1684	1.91	1	0.21
	Marital status	1668	3.142	2	0.15
	Occupation	1673	0.03	1	0.87
	Education	1679	2.30	3	0.53
Physical inactivity	Gender	1684	16.41	1	0.00
	Age	1451	3.50	2	0.17
	ACEs	1643	9.17	4	0.05
	Living Place	1684	1.03	1	0.32
	Marital status	1668	0.69	2	0.71
	Occupation	1673	0.69	1	0.02
	Education	1679	26.46	3	0.00
High-risk sexual behavior	Gender	1684	94.70	1	0.00
	Age	1451	3.27	2	0.19
	ACEs	1643	4.74	4	0.19
	Living Place	1684	3.34	1	0.04
	Marital status	1668	5.37	2	0.00
	Occupation	1673	0.51	1	0.48
	Education	1679	63.98	3	0.00

levels.

In a general trend, as ACE level increased, the adjusted odds ratios for the four risky behaviors also increased. Participants with ACE level 4 had 2.65 times the odds of smoking (95 % CI: 1.35–5.22) compared to those with no ACE. Furthermore, they had 2.99 times the odds of alcohol consumption (95 % CI: 0.86–10.34) and a striking 32.12 times the odds of engaging in risky sexual behavior (95 % CI: 4.38–235.6) compared to those without ACE. The impact of ACE on smoking became significant when the ACE level reached ≥ 3. However, for risky sexual behavior, a significant effect was observed at an ACE level of 2. Further details are provided in [Table 4](#).

Table 4

Logistic Regression analysis findings about the association between demographic variables, ACEs and smoking, alcohol drinking, physical inactivity, and Illicit drug use among Omani Sample, 2022.

	Factor	Smoking (n 1379)	Drinking alcohol (n 1410)	Sexual behavior (n 1379)	Physical inactivity (n 1379)
		OR (95 % CI), p-value	OR (95 % CI), p-value	OR (95 % CI), p-value	OR (95 % CI), p-value
ACE levels (ACE 0 as reference)	ACE 1	0.84 (0.36–1.95) 0.69	0.73 (0.14–3.76) 0.70	5.63 (0.69–46.25) 0.11	0.97 (0.64–1.47) 0.90
	ACE 2	0.93 (0.42–2.08) 0.86	0.46 (0.07–2.83) 0.4	10.14 (1.310–78.53) 0.027	1.08 (0.72–1.63) 0.70
	ACE 3	1.80 (0.84–3.87) 0.013	0.21 (0.02–2.04) 0.18	10.82 (1.39–84.39) 0.02	1.44 (0.95–2.20) 0.09
	ACE 4	2.65 (1.35–5.22) 0.005	2.99 (0.86–10.34) 0.08	32.12 (4.38–235.6) 0.001	1.42 (0.99–2.04) 0.056
Gender (female as reference)	Male	12.52 (6.78–23.12) <0.001	15.32 (3.63–64.65) < 0.001	14.93 (7.57–29.44) < 0.000	0.61 (0.48–0.78) < 0.001
Age groups (<30 years as reference)	30–40	2.48 (1.28–4.79) 0.007	5.07 (1.12–22.84) 0.035	1.71 (0.80–3.67) 0.17	1.23 (0.87–1.72) 0.24
	> 40	1.85 (0.91–3.74) 0.088	5.20 (1.18–22.98) 0.030	1.42 (0.63–3.18) 0.400	1.17 (0.82–1.67) 0.39
Education status (postgraduate as reference)	Less than high school	2.46 (1.10–5.50) 0.029	3.16 (0.97–10.22) 0.055	1.62 (0.68–3.85) 0.28	1.07 (0.64–1.78) 0.80
	High school	1.74 (0.89–3.40) 0.12	0.95 (0.31–2.91) 0.93	1.35 (0.67–2.71) 0.41	0.87 (0.60–1.26) 0.46
	Bachelor	1.38 (0.71–2.69) 0.35	0.79 (0.26–2.39) 0.67	1.37 (0.69–2.72) 0.37	1.34 (0.93–1.92) 0.11
Occupation (not working as reference)	Working	1.37 (0.86–2.16) 0.182	–	0.68 (0.42–1.10) 0.12	1.38 (1.08–1.77) 0.01
Marital status (married as reference)	Single	1.98 (1.09–3.59) 0.025	–	1.20 (0.59–2.47) 0.62	1.10 (0.79–1.54) 0.58
	Separated	5.01 (1.75–14.29) 0.003	–	5.27 (1.75–15.82) 0.003	0.89 (0.44–1.82) 0.75
Living place (rural as reference)	Urban	–	2.24 (1.05–4.78) 0.037	–	–

4. Discussion

This study provides valuable insights into the prevalence of risky behaviors and their association with adverse childhood events among Omani adults. In the context of high-risk behaviors, physical inactivity emerged as the most prevalent, reported by 55 % of the participants, followed by smoking for 11.5 %. The least prevalent high-risk behavior was the use of illicit drugs, reported by 1.0 % of the participants. Furthermore, this study demonstrates that as the level of ACEs increases, there is a corresponding increase in the likelihood of engaging in high-risk behaviors, such as smoking, alcohol consumption, and risky sexual behaviors. However, no significant association was found between ACEs and physical inactivity among the Omani adults in this study.

4.1. Prevalence of high-risk behaviors

The prevalence of high-risk behavior in this study exhibited some variation compared with findings from other prevalence studies conducted in Oman. This study revealed a smoking prevalence of 11.5 %, deviating significantly from the national survey’s finding of 6 % among Omani adults and 23.5 % among college students (Al-Mawali et al., 2020; Al-Hinaai et al., 2021). Illicit drug use prevalence in the study was 1 %, which was slightly lower than that reported in other studies (1.3 %–9.9 %) (Al-Hinaai et al., 2021; AL-Ghafari et al., 2021). In our study, the prevalence of alcohol consumption was 2.5 %, which is in contrast with the findings of a national study by Al-Mawali et al. (2020), which

reported a prevalence of 0.4 %, and Al-Hinaai et al. (2021), who reported a prevalence of 10 %.

Similar to other studies, physical inactivity was the high-risk behavior reported by most Omani’s; however, our investigation found a prevalence rate of 55 %, relatively higher in comparison to where previously reported rates of 42 % by Al-Mawali et al. (2020). Importantly, our findings delineate a noteworthy gender-based discrepancy, indicating a higher prevalence of inactivity among females than males, consistent with the observations made by Al-Mawali et al. (2020). The observed disparities in the prevalence of high-risk behaviors among various studies can be attributed to methodological disparities, variations in measurement tools, geographical distinctions, and differences in participant demographics, particularly in age. Nevertheless, the comprehensive body of evidence derived from our study underscores the tangible presence of high-risk behaviors in Oman. Consequently, it underscores the urgency of concerted initiatives at both the public and policy levels to comprehensively address these behaviors within the Omani population.

4.2. Association between ACEs and high-risk behaviors

Our study’s observations regarding the impact of ACEs on high-risk behaviors align with existing literature from diverse cultures (Almu-neef et al., 2016; Bellis et al., 2014; Campbell et al., 2016; Hughes et al., 2017). A meta-analysis encompassing 253,719 participants across 37 articles that specifically investigated individuals with more than four

ACEs reported a modest association between ACEs (e.g., odds ratio [OR] less than 2) and physical inactivity, a moderate association (e.g., OR range 2–3) with smoking and alcohol consumption, and a strong association (e.g., OR range 3–6) with risky sexual behavior and illicit drug use (Hughes et al., 2017). The results of our study are consistent with the findings of this meta-analysis, demonstrating an OR for physical inactivity below 2, whereas the OR for smoking and alcohol consumption falls within the 2–3 range. However, a notable distinction was observed in the OR for high-risk sexual behavior, which was notably high (OR: 32). This strikingly high OR underscores the particularly robust association between ACEs and risky sexual behaviors in our study. The study's findings demonstrated that irrespective of cultural differences, there is a shared vulnerability among individuals with ACEs towards engaging in high-risk behaviors. This universal pattern underscores the lasting impact of ACEs and emphasizes the critical need for global awareness and intervention strategies to address the collective challenges posed by these experiences across diverse cultural contexts.

Moreover, it is noteworthy that much of the existing research on ACEs predominantly concentrates on outcomes associated with ACEs level 4 and higher. In contrast, our findings revealed significant effects of ACEs starting from level 3 for smoking and from level 2 for risky sexual behavior. This nuanced observation emphasizes the critical impact of ACEs, even at lower levels, shedding light on the importance of considering starting interventions for children with a history of three or more ACEs.

4.3. Strengths and limitations

Several limitations of our study warrant consideration in the interpretation of our findings. First, the inclusion of questions soliciting sensitive information related to high-risk behaviors and ACEs may have introduced the potential for inaccurate responses owing to social desirability bias or reluctance to disclose certain details. While our study collected retrospective data that could increase the likelihood of recall bias, it is noteworthy that individuals exposed to ACEs were generally less likely to forget such experiences. Although participants were recruited exclusively from a single center, the study center received referrals from across the country. Consequently, the results can be considered reasonably generalizable to a broader Omani population. Despite the substantial sample size of this study, it is important to acknowledge that it may not have been adequately powered to conduct regression analyses for some outcomes such as illicit drug use (1 %). Further studies with larger sample sizes are necessary to explore these associations more comprehensively.

4.4. Implications

Future research endeavors to explore the effects of ACEs on illicit drug use are required. Additionally, further studies should delve into the nuanced effects of each ACE on risk behaviors, fostering a more granular understanding of these complex associations. These research endeavors will eventually inform tailored interventions and preventive strategies aimed at mitigating the impact of ACEs on health outcomes in the Omani context.

The findings of this study underscore the necessity for the initiation of robust public health initiatives in Oman. These initiatives should encompass multifaceted strategies, including prevention efforts targeting ACEs when possible. Simultaneously, interventions should be designed to empower and provide necessary support for children who have experienced ACEs to enhance their resilience and equip them and their families with essential resources (Leitch, 2017).

The study's findings underscore the critical necessity of a paradigm shift in healthcare practices in Oman. The current practice approach, which may inadvertently induce re-traumatization in patients with a history of ACEs, underscores the need for a more trauma-informed care (TIC) approach. TIC, rooted in the science of ACEs, prioritizes creating

an environment characterized by safety, choice, collaboration, trustworthiness, and empowerment for patients who have experienced ACEs (Kimberg & Wheeler, 2019). Health professionals under the TIC approach receive training to view ACEs as potential contributors to problematic behaviors and to engage patients in sensitive discussions about their past while ensuring that they feel respected and empowered in their healthcare interactions. Moreover, inspired by practices in many hospitals in the USA, there is a compelling need to explore the feasibility and efficacy of implementing ACEs screening tools in children in Oman. Such screening measures can aid in early identification and intervention, aligning with proactive prevention of potential long-term consequences associated with ACEs (Loveday et al., 2022).

5. Conclusion

The present study significantly augments the existing literature on the prevalence of high-risk behaviors and their association with ACEs by elucidating a discernible association between ACEs and high-risk behaviors among Omani adults. This novel contribution serves as a valuable resource for the formulation and implementation of preventive initiatives and transformation of healthcare practices in Oman.

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CRediT authorship contribution statement

Zeinab Nasser Al Azri: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Khalood Al-abri:** Writing – review & editing, Writing – original draft. **Aziza Al Sawafi:** Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Sanjay Jaju:** Writing – review & editing, Formal analysis. **Mohammad Al Qadire:** Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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