DECEMBER 2024 | IeJSME 2024 Vol 18 (3) ISSN 2231-8194

INTERNATIONAL

E-Journal

OF SCIENCE, MEDICINE AND EDUCATION

CONTENTS

COMMENTARY

Global disparities in public access automated external defibrillation in pre-hospital emergency care: Implications for international travellers 02 - 03
Kais Al-Khaldi, Michael M Smith, Gerard T Flaherty

ORIGINAL ARTICLE

Impact of Transition to Online Teaching on the Work-Life Balance and Mental Health of Lecturers in a Medical University 04 - 14
Kwee Choy Koh, Benjamin Ze Wei Kok, Yun Ni Cheah, Swen Huey Bee, Charlottee Yen Shin Lee, Dalili Hezreen Nazari

Evaluating Online Learning Environment for Medical Students Using Digi-MEE Instrument: A Sequential Mixed-Method Study 15 - 32
Noor-i-Kiran Naeem, Siti Nurma Hanim Hadie, Irwan Mahazir Ismail, Samina Malik, Usman Mahboob, Subhan Ullah, Muhamad Saiful Bahri Yusoff

REVIEW ARTICLE

Prevalence and Associated Factors of General Health Literacy Among Adults in Malaysia: A Systematic Review and Meta-Analysis 33 - 47
Cheong Lieng Teng, Pei Kuan Lai, Hian Jie Heng, Mun Hong Tiew, Chun Wai Chan

IeJSME 2024 Vol 18 (3): 02-03

Commentary

Global disparities in public access automated external defibrillation in pre-hospital emergency care: Implications for international travellers

Kais Al-Khaldi[1], Michael M Smith[1], Gerard T Flaherty[1,2]

The most frequent cause of death in international travellers is cardiovascular disease.[1] We previously reported that two of the leading causes of concern among attendees at a travel clinic were how to access medical care abroad (59%) and the prospect of dying overseas (26%).[2] Since travellers often visit countries with poorly resourced health care systems, the chances of successful pre-hospital resuscitation are likely to be greatly diminished in the event of a cardiac arrest.

Public access automated external defibrillators (AEDs) play a critical role in improving survival rates for victims of cardiac arrest in the community. Without treatment, the chances of survival drop by 10% for every minute in cardiac arrest (www.eena.org). Prompt access to AEDs and the presence of a large network of individuals trained in their use are vital components of an effective response to acute cardiac emergencies.[3]

In a large Danish registry study, the chance of a bystander defibrillation in an out-of-hospital cardiac arrest was tripled, and 30-day survival rates doubled, when the closest AED was accessible at the time of the arrest.[4] However, stark disparities in AED availability, training provisions, and distribution exist between low- and middle-income countries (LMICs) and high-income countries (HICs), with significant public health implications for residents and travellers crossing international borders.

The standard of pre-hospital emergency medical services varies significantly across the globe and awareness of this deficit among travellers may be poor. Inadequate investment in pre-hospital emergency systems in LMICs contributes to a substantial number of avoidable deaths from time-sensitive critical illnesses. A recent systematic review concluded that pre-hospital care in LMICs is "fragmented and uncoordinated", with a lack of adequately trained emergency medical personnel, first responders, and basic resuscitation equipment.[5] A simulation-based study in South Africa of emergency medical service personnel competence at delivering effective cardiopulmonary resuscitation demonstrated substandard knowledge and skill performance.[6] Even developed countries do not always meet targets for the deployment of publicly accessible AEDs and training of volunteer lay first responders. The rollout of drone-assisted AED delivery is still in its infancy globally[7] and likely to be unavailable in most LMICs. The recent application of artificial intelligence and machine learning to AED technology has potential to more effectively detect shockable rhythms during cardiac arrest scenarios.[8]

While AED registries and geo-located maps to locate the nearest AED are available to emergency medical personnel and despatchers in many developed countries, they are beyond the reach of less developed economies, where AED distribution is sparse and fragmented. Furthermore, inadequate AED maintenance, including battery changes, may compromise their utility in the event of an out-of-hospital cardiac arrest. Where AEDs do exist in LMICs, language barriers and restrictions on who is allowed to use them present additional barriers.

[1] School of Medicine, College of Medicine, Nursing and Health Sciences, University of Galway, Galway, Ireland
[2] School of Medicine, International Medical University, Kuala Lumpur, Malaysia

Corresponding author:
Professor Dr Gerard T Flaherty, School of Medicine, College of Medicine, Nursing and Health Sciences, University of Galway, Galway, Ireland. Email: gerard.flaherty@universityofgalway.ie Tel.: +353-91495469

We advocate for greater global health agency and governmental funding towards population-level training in basic life support in LMICs, with installation of AEDs in as many public locations as possible, particularly in crowded areas and sports venues, which attract large numbers of international visitors. Publicly available mapped AED registries and public awareness campaigns will help bystanders to respond more effectively if they witness a cardiac arrest. Travellers at high risk for acute cardiac emergencies should ideally travel with at least one companion who is trained to provide basic life support. Their travel preparations should include knowledge of the limitations and challenges in accessing local emergency medical services at their destination, comprehensive travel health insurance, and active location of public AEDs in their immediate vicinity. Future research should investigate the basic life support training of international travellers and members of the travel industry, including in LMIC settings.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of interests: The authors have no conflicts of interest to declare.

Authors' contributions: GF led on conceptualisation. All authors contributed equally to other aspects of the work. The manuscript was read and approved by each author.

Ethical approval: This work did not involve human or animal subjects.

REFERENCES

1. Lawson C J, Dykewicz C A, Molinari N A, Lipman H, Alvarado-Ramy F. Deaths in international travelers arriving in the United States, July 1, 2005 to June 30, 2008. J Travel Med. 2012 Mar-Apr;19(2):96-103. doi: 10.1111/j.1708-8305.2011.00586.x.
2. Karlsson L, Malta Hansen C, Wissenberg M, Hansem S M, Lippert F K, Raja S, *et al*. Automated external defibrillator accessibility is crucial for bystander defibrillation and survival: A registry-based study. Resuscitation. 2019 Mar;136:30-37. doi: 10.1016/j.resuscitation.2019.01.014.
3. Elhussain M O, Ahmed F K, Mustafa N M, Mohammed D O, Mahgoub I M, Alnaeim N A, *et al*. The Role of Automated External Defibrillator Use in the Out-of-Hospital Cardiac Arrest Survival Rate and Outcome: A Systematic Review. Cureus. 2023 Oct 26;15(10):e47721. doi: 10.7759/cureus.47721.
4. Flaherty G T, Chen B, Avalos G. Individual traveller health priorities and the pre-travel health consultation. J Travel Med. 2017 Sep 1;24(6). doi: 10.1093/jtm/tax059.
5. Bhattarai H K, Bhusal S, Barone-Adesi F, Hubloue I. Prehospital Emergency Care in Low- and Middle-Income Countries: A Systematic Review. Prehosp Disaster Med. 2023 Aug;38(4):495-512. doi: 10.1017/S1049023X23006088.
6. Veronese J P, Wallis L, Allgaier R, Botha R. Cardiopulmonary resuscitation by Emergency Medical Services in South Africa: Barriers to achieving high quality performance. Afr J Emerg Med. 2018 Mar;8(1):6-11. doi: 10.1016/j.afjem.2017.08.005.
7. Zègre-Hemsey J K, Grewe M E, Johnson A M, Arnold E, Cunningham C J, Bogle B M, Rosamond W D. Delivery of Automated External Defibrillators via Drones in Simulated Cardiac Arrest: Users' Experiences and the Human-Drone Interaction. Resuscitation. 2020 Dec;157:83-88. doi: 10.1016/j.resuscitation.2020.10.006.
8. Aqel S, Syaj S, Al-Bzour A, Abuzanouneh F, Al-Bzour N, Ahmad J. Artificial Intelligence and Machine Learning Applications in Sudden Cardiac Arrest Prediction and Management: A Comprehensive Review. Curr Cardiol Rep. 2023 Nov;25(11):1391-1396. doi: 10.1007/s11886-023-01964-w.

IeJSME 2024 Vol 18 (3): 04-14

Impact of Transition to Online Teaching on the Work-Life Balance and Mental Health of Lecturers in a Medical University

Kwee Choy Koh[1], Benjamin Ze Wei Kok[2], Yun Ni Cheah[2], Swen Huey Bee[2], Charlottee Yen Shin Lee[2], Dalili Hezreen Nazari[2]

Introduction: The COVID-19 pandemic in 2020 resulted in a complete lockdown of educational institutions in Malaysia necessitating an immediate shift from conventional face-to-face teaching to online teaching-learning (OTL). This invariably affected the work-life balance and mental health of medical lecturers. This study was done to assess the adequacy of training of lecturers to conduct OTL and the challenges faced, and the impact of transitioning to OTL on the work-life balance and mental health of medical lecturers. The mental health status of lecturers was compared according to age categories of Gen-X, Gen-Y and Baby Boomer (BB) generations. **Methods**: An online survey was conducted between August and October 2021. Participants were asked to answer a series of questions designed to assess adequacy of training received, impact on work life balance, and score themselves with validated scoring tools to assess for anxiety, depression, and stress levels. **Results**: A total of 179 lecturers participated in the study. Training for OTL was deemed to be adequate and prepared the lecturers well for OTL. The transition to OTL negatively disrupted work-life balance causing extra work hours, disruption to family life, sleep issues, exhaustion, and stress but were positive in many other aspects. Gen-X and Gen-Y lecturers had higher perceived stress compared to BB. **Conclusions**: Transitioning to online teaching during COVID-19 pandemic impacted work-life balance positively and negatively. Moderate to high perceived stress were reported, especially among younger lecturers. Training to equip lecturers to conduct online teaching and support for mental health and wellbeing should be provided.

Keywords: *COVID-19 pandemic, mental health, online teaching, work-life balance, medical lecturers.*

INTRODUCTION

In March 2020, to arrest the rapid spread of COVID-19 in Malaysia, the Ministry of Education of Malaysia abruptly announced the closure of all institutions of higher learning in the country with a directive to immediately transition to online teaching and learning (OTL). Initially caught off guard, most institutions of higher learning immediately responded by investing heavily into procuring the necessary technology for OTL delivery and providing support and training to its lecturers to embrace a new way of teaching.

Work-life balance is defined as equilibrium or an overall sense of harmony in work and private life.[1] Poor work-life balance is associated with poor psychosocial well-being.[2] The intersection of mental health, work-life balance, and OTL is a critical area of research, especially with the increasing prevalence of online education during and post COVID-19 pandemic. The sudden transition to OTL has created additional challenges for both teachers and students. Although online learning can enhance work-life balance for students compared to traditional classroom settings, as it provides flexibility that helps manage personal and professional responsibilities, several studies have reported the challenges experienced by tertiary level medical and non-medical students including suboptimal adherence to online classes, lower satisfaction scores, lower quality of life scores and poorer psychological health manifesting as anxiety, depression and stress.[3-5] Similarly, educators at all levels of education reported challenges from transitioning to OTL including frequent and unpredictable changes in time-tabling, extra workload, dismantling of work-life distinction, and emotional issues that threatened their

[1] Professor of Medicine, International Medical University

[2] Medical students, International Medical University

Corresponding author:
Professor Dr Kwee Choy Koh
Address: Department of Medicine, IMU Clinical Campus, Jalan Rasah, 70300 Seremban, Negeri Sembilan, Malaysia.
Email: kweechoy_koh@imu.edu.my Tel: +60126123496

work-life balance and mental health.[6-11] In addition, students and educators alike reported issues with OTL including the lack of interaction and engagement, challenges in adapting to technology, problems with assessment and feedback from students, poorer mental health, and the quality of education.[8,9]

Theories connecting mental health and work-life balance to online teaching and learning primarily centre around the concept of "spillover", where the blurred boundaries between work and personal life in online teaching can negatively impact mental health due to the lack of clear separation between work and personal time. This is particularly exacerbated by factors like constant accessibility to students via digital platforms, irregular working hours, and the need to manage a virtual learning environment.[12-14]

Key theories explaining this connection include the Work-Family Theory, where demands from work clash with demands from family, leading to stress and conflict; the Role Strain Theory, where conflicting role expectations, which can occur in OTL when educators are expected to be constantly available to students while also managing personal responsibilities; the Demand-Control Model where teachers are pressured by the need to constantly adapt to new technologies and cater to diverse student needs while conducting OTL leading to burnout; and the Social Isolation Theory where the lack of face-to-face interaction with OTL can result in feelings of social isolation and disconnection from colleagues, thus contributing to mental health concerns.[12-16]

Mitigating strategies include setting clear boundaries through set working hours, using dedicated workspace, and communicating availability to students; providing adequate training on online platforms and tools to educators to reduce technical stress; and a supportive work culture where open communication, collaboration and access to mental health resources are promoted.[12-17]

In the context of medical education, we found only one study that specifically focused on mental health and quality of life among medical teachers which reported them experiencing high stress levels from transitioning to digital e-learning methods during the COVID-19 pandemic.[11]

We conducted this study approximately 18 months from March 2020 to assess the impact of transition to OTL on the work-life balance and the mental health status of lecturers at a private medical university in Malaysia. At the time, all teaching and learning activities were conducted online. We also compared the impact of transition to OTL on the mental health status of lecturers across three different age categories, namely the Gen-Y, Gen-X and the Baby Boomers.

METHODS

Objectives

The study had three objectives:

1. To determine the adequacy of training received for OTL and the challenges faced by lecturers while conducting OTL
2. To assess the impact of transition to OTL on the work-life balance of lecturers
3. To assess the impact of transition to OTL on the mental health status of lecturers from different age generations

Study design, setting and sample size calculation

A cross-sectional online survey was conducted between August to October 2021 at the International Medical University (IMU), a private medical university in Malaysia. The eligibility criteria for this study were full time and part time lecturers in IMU fluent in English language. At the time of the survey, there were 381 lecturers of which 335 were full time and 46 were part time lecturers. Assuming 20% non-response to participate in the survey, with 5% error and 95% confidence interval, the required sample size was 170.

Survey tool

After obtaining institutional ethical approval a cross-sectional online survey consisting of four parts was created using Google Form and distributed. The first part contained questions to collect demographic data including age, years of being educators, marital status, and dependents. The second part contained questions focusing on training received to prepare for online teaching, lecturers' satisfaction with the training received and challenges experienced with conducting online teaching. The third part contained questions adapted from the Quality of Work-life Questionnaire developed by the National Institute for Occupational Safety and Health (NIOSH).[18] The last part contained the Patient Health Questionnaire-9 (PHQ9), General Anxiety Disorder-7 (GAD7) and Perceived Stress Scale (PSS) questionnaires which are validated. Tools designed to assess mental health status by screening for the presence and severity of depression, anxiety, and stress, respectively.[19-21] Recruitment of participants were done via email invitation to the lecturers' university email accounts. Participation was voluntary and pre-participation consent was obtained online.

Statistical analyses

Descriptive statistical methods were used to describe the sociodemographic characteristics and the lecturers' experience with online teaching. Participants were categorised into Generation Y (born 1981-1996), Generation X (born 1965-1980) and Baby Boomers (born 1946-1964) based on their year of birth. The one sample t-test was used to analyse the significance of challenges related to online teaching, and whether further training in OTL would be beneficial. The chi-square test was used to determine the impact of sudden transition to OTL on the mental health status of lecturers; and to assess if there were statistically significant differences between the different age categories of lecturers. A p value of <0.05 with 95% confidence interval was considered statistically significant. All statistical analyses were conducted using the SPSS Version 20.0 (SPSS Inc, Chicago, IL).

RESULTS

Socio-demographic characteristics of respondents.

A total of 179 lecturers participated in this study. The mean age was 47 years (median 44 years, range 26 – 77 years). Most of the lecturers belonged to the Gen-Y (38.5%) and Gen-X age-categories (40.2%). The mean duration of being a lecturer was 6.87 years (range 0 – 25 years). Most of the lecturers were married (79.3%) and had three or less dependents at home. Most of the lecturers (91.1%) had prior involvement in face-to-face (f2f) teaching. The mean duration of online teaching per lecturer at the time of survey

was 16.3 months (median 18 months, range 0 – 25 months). Most of the lecturers (84.9%) had received professional development or training related to online teaching with 60.3% of them having received training after they had started teaching online. Most (72.6%) had received some training on online teaching less than six months prior to the survey. The details are shown in Table I.

Table I: Socio-demographic characteristics and training received for OTL (N = 179)

SOCIO-DEMOGRAPHIC CHARACTERISTIC	FREQUENCY	PERCENTAGE
Age category*		
Generation Y (1981 – 1996)	69	38.5
Generation X (1965 – 1980)	72	40.2
Baby Boomers (1946 – 1964)	38	21.3
Marital status		
Single	35	19.6
Married	142	79.3
Prefer not to say	2	1.1
Number of dependents at home		
3 or less	123	68.7
> 3	56	31.3
Pre-pandemic face-to-face teaching experience		
Yes	163	91.1
No	16	8.9
Received professional development or training related to online teaching	152	84.9
When was the training received?		
Did not receive any	15	8.4
Prior to becoming a lecturer	6	3.4
Prior to teaching online	50	27.9
Received after teaching online	108	60.3
When was the most recent professional development/ training in online instruction received?		
< 6 months	130	72.6
6 – 12 months	36	20.1
> 12 months	13	7.3

Adequacy of professional development or training related to online teaching received.

Most of the lecturers agreed the professional development or training related to online teaching received was adequate to prepare them well to teach online ($p < 0.001$), were satisfied with the training received ($p < 0.001$) but felt they would still benefit from more training ($p < 0.001$). The details are tabulated in Table II.

Table II:
Adequacy of professional development or training related to online teaching received (N = 179)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	p-value*
The training prepared me well to teach online	7	7	48	96	21	3.65	< 0.001
I am satisfied with training received	5	9	56	93	16	3.59	< 0.001
I would benefit from additional training	6	7	25	100	41	3.91	< 0.001

* *One-sample Student t-test with test value of 3 (neutral)*

Challenges faced by lecturers related to the conduct of online teaching

Most of the lecturers faced significant challenges in conducting online teaching, from navigating the technology to encouraging interaction online. The challenges are tabulated in Table III.

Table III: Challenges related to the conduct of online teaching

Challenges faced	To a great extent	To some extent	To a small extent	Not at all	Mean	p-value*
Navigating technology	20	100	50	9	2.27	< 0.001
Using collaboration tools	29	114	24	12	2.11	< 0.001
Helping students with technology	17	88	59	15	2.40	< 0.001
Keeping up with changing technology	41	98	32	8	2.04	< 0.001
Supplementing content for online courses	18	101	50	10	2.29	< 0.001
Assessment of students online	34	96	42	7	2.12	< 0.001
Isolation from other colleagues	38	76	56	9	2.20	< 0.001

Time management	36	81	55	7	2.18	< 0.001
Balancing of workload	54	79	39	7	1.99	< 0.001
Interaction with students	53	87	27	5	1.91	< 0.001
Getting students to interact with each other	80	75	11	6	1.67	< 0.001

* *One-sample Student t-test with test value of 3 (to a small extent)*

Impact of transition to online teaching on work-life balance

The various aspects of work-life balance impacted by transition to online teaching are tabulated in Table IV.

Table IV: Impact on work-life balance from transition to online teaching (N = 179)

IMPACT OF TRANSITION TO ONLINE TEACHING	FREQUENCY	PERCENTAGE
Worked extra hours		
Yes	152	84.9
No	27	15.1
Had more flexible working hours		
Yes	135	75.4
No	44	24.6
Interference with family/home life		
Often or sometimes	145	81.0
Rarely or never	34	19.0
Adequate support/equipment for online teaching		
Yes	136	76.0
No	4	24.0
Adequate knowledge of how to conduct online teaching		
Yes	138	77.1
No	41	22.9
Freedom to decide ways to conduct online teaching		
Very true or somewhat true	144	80.4
Not too true or not true at all	35	19.6

Adequate time to prepare for online teaching		
Very true or somewhat true	126	70.4
Not too true or not true at all	53	29.6
Access to stress management or reduction in the university		
Yes	104	58.1
No	75	41.9
General health		
Good to excellent	147	82.1
Fair or poor	32	17.9
Poor		
Frequency of sleep problems in last 12 months		
Often or sometimes	124	69.3
Rarely or never	55	30.7
Days of poor physical health in the past 30 days		
< 1 week	167	93.3
1 – 4 weeks	12	6.7
Frequency of feeling stressed at work		
Often to always	72	59.8
Never to sometimes	107	40.2
Days of poor mental health in the past 30 days		
< 1 week	152	84.9
1 – 4 weeks	27	15.1
Days of usual activities affected by poor physical or mental health in the past 30 days		
< 1 week	159	88.8
1 – 4 weeks	20	11.2
Frequency of feeling exhausted at the end of the day in the past 30 days		
Often or sometimes	87	48.6
Rarely or never	92	51.4
Satisfaction with transition to online teaching		
Somewhat to very	149	83.2
Not so to not at all	30	16.8

Anxiety, depression, and perceived stress scores according to age categories

The anxiety, depression, and perceived stress scores according to age categories are shown in Table V. Most of the lecturers had low anxiety scores (n = 111, 62%), and low depression scores (n = 106, 59.2%). However, a large proportion of lecturers (n = 118, 65.9%) had moderate to high perceived stress scores. When compared with Baby Boomers, Gen-X and Gen-Y lecturers had higher perceived stress scores (69.4% versus 34.2%, p < 0.001 and 79.7% versus 34.2%, p < 0.001, respectively). In addition, Gen-Y lecturers had higher anxiety and depression levels compared to Baby Boomers (17.4% versus 0%, p = 0.006 and 21.7% versus 5.3%, p = 0.026, respectively) while there were no statistically significant differences in the anxiety and depression scores between Gen-X and Baby Boomers. Regression analysis showed age categories, marital status, number of dependents, and pre-pandemic f2f teaching experience were not predictors for anxiety, depression, and stress scores.

Table V: Anxiety (GAD7), Depression (PHQ9), and Perceived Stress (PSS) scores

GAD7 SCORES	None to low risk or mild	Moderate – severe	p-value
Age category			
Gen Y	57 (82.6%)	12 (17.4%)	0.006*
Gen X	67 (93.1%)	5 (6.9%)	0.096*
Baby Boomers	38 (100%)	0 (0%)	
PHQ9 Scores	None – mild	Moderate – severe	
Age category			
Gen Y	54 (78.3%)	15 (21.7%)	0.026*
Gen X	62 (86.1%)	10 (13.9%)	0.168*
Baby Boomers	36 (94.7%)	2 (5.3%)	
PSS Scores	Low	Moderate – high	
Age category			
Gen Y	14 (20.2%)	55 (79.7%)	< 0.001†
Gen X	22 (30.6%)	50 (69.4%)	< 0.001†
Baby Boomers	25 (65.8%)	13 (34.2%)	

** Chi-square test, none+mild versus moderate+severe; Baby Boomers as comparator*
† Chi-square test, low versus moderate-high; Baby Boomers as comparator

DISCUSSION

When the COVID-19 pandemic forced the closure of all educational institutions in Malaysia in March 2020, an immediate shift from conventional f2f teaching to distance learning using online platform was the response by IMU to ensure the continuation in students' education and to minimise disruptions to curriculum delivery. Teaching and learning activities in IMU resumed completely online within two weeks from the closure of its physical campuses. At the time of this study, all teaching and learning activities were conducted online. From the beginning, IMU had invested heavily into acquiring safe and secure digital platforms and digital hardware, and the provision of intensive online workshops and courses to equip its lecturers with the technological know-how of conducting OTL sessions.

At the time of survey, most of the lecturers in IMU had received professional development or training and felt that they were well prepared by the training received to conduct OTL activities although more training was felt to be beneficial (Table II). Despite this, they reported experiencing significant challenges in navigating technology and using collaborative tools, helping students with technology, keeping abreast with the rapid changing nature of technology, creating OTL contents, online assessment of students, encouraging interactions with students, grappling with a sense of isolation from colleagues, time management and balancing workload (Table III). These challenges appear to be universal as other studies on educators at all levels of education have reported similar findings.[4-7,10,22]

The impact of transitioning to OTL on work-life balance was largely positive with lecturers reporting having more flexible work hours, receiving adequate support from the University to conduct OTL, possessing adequate knowledge to conduct OTL, freedom to decide on how to conduct OTL, having adequate time to prepare for OTL, access to stress management in the University, good to excellent level of general wellbeing and mental health, and satisfaction with the transition to online teaching. On the flip side, lecturers reported having to work extra hours, interference with family life, sleep issues within the last 12 months, feeling exhausted at the end of the workday, and feeling stressed at work. This is a good reflection of the IMU's efforts to support and help their lecturers adapt to changes. Providing support to staff both physically and mentally is an employer's prerogative which can result in increased productivity, reduced non-engagement, and morale boost.[23] This is more pertinent within the context of a restrictive work environment during the pandemic.

Generally, most of the lecturers in our study had low anxiety and depression scores. On the other hand, most of the lecturers in the Gen-X and Gen-Y age categories had moderate to high perceived stress scores. In contrast, most lecturers who were Baby Boomers had low perceived stress scores. The stress levels experienced by the lecturers in our study are comparable with another study on 322 medical lecturers by Tilwani *et al,* conducted approximately 14 months from the total shutdown of educational institutions in India. In this study, around 76% of lecturers had mild-to-moderate degrees of stress but none with severe stress when teaching remotely.[11]

When compared with lecturers who were Baby Boomers (age 57 – 75 years old), the most striking findings were the statistically significant higher levels of anxiety, depression, and perceived stress experienced by Gen-Y lecturers (age 25 – 40 years old) and Gen-X lecturers (age 41 – 50 years old). This is supported by studies which showed people from younger age groups tend to experience more stress compared to those from the older age groups.[24-25]

Baby Boomers are more successful at coping with stress as they tend to be more flexible and willing to compromise to lifestyle changes, can adjust towards life expectations and are more likely to express feelings in their relationships rather than bottling them up. In contrast, younger people are less inclined to embrace stress management strategies despite being aware of their importance and tend to turn to unhealthy activities such as smoking and drinking alcohol to cope with stress.[25] The difference in stress levels may also be related to the different sources of stress among generations; relationships are particularly more problematic for younger adults, the increased restrictions to face-to-face interactions and the new social norm of being expected to be successful at an early age.[25] In the context of stress related to OTL, Baby Boomers may be more senior in academic positions with less teaching obligations but more administrative work compared to Gen-X and Gen-Y lecturers who have more teaching obligations, and equal or less administrative work which may explain the higher stress scores of the latter.

There were several limitations in our study. We did not consider the possibility of other factors, such as financial difficulties or gender, that may be associated with additional stress, anxiety, and depression.[11] We did not investigate the possibility of lecturers with pre-existing mental health issues which may or may not be treated.

Our study revealed that despite receiving adequate training and support from the University, lecturers especially the younger lecturers reported significant levels of perceived stress transitioning from conventional face-to-face teaching to OTL during the COVID-19 pandemic. Proper counseling services should be available to support the mental health and well-being of lecturers. Intensive promotion of stress-relieving measures including regular leisure-time exercise of any intensity, encouraging daily communication with close family, friends and colleagues, introduction of yoga and music therapy, time management, positive coping strategies and realistic work expectations should be advocated by the University to its lecturers.[26]

ACKNOWLEDGMENT

This study was approved by the Joint Ethics and Research Committee of the IMU University and funded with a research grant, (Project ID No. CSc/Sem6(14)2021).

REFERENCES

1. Clarke M C, Koch L C, Hill E J. The work-family Interface: Differentiating balance and fit. Fam Consumer Sci Res J. 2004; 33(2):121–40.
2. Yang J W, Suh C, Lee C K, Son B C. The work-life balance and psychosocial well-being of South Korean workers. Ann Occup Environ Med. 2018; 30:38.
3. Berry G, Hughes, H. Integrating Work–Life Balance with 24/7 Information and communication technologies: The experience of adult students with online learning. Am J Distance Educ. 2020;34:105 – 91.
4. Silveira E A, de Sousa Romeiro A M, Junger A L, Ramos A C F, Alves P M, Noll M, *et al.* The impact of the COVID-19 pandemic on medical education: A systematic review of distance learning, student's perceptions, and mental health. J Hum Growth Dev. 2023; 33(3):405-19.
5. Bose M, Misra D, Smita D, Mishra T, Biswal J, Mishra S. Impact of the COVID-19 pandemic on the mental health of medical undergraduates of a tertiary care teaching hospital in Eastern Odisha: A cross-sectional study. Al-Rafidain J Med Sci. 2023; 5 (Suppl 1): S14-22.
6. Putri R, Purwanto A, Asbari A, Wijayawanti L M, Choi C H. Impact of the COVID-19 Pandemic on Online Home Learning: An Explorative Study of Primary Schools in Indonesia. Int J Adv Sci & Tech. 2020; 29(5): 4809-18.
7. Tajuddin A J A, Romly R, Hamzah Y, Wan Hussin W R, Wan Muda W M. Lecturers' readiness and emotional presence on online teaching data in a Malaysian university during COVID-19. Adv Soc Sci, Edu Hum Res. 2021; 536:548-56.
8. Lim Z H. Evaluating lecturers' satisfaction towards online teaching in AHIBS, UTM, Kuala Lumpur, Malaysia. Int J Innov & Bus Stra. 2020; 14(2).
9. Kaup S, Jain R, Shivalli S, Pandey S, Kaup S. Sustaining academics during COVID-19 pandemic: The role of online teaching-learning. Indian J Ophthalmol. 2020; 68(6):1220–21.
10. Almeda J A B. Navigating the educational landscape in crisis: A literature review on the challenges encountered by teachers during the COVID-19 pandemic. Int J Multi Res. 2023. 5(5):1-12.
11. Tilwani R K, Awasthi A, Maheshwari M, Tilwani K, Deep A. Impact of online teaching on mental health and quality of life among medical teachers during COVID-19 pandemic – A cross-sectional study. Ann Ind Psy. 2022; 6(4):320-7.
12. Singh Y K, Gautam D N S. The impact of job satisfaction on teacher mental health: A call to action for educational policymakers. Open Educ Studies. 2024;6(1):20240008.
13. Ünal I, Dulay S. Teachers' work-life balance in emergency remote teaching during the COVID-19 pandemic. Asian J Distance Educ. 2022;17(2):89-108.
14. Sok J, Blomme R, Tromp D. Positive and negative spillover from work to home: The role of organizational culture and supportive arrangements. Brit J Management. 2014;25(3):456-72.
15. Bello Z, Tanko G I. Review of work-Life balance theories. GATR Global J Bus Soc Sci Review. 2020;8(4):217-27.
16. Md Shah S, Noranee S, Abdul Munir Z, Noranee S, Shahruddin S, Mujanah S M. The influence of work-life balance, workload and work environment on burnout among teachers in Melaka Tengah district, Malaysia. Info Management & Bus Review. 2024;16(1):137-52.
17. World Health Organization. Mental Health at Work. https://www.who.int/news-room/fact-sheets/detail/mental-health-at-work Accessed: 26 Oct 2024.
18. Centers for Disease Control and Prevention. Quality of Worklife Questionnaire. https://www.cdc.gov/niosh/topics/stress/qwlquest.html Accessed: 10 April 2024.
19. Stanford. Patient Health Questionnaire (PHQ-9). https://med.stanford.edu/fastlab/research/imapp/msrs/_jcr_content/main/accordion/accordion_content3/download_256324296/file.res/PHQ9%20id%20date%2008.03.pdf Accessed: 10 April 2024.
20. Generalized Anxiety Disorder Assessment (GAD-7). https://patient.info/doctor/generalised-anxiety-disorder-assessment-gad-7. Accessed:10th April 2024.
21. Perceived stress scale. https://das.nh.gov/wellness/docs/percieved stress scale.pdf Accessed: 10 April 2024.
22. Yusof A C, Chinnasamy S, Faizal S. COVID-19 pandemic and Online Distance Learning (ODL) issues among Malaysian secondary school teachers. Int J Acad Res Bus & Soc Sci. 2023; 13(4):2026–55.
23. Dobre O I. Employee motivation and organizational performance. Rev Appl Socio Econ Res. 2013; 5(1):53-60.
24. The American Institute of Stress. Combating generational stress in the workplace. https://www.stress.org/combating-generational-stress-in-the-workplace. Accessed: 10 April 2024.
25. Medaris A. American Psychological Association. Gen Z adults and younger millennials are 'completely overwhelmed' by stress. https://www.apa.org/topics/stress/generation-z-millennials-young-adults-worries. Accessed: 10 April 2024.
26. Harvey S B, Øverland S, Hatch S L, Wessely S, Mykletun A, Hotopf M. Exercise and the Prevention of Depression: Results of the HUNT Cohort Study. Am J Psychiatry. 2018;175(1):28-36.

Evaluating Online Learning Environment for Medical Students Using Digi-MEE Instrument: A Sequential Mixed-Method Study

Noor-i-Kiran Naeem[1,7], Siti Nurma Hanim Hadie[2], Irwan Mahazir Ismail[3], Samina Malik[4], Usman Mahboob[5], Subhan Ullah[6], Muhamad Saiful Bahri Yusoff[7]

In light of the increasing use of online learning platforms in medical education, there is a critical need to assess the current state of online learning environments. Despite the global emphasis on digital education, limited studies have systematically explored how medical students perceive the effectiveness and quality of these environments, particularly in Pakistan. This study aims to fill this gap by evaluating medical students' experiences with their institution's online learning environments and identifying key strengths and challenges that impact learning outcomes.

A mixed-method, sequential exploratory design was used, starting with a quantitative assessment followed by qualitative inquiry. Data from 253 medical students were collected via a survey, and 30 focus group interviews were conducted to provide deeper insights into the challenges students face in navigating the online learning environment. The findings revealed critical areas in need of improvement, including digital infrastructure, student engagement, and the accessibility of online resources. Qualitative data highlighted the need for more interactive and student-centred approaches to online education.

By focusing on the status of online learning in medical education, this research provides valuable insights for educators and policymakers aiming to enhance the quality of digital learning environments. The study contributes to ongoing efforts to develop more effective, engaging, and responsive online learning strategies for medical students in Pakistan.

Keywords: *Online learning, Undergraduate Medical Education, Learning environment, Digi-MEE, Perception.*

Introduction

E-learning has emerged as a powerful tool that can provide students with access to valuable resources, such as video lectures and data analytics tools, while also allowing for greater collaboration among peers and educators through online discussion forums and virtual meetings (Bower, 2019). Additionally, e-learning has been shown to improve learner engagement by providing more interactive learning experiences than traditional classroom-based methods alone (Rhim & Han, 2020). The rapid integration of online learning into academic practices across undergraduate, postgraduate, and continuing medical education (CME) has fundamentally reshaped educational delivery, particularly in medical fields.

Despite its advantages, the transition from traditional to online learning presents challenges, burdening clinicians and facing user reservations. Medical students and educators face obstacles that include inconsistent internet access, feelings of physical and social isolation, and the loss of critical integrated bedside teaching. Additionally, digital literacy remains a barrier for both students and educators, hindering the full adoption of e-learning (Tekin *et al*, 2020). Research highlights the importance of connectedness and face-to-face interactions to ensure student well-being (Kamarudin *et al*, 2022; S E Mustafa & Hamzah, 2011). Many students report that the lack of personal interaction is a substantial barrier to fully embracing online learning as a standalone pedagogical approach (Azmat & Ahmad, 2022).

Current research often focuses on the impact of rapid e-learning policies during the pandemic, examining student perceptions of online learning's

[1] Department of Medical Education, School of Medical Sciences, Universiti Sains Malaysia, Malaysia, and Department of Medical Education, ABWA Medical College, Faisalabad, Pakistan.
[2] Department of Anatomy, School of Medical Sciences, Universiti Sains Malaysia, Malaysia.
[3] Kampus Kedah, Universiti Utara Malaysia, Malaysia.
[4] Department of Physiology, University College of Medicine and Dentistry, The University of Lahore, Lahore, Pakistan, and Masters in Med Edu student at The University of Dundee, Scotland.
[5] Department of Medical Education, Institute of Health Professions Education and Research, Khyber Medical University, Peshawar, Pakistan.
[6] Department of Behavioural Sciences, Aziz Fatimah Medical College, Pakistan.
[7] Department of Medical Education, School of Medical Sciences, Universiti Sains Malaysia, Malaysia.
Corresponding author:
Dr Noor-i-Kiran Naeem
Department of Medical Education, School of Medical Sciences, Universiti Sains Malaysia, Malaysia, and Department of Medical Education, ABWA Medical College, Faisalabad, Pakistan. E-mail: noorikiran@yahoo.com Phone no: +923334409262

educational benefits and its implementation during lockdowns (Azmat & Ahmad, 2022; Suci *et al*, 2022). Although these studies have generally reported positive student feedback, the methodologies used to evaluate online learning environments are frequently limited. Commonly used educational tools, such as the DREEM, and other discipline-specific tools like the Anatomy Education Environment Measurement Inventory offer context-dependent insights that may not fully capture the diverse and evolving nature of online learning in medical education (Hadie *et al*, 2017; Rehman *et al*, 2017).

The need to evaluate the overall status of online learning environments has become increasingly urgent. As medical education continues to evolve in a digital context, it is essential to assess not only the technical and instructional aspects of online learning but also its impact on students' digital professionalism, ethics, behaviours, and well-being. A comprehensive understanding of these factors can inform future improvements and support the development of more responsive, student-centred digital learning strategies.

To address these gaps, this mixed-method study explores medical students' perceptions of their institution's online learning environment. By combining a quantitative assessment with qualitative inquiry, this research aims to provide a holistic understanding of the factors that influence student perceptions and identify areas for improvement. The use of both data-driven insights and personal reflections from students allows for a nuanced evaluation of the strengths and challenges of the current online learning environment in medical education.

Curriculum structure of MBBS programme of the Participating Institution

To provide a comprehensive understanding of the curriculum delivery method at the institution under study, we outline the structure of the MBBS programme over five years, emphasising the significance of this understanding in evaluating digital tools like the Digi-MEE instrument. The MBBS curriculum follows an integrated approach, structured into three key phases: the pre-clinical phase (Years 1 and 2), the para-clinical phase (Years 3 and 4), and the clinical phase (Year 5). The pre-clinical years focus primarily on basic medical sciences such as anatomy, physiology, and biochemistry, utilising a combination of traditional lectures, lab-based learning, and introductory problem-based learning sessions. During this period, digital resources, including online lecture recordings, digital anatomy platforms, and quizzes, are introduced to enhance theoretical understanding and foundational knowledge.

As students progress to the para-clinical years, the curriculum emphasises the integration of clinical skills with theoretical knowledge. This includes a blend of case-based discussions, clinical skill sessions, and small group tutorials. Digital learning tools become more interactive, with online modules, case-based assessments, and self-assessment tools introduced to supplement in-person training. By Year 5, students are primarily engaged in clinical rotations across various departments, focusing on the practical application of their medical knowledge. Here, e-learning supports case-based learning, clinical scenario discussions, and research activities.

The curriculum's integration of digital learning tools is tailored to complement the evolving needs of

students at different stages of their medical training. In the pre-clinical years, digital platforms primarily support theoretical learning, while in the clinical years, they facilitate case-based discussions and patient management exercises. This phased approach to curriculum delivery offers valuable context for interpreting the findings of this study, as it highlights the alignment of digital tools with the specific learning requirements and skill development of students at each stage of their education.

Methodology

A sequential explanatory mixed method study was initiated after obtaining ethical approval from the Human Research Ethics Committee at University Sains Malaysia (USM/JEPeM/ 21050350) and from the Institutional Review Board of the participating institution (ERC 122/22/10) from January to July 2023. To maintain the confidentiality and privacy of the institution involved in the study, the specific name of the university is not disclosed. The medical curriculum at the selected institution primarily consists of in-person lectures, clinical rotations, and lab sessions. To supplement these traditional methods, an online learning component was introduced, offering lecture recordings, virtual discussions, and digital resources. While participation in online learning was generally encouraged, certain elements, such as virtual discussions and assignment submissions, were mandatory. This supplemental approach provides greater flexibility and accessibility to course materials beyond regular classroom hours.

In a cross-sectional survey, we invited 294 undergraduate medical students from the private medical university in Pakistan regarding their institution's online learning environment. Sample size was determined based on the total number of medical students eligible for the study (600). Using a 95% confidence interval and a 5% margin of error, a minimum sample size of 235 was calculated, following Krejcie & Morgan's (1970) guidelines. Accounting for an expected response rate of 80% (Fincham, 2008), the final target sample size was adjusted to 294 medical students. Inclusion criteria included undergraduate medical students with at least six months of online education in the university. New admissions or transfer students from other institutions were excluded from the study.

The study proforma included a section inquiring about the demographic data of the participants as well as the Digital Medical Education Environment (Digi-MEE) instrument. Serving as a validated instrument, Digi-MEE is designed to comprehensively evaluate and enhance online learning in the domain of undergraduate medical education. The Digi-MEE instrument is a 28-item questionnaire with a content validity index and face validity index of > 0.90 and 0.87, respectively, along with acceptable levels of the goodness of fit indices and overall Cronbach's alpha >0.90 (N-K Naeem, Hadie, *et al*, 2023). It covers the nine identified main domains of online learning environments (Content Curation, Cognitive Enhancement, Cybergogical Practices, Digital Capability, Social Representations, Platform Usability, Institutional Support, Facilitation Dynamics, and Learner Characteristics) (N-K Naeem, Yusoff, *et al*, 2023). Each of the 28 items has a rating of 1 – 4 on a Likert scale where 1 = "*strongly disagree*" and 4 = "*strongly agree*". Items rated 3 or more out of 4 are positive areas in online learning environments as rated by students, items rated 2–2.9 depict satisfactory

areas with minor improvement, and items rated <2 depict areas of concern in the online learning environment.

The participants were requested to fill out the form via online Google form after debriefing and taking informed consent (link: https://forms.gle/ZPL4qnN6Dxxkqo389). All data was kept anonymous and confidential.

Following the survey, we did five online focus group interviews using the Zoom platform (with six volunteer medical students from each MBBS class) with semi-structured questions to understand their experience and perceptions regarding the online learning environment in their institution. Probing techniques or prompts facilitated us in eliciting participants' reflections and discussions, especially in instances where there was a lack of sufficient dialogue. The initial questions were piloted on two participants and were refined to develop final questions as shown in Figure I.

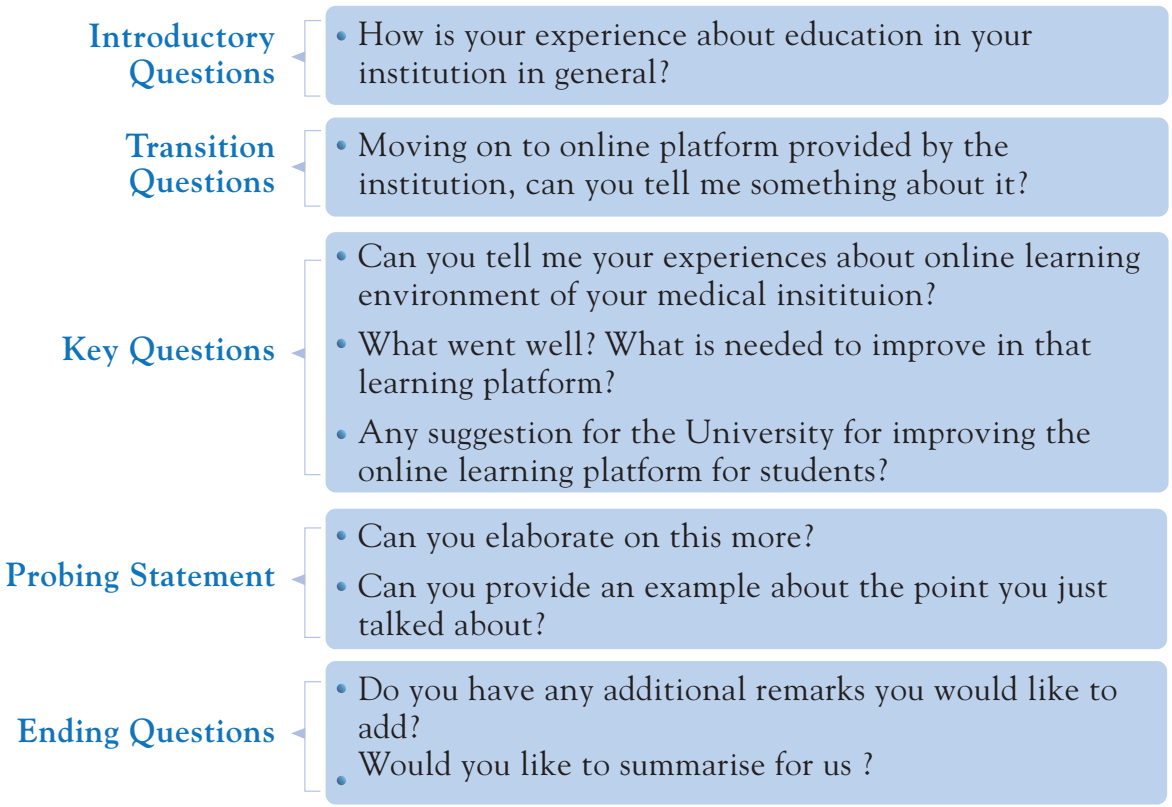


Figure I: Focus group interview questions

We performed descriptive statistical analysis for the cross-sectional survey using SPSS version 25.0 (IBM Corp, Armonk, NY, USA). Missing values were identified and addressed by replacing them with the median of the corresponding variable. All continuous data are presented as the mean ± SD, whereas categorical data are presented as proportions and percentages. The mean perceived expertise was calculated by averaging the scores assigned by participants to various statements related to their proficiency in using online platforms for education from a scale, ranging from 1 to 10.

Thematic analysis using Atlas.ti version 7.5.7 (Atlasti GmbH, Berlin, Germany), following Braun and Clarke's approach (Braun *et al*, 2019) with a- priori coding based on the components of the validated Digi-MEE instrument, involved a systematic process. Initial codes were generated based on pre-determined components, providing a structured foundation. Codes were collated into potential themes, considering both predefined components and emergent patterns by two independent researchers. This iterative process ensured an accurate representation of participants' perspectives. Intercoder reliability was performed to check the credibility and accurate representation of the data analysed (Kappa Index = 0.86). Atlas.ti facilitated systematic organisation and retrieval, enhancing analysis rigor and transparency. This approach allowed for a comprehensive exploration of predefined components while remaining open to the richness of participants' experiences.

Data from both the cross-sectional survey and focus group interviews were reviewed and combined to obtain a comprehensive understanding of the participants' perceptions of online learning environments in their medical school. The focus group interview findings also explained the results of the cross-sectional survey, giving a rich description of the participants' perspectives.

Results

Cross-Sectional Survey:

a. Demographic characteristics of the study participants:

Out of 294 medical students, 253 medical students completed the online survey questionnaire, yielding an overall response rate of 86.05% (See Table I). The mean age of the study participants was 22 ± 1.88 years. Fourth year MBBS students were 21.4% of the participants (highest proportion), while second year MBBS students were 18.5% of the total number (least proportion).

Table I: Demographic characteristics of study participants in the cross-sectional survey

DEMOGRAPHIC CHARACTERISTICS	STUDY PARTICIPANTS (n=253)	PERCENTAGE (%)
Gender		
Male	124	49
Female	129	51

Table I: Demographic characteristics of study participants in the cross-sectional survey

Age		
18- 20 years	59	23.3
21-23 years	141	55.7
24- 26 years	50	19.8
>26 years	3	1.2
MBBS Year		
1st Year	53	21.0
2nd Year	47	18.5
3rd Year	48	18.9
4th Year	54	21.4
Final Year	51	20.2

b. Perceived online learning expertise rating:

Participants rated their expertise in online learning on a scale of zero to 10. Two students rated their expertise to be 2 out of 10. The mean perceived expertise for using online platforms for education was 7.48 ± 1.93. As seen from Figure II, 49 students rated their expertise to be 7, 8 and 10 each, followed by 34 students rating their expertise 9 out of 10.

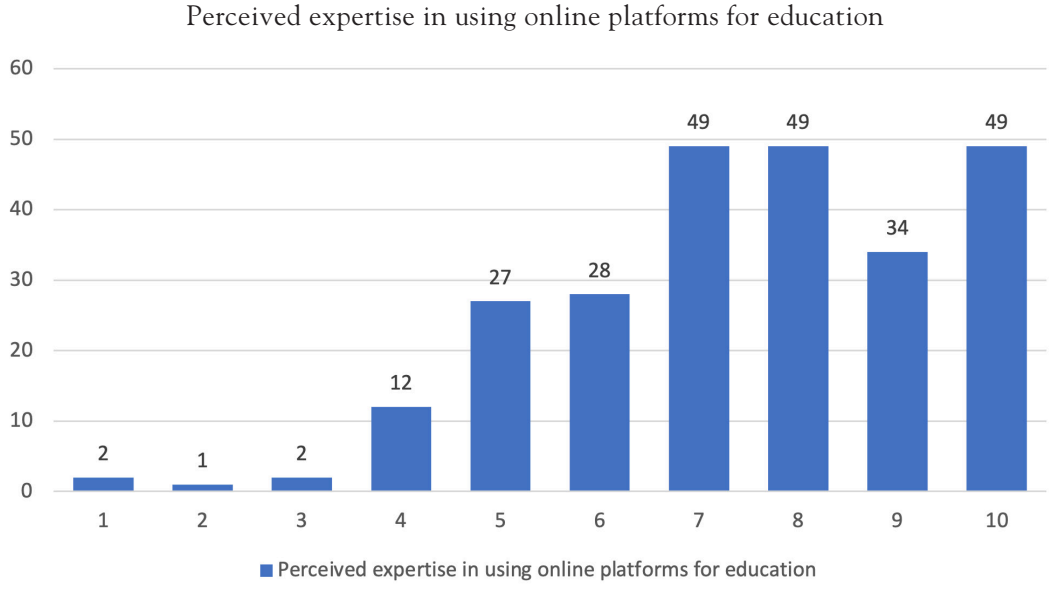


Figure II: Perceived expertise in using online platforms for education

c. Participants' item ratings using the Digi-MEE instrument:

Mean ratings for participants for their online learning environment in their institution are listed in Table II. Participants rated statement number 20, "*The online platform rules and regulations are informed to me*", the most from Component of "Platform Usability" (Mean ± SD = 3.13 ± 0.804), while statement number 12, "*I can manage my digital screen time on online learning platform*", was rated the least from the component of "Digital Capability" (Mean ± SD = 2.53 ± 0.967).

Table II: Mean individual item ratings by students using Digi-MEE Instrument

ITEM NUMBER	ITEM STATEMENT	Mean	SD
1	I feel this online platform being relevant to my learning needs.	3.01	.812
2	The online platform provides opportunities to promote my independent learning.	3.00	.861
3	The content is presented appropriately to enhance my understanding.	2.91	.854
4	I understand the orientation given before the task easily.	2.92	.869
5	The online learning platform provide clear learning outcomes for the given course I am enrolled in.	2.99	.852
6	My online activities with others are monitored in this online learning platform.	2.81	.918
7	The online platform allows me to exchange information with my peers/facilitators easily.	2.75	.957
8	The activities on online platform allow me to interact with others.	2.58	1.033
9	This online platform provides suitable assessment methods to facilitate my learning.	2.85	.942
10	I can communicate and collaborate with my peers/facilitators on this online platform easily.	2.66	.969
11	I can see my basic profile information, as well as that of my peers/facilitators on this online platform.	2.89	.872
12	I can manage my digital screen time on online learning platform.	2.53	.967
13	I feel I am part of online learning community.	2.72	.953
14	I am provided with timely feedback on my work.	2.75	.975

15	I give feedback about courses which I am enrolled in online learning platforms.	3.04	.856
16	The online platform encourages me to participate in online learning activities in professional and ethical manner.	2.79	.921
17	The online content can be accessed with ease.	3.12	.800
18	The platform interface is simple and follows a consistent design.	3.04	.833
19	The online platform usage policies are widely disseminated among students.	2.91	.857
20	The online platform rules and regulations are informed to me.	3.13	.804
21	The institution provides training to me for using online platforms appropriately.	3.01	.908
22	The online content is organised in engaging manner.	2.92	.880
23	The facilitator(s) selects appropriate tool for teaching us online.	3.04	.851
24	The facilitator(s) provides positive encouragement to me during classes.	2.94	.810
25	I show interest in learning about given topic in online learning platform.	2.84	.896
26	My learning is supported on this online learning platform.	2.88	.892
27	I try my best to put in effort during online activities.	3.02	.850
28	The online platform for learning is well accepted by me.	2.82	.938

d. Detailed Breakdown of Component wise Mean Ratings:

Figure III shows the mean ratings of the nine main components of online learning environments as identified in the Digi-MEE instrument. The Component of Platform Usability was rated the highest (3.07/4/00), while overall, students rated "Cybergogical Practices" the lowest (2.68/4/00).

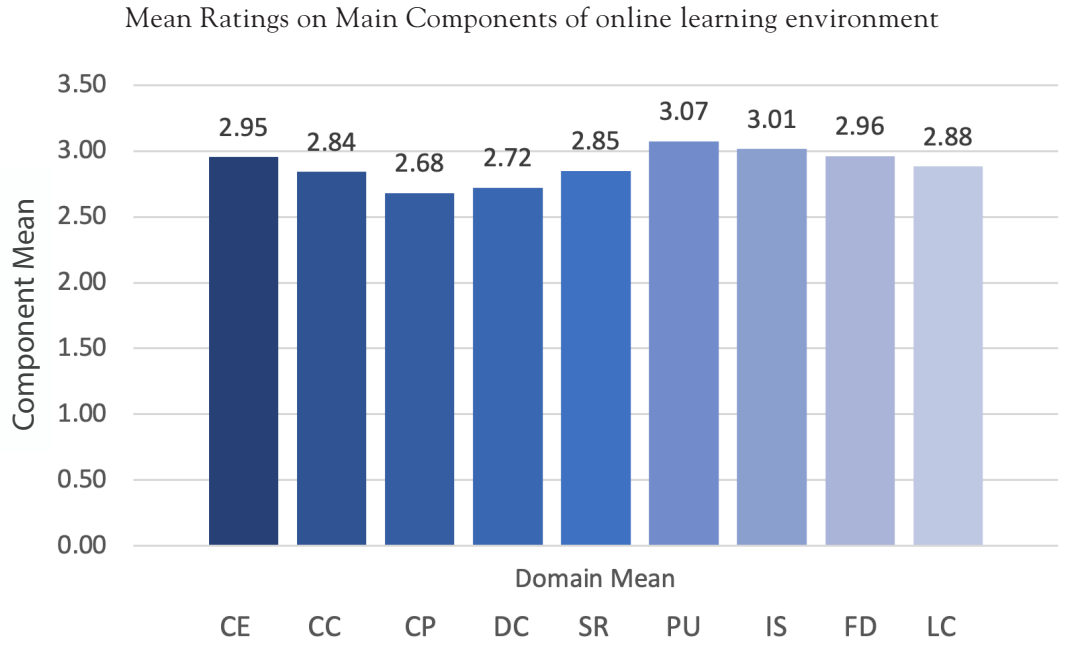


Figure III: Component wise mean ratings using the Digi-MEE instrument

KEY: CC: Content Curation, **CE:** Cognitive Enhancement, **CP:** Cybergogical Practices, **DC:** Digital Capability, **SR:** Social Representations, **PU:** Platform Usability, **IS:** Institutional Support, **FD:** Facilitation Dynamics, **LC:** Learner Characteristics

Focus Group Interviews

b. Demographic characteristics of the study participants in each group.

A total of 30 participants participated in five focus groups (one each for each of the five MBBS classes with six participants each) over the online meetings after checking the availability of the participants. Table III shows the demographic distribution of participants in the focus group interviews.

Table III: Demographic characteristics of study participants in focus group interviews

Demographic Characteristics	1st Year MBBS (n=6)	2nd Year MBBS (n=6)	3rd Year MBBS (n=6)	4th Year MBBS (n=6)	5th Year MBBS (n=6)
Gender					
Male	2	3	3	4	3
Female	4	3	3	2	3
Age					
18-19 years	4	-	-	-	-
20-21 years	2	6	-	-	-
22-23 years	-	-	5	1	-
23-24 years	-	-	1	5	5
25 years or more	-	-	-	-	1

c. Thematic analysis

Students expressed a positive outlook about their learning experience in the institution which was being used to complement their traditional mode of studies. They highlighted the optimised environment, good study experiences, and well-organised materials. The teachers and faculty were generally appreciated for their efforts. Table IV displays emerging codes for each of the nine domains of online learning environment highlighting the positive areas and areas needing improvement.

Table IV: Thematic analysis results of focus group interview sessions

Component	Participant Code	Code	Representative Quotations
Content Curation	M.1.3	Content Quality	*"The content is good… the majority of the content that is uploaded slides… Learning objectives are covered greatly."*
	M1.1	Ease of Access	*"…having the slides where I can open them at any laptop or phone… it is truly great in building your concepts…"*
Cognitive Enhancement	M.2.3	Minimal engagement	*"We have a sense, to download slides from there as well. In the first year, a physiology teacher offered a quiz there. She made a platform there. We can answer these questions. It was interactive. Otherwise, we don't use it that much."*
Cybergogical Practices	M.1.4	Lack of engaging practices	*"The engagement is not as much as offline learning… adding quizzes would engage students more."*
	M.3.5	Lack of interaction	*"We don't have a lot of activities on slate, it is more so used as a collection of learning material for revision… real-world application examples of what we've learned like case studies would be good interactive activities."*
Learner Characteristics	M.1.1	Need for self-regulation	*"Face-to-face lectures are much better than online classes if you don't develop interest. So, the problem is within the student to develop an interest in online learning."*
	M.2.6	Need for determination	*"You should be very focused and willing to learn whatever you are taught. I guess that's important."*
Digital Capability	M3.1	Digital skills training	*"I feel I have the proper skills and proficiency to take full advantage of all online learning tools provided… be given an overview of how to use it and what we are expected to use it for."*
	M.1.2	Lack of anonymity	*"I think most likely students that are at our level most probably have good digital capabilities… there should be a box where students could ask questions anonymously."*

Platform Usability	M.1.4	Limited personalised feedback	*"There should be a platform for a detailed marked sheet of all the work you have done throughout the year… only visible to that one student."*
	M.2.5	Need for enhanced question banks	*"I guess they should provide the question bank and also the summary of what type of questions. Papers with answers so that you can practice."*
Facilitation Dynamics	M.3.4	Good content organization	*"Facilitators are mostly performing their role fine, but sometimes they upload lecture slides late, the material is indexed properly and kept in a structured way to make it accessible easily, but we should be given an overview of how to use it and what we are expected to use it for." "Teachers should ask questions and give quizzes so that students remain attentive."*
	M.1.6	Limited interactions	
Social Representations	M.1.5	Limited communication	*"There should be a separate platform for contacting and interacting with your teachers… apart from Moodle, while you are away from college."*
	M.2.4	Lack of training to use the platform for interaction	*"On Moodle, we have the opportunity to text our teachers. I think we can mail them, but I don't know how to approach our teachers and friends because we haven't had much experience using it."*
Institutional Support	M.1.4	Need for switching to application	*"A special app can be introduced via slides and other information can be put up rather than a website… students in Pakistan are using mobile."*
	M.2.4	Lack of training	*"I think, we don't have much knowledge about Moodle because our university hasn't trained us in that way, like how to use it and what we can do."*

Discussion

This study sought to evaluate the online learning environment at a private medical university in Pakistan, focusing on the students' perceptions across different academic years. The findings reveal that while students generally rated their digital capabilities and platform usability positively, significant challenges remain, particularly in terms of social interaction and institutional support. In alignment with a Kirkpatrick Level 1 evaluation, the study assesses students' initial reactions to their educational experience (Sridharan & Nakaima, 2011).

Cross-Sectional Survey

When placed within the context of the five-year MBBS curriculum at the institution under study, the study's findings highlight the evolving demands of each academic phase on digital learning tools. The MBBS programme is structured into three phases – pre-clinical, para-clinical, and clinical – each demanding different levels of digital integration. In the pre-clinical years, students primarily focus on acquiring foundational knowledge in basic sciences through lecture-based and lab-based learning. Here, digital tools are leveraged to complement traditional

teaching with recorded lectures, online quizzes, and digital anatomy modules, facilitating independent study and reinforcing theoretical concepts. This approach aligns with the study's findings, where students rated their perceived expertise in using online platforms for education at 7.48 ± 1.93 out of 10. This perception echoes results from other institutions like Dubai Medical College, where 70% of students reported no difficulty accessing online learning systems (Eldeeb, 2014).

As students progress into the para-clinical and clinical phases, the curriculum at UCMD emphasises the integration of clinical skills with theoretical knowledge through small-group discussions, case-based learning, and clinical rotations. The increasing complexity of training at these stages correlates with the study's findings that revealed a drop in student satisfaction with platform interactivity. For instance, statement number 8 in the Digi-MEE tool, related to peer interaction, was rated low by students. These observations align with previous research highlighting social isolation as a key drawback in e-learning environments (Back *et al*, 2016). To address this challenge, the study recommends enhancing interactive components such as scenario-based learning, quizzes, and case-based discussions to foster cognitive engagement and collaboration among students.

Similarly, when asked about the important characteristics of online learning that make it more conducive to learning, 92.5% of students involved in another study concluded that ease of use and subsequent acquisition of usage expertise were some of its most supporting aspects (Back *et al*, 2016). In contrast, a systematic review shed light on several papers raising technological or IT-based concerns, as many learners are not fully equipped with the expertise to handle e-learning methods, as foundational technological skills remain lacking due to several sociocultural factors (Docherty & Sandhu, 2006; Khasawneh *et al*, 2016; N Naeem & Khan, 2019). However, the relation of perceived technical expertise with perceived knowledge acquired was a gray area. A 76-participant study by Song et al. pointed out that comfortableness with and expertise over online technologies significantly impacted the overall success of online education (Song *et al*, 2004). Stein *et al*, concluded in their study aimed at bridging the transactional gap in online learning that technical expertise had no effect on overall satisfaction and knowledge perceived (Stein *et al*, 2010).

Statement number 8, "*The activities on the online platform allow me to interact with others*", was rated low on the Digi-MEE tool. A study employing another online learning evaluation tool, "DREEM", concluded that although students were generally satisfied with the environment in different domains, social self-perception was negatively based on the lack of opportunities to develop interpersonal skills (Al-Naggar *et al*, 2014). Our results suggested that students in earlier years of the medical programme were more likely to report challenges related to social isolation and a lack of interaction, as reflected in low ratings for the "interactivity" component of the Digi-MEE tool. Built on exploring the advantages and disadvantages of distance learning, one study revealed that 44% of junior medical students (years 1-3) and 35% of senior medical students (years 4-6) believed social isolation to be a major drawback of e-learning, which was considered less effective in terms of increasing social competencies (Bączek *et al*, 2021).

An overwhelming 70% of first-year medical students in a similar Indian study felt that their online teaching programmes are indeed greatly beneficial, whereas 45% of students in the same study felt the lack of social interaction and inability to meet peers online was greatly challenging (Ramachandran & Kumar, 2021). Thus, the study concluded in favor of the widely accepted view that e-learning has very much the capacity to be detrimental towards development of social skills. This gave the researchers a perspective to focus on recommendations made via the Digi-MEE component of social representation, mainly to encourage student participation and create a separate platform outside Moodle for mutual interaction.

The study data provided strong evidence to conclude that the mean ratings of different years of undergraduate medical education were not equal, supporting the idea that there were notable variations in the ratings among the different MBBS classes as measured by the Digi MEE instrument. A DREEM study conducted to see the Malaysian medical students' perception of their e-learning environment showed significant differences in scores depending upon the year of study (Al-Naggar *et al*, 2014). Differences in the perceived disadvantages of online learning models by a group of Polish medical students were highlighted by the academic years, as students in the first three years more often chose social isolation, lack of technological expertise and self-discipline, whereas senior students in years 4–6 more often chose lack of interaction with patients as the most pressing obstacle (Bączek *et al*, 2021). At the University of Sharjah, senior students were found to have better perceptions of online learning as a pedagogical model compared to sophomores, who found hybrid learning to be more ideal (Osaili *et al*, 2023).

Qualitative Exploratory Study

Qualitative findings further underscore the need to align digital learning strategies with the curriculum's evolving demands. Senior students, who engage heavily in clinical rotations, expressed the necessity for communication tools that support case discussions and collaborative decision-making. This reflects a gap in the current digital environment, where the mere delivery of lectures is deemed insufficient. Consistent with these insights, previous studies have emphasised the importance of feedback, interactive assessments, and structured support systems to enhance learning outcomes (AlFaris *et al*, 2014).

The study also points to significant variations in the perception of the digital learning environment across different academic years, suggesting the need for a tailored approach. Senior students rated platform usability and digital capabilities more positively than their junior counterparts, who reported challenges related to the lack of social interaction and unfamiliarity with digital tools. This variation mirrors the findings of a DREEM study conducted in Malaysia, which showed differences in e-learning perceptions based on students' academic progression (Al-Naggar *et al*, 2014). In the current case study, this indicates the importance of introducing targeted interventions, such as specialised training on digital platforms in the early years and advanced modules on collaborative learning and clinical case discussions in the later years.

Participants also recommended the integration of interactive sessions, scenario-based assessments, and improved facilitation dynamics to enhance cognitive engagement, supporting the need for more active learning strategies in online environments. A literature review states that e-learning methods that are less

interactive are less favourable and that their success is more likely when social interaction, communication and need assessment are prioritised (Cook & Steinert, 2013). The term "interactive sessions" is rather vague and can receive more definition from a new and promising method called "gamification", in which game design elements are used in a nongame context, allowing students to extract cognitive value from an engaging means of study such as flash cards and Kahoot (Dupret, 2022). Another notable method is branching scenarios, which require the learner to make clinical decisions based on a scenario producing further challenges awaiting being solved, engaging students online (Cook *et al*, 2010).

Institutional support plays a pivotal role in optimizing the digital learning environment across all phases of the MBBS programme. Despite students' overall confidence in their digital capabilities, persistent issues related to login difficulties, limited search functionality, and the absence of structured feedback were highlighted in the study. Addressing these issues requires institutional investment in robust digital infrastructure, continuous faculty training, and the development of dedicated spaces for peer and instructor interaction. Previous research underscores the value of feedback and collaborative learning, emphasising that well-designed communication tools are essential for fostering a sense of community within digital learning environments (Garrison *et al*, 2010).

Furthermore, adequate interaction must manifest itself in the form of institutional support, platform improvement and prompt facilitation dynamics, as participants in our study viewed the mere deliverance of lectures as academically unproductive. This was also manifested in the results of a study in Saudi Arabia where students rated the "good support system" on a very low side, thus highlighting its deficiency (Al-Hazimi *et al*, 2004). Learning has indeed been shown to be a social phenomenon such that the embedment of feedback and evaluation in the core of teacher-learner interaction generates the most productive academic dialogue (Kropf, 2013). The role of teachers in all learning models is crucial, as they not only deliver knowledge but also impart skills, qualities and competencies to the students (Capone *et al*, 2017). One study aimed to discover how a teacher-centered medical school curriculum may result in a negative perception of the educational environment and effectively concluded that poor teaching skills and lack of feedback were the top contributory factors (AlFaris *et al*, 2014). Eighty-four percent of students and 58% of residents participating in a study based in Cameroon, Africa, had never had access to e-learning resources reiterating the need for institutional support and strategy to deploy key skills in this domain (Bediang *et al*, 2013).

Other aspects brought to light in the study included learner characteristics and platform usability. Students recognised the importance of active engagement and self-discipline as essential antidotes to online learning distractions. Participants from Taiwan's higher education institutions agreed that motivation had a direct impact on learning engagement and an indirect impact through practicing self-monitoring (Alemayehu & Chen, 2021). Motivational regulation strategies are shown to be highly strategic for a good online learning experience for medical students as well as enhancement of cognition (Wang *et al*, 2021).

There is a dire need to integrate such strategies in online curricula to boost productivity. In addition, although students considered themselves fully digitally capable of using online learning platforms, usability remained an issue as login problems, and a lack of search options and progress clarity were still evident. The qualitative data in our study revealed ongoing usability issues, such as login difficulties and limited search functionality, echoing similar concerns identified in other studies. A relevant study reviewed the usability of an experimental e-learning tool, *Learning Moment (LM)*, which had certain features that maximised its adoption: it included target users, maximised simplicity, allowed diversity and could be incorporated into daily workflows (Yun *et al*, 2021). Similar blueprints that attribute e-learning platform usability to effectiveness, satisfaction and ease of use can be cultivated in practice to gauge this problem actively (Abulafia & De Quincey, 2018).

Garrison *et al*, argued that effective learning can take place from the sufficient interactions of students with peers, teachers and content (Garrison *et al*, 2010). Keeping in like with this principle, students in the study recommended a separate platform for contacting instructors outside of the e-learning platform. As the physical separation of learners from students is an obvious caveat in online learning, technology plays a pivotal role in providing an experience closely matching that of a face-to-face class (Sher, 2009). One review revealed that despite efforts to understand the social setbacks entailed by online education, little work has been done to connect these concepts to produce better learning (WALLACE, 2003). This strongly suggests the need for communication tools to be incorporated into a digital learning environment.

In conclusion, this study demonstrates that while the digital learning environment at the institution offers flexibility and ease of access, it also poses challenges that compromise key elements of social learning and interaction. To address these challenges, the institution should consider tailored digital strategies that align with the curriculum's structured delivery and evolving demands. Incorporating interactive learning elements in the pre-clinical years and enhancing communication tools in the clinical years could significantly improve student engagement and collaboration. Moreover, the integration of scenario-based assessments and real-time case discussions would bridge the gap between theoretical knowledge and practical application, enhancing learning outcomes across all phases of the MBBS programme.

By aligning digital strategies with the structured delivery of the MBBS curriculum, the institution under study can create a more supportive and engaging online learning experience that adapts to the specific needs of students at different stages of their medical training. Future research should explore the long-term impact of these interventions on student satisfaction, social connectedness, and overall learning outcomes.

Limitations of the study

Although this study benefits from incorporating both qualitative and quantitative data from participants, it has some limitations. First, it was conducted at a single institution and only at one point in time, which may limit the generalisability of the findings. Further in-depth qualitative studies are necessary to explore students' perceptions across different institutions and regions, allowing for a more comprehensive understanding of online learning environments in medical education.

Additionally, the usability and applicability of the validated Digi-MEE instrument should be tested in multiple institutions providing online medical education to determine its broader relevance. Future research should also aim to assess the test-retest reliability of the Digi-MEE instrument by replicating this study within the same settings over time. Moreover, the instrument's validation should be extended to other educational contexts beyond undergraduate medical education to ensure its versatility in different online learning environments.

Furthermore, the use of a 4-point Likert scale in the Digi-MEE instrument, intentionally designed to avoid neutral responses, presents a potential limitation. In this study, a score of 3 was considered indicative of positive perceptions, but a higher threshold, such as 3.5, is often preferred in research to denote strong agreement. This difference could affect the interpretation of scores, and future studies may benefit from exploring additional statistical measures like median or mode to provide a more nuanced understanding of the findings.

Conclusion

This study provides valuable insights into the perceptions of medical students regarding their online learning environment, revealing both strengths and areas for improvement. While students report high levels of digital capability and generally find the platform usable, the lack of social interaction and limited institutional support remain key challenges. These findings underscore the need for medical institutions to enhance the interactive elements of their online learning platforms and offer more structured support systems to mitigate the negative impacts of social isolation.

Additionally, the significant variations in perception across different academic years suggest that tailored approaches may be necessary to address the unique needs of students at different stages of their medical education. To further enhance the effectiveness of online learning, institutions should explore the incorporation of interactive learning strategies, such as gamification and scenario-based assessments, and develop communication tools that facilitate better engagement between students and instructors.

Future studies should explore the long-term impact of these interventions on student satisfaction and learning outcomes, as well as the role of social connectedness in maintaining a productive and supportive online learning environment.

Abbreviations

Dig-MEE: Digital Medical Education Instrument
CC: Content Curation
CE: Cognitive Enhancement
CP: Cybergogical Practices
DC: Digital Capability
SR: Social Representations
PU: Platform Usability
IS: Institutional Support
FD: Facilitation Dynamics
LC: Learner Characteristics

Statements and Declarations

Ethical Approval:

1. Human Research Ethics Committee, University Sains Malaysia (USM/JEPeM/ 21050350)
2. Human Research Ethics Committee, University of Lahore, Pakistan (ERC 122/22/10)

Acknowledgements:
None

Competing Interest:
None

Source of funding:
The authors did not receive support from any organisation for the submitted work.

REFERENCES

Abuhlfaia, K, & De Quincey, E (2018). The usability of E-learning platforms in higher education: A systematic mapping study. *Proceedings of the 32nd International BCS Human Computer Interaction Conference, HCI 2018*. https://doi.org/10.14236/ewic/HCI2018.7.

Alemayehu, L, & Chen, H L (2021). The influence of motivation on learning engagement: the mediating role of learning self-efficacy and self-monitoring in online learning environments. *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2021.1977962.

AlFaris, E, Naeem, N, McAleer, S, Qureshi, R, Vleuten, C, Irfan, F, & Jamal, A (2014). Why a teacher centered medical school curriculum may result in a poor educational environment? *Journal of Contemporary Medical Education, 2*(2). https://doi.org/10.5455/jcme.20140620013233.

Al-Hazimi, A, Zaini, R, Al-Hyiani, A, Hassan, N, Gunaid, A, Ponnamperuma, G, Karunathilake, I, Roff, S, McAleer, S, & Davis, M (2004). Educational environment in traditional and innovative medical schools: A study in four undergraduate medical schools. *Education for Health, 17*(2). https://doi.org/10.1080/13576280410001711003.

Al-Naggar, R A, Abdulghani, M, Osman, M T, Al-Kubaisy, W, Daher, A M, Aripin, K N B N, Assabri, A, Al-Hidabi, D A, Mohamed Ibrahim, M I B, Al-Rofaai, A, Ibrahim, H S, Al-Talib, H, Al-Khateeb, A, Othman, G Q, Abdulaziz, Q A, Chinna, K, & Bobryshev, Y V (2014). The Malaysia dreem: Perceptions of medical students about the learning environment in a medical school in Malaysia. *Advances in Medical Education and Practice, 5*, 177–184. https://doi.org/10.2147/AMEP.S61805.

Azmat, M, & Ahmad, A (2022). Lack of Social Interaction in Online Classes During COVID-19. *Journal of Materials and Environmental Science, 13*(2).

Back, D A, Behringer, F, Haberstroh, N, Ehlers, J P, Sostmann, K, & Peters, H (2016). Learning management system and e-learning tools: An experience of medical students' usage and expectations. *International Journal of Medical Education, 7*, 267. https://doi.org/10.5116/IJME.57A5.F0F5.

Bączek, M, Zagańczyk-Bączek, M, Szpringer, M, Jaroszyński, A, & Wożakowska-Kapłon, B (2021). Students' perception of online learning during the COVID-19 pandemic: A survey study of Polish medical students. *Medicine, 100*(7), E24821. https://doi.org/10.1097/MD.0000000000024821.

Bediang, G, Stoll, B, Geissbuhler, A, Klohn, A M, Stuckelberger, A, Nko'O, S, & Chastonay, P (2013). Computer literacy and E-learning perception in Cameroon: The case of Yaounde Faculty of Medicine and Biomedical Sciences. *BMC Medical Education, 13*(1). https://doi.org/10.1186/1472-6920-13-57.

Bower, M. (2019). Technology-mediated learning theory. *British Journal of Educational Technology, 50*(3), 1035–1048. https://doi.org/10.1111/bjet.12771.

Braun, V, Clarke, V, Hayfield, N, & Terry, G (2019). Thematic analysis. In *Handbook of Research Methods in Health Social Sciences*. https://doi.org/10.1007/978-981-10-5251-4_103.

Capone, R, De Caterina, P, & Mazza, G A G (2017). Blended learning, flipped classroom and virtual environment: Challenges and opportunities for the 21st century students. *EDULEARN17 Proceedings, 1*. https://doi.org/10.21125/edulearn.2017.0985.

Cook, D A, Erwin, P J, & Triola, M M (2010). Computerized virtual patients in health professions education: A systematic review and meta-analysis. In *Academic medicine: Journal of the Association of American Medical Colleges* (Vol. 85, Issue 10). https://doi.org/10.1097/acm.0b013e3181edfe13.

Cook, D A, & Steinert, Y (2013). Online learning for faculty development: A review of the literature. *Medical Teacher, 35*(11). https://doi.org/10.3109/0142159X.2013.827328.

Docherty, A, & Sandhu, H (2006). Student-perceived barriers and facilitators to e-learning in continuing professional development in primary care. *Education for Primary Care, 17*(4). https://doi.org/10.1080/14739879.2006.11864084.

Dupret, K (2022). The Promise of Learning Through Gaming at Work. In *Current Practices in Workplace and Organizational Learning: Revisiting the Classics and Advancing Knowledge*. https://doi.org/10.1007/978-3-030-85060-9_7.

Eldeeb, R A (2014). Students' Perceptions to e-learning. *Article in IOSR Journal of Research & Method in Education*, *4*(3), 38–41. https://doi.org/10.9790/7388-04343336.

Fincham, J E (2008). Response Rates and Responsiveness for Surveys, Standards, and the Journal. *American Journal of Pharmaceutical Education*, *72*(2), 43. https://doi.org/10.5688/AJ720243.

Garrison, D R, Cleveland-Innes, M, & Fung, T S (2010). Exploring causal relationships among teaching, cognitive and social presence: Student perceptions of the community of inquiry framework. *The Internet and Higher Education*, *13*(1–2), 31–36. https://doi.org/10.1016/j.iheduc.2009.10.002.

Hadie, S N H, Hassan, A, Ismail, Z I M, Asari, M A, Khan, A A, Kasim, F, Yusof, N A M, MananSulong, H A, Tg Muda, T F M, Arifin, W N, & Yusoff, M S B (2017). Anatomy education environment measurement inventory: A valid tool to measure the anatomy learning environment. *Anatomical Sciences Education*, *10*(5), 423–432. https://doi.org/10.1002/ase.1683.

Kamarudin, Y., Mohd Nor, N. A., Libamin, A. C., Suriani, A. N. H., Marhazlinda, J., Bramantoro, T., Ramadhani, A., & Neville, P. (2022). Social media use, professional behaviors online, and perceptions toward e-professionalism among dental students. *Journal of Dental Education*, *86*(8), 958–967. https://doi.org/10.1002/JDD.12912.

Khasawneh, R, Simonsen, K, Snowden, J, Higgins, J, & Beck, G (2016). The effectiveness of e-learning in pediatric medical student education. *Medical Education Online*, *21*(1). https://doi.org/10.3402/MEO.V21.29516.

Kropf, D C (2013). Connectivism: 21st Century's New Learning Theory. *European Journal of Open, Distance and E-Learning*, *16*(2).

Naeem, N, & Khan, R A (2019). Stuck in the blend: Challenges faced by students enrolled in blended programs of Masters in Health Professions Education. *Pakistan Journal of Medical Sciences*, *35*(4), 929–933. https://doi.org/10.12669/PJMS.35.4.12.

Naeem, N-K, Hadie, S N H, Ismail, I M, & Yusoff, M S B (2023). Development and validation of Digi-MEE Instrument measuring online learning environments in medical education. *Pakistan Journal of Medical Sciences*, *39*(6). https://doi.org/10.12669/PJMS.39.6.8430.

Naeem, N-K, Yusoff, M S B, Hadie, S N H, Ismail, I M, & Iqbal, H (2023). Understanding the Functional Components of Technology-Enhanced Learning Environment in Medical Education: A Scoping Review. *Medical Science Educator*, *33*(1), 1–15. https://doi.org/10.1007/S40670-023-01747-6/TABLES/3.

Osaili, T M, Ismail, L C, ElMehdi, H M, Al-Nabulsi, A A, Taybeh, A O, Saleh, S T, Kassem, H, Alkhalidy, H, Ali, H I, Al Dhaheri, A S, & Stojanovska, L (2023). Comparison of students' perceptions of online and hybrid learning modalities during the Covid-19 pandemic: The case of the University of Sharjah. *PLoS ONE*, *18*(3 March). https://doi.org/10.1371/journal.pone.0283513.

Ramachandran, K, & Kumar, R D (2021). Perception of medical students about online learning in the Covid-19 era. *Biomedicine (India)*, *41*(1). https://doi.org/10.51248/.v41i1.549.

Rehman, R, Ghias, K, Fatima, S S, Hussain, M, & Alam, F (2017). Dream of a conducive learning environment: One DREEM for all medical students! *Journal of the Pakistan Medical Association*, *67*(1), 7–11.

Rhim, H C, & Han, H (2020). Teaching online: foundational concepts of online learning and practical guidelines. *Korean J Med Educ*, *32*(3), 175–183. https://doi.org/10.3946/kjme.2020.171.

S E Mustafa, & Hamzah, A (2011). Online Social Networking: A New Form of Social Interaction. *International Journal of Social Sciences and Humanity*, *1*(2), 96–104.

Sher, A (2009). Assessing the relationship of student-instructor and student-student interaction to student learning and satisfaction in Web-based Online Learning Environment. *Journal of Interactive Online Learning*, *8*(2).

Song, L, Singleton, E S, Hill, J R, & Koh, M H (2004). Improving online learning: Student perceptions of useful and challenging characteristics. *The Internet and Higher Education*, *7*(1), 59–70. https://doi.org/10.1016/J.IHEDUC.2003.11.003.

Sridharan, S, & Nakaima, A (2011). Ten steps to making evaluation matter. *Evaluation and Program Planning*. https://doi.org/10.1016/j.evalprogplan.2010.09.003.

Stein, D S, Wanstreet, C E, Calvin, J, Overtoom, C, & Wheaton, J E (2010). Bridging the Transactional Distance Gap in Online Learning Environments. *http://Dx.Doi.Org/10.1207/S15389286ajde1902_4*, *21*(1), 105–118. https://doi.org/10.1207/S15389286AJDE1902_4.

Suci, W, Muslim, S, & Chaeruman, U A (2022). Use of Social Media for Collaborative Learning in Online Learning: A Literature Review. AL-ISHLAH: *Jurnal Pendidikan*, *14*(3). https://doi.org/10.35445/alishlah.v14i3.833.

Tekin, P Ş, Ilgaz, H, Adanır, G A, Yıldırım, D, & Gülbahar, Y (2020). Flipping e-learning for teaching medical terminology: A study of learners' online experiences and perceptions. *Online Learning Journal*, *24*(2), 76–93. https://doi.org/10.24059/olj.v24i2.2030.

Wallace, R M (2003). Online Learning in Higher Education: A review of research on interactions among teachers and students. *Education, Communication & Information*, *3*(2). https://doi.org/10.1080/14636310303143.

Wang, J, Liu, W, Zhang, Y, Xie, S, & Yang, B (2021). Perceived Stress Among Chinese Medical Students Engaging in Online Learning in Light of COVID-19. *Psychology Research and Behavior Management*, *14*, 549–562. https://doi.org/10.2147/PRBM.S308497.

Yun, H, Kim, S, & Chung, E K (2021). Exploring the structural relationships between medical students' motivational regulation, cognitive learning, and academic performance in online learning. *Korean Journal of Medical Education*, *33*(2). https://doi.org/10.3946/KJME.2021.193.

Prevalence and Associated Factors of General Health Literacy Among Adults in Malaysia: A Systematic Review and Meta-Analysis

Cheong Lieng Teng[1], Pei Kuan Lai[2], Hian Jie Heng[3], Mun Hong Tiew[3], Chun Wai Chan[1].

Introduction:

There is an increasing number of publications on health literacy from Malaysia. We conducted a systematic review of Malaysian studies to determine the prevalence of limited general health literacy and the associated factors among Malaysian adults.

Materials and Methods:

We conducted a comprehensive search for Malaysian studies on health literacy using PubMed, Scopus and Google Scholar. Cross-sectional studies that measured general health literacy using specific rating scales among adults in Malaysia were retrieved for qualitative analysis. Quantitative synthesis of the prevalence of limited health literacy measured using two rating scales (Newest Vital Sign, NVS and various versions of European Health Literacy Survey, HLS) was performed using random effect model.

Results:

Twenty-five studies measuring general health literacy were retrieved for qualitative analysis; the majority were various versions of HLS and NVS. Pooled prevalence rates of limited health literacy were: HLS: 48.59%; NVS: 91.41%. Subgroup analysis of participant type revealed prevalence of limited health literacy measured using NVS was lower in clinical samples vs non-clinical samples (85.67% vs 94.70%). Moderator analysis revealed a small effect of ethnicity on prevalence of health literacy measured using HLS. Assessment of included studies showed very few of them had statistically significant associations between socio-demographic factors and limited health literacy.

Conclusion:

Prevalence of limited health literacy in Malaysian adults was very high: almost one in two adults in HLS studies and nine out of ten adults in NVS studies. Socio-demographic factors associated with limited health literacy were inconsistent with other studies.

Keywords: *adult; health literacy; Malaysia; prevalence; systematic review.*

INTRODUCTION

Health literacy is a rapidly emerging area of research.[1] According to Sørensen, health literacy "entails people's knowledge, motivation and competencies to access, understand, appraise and apply information to make judgements and take decisions in everyday life concerning healthcare, disease prevention and health promotion".[2] Low health literacy has been shown to be associated with increased hospitalisations, more use of emergency care, lower acceptance of preventive care, lower medication adherence, poorer overall health status and higher mortality rates.[3]

To date, a wide variety of health literacy measurement tools have been developed.[4,5] These include objective scales, subjective scales or a combination of both. Objective scales primarily assess reading, comprehensive and numeracy skills (eg, Newest Vital Sign, NVS), whereas subjective scales are based on self-reporting (eg, European Health Literacy Survey, HLS-Eu).

[1] Department of Family Medicine, International Medical University, Seremban Campus, Negeri Sembilan, Malaysia.

[2] Institute for Research, Development and Innovation (IRDI), International Medical University, No.126, Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, Malaysia.

[3] School of Medicine, International Medical University, Seremban Campus, Negeri Sembilan, Malaysia.

Corresponding author:
Professor Dr Cheong Lieng Teng
Address: Department of Family Medicine, International Medical University, Seremban Campus, Negeri Sembilan, Malaysia.
Telephone: +60-7677798 (ext 153) Fax: +60-7677709 Email: cheonglieng_teng@imu.edu.my

Assessing country-specific level of health literacy has potential application for public health policy and health promotion. In the systematic review conducted by Rajah *et al*, up to January 2018 eleven health literacy publications were identified in Southeast Asia and Malaysia contributed to five of them.[6] In the scoping review by Abdullah *et al*, 29 publications were identified from Malaysia up to November 2019, of these 15 of them were on general health literacy.[7] A preliminary search revealed there are now many more publications on general health literacy from Malaysia and thus, we planned to synthesise the prevalence of limited health literacy and the factors that are associated with it.

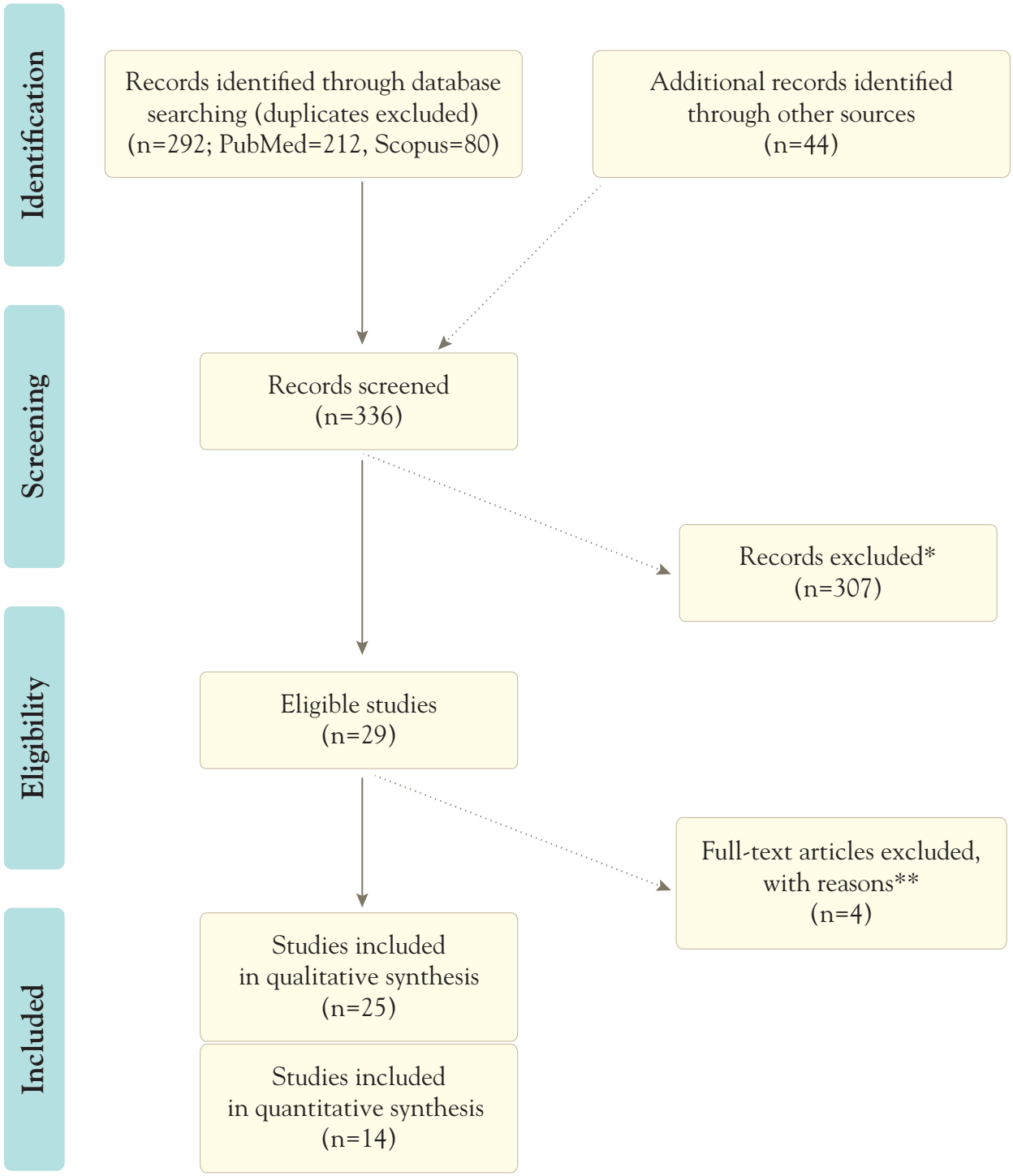
MATERIALS AND METHODS

Study design

This is a systematic review. It was performed following the PRISMA guideline.[8] The protocol of this systematic review has been registered in INPLASY.[9]

Search

A bibliographic search was performed on PubMed/Medline, Scopus and supplemented by a targeted Google Scholar search on 16–20 February 2023. The keywords used were: "health literacy" AND "Malaysia". The publication period was from inception to 31st December 2022. A PRISMA flow diagram of the search method is shown in Figure I.



Note: This information is added to Figure 1I. Literature search was conducted by CLT. Screening was done by one pair of investigators (CLT, CWC). Assessment of bias was done by three pairs of investigators (CLT+LPK; MHT+HJH; CLT+CWC for HLS studies, NVS studies, other studies, respectively). Data extraction and synthesis was performed by CLT and checked by other co-investigators.

*conference abstract=6; non-Malaysian publication=29; comment/letter/editorial=3; review (narrative/systematic)=40; study protocol=5; focus on specific area of health literacy (eg, diabetes, mental health, oral health, nutrition, cancer literacy, computer literacy, ehealth/mhealth literacy, food/nutrition literacy, cancer literacy)=75; health literacy not measured=148; studies on children/adolescent=29; health personnel or medical students=21; qualitative research=22; clinical trial=7; theses=6 [some publications may be in more than one category].

**duplicated datasets (see text).

Figure I: Flow diagram for the selection of studies

Literature management

All references were imported into the Endnote 20 citation manager.[10] After removing the duplicates, eligible articles were identified based on the following inclusion and exclusion criteria.

Inclusion criteria were as follows:

1. Studies that were conducted in Malaysia.
2. Study participants were adults.
3. General health literacy was measured using specific rating scales.
4. Studies that were published in peer reviewed journal articles or large population surveys.

Exclusion criteria were as follows:

1. Studies that were conducted outside Malaysia.
2. Studies that were conducted in Malaysia on non-Malaysians.
3. Study participants were children, adolescents or health personnel.
4. Studies that were only focused on specific aspects health literacy (e.g. cancer literacy, computer literacy, eHealth literacy, food/nutrition health literacy, mHealth literacy, mental health literacy, oral health literacy).
5. Studies that were published in monographs, reports, conference abstracts or theses/dissertations.

Quality assessment of included studies

We assessed the quality of the included studies using JBI critical appraisal checklist for analytical cross-sectional studies.[11]

Data extraction

The following data were extracted from the included studies:

1. Measurement tool (rating scale) of health literacy
2. Publication type
3. Study setting
4. Health problem (if any)
5. Year of publication
6. Socio-demographic characteristics of patients

Data synthesis

We extracted the number of participants with limited health literacy and the total sample size (i.e. those who completed the general health literacy rating scales), as well as mean and standard deviation of health literacy scores. For studies using various versions of Health Literacy Survey (HLS) questionnaires, limited health literacy was defined as Health Literacy Index ≤33 (i.e. including both "inadequate" (0-25) and "problematic" (>25-33) levels of health literacy).[12] For studies using Newest Vital Sign (NVS), score ≤3 was considered as limited health literacy.[13] Meta-analysis of the percentage of low health literacy was performed using MedCalc Statistical Software[14] and Jamovi.[15] Meta-analysis using fixed effect and random effect models were presented separately for NVS and HLS studies. Sensitivity analysis was conducted with or without large national-level population survey. Subgroup analysis and moderator analysis were done for these variables: type of rating scale (NVS vs HLS), participant type (clinical vs non-clinical samples), and socio-demographic variables (age, gender, ethnicity and education level). Heterogeneity was assessed using sensitivity analysis and subgroup analysis. Small study effect (publication bias) was tested using Egger test.

RESULTS

A total of 336 studies were retrieved from bibliographic databases. Twenty-nine publications satisfied the inclusion criteria, out of which 25 unique studies published in the period 2015 to 2022 were included in this systematic review (four studies using duplicated datasets were excluded).[16-19] Figure I illustrates the flow chart of the study selection.

Type of general health literacy scales used in the included studies

We identified six unique health literacy rating scales used in Malaysia (see Table I).

1. Health Literacy Survey Questionnaires (various versions of HLS, n=12)[20-31]: Three were 47-item version (HLS-Eu-Q47) 21, 25, 29; two were 18-item version (HLS-M-Q18) 22, 28; two were 16-item version (HLS-M-Q16, HLS-Asia-Q16) 23, 30; five were 12-item version (HLS-SF12).[20, 24, 26, 27, 31]
2. Newest Vital Sign (NVS, n=7).[32-38]
3. Health Literacy Scale (HLS-14, n=2).[39, 40]
4. Test of Functional Health Literacy in Adults – Short Form (TOFHLA-S, n=2)[41, 42]
5. Health Literacy Management Scale (HeLMS, n=1)[43]
6. Brief Health Literacy Screen (BHLS, n=1)[44]

General health literacy related data in Malaysia

Out of 25 included studies, 22 of them reported health literacy data either in mean (SD) or percentage and 12 of them analysed health literacy by socio-demographic groups (Table I). Psychometric data in Malaysia were available for these versions of rating scales: HLS-Eu-Q47 (Cronbach α=0.85),[25] HLS-M-Q18 (Cronbach α=0.906),[17] HLS-SF12 (Cronbach α=0.85).[26]

Table I: Characteristics of studies measuring general health literacy in Malaysia

	Study	Health literacy scale*	Setting and participants	JBI† Score	GHL‡ %	GHL‡ mean	GHL‡ and socio-demographic data
1	Abdullah 2020[19]	HLS-Eu-Q47	Public primary care clinic, adult diabetes patients	8	Yes	Yes	Yes
2	Duong 2017[23]	HLS-Eu-Q47	Adults in the community	9	No	No	No
3	Salim 2021[27]	HLS-Eu-Q47	Public primary care clinic, adult asthma patients	9	Yes	No	Yes
4	Azlan 2021[20]	HLS-M-Q18	Adults in the community	8	Yes	No	Yes
5	Jaafar 2021[26]	HLS-M-Q18	Adults in the community	9	Yes	No	Yes
6	Baharum 2020[21]	HLS-M-Q16	Adult female from premarital counselling centres	8	No	Yes	No
7	Shibraumalisi 2020[28]	HLS-Asia-Q16	Public primary care clinic, adult diabetes patients	9	Yes	Yes	No
8	Abd-Rahim 2021[18]	HLS-SF12	University primary care clinic, elderly	9	Yes	No	Yes
9	Bahuri 2022[22]	HLS-SF12	Public sector department, employees	8	Yes	No	No
10	Duong 2019[24]	HLS-SF12	Adults in the community	9	No	No	No
11	Goh 2022[25]	HLS-SF12	Public primary care clinic pharmacy, chronic disease patients	8	Yes	No	Yes
12	Yunus 2020[29]	HLS-SF12	Elderly in the community	8	Yes	Yes	Yes
13	Appalasamy 2019[30]	NVS	Hospital neurology clinic, stroke patients	6	Yes	No	No
14	Azreena 2016[31]	NVS	Public primary care clinic, adult diabetes patients	9	Yes	No	Yes
15	Chan 2015[32]	NVS	Hospital pharmacy, adult caregivers	8	Yes	No	Yes
16	NHMS 2015[33]	NVS	Adults in the community	9	Yes	No	No
17	Norrafizah 2018[34]	NVS	Adults in the community	6	Yes	No	No
18	Shahril 2018[35]	NVS	Obese housewives in the community	7	Yes	No	Yes
19	Tan 2020[36]	NVS	Public primary care clinic, adult diabetes patients	8	Yes	No	Yes
20	Froze 2018[37]	HLS-14	Adults in the community	9	Yes	Yes	No
21	Jores 2021[38]	HLS-14	Adults in the community	8	No	No	No
22	Abdullah 2019[39]	TOFHLA-S	Public primary care clinic, adult diabetes patients	9	Yes	No	No
23	Ramlay 2020[40]	TOFHLA-S	Public primary care clinic, outpatients	7	No	Yes	No
24	Hagger 2018[42]	BHLS	UITM clinical training centre, familial hyperlipidemia patients	7	Yes	No	Yes
25	Yunus 2021[29]	HeLMS	Hospitals outpatients	8	No	Yes	No

*HLS-Eu-Q47, HLS-M-Q18, HLS-M-Q16, HLS-Asia_Q16, HLS-SF12 are various versions developed from European Health Literacy Survey Questionnaire; NVS is Newest Vital Sign; HLS-14 is the 14-item Health Literacy Scale; TOFHLA-S is Test of Functional Health Literacy in Adults – short form; BHLS is Brief Health Literacy Screen; HeLMS is Health Literacy Management Scale.
†Joanna Briggs Institute critical appraisal checklist.
‡General health literacy.

Prevalence of limited health literacy

Fourteen studies were used to synthesise the prevalence of limited health literacy (Table II). We excluded two studies with low quality score (JBI score <7).[32, 36] These fourteen studies included nine studies using various versions of European HLS and five studies using NVS. We noted there were two national-level population-based surveys of health literacy in Malaysia: NVS was used in the National Health and Morbidity Survey in 2015[35] but HLS-M-Q18 was used in 2019.[28] In view of the large sample sizes in these two surveys, the meta-analysis was presented separately with and without these two surveys (Table II).

Table II: Prevalence and socio-demographic correlates of limited health literacy

	Study	Health literacy scale	Participants	Health literacy data, n (% limited HL, mean±SD)	Associated factors of limited health literacy*
1	Abdullah 2020[19]	HLS-EU-Q47	428 primary care T2DM (mean age 58.1±10.6)	279 (65.3%), 31.9±7.04	Significant: not English fluency, not attended diabetes education session, low social support. Not significant: age, gender, ethnicity, education, income.
2	Salim 2021[27]	HLS-EU-Q47	550 primary care asthma (mean age 48±15.44)	329 (60.5%)	Significant: lower education no asthma education. Not significant: age, gender, ethnicity, income.
3	Azlan 2021[20]	HLS-M-Q18	866 adults population survey (mean age 33.6)	502 (58.0%)	Significant: age (23-37), self perceived poor health status. Not significant: gender, ethnicity, income.
4	Jaafar 2021[26]	HLS-M-Q18	9478 adults population survey	3317 (35.0%) (weighted to general population)	Not analysed
5	Shibraumalisi 2020[28]	HLS-Asia-Q16	447 primary care T2DM (mean age 58.18±11.39)	191 (42.7%), 12.4±3.3	Not analysed
6	Abd-Rahim 2021[18]	HLS-SF12	413 primary care elderly (median age 67, IQR=8)	79 (19.1%)	Significant: age (≥70), education (primary or less). Not significant: gender, ethnicity, income, perceived health status.
7	Bahuri 2022[22]	HLS-SF12	518 public sector employees (mean age 50.2±5.9)	223 (43%)	Not analysed
8	Goh 2022[25]	HLS-SF12	337 primary care chronic disease patients (mean age 52.6±12.3)	184 (54.6%)	Significant: older age, lower education, lower income. Not significant: gender.
9	Yunus 2020[29]	HLS-SF12	206 community elderly (mean age 66.6±5.5)	129 (62.6%), 30.6±10.0	Univariate analysis only. Lower HL score: female, older age
10	Azreena 2016[31]	NVS	288 primary care T2DM patients (mean age 53.42±9.87)	247 (85.8%)	Significant: ethnic (Chinese), lower diabetes knowledge. Not significant: age, gender, education, income.
11	Chan 2015[32]	NVS	208 caregivers (mean age 30.83±6.08)	196 (94.2%)	Significant: lower education, income (below poverty).
12	NHMS-2015[33]	NVS	13,017 community adults aged ≥18	12,330 (94.7%)†	Not analysed
13	Shahril 2018[35]	NVS	328 community obese housewives	310 (94.5%)	Significant: older age (>44). Not significant: gender, ethnicity, education, income, social support.
14	Tan 2020[36]	NVS	289 primary care T2DM patients (mean age 58.0±9.7)	248 (83.0%)	Significant: older age (>55), education (<tertiary), income (<2000). Not significant: gender, ethnicity.

*Multivariate analysis, unless otherwise specified.
†actual count, % not weighted to population, weighted=93.4%.

Nine studies (total number of participants=13,243) provided prevalence estimates for limited health literacy using various versions derived from the European HLS (Figure II and Table III). The prevalence ranged from a surprisingly low percentage of 19.1% in the study done among primary care elderly outpatients (measured using HLS-SF12),[20] to 65.3% in the study done among primary care diabetes patients (measured using HLS-Eu-Q47).[21] The pooled prevalence of limited health literacy is 48.59% (random effect model, 95%CI 38.78 to 58.45). Without the national survey conducted by Jaafar *et al*,[28] the pooled prevalence of limited health literacy is 50.36% (random effect model, 95%CI 39.84 to 60.88). Pooled prevalence of limited health literacy among clinical samples is shown to be statistically significantly higher only in meta-analysis using fixed effect model. Moderator analysis showed no statistically significant effect of age, gender and education level on prevalence of health literacy measured using HLS. Small but statistically significant effect was observed for ethnicity in that increasing proportion of Malay ethnicity is associated with decreasing prevalence of limited health literacy (Table IV).

Five studies (total number of participants=14,130) provided prevalence estimates for limited health literacy using NVS (Figure II, Table V). The prevalence ranged from 83.0% to 94.7%. The pooled prevalence of health literacy is 91.41% (random effect model, 95%CI 87.00 to 94.98). Without NHMS-2015,[35] the pooled prevalence of health literacy is 90.32% (random effect model, 95%CI 84.89 to 94.66). Pooled prevalence of limited health literacy among non-clinical samples is shown to be statistically significantly higher in meta-analysis using both fixed effect and random effect models. Moderator analysis was not done for NVS studies because there are too few studies which are compounded by missing socio-demographic variables in two studies.

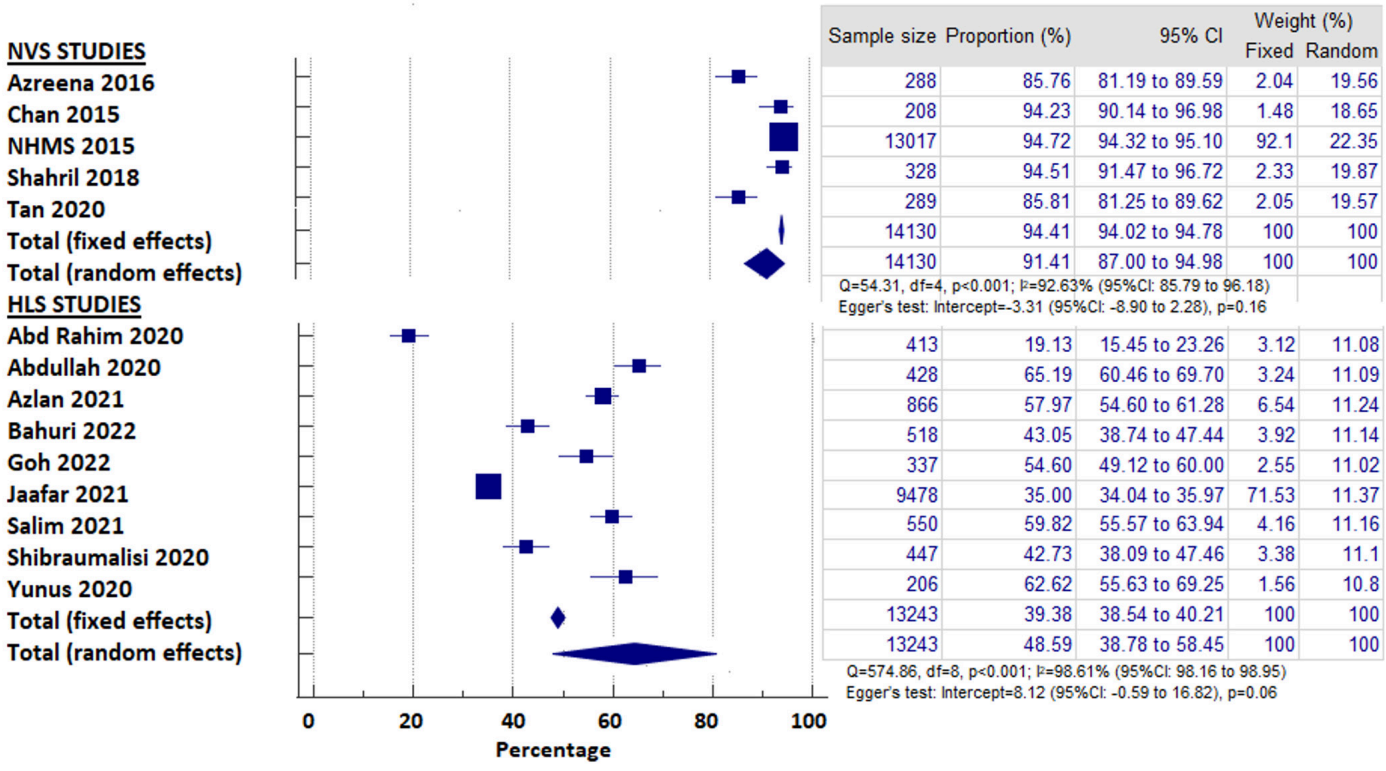


Figure II: Forest plot of pooled prevalence of limited health literacy

Table III: Pooled prevalence of limited health literacy measured using Health Literacy Survey in Malaysia

Meta-analysis	Studies	Sample size	Pooled prevalence (95%CI) (fixed effect)	Pooled prevalence (95%CI) (random effect)	Heterogeneity, I^2 (95%CI)
All studies	9	13,243	39.38% (38.54 to 40.21)	48.59% (38.78 to 58.45)	98.61% (98.16 to 98.95)
All studies excluded Jaafar 2021 (28)	8	3,765	50.67% (49.07 to 52.28)	50.36% (39.84 to 60.88)	97.68% (96.70 to 98.37)
Studies using clinical samples*	5	2,175	48.44% (46.32 to 50.56)	47.88% (31.53 to 64.47)	98.43% (97.64 to 98.96)
Studies using non-clinical samples**	4	11,068	37.62% (36.72 to 38.53)	49.45% (35.59 to 63.35)	98.71% (98.00 to 99.17)

*Studies that recruited specific patient groups, eg, asthma, diabetes.
**Studies that recruited adults from the community or population surveys.

Table IV: Moderator analysis for the pooled prevalence of HLS studies

Socio-demographic variables	Estimate (95%CI)	Standard error	z	p
Mean age	-0.005 (-0.015 to 0.005)	0.005	-0.961	0.337
Female gender*	0.012 (-0.002 to 0.026)	0.007	1.716	0.086
Malay ethnicity*	-0.004 (-0.008 to -0.000)	0.002	-2.03	0.042
Primary or lower education*	-0.002 (-0.010 to 0.006)	0.004	-0.552	0.581

*Data were percentage of participants having the specified subgroup.
Note: Model estimator is Restricted Maximum-Likelihood, mixed-effect model.

Table V: Pooled prevalence of limited health literacy measured using Newest Vital Sign in Malaysia

Meta-analysis	Studies	Sample size	Pooled prevalence (95%CI) (fixed effect)	Pooled prevalence (95%CI) (random effect)	Heterogeneity, I^2 (95%CI)
All studies	5	14,130	94.41% (94.02 to 94.78)	91.41% (87.00 to 94.98)	92.63% (85.79 to 96.18)
All studies excluded NHMS-2015 (35)	4	1,113	90.22% (88.33 to 91.90)	90.32% (84.89 to 94.66)	87.39% (69.88 to 94.72)
Studies using clinical samples*	2	577	85.67% (82.54 to 88.42)	85.67% (82.70 to 88.40)	0%
Studies using non-clinical samples†	3	13,553	94.70% (94.31 to 95.07)	94.70% (94.31 to 95.07)	0%

*Studies that recruited specific patient groups, eg, asthma, diabetes.
†Studies that recruited adults from the community or population surveys.

Factors Associated With Limited Health Literacy

Out of 14 studies providing prevalence data, ten of them analysed factors associated with limited health literacy (Table II). Where available, results for socio-demographic factors are presented below.

- Older age: statistically significant (n=4); not statistically significant (n=4)
- Gender: statistically significant (n=1, univariate analysis, female); not statistically significant (n=9)
- Ethnic group: statistically significant (n=1, Malays and Indian more than Chinese); not statistically significant (n=7)
- Lower educational level: statistically significant (n=3); not statistically significant (n=3)
- Diabetes education (n=1) and asthma education (n=1) associated with reduced limited health literacy
- Lower income: statistically significant (n=3); not statistically significant (n=6)

We also examined associations of limited health literacy with diabetes knowledge, social support and self-report health status, results as shown below:

- Diabetes knowledge: statistically significant (n=1)
- Lower social support: statistically significant (n=1), not statistically significant (n=1)
- Lower health status: statistically significant (n=1), not statistically significant (n=1)

DISCUSSION

Prevalence Of Limited Health Literacy

This meta-analysis revealed that the pooled prevalence rates of limited health literacy in Malaysia are 48.59% (38.78 to 58.45) based on HLS or 91.41% (87.00 to 94.98) based on NVS. In the random

effect model, HLS did not detect a difference in the prevalence of limited health literacy in both clinical and non-clinical samples. However, in the NVS studies, clinical sample is found to have slightly lower prevalence (85.67% vs 94.70%).

Validation studies conducted in Malaysia reported high level of reliability for HLS-Eu-Q47,[25] HLS-M-Q18[17] and HLS-SF12,[26] with Cronbach's α of 0.96, 0.91, 0.85, respectively. NVS has not been formally validated in the Malaysian context, to date there is only a preliminary validation study on 28 obese housewives showing Cronbach's α of 0.75.[45] In the European context, HLS-Eu and NVS had relatively low correlation (Spearman rho, r=0.245), suggesting these two scales measured somewhat different constructs of health literacy.[46] In view of the above, we felt it is inappropriate to synthesise the overall prevalence of health literacy including both NVS and HLS studies.

This meta-analysis showed that limited health literacy is highly prevalent among the Malaysian adults, in both clinical sample, as well as the general population. As expected, higher rate of limited health literacy is detected by NVS since this questionnaire assessed objective or functional health literacy and relied mostly on numerical test, skill that is more likely to be deficient in many adults.

Socio-Demographic Factors Associated With Limited Health Literacy

In the moderator analysis, we managed to detect only a small but statistically significant effect of Malay ethnicity and prevalence of limited health literacy in HLS studies. This lack of relationship between prevalence of limited health literacy and socio-demographic variables appears to be consistent with the assessment of all included studies individually, where we failed to identify a consistent pattern of statistically significant associations. Paasche-Orlow *et al*, conducted a systematic review of studies in the United States (scales used were mostly Rapid Estimate of Adult Literacy in Medicine (REALM) or versions of the Test of Functional Health Literacy in Adults (TOFHLA)) and showed low health literacy was associated with level of education, ethnicity, and age.[47] In another systematic review of 22 studies, Chakraverty *et al*, found that female achieved higher health literacy score than male participants.[48] Our meta-analysis of Malaysian health literacy studies is at variant with the systematic reviews by Paasche-Orlow *et al*, and Chakraverty *et al*, even though we limited the data extraction to two commonly used scales (versions of HLS and NVS). This may be due to the small sample sizes of most Malaysian studies and methodological issues (lack of uniformity of the participants' socio-demographic variables and different ways to define the categories). A majority of the scales used in Malaysia were various versions based on HLS-Eu-Q47. All of them require participants to rate their response on five-point Likert scale. As pointed out by Dowse and others, such response format is often found to be both unfamiliar and poorly understood by low literacy participants.[49, 50]

Further Application

In view of the high prevalence of limited health literacy in Malaysia and possibly little difference (if any) by participant groups or socio-demographic factors, it is probably not worthwhile to screen for limited health literacy in the clinical setting.[51] Rather, improving health communication in all forms

(written, verbal) in both clinical setting and for the general public should be the priority.[52]

Study Limitations

We noted the high level of heterogeneity as shown by I^2 exceeding 90% and remained very high despite sensitivity analysis and subgroup analysis. This observation of high heterogeneity in the meta-analysis of prevalence studies is a common phenomenon and is said to be not discriminative, ie, high I^2 is not always synonymous with high heterogeneity.[53]

CONCLUSION

This systematic review highlighted substantial level of limited health literacy in Malaysia, in both clinical and non-clinical samples, and failed to detect a consistent pattern of socio-demographic associations as seen in other prevalence studies.

REFERENCES

1. Tavousi M, Mohammadi S, Sadighi J, Zarei F, Kermani R M, Rostami R, *et al*. Measuring health literacy: A systematic review and bibliometric analysis of instruments from 1993 to 2021. *PLoS One. 2022;17*(7):e0271524. doi:10.1371/journal.pone.0271524.
2. Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, *et al*. Health literacy and public health: A systematic review and integration of definitions and models. *BMC Public Health. 2012*;12:80. doi:10.1186/1471-2458-12-80.
3. Berkman N D, Sheridan S L, Donahue K E, Halpern D J, Crotty K. Low health literacy and health outcomes: An updated systematic review. *Ann Intern Med. 2011;155*(2):97-107. doi:10.7326/0003-4819-155-2-201107190-00005.
4. Liu H, Zeng H, Shen Y, Zhang F, Sharma M, Lai W, *et al*. Assessment tools for health literacy among the general population: A systematic review. *Int J Environ Res Public Health. 2018;15*(8):1711. doi:10.3390/ijerph15081711.
5. Lee H, Lori JR. Scoping review: Valid and reliable health literacy assessment tools used in low- and middle-income countries. *J Nurs Meas. 2020;28*(1):jnm-d-18-00071. doi:10.1891/jnm-d-18-00071.
6. Rajah R, Hassali M A A, Murugiah M K. A systematic review of the prevalence of limited health literacy in Southeast Asian countries. *Public Health. 2019*;167:8-15. doi:10.1016/j.puhe.2018.09.028;
7. Abdullah A, Liew S M, Salim H S, Ng C J, Chinna K. Health literacy research in Malaysia: A scoping review. *Sains Malaysiana. 2020;49*(5):1021-36. doi:10.17576/jsm-2020-4905-07.
8. Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D, *et al*. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *PLoS Med. 2021;18*(3):e1003583. doi:10.1371/journal.pmed.1003583.
9. Teng C L, Lai P K, Heng H J, Tiew M H, Chan C W. General health literacy in Malaysia: Protocol of a systematic review of Malaysian studies. *Inplasy Protocol. 2023*;202330046. doi:10.37766/inplasy2023.3.0046.
10. EndNote 20. London: Clarivate Analytics; 2020.
11. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Chapter 5: Systematic reviews of prevalence and incidence. In: Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis. Adelaide: Joanna Briggs Institute (JBI); 2020.
12. Sørensen K, Pelikan J M, Röthlin F, Ganahl K, Slonska Z, Doyle G, *et al*. Health literacy in Europe: Comparative results of the European health literacy survey (HLS-EU). *Eur J Public Health. 2015;25*(6):1053-8. doi:10.1093/eurpub/ckv043.
13. Weiss B D, Mays M Z, Martz W, Castro K M, DeWalt D A, Pignone M P, *et al*. Quick assessment of literacy in primary care: The newest vital sign. *Ann Fam Med. 2005;3*(6):514-22. doi:10.1370/afm.405.
14. MedCalc® Statistical Software version 20.006. Ostend, Belgium: MedCalc Software Ltd; 2021.
15. The project jamovi. Jamovi (Version 2.3) [Computer Software]. 2023.
16. Froze S, Arif M T. Determinants of health literacy and healthy lifestyle against metabolic syndrome among major ethnic groups of Sarawak, Malaysia: A multi-group path analysis. *The Open Public Health Journal. 2019;12*(1):172-83. doi:10.2174/1874944501912010172.
17. Mohamad E M W, Kaundan M K, Hamzah M R, Azlan A A, Ayub S H, Tham J S, *et al*. Establishing the HLS-M-Q18 short version of the European health literacy survey questionnaire for the Malaysian context. *BMC Public Health. 2020;20*(1):580. doi:10.1186/s12889-020-08704-7.
18. Shaharudin N A, Suriani I, Shariff Ghazali S, Juni M H, Hayati K S. Socio-demographic predictors of adequate health literacy among type 2 diabetes mellitus patients attending two government health clinics in the district of Kuala Selangor. *International Journal of Public Health and Clinical Sciences. 2020;7*(3):34-41. doi:10.32827/ijphcs.7.3.34.

19. Su T T, Bahuri N H A, Said M A. Health literacy research in Malaysia: Health literacy and other aging challenges among Malaysian public employees. *Stud Health Technol Inform. 2020*;269:212-9. doi:10.3233/shti200034.

20. Abd-Rahim S N H, Mohamed-Yassin M S, Abdul-Razak S, Isa M R, Baharudin N. The prevalence of limited health literacy and its associated factors among elderly patients attending an urban academic primary care clinic in Malaysia. *Int J Environ Res Public Health. 2021;18*(17):9044. doi:10.3390/ijerph18179044.

21. Abdullah A, Ng C J, Liew S M, Ambigapathy S, V P, Chinna K. Prevalence of limited health literacy and its associated factors in patients with type 2 diabetes mellitus in Perak, Malaysia: A cross-sectional study. *BMJ Open. 2020;10*(11):e039864. doi:10.1136/bmjopen-2020-039864.

22. Azlan A A, Hamzah M R, Tham J S, Ayub S H, Ahmad A L, Mohamad E. Associations between health literacy and sociodemographic factors: A cross-sectional study in Malaysia utilising the HLS-M-Q18. *Int J Environ Res Public Health. 2021;18*(9):4860. doi:10.3390/ijerph18094860.

23. Baharum N N, Ariffin F, Isa M R, Tin S T. Health literacy, knowledge on cervical cancer and Pap smear and its influence on pre-marital malay muslim women attitude towards Pap smear. *Asian Pac J Cancer Prev. 2020;21*(7):2021-8. doi:10.31557/apjcp.2020.21.7.2021.

24. Bahuri N H A, Rizal H, Said M A, Myint P K, Su T T. Active ageing awareness and quality of life among pre-elder Malaysian public employees. *Int J Environ Res Public Health. 2022;19*(15):9034. doi:10.3390/ijerph19159034.

25. Duong T V, Aringazina A, Baisunova G, Nurjanah, Pham T V, Pham K M, *et al.* Measuring health literacy in Asia: Validation of the HLS-EU-Q47 survey tool in six Asian countries. J Epidemiol. 2017;27(2):80-6. doi:10.1016/j.je.2016.09.005.

26. Duong T V, Aringazina A, Kayupova G, Nurjanah, Pham T V, Pham K M, *et al.* Development and validation of a new short-form Health Literacy Instrument (HLS-SF12) for the general public in six Asian countries. *Health Lit Res Pract. 2019;3*(2):e91-e102. doi:10.3928/24748307-20190225-01.

27. Goh Q L, Tan S L, Fong F P W, Yen C H, Liau S Y. Health literacy among adult patients with chronic diseases in Sabah: HLS-Sabah. *Borneo Journal of Medical Sciences. 2022;16*(3):33-42. doi:10.51200/bjms.v16i3.3675.

28. Jaafar N, Perialathan K, Krishnan M, Juatan N, Ahmad M, Mien TYS, *et al.* Malaysian health literacy: Scorecard performance from a national survey. *Int J Environ Res Public Health. 2021;18*(11):5813. doi:10.3390/ijerph18115813.

29. Salim H, Shariff Ghazali S, Lee P Y, Cheong A T, Harrun N H, Mohamed Isa S, *et al.* Health literacy levels and its determinants among people with asthma in Malaysian primary healthcare settings: A cross-sectional study. *BMC Public Health. 2021;21*(1):1186. doi:10.1186/s12889-021-11194-w.

30. Shibraumalisi N A, Mat Nasir N, Md Yasin M, Isa M R. The association between health literacy and quality of life and its associated factors among adults with type 2 diabetes mellitus in public primary care clinic. *Journal of Clinical and Health Sciences. 2020;5*(1):60-74.

31. Yunus R M, Saman M S A, Zubillah A, Juni K B, Gaairibi A S A, Yahaya A N, *et al.* Health literacy among urban Malaysian elders: A descriptive study. *ASM Science Journal. 2020;13*(Special Issue 5):7-12.

32. Appalasamy J R, Joseph J P, Seeta Ramaiah S, Quek K F, Md Zain A Z, Tha K K. Exploring stroke survivors' self-efficacy in understanding and taking medication and determining associated factors: A cross-sectional study in a neurology clinic in Malaysia. *Patient Prefer Adherence. 2019*;13:1463-75. doi:10.2147/ppa.s215271.

33. Azreena E, Suriani I, Juni M H, Fuziah P. Factors associated with health literacy among type 2 diabetes mellitus patients attending a government health clinic, 2016. *International Journal of Public Health and Clinical Sciences. 2016;3*(6):50-64.

34. Chan H K, Hassali M A, Lim C J, Saleem F. Exploring health literacy and difficulty in comprehending pediatric medication labels among caregivers in Malaysia: A pilot study. *Journal of Pharmaceutical Health Services Research. 2015;*6(3):165-8. doi:10.1111/jphs.12102.

35. NHMS-2015. National Health and Morbidity Survey 2015. Volume II. Non-Communicable Diseases, Risk Factors & Other Health Problems. Kuala Lumpur: Institute for Public Health, Ministry of Health, Malaysia; 2015.

36. Norrafizah J, Asiah M N, Suraiya S, Zwaha H, Normawati A, Farid B M. Assessment of health literacy among people in a rural area in Malaysia using Newest Vital Signs assessment. *British Journal of Education, Society & Behavioural Science. 2016;16*(2):1-7. doi:10.9734/BJESBS/2016/25737.

37. Shahrir S N, Shamsuddin K, Mohamad Nor N S, Man C S, Omar M A, Ahmad M H, *et al.* Limited health literacy and its associated factors among overweight and obese housewives living in Klang Valley low cost flats: Findings from the my body is fit and fabulous at home (Mybff@Home) study. *Malaysian Journal of Public Health Medicine. 2018;18*(1):19-27.

38. Tan W Y, Ismail M. Health literacy among adult type 2 diabetes mellitus (T2DM) patients in Klang health district Malaysia. *JUMMEC. 2020*;23 Suppl 1:245-53.

39. Froze S, Arif M T, Saimon R. Does health literacy predict preventive lifestyle on metabolic syndrome? A population-based study in Sarawak Malaysia. *Open Journal of Preventive Medicine. 2018*;8(6):169-82. doi:10.4236/ojpm.2018.86016.

40. Jores D, Abdullah A R, Rahman M M. Association between health literacy and screening behavior on colorectal cancer among the adult population in Sarawak, Malaysia. *International Journal of Current Research and Review. 2021;13*(4 special Issue):S-48-S-56. doi:10.31782/IJCRR.2021.SP126.

41. Abdullah N A, Ismail S, Ghazali S S, Juni M H, Shahar H K, Aziz N R A. Predictors of good glycemic controls among type 2 diabetes mellitus patients in two primary health clinics, Kuala Selangor. *Malaysian Journal of Medicine and Health Sciences*. *2019;15*(SP3):58-64.

42. Ramlay M Z, Saddki N, Tin-Oo M M, Arifin W N. Cross-cultural adaptation and validation of Oral Health Literacy Instrument (OHLI) for Malaysian adults. *Int J Environ Res Public Health*. *2020;17*(15):5407. doi:10.3390/ijerph17155407.

43. Mohamad Yunus M, Abd Manaf N H, Omar A, Juhdi N. Healthcare utilisation among elderly in Malaysia: The mediating role of health literacy. *Med J Malaysia*. *2021;76*(2):218-22.

44. Hagger M S, Hardcastle S J, Hu M, Kwok S, Lin J, Nawawi H M, *et al*. Health literacy in familial hypercholesterolemia: A cross-national study. *Eur J Prev Cardiol*. *2018;25*(9):936-43. doi:10.1177/2047487318766954.

45. Cheong S M, Safiza N, Chan W L, Ambak R, Abdul Aziz N, Mohd Zaki N, *et al*. Preliminary assessment of reliability and validation of the Newest Vital Sign questionnaire among obese housewives. 46th APACPH Conference; 2014; Kuala Lumpur.

46. Consortium H-E. Comparative Report of Health Literacy in Eight EU Member States. Wien, Austria: The European Health Literacy Survey HLS-EU; 2012.

47. Paasche-Orlow M K, Parker R M, Gazmararian J A, Nielsen-Bohlman L T, Rudd R R. The prevalence of limited health literacy. *J Gen Intern Med*. *2005;20*(2):175-84. doi:10.1111/j.1525-1497.2005.40245.x.

48. Chakraverty D, Baumeister A, Aldin A, Seven Ü S, Monsef I, Skoetz N, *et al*. Gender differences of health literacy in persons with a migration background: A systematic review and meta-analysis. *BMJ Open*. *2022;12*(7):e056090. doi:10.1136/bmjopen-2021-056090.

49. Dowse R. The limitations of current health literacy measures for use in developing countries. *Journal of Communication in Healthcare*. *2016;9*(1):4-6. doi:10.1080/17538068.2016.1147742.

50. Chang E M, Gillespie E F, Shaverdian N. Truthfulness in patient-reported outcomes: factors affecting patients' responses and impact on data quality. *Patient Relat Outcome Meas*. *2019*;10:171-86. doi:10.2147/prom.S178344.

51. Paasche-Orlow M K, Wolf M S. Evidence does not support clinical screening of literacy. *J Gen Intern Med*. *2008;23*(1):100-2. doi:10.1007/s11606-007-0447-2.

52. Heine M, Lategan F, Erasmus M, Lombaard C M, Mc Carthy N, Olivier J, *et al*. Health education interventions to promote health literacy in adults with selected non-communicable diseases living in low-to-middle income countries: A systematic review and meta-analysis. *J Eval Clin Pract*. *2021;27*(6):1417-28. doi:10.1111/jep.13554.

53. Migliavaca CB, Stein C, Colpani V, Barker T H, Ziegelmann P K, Munn Z, *et al*. Meta-analysis of prevalence: I(2) statistic and how to deal with heterogeneity. *Res Synth Methods*. *2022;13*(3):363-7. doi:10.1002/jrsm.1547.