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Hepatitis B knowledge and stigma in the United Arab Emirates

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Globally, there are 1.2 million new chronic *Hepatitis B Virus* (*HBV*) infections every year. The UAE is a low-endemic region where no previous studies have explored *HBV* stigma. This study aims to evaluate the UAE's population *HBV* knowledge, *HBV* vaccine attitudes, and stigmatizing attitudes towards the *HBV* infection. A cross-sectional study was conducted to evaluate knowledge and stigma; the previously-developed and validated stigma scale (*Hepatitis B Virus* – Stigma Scale, *HBV*-SS) was used. A total of 601 responses were retained for analysis in both python-3 and R. Chi-squared, Mann-Whitney U and Kruskal-Wallis tests were used for bivariate analyses and ordinary least squares (OLS) regression was used for linear modelling. Confirmatory factor analysis (CFA) was conducted, and goodness-of-fit was evaluated. Overall, 77.5%, (*n* = 466/601) reported having some knowledge regarding *HBV*, only 19.3% (*n* = 90/466) had good knowledge regarding *HBV*, with most gaps occurring with symptoms, complications, and treatment of the infection. However, 84.03% (*n* = 505/601) were interested in learning more about the virus. Only 57.6% (*n* = 346/601) were aware of the existence of the vaccine; however, attitudes to it were overwhelmingly positive. Overall, non-stigmatising attitudes dominated; however, both labelling and separating domains highlighted specific items with highly stigmatising attitudes. CFA showed the *HBV*-SS model to have acceptable/good goodness-of-fit. OLS identified higher knowledge levels among healthcare workers and those with higher perceived knowledge. Only perceived knowledge was a significant predictor of lower stigma beyond the bivariate level. The UAE population has shown low levels of knowledge but overall non-stigmatising attitudes. It is imperative that campaigns focus on improving general population *HBV* infection and vaccine knowledge while also solidifying the widespread level of vaccine acceptance and non-stigmatising attitudes.

Keywords Hepatitis B virus, Hepatitis B vaccine, Stigma, Knowledge, United Arab Emirates

Hepatitis B Virus (*HBV*) is a viral liver infection that can cause both acute and chronic disease. The World Health Organization (WHO) estimated that in 2022, 254 million people lived with chronic *hepatitis B* worldwide, with 1.2 million new chronic infections every year [1]. Mortality-wise, *HBV*-related diseases led to 555,000 deaths globally in 2019, an increase of 5.9% from 1990 [2]. *HBV* is highly infectious and can be spread by exposure to infected blood or other body fluids; in endemic regions, perinatal and horizontal transmission among children are the most common transmission methods; in contrast, transmission in low-endemic areas matches closely some well-characterised risk factors such as injecting drugs. More than 95% of immunocompetent adults will recover spontaneously from an acute infection; however, once chronic, there are no treatments that can cure *HBV*, with the current mainstays aiming to relieve symptoms and prevent transmission [3].

HBV vaccination has led to a substantial decrease in carrier rates as well as *HBV* morbidity and mortality, with coverage reaching 85% over the last 5 years [3]. However, a substantial 90% of *HBV* infections remain undiagnosed, with only 30.4 million globally knowing their infection status. In line with this, the World Health Assembly (WHA) adopted the Global Health Sector Strategy (GHSS) in 2016, calling for the elimination of both *hepatitis B* and C viruses as public health problems. Doing so would require a 95% reduction in *HBV* incidence coupled with a 65% reduction in mortality. In line with the GHSS, the WHO released interim targets that aimed to achieve a 10% reduction in *HBV*-related deaths by 2020. 2019 Global Burden of Disease analysis highlighted that very few countries have met the GHSS interim targets with marked disparities across the globe [2]. In fact, Cui *et al*. recommended a new global strategy for 2022–2030 be developed that considers new estimates, updates in targets, and urgently scales up viral hepatitis treatment and screening [4]. As such, the 75th WHA released the GHSS for the period 2022–2030 that outlines 5 strategic directions in hopes of ending the viral hepatitis epidemics globally by 2030 [5]. Progress however has been slow with the organisation's 2024 Global Hepatitis

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Report documenting a rise in the number of deaths due to *HBV*, reaching 1.1 million in 2022 from a baseline of 0.82 million in 2020 [6].

HBV remains one of the major global health problems and tackling it will require concerted efforts by all stakeholders to ensure universal vaccination, increase screening, diagnosis, and disease treatment, as well as remove disease stigma [7]. Chronic *HBV* can be treated but not cured, with most treatment options aiming to slow the advancing of cirrhosis, reduce cases of liver cancer, and improve long-term survival [1]. Back in 2014 after a request from the World Health Assembly, the WHO examined the feasibility of eliminating *HBV* and *HCV*; the results outlined 5 prevention and treatment service coverage targets (including children vaccination coverage, prevention of mother-to-child transmission, blood and injection safety, and treatment coverage) that need to be met such that both viruses can be eliminated as a public health threat [8]. Yet, several gaps and unmet needs persist regarding *HBV* infections as well as public health challenges related to its diagnosis and treatment.

Globally, only 13% of all people living with *HBV* were aware of their infection status, with only 3% overall (7 million) being on treatment [9]. While incidence and prevalence have decreased from historical high points substantially, outbreaks continue to occur especially in high-income countries, exacerbated by the low vaccination rates among adults [7].

In the Eastern Mediterranean region, there are an estimated 18 million people with *HBV*; the United Arab Emirates (UAE) is a low-endemic region with prevalence < 1% (although there are no clear official estimates or studies) [10]. There is a paucity of research on *HBV* in Saudi Arabia and the UAE; from the few papers they reviewed, a number of key points emerged: there is a clear lack of disease awareness and knowledge about *HBV* and its transmission, a lack of proper screening, consistent underdiagnosis, and widespread social stigma [11]. Other studies in the region have also shown low levels of knowledge, low counselling, and widespread stigma [12–14]. In the UAE, only 53% of the general population were aware of *HBV*, with 21% knowing what it is and how it is transmitted [15], in line with previously-reported results [16]. However, neither study explored the attitudes regarding *HBV*, evaluated vaccine attitudes, and outlined *HBV* stigma and its determinants in the UAE. This study aims to assess knowledge of *HBV* infection, attitudes towards the *HBV* vaccine, and stigmatizing attitudes towards individuals living with *HBV* in the UAE.

Methodology

Study population and data collection

A cross-sectional study was conducted from 6th March 2024 to 20th April 2024 using convenience and snowball sampling. Participants were approached through WhatsApp groups and other social media platforms such as X, Meta, and Instagram as well as through email. Our sample frame consisted of individuals within our personal network, mutual acquaintances, and those reached through social media platforms, as well as visitors to public libraries, shopping malls, parks, and similar public spaces. The inclusion criteria consist of all adults aged 18 or older who spoke English and/or Arabic were eligible to participate. Our Exclusion criteria was, people living outside the UAE, residents below 18 years old or above 65 years old. A minimum sample size of 385 participants was calculated using Cochran's sample size formula, assuming a confidence level of 95%, sampling error of 5%, and a standard error of 1.96. A total of 601 responses were retained after removing all responses not meeting the inclusion criteria. Participants were presented with a participant information sheet (PIS) before commencing with the study and filling the questionnaire indicated consent to participate. No identifying information was collected. All data was stored securely and was only accessible to the investigators.

Questionnaire development

The tool used in this study was developed by reviewing the literature on *HBV* [6,11–14,16–18]and including the previously-developed and validated stigma scale by [19]. Given that the original questionnaire was developed for students, some of the questions were expanded by making references to either school or workplace (such as using "student/employee" instead of "student"). The questionnaire was originally developed in English and then translated to Arabic. The Arabic questionnaire was reviewed multiple times to ensure consistency with the English version. Both were pilot tested using a sample 20 university staff and students; all provided feedback was evaluated and incorporated when appropriate. The 43-item self-administered questionnaire consisted of four main sections: demographics, *HBV* knowledge, *HBV* stigmatizing attitudes, and *HBV* vaccine attitudes. It included a mixture of yes/no questions, 5-item Likert scales, as well as single and multi-select questions. This research was reviewed and approved by the Research Ethics Committee of the University of Sharjah (Reference Number: REC-24-02-17-01-F) and was conducted in accordance with the Declaration of Helsinki and local regulations.

Statistical analysis

Data was exported from Google Forms and processed in python-3 using the Matplotlib, pandas, and statsmodels packages for analysis and interpretation. Missing values were dealt with through pairwise deletion. Frequency distributions were calculated for each categorical variable and percentages derived by excluding any missing values. For the stigma scale, the scale's internal consistency reliability was assessed using Cronbach's α. A knowledge score was calculated by assigning + 1 for correct answers, −1 for incorrect answers, and 0 for "I do not know". The overall knowledge score was binned into three groups based on Bloom's cut-off points (< 60% would be 'poor knowledge', $\geq$ 60 but < 80 would be 'moderate knowledge', and $\geq$ 80 would be 'good knowledge'). A stigma score was also calculated for all participants by assigning +1 for agreeing with stigmatising attitudes (+ 2 for strongly agreeing), −1 for disagreeing with stigmatising attitudes (−2 for strongly disagreeing) and 0 for neutral attitudes. As the literature contains no consensus on how to bin the stigma score and most approaches adopted were ad-hoc, it was decided that the stigma score would be kept as is and used as a continuous variable. Outliers were identified as being any value beyond 3 standard deviations from the mean and were dropped. Chi-

squared, Mann-Whitney U and Kruskal-Wallis tests were used for bivariate analyses and ordinary least squares regression was used for linear modelling. P values less than 0.05 were taken to be significant.

Confirmatory factor analysis (CFA) was conducted in lavaan [20] using a diagonally weighted least squares estimator with robust corrections evaluating the model presented by Shi et al., 2013reproduced in Fig. 1. The model outlines four domains of stigma: labelling (distinguishing and labelling differences; items A1-A2), stereotyping (associating human differences with negative attributes; items B1-B3), separating (separating "us" from "them"; items C1-C7), and discriminating (status loss and discrimination; items D1-D5).The model

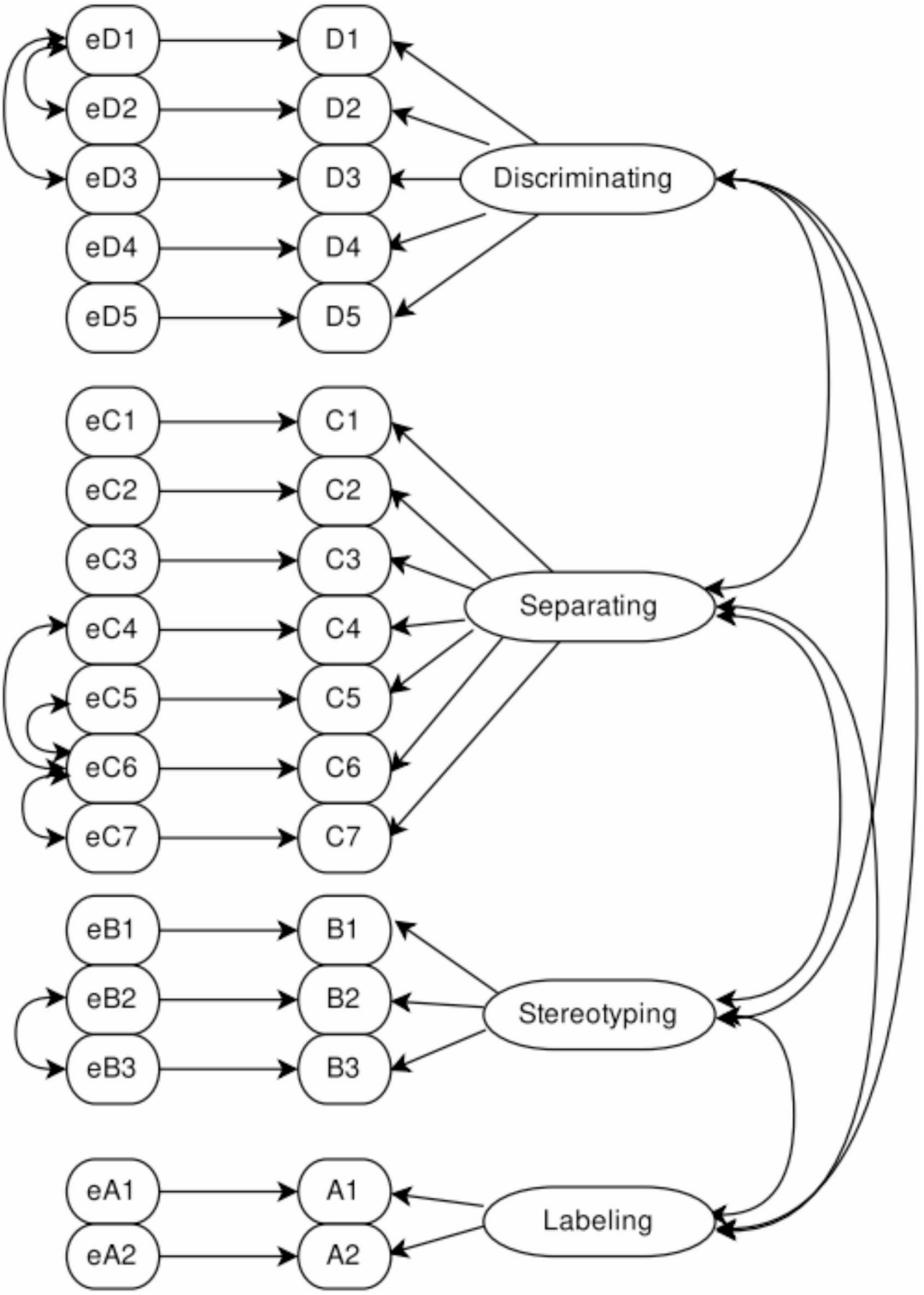

Fig. 1. The proposed factor model for the Hepatitis B Virus Stigma Scale (HBV-SS) by Shi *et al.*, 2013.

Goodness-of-fit was evaluated using χ2, χ2 /df, standardised root mean square residual (SRMR), robust root mean square error of approximation (RMSEA), robust comparative fit index (CFI), and robust Tucker-Lewis index (TLI).

Results

Demographics

Table 1 presents the demographics and baseline characteristics of all participants. A total of 601 responses were included in the final analysis. 46.4% ($n = 279/601$) were male and 55.6% ($n = 334/601$) had a diploma/ bachelor's degree. 81.4% ($n = 489/601$) were middle-aged or older (> 40 years) but only 27.6% ($n = 166/601$) were married. UAE nationals constituted 12.0% ($n = 72/601$) of participants with other Arabs dominating (80.9%, $n = 486/601$). Geographically, 53.7% ($n = 323/601$) lived in Sharjah and other Northern Emirates. 12.0% ($n = 72/601$) were healthcare workers compared to 28.5% ($n = 171/601$) who worked in other non-related fields. 71.7% ($n = 431/601$) had health insurance and 11.7% ($n = 70/600$) reported having some long-term medical condition such as diabetes or hypertension. 40.3% ($n = 242/601$) reported having previously been tested for *HBV*, with only 1.2% ($n = 7/600$) having been infected with the virus previously.

Knowledge regarding the *hepatitis B virus* and *hepatitis B virus* vaccine

Overall, 466 participants (77.5%, $n = 466/601$) reported having some knowledge regarding *HBV*: 26.1% ($n = 157/601$) reported being very or extremely knowledgeable about *HBV* while the majority (50.9%, $n = 306/601$) perceived themselves to have no to slight knowledge regarding the virus. 92.1% ($n = 429/466$) recognized that *HBV* can affect any age group with 63.3% ($n = 295/466$) reporting that an *HBV* infection can occur without any symptoms. However, only 29.2% ($n = 136/466$) were aware that the human body can clear the virus by itself. The majority of participants also recognized that not all *HBV* infections can be cured (56.2%,

Sex - % (*n*)	
Female	53.58% ($n = 322/601$)
Male	46.42% ($n = 279/601$)
Age - % (n)	
Young adult (18–39 years)	18.64% ($n = 112/601$)
Middle-aged/ old-aged (> 40 years)	81.36% ($n = 489/601$)
Highest degree obtained - % (n)	
High school or lower	32.95% ($n = 198/601$)
Diploma/bachelor's degree	55.57% ($n = 334/601$)
Postgraduate degree (MSc, PhD., etc.) or higher	11.48% ($n = 69/601$)
Marital status - % (n)	
Married	27.62% ($n = 166/601$)
Single/ other	72.38% ($n = 435/601$)
Nationality - % (n)	
Non-Arab	7.15% ($n = 43/601$)
Other Arab	80.87% ($n = 486/601$)
UAE national	11.98% ($n = 72/601$)
Place of Residence - % (n)	
Abu Dhabi	22.13% ($n = 133/601$)
Dubai	24.13% ($n = 145/601$)
Sharjah and other northern emirates	53.74% ($n = 323/601$)
Field of work - % (n)	
Non-healthcare worker	28.45% ($n = 171/601$)
Healthcare (doctor, nurse, dentist, pharmacist, etc.)	11.98% ($n = 72/601$)
Student (health-related majors)	34.44% ($n = 207/601$)
Student (non-health related majors)	10.32% ($n = 62/601$)
Housewife	6.49% ($n = 39/601$)
Unemployed	8.32% ($n = 50/601$)
Do you have health insurance - % (n)	
Yes	71.71% ($n = 431/601$)
No	28.29% ($n = 170/601$)
Do you have long-term medical conditions (Hypertension, diabetes, chronic liver or kidney disease, etc.) - % (n)	
Yes	11.67% ($n = 70/600$)
No	88.33% ($n = 530/600$)

Table 1. Demographics and baseline characteristics of participants.

$n = 262/466$). Table 2 displays all the results for the *HBV* knowledge questions. More than half of *HBV* symptoms were correctly identified by the majority of participants, with low results for headaches (29.9%, $n = 123/412$), diarrhoea (38.8%, $n = 160/412$), and flu symptoms (41.8%, $n = 172/412$). Knowledge regarding transmission was excellent with the overwhelming majority correctly reporting the true transmission methods. As for *HBV* complications, complications such as arthritis (11.1%, $n = 45/404$) and depression (14.1%, $n = 57/404$) were less recognized compared to other complications, with liver complications being the most well-known. Figure 2 presents the participant's responses regarding all *HBV* symptoms, transmission mechanisms, and complications.

A knowledge score was calculated for every participant and their true knowledge level was determined as discussed previously in the methodology. The raw knowledge score ($\mu = 7.62$; $\sigma = 10.75$) was scaled to vary from 0 to 100 (with the absolute minimum −30 being mapped to 0% and the absolute maximum + 30 being mapped to 100). After that and using the Bloom's cut-off points as above, 19.3% ($n = 90/466$) were found to have good knowledge compared to 39.3% ($n = 183/466$) who had poor knowledge. Overall, however, 84.0% ($n = 505/601$) were interested in learning more about the virus. Bivariate analyses were conducted to identify predictors of the scaled *HBV* knowledge score; all demographic features from Table 1 as well as perceived knowledge were tested. Marital status, being a healthcare worker, age, and perceived knowledge were all found to be significant and were fed into an ordinary least-squares (OLS) regression model. Supplementary Table 1 shows the results of the model. On multiple regression, it was found that age was not a significant predictor of knowledge score, being married was associated with a lower knowledge score (−5.243; 95% CI: −9.787 - −0.699) while being a healthcare worker predicted a higher actual knowledge score (5.635; 95% CI: 1.629–9.640) and

How knowledgeable are you about hepatitis B virus? - % (n)			
Not at all/ slightly	50.92% ($n = 306/601$)		
Moderately	22.96% ($n = 138/601$)		
Very/ extremely	26.12% ($n = 157/601$)		
For each of the following statements, please choose whether they are true or false.			
Statement - % (n)	True	False	I do not know
Hepatitis B can affect any age group.	92.06%* ($n = 429/466$)	3.00% ($n = 14/466$)	4.94% ($n = 23/466$)
Hepatitis B infection can happen without any symptoms.	63.30%* ($n = 295/466$)	19.31% ($n = 90/466$)	17.38% ($n = 81/466$)
The human body can clear a hepatitis B infection by itself.	29.18%* ($n = 136/466$)	44.42% ($n = 207/466$)	26.39% ($n = 123/466$)
All hepatitis B infections can be cured.	20.17% ($n = 94/466$)	56.22%* ($n = 262/466$)	23.61% ($n = 110/466$)
Have you been tested for hepatitis B before? - % (n)			
Yes	40.27% ($n = 242/601$)		
No	59.73% ($n = 359/601$)		
Have you ever been infected with hepatitis B? - % (n)			
Yes	1.17% ($n = 7/600$)		
No	98.83% ($n = 593/600$)		
Are you interested in learning more about hepatitis B? - % (n)			
Yes	84.03% ($n = 505/601$)		
No	15.97% ($n = 96/601$)		
Are you aware about the existence of the HBV vaccine? *			
Yes	57.57% ($n = 346/601$)		
No	42.43% ($n = 255/601$)		
The hepatitis B vaccine is safe - % (n)			
Disagree/ strongly disagree	2.60% ($n = 9/346$)		
Neutral	8.38% ($n = 29/346$)		
Agree/ strongly agree	89.02% ($n = 308/346$)		
The hepatitis B vaccine is effective - % (n)			
Disagree/ strongly disagree	2.31% ($n = 8/346$)		
Neutral	12.43% ($n = 43/346$)		
Agree/ strongly agree	85.26% ($n = 295/346$)		
The hepatitis B vaccine should be compulsory for all individuals - % (n)			
Disagree/ strongly disagree	5.78% ($n = 20/346$)		
Neutral	14.45% ($n = 50/346$)		
Agree/ strongly agree	79.77% ($n = 276/346$)		
If a doctor determines you need the hepatitis B vaccine, how likely would it be for you to get the vaccine? - % (n)			
Unlikely/ very unlikely	3.18% ($n = 11/346$)		
Neutral	7.23% ($n = 25/346$)		
Likely/ very likely	89.60% ($n = 310/346$)		

Table 2. *HBV* and its vaccine knowledge and attitudes. * indicates correct answers.

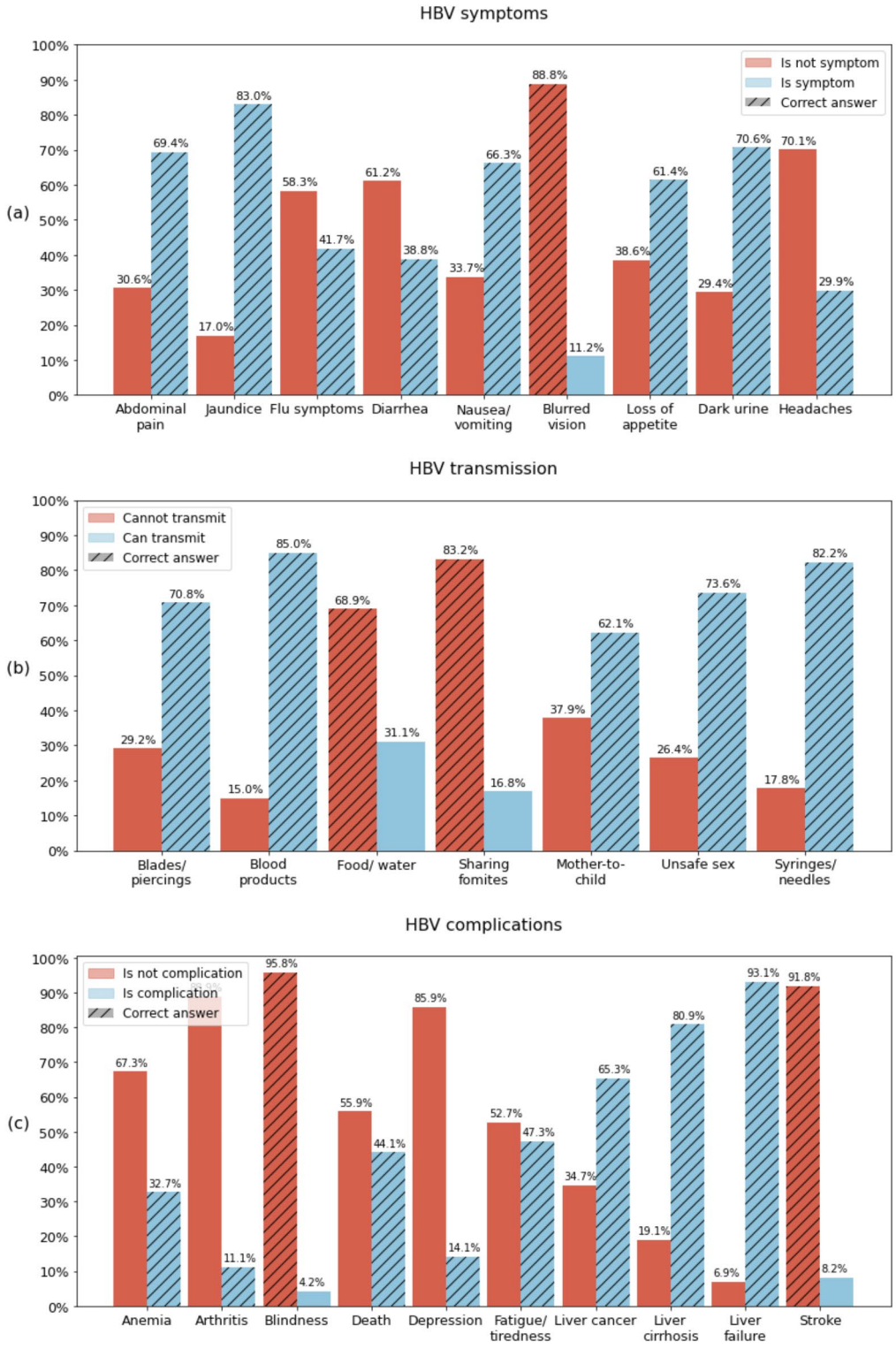

Fig. 2. Participants were asked to choose the (**a**) symptoms, (**b**) transmission modes, and (**c**) complications of *HBV*.

so did higher levels of perceived knowledge (moderately knowledgeable: 10.967; 95% CI: 7.372–14.562; very/ extremely knowledgeable: 18.612; 95% CI: 14.918–22.306).

Participants were also asked about the *HBV* vaccine. Only 57.6% ($n = 346/601$) were aware of the existence of the vaccine. Of those, 89.0% ($n = 308/346$) agreed/ strongly agreed that the *HBV* vaccine is safe, and 85.3% ($n = 295/346$) agreed/strongly agreed that the vaccine is effective. Similarly, there was widespread agreement with compulsory vaccination policies for the *HBV* vaccine (79.8%, $n = 276/346$) as well as trust in physician

recommendations: 89.6% ($n = 310/346$) stated that it would be likely/ very likely for them to get the vaccine if a doctor determined the person needed it.

Hepatitis B infection stigmatizing attitudes

Univariate and multivariate results

Figure 3.a shows the responses to each item of the *HBV*-SS, with the numeric results displayed in supplementary Table 2. The scale showed good internal consistency (Cronbach's $\alpha = 0.89$). The highest proportion of stigmatising views was seen with the labeling domain (items A1 and A2): 54.1% ($n = 251/464$) agreed/ strongly

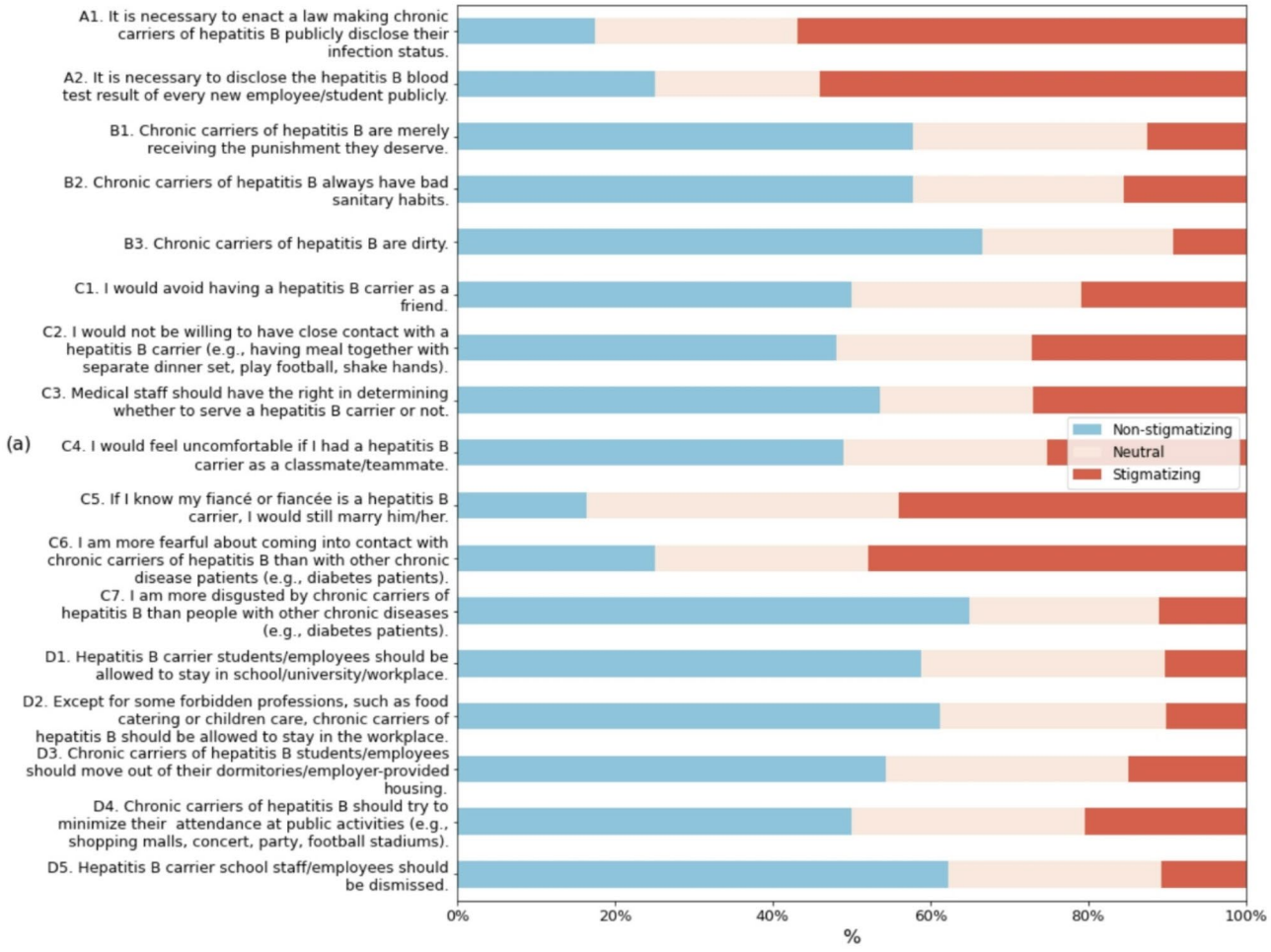

Fig. 3. Participant's *Hepatitis B* Virus Stigma Scale (*HBV*-SS) scores. (**a**) shows the distribution of the raw *HBV*-SS scores while (**b**) shows the response distribution for each scale item.

agreed with the necessity of publicly disclosing *HBV* blood test results for every new student or employee. Similarly, 56.9% ($n = 264/464$) agreed/ strongly agreed with enacting new laws that would require chronic *HBV* patients to publicly disclose their infection status. Responses for the stereotyping domain (items B1-B3) were majorly non-stigmatizing, with more than half of participants disagreeing/ strongly disagreeing that chronic *HBV* patients are: B1 - "receiving the punishment they deserve", B2- "always have bad sanitary habits", and B3- "are dirty".

Results for the separating domain (items C1-C7) showed three levels of stigma. Item C7 ("I am more disgusted by chronic carriers of *HBV* than people with other chronic diseases") showed the lowest level of stigmatising attitudes (11.0%, $n = 51/464$). Next, items C1-C4 showed higher levels of stigma (around a quarter of participants for each); these items dealt with having varying levels of contact (teammate/classmate, heaving a meal together, playing together, befriending) with chronic *HBV* patients. Interestingly, 26.9% ($n = 125/464$) agreed/strongly agreed that "medical staff should have the right in determining whether to serve a *HBV* carrier or not." As for items C5 and C6, the level of stigmatising attitudes was high: 44.0% ($n = 204/464$) agreed/ strongly agreed with item C5, "If I know my fiancé or fiancée is a *HBV* carrier, I would still marry him/her," while 47.8% ($n = 222/464$) were "more fearful about coming into contact with chronic carriers of *HBV* than with other chronic diseases."

Finally, for the discriminating domain (items D1-D5), results for items D1, D2, D3, and D5 matched those of the stereotyping domains, with less than 15% of participants displaying stigmatising attitudes. These items dealt with chronic *HBV* patients and their access to schools, employment opportunities, and housing, as well as the outright dismissal of these patients. However, 29.5% ($n = 137/464$) agreed that chronic *HBV* patients "should try to minimise their attendance at public activities."

An *HBV*-SS score was calculated for every participant as outlined previously in the methodology. Figure 3.b shows the distribution of the stigma score. Two outliers were identified and dropped. The stigma score had a mean ($x^{-} = -6.06$) and standard deviation ($\sigma = 10.96$). Bivariate analyses were conducted to identify predictors of stigma; all demographic features from Table 1 as well as perceived and actual knowledge were tested. Only actual and perceived knowledge were found to be significant and were fed into an OLS regression model. Table 3 shows the results of the OLS model. Only actual knowledge level was found to be significant, with stigma decreasing as *HBV* knowledge increases (moderate knowledge: −4.334; 95% CI: −6.558 - −2.111; good knowledge: −10.169; 95% CI: −13.068 - −7.270).

Confirmatory factor analysis

Table 4 shows the results of the Confirmatory Factor Analysis (CFA) for the *HBV*-SS model and supplementary Table 3 shows the covariances matrix for all the items. The majority of factors showed high standardised loadings with the exception of items C5, C6, and D2. Item C5 specifically showed very poor loading (−0.022, P value: 0.634). While cut-offs vary, the model showed acceptable/good goodness-of-fit: $\chi 2$ /df = 3.316, standardised root mean square residual (SRMR) = 0.046, robust root mean square error of approximation (RMSEA) = 0.077 (0.069–0.086), robust comparative fit index (CFI) = 0.932, and robust Tucker-Lewis index (TLI) = 0.914.

Discussion

This study aimed to evaluate the UAE's population *HBV* knowledge, *HBV* vaccine attitudes, and stigmatizing attitudes towards the *HBV* infection. Overall, 19.3% of participants had good knowledge regarding *HBV* with most gaps occurring with symptoms and complications of the infection. Participants however showed great interest in learning more regarding the virus. Knowledge regarding the existence of the *HBV* vaccine was also lower than expected; yet those that were aware of the vaccine had overwhelmingly positive attitudes. Stigma also presented a mixed picture: for the majority of items, most participants adopted non-stigmatizing attitudes; however, both labelling and separating domains highlighted specific elements and scenarios that elicited very high stigmatizing attitudes (nearly half of the participants). CFA also showed acceptable/good goodness-of-fit for the *HBV*-SS model.

In that UAE, it has been estimated that of approximately 12,000–18,000 cases of *HBV* in the country, less than a third are diagnosed, and of those, only around a fifth are currently on treatment [16]. These low numbers, coupled with a lack of local *HBV* treatment and management guidelines, highlight substantial breaks in the

Predictors of HBV stigma score – Ordinary Least Squares (OLS) regression						
Model Terms		β -coefficient	**95% CI for β**	**SE**	**t-Statistic**	**P value**
Intercept (β_0)		−1.415	−3.102–0.273	0.859	−1.648	0.100
Perceived HBV knowledge **(P value: 0.015)**	Not at all/ slightly	-	-	-	-	-
	Moderate	−0.436	−2.837–1.965	1.222	−0.357	0.721
	Very/ extremely	−2.255	−4.783–0.274	1.287	−1.752	0.080
HBV Knowledge **(P value: 0.007)**	Poor	-	-	-	-	-
	Moderate	**−4.334**	**−6.558 - −2.111**	**1.131**	**−3.831**	**< 0.0005**
	Good	**−10.169**	**−13.068 - −7.270**	**1.475**	**−6.893**	**< 0.0005**
R-squared: 14.9%	Adjusted R-squared: 14.2%		F (4, 459) = 20.09 **(P value < 0.0005)**			

Table 3. The results of the ordinary least squares regression modeling the determinants of HBV stigma. P values for the bivariate Kruskal-Wallis tests are reported below each variable. Rows with significant P values are bolded. *HBV*: *hepatitis B* virus; CI: confidence interval; SE: standard error.

Factor	Item	Estimate	SE	z	*P* value	Standardized loading
Labeling	A1	1	0	NA	NA	0.755
	A2	1.158	0.096	12.026	< 0.0005	0.874
Stereotyping	B1	1	0	NA	NA	0.827
	B2	1.032	0.039	26.276	< 0.0005	0.853
	B3	1.039	0.043	24.281	< 0.0005	0.859
Separating	C1	1	0	NA	NA	0.840
	C2	0.970	0.025	38.806	< 0.0005	0.815
	C3	0.681	0.04	17.166	< 0.0005	0.572
	C4	0.980	0.026	37.901	< 0.0005	0.823
	C5	−0.026	0.055	−0.477	0.634	−0.022
	C6	0.589	0.043	13.614	< 0.0005	0.495
	C7	0.802	0.035	23.16	< 0.0005	0.674
Discriminating	D1	1	0	NA	NA	0.524
	D2	0.904	0.058	15.691	< 0.0005	0.473
	D3	1.385	0.109	12.673	< 0.0005	0.726
	D4	1.634	0.119	13.784	< 0.0005	0.856
	D5	1.493	0.114	13.151	< 0.0005	0.782
Covariances						
B2	B3	0.052	0.028	1.876	0.061	0.193
D1	D2	0.387	0.029	13.136	< 0.0005	0.516
D1	D3	−0.015	0.027	−0.566	0.571	−0.026
C4	C6	0.156	0.03	5.152	< 0.0005	0.315
C5	C6	0.155	0.034	4.542	< 0.0005	0.179
C6	C7	0.046	0.034	1.342	0.180	0.072
Labeling	Stereotyping	0.332	0.037	9.065	< 0.0005	0.533
Labeling	Separating	0.310	0.035	8.960	< 0.0005	0.488
Labeling	Discriminating	0.165	0.026	6.401	< 0.0005	0.417
Stereotyping	Separating	0.551	0.028	19.772	< 0.0005	0.793
Stereotyping	Discriminating	0.313	0.024	12.888	< 0.0005	0.724
Separating	Discriminating	0.379	0.028	13.446	< 0.0005	0.861

Fit indices							
χ^2 (scaled)	df	χ^2/df	P value	CFI (robust)	TLI (robust)	RMSEA (robust)	SRMR
354.838	107	3.316	< 0.0005	0.932	0.914	0.077 (0.069–0.086)	0.046

Table 4. Results of the confirmatory factor analysis (CFA) for the *HBV*-SS scale. The model used is the one displayed in Fig. 1, first proposed by (Shi et al., 2013).

care continuum in the country [11]. A significant portion of these gaps are thought to be explained by stigma, which has been shown to have adverse social and health outcomes for patients, at both the personal and family level [21]. Stigma, like many complex social concepts, is characterized by many competing definitions. Link and Phelan most recently conceptualized stigma as a function of 5 interrelated components: labelling, stereotyping, separating, discriminating, and (political power allowing) identifying [22]. This definition aligns well with the model used for stigma in this study. Smith-Palmer et al. found that *HBV*-related stigma is common in Southeast Asia and among Asian immigrant communities but poorly described in other populations. Overall, the studies reviewed showed that up to 20% of chronic *HBV* patients believed that they may be denied healthcare services and 30% were worried about experiencing workplace discrimination due to their infection status [23]. Additionally, unlike *HIV*, *HBV*-related stigma has not been well characterized. Such stigma may emanate from preconceptions that a person may be using drugs or sexually promiscuous and are fuelled by an irrational fear of contagion and a lack of knowledge and understanding regarding transmission [21,23,24].

In the UAE, there is a severe lack of data regarding the virus' incidence and prevalence: Alali and Abo-Shehada estimated the overall true prevalence of *HBV* in the Gulf Cooperation Council region to be 1.67% in 2020. While the UAE was estimated to have the lowest prevalence, the confidence intervals overlapped suggesting resemblance and similarity in values to neighbouring countries [25]. Sporadic evidence currently points towards a low to intermediate-low endemicity; most recently, Al Zaabi estimated the overall prevalence among the general population to be between 1.0 and 1.5% [16]. Yet, a dental hospital retrospective study showed a 2.2% prevalence among patients [26]. This discrepancy can be explained by the underrepresentation of expatriates in the studies reviewed by Al Zaabi *et al.* and Alali and Abo-Shehada (even though they constitute nearly 90% of the UAE's population).

In the UAE, Sanai *et al.* noted a prominent lack of awareness of disease transmission and widespread social stigma against patients with *HBV* [11]. Additionally, Lazarus et al. found that only 50% of participants in the UAE were aware of *HBV* and even less than 20% were aware of *HBV* transmission and prevention [15]. One of the most common drivers of *HBV*-related stigma was the fear of getting infected, which may also be amplified by the unique socio-demographic, religious, and cultural factors of Arab communities [11]. This is also compounded by the suboptimal local policies and strategies that do not focus on marginalized groups such as people who inject drugs (PWID) [15]. This study however suggests a more nuanced picture; while knowledge was poor, results showed that transmission knowledge was excellent among most participants. As for stigma, while specific items and questions highlighted stigmatizing attitudes, the overall results showed non-stigmatizing attitudes dominating. Compared to Sanai *et al.*, this study used a validated tool and explored *HBV* stigma systematically; however, in line with their results, the items with highly stigmatizing attitudes do reflect an underlying fear of getting infected. More globally, Toumi *et al.* showed that there exists widespread social and self-stigma for CHB patients, leading to social isolation, employment discrimination, and emotional distress. The study emphasizes that a functional cure could alleviate stigma and improve health-related quality of life. In contrast, this study is a quantitative cross-sectional survey assessing public knowledge and stigma levels regarding *hepatitis B* found that while overall stigma levels are low, specific areas, such as labelling and social distancing, are characterized by strong stigmatizing attitudes. Overall, both still highlight the need for public education campaigns to enhance *hepatitis B* awareness and reduce stigma [27].

As for *HBV* infection and vaccine knowledge, attitudes, and practices, several studies were conducted in the region. A study among healthcare professionals (HCPs) in Gaza found good levels of knowledge overall but significant gaps persisted among many dimensions (*HBV* transmission, therapy, and prevention), necessitating awareness campaigns even among healthcare workers. While stigma was not evaluated through a validated scale, attitudes were overall quite positive[18]. Yet, a Saudi HCPs study found substantial poor knowledge and lack of disease understanding, with 16.5% of participants not having received the *HBV*vaccine. More than 30% of participants had concerns regarding vaccine safety and effectiveness [17]. Interestingly, this study's results align more with Sammour *et al.,* given that the UAE's healthcare workers were found to have better knowledge and overall positive non-stigmatizing attitudes towards *HBV* (although no significant difference was found between healthcare workers and non-healthcare workers with regards to stigma).

As for studies focusing on non-healthcare strata, results highlighted deeper gaps. A study among pregnant Jordanian females found poor knowledge regarding all dimensions of *HBV* (cause, transmission, symptoms, complications, and vaccination). Alarmingly, 94% of participants reported they had never received counselling on *HBV* nor had they requested it. Even in a more general sample (Jordanian adults), poor knowledge was evident with the overwhelming majority of participants not knowing *HBV* symptoms and management [14]. However, while attitudes were positive, this did not translate to practices, with only 23.1% of participants having received the *HBV* vaccine. Worryingly, nearly three-quarters of participants reported fear of side effects as one of the main reasons for not getting vaccinated [14]. A similar community-based study in Sudan found widespread misconceptions regarding *HBV* transmission, prevention, and disease states, coupled with poor vaccine coverage [13]. While the knowledge level for this study's sample was also suboptimal with the majority having poor knowledge, there was widespread awareness and understanding of the mechanisms of *HBV* transmission. Additionally, while the awareness of the vaccine was also relatively low, attitudes were overwhelmingly positive.

It is important to acknowledge several limitations of this study. First, the results rely on self-reported data without independent verification, which may introduce recall bias, response bias, and social desirability bias. Second, the use of convenience and snowball sampling, while employed with care to avoid oversampling any group, limits the generalizability of our findings and could introduce self-selection bias. Specifically, distribution through WhatsApp and social media likely skewed the sample towards younger, more educated, and tech-savvy individuals. This, coupled with the lack of direct comparison with national demographics, means we cannot definitively determine the representativeness of our sample to the overall UAE population. Future research should endeavour to employ probability sampling methods and weighting techniques to improve representativeness. While the survey was distributed anonymously across all Emirates to encourage genuine responses, the limitations above should be considered when interpreting the results. Lastly, the study's focus on English and Arabic speakers excludes a small segment of the population, which may limit a full representation of perspectives.

Conclusion

This study found a low level of knowledge regarding *HBV* and its vaccine coupled with a strongly positive belief in the vaccine's effectiveness, safety, and necessity as well as overall non-stigmatising attitudes towards chronic carriers of the virus. Given the lack of a cure, prevention is key, whether it be through improving general population knowledge and awareness or maintaining (or even expanding and solidifying) the widespread level of vaccine acceptance and non-stigmatizing attitudes.

Data availability

Data is provided within the manuscript.

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Author contributions

Conceptualization, HJB, KAS, Methodology, KAS, MMA, AMM, SHO, Validation, KAS, Data Curation, HJB, EAG, MMA, AMM, SHO, EAG, Writing - Original Draft Preparation, KAS, Writing - Review and Editing, HJB, MMA, AMM, SHO, EAG, Visualisation, Supervision. HJB, EAG, Software, Formal Analysis KAS.

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Declarations

Ethics approval and consent to participate

This study was reviewed and approved by the Research Ethics Committee at the University of Sharjah (Reference Number: REC-24-02-17-01-F). It was conducted in accordance with all relevant guidelines and regulations. Informed consent was obtained from all participants.

Competing interests

The authors declare no competing interests.

Additional information

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