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EDITORIAL

Obesity as a Disease: The Malaysian Perspective

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ABSTRACT

Obesity is increasingly recognised as a chronic, relapsing, and progressive disease driven by complex interactions between biological, environmental, and societal determinants. Malaysia faces one of the highest obesity burdens in Southeast Asia, with more than two-thirds of adults classified as overweight or obese when local diagnostic thresholds are applied. This editorial examines obesity through a disease-based lens, highlighting Malaysian epidemiological trends, underlying physiological mechanisms, and the rapidly evolving therapeutic landscape. It further discusses policy and health-economic implications, underscoring the urgent need for a comprehensive, system-wide response that integrates prevention, evidence-based treatment, and stigma-free care. Recognising obesity as a disease is fundamental to reversing current trajectories, preventing long-term complications and collapse of the healthcare economy, as well as to ensure sustainable health outcomes for Malaysians.

Keywords: Obesity, chronic disease, Malaysia, GLP-1 receptor agonists, dual incretin therapy, health policy, health economics

INTRODUCTION

Obesity has undergone a fundamental paradigm shift, evolving from a condition traditionally attributed to individual lifestyle choices to a recognised chronic disease governed by complex biological regulation and associated with adverse long-term clinical outcomes. Leading international authorities, including the World Obesity Federation (WOF) and the World Health Organization (WHO), now define obesity as a chronic relapsing progressive disease process that impairs health; a complex, biologically-driven condition, influenced by environment, genetics, and behaviour, requiring lifelong management [1-3]. Despite this, its recognition as a disease remains uneven, hindered by persistent misconceptions, societal stigma, and implicit bias within healthcare systems. Recognising and addressing obesity as a chronic disease is fundamental to achieving national non-communicable disease (NCD) targets and ensuring long-term health system sustainability.

This shift in understanding is particularly salient in Malaysia, where obesity prevalence has risen steadily over the past decade positioning the country among those with the highest rates in Southeast Asia [4]. Data from the National Health and Morbidity Survey (NHMS) demonstrate a persistent upward trend, with more than half of Malaysian adults currently classified as overweight or obese. Notably, these

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estimates are based on the WHO body mass index (BMI) thresholds of 25 kg/m² for overweight and 30 kg/m² for obesity [5]. When lower Asia Pacific BMI cut-offs recommended in the Malaysian Clinical Practice Guidelines (CPG) 2023 [6] are applied, the true scale of the epidemic becomes unmistakable, with the prevalence of overweight (BMI 23–27.5 kg/m²) and obesity (BMI >27.5 kg/m²) rising to 33.8% and 36.3%, respectively [5].

Of equal concern is the escalating prevalence of overweight and obesity among children and adolescents, signalling early onset of metabolic risk and foreshadowing a substantial future disease burden [7]. This intergenerational propagation of obesity risk poses a serious threat to the sustainability of healthcare systems and underscores the urgency of adopting a comprehensive, disease-oriented approach to obesity prevention and management.

Pathogenesis and Pathophysiology of Obesity

Obesity has historically been oversimplified as a consequence of excess caloric intake and inadequate physical activity, often blamed on growing urbanisation and sedentary populations. This rationalisation fails to account for the biological complexity surrounding weight regulation. Contemporary evidence demonstrates that obesity is characterised by dysregulation of energy homeostasis involving central appetite pathways, peripheral hormonal signalling, adipose tissue inflammation, and strong genetic susceptibility. Hunger is regulated by a complex, adaptive neurobiological system that integrates peripheral metabolic signals with central neural circuits [8]. Homeostatic hunger arises from energy and nutrient depletion and is mediated by hypothalamic pathways responsive to hormones such as ghrelin, leptin, insulin, and gut-derived peptides including GLP-1, PYY, and CCK. In parallel, hedonic pathways within mesolimbic reward circuits modulate food intake independent of energy needs, driven by palatability, emotions, and learned behaviours. The gut microbiota further influences appetite through metabolic by-products and hormonal modulation. Continuous bidirectional gut–brain signalling ensures energy balance but also contributes to dysregulation in obesity.

Obesity must be recognised as a central driver of the nation's escalating burden of diabetes, cardiovascular disease, chronic kidney disease, and premature mortality. Understanding the complex pathophysiological context would promote empathy and objectivity, to perceive obesity beyond simple anthropometry. Although BMI remains a useful population metric, reliance on BMI alone is inherently limited because it neither directly assesses adiposity nor reflects the complex distribution and metabolic activity of body fat. We reiterate our previous editorial scholarship that current diagnostic criteria such as BMI, waist-hip ratio and percentage body fat bear intrinsic weaknesses, and more precise measures that integrate physiological markers of adipocyte dysfunction and inflammation are needed to more accurately link fat mass with disease risk and mortality [9]. Thus, recognising obesity as a chronic disease, with multifaceted disease processes and complications, is absolutely essential for robust evidence-based management, and fundamental to achieving national NCD targets.

The Lancet Diabetes & Endocrinology Commission has coined the term Clinical Obesity as a chronic, systemic illness characterised by alterations in the function of tissues, organs, the entire individual, or a combination thereof, due to excess adiposity. This accurately underscores the impact of obesity leading to severe end-organ damage, causing life-altering and potentially life-threatening complications [3]. Obesity is a major independent risk factor for type 2 diabetes mellitus, hypertension, dyslipidaemia, atherosclerotic cardiovascular disease, obstructive sleep apnoea, non-alcoholic fatty liver disease, and certain malignancies. Thus, obesity should be recognised as an illness, which is characterised by dysregulation of energy homeostasis involving central appetite pathways, peripheral hormonal signals, adipose tissue inflammation, with the background of genetic susceptibility. Neurohormonal adaptations following weight loss, including reductions in satiety hormones and increases in hunger signals, explain the chronic relapsing nature of obesity and the high rates of weight regain following lifestyle intervention alone [10].

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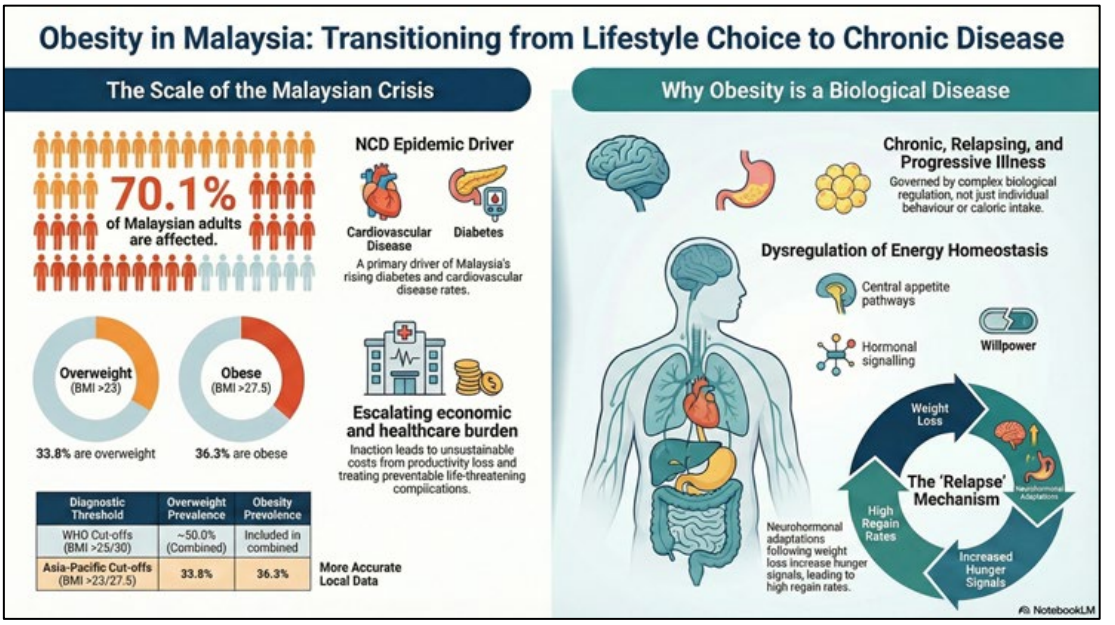

Figure 1 Obesity in Malaysia: Transitioning from Lifestyle Choice to Chronic Disease

Malaysia's obesogenic environment is shaped by easy access to calorie-dense, nutrient-poor foods, cultural norms surrounding eating patterns and relatively poor work-life balances. These promote frequent eating outside the home, high consumption of sugar-sweetened beverages, and long working hours further exacerbate energy imbalance. Additionally, urban design that discourages physical activity, and socioeconomic inequities that limit access to healthier options disproportionately affect lower- and middle-income populations, reinforcing health inequities and perpetuating cycles of chronic disease and reduced productivity.

Despite growing awareness, obesity remains ignored and undertreated in clinical practice. Many individuals living with obesity do not receive formal diagnosis, structured counselling, or access to evidence-based therapies. Weight bias and stigma, both societal and within healthcare settings, further undermine patient engagement, adherence, and outcomes [11]. Recent surveys have highlighted major barriers not only among patients, but also within the healthcare system [11-14]. A large proportion of healthcare practitioners (HCPs) and healthcare decision makers (HCDMs) do not regard obesity as a disease, hold bias against Person with Obesity (PwO) and believe that PwO are responsible for their management of the condition. Therefore, recognising obesity as a disease is critical to improve patient-HCP communication, identify the underlying disease, provide possible support and solutions, and subsequently offer effective treatment options.

The ACTION survey has identified that PwO have attempted some weight loss at a minimum rate of 3x within their lifetime [14]. The progressive nature of obesity would make this almost impossible to most. The management of obesity should be integrated into the primary clinical care. Starting with accurate advice on dietary interventions, there is increasing evidence on the different strategies including calorie restriction, intermittent fasting, the Mediterranean diet, etc. These should be explored with the patient, based on flexibility, adaptability and most importantly sustainability. The Malaysian CPG on the Management of Obesity appropriately recognised obesity as a disease requiring long-term, structured management rather than intermittent, interrupted advice [6]. Lifestyle modifications is also an important element of obesity management, not to be simplified to eat less and move more, but to focus on preventing lean mass loss that accompanies fat loss and overall weight loss. Thus, this should underscore the importance of muscle strengthening exercises in addition to aerobic exercises.

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The therapeutic landscape in obesity management has evolved rapidly. Glucagon-Like Peptide-1 receptor agonist (GLP-1 RA) such as semaglutide and liraglutide, and dual incretin agents combining GLP-1 and glucose-dependent insulinotropic polypeptide (GIP) receptor activity, such as tirzepatide, have demonstrated unprecedented efficacy in weight reduction and metabolic improvement. Randomised controlled trials show mean weight loss exceeding 15–20% with dual incretin therapy, alongside substantial reductions in cardiometabolic risk factors [15]. Importantly, these agents address the biological drivers of obesity by modulating appetite, satiety, and energy intake. In Malaysia, GLP-1 receptor agonists are already widely used for diabetes management, providing a practical platform for expanded obesity treatment. However, access remains limited by cost, reimbursement policies, and lack of formal integration into public sector obesity care pathways. Addressing these barriers is essential to ensure equitable and fair access to healthcare services for all deserving Malaysians.

Obesity imposes a significant economic burden through direct healthcare costs and indirect costs related to productivity loss, disability, and premature mortality [16]. International and regional analyses consistently demonstrate that effective obesity treatment is cost-effective when downstream savings from reduced diabetes, cardiovascular events, renal disease, and hospitalisations are considered [17].

Thus, impactful national obesity strategies in the management of obesity may need to be drastic and aggressive. More importantly, there is urgency to address the whole disease spectrum from awareness campaigns in recognising obesity as a disease, to routine early obesity screening and diagnosis in the primary care setting, no longer seeing obesity as normalcy but identifying it as an urgent healthcare crisis. This should be accompanied by comprehensive multidisciplinary management models, addressing the pathophysiological, emotional, psychological and social aspects of this disease complex. The initiation of the nation-wide multidisciplinary integrated management for obesity (MIMO) services at selected Ministry of Health (MOH) primary care centres as part of the National Strategic planning (NSP) for Obesity 2025-2030 [18] would be a testament for the nation. This would be able to demonstrate that investing in structured obesity management programs could provide a strategic opportunity to halt larger long-term healthcare burden.

In addition, there is a pressing need for policy makers to understand evidence-based outcomes of pharmacotherapy and bariatric surgery that could strengthen the justifications for equitable access of these treatment options. Current policies for obesity have comprehensively covered the fundamental aspects of obesity management i.e. dietary interventions and lifestyle changes [19, 20]. However, with the in-depth understanding of obesity as a chronic progressive, relapsing disease, we must seek more effective interventions. Availability of pharmacotherapy and surgical interventions for selected patients should be looked into to ensure individualisation of appropriate and effective treatment [21]. Failure and even delay to act will likely result in escalating healthcare costs that would far exceed the initial expenses required for early and successful interventions.

To address the other obesity drivers including unhealthy food environments, sedentary lifestyles, stress and lack of sleep, occupational factors etc, all relevant stakeholders should be involved to develop strong and meaningful fiscal and regulatory policies. The WHO investment case, which comprised of economic and political analyses of Malaysia's current and potential interventions in preventing and controlling NCDs, aptly concluded that adoption of a whole-of-system approach to NCDs should be the main priority [22]. All parties must work together to tackle urban planning that promotes physical activity, food environment to ensure affordable healthy nutritious food, and anti-stigma frameworks to be embedded in healthcare trainings. The recommendations highlighted the need to include food security and health equity as national priorities. This would be strengthened by policy recognition of obesity as a disease, which will be fundamental and pivotal to allow insurance coverage, public sector funding, and sustainable service delivery [23].

In summary, obesity in Malaysia is currently at critical level, with profound clinical, societal, and economic consequences. The convergence of rising prevalence, early onset, and expanding therapeutic possibilities present both many challenges and many more opportunities. Reframing obesity as a disease, supported by the growing effective treatment options, integrated care pathways, and robust policy actions

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are essential to reverse current trends. Malaysia stands at a critical juncture. Decisive action today will determine whether obesity continues to drive the nation's NCD crisis or becomes a model for effective, compassionate, and evidence-based chronic disease management in the region and beyond.

REFERENCES

1. World Health Organization. Obesity and Overweight. Geneva: WHO; Updated 2024.
2. World Obesity Federation. Obesity as a Chronic Disease: Position Statement. London: World Obesity Federation; 2017.
3. Rubino F, Cummings DE, Eckel RH, Cohen RV, Wilding JP, Brown WA, Stanford FC, Batterham RL, Farooqi IS, Farpour-Lambert NJ, le Roux CW. Definition and diagnostic criteria of clinical obesity. The Lancet Diabetes & Endocrinology. 2025;13(3):221-62.
4. World Obesity Federation. (2024). Global Obesity Observatory. WHO Western Pacific region. https://data.worldobesity.org/region/who-western-pacific-region-7/#data_prevalence
5. National Health and Morbidity Survey (NHMS) 2023. Ministry of Health Malaysia. https://iku.gov.my/nhms-2023.
6. Clinical Practice Guideline on the Management of Obesity, 2nd Edition (2023). https://mems.my/wp-content/uploads/2023/06/230518_MEMS_CPG-Management-Obesity_FA8-Digital.pdf
7. Technical Report National Health and Morbidity Survey (NHMS) 2022: Adolescent Health Survey, Malaysia. Putrajaya (Malaysia): Ministry of Health Malaysia, 2022.
8. A Fasano. The Physiology of Hunger. Engl J Med 2025; 392: 372-81. DOI: 10.1056/NEJMra2402679.
9. Harbindar JS, Rohana AG, Anis Safura R, Damayanthi D. Revisiting the Name, Definition and Classification of Obesity. J Clin Health Sci. 2024; 9(1): 1-5. https://doi.org/10.24191/jchs.v9i1.25785
10. Swinburn BA, Kraak VI, Allender S, Atkins VJ, Baker PI, Bogard JR, Brinsden H, Calvillo A, De Schutter O, Devarajan R, Ezzati M. The global syndemic of obesity, undernutrition, and climate change: the Lancet Commission report. The lancet. 2019; 393(10173): 791-846.
11. Tham KW, Ahmed A, Boonyavarakul A, Garcia MM, Guajardo M, Hanipah ZN, Nam TQ, Nicodemus Jr NA, Pathan F, Romano JG, Soegonda S. Action APAC: understanding perceptions, attitudes and behaviours in obesity and its management across south and Southeast Asia. Clinical Obesity. 2024; 14(3): e12644.
12. Nor Hanipah, Rohana AG, Mohd Danial MEG. ACTION Malaysia—perception and barriers to obesity management among people with obesity and healthcare professionals in Malaysia. BMC Public Health. (2025); 835: 25: https://doi.org/10.1186/s12889-025-22052-4.
13. Dixon JB, Abdul Ghani R, Sbraccia P. Perceptions of obesity among healthcare professionals and policy makers in 2023: Results of the Global OPEN Survey. Obesity Science & Practice. 2025; 11(1): e70033. https://doi.org/10.1002/osp4.70033.
14. Abdul Ghani R, Mukhtar F, Mohd Yusof BN, Nor Hanipah Z. Perceptions of obesity among healthcare professionals in Malaysia: a subgroup analysis of the OPEN Models of Care survey. BMC Health Services Research. 2025. https://doi.org/10.1186/s12913-025-13867-3.

FOR PROOFREADING

15. Aronne LJ, Horn DB, le Roux CW, Ho W, Falcon BL, Gomez Valderas E, Das S, Lee CJ, Glass LC, Senyucel C, Dunn JP. Tirzepatide as compared with semaglutide for the treatment of obesity. N Engl J Med. 2025; 393(1): 26-36.

16. Tremmel M, Gerdtham UG, Nilsson PM, Saha S. Economic burden of obesity: a systematic literature review. Int J Environ Res Public Health. 2017; 14(4): 435.

17. Lingvay I, Cohen RV, le Roux CW, Sumithran P. Obesity in adults. The Lancet. 2024; 404(10456): 972-87.

18. Chan KJ, Toh M. Health ministry to set up 10 obesity management clinics. Free Malaysia Today. 2025. https://www.freemalaysiatoday.com/category/nation/2025/09/23/health-ministry-to-set-up-10-obesity-management-clinics.

19. National Coordinating Committee on Food and Nutrition. Malaysian Dietary Guidelines 2020. Kuala Lumpur: Ministry of Health Malaysia; 2020.

20. Ministry of Health Malaysia. National Strategic Plan for Non-Communicable Diseases (NSP-NCD) 2016–2025. Putrajaya: MOH Malaysia; 2016.

21. Sinar Harian. KKM perkenal ubat generasi baharu rawat pesakit diabetes, obesiti golongan rentan. 2025.https://www.sinarharian.com.my/article/754290/berita/nasional/kkm-perkenal-ubat-generasi-baharu-rawat-pesakit-diabetes-obesiti-golongan-rentan.

22. Ministry of Health Malaysia. 2024. Prevention and control of noncommunicable diseases in Malaysia. The case for investment. *https://www.moh.gov.my/moh/resources/Penerbitan/Laporan/Umum/NCD_Investment_Case.pdf.*

23. Transforming Health: Malaysia's RM 30 Billion NCD Strategy. World Health Organisation (WHO) Western pacific. Newsroom. https://www.who.int/westernpacific/newsroom/feature-stories/item/transforming-health--malaysia-s-rm-30-billion-ncd-strategy

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ORIGINAL ARTICLE

Utilising pulse wave velocity in assessing arterial stiffness in patients with mild-to-moderate chronic kidney disease

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ABSTRACT

Introduction: Arterial damage in patients with chronic kidney disease (CKD) is characterized by increased arterial stiffness, which is associated with increased cardiovascular risk, particularly seen in elderly patients with advanced CKD. However, arterial stiffness among the young early CKD is not clear. The aim of this study is to investigate the presence of arterial stiffness using pulse wave velocity (PWV) in the younger-age adults with stages 2 to 4 CKD. **Methods:** Eighty-seven patients with stages 2-4 CKD and eighty-seven control subjects with normal renal function participated in the study. Demographic details, comorbidities, risk factors, medications as well as blood samples were collected. Arterial stiffness was determined using carotid-femoral PWV. **Results:** The mean age for CKD patients was 47+5.4 years. CKD patients had a higher mean PWV (7.8+1.7 m/s) compared to control subjects (5.6+1.0 m/s) ($p<0.001$, 95% CI -2.59-1.77). A significant difference in mean PWV was also found between patients with stage 2 CKD (7.6+1.5 m/s) and control subjects (5.6+1.0 m/s) ($p<0.001$, 95% CI -2.40, -1.49). A stepwise increase in PWV corresponding to CKD stages was observed ($p<0.001$). Furthermore, significant differences were seen in mean PWV in CKD patients with diabetes (8.2+1.8 m/s) compared to non-diabetic CKD patients (7.3 + 1.3 m/s) ($p=0.022$, 95% CI -1.50, -0.12). Multiple linear regression analysis revealed pulse pressure as an independent predictor of abnormal PWV ($r2=0.249$, $p<0.001$). **Conclusion:** In summary, arterial stiffness occurs early in younger CKD stage 2 patients. Increased arterial stiffness occurs in parallel with a decline in glomerular filtration rate in patients with mild-to-moderate CKD.

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1. INTRODUCTION

Chronic kidney disease (CKD) contributes significantly to global health issues, particularly to the increased risk of cardiovascular disease. In this regard, arterial stiffness is recognized as an independent predictor for cardiovascular events in patients with CKD [1-4]. Cardiovascular mortality risk increases 30-fold in end-stage renal disease (ESRD) compared to age-adjusted normal population without renal impairment [5]. Increased arterial stiffness has been observed in young patients with end-stage renal disease (ESRD) [6],

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though literature on arterial stiffness in early CKD is lacking, and current reports reveal inconsistent findings. Although several studies report a link between arterial stiffness and early CKD [7-11], numerous other studies mainly in older subjects have found no significant correlation between arterial stiffness and mild-to-moderate CKD [12-14]. The reason for these discrepancies remains unclear. This study, however, investigates arterial stiffness using pulse wave velocity among younger-aged patients with mild-to-moderate CKD, and at the same time determines the risk factors associated with arterial stiffness.

2. MATERIALS AND METHODS

Patients with CKD stages 2 to 4 were recruited from the cardiology clinic, Universiti Teknologi MARA, Sungai Buloh, Malaysia. The inclusion criteria consisted of those aged 18 to 54 years with confirmed CKD, stages 2 to 4, in accordance with the criteria from the Clinical Practice Guidelines for CKD from the National Kidney Foundation–Kidney Disease Outcomes Quality Initiative [estimated glomerular filtration rate (eGFR) >15 to <90 ml/min/1.73m2 derived from CKD Epidemiology Collaboration (CKD-EPI) formula] 15. The exclusion criteria consisted of patients with acute coronary syndrome within three months of study, chronic inflammatory disease, atrial fibrillation, complete heart block, aortic or femoral artery grafts, history of renal transplant, and pregnancy.

The control group was recruited from the family medicine clinic of the same institution, and consisted of only those with normal estimated glomerular filtration rate (eGFR) > 90 ml/min/1.73m2 derived from CKD Epidemiology Collaboration (CKD-EPI) formula, without a history of diabetes mellitus (defined as fasting venous plasma glucose values no greater than 7.0 mmol/L and random glucose values no greater than 11.0 mmol/L, and not on antidiabetic medication), hypertension (defined as systolic blood pressure of < 140 mmHg or and/or diastolic blood pressure of <90 mmHg, and not on any antihypertensive medication), no history of cardiovascular disease events, such as acute coronary syndrome or history of revascularization or positive diagnostic tests (e.g. exercise stress test, dobutamine stress echocardiogram and/or computed tomography angiography), were non-smokers. Comorbidities, concurrent medications, socio-demographic and anthropometric information was collected upon recruitment from all participants. Blood and urine samples were collected from each subject prior to PWV measurement to determine serum creatinine, glycated hemoglobin (HbA1C), total cholesterol, triglyceride, LDL-cholesterol, HDL-cholesterol and urine protein-creatinine ratio (UPCR).

A carotid-femoral PWV (cfPWV) measurement was performed on each patient to assess arterial stiffness. Blood pressure measurement: After at least five minutes of rest, blood pressure was taken using the Omron HBP sphygmomanometer (Model 1120-E, China) while seated and reported as the mean of three measures. Prior to the investigation, and in accordance with the calibration schedule, the Omron HBP T-105 sphygmomanometer was calibrated. blood pressure's systolic (SBP) and diastolic (DBP) differences measurements was used to compute pulse pressure (PP). Mean blood pressure (MAP) was calculated using the formula MAP = DBP+PP/3. For PWV measurement, a skilled medical laboratory technician at the non-invasive cardiac laboratory used the SphygmoCor XCEL PWV + PWA (Model EM4C, Australia) to automatically measure the carotid-femoral PWV, which was used to evaluate arterial stiffness. A thigh blood pressure cuff was applied over the patient's right femoral artery area. The thigh cuff will inflate automatically once a reliable signal from carotid tonometer is detected. Length of the common carotid artery to sternal notch, sternal notch to femoral pulse and femoral pulse to femoral cuff were measured in millimeters. These parameters were recorded into the computerized database. Using an arterial tonometer, transcutaneous recordings of pulse waveforms were performed over the common carotid artery. The PWV was automatically calculated by the PWV device as L/t (in m sec-1), where L is the distance between recording sites recorded over the body's surface and t, the time interval between the pressure wave feet.

Statistical analyses were performed using either t-test, One-Way ANOVA, or Chi-Square testing for categorical variables contained in the Statistical Package for the Social Sciences (SPSS Version 22.0, SPSS Inc., Chicago, IL, USA). Correlations between two continuous variables were analysed using Pearson rho test. For variables that had a significant degree of correlation, simple linear regression analysis was done.

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A multivariate linear regression analysis, which included the variables previously chosen in the linear univariate regression was carried out to assess the variables that were independently linked with PWV. Except where otherwise noted, $p<0.05$ was used as the significance level. Sociodemographic data of the patients are presented as mean + standard deviations, and percentages were used to represent categorical data.

3. RESULTS

Table 1 lists the baseline characteristics of the study population. The mean age of patients with CKD was 47 + 5.4 years. Half (52%) of the CKD patients were obese, class 1 (BMI: 27.5 – 32.4 kg/m2) according to Malaysian Obesity Guidelines 2023 that has adopted Asian population-specific classification (16). Investigation results and medications usage are also shown in Table 1.

Table 1. Sociodemographic, biochemical profile and medication usage of controls and CKD patients

Variables	Controls (n=87)	CKD 2 (n=39)	CKD 3 (n=39)	CKD 4 (n=9)	P-value
Age (years)	45 ± 8	47 ± 6	48 ± 6	48 ± 3	0.422
Male sex (%)	69	97	72	67	0.005
BMI (kg/m^2)	28 ± 3	30 ± 5	29 ± 5	30 ± 6	0.195
SBP (mm/Hg)	120 ± 12	133 ± 17	141 ± 22	152 ± 27	< 0.001
DBP (mm/Hg)	73 ± 8	82 ± 12	82 ± 14	89 ± 11	< 0.001
MAP (mm/Hg)	89 ± 9	99 ± 14	102 ± 16	110 ± 15	< 0.001
PP (mm/Hg)	47 ± 8	51 ± 8	59 ± 13	63 ± 20	< 0.001
HR (bpm)	72 ± 15	69 ± 14	75 ± 12	79 ± 15	0.191
Hypertension (%)	-	95	95	100	0.785
DM (%)	-	41	69	67	0.034
IHD (%)	-	72	62	78	0.498
Smoking (%)	-	62	46	44	0.343
Creatinine (µmol/l)	78 ± 8	106 ± 8	137 ± 24	259 ± 37	< 0.001
eGFR (ml/min per 1.73 m^2)	95 ± 8	72 ± 6	50 ± 7	22 ± 5	< 0.001
HbA1C (%)	6.1 ± 3.1	7.1 ± 2.3 (n=28)	10.0 ± 2.9 (n=24)	8.0 ± 2.7 (n=7)	0.001
Total-C (mmol/l)	4.2 ± 1.2	4.4 ± 1.0	5.0 ± 1.7	5.8 ± 1.4	0.028
TG (mmol/l)	1.6 ± 0.5	1.7 ± 0.8	2.4 ± 1.2	2.6 ± 1.1	0.010
LDL-C (mmol/l)	2.3 ± 1.2	2.6 ± 1.1	2.8 ± 1.4	3.4 ± 0.9	0.344
HDL-C (mmol/l)	1.0 ± 0.2	1.0 ± 0.2	1.1 ± 0.4	1.0 ± 0.2	0.252
UPCR (g/mmol)	0.02 ± 0.05	0.04 ± 0.06	0.15 ± 0.21	0.10 ± 0.16	0.014
Antihypertensive therapy (%)	-	95	95	100	0.785

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Number of antihypertensive	-	2.6 ± 1.2	2.4 ± 1.2	2.7 ± 1.5	0.729
RAS blocker (%)	-	84	87	55	0.071
ACE inhibitor (%)	-	56	58	55	0.999
ARB (%)	-	28	31	0	0.159
CCB (%)	-	39	51	56	0.436
Beta Blocker (%)	-	80	56	56	0.073
Diuretics (%)	-	36	33	67	0.167
Statin (%)	-	97	92	89	0.477

Data are expressed as mean ± SD for the continuous variables and as percentage for categorical variables. Data are analysed using One-Way ANOVA for continuous variables and Chi-Square for categorical variables.
ACE = angiotensin-converting enzyme; ARB = angiotensin-receptor blocker; BMI = body mass index; C = cholesterol; CCB = calcium-channel blocker; CKD = chronic kidney disease; DBP = diastolic blood pressure; DM = diabetes mellitus; eGFR = estimated glomerular filtration rate; HbA1C = glycated haemoglobin; HDL = high density lipoprotein; HR = heart rate; IHD = ischaemic heart disease; LDL = low density lipoprotein; PP = pulse pressure; RAS= renin-angiotensin system; SBP = systolic blood pressure; TG = triglyceride; UPCR = urine protein-creatinine ratio

Source: Ahmad Bakhtiar Md Radzi (2026)

Renin-angiotensin system (RAS) blockers including ACE inhibitors or angiotensin receptor blockers (ARBs), calcium-channel blockers, beta-adrenergic blockers, and diuretics were among the anti-hypertensive drugs taken by CKD patients. A comparison of 87 individuals with stages 2-4 CKD and 87 control participants with normal renal function was made. The CKD group's mean PWV was significantly greater than that of the control group, indicating increased arterial stiffness in the former (Table 2).

Table 2. PWV between control and CKD stage 2-4 patients

Variables	**Control (n=87)**	**CKD 2-4 (n=87)**	**P-value**
PWV (m/s)	5.6 ± 1.0	7.8 ± 1.7	< 0.001

Data are expressed as mean + SD for the continuous variables and as percentage for categorical variables. Data are analysed using independent T-test for continuous variables and Chi-Square for categorical variables.

Source: Ahmad Bakhtiar Md Radzi (2026)

The box-plot analysis in Figure 1 ($p<0.001$) shows a gradual rise in PWV from control subjects (5.6 + 1.0 m/s), CKD stage 2 (7.6 + 1.5 m/s), stage 3 (7.8 + 1.8 m/s), and stage 4 (9.0 + 0.8 m/s) (Table 3). There was a significant difference in the mean PWV between stage 2 CKD patients and controls ($p<0.001$, 95% CI -2.40,-1.49). In stages 2 - 4 CKD, the mean PWV was significantly different between diabetic (8.2 + 1.8 m/s) and non-diabetic (7.3 + 1.3 m/s) populations ($p<0.05$, 95% CI -1.50,-0.12). Age, MAP, PP, and eGFR were significantly and positively associated with PWV among patients with stages 2-4 CKD (Table 4). Only PP was found to be independently linked with PWV ($r2=0.078$; $p<0.05$) in the multivariate analysis using multiple linear regression ($r2=0.248$; $p<0.001$) (Figure 2).

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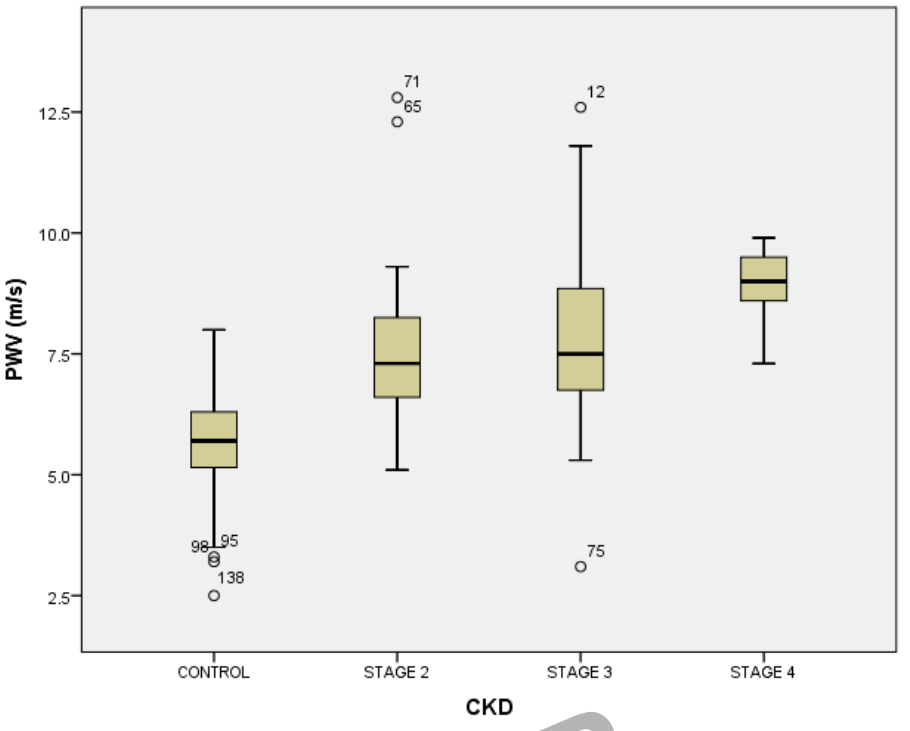

Fig.1 PWV between control and CKD stage 2-4 patients

Source: Ahmad Bakhtiar Md Radzi (2026)

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Table 3. Mean of PWV between control and CKD stage 2-4 patients

Variables	Control (n=87)	CKD Stage 2 (n=39)	CKD Stage 3 (n=39)	CKD Stage 4 (n=9)	P-value
PWV (m/s)	5.6 ± 1.0	7.6 ± 1.5	7.8 ± 1.8	9.0 ± 0.8	<0.001

Source: Ahmad Bakhtiar Md Radzi (2026)

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Table 4. Factors associated with PWV (m/s) among CKD stage 2-4 patients (n=87) using simple and multiple linear regression

Variable	SLR[α]				MLR[b]	
	β	r^2	95% CI	p-value	β	p-value
Age (year)	0.066	0.048	0.00, 0.13	0.042	0.042	0.186
MAP (mmHg)	0.033	0.087	0.01, 0.06	0.006	0.008	0.556
Pulse pressure (mmHg)	0.060	0.219	0.31, 0.08	<0.001	0.045	0.009
BMI	0.021	0.004	-0.05, 0.09	0.564	-	-
eGFR (ml/min per 1.73m^2)	-0.027	0.079	-0.04, -0.01	0.008	-0.011	0.276
LDL (mmol/l)	0.135	0.010	-0.18, 0.45	0.400	-	-
TG (mmol/l)	0.014	0.000	-0.33, 0.36	0.936	-	-
Hba1C (%)	0.016	0.001	-0.13, 0.16	0.836	-	-
UPCR (g/mmol)	0.777	0.006	-1.58, 3.14	0.514	-	-

α = Simple linear regression (Outcome as PWV m/s)
b = Multiple linear regression (Outcome as PWV m/s), r^2=0.248, p<0.001
β = crude regression coefficient
Source: Ahmad Bakhtiar Md Radzi (2026)

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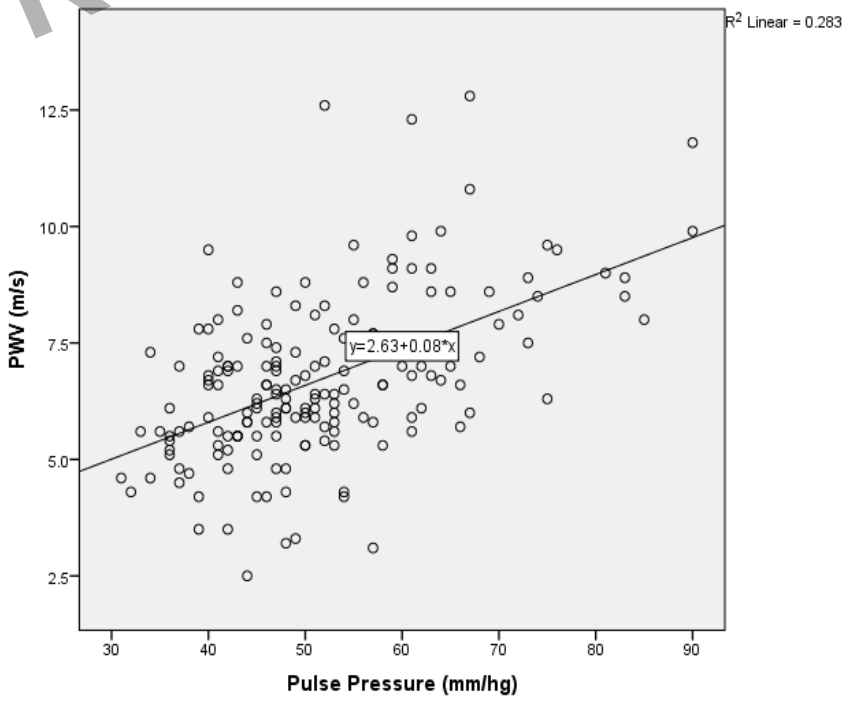

Fig 2. Correlation between PWV and PP in CKD stage 2-4 patients

Source: Ahmad Bakhtiar Md Radzi (2026)

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4. DISCUSSION

In this study, increased arterial stiffness, as determined by measurement of PWV, was observed in younger age patients from as early as stage 2 CKD. Our findings are in line with earlier reports, mostly from studies on older CKD patients, that had reported a link between elevated central arterial stiffness and decreased creatinine clearance. A study on a group of 150 CKD patients (65 + 11 years), e.g. showed higher adjusted PWV than that in healthy individuals, regardless of disease stage [7]. Another study in patients with a mean age of 58.4 + 14.9 years, found that stiffness of the aorta, as measured by cfPWV, was considerably higher in mild-to-moderate CKD patients (GFR<60 ml/min/1.73m2 calculated using MDRD) than that in hypertensive and normotensive participants by 7% and 19% respectively [8]. Furthermore, aortic stiffness (cfPWV) was correlated independently with the pace of renal function decrease in a sample of 120 individuals aged 69 + 12 years with CKD stages 3 and 4 [10]. In another study of 1290 participants (49 + 11 years) with a mixed group of normal and impaired kidney function, individuals in the lowest tertile of kidney function (creatinine clearance 68.5 + 15.6 mL/min/1.73 m2) demonstrated an inverse relationship between creatinine clearance and aortic PWV [11]. The results showed that elevated arterial stiffness manifests early in CKD patients, which is consistent with our study's findings in a cohort of comparatively younger CKD participants.

Our findings are consistent with those in the literature that indicate a link between arterial stiffness and mild-to-moderate CKD. However, some researchers have reported inconsistent findings regarding the relationship between arterial stiffness and renal function. For instance, the Framingham Heart Study, which included 2680 people, found no link between PWV and a decline in eGFR in people with mild-to-moderate chronic kidney disease (defined as having an eGFR of less than 60 ml/min per 1.73 m2) [12]. Most of the participants in this study were community-dwelling people with stage 3 CKD and a mean age of 70. Similar results were found in the Hoorn Study, which found no significant difference in PWV between patients with an eGFR of less than 56 ml/min/1.73 m2 and those with greater 56 ml/min/1.73 m2 [13]. The participants in this study were senior individuals with diabetes, and cfPWV was not used to measure arterial stiffness. Carotid-femoral transit time, which measures aortic (thoracic-abdominal) compliance, was used to quantify aortic stiffness instead. Another study with 913 patients aged 62.5 ± 10 years found that after controlling for various confounders, arterial stiffness, measured using cfPWV and brachial-ankle PWV (baPWV), was not associated with lower eGFR in populations with relatively preserved kidney function (estimated GFR 30 mL/min/1.73 m2) [14].

Overall, discrepancies in research populations, notably disparities in the groups of CKD patients, could partially account for the contradictory results between these studies including our investigation. Our study's findings, which are in line with those of research involving older CKD patients, indicate a stepwise increase in PWV from control normal to CKD stage 2 through stage 4 patients. BaPWV increased progressively with CKD progression from stages 1 through to stage 5 according to a Japanese study that looked at the association between eGFR and the severity of arterial stiffness in the population [17]. Similarly, a Taiwanese study revealed a stepwise increase in PWV from CKD stage 1 through to stage 5, but did not find a significant difference in PWV between patients in CKD stages 3, 4 and 5 [9]. Another study also demonstrated similar stepwise results but did not observe any further increases in PWV from CKD stages 4, 5 to CKD 5D (dialysis) [7]. According to Mourad et al. (2001) [11] only the lowest tertile group of patients with normal and elevated blood pressure (eGFR 68.5 + 15.6 ml/min per 1.73 m2), but not the intermediate tertile group (eGFR 89.4 + 17.4 ml/min per 1.73 m2) demonstrated a strong inverse relationship between PWV and creatinine clearance [11]. There was a tendency of little to no progression of PWV at stages 3, 4 and above. A definite conclusion cannot be made regarding the increment of PWV as renal function declines, which therefore warrants a larger prospective study to address this theory. When compared to patients with normal renal function, people with CKD stages 3 and above have a two-fold greater mortality rate from cardiovascular disease [18].

In the present study, stiffening of the arteries was noted to occur as early as stage 2 CKD. Therefore, CKD stage 2 may be considered as a non-traditional risk marker for cardiovascular event and should be

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considered in high-risk individuals for primary prevention. One of the risk factors for the onset of arterial stiffness in the early stages of CKD may be the micro uremic milieu although significant uremia only becomes apparent in the later stages of CKD. Some of the suggested causes for increased arterial stiffness in CKD patients include chronic inflammation, elevated oxidative stress, abnormalities of calcium-phosphate metabolism, activation of the renin angiotensin system, and fluid volume retention [19-20]. High carotid-femoral PWV in young adults also correlated with other vascular indicators such as augmentation index (AIx), carotid intima media thickness (CIMT), and C-reactive protein (CRP), which may have contributed to the above-mentioned probable mechanisms [21].

4.1 Study Limitations

The current study has certain limitations. It mainly focused on mild-to-moderate CKD population with diabetes mellitus and hypertension in which it compared these patients with those with normal renal function who are non-diabetic and normotensive. This does partly contribute to the confounding variables and makes it a little difficult to directly link the increasing PWV with kidney disease. Ideally, the inclusion of a group with patients who were hypertensive and diabetic but without kidney disease would have been useful to clearly establish the effect of renal disease per se on PWV. Nevertheless, multivariate analysis did show significant link between renal disease and PWV, after considering these variables.

The other limitation was that the number of patients with stage 4 CKD was relatively small compared to that with stage 2 and 3 CKD patients. Besides that, the study participants were recruited from a single centre, which may introduce a sampling bias. Patients on antihypertensive medications may have also affected the mean arterial pressure measurements and thus influenced the overall results. Finally, with GFR values of 60 ml/min/1.73 m2 or higher, the precision of GFR based on creatinine may not be accurate. Future research that calculates the GFR using a more precise and trustworthy marker, such as plasma cystatin C levels, is, therefore necessary.

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5. CONCLUSION

This study revealed that arterial stiffness becomes evident in the younger-age CKD patients with hypertension and diabetes from as early as stage 2 CKD. Increased arterial stiffness occurs in parallel with a decline in glomerular filtration rate in patients with mild-to-moderate CKD. Whether the changes in PWV in patients with CKD are exaggerated in the presence of hypertension and diabetes remains to be clearly established.

6. ACKNOWLEDGEMENTS/FUNDING

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7. CONFLICT OF INTEREST

Authors declare none.

8. AUTHORS' CONTRIBUTION

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

9. ETHICS STATEMENT

The study was approved by the institutional research ethics committee (600-RMI-5/1/6) and written informed consents were received from all participants.

10. REFERENCES

1. Blacher, J., Guérin, A. P., Pannier, B., Marchais, S. J., Safar, M. E., & London, G. M. (1999). Impact of aortic stiffness on survival in end-stage renal disease. *Circulation, 99*(18), 2434–2439. https://doi.org/10.1161/01.CIR.99.18.2434

2. Laurent, S., Boutouyrie, P., Asmar, R., Gautier, I., Laloux, B., Guize, L., Ducimetiere, P., & Benetos, A. (2001). Aortic stiffness is an independent predictor of all-cause and cardiovascular mortality in hypertensive patients. *Hypertension, 37*(5), 1236–1241. https://doi.org/10.1161/01.HYP.37.5.1236

3. Meaume, S., Benetos, A., Henry, O. F., Rudnichi, A., & Safar, M. E. (2001). Aortic pulse wave velocity predicts cardiovascular mortality in subjects >70 years of age. *Arteriosclerosis, Thrombosis, and Vascular Biology, 21*(12), 2046–2050. https://doi.org/10.1161/hq1201.100226

4. London, G. M., Pannier, B., Marchais, S. J., & Guerin, A. P. (2013). Vascular calcifications, arterial aging and arterial remodelling in ESRD. *Blood Purification, 35*(1–3), 16–21. https://doi.org/10.1159/000345172

5. Foley, R. N., Parfrey, P. S., & Sarnak, M. J. (1998). Clinical epidemiology of cardiovascular disease in chronic renal disease. *American Journal of Kidney Diseases, 32*(5, Suppl 3), S112–S119.

6. Blacher, J., Safar, M. E., Guérin, A. P., Pannier, B., Marchais, S. J., & London, G. M. (2003). Aortic pulse wave velocity index and mortality in end-stage renal disease. *Kidney International, 63*(5), 1852–1860. https://doi.org/10.1046/j.1523-1755.2003.00932.x

7. Temmar, M., Liabeuf, S., Renard, C., Czernichow, S., Esper, N. E., Shahapuni, I., Presne, C., Makdassi, R., Andrejak, M., Tribouilloy, C., Galan, P., Safar, M. E., Choukroun, G., & Massy, Z. (2010). Pulse wave velocity and vascular calcification at different stages of chronic kidney disease. *Journal of Hypertension, 28*(1), 163–169. https://doi.org/10.1097/HJH.0b013e328331b81e

8. Briet, M., Bozec, E., Laurent, S., Fassot, C., London, G. M., Jacquot, C., Boutouyrie, P., & others. (2006). Arterial stiffness and enlargement in mild-to-moderate chronic kidney disease. *Kidney International, 69*(2), 350–357. https://doi.org/10.1038/sj.ki.5000047

9. Wang, M.-C., Tsai, W.-C., Chen, J.-Y., & Huang, J.-J. (2005). Stepwise increase in arterial stiffness corresponding with the stages of chronic kidney disease. *American Journal of Kidney Diseases, 45*(3), 494–501. https://doi.org/10.1053/j.ajkd.2004.11.011

10. Ford, M. L., Tomlinson, L. A., Chapman, T. P., Rajkumar, C., & Holt, S. G. (2010). Aortic stiffness is independently associated with rate of renal function decline in chronic kidney disease stages 3 and 4. *Hypertension, 55*(5), 1110–1115. https://doi.org/10.1161/HYPERTENSIONAHA.109.143024

11. Mourad, J.-J., Pannier, B., Blacher, J., Rudnichi, A., Benetos, A., London, G. M., & Safar, M. E. (2001). Creatinine clearance, pulse wave velocity, carotid compliance and essential hypertension. *Kidney International, 59*(5), 1834–1841. https://doi.org/10.1046/j.1523-1755.2001.0590051834.x

FOR PROOFREADING

12. Upadhyay, A., Hwang, S.-J., Mitchell, G. F., Vasan, R. S., Vita, J. A., Stantchev, P. I., Meigs, J. B., Larson, M. G., Levy, D., Benjamin, E. J., & Fox, C. S. (2009). Arterial stiffness in mild-to-moderate CKD. *Journal of the American Society of Nephrology, 20*(9), 2044–2053. https://doi.org/10.1681/ASN.2009010074

13. Hermans, M. M. H., Henry, R., Dekker, J. M., Kooman, J. P., Kostense, P. J., Nijpels, G., Heine, R. J., & Stehouwer, C. D. A. (2007). Estimated glomerular filtration rate and urinary albumin excretion are independently associated with greater arterial stiffness: The Hoorn Study. *Journal of the American Society of Nephrology, 18*(6), 1942–1952. https://doi.org/10.1681/ASN.2006111217

14. Kim, C. S., Kim, H. Y., Kang, Y. U., Choi, J. S., Bae, E. H., Ma, S. K., & Kim, S. W. (2014). Association of pulse wave velocity and pulse pressure with decline in kidney function. *The Journal of Clinical Hypertension, 16*(5), 372–377. https://doi.org/10.1111/jch.12302

15. National Kidney Foundation. (2002). *K/DOQI clinical practice guidelines for chronic kidney disease: Evaluation, classification, and stratification*. *American Journal of Kidney Diseases, 39*(2, Suppl 1), S1–S266. https://www.kidney.org/professionals/kdoqi

16. Ministry of Health Malaysia. (2023). *Clinical practice guidelines: Management of obesity* (2nd ed.). https://mems.my/wp-content/uploads/2023/06/230518_MEMS_CPG-Management-Obesity_FA8-Digital.pdf

17. Nakagawa, N., Takahashi, F., Chinda, J., Kobayashi, M., Hayashi, Y., Abe, M., Saijo, Y., Kikuchi, K., & Hasebe, N. (2008). A newly estimated glomerular filtration rate is independently associated with arterial stiffness in Japanese patients. *Hypertension Research, 31*(2), 193–201. https://doi.org/10.1291/hypres.31.193

18. Catapano, A. L., Graham, I., De Backer, G., Wiklund, O., Chapman, M. J., Drexel, H., Hoes, A. W., Jennings, C. S., Landmesser, U., Pedersen, T. R., Reiner, Ž., Riccardi, G., Taskinen, M.-R., Tokgozoglu, L., Verschuren, W. M. M., Vlachopoulos, C., Wood, D. A., & Zamorano, J. L. (2016). 2016 ESC/EAS Guidelines for the Management of Dyslipidaemias. *European Heart Journal, 37*(39), 2999–3058. https://doi.org/10.1093/eurheartj/ehw272

19. Pannier, B., Guérin, A. P., Marchais, S. J., Safar, M. E., & London, G. M. (2005). Stiffness of capacitive and conduit arteries: Prognostic significance for end-stage renal disease patients. *Hypertension, 45*(4), 592–596. https://doi.org/10.1161/01.HYP.0000159190.71253.c3

20. Ma, Y., Zhou, L., Dong, J., Zhang, X., & Yan, S. (2015). Arterial stiffness and increased cardiovascular risk in chronic kidney disease. *International Urology and Nephrology, 47*(7), 1157–1164. https://doi.org/10.1007/s11255-015-1009-x

21. Gusbeth-Tatomir, P., & Covic, A. (2007). Causes and consequences of increased arterial stiffness in chronic kidney disease patients. *Kidney and Blood Pressure Research, 30*(2), 97–107. https://doi.org/10.1159/000100905

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ORIGINAL ARTICLE

Knowledge of Chronic Kidney Disease Management among Primary Healthcare Doctors: A Cross-Sectional Study

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ABSTRACT

Introduction: The prevalence of chronic kidney disease (CKD) is increasing worldwide including in Malaysia. Primary healthcare professionals are required to have sufficient knowledge in all aspects of CKD management. The study aims to determine the level of knowledge on chronic kidney disease and management, its associated factors, and to describe the practice of chronic kidney disease management among public primary healthcare providers in Kelantan. **Methods:** This was a cross-sectional study using an online self-administered questionnaire involving purposively sampled medical officers working at the health clinics in the Ministry of Health. The questionnaire assessed knowledge of CKD definition, risk factors, complications, investigations, and management. Descriptive statistics and multivariate analysis were used to determine factors associated with knowledge level. **Results:** One hundred seventy-nine primary healthcare providers in Kelantan participated in this study. The mean score for knowledge among primary healthcare providers was 71.6% (SD= 13.5). Most participants were able to identify the risk factors of CKD correctly. Previous exposure to CKD management training (p= 0.004; 95% CI: -9.49, -1.79%) and use of clinical practice guidelines (p< 0.001; 95% CI: -13.91, -4.17%) were significantly associated with knowledge. Some practices among the participants were discordant with the guidelines. More than three-quarters (n=137) of participants used serum creatinine as the initial screening test for CKD, whereas only 47.5% (n=85) screened for anaemia among CKD patients. **Conclusion:** Previous exposure to training and usage of guidelines were significant associated factors for the level of knowledge. Educational activities and the availability of guidelines in clinical practice are important to improve the quality of care among healthcare professionals.

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INTRODUCTION

Chronic kidney disease (CKD) is a significant global health burden, affecting an estimated 850 million people worldwide. The increasing prevalence of CKD has been attributed to the growing incidence of diabetes mellitus and hypertension, the two leading causes of CKD globally and in Malaysia [1,2]. This is worrying as CKD is a disease that not only affects one's health but also financially burdens the patient, the close family members, and the country [3,4]. With the rise in these conditions, the need for effective CKD management, especially at the primary care level, has become more critical. A comprehensive understanding of CKD among healthcare providers is essential for early detection and intervention, which can significantly reduce the progression of the disease and improve patient outcomes.

Despite the importance of CKD management, studies have shown that knowledge levels among healthcare providers vary widely. A study conducted among internal medicine residents at United States found that there were gaps in knowledge on CKD among the internal medicine residents [5]. In addition, this also applied to general practitioners, non-nephrology specialists and family medicine residents [6,7].

In Malaysia, a study conducted by Loo et al. (2022) revealed that both undergraduate and postgraduate students had gaps in their knowledge of CKD, particularly in areas related to disease staging and risk factors [8]. This lack of knowledge is concerning, as it can lead to suboptimal patient care and delayed referrals to specialists, ultimately worsening patient outcomes. Similarly, a study by Ng et al. (2016) among medical outpatient clinic patients highlighted the need for better education and training for healthcare providers to improve CKD management in primary care settings [9]. Despite these findings, there are still gaps in research regarding recent knowledge and practice of CKD management among primary health care professionals working in health clinics under the Ministry of Health which are the backbone of primary health care in Malaysia.

Primary healthcare providers (PHCPs) in Malaysia especially those working under the Ministry of Health play a crucial role in managing CKD due to the limited number of nephrologists available in the country. With a ratio of 1 nephrologist to 197,450 patients, the burden of CKD management falls heavily on PHCPs [10]. As such, these providers must be equipped with the necessary knowledge and skills to diagnose and manage CKD effectively. This study aims to assess the knowledge and practices related to CKD management among PHCPs working in the health clinics in Kelantan, Malaysia, and to identify factors that may influence their knowledge levels.

The findings of this study are expected to provide valuable insights into the current state of CKD management in primary care settings in Malaysia. By identifying knowledge gaps and associated factors, the study can inform future educational interventions and policy changes to improve CKD care. Moreover, understanding the practices of PHCPs in managing CKD will help in developing targeted strategies to enhance adherence to clinical practice guidelines and improve patient outcomes.

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MATERIALS AND METHODS

This cross-sectional study assessed the knowledge and practices related to chronic kidney disease (CKD) management among primary healthcare providers (PHCPs) in Kelantan, Malaysia. The study utilized a self-administered online English questionnaire for data collection, targeting PHCPs working in government health clinics within the state.

The study population consisted of medical officers fully registered with the Malaysian Medical Council (MMC) and working in health clinics under the Ministry of Health in Kelantan regardless of duration of service. This includes those under training for the family medicine specialty. The exclusion criteria included medical officers working in clinics without outpatient departments, family medicine specialists, and those performing purely administrative duties. Family medicine specialists (FMSs) might distort the results due to their advanced knowledge, while medical officers (MOs) in charge of administrative duty are excluded because their limited clinical work may result in lower knowledge levels.

The study was conducted between February 17, 2021, and March 25, 2021.

Sampling was carried out in two stages. Simple random sampling was first used to select districts within Kelantan. The selected districts were Kota Bharu, Pasir Mas, Pasir Puteh, Kuala Krai, and Machang. Convenience sampling was then applied within these districts to select participants. Due to the constraints posed by the COVID-19 pandemic and the implementation of movement control orders, the originally planned paper-based survey was shifted to an online format.

The sample size for this study was calculated based on the study objectives, with the largest sample size required derived from the second objective, which aimed to identify socio-demographic and health service-related factors associated with CKD knowledge among PHCPs. The calculations were performed using the Power and Sample Size Calculation software (Dupont and Plummer, 2009)[11], with alpha value of 0.05, power set at 0.8 and detectable difference of 6.5. The standard deviation (SD) of 12.9 was taken form the SD gender differences taken from our pilot study and the ratio of female to male participants (m) set 3:1. The calculated sample size for this objective was 168. After considering a 20% non-response rate, the final sample size required was 202 participants.

Data were collected through a self-administered online English questionnaire designed specifically for this study. The questionnaire consisted of three main sections: socio-demographic information, details of health service, and assessments of CKD knowledge and practices. The first component was knowledge on CKD, which consists of 18 items to assess the knowledge on definition (2 items), staging of CKD (2 items), risk factors (8 items), complications (2 items), investigations (2 items) and management of patient with CKD (2 items). Participants were instructed to answer the statements with True/False or Unsure. 1 point was given for each correct answer and no marks were given if they answered wrongly or as 'unsure'. The maximum knowledge score was 18 marks. The knowledge score was calculated in the percentage format, with the numerator being the sum of correct responses and the denominator being the total number of items (i.e. 18). The practice assessment section included 12 items focusing on CKD management, including the frequency of relevant investigations, management practices, and timing of referrals. Responses in this section were rated on a scale of Never, Sometimes, or Always.

The development of the questionnaire involved several stages to ensure validity and reliability. Initially, the questionnaire was designed based on the Malaysian Clinical Practice Guidelines (CPG) on CKD (2018) to ensure content validity. The content of the CPG is considered valid for up to 5 years. Expert opinions were sought from three family medicine specialists to validate the content further. Face validity was conducted with six master's students in family medicine, leading to minor adjustments in wording for clarity. A pilot study involving 57 healthcare providers from the outpatient department of Hospital Universiti Sains Malaysia was conducted to assess the construct validity and reliability of the questionnaire. The participants were not included in the actual study. The Cronbach's Alpha value for the knowledge section was 0.618, indicating acceptable internal consistency. Due to pandemic-related restrictions, the final version of the questionnaire was administered online using Google Forms.

Data collection occurred over two months. An email containing a link to the online questionnaire and an ethics approval letter was sent to the administrative offices of the selected district health offices (Pejabat Kesihatan Daerah, PKD). Study information and inclusion criteria were communicated to family health coordinators, who then disseminated the questionnaire link to the eligible medical officers in their respective districts through the clinic's group email and WhatsApp. Consent for the study was also included on the first page of the Google form. Participation was voluntary, and confidentiality was maintained by not recording any personal identifiers.

The data retrieved from the online responses were entered into SPSS version 23 for analysis. Descriptive statistics were used to summarize the data. Categorical variables were presented as frequencies and percentages, while continuous variables were described using means and standard deviations for normally distributed data or medians and interquartile ranges for skewed data. To identify socio-demographic and health service-related factors associated with CKD knowledge, simple linear regression was first employed to screen variables, followed by multiple linear regression to adjust for potential confounders. All variables with p-value less than 0.1 and clinically important variables were included in Multiple Linear Regression. The p value was set as such for screening variables in simple linear regression

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before being selected into the subsequent analysis of multiple linear regression. The level of significance was set at 0.05 for all analyses.

Ethical approval for the study was obtained from the Human Research Ethics Committee (HREC) of USM (JEPeM Code: USM/JEPeM/19080461) and the Medical Research & Ethics Committee (MREC) of the Ministry of Health Malaysia (Research ID: NMRR-19-3654-50055). Participants provided informed consent before participating in the study, and all data were handled with strict confidentiality.

RESULTS

One hundred and seventy-nine participants consented to participate in this study. The study involved mostly Malay healthcare providers (95.5%). The participants' mean (SD) age was 33.9 (4.6) years, with the age range being 27.7 years to 52.5 years old. Mean (SD) duration of working experiences was 8.60 (5.00) years. The mean (SD) number of clinic consultations seen per day by the participants was 28.0 (9.4) cases. Most of the participants used clinical practice guidelines (CPG) regarding CKD in their practice (81.0%). Almost half of the responders did not attend any related training activities or courses to the CPG CKD (44.7%) (Table 1).

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Table 1 Characteristics of study participants (n=179)

Variables	Mean (SD)	n (%)
Socio-demographic data		
Age (year)*	33.9 (4.6)	
Sex		
Male		34 (19.0)
Female		145 (81.0)
Race		
Malay		171 (95.5)
Non-Malay		8 (4.5)
Marital Status		
Married		152 (84.9)
Single/Divorced/Widowed		27 (15.1)
Health Service Factors		
Type of Health Clinics		
Clinic without FMS		74 (41.3)
Clinic with FMS		105 (58.7)
Working Experiences (years)	8.6 (5.0)	
Number of cases seen per day	28.0 (9.4)	
Previous exposure to training		
No		80 (44.7)
Yes		99 (55.3)
Awareness of CPG CKD 2018		
No		15 (8.4)
Yes		164 (91.6)
Use of CPG CKD 2018		
No		34 (19.0)
Yes		145 (81.0)
Attended TOT course		
No		153 (85.5)
Yes		26 (14.5)

*one missing data

The mean score on the CKD knowledge questionnaire was 71.6 % (SD = 13.5). The minimum score was 33.3 % and the maximum score was 100%. Less than half of the participants were able to define

CKD correctly; 49.2% of them correctly answered that a patient is diagnosed to have CKD when he/she has persistent proteinuria for more than 3 months despite normal estimated glomerular flow rate (eGFR), while only 40.2% of the participants knew that the item K1b: "A patient is diagnosed to have CKD when his/her eGFR is less than 60ml/min/1.73m^2 regardless of duration" is a wrong statement (Table 2).

Table 2 Knowledge of chronic kidney disease management (n = 179)

Knowledge score		Mean (SD) 71.6 (13.5)		
Knowledge	Items		Correct answers n	(%)
	K1	**A patient is diagnosed to have CKD when:**		
Definition of CKD	K1a	he/she has persistent proteinuria > 3 months despite normal eGFR (estimated glomerular flow rate).	88	49.2
	K1b	his/her eGFR is less than 60ml/min/1.73m2 regardless of duration.	72	40.2
	K2	**Regarding staging of CKD:**		
Staging of CKD	K2a	It categorized into 4 stages based on eGFR.	161	89.9
	K2b	Persistent eGFR 30-59ml/min/1.73m^2 is categorized as Stage 3 CKD.	164	91.6
	K3	**The following is/are risk factor(s) of CKD:**		
	K3a	Hypertension	179	100.0
	K3b	Diabetes mellitus	179	100.0
	K3c	Pregnancy	140	78.2
Risk factor of CKD	K3d	Obesity	117	65.4
	K3e	Age > 65 years old	151	84.4
	K3f	Long term use of proton-pump inhibitors	94	52.5
	K3g	Autoimmune disease	162	90.5
	K3h	Gout	160	89.4
	K4	**The following is/are potential complication(s) of CKD:**		
Complication of CKD	K4a	Anaemia	175	97.8
	K4b	Hypercalcemia and hypophosphatemia	85	47.5
	K5	**Regarding investigations of CKD:**		
Investigations of CKD	K5a	Patients with type 2 diabetes without evidence of microalbuminuria should be tested for microalbuminuria every 6 months.	33	18.4
	K5b	Testing on serum creatinine alone is adequate to assess renal function.	156	87.2
	K6	**Regarding management of CKD:**		
Management of CKD	K6a	The targeted BP for patient with proteinuria (≥1g/day) is ≤140/90mmHg.	105	58.7
	K6b	Asymptomatic patient at CKD stage 4 requires renal replacement therapy referral.	86	48.0

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Most of the participants were able to classify CKD correctly. The majority were able to recognize that persistent eGFR 30-59ml/min/1.73m^2 is categorized as Stage 3 CKD. All participants answered correctly that hypertension and diabetes mellitus were risk factors for CKD, but only 52.5% of participants knew long-term use of proton-pump inhibitors is one of the risk factors of CKD.

The items that the participants scored poorly include questions regarding the frequency of rechecking for microalbuminuria in patients with diabetes mellitus without evidence of microalbuminuria (18.4%). Only about half of the participants were able to answer questions regarding CKD management correctly; 58.7% of them knew that the targeted blood pressure (BP) for patients with heavy proteinuria is not lesser or equal to 140/90 mmHg, and 48% of them answered correctly that asymptomatic patient at CKD stage 4 requires renal replacement therapy referral (Table 2).

A multiple regression analysis was performed following simple regression analysis to analyze the associated factor for knowledge score (Table 3). There is a significant linear relationship between previous exposure to CKD management training and knowledge level of chronic kidney disease (p=0.004). Those without previous exposure have a knowledge level reduced by 5.64% (95% CI: -9.49, -1.79 %). There is a significant linear relationship between the usage of the clinical practice guideline on CKD and the knowledge level of chronic kidney disease (p<0.001). Those who do not practice the CPG CKD 2018 have a knowledge level reduced by 9.05% (95% CI: -13.91, -4.17 %). With these 2 significant variables, the model explains 13% of the variation of the knowledge score on CKD in the study sample (R^2=0.13).

Table 3 Factors associated with knowledge on CKD

Independent Variable	SLR[a]				MLR[b]				
	b[c]	95%	CI	p-value	*Adj. B*[d]	95%	CI	t-stat	p-value
Age(years)	0.46	0.03	0.899	0.035	-	-	-	-	-
Gender: Male	-2.66	-7.77	2.44	0.305	-	-	-	-	-
Race: Malay	-9.37	-19.00	0.25	0.056	-	-	-	-	-
Marital Status: Married	3.87	-1.71	9.46	0.173	-	-	-	-	-
Type Of Health Clinic: Clinic Without Family Medicine Specialist	-1.12	-5.19	2.96	0.589	-	-	-	-	-
Working Experience (Including housemanship) (months)	0.04	0.01	0.07	0.009	-	-	-	-	-
Number Of Cases Seen Per Day	-.0002	-0.216	0.212	0.987	-	-	-	-	-
Previous Exposure to CKD Management Training: No	-7.17	-11.06	-3.27	<0.001	-5.64	-9.49	-1.79	-2.89	0.004
Aware Of CPG CKD 2018: No	-9.02	-16.15	-1.90	0.013	-	-	-	-	-
Use Of CPG CKD 2018: No	-10.53	-15.40	-5.65	<0.001	-9.05	-13.91	-4.17	-3.67	<0.001
Attended Training of Core Trainer (TOT) CPG CKD 2nd Edition: No	-7.23	-12.83	-1.63	0.012	-	-	-	-	-

[a] Simple linear regression. [b] Multiple linear regression (R^2=0.13; The model reasonably fits well; Model assumptions are met; There is no interaction between independent variables, and no multicollinearity problem. Variables in final model were selected via backward selection). [c] Crude regression coefficient. [d] Adjusted regression coefficient. constant: 75.77

The result of the practice section is as illustrated in Table 4. In terms of practice, the majority (76.5%) reported ordering serum creatinine for initial screening of CKD, with only 7.3% of participants not utilizing this as an initial test. For diabetic patients, only 46.4% of participants indicated that they would request an albumin: creatinine ratio test for microalbuminuria when the initial urine dipstick was negative for protein.

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Table 4 CKD practice test items

Practice domain		Items	Always		Sometimes		Never	
			n	(%)	n	(%)	n	(%)
Investigation used to screen for CKD	**1**	**Regarding investigations on CKD:**						
	a)	I order serum creatinine as initial screening test.	137	(76.5)	29	(16.2)	13	(7.3) [a]
	b)	I order urine albumin: creatinine ratio (early morning spot urine sample) to screen for microalbuminuria in diabetic patient if urine dipstick for protein is negative.	83	(46.4) [a]	56	(31.3)	40	(22.3)
	c)	I screen for anaemia when patient diagnosed CKD.	85	(47.5) [a]	75	(41.9)	19	(10.6)
	2	**Regarding managing a patient with CKD:**						

General management of CKD	a)	I prescribe (or refer to prescribe) Angiotensin-converting enzyme inhibitor (ACEi)/ Angiotensin-receptor blocker (ARB) for diabetic patients who develop persistent microalbuminuria regardless of his/her blood pressure level.	131	(73.2) [a]	37	(20.7)	11	(6.1)
	b)	I target HbA1c 6.5 % to 7 % in a young diabetic nephropathy patient without other comorbid.	128	(71.5) [a]	32	(17.9)	19	(10.6)
	c)	I provide (or refer dietician) for low protein diet counselling to CKD patient.	84	(46.9) [a]	70	(39.1)	25	(14.0)
	d)	I prescribe (or refer to prescribe) aspirin as primary prevention of cardiovascular disease in CKD patient	37	(20.7)	58	(32.4)	84	(46.9) [a]
	e)	I aim blood pressure <130/80 mmHg in young diabetic nephropathy patient.	123	(68.7) [a]	45	(25.1)	11	(6.1)
Regarding referral to physician or nephrologist	**3**	**Regarding referral to physician or nephrologist:**						
	a)	I refer when patient has persistent heavy proteinuria.	122	(68.2) [a]	43	(24.0)	14	(7.8)
	b)	I refer when eGFR reduce >5ml/min/1.73m2 within one year	96	(53.6) [a]	57	(31.8)	26	(14.5)
	c)	I refer to nephrologist when patient has CKD secondary to renal outflow obstruction.	91	(50.8)	30	(16.8)	58	(32.4) [a]
	d)	I refer all asymptomatic elderly patients with CKD to the nephrologist.	17	(9.5)	89	(49.7)	73	(40.8) [a]

[a:] correct practice

Approximately 47.5% of participants screened for anemia in CKD patients. In managing CKD, 73.2% of participants prescribed Angiotensin-converting enzyme inhibitors (ACEi) or Angiotensin-receptor blockers (ARB) for diabetic patients who developed persistent microalbuminuria, while 71.5% adhered to a target HbA1c of 6.5% to 7.0% in young diabetic nephropathy patients without comorbidities. A significant proportion (68.7%) of participants aimed for a blood pressure target of less than 130/80 mmHg in the same patient group.

Referral practices showed that 68.2% referred patients with persistent heavy proteinuria to a nephrologist, and 53.6% referred patients when the estimated glomerular filtration rate (eGFR) decreased by more than 5 ml/min/1.73m² within a year. However, 14.5% did not refer in these cases. When CKD was secondary to renal outflow obstruction, 50.8% of participants referred patients to a nephrologist, while 41% did not refer asymptomatic elderly patients with CKD as this was not typically indicated. These findings reflect varying adherence to CKD management guidelines.

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DISCUSSION

Our result showed that the mean score on the CKD knowledge questionnaire of primary healthcare providers in our study was 71.6 %. This is in comparison to a study by Loo et al. that involved undergraduate and postgraduate medical students and found that the students' baseline knowledge of chronic kidney disease was lower [8]. This contrasts with our study, which involved professionals who are expected to have a better foundational knowledge of CKD. However, despite this, we identified some knowledge gaps that led to suboptimal knowledge level and these knowledge gaps needed to be filled in to provide better quality of care for patients with CKD as well as patients at risk of CKD.

Knowledge on the correct definition of CKD is important for better coordination of care between nephrologist and primary healthcare providers. In our study, more than half of the medical officers were not aware that a more-than-three-month duration is required for the diagnosis of CKD. Furthermore, only nearly half (49.2%) of the participants could correctly identify that persistent proteinuria defines CKD.

These findings were similar to a study conducted in the United States, which showed that 46.1% (n=221) of internal residents did not know that kidney injury for 3 months or longer defines CKD [5,12]. In comparison, according to a study from Cameroon, 58.8% (n=67) of general practitioners and non-nephrologists were able to define CKD correctly [7]. Al-Ali from Saudi Arabia also reported a higher percentage (68.9%; n=217) of family medicine residents that provided a correct definition of CKD [6]. From the results of our study and the studies carried out across the globe, the percentage of doctors in our study who can define CKD correctly remains low. The reason behind this could be due to the inadequate training on the management of CKD during internship as well as when working as a medical officer as highlighted by the percentage of respondents who had prior training in this study. Additionally, this could be due to inadequate exposure to continuous medical education on the subject. The implication of not knowing the correct definition of CKD may lead to unnecessary referral to tertiary centre.

In contrast to the ability to define CKD, the majority of the participants were able to stage CKD correctly and were able to pick out most of the risk factors for CKD precisely. All participants (100%) in our study were able to identify that hypertension and diabetes mellitus were risk factors for CKD. These results were similar to previous studies [7,13]. In our opinion, this finding is important as most patients with diabetes mellitus and hypertension are under regular follow-up for their chronic diseases at primary health clinics in Malaysia.

Concerning complications of CKD, almost all the participants (97.8%) were able to identify anaemia as one of the potential complications correctly. However, only 47.5% of the participants were able to recognize that hypercalcemia and hypophosphatemia are not complications of CKD accurately. The pathophysiology of mineral bone disease of CKD is complex, and it usually results in hypocalcaemia and hyperphosphatemia instead of hypercalcemia and hypophosphatemia. The reason why the majority of the participants were unable to identify this correctly is unclear.

Around 78% of the participants had the false impression that "patients with type 2 diabetes without evidence of microalbuminuria should be tested for microalbuminuria for every 6 months", and only 18.4% of them were able to identify that this was a wrong statement. It is encouraging to know that most participants were aware that there is a need to test for microalbuminuria among patients with diabetes; however, the duration to repeat the test should be reasonably justified and should follow the local guidelines, especially among diabetic patients with stable eGFR, good diabetic and blood pressure control. The natural history of diabetic nephropathy shows that it usually requires several years to develop this complication in a patient with diabetes mellitus and it takes a few years to progress from albuminuria to overt nephropathy [14,15]. As suggested by the Malaysian CPG CKD 2018 and the American Diabetes Association, testing for urine albumin should be repeated annually if the initial test was negative [16]. It's noteworthy to observe that, even though information on the frequency of screening for diabetes complications, such as nephropathy, is easily visible in the medical records and patient portable records, knowledge of this was nevertheless poor.

To slow down the progression of CKD, the CPG CKD guidelines also recommend good blood pressure and glycaemic control, with the target blood pressure of a patient with proteinuria at less than 130/80 mmHg. More than half of the doctors (58.7%, n= 105) in our study were aware of this treatment goal and this result was consistent with the study conducted by Agrawal *et al* [12]. The target blood pressure of less than 130/80 mmHg is also stated in the Malaysian CPG Hypertension 2018 guidelines, in which most primary care doctors are more familiar with.

Several factors were identified in our study that were believed to be in association with the level of knowledge on CKD among primary healthcare providers. Our study indicated a significant association between use of CPG CKD and level of knowledge, whereby PHC who did not use the guideline was associated with lower level of knowledge on CKD than those who used it. This finding was consistent with the study performed by Cabana *et al.* where barriers affecting adherence to guidelines would affect knowledge of physicians [17]. CPGs are drafted based on latest evidence-based studies that have been shown to improve patients' outcome and have been related to better patient prognosis [18]. CPGs usually contain the latest information regarding treatment options, up-to-date and evidence-based recommendations, with reliable information regarding the disease, thus, it is reasonable that CPG users

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would be better equipped with latest knowledge. However, lack of awareness and familiarity towards guidelines were the barriers identified in previous research studies which could affect a physician's knowledge [17]. In our study, the level of awareness towards the existence of the CPG was high, however the percentage of respondents who used the CPG in their daily practice was slightly lower. This might suggest that there are barriers to using the CPG despite knowing its existence. The most reported barriers were suboptimal healthcare networks, time constraints, poor applicability of CPGs in real-world practice, poor motivations and adherence, and inadequate reinforcement [19]

We also found a statistically significant association between previous training experience on CKD management and level of knowledge on CKD. Primary healthcare providers who did not attend CKD management training were associated with lower level of knowledge than those who did. Examples of training activities related to CKD management include, but not confined to, attending continuous medical education (CME) sessions about CKD, doing attachment or rotation in a nephrology unit in a tertiary hospital, and attending courses related to CKD. The respondents who had not attended these training sessions scored 5.64% lower in the knowledge section of our study. This finding was similar to a cross-sectional study done among physicians in Iran on knowledge of hypertension [20]. The researchers concluded that the study participants' (i.e. doctors') level of knowledge improved after they had had previous training related to management of the respective diseases.

Chronic kidney disease (CKD) is often asymptomatic in its early stages, necessitating the use of laboratory investigations for detection. According to the CKD-EPI formula, serum creatinine is frequently used to estimate glomerular filtration rate (GFR), but this marker shows changes much later than albuminuria, an earlier indicator of CKD [21]. Despite this, the majority of healthcare providers in the study still rely on serum creatinine for initial CKD screening, which is not recommended as the most appropriate method.

Anemia is a well-known complication of CKD, yet only 47.5% of the respondents reported screening for it, despite nearly all participants (97.8%) acknowledging its importance. This finding mirrors a U.S. study where 40% of physicians screened for anemia, although 90% recognized it as a major CKD complication [22]. Screening for anemia in CKD patients is crucial, as untreated anemia can lead to worse outcomes, including a higher risk of death, heart failure, and a diminished quality of life. In Malaysia, the prevalence of anemia among pre-dialysis CKD patients is notably high, yet treatment rates remain low [23]

Encouragingly, a majority of primary care providers in the study demonstrated good practices in other areas of CKD management, namely on the use of angiotensin-converting enzyme inhibitors (ACEi) or angiotensin II receptor blockers (ARB) for patients with diabetic nephropathy and persistent albuminuria. These results highlight better adherence to guidelines compared to a study in Pakistan, where only 66.7% of doctors chose ACEi/ARB for CKD patients [24]. Furthermore, over half of the respondents referred CKD patients to nephrologists based on appropriate indications, which is crucial in improving patient outcomes by facilitating early intervention.

We identified a few limitations in our study. This study used a convenience sampling method which might lead to sampling bias. Secondly, the study only assessed knowledge on CKD which might not translate into their practice. Although there is a link between theoretical understanding and practical application, our study could not identify whether the respondents behave in a manner consistent with the reported answers. Thus, further research is required to evaluate these areas further.

CONCLUSIONS

There are still knowledge gaps in some areas regarding chronic kidney disease among primary care professionals that would require improvement. Previous exposure to training and usage of guidelines showed a significant association with the level of knowledge. As knowledge can affect one's practice, more educational activities can be organized to provide up-to-date knowledge. Furthermore, healthcare professionals should be encouraged to use the latest evidence-based guidelines to provide better quality of care in primary healthcare settings.

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CONFLICT OF INTEREST

Authors declare none.

AUTHORS' CONTRIBUTION

LKY, LHY and SBI were involved in the conceptual design, statistical analysis, manuscript preparation, editing and review.

REFERENCES

1. Saminathan TA, Hooi LS, Mohd Yusoff MF, Ong LM, Bavanandan S, Rodzlan Hasani WS, Tan EZ, Wong I, Rifin HM, Robert TG, Ismail H.. Prevalence of chronic kidney disease and its associated factors in Malaysia; findings from a nationwide population-based cross-sectional study. BMC Nephrol. 2020; 21(1): 344. doi: 10.1186/s12882-020-01966-8. PMID: 32795256; PMCID: PMC7427283.

2. Crews DC, Bello AK, Saadi G; World Kidney Day Steering Committee. Burden, access, and disparities in kidney disease. Kidney Int. 2019 Feb;95(2):242-248. doi: 10.1016/j.kint.2018.11.007. PMID: 30665560.

3. Ismail H, Abdul Manaf MR, Abdul Gafor AH, Mohamad Zaher ZM, Ibrahim AIN. Economic Burden of ESRD to the Malaysian Health Care System. Kidney Int Rep. 2019;4(9):1261-1270. doi: 10.1016/j.ekir.2019.05.016. Erratum in: Kidney Int Rep. 2019 Dec 03;4(12):1770. PMID: 31517145; PMCID: PMC6732754.

4. Avery NW, Leggett SS, Juncos LA. Strengthening Chronic Kidney Disease Knowledge Among Students Attending a Historically Black University. JNSW [Internet]. 2016 ;40(2):38-43. https://jnsw.kidney.org/index.php/jnsw/article/view/72.https://doi.org/10.61658/jnsw.v40i2.72

5. Agrawal, V., Ghosh, AK., Barnes, MA. & McCullough, PA. Awareness and knowledge of clinical practice guidelines for CKD among internal medicine residents: a national online survey. Am J Kidney 2008; 52(6): 1061-1069. doi: 10.1053/j.ajkd.2008.06.022

6. Al-Ali, S. Knowledge and practices of family medicine sesidents in Saudi Arabia who are on Saudi Board of Family Medicine regarding chronic kidney disease and their attitudes toward referral. International Journal of Scientific Study, 2018; 6(8). doi: 10.17354/ijss/2018/313

7. Choukem SP, Nchifor PK, Halle MP, Nebongo DN, Mboue-Djieka Y, Kaze FF, Monekosso GL. Knowledge of physicians on chronic kidney disease and their attitudes towards referral, in two cities of Cameroon: a cross-sectional study. BMC Res Notes. 2016; 9: 29. doi: 10.1186/s13104-016-1845-5. PMID: 26781039; PMCID: PMC4716638.

8. Loo LC, Ong KW, Ahmad Nidzwal AK, Razali MH, Ahmad N, Naim A, Daud F, Abdul Gafor AH, Ahmad N. Knowledge of chronic kidney disease among undergraduate and postgraduate students in a public university in Klang Valley, Malaysia: A cross sectional study. PLoS ONE. 2022; 17(9): e0274038. https://doi.org/10.1371/journal.pone.0274038

FOR PROOFREADING

9. Ng CY, Lee ZS, Goh KS. Cross-sectional study on knowledge of chronic kidney disease among medical outpatient clinic patients. Med J Malaysia. 2016;71(3):99-104. PMID: 27495881.

10. Ministry of Health (MOH), Malaysia. (2018b). *National Action Plan for Health Kidney (ACT-KID) 2018-2025* (1 ed.): Non-Communicable Disease (NCD) Section, Disease Control Division, MOH. act_kid-1-min.pdf

11. Dupont WD, Plummer WD Jr. Power and sample size calculations. A review and computer program. Control Clin Trials. 1990; 11(2): 116-28. doi: 10.1016/0197-2456(90)90005-m. PMID: 2161310.

12. Agrawal V, Agarwal M, Ghosh AK, Barnes MA, McCullough PA. Identification and management of chronic kidney disease complications by internal medicine residents: a national survey. Am J Ther. 2011; 18(3): e40-7. doi: 10.1097/MJT.0b013e3181bbf6fc. PMID: 19918169.

13. Delatorre T, Romão EA, Mattos ATR, Ferreira JBB. Management of chronic kidney disease: perspectives of Brazilian primary care physicians. Prim Health Care Res Dev. 2021; 22: e8. doi: 10.1017/S1463423621000074. PMID: 33729114; PMCID: PMC8060812.

14. Ayodele OE, Alebiosu CO, Salako BL. Diabetic nephropathy--a review of the natural history, burden, risk factors and treatment. J Natl Med Assoc. 2004; 96(11):1445-54. PMID: 15586648; PMCID: PMC2568593.

15. Gross JL, de Azevedo MJ, Silveiro SP, Canani LH, Caramori ML, Zelmanovitz T. Diabetic nephropathy: diagnosis, prevention, and treatment. Diabetes Care. 2005; 28(1): 164-76. doi: 10.2337/diacare.28.1.164. PMID: 15616252.

16. American Diabetes Association. 11. Microvascular Complications and Foot Care: *Standards of Medical Care in Diabetes-2019*. Diabetes Care. 2019; 42(Suppl 1): S124-S138. doi: 10.2337/dc19-S011. PMID: 30559237.

17. Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA. 1999; 282(15): 1458-65. doi: 10.1001/jama.282.15.1458. PMID: 10535437.

18. Oh SW, Lee HJ, Chin HJ, Hwang JI. Adherence to clinical practice guidelines and outcomes in diabetic patients. Int J Qual Health Care. 2011; 23(4): 413-9. doi: 10.1093/intqhc/mzr036. Epub 2011 Jun 25. PMID: 21705772.

19. Wang T, Tan J, Liu X, Zhao I. Barriers and enablers to implementing clinical practice guidelines in primary care: an overview of systematic reviews. BMJ Open 2023; 13: e062158. doi: 10.1136/bmjopen-2022-062158

20. Farshidi H, Nikparvar M, Rostami-Qeshmi I, Ezzati-Rad R, Piroozan A, Boushehri E. Physicians' knowledge, attitudes, and practice for hypertension management: A cross-sectional study in Hormozgan province, Iran. ARYA Atheroscler. 2018; 14(3): 132-138. doi: 10.22122/arya.v14i3.1674. PMID: 30349576; PMCID: PMC6191572.

21. Ayodele, OE, Alebiosu, CO, Salako BL. Diabetic nephropathy--a review of the natural history, burden, risk factors and treatment. *Journal of the National Medical Association.* 2004 ;96(11): 1445-1454.

FOR PROOFREADING

22. Lenz O, Fornoni A. Chronic kidney disease care delivered by US family medicine and internal medicine trainees: results from an online survey. *BMC Med.* 2006; 4: 30. doi: 10.1186/1741-7015-4-30

23. Salman M, Khan AH, Adnan AS, Sulaiman SA, Hussain K, Shehzadi N, Islam M, Jummaat F. Prevalence and management of anemia in pre-dialysis Malaysian patients: a hospital-based study. Rev Assoc Med Bras (1992). 2016; 62(8): 742-747. doi: 10.1590/1806-9282.62.08.742

24. Mahmud M, Hussain N, Kamal A, Samoo ZI, Khan WA. Doctors' Knowledge and Practices Regarding Chronic Kidney Disease at a Tertiary Care Hospital. International Archives of Medicine. 2016; 9. doi: 10.3823/1959

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ORIGINAL ARTICLE

Predictors of knowledge, attitude and practice among seropositive leptospirosis cattle farmers in northeastern Malaysia

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ABSTRACT

Introduction: Leptospirosis is a neglected re-emerging disease, with Kelantan being the leading state in Malaysia for its annual incidence. Among agricultural workers, cattle farmers significantly contribute to the high incidence in Kelantan. In 2018, a high seroprevalence of leptospirosis (72.5%) was reported among these farmers. Despite various studies on leptospirosis in Kelantan, none have focused on cattle farmers. This study aims to assess knowledge, attitudes, and practices (KAP) levels and identify associated factors among seropositive leptospirosis cattle farmers in Kelantan. **Methodology**: This cross-sectional study utilized an interviewer-guided validated questionnaire to collect data from all seropositive leptospirosis cattle farmers in Kelantan. A Likert scale was used to score KAP, with total scores converted to percentages. Descriptive analysis was performed using IBM SPSS version 24.0. **Result**: Most respondents (64.4%) demonstrated good knowledge of leptospirosis, yet only 38.4% had a satisfactory attitude, and a mere 16.4% practised satisfactory preventive measures. Not eating or drinking at the workplace was associated with good knowledge, satisfactory attitudes, and practices. Wearing rubber boots and experiencing rat infestation at the workplace were linked to good knowledge. Living more than 200 meters from a river correlated with satisfactory attitudes while increasing age was associated with better practices. Additionally, wearing rubber gloves was linked to satisfactory practices. **Conclusion**: Despite their good knowledge, respondents exhibited unsatisfactory attitudes and practices toward leptospirosis prevention. Future efforts should focus on improving attitudes and practices to enhance preventive measures against leptospirosis.

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1. INTRODUCTION

Leptospirosis is a re-emerging zoonotic disease with a significant health impact towards the human population across the globe [1]. It is caused by Gram-negative bacteria of the genus Leptospira. While it is present in wild animals, it is more commonly associated with domestic animals like pigs, rodents, dogs, and cattle. Additionally, once excreted in the urine of an infected host, the bacteria can survive in the environment for weeks to months [2]. Humans are incidental hosts, typically infected through contact with urine-contaminated environments [3].

Globally, most leptospirosis infections in humans were attributable to rodents, primarily due to direct or indirect contact with the contaminated urine of the infected animals [4; 5]. Annually, over one million cases occur globally, resulting in approximately 60,000 deaths [6]. In addition, the most affected regions were America and Asia [7]. Several studies have highlighted the increasing global burden of leptospirosis, particularly in tropical and subtropical regions [8; 9]. Currently, leptospirosis is still under-reported, contributed by a wide range of non-specific clinical manifestations that mimic other endemic infectious diseases such as malaria and dengue [10-12].

In Malaysia, leptospirosis became a mandatory notifiable infectious disease in 2010. Since then, reported cases have increased exponentially, from 248 in 2004 to 3604 in 2012 [13]. Kelantan, in northeastern Malaysia, consistently reports the highest incidence rates, with 126.7 per 100,000 population in 2015 [14]. This might be due to their high annual rainfall, Kelantan being geographically prone to flooding and unstructured development harboured by the state [15; 16].

Cattle farmers have been identified as a high-risk group for leptospirosis in Malaysia due to their occupational exposure to contaminated environments [17]. This elevated risk has been supported by local studies demonstrating increased infection rates among cattle farmers [18]. Furthermore, this occupational group contributed to a high incidence of leptospirosis in Kelantan in 2016 [19], and Daud et al. (2018) reported a high seroprevalence of leptospirosis (72.5%) among cattle farmers in the state. However, despite these alarming findings, research on leptospirosis among cattle farmers in Malaysia remains limited.

Understanding the knowledge, attitudes, and practices (KAP) regarding leptospirosis among high-risk populations is crucial for disease prevention [20]. Knowledge and attitude can predetermine their practice on preventive measures against communicable diseases such as leptospirosis thus, improving their safety and health at work. Awareness and knowledge of the disease will create a basis for behavioural changes, which help in disease control by planning and prioritising resources to prevent the disease from occurring [21].

Several studies have emphasized the importance of KAP assessments in developing effective leptospirosis prevention strategies [22; 23]. For instance, despite the presence of adequate KAP within the study community in Sri Langka, gaps were identified from the understanding of the source and mode of transmission, symptoms, complications, risk factors, utilization of personal protective equipment, and prophylaxis, which could influence the extent and frequency of appropriate preventive measures [24]. While a study done in Elassona, Greece reported that education was positively correlated with enhanced knowledge and practices, whereas tight veterinarian oversight of the farm was linked to improved practices in zoonotic prevention such as leptospirosis [25].

Various knowledge, attitude, and practice studies on leptospirosis were done in Malaysia, but none were conducted among cattle farmers despite their being prone to leptospirosis infection. Therefore, this study aims to assess the level of knowledge, attitudes, and practices, along with associated factors, among seropositive leptospirosis cattle farmers in Kelantan.

2. METHODOLOGY

A cross-sectional study of 87 seropositive cattle farmers was carried out in northeastern Malaysia. This study was a continuation of a recent study by Daud et al., 2018 entitled “Study on Seroprevalence of Leptospirosis and Its Serovars Among Cattle Farmers in Northeastern Malaysia”, where the study revealed

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high seroprevalence of leptospirosis (73%) among cattle farmers in Northeastern Malaysia [26]. Seropositive farmers were defined as asymptomatic individuals whose microscopic agglutination test (MAT) showed fewer than 50.0% free Leptospira organisms in the control well. A titre threshold of ≥1:100 was used to classify farmers as seropositive, indicating prior exposure to Leptospira. Out of the 87 seropositive farmers, 73 were chosen based on criteria requiring a minimum of six months in the occupation, ownership of at least three cattle, and use of either traditional or modern Travis systems for blood collection from cattle.

This study used a validated questionnaire by Azfar et al. [11] as the tool. Respondents participated in an interviewer-guided survey covering sociodemographic factors, as well as their knowledge, attitudes, and practices (KAP). The questionnaire demonstrated strong internal consistency, with Cronbach alpha values of 0.96 for knowledge, 0.71 for attitudes, and 0.74 for practices. The survey, delivered in Bahasa Malaysia—the native language of the participants, who were all Malays—took around 15 minutes to complete. To ensure consistency, only one interviewer conducted all the sessions, providing clarifications as needed. The survey comprised two sections: the first focused on demographics, working conditions, and living environments, while the second addressed the participants' understanding, attitudes, and behaviors regarding leptospirosis.

The knowledge domain started by asking the respondents if they had ever heard about leptospirosis and the source of information that they had on leptospirosis. Only those who have heard of the disease will proceed to answer the rest of the knowledge questions. They were designed to be answered as "correct", "incorrect" or "do not know". For scoring, "2" marks were given for a correct response, "1" mark for "do not know", and "0" mark for an "incorrect" response. Twenty-four knowledge questions covered the causes, signs, symptoms, complications, treatment, prevention, and risk factors of leptospirosis.

For the attitude domain, 12 questions covering safe work practices, personal protective equipment (PPE) and general practices were asked. Questions on attitude were designed to be answered using a Likert scale of "strongly agree", "agree", "not sure", "not agree", and "strongly not agree". For positive attitude items, scores of "4", "3", "2", "1", and "0" for "strongly agree", "agree", "not sure", "not agree", and "strongly not agree" were given respectively. Meanwhile, the above scoring system was reversed for negative attitude items.

The questions on practice domain were also designed to be answered using a Likert scale of "never", "seldom", "sometimes", "often" and "always". For good practice items, scores of "4", "3", "2", "1", and "0" for "always", "often", "sometimes", "seldom", and "never" were given, respectively. The above scoring system was reversed for unsatisfactory practice items. A total of 12 questions on practices were asked, covering safe work practices and the use of PPE during work and off-work general practices.

Descriptive statistics for continuous variables were presented as means (SD), while categorical variables were shown as frequencies and percentages. The average scores (SD) for KAP items were also calculated. Knowledge, attitude, and practice responses were categorized based on percentages. For knowledge, a score of 72.0% or higher was considered good, while lower scores indicated poor knowledge [11]. Similarly, attitude and practice scores of 75.0% or higher were classified as satisfactory, while scores below this threshold were considered unsatisfactory.

The data was analyzed using IBM SPSS version 24.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were described using means (SD). Univariable analysis through simple logistic regression was used to explore associations between KAP and variables such as sociodemographic characteristics, working conditions, and living environments. Variables with a p-value below 0.25 were further tested with multiple logistic regression. The preliminary final model was built using Forward Likelihood Ratio (Forward LR) selection and Backward Likelihood Ratio (Backward LR) elimination. No significant two-way interactions were detected, and multicollinearity was ruled out by Variance Inflation Factors (VIF) under 10. The model's fitness was evaluated using the Hosmer-Lemeshow test, classification tables, and the area under the Receiver Operating Characteristic (ROC) curve. Variables with p-value <0.05 were considered as statistically significance in determing the predictors of in multiple logistic regression test.

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This was an anonymous survey, and participants' identities were not disclosed to management. The questionnaire was administered at the participants' convenience, and informed consent was obtained prior to the study. The research team had no conflicts of interest. Data entry into IBM SPSS was handled anonymously, with only research team members having access. Data was presented in aggregate form to maintain confidentiality.

3. RESULTS

Seventy-three seropositive cattle farmers participated in this study, resulting in a response rate of 84%. All participants were of Malay ethnicity, with ages ranging from 22 to 81 years, and a mean (SD) age of 52.9 (14.33) years. Among them, 17.8% were female. The majority (82.2%) were married, with a mean (SD) of 4.6 (3.1) children. Only 5% of the respondents had no formal education. The average monthly income was RM1286, with 14 farmers (19.2%) earning RM2000 or more. Most of the farmers (57.5%) were non-smokers, and all had heard of leptospirosis, either through mass media or healthcare professionals. The sociodemographic details are summarized in Table 1.

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Table 1 Sociodemographic characteristic*s* of seropositive cattle farmers (n=73)

Characteristics	n (%)	Mean (SD)
Age		52.9 (14.33)
Gender		
Male	60 (82.2)	
Female	13 (17.8)	
Marital Status		
Single	10 (13.7)	
Married	60 (82.2)	
Divorce	3 (4.1)	
Number of Children		4.6 (3.14)
Education Level		
No Formal Education	4 (5.5)	
Primary Education	17 (23.3)	
Secondary Education	39 (53.4)	
Tertiary Education	13 (17.8)	
Income		1286.03 (1084.24)
< RM1000	27 (37.0)	
RM1000 - RM1999	32 (43.8)	
≥ RM2000	14 (19.2)	
Smoking Status		
Smoker	31 (42.5)	
Non-smoker	42 (57.5)	
Heard about Leptospirosis		
Yes	73 (100.0)	
No	0 (0.0)	

Source: Aziah Daud et al (2026)

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Tables 2 and 3 provide details on the knowledge, attitude, and practice characteristics of the participants. Knowledge scores ranged from 44.0% to 94.0%, with a mean (SD) of 73.6 (10.68). In this study, 64.4% of respondents were found to have good knowledge of leptospirosis. On the other hand, attitude scores ranged from 33.0% to 100.0%, with a mean (SD) of 69.3 (15.82), and the majority of respondents (61.8%) displayed an unsatisfactory attitude towards leptospirosis. Moreover, 83.6% of the respondents were found to have unsatisfactory practices in preventing leptospirosis.

Table 2 Descriptive statistic of knowledge, attitude and practice score among seropositive cattle farmers (n=73)

Domain	Min (%)	Max (%)	Mean (SD)
Knowledge Score	44	94	73.6 (10.68)
Attitude Score	33	100	69.3 (15.82)
Practice Score	23	98	58.1 (16.40)

Source: Aziah Daud et al (2026)

Table 3 Proportion of knowledge, attitude and practice among seropositive cattle farmers (n=73)

Categories	n	(%)
Knowledge		
Good	47	(64.4)
Poor	26	(35.6)
Attitude		
Satisfactory	28	(38.4)
Unsatisfactory	45	(61.6)
Practice		
Satisfactory	12	(16.4)
Unsatisfactory	61	(83.6)

Source: Aziah Daud et al (2026)

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3.1 Factors associated with Knowledge

Multiple logistic regression analysis identified three key factors associated with good knowledge among the seropositive cattle farmers: eating or drinking at the workplace, wearing rubber boots, and rat infestation at the workplace, as outlined in Table 4.

Table 4 Multiple logistic regression of factors associated with knowledge among seropositive cattle farmers (n=73)

Variables	β	Adjusted OR (95% CI)	Wald Statistic (df)	p-value
Eat/Drink at Workplace				
Yes		1		
No	1.69	5.40 (1.44,20.27)	6.25	0.012

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Wear Rubber Boot				
No		1		
Yes	1.81	6.09 (1.34, 27.65)	5.47	0.019
Rat at Workplace				
No		1		
Yes	-1.62	5.03 (1.26, 20.12)	5.22	0.022

Multiple Logistic Regression
Constant = -1.202
Forward LR and backward LR method were applied.
No multicollinearity and no interaction between the variables.
Hosmer-Lemeshow test, p=0.907
Classification table was 72.6% correctly classified
Area under Receiver Operating Characteristics (ROC) curve was 73.2%

Source: Aziah Daud et al (2026)

Farmers who refrained from eating or drinking at their workplace were 5.4 times more likely to have good knowledge (95% CI: 1.44, 20.27; P = 0.012) compared to those who did, after adjusting for the variables of wearing rubber boots and rat infestations. Additionally, those who wore rubber boots had 6.09 times the likelihood of possessing good knowledge (95% CI: 1.34, 27.65; P = 0.019) compared to those who did not wear rubber boots, when controlling for eating or drinking and rat sightings at the workplace. Furthermore, the presence of a rat infestation increased the odds of having good knowledge by 5.03 times (95% CI: 0.05, 0.80; P = 0.02) compared to workplaces without infestations, adjusting for eating or drinking and wearing rubber boots.

3.2 Factors associated with Attitude

In terms of attitude, the study found that cattle farmers who refrained from eating or drinking while working were 4.58 times more likely to have a satisfactory attitude (95% CI: 1.48, 14.17; P = 0.008) compared to those who ate or drank while working, after adjusting for the distance between their residence and the nearest river. Additionally, farmers who lived more than 200 meters from a river had 4.72 times the likelihood of having a satisfactory attitude (95% CI: 1.03, 21.68; P = 0.046) compared to those living less than 100 meters away, when the variable of eating or drinking was adjusted (Table 5).

Table 5 Multiple logistic regression of factors associated with attitude among seropositive cattle farmers (n=73)

Variables	β	Adjusted OR (95% CI)		Wald Statistic (df)	p-value
Eat/Drink					
Yes			1		
No	1.52	4.58	(1.48,14.17)	6.99	0.008
Distance From River					
< 100M			1		
100M-200M	0.52	1.68	(3.56,7.98)	0.43	0.512
> 200M	1.55	4.72	(1.03,21.68)	3.99	0.046

Multiple Logistic Regression
Constant = -2.942
Forward LR and backward LR method were applied.
No multicollinearity and no interaction between the variables.
Hosmer-Lemeshow test, p=0.995
Classification table was 71.2% correctly classified
Area under Receiver Operating Characteristics (ROC) curve was 80.5%
Source: Aziah Daud et al (2026)

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3.3 Factors associated with Practice

The study revealed that cattle farmers who did not eat or drink at their workplace were 11.76 times more likely to exhibit satisfactory practices (95% CI: 1.65, 83.70; P = 0.014) compared to those who did, after controlling for age and the use of rubber gloves. Furthermore, those who wore rubber gloves while working had 14.05 times the odds of demonstrating satisfactory practices (95% CI: 2.43, 81.37; P = 0.003) compared to those who did not, after adjusting for age and eating or drinking at the workplace. Additionally, each one-year increase in age was associated with 1.09 times higher odds of engaging in satisfactory practices (95% CI: 1.01, 1.17; P = 0.025), controlling for eating or drinking at the workplace and wearing rubber gloves (Table 6).

Table 6 Multiple logistic regression of factors associated with practice among seropositive cattle farmers (n=73)

Variables	β	Adjusted OR (95% CI)	Wald Statistic (df)	p-value
Age	1.50	1.09 (1.01,1.17)	5.01 (1)	0.025
Eat/Drink				
Yes		1		
No	1.27	11.76 (1.65,83.70)	6.06 (1)	0.014
Rubber Glove				
Yes		1		
No	2.06	14.05(2.43,81.37)	8.70 (1)	0.003

Multiple Logistic Regression
Constant = -4.82
Forward LR and backward LR method were applied.
No multicollinearity and no interaction between the variables.
Hosmer-Lemeshow test, p=0.212
Classification table was 89.0% correctly classified
Area under Receiver Operating Characteristics (ROC) curve was 85%
Source: Aziah Daud et al (2026)

4. DISCUSSION

Public Health practice has since adopted KAP studies in various fields to understand the knowledge, attitude and practice of the respondents regarding certain subject matters. Gathering information on knowledge, attitude and practice can assist public health professionals and other related agencies to come up with practical preventive recommendations that can be implemented at ground level.

In this current study, most of the respondents (64.4%) have good knowledge of leptospirosis. This result was contrary to many KAP studies done among high-risk and non-high-risk groups in Malaysia. For example, Azfar et al. [11] discovered a low level of knowledge regarding leptospirosis among town service workers in Northeastern Malaysia and Sakinah et al. [27] elicited that only 2% of the respondents had good knowledge of leptospirosis in a non-high-risk group in Selangor, Malaysia. However, the same finding was found in a study by Edre et al. [28], where the majority of respondents from a flood-prone area in the central region of Malaysia had good knowledge on leptospirosis. This implies that the coverage of information regarding leptospirosis in the Malaysian population still needs to be well distributed despite continuous efforts done by the Malaysian government through the Ministry of Health (MOH) to educate the Malaysian population, especially those in high-risk groups. MOH is actively spreading awareness among the public, particularly in high-risk groups, regarding leptospirosis through various means, such as healthy education and promotion via mass media and health personnel [16]. A possible reason why cattle farmers have better outcomes in terms of knowledge is due to active engagement from other stakeholders, such as the veterinary department.

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In Malaysia, the veterinary department is actively involved with leptospirosis prevention and control programs, including environment and animal sampling during an outbreak [29]. Engaging with various stakeholders is one of the key factors for intended information to reach specific targeted groups. This is in tandem with the One Health approach proposed by WHO, where all agencies such as veterinarians, clinicians, environmental health professionals, local authorities and universities work together to empower the community to fight against zoonotic diseases, particularly leptospirosis [30]. The One Health approach has gained increasing recognition in recent years for its effectiveness in addressing zoonotic diseases like leptospirosis [31; 32].

In addition, Nozmi et al. [33] reported that Malays had 2.6 times higher odds of having good leptospirosis knowledge than non-Malays. This is in line with our findings due to our respondents being all Malays, thus reflecting a high percentage of good knowledge regarding leptospirosis. Additionally, another possible reason could be due to a high prevalence of leptospirosis among Malays compared to other races in Malaysia [34], causing an increment in knowledge-seeking behaviour among them as a coping mechanism where Schneider et al. [35] suggested that the public's sensitivity on the disease will increase with the presence of a health warning.

In contrast to the knowledge scores, most cattle farmers exhibited poor attitudes and practices, with 61.8% and 83.6% scoring unsatisfactorily, respectively. This could be attributed to their limited perception of the benefits associated with leptospirosis prevention measures. Similar findings were revealed in a study by Edre et al. [28] among residents in a flood-prone area in Pahang, Malaysia, where a majority of the respondents had good knowledge but, at the same time, had unsatisfactory attitudes and practices. The low level of satisfactory attitude and practice was reflected by the increasing trend of leptospirosis in Kelantan, as described by Azimullah et al. [19]. These findings were in line with the Theory of Reason Action (TRA) proposed by Fishbein in 1967, where knowledge did not directly influence behaviour and practice. He suggested that attitude is the main factor that directly affects an individual's practice [36].

This study also found that cattle farmers who refrained from eating or drinking at their workplace were 5.4 times more likely to possess good knowledge, 4.58 times more likely to exhibit a positive attitude, and 11.76 times more likely to practice preventive measures compared to those who did consume food or beverages at work. It is known that eating or drinking at the workplace attracts rodents, particularly rats, especially when there are spillovers or leftover foods. Subsequently, workplaces with plenty of leftover food will become their breeding grounds [37]. Additionally, this finding may reflect a successful health education done by MOH towards cattle farmers where workers were encouraged to not eat or drink at their workplace as it is a risk factor for leptospirosis [11; 38].

This study also elicited that cattle farmers who wore rubber boots while working were 6 times more likely to have better knowledge regarding leptospirosis prevention compared to those who did not wear rubber boots while working. We also discovered that a majority of the respondents (83.6%) wore rubber boots while working. This finding was in contrast with a study by Nozmi et al. [33], where only 26.4% of the respondents wore rubber boots every time they worked, which equally reflected their low knowledge score. Rubber boots are among the personal protective equipment (PPE) that cattle farmers should wear to reduce the risk of leptospirosis infection, unlike rubber gloves and aprons [39]. However, the rubber boots need to be used appropriately, including washing after everyday usage. Without proper utilization, contaminated urine can still be in contact with the human body, hence increasing the chances of getting leptospirosis. This finding is reflected in a study that reported a high seroprevalence of leptospirosis among cattle farmers in Northeastern Malaysia despite having good knowledge of leptospirosis among a majority of them. Workers must be trained on proper PPE usage, such as donning and doffing, to maximize their protective properties [40].

Additionally, the presence of rats in the workplace was strongly linked to higher levels of leptospirosis knowledge. Farmers who experienced rat infestations were five times more likely to have good knowledge than those without this issue. Having rat infestation at their workplace made them more vigilant about the disease carried by the rodents. Moreover, as the rat is a well-known reservoir for leptospirosis [41], they might seek more knowledge regarding leptospirosis as leptospirosis is also commonly known as 'rat urine

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disease' among the Malaysian population [42]. As they perceive rats as a threat, their knowledge-seeking behaviour regarding ways to eliminate the threat will increase. This was explained by Berdi et al. [43], who found that patients with low perceived threat levels have low knowledge of the disease. Recent research has explored innovative approaches to rodent control in leptospirosis prevention [44].

The study also revealed that cattle farmers residing more than 200 meters from a paddy field were 4.72 times more likely to have a positive attitude (95% CI: 1.03, 21.68; P= 0.046) compared to those living less than 100 meters away, after adjusting for eating or drinking at work and wearing long-sleeved shirts. Many studies proved that river-related activities were closely related to leptospirosis infection [45-47]. The river is also a breeding place for leptospirosis reservoirs, particularly rats [48]. Usually, a person who lives far away from a river will be less exposed to river-related activities and possibly less flood occurrence. This will reduce the time of contact with a leptospirosis-contaminated environment, as river and flood are environmental risk factors for leptospirosis [49; 50]. Baharom et al., [51] explored the role of environmental factors in leptospirosis transmission, such as water-related issues, infrastructure, landscape, and agriculture. However, the possible explanation for this irregularity is that access to health education and community initiatives plays a crucial role in shaping attitudes towards leptospirosis prevention. Farmers living farther from paddy fields may benefit from better access to educational resources that promote awareness of leptospirosis and its prevention. Studies have shown that individuals with higher levels of education regarding health risks are more likely to engage in preventive practices [20; 52]. Future qualitative study might be suitable to explain this phenomenon.

Moreover, the findings indicated that with each additional year of age, cattle farmers were 1.09 times more likely to adopt satisfactory practices (95% CI: 1.01,1.17; P= 0.025), adjusting for eating or drinking and wearing rubber gloves. The mean (SD) age of respondents was 52.9 (14.3) years, and the results align with other studies, such as by Brown et al. [53], which identified younger age as a risk factor for leptospirosis infection. This suggests that older farmers may have accumulated more experience and awareness of preventive measures against leptospirosis. In 2014, leptospirosis was more prevalent among younger individuals in Kelantan, with a mean age of 33.2 years [19], indicating that older farmers might be more vigilant about leptospirosis prevention.

Rubber gloves are a key component of personal protective equipment (PPE) in preventing leptospirosis [39]. This study found that cattle farmers who used rubber gloves had 14.05 times the odds of practicing good preventive behavior (95% CI: 2.43,81.37; P= 0.003) compared to those who did not, adjusting for age and eating habits at work. However, despite this association, the study reported a low percentage (19.2%) of farmers who wore gloves while working, reflecting an overall unsatisfactory practice level (83.6%). The same finding was found in a study by Azfar et al. [11], where a low percentage of respondents (43.0%) who wore rubber gloves while working was reported. Not wearing rubber gloves was reflected in the study with a reported high seroprevalence of leptospirosis (72.5%) among cattle farmers in the Kelantan from study by Daud et al., 2018, because almost all (90.0%) of them have direct contact with cattle via touching and a staggering percentage of them (75.3%) were still working despite having wound at either of their hands or feet [26]. Interestingly, some cattle farmers mentioned during interviews that they believed allowing cattle to lick their sweat helped establish a strong bond with the animals. This traditional belief, particularly common in Kelantan, extends to allowing cattle to lick their faces, further compounding the risk of leptospirosis infection.

This study has several notable strengths and limitations. Among its strengths is the high response rate (84%), which enhances the reliability and generalizability of the findings within the population of seropositive cattle farmers in northeastern Malaysia. The use of a validated questionnaire with strong internal consistency ensured the reliability of the KAP assessment. However, the study is limited by its cross-sectional design, which restricts causal inferences regarding the relationships between variables. The reliance on self-reported data may also introduce reporting bias, particularly in responses concerning practices. Additionally, the study focused exclusively on Malay farmers, limiting its applicability to more diverse populations. Finally, the absence of qualitative methods to explore underlying beliefs and practices

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could have limited the depth of understanding of the cultural factors influencing leptospirosis prevention behaviors.

Future research should include qualitative studies to help uncover cultural beliefs, traditional practices, and challenges in adopting preventive measures like using protective gear. Expanding studies to include different ethnic groups and occupations would improve the applicability of the findings. Community-based health education programs should address gaps in attitudes and practices, using culturally sensitive approaches and involving key stakeholders like veterinary and public health agencies. Efforts should also focus on making protective gear more accessible and ensuring proper training for its use. Lastly, promoting the One Health approach can strengthen collaboration between sectors to address environmental, occupational, and behavioral factors in leptospirosis prevention.

5. CONCLUSION

This study provides a promising foundation for leptospirosis prevention among cattle farmers, as it reveals good knowledge levels about the disease. Future health promotion strategies should prioritize educating farmers about preventive measures and risk factors, aiming to improve attitudes and practices. The findings of this study can serve as a basis for targeted interventional studies among cattle farmers in Kelantan, addressing the alarmingly high prevalence in this high-risk group. Specifically, interventions should focus on enhancing attitudes and practices related to preventive measures, as the study identified these areas as particularly lacking despite good knowledge levels.

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7. CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

8. AUTHORS' CONTRIBUTIONS

A.D. conceptualised the study, supervised the research, administered the project, secured funding, and approved the final manuscript. I.S.M.B. conducted data visualisation, and manuscript review and editing. E.A. contributed to study conceptualisation, validation, data collection, data curation, and manuscript review. W.M.Z.W.M. was involved in validation, formal analysis, supervision, and manuscript review and editing. N.I. conducted investigation activities, visualisation, and manuscript review and editing. F.A. contributed to conceptualisation, methodology development, validation, data curation, and manuscript review and editing. All authors have read and approved the final version of the manuscript.

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9. ETHICS STATEMENT

The study was approved by the Jawatankuasa Etika Penyelidikan Manusia University Sains Malaysia (JePEM), Code: USM/JEPeM/18100512.

10. REFERENCES

1. Pappas, G., Papadimitriou, P., Siozopoulou, V., Christou, L., & Akritidis, N. (2008). The globalization of leptospirosis: worldwide incidence trends. *Int J Infect Dis*, *12*. https://doi.org/10.1016/j.ijid.2007.09.011
2. Bahaman, A. R., Ibrahim, A. L., & Adam, H. (1987). Serological prevalence of leptospiral infection in domestic animals in West Malaysia. *Epidemiol Infect*, *99*(2), 379-392. https://doi.org/10.1017/S0950268800067868
3. WHO. (2003). *World Health Organization. Human Leptospirosis: Guidance for Diagnosis, Surveillance and Control.* https://iris.who.int/bitstream/handle/10665/42667/WHO_CDS_CSR_EPH_2002.23.pdf?sequence=1
4. El Jalii, I. M., & Bahaman, A. R. (2004). A review of human leptospirosis in Malaysia. *Trop Biomed*, *21*(2), 113-119. https://www.ncbi.nlm.nih.gov/pubmed/16493403
5. Miller, D., Wilson, M., & Beran, G. (1991). Relationships between prevalence of Leptospira interrogans in cattle, and regional, climatic, and seasonal factors. *American Journal of Veterinary Research*, *52*(11), 1766-1768.
6. Centers for Disease Control and Prevention. (2018). *Leptospirosis: Fact sheet for clinicians.* https://www.cdc.gov/leptospirosis/pdf/fs-leptospirosis-clinicians-eng-508.pdf
7. World Health Organization. (2006). *Informal consultation on global burden of leptospirosis: Methods of assessment.* https://www.who.int/foodsafety/zoonoses/InformalConsultationOnBoDLeptospirosis.pdf
8. Costa, F., Hagan, J. E., Calcagno, J., Kane, M., Torgerson, P., Martinez-Silveira, M. S., Stein, C., Abela-Ridder, B., & Ko, A. I. (2015). Global Morbidity and Mortality of Leptospirosis: A Systematic Review. *PLoS Negl Trop Dis*, *9*(9), e0003898. https://doi.org/10.1371/journal.pntd.0003898
9. Haake, D. A., & Levett, P. N. (2015). Leptospirosis in humans. *Curr Top Microbiol Immunol*, *387*, 65-97. https://doi.org/10.1007/978-3-662-45059-8_5
10. Victoriano, A. F. B., Smythe, L. D., Gloriani-Barzaga, N., Cavinta, L. L., Kasai, T., Limpakarnjanarat, K., Ong, B. L., Gongal, G., Hall, J., & Coulombe, C. A. (2009). Leptospirosis in the Asia Pacific region. *BMC infectious diseases*, *9*(1), 147. https://doi.org/10.1186/1471-2334-9-147
11. Azfar, Z. M., Nazri, S. M., Rusli, A. M., Maizurah, O., Zahiruddin, W., Azwany, Y., Nabilah, I., Asma, H. S., & Aziah, B. (2018). Knowledge, attitude and practice about leptospirosis prevention among town service workers in northeastern Malaysia: a cross sectional study. *Journal of Preventive Medicine and Hygiene*, *59*(1), E92. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6009071/pdf/jpmh-2018-01-e92.pdf
12. Ricardo, T., Bergero, L. C., Bulgarella, E. P., & Previtali, M. A. (2018). Knowledge, attitudes and practices (KAP) regarding leptospirosis among residents of riverside settlements of Santa Fe, Argentina. *PLoS neglected tropical diseases*, *12*(5), e0006470. https://doi.org/10.1371/journal.pntd.0006470
13. Benacer, D., Thong, K. L., Verasahib, K. B., Galloway, R. L., Hartskeerl, R. A., Lewis, J. W., & Mohd Zain, S. N. (2016). Human Leptospirosis in Malaysia: Reviewing the Challenges After 8 Decades (1925-2012). *Asia Pacific Journal of Public Health*, *28*(4), 290-302. https://doi.org/10.1177/1010539516640350

FOR PROOFREADING

14. Ministry Of Health (MOH). (2015). *MOH: Epidemiology and Current Situation of Leptospirosis in Malaysia. In. Putrajaya: Disease Control Division; 2015*. http://jkt.kpkt.gov.my/jkt/resources/PDF/Persidangan_2015/persidangan%20kesihatan/Leptospirosis_in_Malaysia.pdf
15. Garba, B., Bahaman, A. R., Bejo, S. K., Zakaria, Z., Mutalib, A. R., & Bande, F. (2018). Major epidemiological factors associated with leptospirosis in Malaysia. *Acta Trop*, *178*, 242-247. https://doi.org/10.1016/j.actatropica.2017.12.010
16. Mohd Radi, M. F., Hashim, J. H., Jaafar, M. H., Hod, R., Ahmad, N., Mohammed Nawi, A., Baloch, G. M., Ismail, R., & Farakhin Ayub, N. I. (2018). Leptospirosis Outbreak After the 2014 Major Flooding Event in Kelantan, Malaysia: A Spatial-Temporal Analysis. *Am J Trop Med Hyg*, *98*(5), 1281-1295. https://doi.org/10.4269/ajtmh.16-0922
17. Soo, Z. M. P., Khan, N. A., & Siddiqui, R. (2020). Leptospirosis: Increasing importance in developing countries. *Acta Tropica*, *201*, 105183. https://doi.org/https://doi.org/10.1016/j.actatropica.2019.105183
18. Daud, A., Fuzi, N. M. H. M., Mohammad, W. M. Z. W., Amran, F., Ismail, N., Arshad, M. M., & Kamarudin, S. (2018). Leptospirosis and workplace environmental risk factors among cattle farmers in northeastern Malaysia. *Int J Occup Environ Med*, *9*(2), 88. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6466985/pdf/ijoem-9-88.pdf
19. Azimullah, A., Aziah, B., & Fauziah, B. (2016). The rise of leptospirosis in Kelantan 2014: Characteristics, geographical pattern and associated factors. *International Journal of Public Health and Clinical Sciences*, *3*(4). https://publichealthmy.org/ejournal/ojs2/index.php/ijphcs/article/view/309?utm_source=chatgpt.com
20. Arbiol, J., Orencio, M. P., Romena, N., Nomura, H., Takahashi, Y., & Yabe, M. (2016). Knowledge, Attitude and Practices towards Leptospirosis among Lakeshore Communities of Calamba and Los Baños, Laguna, Philippines. *Agriculture*, *6*(2). https://doi.org/10.3390/agriculture6020018
21. Abiayi, E., Inabo, H., Jatau, E., Makinde, A., Sar, T., Ugbe, D., Kumbish, P., & Okewole, P. (2015). Knowledge, attitudes, risk factors and practices (KARP) that favor Leptospira infection among abattoir workers in North Central Nigeria. *Asian Journal of Epidemiology*, *8*(4), 104-113. https://doi.org/10.3923/aje.2015.104.113
22. Philip, N., & Ahmed, K. (2023). Leptospirosis in Malaysia: current status, insights, and future prospects. *J Physiol Anthropol*, *42*(1), 30. https://doi.org/10.1186/s40101-023-00347-y
23. Abdullah, N. M., Mohammad, W., Shafei, M. N., Sukeri, S., Idris, Z., Arifin, W. N., Nozmi, N., Saudi, S. N. S., Samsudin, S., Zainudin, A. W., Hamat, R. A., Ibrahim, R., Masri, S. N., Saliluddin, S. M., Daud, A., Osman, M., & Jamaluddin, T. (2019). Leptospirosis and its prevention: knowledge, attitude and practice of urban community in Selangor, Malaysia. *BMC Public Health*, *19*(1), 628. https://doi.org/10.1186/s12889-019-6981-0
24. Mathanamohan, J., Kaleel, F., Hyderaly, H., Imthiyaz, I., Unais, R., Nisansala, T., Weerasekera, M., Fernando, N., Liyanage, T., & Gunasekara, C. (2020). Farmers' occupational health, perception and practices towards leptospirosis: A cause for concern. *Sri Lankan Journal of Infectious Diseases*. https://doi.org/10.4038/sljid.v10i1.8247
25. Moutos, A., Doxani, C., Stefanidis, I., Zintzaras, E., & Rachiotis, G. (2022). Knowledge, Attitude and Practices (KAP) of Ruminant Livestock Farmers Related to Zoonotic Diseases in Elassona Municipality, Greece. *European Journal of Investigation in Health, Psychology and Education*, *12*(3), 269-280. https://doi.org/10.3390/ejihpe12030019
26. Daud, A., Fuzi, N., Arshad, M. M., Kamarudin, S., Mohammad, W., Amran, F., & Ismail, N. (2018). Leptospirosis seropositivity and its serovars among cattle in Northeastern Malaysia. *Vet World*, *11*(6), 840-844. https://doi.org/10.14202/vetworld.2018.840-844

FOR PROOFREADING

27. Sakinah, S., Suhailah, S., Jamaluddin, T., Norbaya, S., & Malina, O. (2015). Seroprevalence of leptospiral antibodies and knowledge, attitude and practices of leptospirosis to non high risk group in Selangor. *International Journal of Public Health and Clinical Sciences*, *2*(1), 92-104.
28. Edre, M., Hayati, K., Salmiah, M., & Sharifah, N. (2018). Spatial distribution of knowledge, attitude and practice on leptospirosis prevention and its predictors using stratum risk identification methods among residents in a flood prone area in Kuantan, Pahang, Malaysia. *Asian Journal of Agriculture and Biology*(Special Issue), 103-107.
29. Sapian, M., Khairi, M., How, S., Rajalingam, R., Sahhir, K., Norazah, A., Khebir, V., & Jamalludin, A. (2012). Outbreak of melioidosis and leptospirosis co-infection following a rescue operation. *Med J Malaysia*, *67*(3), 293-297.
30. Day, M. J. (2011). One health: the importance of companion animal vector-borne diseases. *Parasites & vectors*, *4*(1), 49. https://doi.org/10.1186/1756-3305-4-49
31. Ghai, R. R., Wallace, R. M., Kile, J. C., Shoemaker, T. R., Vieira, A. R., Negron, M. E., Shadomy, S. V., Sinclair, J. R., Goryoka, G. W., Salyer, S. J., & Barton Behravesh, C. (2022). A generalizable one health framework for the control of zoonotic diseases. *Sci Rep*, *12*(1), 8588. https://doi.org/10.1038/s41598-022-12619-1
32. Aggarwal, D., & Ramachandran, A. (2020). One Health Approach to Address Zoonotic Diseases. *Indian J Community Med*, *45*(Suppl 1), S6-s8. https://doi.org/10.4103/ijcm.IJCM_398_19
33. Nozmi, N., Samsudin, S., Sukeri, S., Shafei, M. N., Wan Mohd, W. M. Z., Idris, Z., Arifin, W. N., Idris, N., Saudi, S. N. S., Abdullah, N. M., Abdul Wahab, Z., Tengku Jamaluddin, T. Z. M., Abd Rahman, H., Masri, S. N., Daud, A., Osman, M., & Awang Hamat, R. (2018). Low Levels of Knowledge, Attitudes and Preventive Practices on Leptospirosis among a Rural Community in Hulu Langat District, Selangor, Malaysia. *Int J Environ Res Public Health*, *15*(4). https://doi.org/10.3390/ijerph15040693
34. Benacer, D., Thong, K. L., Min, N. C., Bin Verasahib, K., Galloway, R. L., Hartskeerl, R. A., Souris, M., & Mohd Zain, S. N. (2016). Epidemiology of human leptospirosis in Malaysia, 2004-2012. *Acta Trop*, *157*, 162-168. https://doi.org/10.1016/j.actatropica.2016.01.031
35. Schneider, T. R., Salovey, P., Pallonen, U., Mundorf, N., Smith, N. F., & Steward, W. T. (2001). Visual and Auditory Message Framing Effects on Tobacco Smoking 1. *Journal of Applied Social Psychology*, *31*(4), 667-682. https://doi.org/10.1111/j.1559-1816.2001.tb01407.x
36. Montano, D. E., & Kasprzyk, D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. *Health behavior: Theory, research and practice*, *70*(4), 231.
37. Benacer, D., Mohd Zain, S. N., Sim, S. Z., Mohd Khalid, M. K. N., Galloway, R. L., Souris, M., & Thong, K. L. (2016). Determination of Leptospira borgpetersenii serovar Javanica and Leptospira interrogans serovar Bataviae as the persistent Leptospira serovars circulating in the urban rat populations in Peninsular Malaysia [journal article]. *Parasites & vectors*, *9*(1), 117. https://doi.org/10.1186/s13071-016-1400-1
38. Campagnolo, E. R., Warwick, M. C., Marx Jr, H. L., Cowart, R. P., Donnell Jr, H. D., Bajani, M. D., Bragg, S. L., Esteban, J. E., Alt, D. P., & Tappero, J. W. (2000). Analysis of the 1998 outbreak of leptospirosis in Missouri in humans exposed to infected swine. *Journal of the American Veterinary Medical Association*, *216*(5), 676-682. https://doi.org/10.2460/javma.2000.216.676
39. Colavita, G., & Paoletti, M. (2007). Leptospirosis: occupational risk in the chain of food of animal origin. *Giornale italiano di medicina del lavoro ed ergonomia*, *29*(1), 21-24.
40. Verbeek, J. H., Rajamaki, B., Ijaz, S., Sauni, R., Toomey, E., Blackwood, B., Tikka, C., Ruotsalainen, J. H., & Balci, F. S. K. (2020). Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. *Cochrane Database of Systematic Reviews*(4). https://doi.org/10.1002/14651858.CD011621.pub4
41. Adler, B., & de la Peña Moctezuma, A. (2010). Leptospira and leptospirosis. *Veterinary Microbiology*, *140*(3), 287-296. https://doi.org/https://doi.org/10.1016/j.vetmic.2009.03.012

FOR PROOFREADING

42. Sukeri, S., Idris, Z., Zahiruddin, W. M., Shafei, M. N., Idris, N., Hamat, R. A., Jamaluddin, T. Z. T., Osman, M., Wahab, Z. A., & Daud, A. (2018). A qualitative exploration of the misconceptions, knowledge gaps and constructs of leptospirosis among rural and urban communities in Malaysia. *PLoS One*, *13*(7), e0200871. https://doi.org/10.1371/journal.pone.0200871
43. Berdi, G. A., Charkazi, A., & Razzaq, N. A. (2013). Knowledge, practice and perceived threat toward breast cancer in the women living in Gorgan, Iran.
44. Zeng, Z., Chen, H., Xu, J., Zhang, H., Xu, C., Fan, L., Chen, S., Chen, K., Yang, Z., & Wei, Y. (2023). Characteristics of leptospirosis cases, prevention and control managements 1955-2020, Guangzhou, China. *One Health*, *16*, 100541. https://doi.org/10.1016/j.onehlt.2023.100541
45. Sejvar, J., Bancroft, E., Winthrop, K., Bettinger, J., Bajani, M., Bragg, S., Shutt, K., Kaiser, R., Marano, N., & Popovic, T. (2003). Leptospirosis in "eco-challenge" athletes, Malaysian Borneo, 2000. *Emerg Infect Dis*, *9*(6), 702. https://doi.org/10.3201/eid0906.020751
46. Yanagihara, Y., Villanueva, S. Y., Yoshida, S.-i., Okamoto, Y., & Masuzawa, T. (2007). Current status of leptospirosis in Japan and Philippines. *Comparative immunology, microbiology and infectious diseases*, *30*(5-6), 399-413. https://doi.org/10.1016/j.cimid.2007.05.003
47. Monahan, A., Miller, I., & Nally, J. (2009). Leptospirosis: risks during recreational activities. *Journal of applied microbiology*, *107*(3), 707-716. https://doi.org/10.1111/j.1365-2672.2009.04220.x
48. Brown, P. R., Hung, N. Q., Hung, N. M., & van Wensveen, M. (1999). 15. Population Ecology and Management of Rodent Pests in the Mekong River Delta, Vietnam.
49. Figueiredo, C. M. d., Mourão, A. C., Oliveira, M. A. A. d., Alves, W. R., Ooteman, M. C., Chamone, C. B., & Koury, M. C. (2001). Human leptospirosis in Belo Horizonte City, Brazil: a geographic approach. *Revista da Sociedade Brasileira de Medicina Tropical*, *34*(4), 331-338. https://doi.org/10.1590/S0037-86822001000400004
50. Fajriyah, S. N., Udiyono, A., & Saraswati, L. D. (2017). Environmental and risk factors of leptospirosis: a spatial analysis in Semarang City. IOP Conference Series: Earth and Environmental Science. https://doi.org/10.1088/1755-1315/55/1/012013
51. Baharom, M., Ahmad, N., Hod, R., Ja'afar, M. H., Arsad, F. S., Tangang, F., Ismail, R., Mohamed, N., Mohd Radi, M. F., & Osman, Y. (2024). Environmental and Occupational Factors Associated with Leptospirosis: A Systematic Review. *Heliyon*, *10*(1), e23473. https://doi.org/https://doi.org/10.1016/j.heliyon.2023.e23473
52. Rahman, M. H. A. A., Hairon, S. M., Hamat, R. A., Jamaluddin, T. Z. M. T., Shafei, M. N., Idris, N., Osman, M., Sukeri, S., Wahab, Z. A., Mohammad, W. M. Z. W., Idris, Z., & Daud, A. (2018). Leptospirosis Health Intervention Module Effect on Knowledge, Attitude, Belief, and Practice among Wet Market Workers in Northeastern Malaysia: An Intervention Study. *International Journal of Environmental Research and Public Health*, *15*(7), 1396. https://www.mdpi.com/1660-4601/15/7/1396
53. Brown, P., McKenzie, M., Pinnock, M., & McGrowder, D. (2011). Environmental risk factors associated with leptospirosis among butchers and their associates in Jamaica. *Int J Occup Environ Med (The IJOEM)*, *2*(1 January).

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Development and validation of a nutrition education module on free sugar for individuals with metabolic syndrome: My 3S (Smart Sugar Study)

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ABSTRACT

Introduction: Metabolic syndrome (MetS) is a measure of an individual's risk of developing cardiovascular disease. This paper describes the development and validation of a nutrition education module, The My 3S (Smart Sugar Study) that focused on free sugar. **Methodology**: The My 3S have three phases: Phase 1 Needs assessment, Phase 2 Development and validation of nutrition education module, and Phase 3 Feasibility study. Phase 1 Needs assessment, which is a cross-sectional study was conducted using surveys on dietary free sugar of general population (n=209) and individuals with MetS (n=39), and clinical observation of dietetic consultation (n=20). The inclusion criteria included Malaysian; 30-65 years old; able to communicate in Malay or English; presence with MetS. The module development involved five experts in nutrition, dietetics, and medicine. The content validity was conducted using a content validity index (CVI) among five expert panels who were health care experts. And the face validity involved 32 target audiences and five expert panels. **Result**: The free sugar of individuals with MetS was 18.6 (9.09) % of total energy intake and the dietetic consultation did not include daily free sugar allowance. The developed module showed good content validity (CVI = 1.0) and face validity (average score of 78.3% to 91.7% from the expert panels and 96.9% to 100.0% from the target audiences). **Conclusion**: Individuals with MetS consumed high free sugar and there is lack of nutrition education module on free sugar for them. The newly developed nutrition education module can be used to educate individuals with MetS and high free sugar.

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1. INTRODUCTION

Metabolic syndrome (MetS) is a measure of an individual's risk of developing diseases such as type 2 diabetes (T2DM) and cardiovascular disease [1,2]. The prevalence of MetS in the Asia-Pacific region is 12 to 37% [3]. In Malaysia, the prevalence of MetS is between 38 to 49% among the adult population, which is one of the highest in the Asia-Pacific region [4].

The dietary factors are responsible for more than 40% of the most common cardiometabolic-related deaths in the U.S. [5]. Studies showed that high sugar intake is among the contributing factors to the development of cardiometabolic risk (CMR) [6–10]. The free sugar is quickly absorbed and may lead to significant high blood glucose levels, leading to increased insulinemia. This in long term will result in glucose intolerance and insulin resistance, leading to increased CMR [11]. The World Health Organisation (WHO) issued dietary guidelines which recommend limiting free sugar intake to less than 10% of daily energy intake [12]. Malaysian population consumed high dietary sugar (85 g/day) [13]. And the availability of sugar (kg per capita per year) in Malaysia has risen by 91%, from 22.5 kg in 1963 to 42.9 kg in 2013 [14]. This rise in dietary sugar is in parallel with the increased prevalence of MetS in Malaysia.

Systematic review and meta-analyses of randomised controlled trials have been conducted to investigate the effect of lifestyle intervention focusing on dietary modification in individuals with CMR [15,16]. However, the positive impact of the nutrition education focusing on lifestyle modification was not sustained over time [17]. This may be because the participants become demotivated and discouraged from following a healthy diet. Incorporating a theoretical framework in the individualised nutrition care may improve the success of the lifestyle modification. This was supported by the U.K. Medical Research Council where it recommends using a theory to develop interventions [18].

The standard theoretical framework incorporated in the nutrition intervention include Health Belief Model (HBM), Social Cognitive Theory, Theory of Planned Behaviour, Self-determination Theory and others. The HBM is one of the theories used to study individuals' responses to symptoms and their responses to a diagnosed disease [19,20]. Its constructs include perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, self-efficacy, and cues to action [19,20]. The rationale of the HBM is that individuals with MetS will be more likely to follow the dietary advice if they believe that they are susceptible to CMR, serious consequence to them, and following the advice would lower the CMR [19,20]. A scoping review reported that integrating HBM in nutrition education positively impacted the outcome measures in individuals with MetS, particularly in improving dietary habits [21]. Hence, incorporating HBM in the nutrition education intervention would improve the sustainability of the outcomes of the intervention.

In Malaysia, there is a lack of nutrition education module focusing on dietary free sugar that incorporates a theoretical framework, tailored for individuals with MetS. Hence, the present study aimed to develop and validate a nutrition education module focusing on dietary free sugar for individuals with MetS. Dietitians are the key healthcare professionals to provide medical nutrition therapy and nutrition care plan to individuals with MetS in the outpatient healthcare setting. The objective of The My 3S (Smart Sugar Study) is to determine the feasibility of the nutrition education module focusing on free sugar among individuals with MetS. The nutrition education module will serve as one of the main education materials for clinical dietitian to utilise during the dietetic consultation.

2. MATERIALS AND METHODS

2.1 Study design

The present study was conducted in three phases: Phase 1 Needs assessment, Phase 2 Development and validation of nutrition education module, and Phase 3 Feasibility study. Phase 1 Cross-sectional study and Phase 2 Development and validation of nutrition education module are complete, while Phase 3 Feasibility study is still in progress.

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2.2 Phase 1 needs assessment

The study design of Phase 1, which is a cross-sectional study has been documented in another publication [22]. Sample size was calculated based on the objective of the study, using the standard formula n=[(Zα+Zβ)/C]2+3[23]. A sample size of 191 was needed with 95% level of significance and 80% power. The drop-out rate was assumed to be about 20%, hence a minimum sample size of 229 was needed. The cross-sectional study showed that the CMR among general population (adult Malaysians) was 39.6% and the quantity of sugars added in coffee was one of the factors that was significantly associated with CMR [22]. Hence, we further conducted a physical survey to investigate the amount of free sugar consumed by individuals with MetS, and a clinical observation to investigate the structure of free sugar education for patients with MetS during their dietetic consultation with the clinical dietitian.

2.2.1 Physical survey of daily sugar intake in patients with MetS

The inclusion criteria included Malaysian citizen; patients from the Hospital Sultan Abdul Aziz Shah (HSAAS); aged 30-65 years old; able to communicate in Malay or English; presence with MetS. The researcher obtained permission from HSAAS to access the list of patients' who are present with MetS and contact them via WhatsApp. The potential candidates were informed about the nature of the research and if they agreed to participate, an appointment would be arranged to meet the researcher at HSAAS. Potential candidates who agreed to participate in the survey signed the written informed consent. They provided their daily total sugar intakes by completing two questionnaires, which were the 24-hour diet recall and semi-quantitative Food Frequency Questionnaire (FFQ) of added sugar intake [24].

The estimated basal metabolic rate (BMR) was calculated using the Harris-Benedict equations [25,26]. The reliability of dietary intake data was evaluated using the Goldberg method for the misreporting of energy intake [27]. All the foods obtained were analysed using Nutritionist Pro Software (Axxya Systems, United States) for energy and macronutrients. In addition, free sugar was analysed using the sugar database [14,28].

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2.2.2 Clinical observation of dietetic consultation

The inclusion criteria included Malaysian citizen; patients from HSAAS; aged 30-65 years old; able to communicate in Malay or English; presence with MetS; seeing the clinical dietitian in HSAAS. The sample size estimation was 20 patients or until data saturation has been achieved.

The researcher obtained permission from the clinical dietitians in HSAAS to access the list of patients who are present with MetS and had face-to-face session with the clinical dietitian. The clinical dietitians who agree to let the researcher observed their session with patients signed the written informed consent. The researcher then sat in and observed the whole session without interfering with the discussion. The researcher filled up a clinical observation form where it included information about nutrition assessment, nutrition diagnosis, and nutrition intervention of the patients. A reference list of the recommendations related to sugar intake for the dietetic session was used to indicate the sugar-related information provided by the clinical dietitian.

2.3 Phase 2 Development and validation of nutrition education module

2.3.1 Development of nutrition education module

The content of the nutrition education module was developed based on the international and local guidelines, which were the Medical Nutrition Therapy and Clinical Practice Guidelines [29–38]. A psychosocial theory, the Health Belief Model (HBM) was incorporated in the module. Besides, scientific

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facts, strategies used in other nutrition education interventions, and findings of the needs assessment study were also included in the module. To better fit the dietary intake of Malaysian adults, local and common food choices were incorporated in the module. This module also included information from Phase 1 Needs assessment, which were the foods and drinks that are high in free sugar that were commonly consumed by individuals with MetS and maximum daily free sugar allowance for individuals with MetS.

The module development involved three dietitians (B.N.M.Y., Z.A.Z. and W.L.C.), a nutritionist (A.A.), and a physician (I.Z.I.). The module consisted of a flip chart and a booklet, which was used by the dietitian during the consultation sessions with patients with MetS in the nutrition education intervention. Clear and simple language and realistic and suitable examples were used in the module to facilitate effective communication.

2.3.2 Validation of the nutrition education module

The face and content validation of the nutrition education module was done by the expert panels and target audiences. The selection criteria for the expert panels were health care experts, who had a background in nutrition and dietetics, and with experience in providing the health care process to individuals with MetS. Meanwhile, the selection criteria for the target audiences were patients from HSAAS, Malaysian citizens, aged 18 to 65 years old, Malay literate, and present with MetS.

The evaluation process was conducted from November 2022 to January 2023. The validation form, adapted from a local study was used to determine the face and content validation of the module [39]. Face validity was conducted to determine the degree to which the module appears, on its face value, to deliver the aspects that it intends to deliver [40]. Meanwhile, content validity is the extent to which a measurement tool detects the different facets of an entire aspect area [41].

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2.3.2.1 Validation by expert panels

The validation form for the expert panels consisted of seven aspects, which were scientific accuracy, content, format, illustration, design and layout, presentation and organisation, and quality of information. The scientific accuracy and content were used to evaluate the content validity of the module and the remaining aspects were used for face validity. The components in the module were rated using the four-point Likert scale (1 = not relevant, 2 = some revision required, 3 = relevant but needs minor revision, and 4 = very relevant).

A content validity index (CVI) was used to quantify the content validity and the proportion of agreement on the appropriateness of the aspects was expressed between zero and one [42,43]. To determine the CVI, the number of experts who rated the components of the two aspects (scientific accuracy and content) as relevant, which is rating 3 and 4, were divided by the total number of experts [43]. A CVI of more than 0.79 indicates that the item is acceptable, 0.7 to 0.79 indicates that the item needs revision and less than 0.7 indicates that the item should be eliminated [43].

For face validity of the module, the rating of the components in each aspect (format, illustration, design and layout, presentation and organisation, and quality of information) were determined. The average score of each aspect has to be at least 75%, to be considered appropriate [44].

2.3.2.2 Validation by target audiences

The target audiences were required to evaluate the module and completed a validation form that consisted of five aspects: format, illustration, design and layout, presentation and organisation, and quality of information. The components of the aspects were rated as ‘1 = yes’ or ‘0 = no’. The average score of each aspect was determined and only those aspects with at least 75% were considered appropriate [44]. The validation process was carried out until data saturation had been achieved.

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2.4 Statistical analysis

Statistical analysis of Phase 1 data was performed using the IBM Statistical Package for Social Sciences (SPSS) Version 25. All statistical tests were set at a significance level of $p<0.05$. Distribution normality of continuous data was checked using the Shapiro-Wilk test. Descriptive analysis was conducted to determine the means and standard deviations for continuous data, and percentages and frequencies for categorical data.

3. RESULTS

3.1 Phase 1 physical survey of free sugar intake in patients with MetS

A total of 39 patients with MetS aged 30 to 65 years old from HSAAS participated in the survey. By using the Goldberg method for the misreporting of energy intake, 5 misreporting patients were excluded from the analysis. Table 1 shows the demographic characteristics of the patients involved in the survey. The median age of the patients was 44.0 (1.46) years. About half (52.9%) of the patients were female and 97.1% were Malay. A total of 17.6% of them were overweight and 79.4% were obese.

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Table 1. General characteristics of the participants (n=34)

Variables	n (%)
Age (year)	**Median (SEM):** 44.0 (1.46)
Age category	
30-39	10 (29.4)
40-49	12 (35.3)
50-59	9 (26.5)
60 and above	3 (8.8)
Sex	
Male	18 (52.9)
Female	16 (47.1)
Ethnicity	
Malay	33 (97.1)
Chinese	0 (0.0)
Indian	1 (2.9)
Others	0 (0.0)
Height (m)	Mean (SD): 1.6 (0.09)
Weight (kg)	Mean (SD): 88.4 (22.83)
BMI (kg/m^2)	Median (SD): 32.4 (1.35)
BMI category (kg/m^2)	
<18.5	0.(0.0)
18.5-22.9	1 (2.9)
23.0-27.5	6 (17.6)
>27.5	27 (79.4)
Supplement usage	
Yes	18 (52.9)
No	16 (47.1)

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Cigarette smoking	
Yes	4 (11.8)
No	30 (88.2)
Past medical history	
Type 2 diabetes	
Yes	22 (64.7)
No	12 (35.3)
Dyslipidaemia	
Yes	34 (100.0)
No	0.(0.0)
Hypertension	
Yes	24 (70.6)
No	10 (29.4)
Others	
Yes	4 (11.8)
No	30 (88.2)

Source: Wan Ling Chiang et al (2026)

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The mean energy intake of the participants was 1725.1 (370.55) kcal/day, while the carbohydrate, protein and fat intake were 55.1 (7.50) % total energy intake (TEI), 15.2 (2.44) % TEI and 30.1 (6.65) % TEI, respectively. The median fibre was 4.8 g (0.63) and free sugar was 18.6 (9.09) % TEI. The dietary energy and nutrient intakes of the participants was shown in Table 2.

Table 2. Descriptive findings of dietary energy and nutrient intakes of the participants (n=34)

Dietary variables	Range	Intake Mean (SD)	Recommendation
Energy (kcal/d)	1195 – 2710	1725.1 (370.55)	1780 – 2460[a]
Carbohydrate (% TEI)	32 – 69	55.1 (7.50)	55 – 70[a]
Protein (% TEI)	9 – 20	15.2 (2.44)	10 - 15[a]
Fat (% TEI)	18 – 49	30.1 (6.65)	20 - 30[a]
Fibre (g)	1 – 18	4.8 (0.63)*	20 – 30[b]
Free sugar (% TEI)	4 – 36	18.6 (9.09)	<10[c]
Vitamin A (mcg RE)	62 – 837	450.6 (161.83)	-
Thiamine (mg)	0 – 2	0.7 (0.71)*	1.1 – 1.2[a]
Riboflavin (mg)	0 – 3	1.1 (0.47)	1.1 – 1.3[a]
Niacin (mg)	6 – 33	11.4 (0.84)*	14 - 16[a]
Folate (mcg)	49 – 736	236.6 (19.29)*	400[a]
Vitamin C (mg)	7 – 213	93.4 (44.63)	70[a]
Vitamin D (mg)	0 – 6	0.0 (0.23)*	5 - 10[a]
Vitamin E (mcg)	3 – 32	6.3 (0.88)*	7.5 - 10[a]
Calcium (mg)	183 – 978	477.0 (203.44)	800 - 1000[a]
Iron (mg)	1 – 45	17.4 (1.82)*	11 - 29[a]
Zinc (mg)	2 – 20	5.4 (0.50)*	4.9 – 6.7[a]
Selenium (mcg)	0 - 99	26.6 (3.86)*	25 - 33[a]

*Median (SEM); [a] Recommendations by the Malaysian RNI; [b] Recommendations by the Malaysian Dietary Guideline; [c] WHO recommendation; RE, retinol equivalent.

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The food groups in the FFQ of added sugar intake was classified into the descending order of their contribution to the free sugar intake. About 2/3 (66.9%) of the free sugar intake of the patients were contributed by mixed drinks, where majority were homemade or non-franchised coffee/ tea/ malt drink. This order was followed by canned/box/bottle drink (7.1%), miscellaneous (including jam, coconut milk jam [kaya] and honey).

3.2 Clinical observation of dietetic consultation

A total of 20 patients with MetS aged 30 to 65 years old from HSAAS participated in the clinical observation. Table 3 shows the demographic characteristics of the patients. The mean age of the patients was 50.8 (10.88) years. About 40% of the patients were male, 85.5% were Malay and 60% were first visit. A total of 65.0% of the patients has obesity and 70% of the patients had high fasting blood glucose, 45.0% had high triglyceride and 35.0% low HDL-cholesterol and 60.0% had high blood pressure.

During the clinical observation, the dietitians asked patients to reduce foods/ drinks high in sugar, discussed the types of foods/ drinks high in sugar and suggested the alternatives to reduce foods/ drinks high in sugar. The dietitians also educated patient about the recommended type and amount of dietary sugar intake. However, the dietitians did not inform patients about his/her maximum daily free sugar allowance and educate patients about calculating the daily free sugar.

Table 3. General characteristics of the participants (n=20)

Variables	n (%)
Age (year)	**Mean (SD):** 50.8 (10.88)
Age category	
30-39	1 (5.0)
40-49	8 (40.0)
50-59	6 (30.0)
60-65	5 (25.0)
Sex	
Male	8 (40.0)
Female	12 (60.0)
Ethnicity	
Malay	17 (85.0)
Chinese	1 (5.0)
Indian	2 (10.0)
Others	0 (0.0)
Dietetic consultation	
New	12 (60.0)
Follow-up	8 (40.0)
Duration of follow-up	3
Height (m)	Mean (SD): 1.6 (0.09)
Weight (kg)	Mean (SD): 84.5 (23.15)
BMI (kg/m^2)	Mean (SD): 31.8 (7.09)
BMI category (kg/m^2)	
<18.5	0 (0.0)
18.5-22.9	2 (10.0)
23.0-27.5	5 (25.0)
>27.5	13 (65.0)

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HbA1c	Mean (SD): 7.3 (1.62)
Fasting blood glucose	Median (SEM): 6.5 (0.81)
High fasting blood glucose (≥5.6mmol/ L) or diabetes	
Yes	14 (70.0)
No	6 (30.0)
Triglyceride	Mean (SD): 1.6 (0.56)
High triglyceride (≥1.7 mmol/ L or on triglycerides treatment)	
Yes	9 (45.0)
No	11 (55.0)
HDL-cholesterol	1.3 (0.42)
Low HDL-cholesterol (<1.0 mmol/ L in men or <1.3 mmol/ L in women or on HDL- cholesterol treatment)	
Yes	7 (35.0)
No	13 (65.0)
High blood pressure (≥130/ 85 mmHg or on anti-hypertensive therapy)	
Yes	12 (60.0)
No	8 (40.0)

Source: Wan Ling Chiang et al (2026)

3.3 Development and validation of nutrition education module

A total of five experts, composed of three clinical dietitians, a community dietitian, and a lecturer were invited to review, provide feedback and judge the validation of the nutrition education module. The three clinical dietitians are working in the clinical field and the community dietitian is from the Disease Control Division, Ministry of Health, Malaysia. The lecturer, with a background in nutrition and dietetics, is currently working at a local government university.

A total of 32 patients with MetS, aged 18 to 65 were recruited from the HSAAS to participate in the validation of the nutrition education module. Table 4 shows the characteristics of the patients. Most (43.8%) of the subjects were in the age range of 40 to 49 years old, 90.6% were Malay, 90.6% had a tertiary education level and 68.8% were working. The median Body Mass Index (BMI) for the subjects was 27.7 kg/m2, where 40.9% of them were in the BMI range of 25.0 to 29.9 kg/m2.

Table 4. Characteristic of target audiences (n=32)

Characteristics	Male (n=12) n (%)	Female (n=20) n (%)	Overall (n=32) n (%)
Age (median)	42.5 (2.35)	48.0 (1.80)	46.0 (1.44)
Age group			
18 to 29	0 (0.0)	0 (0.0)	0 (0.0)
30 to 39	4 (33.3)	3 (15.0)	7 (21.9)
40 to 49	5 (41.7)	9 (45.0)	14 (43.8)
50 to 60	3 (25.0)	8 (40.0)	11 (34.4)
Ethnicity			
Malay	11 (91.7)	18 (90.0)	29 (90.6)
Chinese	1 (8.3)	1 (5.0)	2 (6.2)

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Indian	0 (0.0)	1 (5.0)	1 (3.1)
Others	0 (0.0)	0 (0.0)	0 (0.0)
Education level			
No formal	0 (0.0)	0 (0.0)	0 (0.0)
Primary education	0 (0.0)	0 (0.0)	0 (0.0)
Secondary education	1 (8.3)	2 (10.0)	3 (9.4)
Tertiary education	11 (91.7)	18 (90.0)	29 (90.6)
Employment status			
Working	9 (75.0)	13 (65.0)	22 (68.8)
Not working	3 (25.0)	7 (35.0)	10 (31.2)
Body Mass Index (BMI) (median) (kg/m^2)	27.5 (1.80)	28.7 (1.52)	27.7 (1.15)
BMI category			
<18.5	0 (0.0)	0 (0.0)	0 (0.0)
18.5 to 24.9	2 (16.7)	5 (25.0)	7 (21.9)
25.0 to 29.9	6 (50.0)	7 (35.0)	13 (40.6)
≥30.0	4 (33.3)	8 (40.0)	12 (37.5)

Source: Wan Ling Chiang et al (2026)

3.3.1 Development of a nutrition education module

The nutrition education module consists of a flip chart and a booklet that will be used in the Phase 3 nutrition education intervention. The constructs of HBM (perceived susceptibility, perceived seriousness, perceived benefits, perceived barriers, self-efficacy, and cues to action) were incorporated in the flip chart and booklet (Table 5).

The flip chart is a nutrition guide for clinical dietitian's use during the consultation sessions with patients with MetS. It has a dietitian's view (detailed explanations) and a patient's view (simple language and infographics). The flip chart is double-sided and consists of 30 pages. The dimensions of the flip chart are 7.5 inches x 10.8 inches.

The booklet provides detailed information of free sugar, including the quantity of free sugars in foods and drinks that were commonly consumed by individuals with MetS, as reported in Phase 1 Needs assessment. It also provides information of the maximum daily free sugar allowance based on patients' daily energy intake, which the dietitians did not inform the patients during the dietetic consultation. Besides, the booklet contains a fill-in-the-blank activity, crossword puzzles, and a scenario of calculating daily sugar intake to facilitate learning and critical thinking. The booklet is double-sided and consists of 31 pages. The dimensions of the booklet are 5.9 inches x 8.3 inches.

Table 5. Description of dietary modification based on the Health Belief Model constructs

No.	Health Belief Model constructs	Topic	Description	Tools
1	Perceived susceptibility	• Prevalence of MetS • Risk factors of MetS Free sugar intake in Malaysia	• Overview of the MetS and the prevalence of overweight/ obese, diabetes, hypertension, and dyslipidaemia in Malaysia • Discussion on the risk factors of MetS based on the subjects' medical condition and emphasise subjects'	Flipchart

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			susceptibility to cardiometabolic conditions Overview of free sugar and the consumption of free sugar among Malaysian population	
2	Perceived severity	• Health complications of MetS	• Discussion on the severity and complication of cardiometabolic conditions in relation to high free sugar intake	• Flipchart and booklet
3	Perceived benefits	• Benefits of adhering to the dietary recommendation and reducing free sugar	• Discussion on the benefits of adhering to the dietary recommendation and reducing free sugar intake based on the subjects' medical condition	• Flipchart and booklet
4	Perceived barriers	• Barriers of adhering to the dietary recommendation and reducing free sugar	• Discussion on the barriers when adhering to the dietary recommendation and reducing free sugar intake based on the subjects' background including socioeconomic status and dietary behaviour	• Booklet
5	Cues to action	• Guidelines of free sugar intake • Strategies on reducing free sugar • Application of Free Sugar Point System	• Discussion on the international and local guidelines of free sugar • Discussion on tips to reduce free sugar • Calculate maximum free sugar intake using Free Sugar Point System, based on daily energy intake	• Flipchart and booklet
6	Self-efficacy	• Set personal goal	• Discussion on the personal goals	• Booklet

Source: Wan Ling Chiang et al (2026)

3.3.2 Content validation by the expert panels

Both the two aspects "scientific accuracy" and "content" obtained a CVI of 1.0, indicating an excellent agreement on the appropriateness of the aspects. Three out of five experts agreed that the "scientific accuracy" was relevant but needs minor revision. Their comments were (a) to provide more explanation on the difference between added sugar and free sugar, (b) to elaborate more about different types of sugar, and (c) not to use 'sugar exchange' to avoid confusion with 'carbohydrate exchange'. Other minor changes were to replace technical terms with layman terms and some grammatical errors. All the feedback from the experts was reviewed and the nutrition education module was revised based on the feedback.

3.3.3 Face validation by the expert panels and target audiences

The average score of the aspects by the expert panels ranged from 78.3% to 91.7%, and 96.9% to 100.0% by the target audiences, both were considered appropriate (≤ 75.0%) (Table 6). The comments of the experts included reformulating illustrations and to standardise the font size, as well as having more examples and

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pictures of food items. In terms of format, all the audiences commented that the size of the letters was appropriate, the spaces between the letters and words facilitate reading, and the font was easy to read. All the audiences also commented that the illustration was properly labelled and the colour was appropriate, the design and layout were harmonious, and the length of the sentence is suited to the comprehension level of the target audience. However, they suggested including more pictures and fewer words, elaborating on the difference between added sugar and free sugar, and some grammatical errors.

Table 6. Face validity of nutrition education module by the experts (n=5)

Criteria	Experts (n=5) Percentage (%)	Target audiences (n=32) Percentage (%)
Format	91.7	100.0
Illustration	86.0	98.1
Design and layout	80.0	97.9
Presentation and organisation	88.8	97.7
Quality of information	78.3	96.9

Source: Wan Ling Chiang et al (2026)

4. DISCUSSION

The physical survey on dietary free sugar showed that individuals with MetS consumed high free sugar, which exceeded the World Health Organisation recommendation of no more than 10% of the total daily energy intake. This was in line with the finding of a local study, where Malaysians consumed high sugar intake [13]. This high sugar intake is paralleled by consequent rises of MetS, where the prevalence of MetS in Malaysia is higher than the prevalence of MetS of the worldwide adult population [3,4]. Excessive dietary sugar is associated with MetS where it affects the regulation of lipid and carbohydrate metabolism directly or indirectly, by promoting positive energy balance, resulting in weight gain, dyslipidaemia, insulin resistance and glucose intolerance or T2DM and hypertension [8–10,45,46]. The clinical observation of dietetic consultation also confirmed the lack of nutrition education module on free sugar intake for individuals with MetS. Therefore, it is vital to develop a nutrition education module targeting individuals with MetS on their free sugar intake.

We have successfully developed a nutrition education module focusing on dietary sugar for individuals with MetS. This module was developed based on the finding of the needs assessment study and would be used by the clinical dietitians as one of the educational materials when providing care for patients with MetS. The goal of the education intervention is to educate patients with MetS on daily sugar calculation, and manage their daily meal plan more effectively, which then encourages long-term behavioural changes in sugar intake.

The developed nutrition education materials were tailored to the needs of Malaysian adults with MetS who had high free sugar intake. We incorporated local food choices to encourage behavioural change. This is because tailored print materials were more effective than non-tailored materials in influencing individuals to change their health-related behaviours [47]. Besides, we used pictures in our educational materials as the use of pictures in addition to the written and spoken text increases the patient's attention, recall, and adherence to the recommended dietary advice [48].

We incorporated HBM into our nutrition education module and the topics of the module were based on the constructs: perceived susceptibility; perceived severity; perceived benefits; perceived barriers; cues to action; self-efficacy. This is because the use of a theoretical framework in developing educational interventions improves the success of the interventions [18]. A scoping review reported that nutrition interventions that incorporated theories had positive impacts in reducing the consumption of sugar-sweetened beverages and 100% fruit juice in children and adolescents [49]. Moreover, integrating HBM in

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three to 12 months of nutrition education has been shown to improve dietary habits, physical activity levels, knowledge, health belief, and anthropometric and MetS factors in individuals with MetS [21].

In our study, we had five expert panels and they agreed on the appropriateness of the aspects for content validity. Studies have recommended at least five experts in module evaluation to avoid chance agreement [50,51]. Hence, the number of our experts was adequate and able to provide complementary areas of expertise in evaluating the module. The CVI is commonly used to measure the content validity of the developed education materials [52,53]. Previous studies of various areas had used CVI to measure the content validity of their educational materials and amendments were made until the validated final version was reached [39,44].

Our study was the first study in Malaysia to develop a nutrition education module focusing on free sugar education that is tailored for individuals with MetS whose free sugar intake exceed the recommendation. It was developed based on scientific evidence and the latest guidelines. The nutrition education module has also been validated by expert panels and target audiences. The limitation of the study is that the module was developed in the Malay language only and this may cause language barriers in individuals who are not Malay literate. Moreover, the information in the nutrition education module may be difficult for patients to understand. Hence, clinical dietitians need to assist patients when using the nutrition education module.

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5. CONCLUSION

Individuals with MetS consumed high free sugar and there is a notable lack of nutrition education modules addressing free sugar intake tailored for them. The newly developed nutrition education module from My 3S (Smart Sugar Study) can be used to educate individuals with MetS and high free sugar intake. It will also be used in the Phase 3 Feasibility study to determine the feasibility of this nutrition education module, with the aim to increase nutrition knowledge, particularly dietary sugar among individuals with MetS.

6. ACKNOWLEDGEMENTS

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7. CONFLICT OF INTEREST STATEMENT

Authors declare none.

8. AUTHORS' CONTRIBUTIONS

WLC, BNMY, AA, IZI and ZAZ participated in the conception and design of the study protocol. WLC involved in the writing of the manuscript. BNMY involved in the critical revision of the manuscript. All authors approved the final version of the manuscript that has been submitted.

9. ETHICS STATEMENT

Ethics approval was obtained from the Research Ethics Committee of Universiti Putra Malaysia (No.: JKEUPM-2023-044). Only participants with written, informed consent were recruited. This study is registered under ClinicalTrials.gov NCT05746000.

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10. REFERENCES

1. Agyei-Mensah, S., & De-Graft Aikins, A. (2010). Epidemiological transition and the double burden of disease in Accra, Ghana. *Journal of Urban Health, 87*, 879–897. https://doi.org/10.1007/s11524-010-9492-y

2. De Magalhães Cunha, C., Costa, P. R. F., De Oliveira, L. P. M., Queiroz, V. A. D. O., Pitangueira, J. C. D., & Oliveira, A. M. (2018). Dietary patterns and cardiometabolic risk factors among adolescents: Systematic review and meta-analysis. *British Journal of Nutrition, 119*(8), 859–879. https://doi.org/10.1017/S0007114518000533

3. Ranasinghe, P., Mathangasinghe, Y., Jayawardena, R., Hills, A. P., & Misra, A. (2017). Prevalence and trends of metabolic syndrome among adults in the Asia-Pacific region: A systematic review. *BMC Public Health, 17*, Article 101. https://doi.org/10.1186/s12889-017-4041-1

4. Lim, K. G., & Cheah, W. K. (2016). A review of metabolic syndrome research in Malaysia. *Medical Journal of Malaysia, 71*(Suppl 1).

5. Carbone, S., Billingsley, H. E., & Lavie, C. J. (2019). The effects of dietary sugars on cardiovascular disease and cardiovascular disease–related mortality: Finding the sweet spot. *Mayo Clinic Proceedings, 94*(12), 2452–2465. https://doi.org/10.1016/j.mayocp.2019.10.017

6. Zainuddin, N. Z. S., Shahar, S., Safii, N. S., Haron, H., & Omar, M. A. (2018). Sugar intake and metabolic syndrome among older adults in Peninsular Malaysia. *Malaysian Journal of Nutrition, 24*, 163–174.

7. Olatona, F. A., Onabanjo, O. O., Ugbaja, R. N., Nnoaham, K. E., & Adelekan, D. A. (2018). Dietary habits and metabolic risk factors for non-communicable diseases in a university undergraduate population. *Journal of Health, Population and Nutrition, 37*, Article 21. https://doi.org/10.1186/s41043-018-0152-2

8. Chiang, W. L., Azlan, A., & Yusof, B.-N. M. (2022). Sugar consumption pattern among cardiometabolic risk individuals: A scoping review. *Current Diabetes Reviews, 18*(6), e080322201???. https://doi.org/10.2174/1573399818666220324095435

9. Te Morenga, L. A., Mallard, S., & Mann, J. (2013). Dietary sugars and body weight: Systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ, 346*, e7492. https://doi.org/10.1136/bmj.e7492

10. Te Morenga, L. A., Howatson, A. J., Jones, R. M., & Mann, J. (2014). Dietary sugars and cardiometabolic risk: Systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. *The American Journal of Clinical Nutrition, 100*(1), 65–79. https://doi.org/10.3945/ajcn.113.081521

11. Ferreira-Junior, M. D., Cavalcante, K. V. N., Mota, A. P. C. da, & Gomes, R. M. (2023). Dietary sugars during critical phases of development and long-term risk of non-communicable diseases. *Diabetology, 4*(3), 273–292. https://doi.org/10.3390/diabetology4030021

FOR PROOFREADING

12. Amoutzopoulos, B., Page, P., Steer, T., Roberts, C., & Collins, D. (2020). Free and added sugar consumption and adherence to guidelines: The UK National Diet and Nutrition Survey (2014/15–2015/16). *Nutrients, 12*(11), 3393. https://doi.org/10.3390/nu12113393

13. Amarra, M. S. V., Khor, G. L., & Chan, P. (2016). Intake of added sugar in Malaysia: A review. *Asia Pacific Journal of Clinical Nutrition, 25*(2), 227–240. https://doi.org/10.6133/apjcn.2016.25.2.13

14. Chong, C. P., Shahar, S., Haron, H., & Che Din, N. (2019). Habitual sugar intake and cognitive impairment among multi-ethnic Malaysian older adults. *Clinical Interventions in Aging, 14*, 1331–1342. https://doi.org/10.2147/CIA.S211534

15. Marcos-Delgado, A., Hernández-Segura, N., Fernández-Villa, T., Molina, A. J., & Martín, V. (2021). The effect of lifestyle intervention on health-related quality of life in adults with metabolic syndrome: A meta-analysis. *International Journal of Environmental Research and Public Health, 18*(3), 887. https://doi.org/10.3390/ijerph18030887

16. van Namen, M., Prendergast, L., & Peiris, C. (2019). Supervised lifestyle intervention for people with metabolic syndrome improves outcomes and reduces individual risk factors of metabolic syndrome: A systematic review and meta-analysis. *Metabolism, 101*, 153988. https://doi.org/10.1016/j.metabol.2019.153988

17. Choo, J., Yoon, S. J., Ryu, H., Park, M. S., Lee, H. S., Park, Y. M., et al. (2016). The Seoul metropolitan lifestyle intervention program and metabolic syndrome risk: A retrospective database study. *International Journal of Environmental Research and Public Health, 13*(7), 667. https://doi.org/10.3390/ijerph13070667

18. Tougas, M. E., Hayden, J. A., McGrath, P. J., Huguet, A., & Rozario, S. (2015). A systematic review exploring the social cognitive theory of self-regulation as a framework for chronic health condition interventions. *PLOS ONE, 10*(8), e0134977. https://doi.org/10.1371/journal.pone.0134977

19. Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2008). *Health behavior and health education: Theory, research, and practice* (4th ed.). Jossey-Bass.

20. Janz, N. K., & Becker, M. H. (1984). The Health Belief Model: A decade later. *Health Education & Behavior, 11*(1), 1–47. https://doi.org/10.1177/109019818401100101

21. Chiang, W. L., Yusof, B. N. M., & Azlan, A. (2021). Integrating Health Belief Model in nutrition education for individuals with cardiometabolic risk: The state-of-the-art. *International Journal of Academic Research in Business and Social Sciences, 11*, 381–403.

22. Chiang, W. L., Barakatun Nisak, M. Y., Azrina, A., Irmi, Z. I., & Zalina, A. Z. (2022). Has dietary intake changed the cardiometabolic risk during COVID-19 lockdowns among a sample of Malaysian adults? *Proceeding B-ICON, 1*, Article 25. https://doi.org/10.33088/bicon.v1i1.25

23. Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2013). *Designing clinical research* (4th ed.). Lippincott Williams & Wilkins.

24. Nik Shanita, S., Norimah, A. K., & Abu Hanifah, S. (2012). Development and validation of a food frequency questionnaire (FFQ) for assessing sugar consumption among adults in Klang Valley, Malaysia. *Malaysian Journal of Nutrition, 18*, 283–293.

FOR PROOFREADING

25. Kien, C. L., & Ugrasbul, F. (2004). Prediction of daily energy expenditure during a feeding trial using measurements of resting energy expenditure, fat-free mass, or Harris-Benedict equations. *The American Journal of Clinical Nutrition, 80*(4), 876–880. https://doi.org/10.1093/ajcn/80.4.876

26. Pinto, A. S., Chedid, M. F., Guerra, L. T., Álvares-da-Silva, M. R., Araújo, A. de, Guimarães, L. S., et al. (2016). Estimating basal energy expenditure in liver transplant recipients: The value of the Harris-Benedict equation. *Arquivos Brasileiros de Cirurgia Digestiva, 29*(3), 177–180. https://doi.org/10.1590/0102-6720201600030013

27. Goldberg, G. R., Black, A. E., Jebb, S. A., Cole, T. J., Murgatroyd, P. R., Coward, W. A., et al. (1991). Critical evaluation of energy intake data using fundamental principles of energy physiology: 1. Derivation of cut-off limits to identify under-recording. *European Journal of Clinical Nutrition, 45*, 569–581.

28. Sharifah Azizah, T. N., Nik Shanita, S., & Hasnah, H. (2015). Amount and types of sugars in selected commercial and traditional kuih in Klang Valley, Malaysia. *International Food Research Journal, 22*, 2642–2649.

29. Evert, A. B., Dennison, M., Gardner, C. D., Garvey, W. T., Lau, K. H. K., MacLeod, J., et al. (2019). Nutrition therapy for adults with diabetes or prediabetes: A consensus report. *Diabetes Care, 42*(5), 731–754. https://doi.org/10.2337/dci19-0014

30. Ministry of Health Malaysia. (2017). *Clinical practice guidelines: Primary & secondary prevention of cardiovascular disease (1st ed.).* Health Technology Assessment Unit, Medical Development Division, Ministry of Health Malaysia. https://www.moh.gov.my/moh/resources/Penerbitan/CPG/CARDIOVASCULAR/3.pdf

31. Ministry of Health Malaysia. (2018). Clinical practice guideline: Management of hypertension (5th ed.). https://www.moh.gov.my/moh/resources/Penerbitan/CPG/CARDIOVASCULAR/Hypertension/CPG_Management_of_Hypertension_5th_Edition_2018.pdf

32. Ministry of Health Malaysia. (2017). Clinical practice guidelines: Management of dyslipidaemia (5th ed.). https://www.moh.gov.my/moh/resources/Penerbitan/CPG/Cardiovascular/CPG_Management_of_Dyslipidaemia_5th_Edition_2017.pdf

33. Ministry of Health Malaysia. (2015). Clinical practice guidelines: Management of type 2 diabetes mellitus. https://www.moh.gov.my/moh/resources/Penerbitan/CPG/Endocrine/CPG_T2DM_5th_Edition_2015.pdf

34. Ministry of Health Malaysia. (2013). Medical nutrition therapy guidelines for type 2 diabetes mellitus (2nd ed.). https://mems.my/wp-content/uploads/2023/06/MNT_Guidelines_for_Type_2_Diabetes_Mellitus_2nd_Edition.pdf

35. Ministry of Health Malaysia. (2005). Medical nutrition therapy guidelines for hypertension.

36. Ministry of Health Malaysia. (2005). Medical nutrition therapy guidelines for hyperlipidaemia.

FOR PROOFREADING

37. National Coordinating Committee on Food and Nutrition, Ministry of Health Malaysia. (2021). Malaysian dietary guidelines 2020. https://hq.moh.gov.my/nutrition/wp-content/uploads/2022/06/MDG-2020.pdf

38. World Health Organization. (2015). WHO guideline: Sugars intake for adults and children. https://www.who.int/publications/i/item/9789241549028

39. Lau, X. C., Wong, Y. L., Wong, J. E., Koh, D., Sedek, R., Jamil, A. T., et al. (2019). Development and validation of a physical activity educational module for overweight and obese adolescents: CERGAS programme. International Journal of Environmental Research and Public Health, 16(9), 1506. https://doi.org/10.3390/ijerph16091506

40. Devon, H. A., Block, M. E., Moyle-Wright, P., Ernst, D. M., Hayden, S. J., Lazzara, D. J., et al. (2007). A psychometric toolbox for testing validity and reliability. Journal of Nursing Scholarship, 39(2), 155–164. (No DOI confirmed.)

41. Rungtusanatham, M. (1998). Let's not overlook content validity. Decision Line, 29(4), 10–13.

42. Davis, L. L. (1992). Instrument review: Getting the most from a panel of experts. Applied Nursing Research, 5(4), 194–197. https://doi.org/10.1016/S0897-1897(05)80008-4

43. Abdollahpour, I., Nedjat, S., Noroozian, M., & Majdzadeh, R. (2011). The process of content validity in instrument development. Iranian Journal of Epidemiology, 7(2), 66–74.

44. Teles, L. M. R., de Oliveira, A. S., Campos, F. C., Lima, T. M., da Costa, C. C., Gomes, L. F. de S., et al. (2014). Construction and validation of an educational manual for companions during labor and birth. Revista da Escola de Enfermagem da USP, 48(6), 977–984.

45. Cheungpasitporn, W., Thongprayoon, C., Edmonds, P. J., Srivali, N., Ungprasert, P., Kittanamongkolchai, W., et al. (2015). Sugar and artificially sweetened soda consumption linked to hypertension: A systematic review and meta-analysis. Clinical and Experimental Hypertension, 37(7), 587–593. https://doi.org/10.3109/10641963.2015.1026044

46. Stanhope, K. L. (2016). Sugar consumption, metabolic disease and obesity: The state of the controversy. Critical Reviews in Clinical Laboratory Sciences, 53(1), 52–67. https://doi.org/10.3109/10408363.2015.1084990

47. Kreuter, M. W., Oswald, D. L., Bull, F. C., & Clark, E. M. (2000). Are tailored health education materials always more effective than non-tailored materials? Health Education Research, 15(3), 305–315. https://doi.org/10.1093/her/15.3.305

48. Houts, P. S., Doak, C. C., Doak, L. G., & Loscalzo, M. J. (2006). The role of pictures in improving health communication: A review of research on attention, comprehension, recall, and adherence. Patient Education and Counseling, 61(2), 173–190. https://doi.org/10.1016/j.pec.2005.05.004

49. Chiang, W. L., Azlan, A., & Mohd Yusof, B. N. (2022). Effectiveness of education intervention to reduce sugar-sweetened beverages and 100% fruit juice in children and adolescents: A scoping review. Expert Review of Endocrinology & Metabolism, 17(3), 179–200. https://doi.org/10.1080/17446651.2022.2060818

FOR PROOFREADING

50. Zamanzadeh, V., Ghahramanian, A., Rassouli, M., Abbaszadeh, A., Alavi-Majd, H., & Nikanfar, A. R. (2015). Design and implementation content validity study: Development of an instrument for measuring patient-centered communication. Journal of Caring Sciences, 4(2), 165–178. https://doi.org/10.15171/jcs.2015.017

51. Parmenter, K., & Wardle, J. (2000). Evaluation and design of nutrition knowledge measures. Journal of Nutrition Education, 32(5), 269–277. https://doi.org/10.1016/S0022-3182(00)70575-9

52. Waltz, C. F., & Bausell, R. B. (1981). Nursing research: Design, statistics, and computer analysis (2nd ed.). F.A. Davis Company.

53. Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. Research in Nursing & Health, 29(5), 489–497. https://doi.org/10.1002/nur.20147

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ORIGINAL ARTICLE

Knowledge, risk perceptions, and preventive behaviours among undergraduate students in Selangor amidst the Covid-19 transition: An observational study

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ABSTRACT

Introduction: The emergence of COVID-19 in 2019 marked one of the most devastating pandemics in recent history, leading to widespread infections and fatalities globally. In response to efforts to mitigate its impact, people were enlightened through various channels about the new disease and necessary preventive measures, prompting a significant lifestyle shift to scale down the transmission. This study determines the level of knowledge knowledge, risk perception, and preventive behaviors among undergraduate students at a public university in Selangor, Malaysia during the endemic transition phase, which began from 1st April 2022 until 5th May 2023. **Method:** Employing a cross-sectional design and stratified random sampling method across six medical and health sciences courses, questionnaires were distributed via email to selected participants. Statistical analysis was conducted with SPSS version 27.0, utilizing Pearson correlation, independent t-tests, and One-Way ANOVA to examine associations between variables. **Results:** The study revealed mean scores of 29.50 ± 2.2 for knowledge, 35.60 ± 0.2 for risk perception, and 31.55 ± 6.6 for preventive behavior. Gender showed significant associations with both risk perception (t: -2.6, p: .011) and preventive behaviour (t: -3.0, p: .004), while educational background was significantly correlated with preventive behaviour. Risk perception was significantly associated with both knowledge (r: .124, p: .007) and preventive behaviour (r: .054, p: .241). **Conclusions:** There are significant associations between COVID-19 risk perception and both knowledge and preventive behaviour. Gender has a significant association with risk perception and preventive behaviour, and educational background has a significant association with preventive behaviour. Unfaltering awareness and proactive engagement in preventive measures are essential to sustaining efforts against the ongoing threat of the pandemic.

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1. INTRODUCTION

The global outbreak of COVID-19, caused by SARS-CoV-2 virus, one of the $\boldsymbol{\beta}$ group of coronaviruses [12], rapidly escalated into an unprecedented public health crisis in 2020. Within the first fifty days of the epidemic that began in Wuhan, China on 31st December 2019, the virus reportedly killed over 1,800 people and infected more than 70,000 [1]. While early concerns centered on the clinical manifestations of the disease [2,3]—ranging from asymptomatic presentations to severe respiratory distress—public health experts have increasingly recognized that effective containment hinges not only on medical interventions but also on public knowledge, risk perception, and preventive behaviors [27].

As of late June 2023, there were approximately 760 million confirmed cases of COVID-19 worldwide, with 6,945,714 reported deaths globally [23]. In Malaysia, around 5 million cases were reported, with a total cumulative death toll of 38,887 due to COVID-19 [14]. The mortality rate of COVID-19 has been a major concern since the pandemic began. Even during the endemic transition phase of almost a year, the number of cases continues to rise. Several studies conducted early in the pandemic demonstrated a significant association between knowledge, risk perception, and preventive behaviour [9,11,15,19]. Understanding the public's knowledge, risk perception, and practices is critical in controlling the spread of infectious diseases such as COVID-19. Studies have consistently demonstrated that higher levels of knowledge correlate positively with heightened risk perception and the adoption of preventive behaviors, including mask-wearing, hand hygiene, and physical distancing [5,11]. This linkage highlights the importance of public education as a non-pharmaceutical intervention, especially in mitigating community transmission. Although COVID-19 is no longer classified as a Public Health Emergency of International Concern, the persistent emergence of new variants necessitate continued Public Health vigilance.

Focusing on this transitional period, it is particularly vital to assess the prevailing knowledge, risk perception, and preventive behaviour concerning COVID-19. Endemic transition does not signify the elimination of the virus but rather its managed presence within communities. The level of knowledge, risk perception and preventive behaviours may be different as we believe that the understandings related to COVID-19 among people may change since the beginning of the pandemic. This study provides valuable insights for tailoring ongoing public health strategies, ensuring that communities remain resilient against potential resurgences.

This study specifically targets undergraduate students at a public university in Selangor, Malaysia, as the focal population. Young adults, particularly university students, represent a socially dynamic group characterized by tertiary education level, high mobility, and frequent interpersonal interactions. However, research indicates that many university students possess limited health literacy, which can adversely affect their health outcomes and behaviors [28]. Furthermore, there is limited study investigating the knowledge, risk perception, and preventive behaviour among Malaysian university students during the endemic transition phase, rendering this investigation timely and significant.

This study determines sociodemographic factors and the level of knowledge, risk perceptions, and preventive behaviours related to COVID-19 among undergraduate students at a public university in Selangor, Malaysia during the endemic transition phase, which began from 1st April 2022 until 5th May 2023. It also aims to determine the association between knowledge, risk perception and preventive behaviours related to COVID-19. Based on existing literature, we hypothesize that higher levels of knowledge are associated with greater risk perception and more consistent engagement in preventive behaviors. By elucidating these relationships, our findings aim to inform targeted health promotion interventions and contribute to the broader body of knowledge on pandemic management in endemic contexts.

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2. MATERIALS AND METHODS

2.1 Study design

This study used cross sectional study to study knowledge, risk perception and preventive behaviour among undergraduate students in a public university using an online Google Form Questionnaire.

2.2 Population, samples and sampling

The study was conducted among undergraduate students from Faculty of Medicine and Health Sciences session 2022/2023. Undergraduate students who were registered and actively studying at the Faculty of Medicine and Health Sciences in University Putra Malaysia for session 2022/2023 were selected randomly based on the calculated sample size by using a random number generator. Those who refused to participate, aged less than 18 years old or more than 25 years old, non-citizens, and the researchers of the study (part of study population) were excluded from the study.

2.3 Sample calculation

One-sample problem formula was used to calculate the sample size. This calculation was done by using ethnicity factor [26] and adjusted for 10%, resulting in 531 students. As this study used a stratified random sampling method, an equal proportion of samples was randomly selected from each department in the faculty. After the calculated sample size divided by the total population size (1515 undergraduate students), 35.05% of students were selected from each department of the faculty.

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2.4 Instruments

Risk perception and preventive behaviour questionnaires were adopted from Survey, Tool and Guidance on COVID-19 by World Health Organization (WHO), which has been validated [7]. The 11 questions for the knowledge section were adapted from the instrument used among preparatory school students in Southwest Ethiopia, that was reviewed by research and community service experts [24]. Knowledge of COVID-19 was evaluated through a set of eleven factual questions to assess respondents' knowledge acquired through experience or education. Respondents were then asked to indicate their level of familiarity using 'Yes', 'No', or 'Don't Know' responses. Individuals who got higher scores indicate they had a higher knowledge on COVID-19. On the other hand, participants who got a lower score meant that they had lower knowledge of COVID-19. The highest score for knowledge was 33 and lowest score was 11.

Risk perception on COVID-19 was measured by ten questions aimed at assessing individuals' judgments and appraisal of risk of immediate or long-term threat to their health and well-being [7]. Respondents were asked to indicate how likely they thought each statement was to be true, with five response options from 'Extremely likely' (point 5) to 'Extremely Unlikely'(point 1), providing insight into their perceptions of risk. Higher scores reflected greater risk perception of COVID-19, while lower scores indicated lower risk perception. The risk perception scale ranged from 10 to 50.

Preventive behaviour regarding COVID-19 was examined through nine questions focused on actions took by individuals to prevent or recognize illness when they do not show symptoms of disease [7]. Participants were asked how often they did each behaviour, on a five-point Likert scale that ranged from 1 = Not at all to 5 = Very much for each question, which reflected on their preventive behaviours. A higher score indicated greater adoption of preventive behaviours to reduce the risk of COVID-19 infection, while a lower score reflected lower adoption. The preventive behaviour scale ranged from 9 to 45.

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2.5 Validity and reliability

The questionnaire used in this study was partially developed by the authors, with several items adopted and adapted from established instruments in previous studies. The content validity of the questionnaire was evaluated by two experts, and revisions were made based on their feedback. A pilot test was then conducted with 20 students, who were subsequently excluded from the main study. Reliability analysis was performed separately for each component of the questionnaire—Knowledge, Attitudes, and Practices (KAP)—using data from the pilot test. Cronbach's Alpha Coefficients for all components exceeded 0.7, indicating acceptable internal consistency.

2.6 Data collection

After gaining ethical approval, an email was sent to the Faculty of Medicine and Health Sciences to request student details. The distributed questionnaire is an online version of questionnaire via Google Form link, that was distributed to the selected students via email. Study information was clearly stated to participants before the study commenced via attached Study Information Sheet. Participants provided their informed consent by electronically signing the consent form, which was included as the initial section of the online questionnaire distributed via email. All questions were provided in English. A follow-up email was sent a week later to remind participants who had not yet responded. Additionally, class representatives from each course were involved to remind their peers to complete the questionnaire. Data collection period was from 27th February until 28th March 2023.

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2.7 Data analysis

The data collected were analyzed using SPSS IBM version 27 (Statistical Program for Social Science). Descriptive analysis was employed in the study. A normality test for the scores of knowledge, risk perception, and preventive behaviour was conducted using a histogram with a normal curve, Q-Q plot, detrended Q-Q plot, and box plot. Pearson correlation, independent t-tests, and One-Way ANOVA were used to examine the associations between sociodemographic factors, knowledge, risk perception, and preventive behaviour. Findings with a p-value < 0.05 were considered to be statistically significant.

3. RESULTS

Responses were received from 468 out of 531 students, yielding a response rate of 88.14%. Prior to data analysis, a normality test was conducted, confirming that the data were normally distributed.

The mean age of study participants was 21.6 ± 0.1 years (range: 17 to 35 years). As shown in Table 1, the sample predominantly comprised females, accounting for 81.8% (n=383), while males represented 18.2% (n=85). The majority of participants were Malay at 62.6% (n=293), followed by Chinese 20.5% (n=96), Indian 12.6% (n=59), and Others 4.3% (n=20). The "Others" category included Indonesian, African, Peribumi Sabah, Peribumi Sarawak, Iranian, Bugis, Saudi Arabian, Bidayuh, Dusun, Iraqi, and Melanau ethnicities. In terms of educational background, the largest proportion were Doctor of Medicine students at 37.8% (n=177), followed by Bachelor of Biomedical Sciences 19.2% (n=90), Bachelor of Science Environmental and Occupational Health 17.7% (n=83), Bachelor of Science Nutrition and Community Health 9.4% (n=44), Bachelor of Science Dietetics 8.5% (n=40), and Bachelor of Nursing 7.3% (n=34). Socioeconomic status was mainly from the B40 income group at 43.2% (n=202), followed by M40 at 35.0% (n=164), and T20 at 21.8% (n=102). Most participants were Malaysian citizens, comprising 97.9% (n=458), while non-Malaysians accounted for 2.1% (n=10), including Indonesian, Senegalese, Iranian, Saudi, Chinese, and Iraqi nationals.

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Table 1. Sociodemographic characteristics of respondents

Variables	Mean (s.d.)	Frequency (n)	Percentage (%)
Age	21.6 (0.1)		
Gender			
Male		85	18.2
Female		383	81.8
Ethnicity			
Malay		293	62.6
Chinese		96	20.5
Indian		59	12.6
Others		20	4.3
Educational background			
Doctor of Medicine		177	37.8
Bachelor of Biomedical sciences		90	19.2
Bachelor of Nursing		34	7.3
Bachelor of Science Dietetic		40	8.5
Bachelor of Science Nutrition and Community Health		44	9.4
Bachelor of Science Environmental and Occupational Health		83	17.7
Household Income per month (RM)			
≤ RM4,849 (B40)		202	43.2
RM4,850 - RM10,959 (M40)		164	35.0
≥ RM10,960 (T20)		102	21.8
Nationality			
Malaysian		458	97.9
Non-Malaysian		10	2.1

Source: Fatimah Ahmad Fauzi et al (2026)

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3.1 Descriptive findings of knowledge, risk perceptions & preventive behaviours

The total mean score of respondents regarding knowledge was 29.50 ± 2.2. From the study, the highest score was 33 while the lowest score was 11. Question stated that "COVID-19 is caused by a virus" had the highest number of respondents who answered correctly with 99.36% whereas question about "COVID-19 cannot penetrate cloth masks", had the lowest number of respondents who answered correctly with 47.22%.

The mean score for respondents regarding risk perception is 35.60 ± 0.2. Question about the "likelihood of getting COVID-19 if not vaccinated" had the highest number of respondents who answered correctly with 55.1% respondents. Whereas question about the "ability to manage daily activities as long as being able to self-isolate if being infected with COVID-19" had the lowest number of respondents who answered correctly with about 7.1%. From the study, the highest score was 50 while the lowest score was 10.

The total mean score for respondents on preventive behaviour is 31.55 ± 6.6. Question stated that "I use disinfectants to clean hands when soap and water are not available" had the highest number of respondents who answered correctly with 29.9 % respondents. Whereas question stated "I use antibiotics to prevent or treat COVID-19" had the lowest number of respondents who answered correctly with 13.5%. From the study, the highest score was 45 while the lowest score was 13.

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3.2 Association between sociodemographic factors & knowledge, risk perceptions & preventive behaviours

The analysis showed no significant association between sociodemographic factors and knowledge. An independent t-test was conducted to compare risk perception scores between males and females. A significant association was found between gender and risk perception, with t (466) = -2.6, P = 0.011. The mean score for females (M = 35.9, SD = 4.6) was higher than that for males (M = 34.5, SD = 4.4). The magnitude of the difference in means (mean difference = -1.4, 95% CI: -2.5 to -0.3) was significant. Therefore, the result indicates a significant association between gender and risk perception (P = 0.011).

There were significant differences in preventive behaviour scores between males and females, with t (110.635) = -2.963, P = 0.004. The mean score for females (M = 32.03, SD = 6.27) was higher than that for males (M = 29.40, SD = 7.62). The magnitude of the difference in means (mean difference = -2.63, 95% CI: -4.382 to -0.870) was significant, indicating a significant association between gender and preventive behaviour (P = 0.004).

Educational background also showed a significant association with preventive behaviour. Although this association reached statistical significance, the actual difference in mean scores between groups was relatively small, with an effect size (eta squared) of 0.02. Post-hoc comparisons using the Dunnett C test indicated that the mean score for Bachelor of Nursing students (M = 34.38, SD = 5.24) was significantly different from Doctor of Medicine students (M = 31.28, SD = 6.88) and Bachelor of Biomedical Sciences students (M = 30.66, SD = 6.52). However, Bachelor of Science Dietetic students (M = 30.90, SD = 7.18), Bachelor of Science Nutrition and Community Health students (M = 30.89, SD = 6.12), and Bachelor of Science Environmental and Occupational Health students (M = 32.59, SD = 6.31) did not differ significantly from Groups 1, 2, or 3. Thus, the results show a significant association between educational background and preventive behaviour (P = 0.049). The summary for association result of sociodemographic factors with knowledge, risk perception and preventive behaviour were presented in Table 2.

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Table 2. Summary for result of sociodemographic factors association with knowledge, risk perception and preventive behaviour on COVID-19

Socio-demographic Factors	Knowledge			Risk Perception			Preventive Behaviour		
	Mean	Test Statistic r/t/F	p-value	Mean	Test Statistic r/t/F	p-value	Mean	Test Statistic r/t/F	p-value
Age	29.5	0.03	0.586	21.6	-0.33	0.747	21.6	-0.06	0.217
Gender									
Male	29.1	-1.70	0.102	34.5	-2.60	0.011*	29.4	-3.00	0.004**
Female	29.6			35.9			32.0		
Nationality									
Malaysian	29.5	-0.40	0.664	35.6	1.50	0.120	31.6	0.90	0.346
Non-Malaysian	29.8			33.4			29.6		
Ethnicity									
Malay	29.6	1.30	0.287	35.6	0.40	0.988	31.2	1.30	0.275
Chinese	29.3			35.6			31.6		
Indian	29.2			35.8			33.1		
Others	30.2			35.6			31.8		

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Educational Background									
DM	29.2	1.30	0.256	36.0	1.3	0.252	31.3	2.2	0.049*
BBS	29.8			35.0			30.7		
BN	29.9			36.7			34.4		
BSD	29.8			35.5			30.9		
BSNCH	29.3			34.7			30.9		
BSEOH	29.6			35.5			32.6		
Household Income									
B40	29.5	0.02	0.981	35.4	0.6	0.572	31.5	0.1	0.878
M40	29.5			35.9			31.7		
T20	29.5			35.6			31.3		

*p<.05
**p<.01

DM: Doctor of Medicine
BBS: Bachelor of Biomedical Sciences
BN: Bachelor of Nursing
BSD: Bachelor of Science Dietetic
BSNCH: Bachelor of Science Nutrition and Community Health
BSEOH: Bachelor of Science Environmental and Occupational Health

Source: Fatimah Ahmad Fauzi et al (2026)

3.3 Association between knowledge, risk perceptions & preventive behaviours

Summary for association results between knowledge, risk perception, and preventive behaviours were presented in Table 3. The Pearson correlation test revealed a significant association between knowledge and risk perception related to COVID-19 (P = 0.007), with a correlation coefficient of r = 0.1, indicating a small correlation. However, no significant association was found between knowledge and preventive behaviour (P = 0.2). On the other hand, there was a significant association between risk perception and preventive behaviour (P < 0.001), with a correlation coefficient of r = 0.3, suggesting a moderate correlation.

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Table 3. Summary for Association Result of Knowledge, Risk Perception and Preventive Behaviour

	Pearson Correlation, r	P-value
Knowledge and Risk Perception	0.1	0.007**
Knowledge and Preventive Behaviour	0.1	0.2
Risk Perception and Preventive Behaviour	0.3	< 0.001***

**p<0.01
***p<0.001

Source: Fatimah Ahmad Fauzi et al (2026)

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4. DISCUSSIONS

4.1 Knowledge, risk perceptions & preventive behaviours

The findings of this study indicate that undergraduate students demonstrated a relatively high level of knowledge, with a mean score of 29.50 ± 2.2 out of a maximum of 33. Most participants (99.36%) correctly identified that COVID-19 is caused by a virus, indicating good understanding of the basic cause of the disease. However, knowledge about the effectiveness of cloth masks in preventing COVID-19 was lower, with only 47.22% answering correctly. This difference suggests some gaps in knowledge about protective measures. As reported by Kundu (2021), such differences may be related to participant characteristics, including the higher educational level of the study population [9, 29]. The high level of knowledge observed may also be explained by the timing of the questionnaire distribution, which coincided with the height of the COVID-19 outbreak, when widespread coverage likely increased public awareness and understanding of the disease, as people sought information to protect themselves and their families.

The mean score for risk perception towards COVID-19 in this study was 35.60 ± 0.2 out of a maximum of 50, indicating a moderately high level of perceived risk. The responses showed that many participants correctly recognized the risk of contracting COVID-19 without vaccination. In comparison, Asefa (2020) reported a higher mean risk perception score of 40.7, with 53.4% of participants showing higher levels of perceived risk [10]. This difference may be related to different study instruments used to measure risk perception. The higher mortality rate associated with COVID-19 compared to other respiratory diseases could also influence risk perception [10]. On the other hand, a study conducted among health professionals working in selected public university hospitals in Ethiopia reported a lower mean score for risk perception, at 23.59, indicating a lower perception of risk [9]. Furthermore, media coverage in Scandinavian countries was reported to focus more on the risks of COVID-19 abroad rather than domestic risks, which contributed to lower public risk perception towards the virus within those countries [11].

The mean score for preventive behaviour towards COVID-19 in this study was 31.55 ± 6.6 out of a maximum of 45, indicating a relatively high level of preventive practices. In the questionnaire, the highest correct response rate was observed for the statement, "I use disinfectants to clean hands when soap and water are not available," with 29.9% of participants responding correctly. Similarly, an online survey among Bangladeshi residents showed 67.2% of study respondents scored well for the preventive practices, with participants commonly engaging in measures such as wearing masks consistently outside home and washing hands with soap after returning home [13].

4.2 Association between sociodemographic factor & knowledge

This study revealed no significant association between sociodemographic factors and knowledge of COVID-19. This finding is consistent with previous research involving university students in health-related fields [19,26], where similar levels of knowledge were reported across different demographic groups, likely due to shared educational exposure to health topics. In the context of this study, the shared academic background of participants likely contributed to the uniformity in knowledge levels observed.

Another important significant association between education level and COVID-19 knowledge was also reported by Sazali et al. in 2021 [17]. The study reported that participants holding a diploma had significantly higher mean knowledge scores compared to those with a degree ($p<0.05$). Additionally, students enrolled in medical faculties demonstrated notably higher knowledge levels than those in non-medical faculties ($p<0.001$). The findings differed from current study, and this mismatch could be due to differences in the characteristics of sampling. This study was conducted among undergraduate students aged 20 to 25 years old, with educational background limited to Medical and Health Sciences courses, which may explain the absence of a significant association between education and COVID-19 knowledge.

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Also, in this study gender did not show a significant relation with knowledge. This contrasts with findings by Sultana et al, which demonstrated that females had higher levels of COVID-19 knowledge compared to male [18]. Such differences may be attributable to variations in sample demographics, cultural contexts, and pandemic phase.

4.3 Association between sociodemographic factor & risk perception

There was a statistically significant association between gender and risk perception (P = 0.011) in which females showed more impact of risk perception about their surroundings compared to males. This increased concern among females may clarify the observed association. A study conducted across eight countries also found this similar association, suggesting that females are more into anticipating and following the rules and guidelines, which may contribute to their higher risk perception [8].

However, other variables considered including age, nationality, ethnicity, education, and household income were not significantly associated with risk perception in this study. Nonetheless, risk perception has been associated with these factors in several other studies [26–34]. For instance, a study carried out in China revealed a significant association between age and risk perception, where older age group had a higher risk perception compared to younger ones [25]. Moreover, it has been observed that individuals with higher educational backgrounds have have a higher risk perception towards COVID-19 [15].

The differences in findings between this study and others may be attributed to variations in sample characteristics. This study focused on students aged 20 to 25, with educational backgrounds limited to Medicine and Health Sciences courses, which may explain the absence of significant associations for certain sociodemographic factors in this context.

FOR PROOFREADING

4.4 Association between sociodemographic factor & preventive behaviour

The study found a significant association between gender and preventive behaviour (P = 0.004). This finding aligns with a study conducted in Taiwan, which also showed that women are more likely than men to engage in health-preventive behaviours related to COVID-19 [20]. These results support previous research indicating that women are generally more inclined to adopt new preventive measures.

In terms of educational background, there was also a significant association between education level and preventive behaviour. According to Sazali (2021), individuals with higher educational backgrounds tend to exhibit more preventive behaviours towards COVID-19, possibly due to their greater factual knowledge, particularly among respondents from medical faculties [17].

However, other factors such as age, nationality, ethnicity, and household income were not significantly associated with preventive behaviour in this study. Despite this, several other studies have identified associations between these factors and preventive behaviour. For instance, González-Herrera (2022) found that older individuals are more likely to engage in preventive behaviours, with a significant association between age and the frequency of preventive behaviours (P < 0.001) [10]. Given that most of the respondents in this study were among young aged group, it explains the insignificant association between age and preventive behaviour.

Other studies also have linked household income with preventive behaviour. A study conducted in Malaysia by Azlan (2020) found that young people aged 18 to 49 years, students, and those with household monthly income less than RM3,000 were more likely to wear face masks when leaving their house, whereas those earning more than RM12,000 per month were less likely to do so [5]. It could be explained by public awareness to monitor health status and avoid high healthcare costs among low-income population [5].

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4.5 Association between knowledge & risk perception

This study found a significant association between knowledge and COVID-19 risk perception (P = 0.007). The link might be attributed to the participants' educational backgrounds as they are enrolled in faculties of medical and health sciences. Observational study among university students in Borneo, Malaysia [17] showed students enrolled in medical faculties demonstrated higher knowledge levels than those in non-medical faculties ($p<0.001$). Research done by Cipolletta et al. has identified a relationship between the level of education and risk perception for COVID-19, suggesting that people with higher educational attainment had increased perceived risk related to COVID-19 and avoid behaviours aimed at preventing transmission of the disease [6]. Similarly, Taghrir et al. noted that people with more education were more likely to practice precautionary behaviours, possibly because their education contributes to the likelihood of engaging in safety behaviours [19].

4.6 Association between knowledge & preventive behaviour

This study also demonstrated that there was no significant association between knowledge and preventive behaviour (P = 0.241), which contrasts with the findings presented by Honarvar et al. [11]. Nonetheless, past studies have shown some people do protect themselves according to trusted policies and evidence-based information rather than their own knowledge or beliefs [21]. Appropriately, in line with the present finding that knowledge was not a significantly associated with protective behaviour.

There is a possibility for young Malaysian adults being lack of knowledge on the characteristics of this new virus since COVID-19 itself is a new virus and they followed the protective standard operating procedure (SOP) as to comply with government orders. The findings indicate that Malaysian young adults implement preventive behaviours directed by authority figures irrespective of their knowledge on COVID-19. This is perhaps due to perception or reluctance to embrace preventive measures. Furthermore, external misinformation may also affect individual compliance with preventive behaviours.

FOR PROOFREADING

4.7 Association between risk perception & preventive behaviour

Results indicated a significant association between risk perception and preventive behaviour ($P < 0.001$). Those who are more at risk may be more motivated to seek preventive information and think about the benefits and costs of engaging in them. This finding aligns with results from Tsegaw (2022), who reported that individuals with higher levels of perceived risk were more likely to adopt preventive behaviours such as physical distancing, handwashing, and facemask-wearing practices [22]. In contrast, a study conducted among Iranian Medical students [19] found that self-reported preventive behaviours and risk perception was significantly negative correlated ($r = -0.128$; $P < 0.05$). It indicated that risk perception declines as preventive behaviours increased. The study investigated among medical students who may know the consequences of preventive behaviours, which may explain the negative correlation. In the context of present study population, consisting of undergraduate students from medical and health sciences backgrounds, this association is particularly meaningful. Furthermore, as the population transitions into the endemic phase of COVID-19, maintaining risk awareness among students remains essential to sustain adherence to preventive measures. Strengthening risk communication strategies tailored to student populations could help maintain vigilance and promote continued engagement in preventive behaviours, thereby supporting broader public health efforts in managing endemic COVID-19.

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5. CONCLUSIONS

In conclusion, there are significant associations between COVID-19 risk perception and both knowledge and preventive behaviour. Gender has a significant association with risk perception and preventive behaviour, and educational background has a significant association with preventive behaviour. On the other hand, COVID-19 knowledge did not significantly correlate with any sociodemographic features in this study population.

6. STRENGTH AND LIMITATIONS

The study used an observational study design, allowing for quick execution at minimal expense. The cross-sectional design enabled the examination of multiple variables simultaneously and was well-suited for both descriptive analysis and hypothesis testing.

However, there were several limitations. First, the sample consisted exclusively of students from the Faculty of Medicine and Health Sciences, which limited the generalizability of the findings to broader populations or different settings. Additionally, the understanding of COVID-19 remains incomplete due to its relatively recent emergence. As a result, long-term follow-up studies are needed to better understand the long-term effects and complications of the virus, which may influence knowledge, risk perception, and preventive behaviour related to COVID-19.

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7. RECOMMENDATIONS

The study found no association between knowledge and preventive behaviour towards COVID-19, indicating that the current health education strategies may need modification to enhance preventive behaviours. The government could consider expanding its approach by disseminating more information about COVID-19 prevention not only through social media but also via campus-based awareness campaigns, peer education networks, and virtual reality simulations that provide immersive experiences related to COVID-19 transmission and prevention.

Additionally, more research on knowledge, risk perception, and preventive behaviour towards COVID-19 is encouraged. This study was limited to students from the Faculty of Medicine and Health Sciences, which restricts the generalizability of the findings. Future studies should aim to include broader populations across Malaysia to gain a more comprehensive understanding of the public's knowledge, risk perception, and preventive behaviours related to COVID-19.

8. CONFLICT OF INTEREST

The authors declare no conflicts of interest regarding the research, authorship, and publication of this manuscript. The study was conducted independently, without any financial or personal relationships that could influence the research outcomes.

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7. CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest regarding the research, authorship, and publication of this manuscript. The study was conducted independently, without any financial or personal relationships that could influence the research outcomes.

8. AUTHORS' CONTRIBUTIONS

Ding Ming Zhi , Sofara Ashfia Tasnim Binti Mohammad Zairy , and Somaganth A/L Armugum carried out the research, wrote and performed analysis. Fatimah Ahmad Fauzi conceptualised the central research idea and refined the manuscript writing. Nor Afiah Mohd Zulkefli supervised research progress; Norhasliza Abu Bakar anchored the review, revisions before the article submission.

9. ETHICS STATEMENT

This study received ethical approval from the Human Research Ethics Committees of Universiti Putra Malaysia (JKEUPM-2022-146), and written informed consent from all study participants were obtained prior to their responses.

10. REFERENCES

1. Adnan Shereen, M., Khan, S., Kazmi, A., Bashir, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *Journal of Advanced Research, 24*, 91–98. https://doi.org/10.1016/j.jare.2020.03.005

2. Agrawal, R. K., Pandey, M., Singh, A., Sanghvi, N., & Yadav, K. (2022). Clinical presentation and outcome of COVID-19 in children: A case series. *Journal of Clinical and Diagnostic Research, 16*(3), SR01–SR03. https://doi.org/10.7860/JCDR/2022/51443.16136

3. Alshoabi, S. A., Alhazmi, F. H., Abdulaal, O. M., Gameraddin, M. B., Algaberi, A. K., Hamid, A. M., Alsultan, K. D., & Alamri, A. M. (2021). Frequent clinical and radiological manifestations of the novel SARS-CoV-2: A review article. *Journal of Family Medicine and Primary Care, 10*(1), 122–126. https://doi.org/10.4103/jfmpc.jfmpc_1985_20

4. Asefa, A., Qanche, Q., Hailemariam, S., Dhuguma, T., & Nigussie, T. (2020). Risk perception towards COVID-19 and its associated factors among waiters in selected towns of Southwest Ethiopia. *Risk Management and Healthcare Policy, 13*, 2601–2610. https://doi.org/10.2147/RMHP.S276257

5. Azlan, A. A., Hamzah, M. R., Sern, T. J., Ayub, S. H., & Mohamad, E. (2020). Public knowledge, attitudes and practices towards COVID-19: A cross-sectional study in Malaysia. *PLOS ONE, 15*(5), e0233668. https://doi.org/10.1371/journal.pone.0233668

6. Cipolletta, S., Andreghetti, G. R., & Mioni, G. (2022). Risk perception towards COVID-19: A systematic review and qualitative synthesis. *International Journal of Environmental Research and Public Health, 19*(8), 4649. https://doi.org/10.3390/ijerph19084649

7. World Health Organization. (2020). *Survey tool and guidance: Rapid, simple, flexible behavioural insights on COVID-19.* WHO Regional Office for Europe. https://apps.who.int/iris/handle/10665/333549

FOR PROOFREADING

8. Galasso, V., Pons, V., Profeta, P., Becher, M., Brouard, S., & Foucault, M. (2020). Gender differences in COVID-19 attitudes and behavior: Panel evidence from eight countries. *Proceedings of the National Academy of Sciences, 117*(44), 27285–27291. https://doi.org/10.1073/pnas.2012520117

9. Girma, S., Agenagnew, L., Beressa, G., Tesfaye, Y., & Alenko, A. (2020). Risk perception and precautionary health behavior toward COVID-19 among health professionals working in selected public university hospitals in Ethiopia. *PLOS ONE, 15*(10), e0241101. https://doi.org/10.1371/journal.pone.0241101

10. González-Herrera, A., Rodríguez-Blázquez, C., Romay-Barja, M., Falcon-Romero, M., Ayala, A., & Forjaz, M. J. (2022). Age differences in knowledge, attitudes and preventive practices during the COVID-19 pandemic in Spain. *Scientific Reports, 12*, 20863. https://doi.org/10.1038/s41598-022-25353-5

11. Honarvar, B., Lankarani, K. B., Kharmandar, A., Shaygani, F., Zahedroozgar, M., Haghighi, M. R. R., et al. (2020). Knowledge, attitudes, risk perceptions, and practices of adults toward COVID-19: A population and field-based study from Iran. *International Journal of Public Health, 65*, 731–739. https://doi.org/10.1007/s00038-020-01406-2

12. Khedkar, P. H., & Patzak, A. (2020). SARS-CoV-2: What do we know so far? *Acta Physiologica, 229*(2), e13470. https://doi.org/10.1111/apha.13470

13. Kundu, S., Al Banna, M. H., Sayeed, A., Begum, M. R., Brazendale, K., Hasan, M. T., et al. (2021). Knowledge, attitudes, and preventive practices toward the COVID-19 pandemic: An online survey among Bangladeshi residents. *Journal of Public Health, 43*, e1–e15. https://doi.org/10.1007/s10389-021-01636-5

14. Ministry of Health Malaysia. (2021). *COVID-19 | KKMNOW dashboard.* https://data.moh.gov.my/dashboard/covid-19

15. Rattay, P., Michalski, N., Domanska, O. M., Kaltwasser, A., De Bock, F., Wieler, L. H., & Jordan, S. (2021). Differences in risk perception, knowledge and protective behaviour regarding COVID-19 by education level among women and men in Germany. *PLOS ONE, 16*(5), e0251694. https://doi.org/10.1371/journal.pone.0251694

16. Saxena, S. K. (Ed.). (2020). *Coronavirus disease 2019 (COVID-19): Epidemiology, pathogenesis, diagnosis, and therapeutics.* Springer. https://doi.org/10.1007/978-981-15-4814-7

17. Sazali, M. F., Rahim, S. S. S. A., Mohamed, M. H., Omar, A., Pang, N. T. P., Jeffree, M. S., et al. (2021). Knowledge, attitude and practice on COVID-19 among students during the early phase of pandemic in a university in Borneo, Malaysia. *Journal of Public Health Research, 10*(3), 2122. https://doi.org/10.4081/jphr.2021.2122

18. Sultana, M. S., Khan, A. H., Islam, M. R., Hossain, S., Hasan, M. T., & Sikder, M. T. (2022). Gender differences in knowledge, attitudes and preparedness to respond to COVID-19 among adults in Bangladesh: A cross-sectional study. *Population Medicine, 4*, 1–11. https://doi.org/10.18332/popmed/145763

19. Taghrir, M. H., Borazjani, R., & Shiraly, R. (2020). COVID-19 and Iranian medical students: A survey on their related knowledge, preventive behaviors and risk perception. *Archives of Iranian Medicine, 23*(4), 249–254. https://doi.org/10.34172/aim.2020.06

20. Tan, J., Yoshida, Y., Ma, S.-K., & Mauvais-Jarvis, F. (2021). Gender differences in health protective behaviors during the COVID-19 pandemic in Taiwan: An empirical study. *medRxiv.* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8077589/

FOR PROOFREADING

21. Teovanović, P., Lukić, P., Zupan, Z., Lazić, A., Ninković, M., & Žeželj, I. (2021). Irrational beliefs differentially predict adherence to guidelines and pseudoscientific practices during the COVID-19 pandemic. *Applied Cognitive Psychology, 35*(2), 486–496. https://doi.org/10.1002/acp.3770

22. Tsegaw, M., Mulat, B., & Shitu, K. (2022). Risk perception and preventive behaviours of COVID-19 among university students, Gondar, Ethiopia: A cross-sectional study. *BMJ Open, 12*(4), e057404. https://doi.org/10.1136/bmjopen-2021-057404

23. World Health Organization. (2023). *WHO COVID-19 dashboard.* https://covid19.who.int/

24. Yesuf, M., & Abdu, M. (2022). Knowledge, attitude, prevention practice, and associated factors toward COVID-19 among preparatory school students in Southwest Ethiopia, 2021. *PLOS ONE, 17*(1), e0262907. https://doi.org/10.1371/journal.pone.0262907

25. Zhang, R., & Wang, C. (2023). Risk perception of COVID-19 and its related factors among centralized medical isolation groups in China. *Frontiers in Psychology, 14*, 1131076. https://doi.org/10.3389/fpsyg.2023.1131076

26. Ismail, A., Ismail, N. H., Abu Kassim, N. Y. M., Lestari, W., Ismail, A. F., & Sukotjo, C. (2021). Knowledge, perceived risk, and preventive behaviors amidst COVID-19 pandemic among dental students in Malaysia. *Dentistry Journal, 9*(12), 151. https://doi.org/10.3390/dj9120151

27. Zhong, B. L., Luo, W., Li, H. M., Zhang, Q. Q., Liu, X. G., Li, W. T., & Li, Y. (2020). Knowledge, attitudes, and practices towards COVID-19 among Chinese residents during the rapid rise period of the COVID-19 outbreak: A quick online cross-sectional survey. *International Journal of Biological Sciences, 16*(10), 1745–1752. https://doi.org/10.7150/ijbs.45221

28. Bhusal, S., Paudel, R., Gaihre, M., Paudel, K., Adhikari, T. B., & Pradhan, P. M. (2021). Health literacy and associated factors among undergraduates: A university-based cross-sectional study in Nepal. *PLOS Global Public Health, 1*(11), e0000016. https://doi.org/10.1371/journal.pgph.0000016

29. Al-Hanawi, M. K., Angawi, K., Alshareef, N., Qattan, A. M. N., Helmy, H. Z., Abudawood, Y., et al. (2020). Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: A cross-sectional study. *Frontiers in Public Health, 8*, 217. https://doi.org/10.3389/fpubh.2020.00217

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ORIGINAL ARTICLE

Paternal Peripartum Depression and its Risk Factors among Men transitioning into Fatherhood in Malaysia

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ABSTRACT

Introduction: Fatherhood can be challenging, and men's well-being during their partner's perinatal period is often overlooked. This study aims to assess the prevalence of paternal perinatal depression (PPND) and associated factors among men in a Malaysian district during their partner's perinatal period. **Methods:** This cross-sectional study used a self-administered questionnaire for men whose partners attended the maternal and child health clinic (MCHC) during the perinatal period. Eligible participants received either a hard copy or a link to an online Google Form. The questionnaire covered sociodemographic, economic, and clinical details, as well as the Multidimensional Scale of Perceived Social Support (MSPSS) and the Edinburgh Postnatal Depression Scale (EPDS). Informed consent was obtained, and men with EPDS scores of 10 or higher were considered at risk for post-partum neural depression (PPND). Data were analyzed using SPSS version 26. **Results:** 400 men responded, but only 381 completed data were analyzed. The mean age of participants was 32.72 (±5.648). The prevalence of PPND in this sample was 12.4%. The two significant factors for PPND were low or moderate social support and the presence of existing chronic disease. **Conclusion:** The study concluded that men lacking social support are at an increased risk of PPND. It also emphasized that men with pre-existing chronic conditions face a higher risk of PPND. Therefore, it is crucial to screen for PPND in men, particularly those with chronic illnesses and limited social support. Additionally, the well-being of fathers should be considered in the follow-up and care of their female partners during the perinatal period.

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INTRODUCTION

Fatherhood has a substantial impact on men's physical and mental well-being. The perinatal period [1] often focuses more on the mother's physical and mental well-being. As a result, the preparation for men to become fathers, for the first time or for subsequent children is often overlooked.

Paternal perinatal depression (PPND) is the presence of major depressive disorder (MDD) among men that developed during their partner's perinatal period [1]. PPND may occur during the pregnancy and up to one year after the birth of the child [2]. This period is a crucial time for the couple and the development of their newborn child. The presence of PPND can negatively affect the man, which can lead to further negative effects on his partner and child such as poor psychological support that is much needed by his female partner. Partner support is a protective factor against maternal perinatal depression (MPND) and on the contrary, poor support from the partner can lead to the mother becoming more prone to stress and psychopathology [3].

The presence of undiagnosed PPND has a negative impact on marital relationships and can lead to depression in the partner [4,5]. PPND can also lead to violence towards the partner, it is found that one-fourth of postnatal women reported violence from their partner with 69% being the first occurrence, meaning the violence happened for the first time during the relationship [6]. PPND can also lead to negative emotional and behavioral consequences in children including later psychopathology [7]. The child exposed to two parents with depression has a higher psychopathology risk in later life than exposure to only one [8]. Infants and children born to fathers who have depressive disorder during the perinatal period are likely to suffer from developmental delay, psychopathology, and behavioral problems [7]. These negative impacts of PPND are detrimental and the transition of men towards fatherhood needs to be addressed urgently. This study aims to determine the prevalence of PPND and factors that are associated with PPND among men whose partners are during the perinatal period in the Gombak district in Malaysia.

MATERIALS AND METHODS

Study Design

A cross-sectional study was conducted among men whose partners attended a maternal and child health clinic (MCHC) at two public health clinics in the Gombak district of Malaysia. Data collection took place from June 2021 to December 2021, using a self-administered questionnaire.

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Sampling Population and Participant's Criteria

The sampling population was all men whose female partners attended the MCHC during the data collection period. The men whose female partners were during the perinatal period were invited to participate in the study. For this study, perinatal is defined as the antenatal and postnatal period up until the child is one year old. Convenience sampling was deployed due to the COVID-19 pandemic, and difficulty in collecting data. The inclusion criteria were men who were ≥18 years old and whose partners were during the perinatal period. The exclusion criteria were men who had a history of MDD or received treatment for the condition from a psychiatrist or Family Medicine Specialist (FMS).

Study Tools

This is a quantitative study using a questionnaire. The questionnaire was divided into sociodemographic, economic, and clinical details and two study tools. The study tools are the validated English and Malay version of the Multidimensional Scale of Perceived Social Support (MSPSS) and the validated English and Malay version of the Edinburgh Postnatal Depression Scale (EPDS)[9]. Those with an EPDS score of ≥ 10 are considered at risk of having PPND.

For the screening of PPND, several questionnaires have been documented to screen this construct including the EPDS, Beck's Depression Inventory (BDI) [10], and Patient Health Questionnaire (PHQ) [11]. There has not been a consensus on the most appropriate screening tool to assess PPND. However, In PPND studies, the most used screening tool is the EPDS [12]. The EPDS is a self-rated questionnaire. It contains ten brief questions regarding general depressive symptoms, and it uses a Likert-type format for

answers. The respondents may choose the nearest to how they have been feeling for the preceding week. Every question has a scale from 0-3 indicating the severity of the symptoms. Probable scores on the EPDS vary from 0-30. In one study, at the cut-off point of ≥ 10, the sensitivity and specificity of the EPDS were 77.3% and 92.9% respectively [13]. The Cronbach alpha for the Malay EPDS was 0.78 [14]. Those participants who were at risk of having PPND were given information and advised to seek further medical care and referred to the family medicine specialist or a psychiatrist.

MSPSS questionnaire is a 12-item questionnaire to identify an individual's perceived level of social support from family, friends, and significant other. It has been translated into the Malay language and validated using confirmatory factor analysis (CFA) which supported the three-factor model of the original English version. The Cronbach alpha ranges from 0.9 to 0.932 [15]

Study Procedure

The data collection was conducted during the COVID-19 pandemic period, and therefore men accompanying their partners to the MCHC were not allowed to enter the premises. Hence, the researcher approached the women partners who attended the MCHC during the data collection days. The women were asked to contact their partners, and with the permission of the men, the researcher obtained their contact details. They were given either a hard copy of the questionnaire or an online link to a Google Form via WhatsApp, based on their preferred choice. Both the hard copy and online questionnaire contained the study information and consent form. The men who agreed and consented will proceed to answer the questions. The inclusion and exclusion criteria are asked in the hard copy and for the online questionnaire, only eligible participants can proceed to the next part. The completed online questionnaires were received by the researcher via the Google platform and those who opted for the hard copy returned the completed questionnaires to the clinic at their next visit. The completed questionnaire was then collected by the researcher.

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Sample Size Calculation

Sample size calculation used the Raosoft online calculator, which is an online software used to calculate sample size using a single proportion formula. At a significant level of 0.05, power of 80%, and the highest PPND prevalence of 25.6% with a 95% confidence interval and 0.05 margin of error, the sample size required is 292. and taking into consideration 20% of non-responses, the minimum sample size needed was 350 samples. Due to the concern of not getting enough samples, especially during the COVID-19 pandemic, a convenient sampling method was applied in this study. As a result, this may influence the sample cohort and affect the generalisability of the study.

Data and Statistical Analysis

Data entry and statistical analysis were performed using the IBM SPSS version 26. Descriptive analysis was used to describe the frequency distribution, measures of central tendencies, and measures of distribution on the socio-demographic characteristics. For the normally distributed data, continuous variables were presented by mean and standard deviation, and categorical variables were presented by absolute numbers and percentages. Factors associated with paternal depressive disorder status were determined by using simple and multiple logistic regression. Factors with p-values <0.25 in simple logistics were further included in the multiple logistic regression and p-values <0.05 were taken as significant p-values for the final model.

Ethical Consideration

Ethical approval of this study was obtained from two ethical bodies namely the Research Management Centre (RMC), University Technology MARA (UiTM) (approval code: MR/259), and National Medical Research Register (NMRR-20-2397-56114 (IIR)). Consent obtained for the online questionnaire was via those who clicked the 'agree' button to the consent were allowed to proceed to the questionnaire.

RESULTS

A total of 400 responses were collected, and 19 responses were excluded due to incomplete or missing data. The final sample of 381 participants was analyzed with a mean age of 32.72±5.648. Table 1 highlights the sociodemographic details of the participants. The participants are mainly from the Malay Muslim community. Many of them have certificates or diplomas in their education and almost all are married.

Table 1 Socio-demographic details of participants

Variables	Total Number (N)	Frequency, n (%)
Self-reported Ethnicity	381	
Malay		280 (73.5%)
Chinese		66 (17.3%)
Indian		23 (6%)
Others		12 (3.1%)
Religion	381	
Islam		289 (75.9%)
Buddhist		62 (16.3%)
Hindu		19 (5.0%)
Christianity		8 (2.1%)
Others		3 (0.8%)
Highest Level of Education Completed	374	
Secondary school		13 (3.5%)
Certificate		125 (33.4%)
Diploma		50 (13.4%)
Degree		90 (24.1%)
Masters		89 (23.8%)
Others		7 (1.9%)
Marital status	380	
Married		377 (99.2%)
Unmarried		3 (0.8%)

Table 2 looks at the economic and clinical details of the participants. The Majority are employed. Many of them are from the bottom 40% (B40) and middle 40% (M40) of monthly household income. The number of smokers and non-smokers is almost equal. Most of the participants neither have chronic disease nor a family history of depression. The World Health Organization defines chronic diseases as a disease that are not passed from person to person, they are long duration and slow progression. The most common chronic diseases are cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes.

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Table 2 Economic and clinical details of participants

Variables	Total Number (N)	Frequency, n (%)
Monthly Household Income (RM)	378	
≤RM 4849.00 (B40)		245 (64.8%)
RM 4850.00 – 10 959. 00 (M40)		115 (30.4%)
≥RM 10 960 (T20)		18 (4.8%)
Employment Status	381	
Employed		370 (97.1%)
Unemployed		11 (2.9%)
Smoking status	379	
Smoker		165 (43.5%)
Non-smoker		167 (44.1%)
Ex-smoker		47 (12.4%
Presence of Existing Chronic disease	378	
Yes		43 (11.3%)
No		335 (88.6%)
Family history of depression	379	
Yes		25 (6.6%)
No		354 (93.4%)

RM = Malaysian Ringgit
Income bracket as defined by the Ministry of Finance, Malaysia 2019 are B40 ≤RM 4849.00, M40 RM 4850.00 – 10 959. 00 and T20 ≥RM 10 960

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Table 3 represents the logistic regressions and from the multiple logistic regression, two variables that are found to be significantly associated with PPND are the presence of existing chronic diseases with OR of 2.384 [95% CI (1.043, 5.450), p-value:0.039], and low to moderately perceived social support with OR of 2.176 [95% CI (1.095, 4.324), p-value:0.026].

Table 3 Summary of predictors associated with PPPD (n=381)

Variable	SLogR		MLogR	
	Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Age	0.921 (0.812, 1.043)	0.195		
Race			-	-
Malay	3.178 (0.213, 47.462)	0.402		
Non-Malay				
Religion			-	-
Islam	3.106 (0.178, 54.180)	0.437		
Others				

Female partner in antepartum or postpartum stage	0.754 (0.000, -)	1.000	-	-
Family history of Depression	2.377 (0.226, 24.99)	0.471	-	-
Suffers from chronic disease	4.126 (1.074, 15.851)	0.039	2.384 (1.043, 5.450)	0.039
History of depression	0.320 (0.043, 2.376)	0.265	-	-
History of anxiety disorder	0.394 (0.054, 2.857)	0.357	-	-
Marriage duration	0.998 (0.786, 1.267)	0.988	-	-
Number of children	1.479 (0.016,141.074)	0.866	-	-
Number of miscarriage / IUD	1.683 (0.017,164.953)	0.824	-	-
Number of pregnancies	0.620 (0.105, 3.678)	0.599	-	-
Spouse diagnosed as peripartum depression	5.048 (0.199,128.090)	0.326	-	-
Baby gender	0.498 (0.179, 1.387)	0.182	-	-
Baby medical illness	0.000 (0.000, -)	0.998	-	-
Paternity leave	0.824 (0.151, 4.503)	0.823	-	-
Low-moderate perceived social support	2.958 (0.989, 8.849)	0.052	2.176 (1.095, 4.324)	0.026

SLogR = Simple Logistic Regression

MLogR = Multiple Logistic Regression (R2= 0.043; the model reasonably fits well because Hosmer and Lemeshow test showed p value of 0.698; model assumptions are met; there was no interaction between independent variables and multicollinearity problem)

CI: Confidence interval

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DISCUSSION

The prevalence of PPND during the perinatal period in this study is 12.4%. Other Malaysian studies on the prevalence of PPND during the antenatal period, found 8.4%[16] and 12.1%[17]. A meta-analysis looking at international EPDS studies found that the PPND was 8.75% (95% CI = 6.68-11.07%) within a year of birth but with a variety of cut-off points[18]. A study using EPDS with a cut-off value of ≥10 found a PPND prevalence of 12% [19]. Therefore, we can conclude that the prevalence of PPND in this study is comparable to other studies on PPND using EPDS with the same cut-off value.

This study found two risk factors for PPND namely; low to moderate social support, and the presence of existing chronic disease. Using the ecological framework of the World Health Organisation, PPND risk factors can be summarised according to individual factors, micro-level factors, and macro-level factors. Individual factors can be biological such as a family history of depression[20,21] or chronic medical illness that predisposes to depression[22]. Psychological include premorbid personalities such as low self-esteem, poor problem-solving [23], and, substance or alcohol abuse[24,25]. Social factors include interaction with micro-level factors such as the partner, the newborn, family, and social support. At the micro level, PPND has been found to be correlated to maternal peripartum depression (MPPD)[25,26]. Quality of marriage and support system (from the partner and others) is vital for the father's mental health[4,5]. At the macro level, economic inequality, unemployment[27], poor public awareness, and stigma on mental health may lead to delayed help-seeking behavior and can increase the risk of PPND[28]. This study looked at the individual level and some micro-level factors. Unfortunately, the study was not able to look at the macro level factors which would have added richness to the data and its interpretation.

A higher level of social support, particularly at the micro level, is recognized as a protective factor against PPND. This conclusion is backed by a systematic review. The study indicates that low to moderate social support significantly increases the risk of developing PPND, with an odds ratio suggesting that individuals in this category are twice as likely to experience PPND compared to those with strong social support. The Multidimensional Scale of Perceived Social Support (MSPSS) is effective due to its three domains, which help identify the specific sources of support perceived by the individual. One study revealed that strong support from a partner or family members plays a more crucial role in reducing the risk of PPND than support from friends or healthcare professionals. This underscores the importance of support from partners and family during the perinatal period.

The presence of existing chronic diseases is an individual risk factor for postpartum depression (PPND). This study is the first to explicitly identify such an association. Generally, having chronic diseases can increase a person's likelihood of developing depression. The prevalence of depression among patients with heart disease, stroke, cancer, and diabetes is thought to be significantly higher than that of the general population. In this particular PPND study, it is suggested that men with pre-existing chronic diseases are especially vulnerable to developing PPND. It is important to explore this further to determine the possible reasons behind this phenomenon.

PPND is closely related to MPND, but in this study, only two of the female partners of the participants were diagnosed with MPND. This may be linked to the male partners' awareness and knowledge of MPND. Several questions arise from this finding. Firstly, were the female partners screened for MPND during their antenatal or postnatal follow-ups? If screening was not conducted, this could mean that the possibility of MPND went undetected. A clinical audit could be performed to ensure that screening for MPND is conducted regularly. Secondly, were the men aware that their partners might have MPND? Low awareness could explain the limited diagnoses. Regarding awareness of perinatal depression, only 56% of respondents reported being aware of it. This level of awareness needs to be addressed to enhance knowledge and understanding of both PPND and MPND within the community.

This study shows the need to screen for PPND among men and the assessment of the father's well-being needs to be included during the perinatal follow-up. The role and importance of fathers in providing support and care for their partner and newborn child need to be considered by healthcare professionals and the current health system.

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Study Limitations

The limitations of the study include the use of convenience sampling that can lead of potential selection bias. Additionally, the restrictions imposed during the COVID-19 pandemic meant that the research had to be conducted at two public health clinics in the Gombak district, where the researcher both works and lives. As a result, the findings of this study cannot be generalized to other regions of Malaysia.

Additionally, the EPDS questionnaire has its own limitations as it is primarily a screening tool. Nonetheless, its application in primary care settings among men to identify PPND is deemed adequate. With a cut-off score of ≥ 10, the EPDS demonstrates a good sensitivity of 77.3% and a specificity of 92.9% [13]. Furthermore, the EPDS was specifically developed for individuals during the perinatal period and is easy to implement in primary care clinics.

CONCLUSION

There is a high prevalence of paternal perinatal depression (PPND) among men, highlighting the need for regular screening of fathers whose partners are in the perinatal period. Assessments for fathers could be conducted alongside their female partners during antenatal or postnatal follow-ups. It's important to involve men during these follow-up visits, and those identified as being at risk for PPND should be referred for further evaluation and counseling.

Factors such as low to moderate social support and existing chronic diseases increase the risk of developing PPND. These men need close monitoring and additional support. This situation underscores the responsibility of healthcare professionals and the healthcare system to ensure that fathers are assessed and engaged during the postnatal period.

FOR PROOFREADING

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CONFLICT OF INTEREST

Authors declare none.

AUTHORS' CONTRIBUTION

Mohamad Ya'akob Yusof was the postgraduate student of this study. Farnaza Ariffin was the main supervisor with Zaliha Ismail and Salmi Razali as co-supervisors for this study. The student formulated and conceptualized the study, collected data, analysed and interpreted the data and wrote the manuscript. Ariffin F, Isa MR and Mat Nasir N supervised in the conception of the study, reviewed the analysis and interpretation of the data and contributed to the critical revisions of the results and manuscript. Ariffin F reviewed and finalized the manuscript. All authors read and approved the final manuscript. All authors agreed to be accountable for the accuracy and integrity of any part of this manuscript.

REFERENCES

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th Ed.). 2022. https://doi.org/10.1176/appi.books.9780890425787

2. Chen J, Zhao J, Chen X, Zou Z, Ni Z. Paternal Perinatal Depression: A concept analysis. Nursing Open. 2023; 10: 4995-5007 http://doi:10.1002/nop2.1797

3. Kim P, Swain JE. Sad Dads: Paternal Postpartum Depression. Psychiatry. (Edgmont). 2007; 4(2): 35-47.

4. Paulson JF, Bazemore SD. Prenatal and Postpartum Depression in Fathers and Its Association With Maternal Depression A Meta-analysis. JAMA. 2010; 303(19): 1961-69. http://doi:10.1001/jama.2010.605

5. Wee KY, Skouteris H, Pier C, Richardson B, Milgrom J. Correlates of ante- and postnatal depression in fathers: A systematic review. Journal of Affective Disorders. 2011; 130(3): 358-77. https://doi.org/10.1016/j.jad.2010.06.019

6. Hedin LW, Janson PO. Domestic violence during pregnancy. Acta Obstet Gynecol Scand. 2000; 79: 625-630.

7. Ramchandani P, Stein A, Evans J, O'Connor TG. Paternal depression in the postnatal period and child development: a prospective population study. The Lancet. 2005;365:2201-5. https://doi 10.1016/S0140-6736(05)66778-5

8. Aktar E, Qu J, Lawrence PJ, Tollenaar MS, Elzinga BM, Bögels SM. Fetal and Infant Outcomes in the Offspring of Parents with Perinatal Mental Disorders: Earliest Influences. Frontier in Psychiatry. 2019; 10(391): 1-20. https://doi.org/10.3389/fpsyt.2019.00391

9. Kadir AA, Nordin R, Ismail SB, Yaacob MJ, Mustapha W. Validation of the Malay Version of Edinburgh Postnatal Depression Scale for Postnatal Women in Kelantan, Asia Pacific Family Medicine. 2004; 3(1-2): 9-18.

10. García-Batista ZE, Guerra-Peña K, Cano-Vindel A, Herrera-Martínez SX, Medrano LA. Validity and reliability of the Beck Depression Inventory (BDI-II) in general and hospital population of the Dominican Republic. PLoS One. 2018; 13(6): e0199750. Doi: 10.1371/journal.pone.0199750

11. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. 2001; 16(9): 606-13. DOI: 10.1046/j.1525-1497.2001.016009606.x

12. Edmondson OJH, Psychogiou L, Vlachos H, Netsi E, Ramchandani PG. Depression in Fathers in the Postnatal Period: Assessment of the Edinburgh Postnatal Depression Scale as a Screening Measure. Journal of Affect Disorder. 2010; 125(1-3): 365-8. doi 10.1016/j.jad.2010.01.069

13. Kennedy E, Munyan K. Sensitivity and reliability of screening measures for paternal postpartum depression: an integrative review. Journal of Perinatology. 2021; 41(12): 2713-2721. DOI: 10.1038/s41372-021-01265-6

14. Nursazila Asikin MA, Siti Norhani S, Nur Arzuar AR, Eshaifol Azam O. Reliability and Validity of the Malay Version of Edinburgh Postpartum Depression Scale (EPDS) When Administered to Postpartum Mothers at Two Points in Time. 2019 *IIUM Medical Journal Malaysia*, *18*(1). https://doi.org/10.31436/imjm.v18i1.226

15. Song W, Mansor NS, Shari NI, Azman N, Zhang R, Leong Bin Abdullah MFI. Validation of the Malay version of the Multidimensional Scale of Perceived Social Support (MSPSS-M) among patients with cancer in Malaysia. PLoS ONE. 2023; 18(11): e0293698. https://doi.org/10.1371/journal.pone.0293698

FOR PROOFREADING

16. Nasreen HE, Rahman JA, Rus RM, Kartiwi M, Sutan R, Edhborg M. Prevalence and determinants of antepartum depression and anxiety symptoms in expectant mothers and fathers: results from a perinatal psychiatric morbidity cohort study in the east and west coast of Malaysia. BMC Psychiatry. 2018; 18: 195 https://doi.org/10.1186/s12888-018-1781-0

17. Ahmad S, Jaffar A, Osman MT, Mohamed-Ismail NA, Ab Jalil NK, Zulkapli MF, Yee LC, Othman F. Psychological distress among expectant Malaysian fathers during the antepartum period. Jokull Journal. 2016; 66(2): 48-62.

18. Roa WW, Zhu XM, Zong QQ, Ziang Q, Hall BJ, Ungvari GS, Xiang YT. Prevalence of prenatal and postpartum depression in fathers: A comprehensive meta-analysis of observational surveys. Journal of Affective Disorders. 2020; 263: 491-499 DOI: 10.1016/j.jad.2019.10.030

19. Howarth AM, Swain NR. Predictors of postpartum depression in first-time fathers. Australasian Psychiatry. 2020; 28(5): 552-554. DOI: 10.1177/1039856220924324

20. Nestler EJ, Barrot M, DiLeone RJ, Eisch AJ, Gold SJ, Monteggia LM. Neurobiology of Depression. Neuron. 2002; 34(1): 13–25. doi.org/10.1016/S0896-6273(02)00653-0

21. Couto TC, Brancagilion MYM, Alvim-Soares A, Moreira L, Garcia FD, Nicolato R, Aguiar RA, Leite HV, Corrêa H. Postpartum depression: A systematic review of the genetics involved. World Journal of Psychiatry. 2015;22(5): 103-11. doi: 10.5498/wjp.v5.i1.103

22. Boing AF, Melo GR, Boing AC, Moretti-Pires RO, Peres KG, and Peres MA. Association between depression and chronic diseases: results from a population-based study. Instituto Brasileiro de Geografi a e Estatistica. 2012; 46(4): 617-23. DOI: 10.1590/s0034-89102012005000044

23. Koh YW, Chui CY, Tang CSK, Lee AM. The Prevalence and Risk Factors of Paternal Depression from the Antenatal to the Postpartum Period and the Relationships between Antenatal and Postpartum Depression among Fathers in Hong Kong. Depress Res Treat. 2014; 2014; 1276332. https://doi.org/10.1155/2014/127632

24. Yang JH, Choi CK, Kim H-Y, Heo Y-R, Shin M-H. Association between Alcohol Drinking Status and Depressive Symptoms in Korean Adults. Chonnam Medical Journal. 2021; 57(1): 68-75. DOI: 10.4068/cmj.2021.57.1.68

25. Pinheiro RT, Magalhaes PV, Horta BL, Pinheiro KA, da Silva RA, Pinto RH. Is paternal postpartum depression associated with maternal postpartum depression? Population-based study in Brazil. Acta Psychiatry Scandinavia. 2006; 113(3): 230-2. DOI: 10.1111/j.1600-0447.2005.00708.x

26. Mohamad Yusuff AS, Tang L, Binns CW, Lee AH. Prevalence and risk factors for postnatal depression in Sabah, Malaysia: A cohort study. Women and Birth. 2015; 28(1): 25-9. DOI: 10.1016/j.wombi.2014.11.002

27. Bruno A, Celebre L, Mento C, Rizzo A, Silvestri MC, De Stefano R, Zoccali RA, Muscatello MR. When Fathers Begin to Falter: A Comprehensive Review on Paternal Perinatal Depression. Int J Environ Res Public Health. 2020; 17(4): 1139. DOI: 10.3390/ijerph17041139

FOR PROOFREADING

28. Oliffe JL, Phillips MJ. Men, depression, and masculinities: A review and recommendations. Journal of Men's Health. 2008; 5(3): 194–202. https://doi.org/10.1016/j.jomh.2008.03.016

29. Wang D, Li YL, Qiu D, Xiao SY. Factors Influencing Paternal Postpartum Depression: A Systematic Review and Meta-Analysis Journal of Affective Disorders. 2021; 293: 51–63. DOI: 10.1016/j.jad.2021.05.088

30. Philpott LF, Corcoran P. Paternal postnatal depression in Ireland: Prevalence and associated factors Midwifery. 2018; 56: 121-7. https://doi.org/10.1016/j.midw.2017.02.009

31. Voinov B, Richie WD, Bailey RK. Depression and Chronic Diseases: It Is Time for a Synergistic Mental Health and Primary Care Approach. Prim Care Companion CNS Disord. 2013; 15(2): PCC12301468. DOI: 10.4088/PCC.12r01468

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REVIEW ARTICLE

Comparing the immunogenicity of mRNA and non-mRNA COVID-19 vaccines: A scoping review

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ABSTRACT

For the past five years, the Coronavirus disease (2019 COVID-19) has spread alarmingly, challenging the economy and public health. The COVID-19 mRNA vaccines, such as Pfizer-BioNTech's BNT162 and Moderna's mRNA-1273, were developed in a short space of time and were the first mRNA vaccines approved by the United States Food and Drug Administration (US FDA) for Emergency Use Authorization (EUA). In phase II trials, the BNT16b2 vaccine was reported to have 91.3% efficacy against COVID-19, while the mRNA-1273 vaccine showed a slightly higher (94.1%) efficacy against COVID-19 in phase III trials. Both mRNA vaccines are reported to be safe and effective against COVID-19 and have an acceptable adverse event profile. The analysis from this scoping review suggests that the efficacy of the mRNA vaccines was superior to non-mRNA vaccines, which is based on the vaccine efficacy (VE) and antibody response analysis. Further analysis of the mRNA vaccines showed that the Moderna (mRNA-1273) vaccine had higher efficacy compared to the BioNTech, Pfizer (BNT1262b) vaccine. However, the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) appears to undergo frequent mutations in its spike protein gene, posing substantial public health concerns as even fully vaccinated individuals can succumb to the newer variants of the COVID-19 virus, warranting further investigation.

PROOF READING

1. INTRODUCTION

In late 2019, the coronavirus disease-2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first discovered in Wuhan, China [1]. The virus spread internationally at an alarming pace, challenging public health, and causing severe economic and societal disruptions. The virus outbreak was declared a public health emergency of international concern by the World Health Organization (WHO) on 30 January 2020 and was subsequently declared a global pandemic on 11 March 2020 [2]. The virus is transmitted human-to-human via inhalation of respiratory droplets from coughing and sneezing COVID-19-positive patients [3]. The viral infection caused mild to moderate symptoms in approximately 80% of the patients, while 20% experienced acute symptoms such as sepsis, acute respiratory distress syndrome, severe pneumonia, and death [4]. As of February 2022, the WHO has recorded 428 million confirmed cases of COVID-19, including approximately 5.9 million deaths [5]. To limit the spread of the COVID-19 pandemic, the WHO proposed some Public Health and Social Measures (PHSM)

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guidelines such as wearing face masks, adapting or closing schools and businesses, imposing restrictions on gathering, limiting domestic movements and international travelling [6]. Besides these preventative measures, vaccination was considered a crucial way to stop the spread of COVID-19.

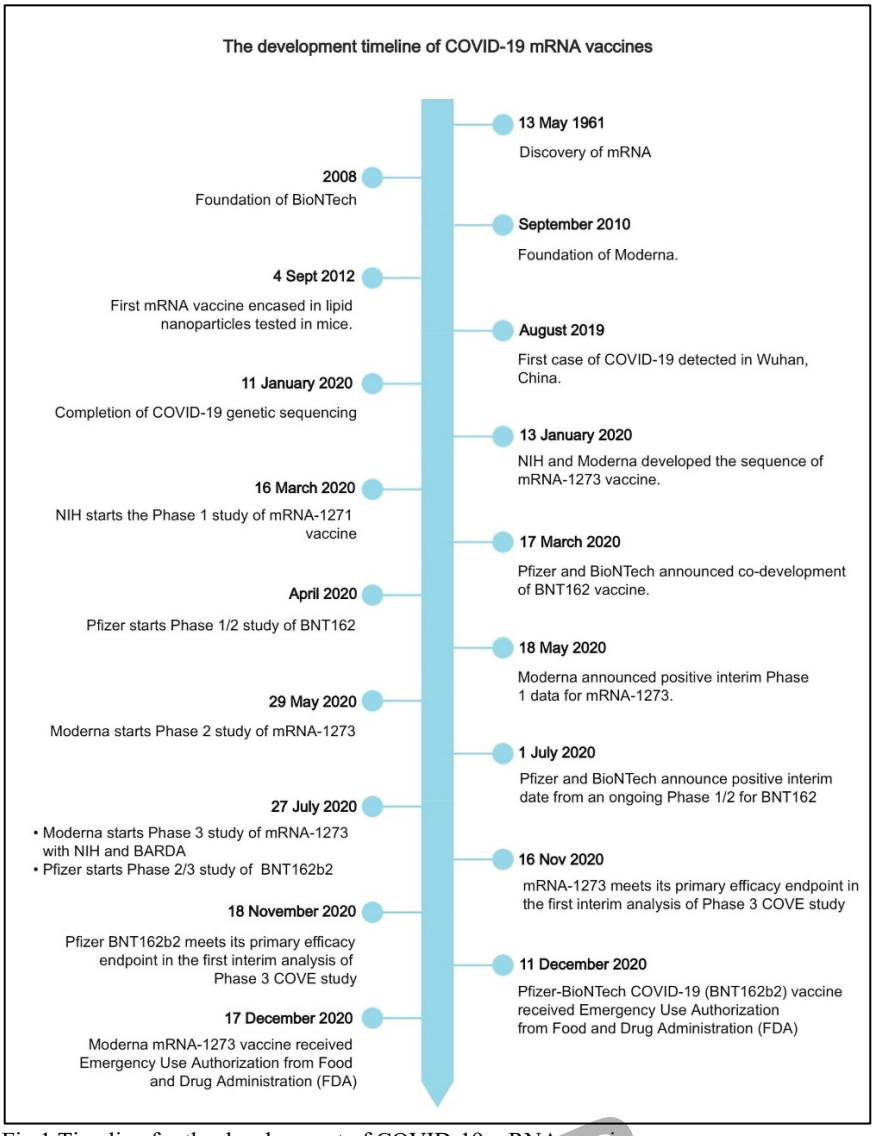

Fig.1 Timeline for the development of COVID-19 mRNA vaccines

Various COVID-19 vaccines were developed using several platforms such as the mRNA vaccine, DNA vaccine, attenuated virus vaccine, inactivated virus vaccine, and adenovirus vector vaccine. Major pharmaceutical companies like Pfizer and Moderna have developed mRNA vaccines against COVID-19 in record time (Figure 1), making mRNA COVID-19 vaccine the first mRNA vaccine authorized to be used in humans, marking the beginning of a new era in vaccine development. The mRNA vaccines became new players in human vaccines developed using a newly authorized platform, which have the edge over the traditional approaches in a pandemic situation. The COVID-19 mRNA vaccines were developed based on the genetic sequence coding for the spike protein of the SARS-Cov-2 virus, which can be rapidly produced

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in a laboratory setting compared to inactivated-virus vaccines that require bioreactor culture [7]. In addition, the mRNA vaccines elicited robust immune responses while maintaining cost-effective, rapid, large-scale production.

This paper assesses the development of the COVID-19 mRNA vaccines, their mechanism of action, the efficacy of the vaccines, the obstacles faced in developing mRNA vaccines, the side effects reported post-vaccination and the research gaps in COVID-19 mRNA vaccines. Additionally, we also carried out a scoping review aimed to review research articles to compare the efficacy of mRNA and non-mRNA COVID-19 vaccines.

2. REVIEW

2.1 History of the development of mRNA vaccine

Since the discovery of mRNA, research in this field has grown exponentially, ultimately leading to the development of RNA-base vaccines [8]. In the early phase, the research on mRNA is impeded by poor cellular uptake of naked mRNA. In 1978, the challenge was overcome by the development of lipid-based formulations, where rabbit globin mRNA introduced to mouse lymphocytes have been translated successfully [9]. Following closely in that year, protein expression from human epithelial carcinoma cells (HEp-2) was successfully stimulated by Iiposomally-encapsulated mRNA [10]. Subsequently, the efficiency of RNA transfection was further improved by incorporating synthetic cationic lipid in liposome [11].

The discovery of deoxyribonucleic acid (DNA)-dependent RNA polymerase enzymes enables in-vitro mRNA transcription (IVT) based on DNA templates. This led to the first transcription of specific mRNA using a template in 1984 [12]. mRNA was not used as a vaccine until 1993, where liposome-encapsulated mRNA was applied in preclinical study [13]. mRNA vaccines were tested against infectious disease such as influenza and rabies by Phase I clinical trials in 2017 [14, 15]. To overcome the potential toxicity of liposomes, mRNA is delivered using ionizable lipid nanoparticles (LNPs) [16, 17]. LNPs also serve as potent vaccine adjuvant and significantly improve the delivery efficacy [18].

The combination of modified mRNAs and LNPs serves as the current foundation of the mRNA vaccine [19]. This platform has been well-proven to elicit optimal immune response, this is contributed by the synergy between LNPs and modified mRNA which improve vaccine safety and efficacy [18]. During the COVID-19 outbreak, the nucleoside-modified mRNA-LNP vaccine platform is applied by Pfizer-BioNTech and Moderna for their vaccine development [20].

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2.2 Development and efficacy of COVID-19 mRNA vaccines

Within a year, Pfizer and Moderna had developed their mRNA vaccines, and the WHO and the Food and Drug Administration (FDA), USA, authorized these vaccines for emergency use (Table 1) [21, 22]. The mRNA vaccine platform has been proven to be time-effective as these vaccines can be produced rapidly, an essential feature in a pandemic scenario like the COVID-19 pandemic. In addition, the mRNA vaccine platform allows flexible vaccine design and, most importantly, the mRNA vaccines are deemed to be safe as the mRNA is eliminated in the host body naturally and does not integrate into the host genome. The study of the Pfizer BNT162 vaccine was determined based on pooled data from phase I and II/III studies, 26 observational vaccine effectiveness studies, and two post-authorization vaccine safety monitoring systems, i.e. 1) the vaccine adverse events reporting system (VAERS) and 2) the vaccine safety datalink (VSD). The Pfizer BNT162 vaccine had an efficacy of 94.3% in the prevention of COVID-19–associated hospitalization; 89.3% in preventing asymptomatic SARS-CoV-2 infection; and 96.1% in the prevention of COVID-19–associated death [23]. A Phase III study using the Moderna mRNA-1273 vaccine achieved an efficacy of 93.2% in preventing COVID-19, 98.2% in preventing severe COVID-19, and 63.0% against asymptomatic COVID-19 [24].

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Table 1. Information of COVID-19 mRNA vaccines

Vaccines	Developer	Dose	Schedule	Efficacy	References
Moderna mRNA -1273	Moderna, National Institute of Allergy and Infectious Diseases (NIAID)	2 (50 µg, 0.5 mL)	Day 0 + 28	Phase III 94.1%	[8]
Pfizer BNT162b2 /Comirnaty	Pfizer/BioNTech, Fosun Pharma	2 (30 µg, 0.3 mL)	Day 0 + 21	Phase II/III 91.3%	[9]

2.3 Vaccination and host immune system

Vaccination is a simple and effective way to provide immunity against harmful diseases. It stimulates pathogenic exposure, activating our immune system to generate effector cells and antibodies against specific infectious agents. The human immune system consists of leucocytes, lymphoid organs and tissues, soluble factors and various molecules/proteins that work together to help the body fight pathogens and to develop long term protection against infectious agents. In general, the human immune system has two main arms, i.e., innate, and adaptive immune systems that protect the human body against various infectious agents and cancer. The innate arm has an important role in preventing entry and containing any breach by pathogens. The leucocytes involved in innate immune response [e.g., neutrophils, eosinophils, natural killer (NK) cells, dendritic cells (DC), macrophages, and mast cells] can respond rapidly to pathogens [25], but these cells cannot provide long-lasting immunity [25]. In the adaptive immune system, the lymphocytes (T- and B-cells) possess cell surface receptors that enable specific antigen recognition. Upon activation by specific antigens, these lymphocytes will undergo clonal expansion and differentiate into effector and long-lived memory cells that are specific for the targeted pathogen [25, 26]. The T-cells are responsible for coordinating the immune responses and killing infected cells, whereas the activated B-cells differentiate into plasma cells that produce antigen-specific antibodies The adaptive immune system requires a longer response time compared to the innate immune system, and proper activation of the adaptive arm will produce long-lived memory B- and T-cells, which can provide a faster and stronger immune response when faced with reinfection [25]. This is the principle used in vaccination, which means that vaccinations can be used to generate immunological memory that can help to defend the host against future infections by vaccine-specific pathogens.

2.4 How do mRNA vaccines work?

Coronavirus is an enveloped RNA virus with four structural proteins, namely: envelope (E), membrane (M), nucleocapsid (N), and spike (S) proteins [25]. The S-protein is the primary surface protein of the SARS-CoV-2 virus is responsible for infection of human cells as these proteins allow viral attachment, fusion, and entry into target human cells [27-29]. The receptor for the S-protein of SARS-CoV 2 is the angiotensin-converting enzyme 2 (ACE 2) receptor found on host cells [28]. The receptor-binding domain (RBD) located in the S1 subunit initiates viral attachment to the host cell by binding to the ACE 2 receptors on host cells. The S2 subunit induces significant structural rearrangement, which allows the fusion of the

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viral and host membranes [27, 28]. Therefore, the viral S-protein of the SARS-CoV 2 virus was the main target for developing vaccines, host antibodies, and entry inhibitors.

In the development of the mRNA vaccine, the mRNA that codes for the S-protein of SARS-CoV 2 was encapsulated in lipid nanoparticles (NPs) as these NPs enable uptake of mRNA into host cells [30]. Once the vaccine is injected intramuscularly, the encapsulated mRNA enters the muscle cells, and translation of the mRNA will be initiated to produce the S-protein (Fig. 2) [27]. The peptides presented on the major histocompatibility complex (MHC) class II (MHC II) proteins can activate CD4+ T-lymphocytes, also known as T-helper (Th) cells [27]; while peptides presented on MHC class I (MHC I) proteins can activate the CD8+ T-cells, also known as the cytotoxic T-lymphocytes (CTL) [27]. The activated CD4+ T-cells will produce cytokines that stimulate activation of antigen-specific B-lymphocytes, inducing them to differentiate into plasma cells, which produce S-protein-specific antibodies and memory cells. The S-protein-specific antibodies can be used as defence mechanisms against the antigen [27]. In addition, the T-cell receptor (TCR) of the activated CD8+ T-cells can recognize virus-infected cells through the S-protein peptides expressed on the surface of some host cells [25, 26].

The S-protein produced from the mRNA vaccines can also directly activate antigen-specific B-lymphocytes, which will induce these cells to differentiate into plasma cells that produce IgM class antibodies against various epitopes on the S-protein. However, for memory cells to develop, it is crucial that the Th cells are also activated as the interactions between the T- and B-cells are crucial for development of memory cells as well as producing antibodies of different isotypes, in particular IgG [27, 28]. The plasma cells will secrete large amounts of antibodies against the S-protein, while the memory B cells serve as long term immunological memory against future detection of S-protein [25].

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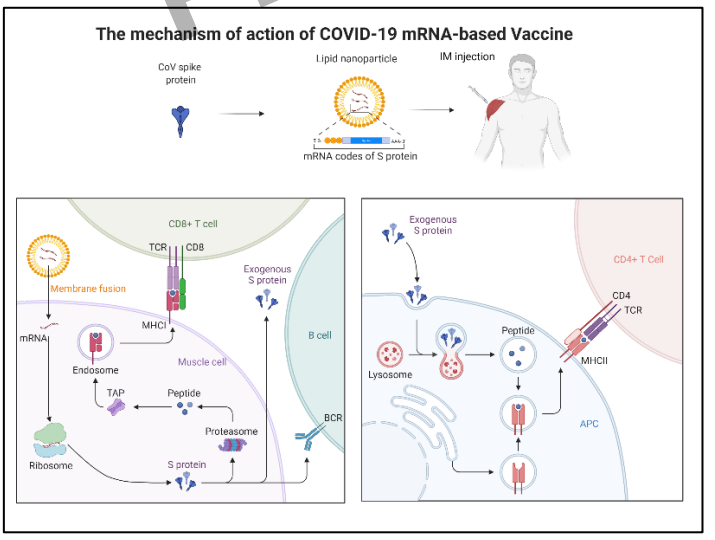

Fig.2 The mechanism of action of COVID-19 mRNA vaccines

Source: Corbett et al (2020)

2.5 Adverse effects of mRNA vaccines

Several post-vaccination adverse effects were reported with the two COVID-19 mRNA vaccines, i.e., Pfizer BNT162 and Moderna mRNA-1273. Some common post-vaccination symptoms include allergy, pain and swelling at the injection site, fatigue, fever, headache, nausea, itching, joint pain, chills, and vomiting [31, 32]. Both vaccines appear to induce rare side effects such as myocarditis and anaphylactic shock [31, 32]. Long term post-vaccination studies should be carried out to monitor the safety and effectiveness of the

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vaccines post-vaccination. In addition, similar monitoring should be observed with booster doses and heterologous vaccinations.

2.6 Emerging variants of concern

The SARS-CoV-2 virus appears to undergo mutations over time, producing newer viral strains circulating in the community. Some of the newly emerging virus strains pose serious concerns to the community, while some are relatively harmless. Some of the variants of concern (VOC) include the Alpha (B.1.1.7), Beta (B.1.351), Delta (B.1.17.2) and Omicron (B.1.1.529) variants [33-35]. These VOC have mutations in the spike protein's receptor-binding domain (RBD) and have increased viral transmission. These mutations can potentially affect the molecular, antigen and serology tests for COVID-19 and the vaccine effectiveness against the virus. In a study conducted in South Africa, vaccination with the Pfizer BNT162b2 had an efficacy of 70% and 93% against COVID-19 hospitalization during the omicron and delta dominant period [33].

Individuals vaccinated with the Moderna mRNA-1273 or Pfizer BNT162b2 vaccine had 27±17 times lower plasma neutralization potency against the omicron S-protein compared to the original (Wuhan-hu-1) variant [36]. These findings indicate a reduction in vaccine effectiveness against the new emerging variants. Therefore, the vaccines must be constantly tested against the emerging virus strains and, in some cases, be redesigned to adapt to the emerging virus strains. The recent authorization of booster dosage and heterologous vaccination reported enhancement of protection from the primary vaccination dosage, which is essential to defend against the mutated variants [37, 38].

A scoping review was undertaken to compare the immunogenicity of mRNA and non-mRNA vaccines against the COVID-19 virus.

3. MATERIALS AND METHODS

This scoping review followed the Arksey and O'Malley's five-stage framework, which includes, Stage 1: identifying the research question, Stage 2: identifying relevant studies, stage 3: Study selection, Stage 4: charting the data and lastly, Stage 5: collating, summarizing, and reporting the results [39].

3.1 Research question

The research question of this scoping review was "Do mRNA COVID-19 vaccines have higher immunogenicity compared to non- mRNA COVID-19 vaccines?"

3.2 Identification of relevant studies

A PICO template with was used to identify and develop the description that would fit each category for this study (Table 2), which was used to develop search terms that were used to search for relevant original research articles in the five databases, which were Ovid MEDLINE, Cochrane, PubMed, Scopus and Web-of-Science (WOS). The search was limited to research articles published in the last one year (2021 to 2022) as there was a huge number of research papers on this topic as COVID-19 is a heavily researched area presently. The research papers identified from the five databases were imported into EndNote X9, where duplicate papers from the different databases were removed.

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Table 2. PICO template used to develop search terms

PICO Terms		Description
P	Patient/Problem	COVID-19 pandemic
I	Intervention	COVID-19 mRNA vaccines
C	Comparison	COVID-19 non-mRNA vaccines
O	Outcome	Higher antibody response and improved efficacy

Source: Tan et al (2026)

3.3 Study selection

The articles were then exported to an online software Covidence, for further de-duplication and screening steps. Covidence is an online software that can be used to carry out systematic review-based research. In the initial screening step, the title and abstract of the selected articles were screened based on the exclusion and inclusion criteria of this study (Table 3). Then, full-text review based on the exclusion and inclusion criteria of this study was performed. In both these screening steps, each research article was reviewed independently by two researchers, and any arising conflicts were resolved by a third independent researcher. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) chart (Fig. 3) was used to show the details of these screening and selection steps.

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Table 3. Exclusion and inclusion criteria of this study

Inclusion criteria	Exclusion criteria
• Studies comparing the efficacy of COVID-19 mRNA vaccines in humans. • Studies conducting a trial on non-mRNA vaccines. • Studies that are in English. • Studies that are conducted in adults (above 18 years old).	• Studies comparing the efficacy of the COVID-19 vaccines in pregnant women, lactating women and in children (below 18 years old). • Studies that tested the efficacy of vaccines in animals. • Studies that are conducted as a review, opinion papers and systematic reviews. • Non-English language papers.

Source: Tan et al (2026)

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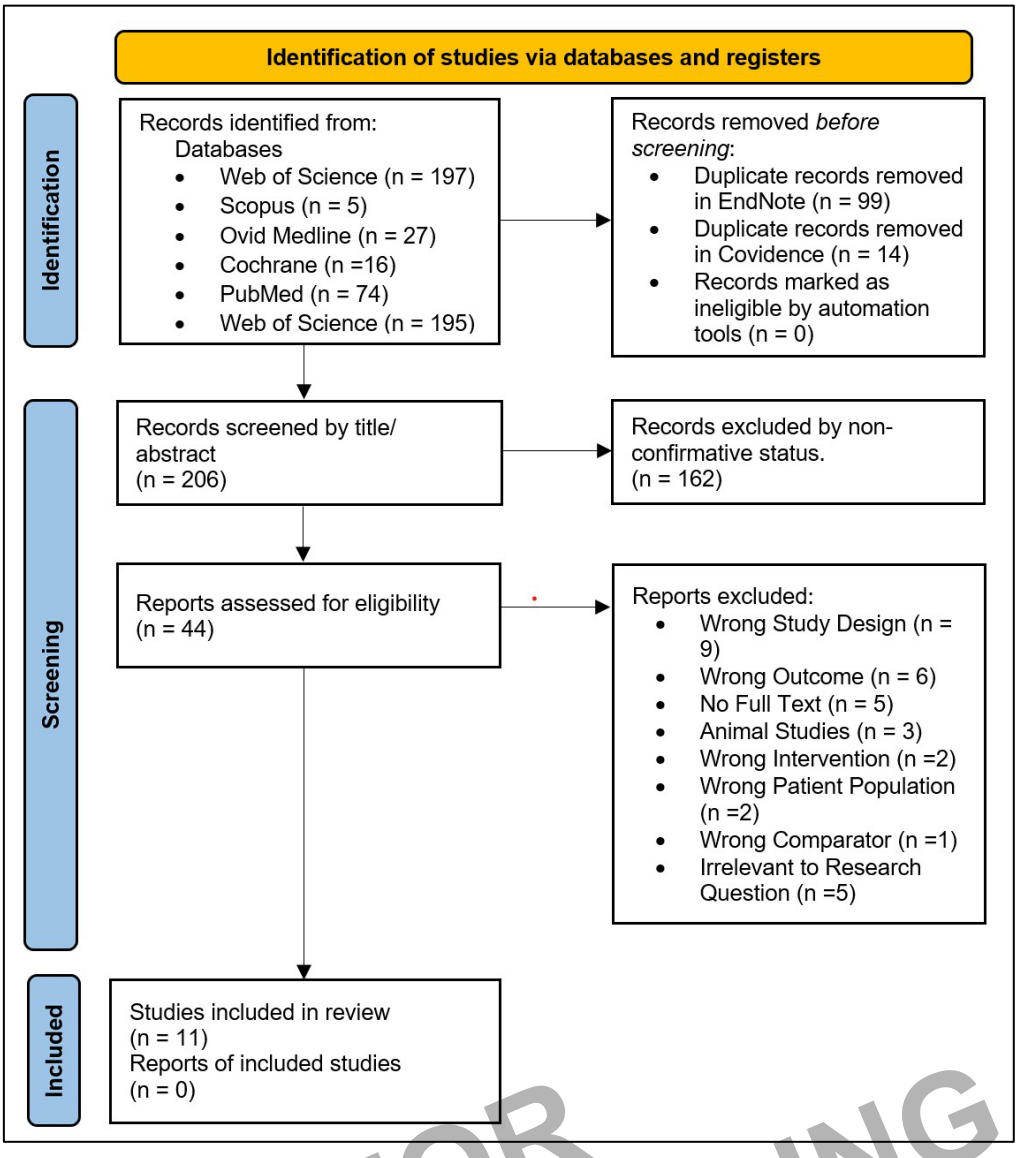

Fig.3 PRISMA chart showing the details of screening and selection of research articles

Source: Tan et al (2026)

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3.4 Data charting and analysis

Each article that was included for the final analysis was read and the relevant data was gathered in an organized way using a template generated on an Excel sheet. The data were critically analysed. After data extraction was completed, analysing the data was next. Each article that was extracted was then analysed to achieve a common conclusion. The therapeutic outcomes were analysed and divided based on (i) vaccine efficacy, (ii) antibody response and (iii) neutralizing capacity.

4. RESULTS

4.1 Selection of research articles

The initial search identified 319 publications, which was reduced to 220 studies once the duplicate records were removed using a function in the EndNote X9 software. A second round of removing duplicates was performed once these articles were imported into Covidence, where the total number of eligible papers dropped to 206 articles. Screening these 206 articles initially based on title and abstract reduced the number of papers to 44 articles (Fig. 3). Then, the 44 articles were subjected to full-text review, which eliminated 33 articles, yielding 11 articles. In both cases, screening and selection were performed based on the exclusion and inclusion criteria of this study (Table 3) and their relevance to the research question. In addition, the broad reasons for rejecting research articles during the full-text review are provided for each article (Fig. 3). Following this, relevant data were extracted from the 11 research articles that were included in this study (Table 4), which was then used for analysis.

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4.2 Information on research article

Of the 11 research articles shortlisted for this study, four (36%) were published in the year 2021; five (46%) were published in 2022, while the remaining two were published in 2023 (Fig. 4a).

Three research approaches were used in the nine studies i.e. (i) observational studies (18%; n=2); (ii) cohort studies (73%; n=8); and (iii) prospective study (9%; n=1) (Fig. 4b). The nine research articles were classified into three regions of studies (Fig. 4c), eight studies from Europe (73%), two studies from North America (18%), and a study from Asia (9%). In addition, eight studies compared the efficacy of mRNA vaccines with viral vector vaccines, one study compared the efficacy of mRNA vaccines to the inactivated vaccines while two studies compared the efficacy of mRNA vaccine to both viral vector vaccine and inactivated virus vaccine (Fig. 4d).

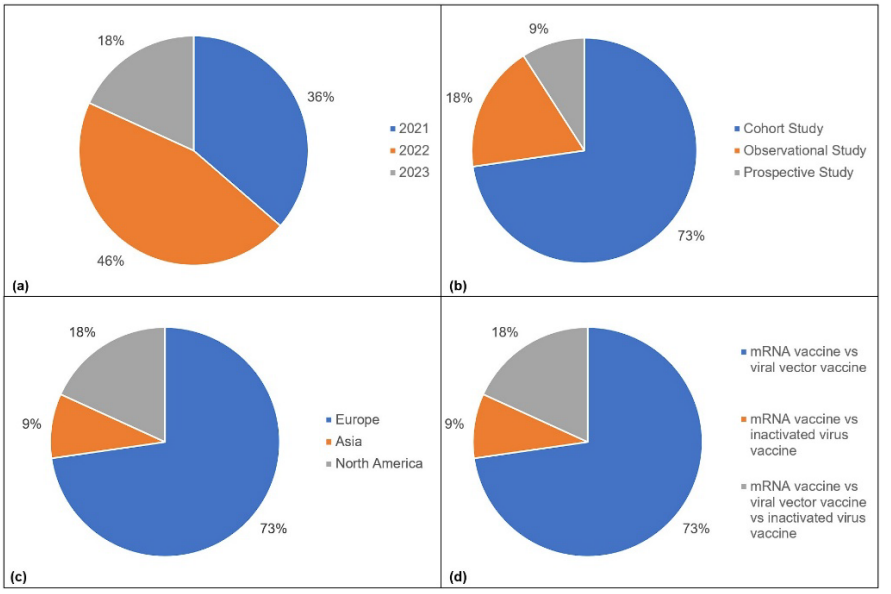

Fig. 4 Analysis of the short-listed research articles (a) type of studies included in the scoping review; (b) region in the world where the studies included in the scoping review were conducted; (c) the types of vaccine intervention used in the studies included in this scoping review

Table 4 Summary of data extracted from studies comparing immune response parameters of mRNA and non-mRNA COVID-19 vaccinations

	Author (s)	Region	Vaccine Type	Vaccine Name	Groups	Number	Number of doses	Duration between doses	Vaccine Efficacy	Binding antibody responses	Neutralizing antibody
1	Braeye *et al*., 2021	Europe	mRNA	mRNA-1273	mRNA-1273	652	2	3-5 weeks	85% (95% CI 80–90)	NA	NA
				BNT162b2	BNT162b2	7275	2	3-5 weeks	74% (95% CI 72–76)		
			Viral vector	ChadOx1	ChadOx1	55	2	12 weeks	53% (95% CI 12–84)		
				Ad26.CoV2.S	Ad26.CoV2.S	74	1	NA	61% (95% CI 29–84)		
2	Vitek *et al*., 2022	Europe	mRNA	BNT162b2 +mRNA-1273	mRNA-Age group 18-49	8	2	NA	18-49: 92% (85-96%)	NA	NA
					mRNA-Age group 50-64 age group	22	2		50-64: 93% (90-96%)		
					mRNA-Age group ≥ 65	243	2		≥ 65: 79% (75-82%)		
			Viral vector	ChAdOx1CoV-19 + Ad26.CoV2-S	Viral vector- Age group 18-49	19	2		18-49: 76% (62-85%)		
					Viral vector-Age group 50-64	39	2		50-64: 82% (75-87%)		
					Viral vector-Age group ≥ 65	36	2		≥ 65: 61% (46-72%)		
3	Paris *et al*., 2021	Europe	mRNA	mRNA-1273	mRNA-1273	Partially vaccinated 262; Fully vaccinated 464	2	3-4 weeks	Partially vaccinated = 38.2% (6.3-59.2%)	NA	NA
				BNT162b2	BNT162b2	Partially vaccinated 246; Fully	2	3-4 weeks	Partially vaccinated = 49.2% (19.1-68.1%); Fully		

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						vaccinated 685			vaccinated = 94.6% (61.0-99.2%)		
			Viral vector	ChadOx1	ChadOx1	Partially vaccinated 776; Fully vaccinated 1	2	12 weeks	Partially vaccinated= 86.2% (76.5-91.0%)		
4	Poukkaa *et al*., 2021	Europe	mRNA	BNT162b2 + mRNA-1273	BNT162b2 + mRNA-1273	315413	2	3-4 weeks	VE against infection= 82% (95% CI 79–85%); 91–180 days after the second dose= 62% (95% CI 55–68%)	NA	NA
			Viral vector	ChAdOx1	ChAdOx1	14760	2	12 weeks	VE against infection= 89% (73–95%); 91–180 days after the second dose= 63% (-166–95%)		
5	Self *et al*., 2021	North America	mRNA	mRNA-1273	mRNA-1273	476	2	4 weeks	Full surveillance period= 93% (91-95%); 14–120 days after full vaccination =93% (90-95%); >120 days after full vaccination 92% (87-96%)	Anti-RBD IgG level (median = 4,333; interquartile range [IQR] = 3,134–7,197; geometric mean = 4,274; 95% CI = 3,393–	Anti-spike IgG level (median = 3,236; IQR = 2,125–4,975, geometric mean = 3,059; 95% CI = 2,479–3,774 BAU/mL)

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				BNT162b2	BNT162b2	738	2	3 weeks	Full surveillance period= 88% (85-91%); 14–120 days after full vaccination= 91% (88–93%); >120 days after full vaccination 77% (67–84%)	5,384 BAU/mL) Anti-RBD level (median = 3,217; IQR = 2,048–4,668; geometric mean = 2,950; 95% CI = 2,325–3,742 BAU/mL) (p = 0.033)	Anti-spike IgG level (median = 2,983; IQR = 1,954–4,059; geometric mean = 2,444; 95% CI = 1,936–3,085 BAU/mL) (p = 0.217)
			Viral vector	Ad26.CoV2.S	Ad26.CoV2.S	113	1	NA	Full surveillance period=71% (56–81%); >28 days after full vaccination=68 % (49–80%)	Anti-RBD level (median = 57; IQR = 26–94; geometric mean = 51; 95% CI = 30–90 BAU/mL) (p<0.001)	Anti-spike IgG level (median = 59; IQR = 30–104; geometric mean = 56; 95% CI = 32–97 BAU/mL) (p<0.001)
6	Goldblatt *et al*., 2022	Europe	mRNA	mRNA-1273	mRNA-1273	19/19	1/2	27(26–28)	NA	Anti-spike IgG, Geometric mean concentrations (GMC) against wild-type 5530 (4007–7633), alpha	NA

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						3890(2791–5421) or delta 1957(1426–2686) variants
	BNT162b2	BNT162b2	36/51	1/2	21(20–60)	IgG GMC against wild-type 2667 (2077–3425), alpha 1801 (1390–2332) or delta 1061 (811–1387) variants
Viral vector	ChadOx1	ChadOx1	28/21	1/2	66 (33–79)	IgG GMC against wild-type 196 (141–273), alpha 108 (76–154) or delta 52 (35–77) variants
	Ad26.CoV2.S	Ad26.CoV2.S	25/NA	1/2	NA	IgG GMC against wild-type virus 61 (37–101), alpha 37 (22–62) or delta 32 (35–77) variants

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7	Kwok *et al*., 2022	Asia	mRNA	BNT162b2	BNT162b2	BNT162b2, 0 month after vaccination = 140	2	NA	NA	ELISA positive IgG against RBD,% (≥ 0.5)= 100 (97.4-100)	Surrogate virus neutralisation test (sVNT) % of positives (≥ 30%)=98.6 (94.9-99.8)
						BNT162b2, 1 month after vaccination = 188	2			ELISA % of positives(≥ 0.5)= 99.5 (97.1-100)	(sVNT) % of positives (≥ 30%)=100 (98.1-100)
						BNT162b2, 2 month after vaccination = 121	2			ELISA % of positives(≥ 0.5)= 100 (97.0-100)	(sVNT) % of positives (≥ 30%)=100 (97.0-100)
						BNT162b2, 3 month after vaccination = 83	2			ELISA % of positives(≥ 0.5)= 100 (95.7-100)	(sVNT) % of positives (≥ 30%)=100 (95.7-100)
						BNT162b2, 4 month after vaccination = 35	2			ELISA % of positives(≥ 0.5)= 97.1 (85.1-99.9)	(sVNT) % of positives (≥ 30%)=97.1 (85.1-99.9)
						BNT162b2, 5 month after vaccination = 23	2			ELISA % of positives(≥ 0.5)= 100 (85.2-100)	(sVNT) % of positives (≥ 30%)=100 (85.1-100)
						BNT162b2, 6 month after	2			ELISA % of positives(≥	(sVNT) % of positives (≥

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				vaccination = 3			0.5)= 100 (29.2-100)	30%)=100 (29.2-100)
	Inactivated virus	Cvac	257	Cvac, 0 month after vaccination = 57	2		ELISA % of positives(≥ 0.5)= 93 (83.0-98.1)	(sVNT) % of positives (≥ 30%)=96.5 (87.9-99.6)
				Cvac, 1 month after vaccination = 81	2		ELISA % of positives(≥ 0.5)= 85.2 (75.6-92.1)	(sVNT) % of positives (≥ 30%)=77.8 (67.2-86.3)
				Cvac, 2 month after vaccination = 48	2		ELISA % of positives(≥ 0.5)= 79.2 (65-89.5)	(sVNT) % of positives (≥ 30%)=75(60 .4-86.4)
				Cvac, 3 month after vaccination = 23	2		ELISA % of positives(≥ 0.5)= 47.8 (26.8-69.4)	(sVNT) % of positives (≥ 30%)=60.9 (38.5- 80.5)
				Cvac, 4 month after vaccination = 19	2		ELISA % of positives (≥ 0.5)= 26.3 (9.1-51.2)	(sVNT) % of positives (≥ 30%)= 21.1 (6.1-45.6)
				Cvac, 5 month after vaccination = 17	2		ELISA % of positives (≥ 0.5)= 47.1 (23-72.2)	(sVNT) % of positives (≥ 30%)= 23.5 (6.8-49.9)

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						Cvac, 6 month after vaccination = 12	2			ELISA % of positives(≥ 0.5)= 41.7 (15.2-72.3)	(sVNT) % of positives (≥ 30%)= 16.7 (2.1-48.8)
8	Ukey *et al*., 2022	North America	mRNA	mRNA-1273 + BNT162b2	mRNA - 1273 + BNT162b2	16	2	NA	NA	Estimates of the mean difference in each measurement between mRNA and J&J: Anti-RBD IgG titers 519.9 (169.1, 870.8), NT50 99.1 (47.9, 150.3), RBD+ (%B cells) 0.036 (− 0.084, 0.156), IFNγ (pg/ml) 35.7	NA
			Viral vector	Ad26.CoV2.S	Ad26.CoV2 .S	17	2	NA			

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9	Terpos *et al*., 2022	Europe	mRNA	BNT162b2	BNT162b2	83	2	3 weeks	1 Month after second vaccination: 95.2% 3 Month after second vaccination: 91.25% 6 Month after second vaccination: 75.3%	NA
			Viral vector	ChAdOx1	ChAdOx1	199	2	12 weeks	1 Month after second vaccination: 81.6% 3 Month after second vaccination: 63.09% 6 Month after second vaccination: 59.4%	

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10	Böröcz *et al*., 2023	Europe	mRNA	BNT162b2	BNT162b2	106	2	NA		Anti-SARS-CoV-2 spike IgG Sero-Positivity Ratio= 95.88%; Anti-SARS-CoV-2 IgA Sero-Positivity Ratio= 65.38%
			Viral vector	ChadOx1, Sputnik V	ChadOx1, Sputnik V	77	2			87.67%; 45.21%
			Inactivated virus	BBIP	BBIP	34	2			69.23%; 22.58%
11	Csoma, *et al*., 2023	Europe	mRNA	BNT162b2	BNT162b2	50	2		Total SARS-CoV-2 S-specific antibody (S-Ab) titer: 993 BAU/mL	Anti-SARS-CoV-2 Neutralizing Antibody, Snibe assay: 1.59 μg/mL; Medcaptain test: 31.82 AU/mL
			Viral vector	ChadOx1, Sputnik V	ChadOx1, Sputnik V	50	2		237 BAU/mL	0.50 μg/mL; 12.25 AU/mL
			Inactivated virus	BIBP	BIBP	50	2		139 BAU/mL	0.41 μg/mL; 8.97 AU/mL

NA: not applicable; mRNA: mRNA vaccine; Ad26.CoV2.S: Janssen viral vector; BNT162b2: Pfizer-BioNtech mRNA vaccine; ChAdOx1: Astra-Zeneca viral vector vaccine; Cvac: CoronaVac inactivated virus vaccine; mRNA-1273: Moderna mRNA vaccine; Sputnik V : Gamaleya Center viral vector vaccine; BIBP: Sinopharm inactivated virus vaccine

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4.3 Comparison of immune response parameters

Majority of the studies reported higher vaccine efficacy in mRNA vaccination regimen compared to non-mRNA vaccinations (viral vector vaccine, inactivated vaccine). Similarly, mRNA vaccination also displayed superior immunogenicity in eliciting production of IgG, IgA and neutralizing antibodies (Table 5).

Table 5. Comparing immune response parameters from mRNA vaccination versus non-mRNA vaccination regime

Immune response parameter	Total studies	Number of studies showing higher immune parameters with mRNA vaccination regime [n(%)]	References
Vaccine efficacy	6	4 (67%)	[42-47]
Anti-Spike IgG antibodies	4	4 (100%)	[40, 41, 48, 45]
Anti-RBD IgG antibodies	3	3 (100%)	[49, 45, 50]
Anti-Spike IgA antibodies	1	1 (100%)	[40]
Neutralizing antibodies	2	2 (100%)	[41, 49]

4.4 Vaccine efficacy

Six studies (Table 5) measured the therapeutic outcomes based on vaccine efficacy (VE) [42-47]. In most studies (67%) of this review, mRNA vaccination displayed higher VE compared to non-mRNA counterparts. Contrastingly, in the study comparing the efficacy of partial vaccination by Paris et al., mRNA vaccines displayed lower VE (mRNA-1273: 38.2%; BNT162b2: 49.2%) than viral vector vaccination (ChadOx1: 86.2%). However, the cohort that received full dosage of BNT162b2 mRNA vaccine reported the highest VE (94.6%) in the study, suggesting the need of full vaccination, particularly for mRNA vaccination [43]. In a cohort study, two dosage of homologous mRNA vaccination (mRNA-1273+BNT162b2) were reported have lower VE than two dosage of ChAdOx1 vaccine, although the differences are not meaningful (mRNA: 82%; ChAdOx1: 89%).

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4.5 Anti-SARS-CoV-2 IgG and IgA Antibody Levels

Three studies that compared (anti-RBD, spike) IgG antibody levels from individuals who were fully vaccinated with either mRNA or viral vector vaccines [48, 45, 50]. The results show that all the COVID-19 vaccines passed this threshold. The mRNA vaccines produced substantially higher IgG antibody compared to viral vector vaccines [48, 45, 50]. In addition, it was also noted that the mRNA-1273 (Moderna) vaccine produced the highest antibody response compared to the other vaccines.

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The mRNA vaccine regimen is compared to viral vector and inactivated virus vaccines in two cohort studies by Böröcz et al., and Csoma et al., Both studies reported mRNA (BNT162b2) to elicit the highest production of antibodies (anti-spike IgG, IgA), followed by viral vector vaccine (ChadOx1, Sputnik V), while inactivated virus vaccine (BBIP) has the lowest antibody response.

One study compared antibody responses between BNT162b2 vaccinated and CoronaVac vaccinated cohorts over a period of 6-months. Majority of BNT162b2-vaccinated group have higher levels of antibody responses compared to the CoronaVac group. In addition, the antibody response appears to be stable for BNT162b2 vaccinated group throughout 6-months post-vaccination while CoronaVac vaccinated group drastically dropped at four-months after vaccination [49].

4.6 Neutralizing antibodies

In a cohort study conducted by Csoma et al., mRNA (BNT162b2) vaccinated group were reported to produce the highest neutralizing antibody level at 31.82 AU/mL compared to viral vector vaccinated group (ChadOx1, 12.25 AU/mL), and inactivated virus vaccinated group (BIBP, 8.97 AU/mL).

Similarly in the study conducted by Kwok et al., BNT162b2 vaccinated cohort displayed stable prolonged neutralizing antibody production (sVNT % of positives [≥ 30%]) post-vaccination (0 month after vaccination = 98.6%; 6 months after vaccination= 100%). While CoronaVac vaccinated cohort exhibited substantial waning (0 month after vaccination = 96.5%; 6 months after vaccination= 16.7%). This suggests mRNA vaccines can provide strong and long-lasting immunity compared to viral vector vaccine and inactivated virus vaccine.

5. DISCUSSION

The concept of mRNA Vaccine have been in development to be since the early 21st century. The mechanism of the mRNA vaccine is through introducing the mRNA that corresponds to a viral protein. In general, the vaccine ends up providing the recipient's cells to construct the protein. This process leads to initiate an immune response against the protein. Furthering into the process, inducing an immune response will proceeds to the beginning of antibody production [51]. As this is a new vaccine production, there have been concerns regarding the harmful side effects that this vaccine might cause. The common side effects that are associated with the administration includes local side effects such as fever, pain at site of injection and redness and swelling [51]. A study by Oster ME et al., showed that myocarditis was identified as a rare but severe adverse effect after Covid-19 mRNA vaccination. There was an increased risk in adolescent males and young men particularly after the second dose of the vaccination [52]. The long-term side effects should be explored to ensure proper prevention and treatment can be taken into consideration.

Viral vector vaccines were commonly compared in this review to mRNA Vaccines as it is widely used in many different countries. Viral vector vaccines consist of a genetic modified virus, and it exhibits foreign antigen using the host translational machinery [53]. The common side effects that are exhibited are systemic side effects such as headache, fever, and fatigue. Most of these side effects depletes after 1-3 days of vaccination which is promising [54]. However, the ChAdOx1 nCoV-19 have been associated with thrombosis and thrombocytopenia [55]. It was noted that in the study approximately five patients previously healthy) were associated with this rare side effect after 10 days receiving the first dose of AstraZeneca. They were aged between 32-54 years old. This side effect was found in other studies particularly in the younger age group, proving further safety of this vaccine needs to be investigated.

Inactivated vaccines have been effectively used for many years against Polio, Hepatitis A and Rabies. The mechanism of the vaccine is initiated by chemical neutralization of the virus, cultivated using Vero cell lines in conditional medium [53]. CoronaVac has been approved to use in China and has Emergency Use Authorization (EUA) in multiple countries such as Brazil and Malaysia. This vaccine has been

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associated with a lower vaccine efficacy compared to other in multiple studies. However, on the bright side this vaccine is associated with higher safety recognition due to its property of being an inactivated vaccine.

This scoping review aims to explore the efficacy of mRNA vaccines to non-mRNA Vaccines. According to the studies included, the efficacy of the mRNA Vaccination deemed to be more superior compared to non-mRNA Vaccines based on the analysis of VE and overall antibody response. Further analysing of information showed that, Moderna (mRNA-1273) had a better general efficacy compared to BioNTech, Pfizer (BNT1262b). Nevertheless, both mRNA Vaccines have proofed to be efficacious and beneficial to combat the pandemic, Covid-19. Despite that, the vaccines can be resistant to different variants which complicates the situation. In a study, comparing VE of one dose versus two dose mRNA Vaccine (mRNA-1273, Moderna) with different variants of concern (VOC) of the COVID-19 virus concluded that the mRNA vaccines were efficacious when two-doses were administered instead of one dose, suggests the significance of receiving full vaccination [56]. For instance, the VE against Delta variant was 86.7%, significantly lower compared to efficacy against Alpha Variant (98.4%). This is important to note as SARS-CoV2 is a virus that will continue replicating and the efficacy of the vaccine now will not remain the same as more variants come into play. More research should be conducted as more variants develop to ensure a better understanding is entailed from this situation.

Another aspect that was noted through this review were, certain studies compared the efficacy of the vaccines based on the age groups. Girgic VM et al., compared the Vaccine Efficacy of the mRNA Vaccines (BioNTech, Pfizer (BNT1262b), Moderna (mRNA-1273) to Viral Vector Vaccines (Oxford, AstraZeneca (ChAdOx1), Johnson & Johnson (Ad26.CoV2.S)) based on three categories of age group being 18-49, 50-64 and ≥ 65 years. The study showed the efficacy of mRNA vaccine being more efficacious in all three age groups compared to the viral vector vaccines. However, vaccine efficacy of both mRNA and viral vector vaccines depleted in the age group of ≥ 65 years old [47]. This can also be proved in the study by Collier DA et al., that showed the serum neutralization and antibody response of IgA and IgG after the first dose of Pfizer vaccine were lower in the older individuals (>80 years) [57]. This indicates that antibody response is lower in the older age group compared to the younger age group which is crucial as the older generation is more susceptible to the disease of Covid-19 even if they have gotten their full vaccination.

Elderly people (≥ 65 years) who got either mRNA vaccine 6 months ago or more showed a substantial reduction of Vaccine Efficacy to 43% [47]. This proves the need of a booster to ensure proper protection against Covid-19 particularly in the older age group. Many countries are urging the citizens for their need of booster to ensure the waning of the antibody response would not put their lives in danger and lead to hospitalisation and death. Interestingly, the intervals between the doses of the vaccines have also been shown to modify the efficacy of vaccines. A study shows that an interval of at least six weeks between the administration of two doses of mRNA Vaccine increased the neutralising antibodies [58]. This shows the importance of spacing the doses to ensure better overall efficacy can be achieved. However, certain countries reduced the interval at the beginning of the pandemic to ensure herd immunity was achieved at a faster rate due to the situation being out of hand. All in all, this review shows the importance of research to ensure information stays up-to-date and more guidelines can be created to ensure a safer and protected community.

5.1 Future challenges and research gaps of COVID-19 mRNA vaccines

Recently, the FDA USA authorized booster doses of the COVID-19 vaccines and heterologous vaccination regimes to restore or enhance the protection provided by the primary vaccination [59]. Due to the constant mutation of the SARS-CoV-2 virus, vaccines may require regular evaluation and updating to accommodate mutated viral strains. Moreover, the newer or better COVID-19 vaccines, booster dosage strategies and heterologous vaccination regimes were developed and authorized for emergency use in record time. However, the long-term safety of the vaccines, particularly in immunocompromised individuals, should be closely monitored. Currently, most studies of COVID-19 mRNA vaccines prioritize neutralizing

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antibodies, additional parameters of vaccine immune response such as T- and B-cell responses should be carried out to provide better insight into the effect of these vaccines on the SARS-CoV-2 virus.

5.2 Advantages of mRNA vaccines

mRNA vaccines, such as Moderna mRNA-1273 and Pfizer-BioNTech BNT162b2, offer several distinct advantages compared to the inactivated virus vaccine and viral vector vaccine.

One of the most crucial advantages offered by the mRNA vaccine platform is its short development time. Both Moderna and Pfizer have successfully developed their respective mRNA against SARS-CoV 2 and were authorized to use in a short time [21, 22]. This is contributed by the flexibility in manufacturing mRNA vaccine [60]. Upon acquisition of the sequence of the antigen, the mRNA can be synthesized, enabling rapid large-scaled production at a lower cost [60]. This nature of mRNA vaccine also allows rapid adaptation against virus mutation by adapting the mRNA sequence against the mutated variant accordingly [61].

Additionally, mRNA vaccine can eliminate the risk of infection compared to the inactivated virus vaccine. Inactivated virus vaccine utilizes whole virus particles that has been killed, which have a small chance for incomplete inactivation that can poses as a safety concern [62]. In contrast, since mRNA vaccines do not use any live virus, the risk of infection can be eliminated [63].

Lastly, mRNA vaccine has demonstrated a stronger immune response and higher vaccine efficacy than the inactivated virus vaccine. Inactivated virus vaccines present the virus in a non-replicating form [62]. Although they stimulate both humoral (antibody-mediated) and cellular (T cell-mediated) immunity, they may not closely replicate the natural infection compared to the mRNA vaccines, which influence the strength and specificity of the immune response [64]. mRNA vaccines are encoded to produce a specific antigen protein (such as the spike protein of SARS-CoV-2), this contributes to a robust and highly specific activation of antibody-producing B-cells and T-cells and against the virus [65].

In comparison, inactivated vaccines from Sinovac and Sinopharm have been applied widely and are effective vaccines, they generally are more time-consuming to be developed and to scale up for production as biosafety level 3 is required for production of inactivated virus vaccines [62]. They are also based on a more traditional vaccine platform, which can be a bottleneck when rapid adaptation to new variants is required.

These vaccines have played important roles in combating the COVID-19 pandemic, with mRNA vaccines standing out for their rapid development, high efficacy, and adaptability to emerging variants.

5.3 Disadvantages of mRNA vaccine

While mRNA vaccines have displayed remarkable efficacy and have been crucial against the spread of COVID-19 infection, there are a few disadvantages associated with the mRNA vaccine platform.

mRNA vaccines, such as Moderna mRNA-1273 and Pfizer-BioNTech BNT162b2, require ultra-cold storage temperatures (-20°C for Moderna and -80°C to -60°C for Pfizer-BioNTech) for long-term storage up to 6 months [66]. This stringent requirement can be logistically challenging, particularly in regions with limited access to specialized storage facilities or in tropical countries. Once mRNA vaccines are removed from ultra-cold storage, the shelf life and stability of the vaccines are reduced significantly (6 month in ultra-cold storage; up to 30 days in 4°C) [66].

Currently, mRNA COVID-19 vaccines from Pfizer-BioNTech and Moderna have a cost disadvantage compared to inactivated virus vaccines [67]. The higher cost of mRNA vaccines can be attributed by higher upfront research and development cost, and production cost as the mRNA vaccine platform is novel and have a complex manufacturing process. In addition, the distribution cost of the mRNA vaccine is higher due to the requirement of ultra-low temperature for cold chain.

mRNA vaccines are reported to have a higher potential for reactogenicity compared to inactivated virus vaccines [63]. Studies have shown a higher rate of short-term side effects such as fatigue, fever and

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muscle pain after vaccination compared to inactivated virus vaccines [31, 32]. The novel implementation of mRNA technology into COVID-19 vaccines received some negative public perceptions. The hesitancy toward the mRNA vaccine mainly circles the safety concern of the mRNA vaccination [63]. While mRNA vaccines have shown excellent efficacy and flexibility, especially against evolving variants of SARS-CoV-2, they need to overcome some challenges such as logistic, cost, and public perception to expand their impact and accessibility.

6. CONCLUSION

Although vaccines are not the panacea for COVID-19, it is the key to controlling the pandemic's spread and minimizing the adverse effects caused by SAR-CoV-2 infections. A good candidate COVID-19 vaccine should be safe, reliable, induce long-lasting immunity and be widely available. The ability of COVID-19 mRNA vaccines to be designed and be mass-produced in a short time while prompting robust immune response against SAR-CoV-2 is truly remarkable, which indicates the success of the mRNA vaccine platform. However, vaccine-related adverse effects and the long-term effectiveness of mRNA vaccines should be closely monitored to evaluate the safety of the vaccines and facilitate the design of a better mRNA vaccine in the future.

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8. CONFLICT OF INTEREST

Authors declare none.

8. AUTHORS' CONTRIBUTION

Kang Wei Tan, Ashwini Mahendran, and Samantha Khoo Si Mei conducted the review and drafted the manuscript. Saatheeyavaane Bhuvanendran, and Ammu Kutty Radhakrishnan provided critical input towards its content. Kang Wei Tan revised the manuscript.

9. REFERENCES

1. Amanat, F., & Krammer, F. (2020). SARS-CoV-2 vaccines: Status report. *Immunity, 52*(4), 583–589. https://doi.org/10.1016/j.immuni.2020.03.007
2. Cucinotta, D., & Vanelli, M. (2020). WHO declares COVID-19 a pandemic. *Acta Biomedica, 91*(1), 157–160. https://doi.org/10.23750/abm.v91i1.9397
3. Harrison, A. G., Lin, T., & Wang, P. (2020). Mechanisms of SARS-CoV-2 transmission and pathogenesis. *Trends in Immunology*.
4. Wu, Z., & McGoogan, J. M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention. *JAMA, 323*(13), 1239–1242. https://doi.org/10.1001/jama.2020.2648
5. World Health Organization. (2022). *WHO Coronavirus (COVID-19) dashboard*. https://covid19.who.int/
6. World Health Organization. (2020, March 29). *Modes of transmission of virus causing COVID-19:*

 ©UiTM Press, Universiti Teknologi MARA

Implications for IPC precaution recommendations (Scientific brief).

7. Conforti, A., Marra, E., Roscilli, G., Palombo, F., Ciliberto, G., & Aurisicchio, L. (2020). Are genetic vaccines the right weapon against COVID-19? *Molecular Therapy, 28*(7), 1555–1556. https://doi.org/10.1016/j.ymthe.2020.06.007
8. Brenner, S., Jacob, F., & Meselson, M. (1961). An unstable intermediate carrying information from genes to ribosomes for protein synthesis. *Nature, 190*, 576–581. https://doi.org/10.1038/190576a0
9. Dimitriadis, G. J. (1978). Translation of rabbit globin mRNA introduced by liposomes into mouse lymphocytes. *Nature, 274*(5674), 923–924.
10. Ostro, M. J., Giacomoni, D., Lavelle, D., Paxton, W., & Dray, S. (1978). Evidence for translation of rabbit globin mRNA after liposome-mediated insertion into a human cell line. *Nature, 274*(5674), 921–923. https://doi.org/10.1038/274921a0
11. Malone, R. W., Felgner, P. L., & Verma, I. M. (1989). Cationic liposome-mediated RNA transfection. *Proceedings of the National Academy of Sciences, 86*(16), 6077–6081. https://doi.org/10.1073/pnas.86.16.6077
12. Krieg, P. A., & Melton, D. A. (1984). Functional messenger RNAs are produced by SP6 in vitro transcription of cloned cDNAs. *Nucleic Acids Research, 12*(18), 7057–7070. https://doi.org/10.1093/nar/12.18.7057
13. Martinon, F., Krishnan, S., Lenzen, G., Magné, R., Gomard, E., Guillet, J.-G., & Meulien, P. (1993). Induction of virus-specific cytotoxic T lymphocytes in vivo by liposome-entrapped mRNA. *European Journal of Immunology, 23*(7), 1719–1722. https://doi.org/10.1002/eji.1830230749
14. Alberer, M., Gnad-Vogt, U., Hong, H. S., Mehr, K. T., Backert, L., Finak, G., … (2017). Safety and immunogenicity of a mRNA rabies vaccine in healthy adults: An open-label, non-randomised, prospective, first-in-human phase 1 clinical trial. *The Lancet, 390*(10101), 1511–1520. https://doi.org/10.1016/S0140-6736(17)31665-3
15. Bahl, K., Senn, J. J., Yuzhakov, O., Bulychev, A., Brito, L. A., Hassett, K. J., … Ciaramella, G. (2017). Preclinical and clinical demonstration of immunogenicity by mRNA vaccines against H10N8 and H7N9 influenza viruses. *Molecular Therapy, 25*(6), 1316–1327. https://doi.org/10.1016/j.ymthe.2017.03.035
16. Leung, A. K. K., Tam, Y. Y. C., & Cullis, P. R. (2014). Lipid nanoparticles for short interfering RNA delivery. *Advances in Genetics, 88*, 71–110. https://doi.org/10.1016/B978-0-12-800148-6.00004-3
17. Lv, H., Zhang, S., Wang, B., Cui, S., & Yan, J. (2006). Toxicity of cationic lipids and cationic polymers in gene delivery. *Journal of Controlled Release, 114*(1), 100–109. https://doi.org/10.1016/j.jconrel.2006.04.014
18. Alameh, M.-G., Tombácz, I., Bettini, E., Lederer, K., Ndeupen, S., Sittplangkoon, C., … (2021). Lipid nanoparticles enhance the efficacy of mRNA and protein subunit vaccines by inducing robust T follicular helper cell and humoral responses. *Immunity, 54*(12), 2877–2892.e7. https://doi.org/10.1016/j.immuni.2021.11.001
19. Richner, J. M., Himansu, S., Dowd, K. A., Butler, S. L., Salazar, V., Fox, J. M., … (2017). Modified mRNA vaccines protect against Zika virus infection. *Cell, 168*(6), 1114–1125.e10. https://doi.org/10.1016/j.cell.2017.02.017
20. Zhang, L., More, K. R., Ojha, A., Jackson, C. B., Quinlan, B. D., Li, H., … (2023). Effect of mRNA-LNP components of two globally-marketed COVID-19 vaccines on efficacy and stability. *npj Vaccines, 8*(1), 156. https://doi.org/10.1038/s41541-023-00751-6
21. Baden, L. R., El Sahly, H. M., Essink, B., Kotloff, K., Frey, S., Novak, R., … (2021). Efficacy and safety of the mRNA-1273 SARS-CoV-2 vaccine. *New England Journal of Medicine, 384*(5), 403–416. https://doi.org/10.1056/NEJMoa2035389

FOR PROOFREADING

22. Thomas, S. J., Moreira, E. D., Jr., Kitchin, N., Absalon, J., Gurtman, A., Lockhart, S., … (2021). Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine through 6 months. *New England Journal of Medicine, 385*(19), 1761–1773. https://doi.org/10.1056/NEJMoa2110345

23. Dooling, K., Gargano, J. W., Moulia, D., Wallace, M., Rosenblum, H. G., Blain, A. E., … (2021). Use of Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years: Recommendations of the Advisory Committee on Immunization Practices—United States, September 2021. *MMWR. Morbidity and Mortality Weekly Report, 70*(38), 1344–1348. https://doi.org/10.15585/mmwr.mm7038e2

24. El Sahly, H. M., Baden, L. R., Essink, B., Doblecki-Lewis, S., Martin, J. M., Anderson, E. J., … (2021). Efficacy of the mRNA-1273 SARS-CoV-2 vaccine at completion of blinded phase. *New England Journal of Medicine, 385*(19), 1774–1785. https://doi.org/10.1056/NEJMoa2113017

25. Chumakov, K., Avidan, M. S., Benn, C. S., Bertozzi, S. M., Blatt, L., Chang, A. Y., … (2021). Old vaccines for new infections: Exploiting innate immunity to control COVID-19 and prevent future pandemics. *Proceedings of the National Academy of Sciences, 118*(21), e2101718118. https://doi.org/10.1073/pnas.2101718118

26. Giannotta, G., & Giannotta, N. (2021). mRNA COVID-19 vaccines and long-lived plasma cells: A complicated relationship. *Vaccines, 9*(12), 1503. https://doi.org/10.3390/vaccines9121503

27. Corbett, K. S., Edwards, D. K., Leist, S. R., Abiona, O. M., Boyoglu-Barnum, S., Gillespie, R. A., … (2020). SARS-CoV-2 mRNA vaccine design enabled by prototype pathogen preparedness. *Nature, 586*(7830), 567–571. https://doi.org/10.1038/s41586-020-2622-0

28. Tai, W., He, L., Zhang, X., Pu, J., Voronin, D., Jiang, S., … (2020). Characterization of the receptor-binding domain (RBD) of 2019 novel coronavirus: Implication for development of RBD protein as a viral attachment inhibitor and vaccine. *Cellular & Molecular Immunology, 17*(6), 613–620. https://doi.org/10.1038/s41423-020-0400-4

29. Wu, A., Peng, Y., Huang, B., Ding, X., Wang, X., Niu, P., … (2020). Genome composition and divergence of the novel coronavirus (2019-nCoV) originating in China. *Cell Host & Microbe, 27*(3), 325–328. https://doi.org/10.1016/j.chom.2020.02.001

30. Kalnin, K. V., Plitnik, T., Kishko, M., Zhang, J., Zhang, D., Beauvais, A., … (2021). Immunogenicity and efficacy of mRNA COVID-19 vaccine MRT5500 in preclinical animal models. *npj Vaccines, 6*(1). https://doi.org/10.1038/s41541-021-00324-5

31. Meo, S. A., Bukhari, I. A., Akram, J., Meo, A. S., & Klonoff, D. C. (2021). COVID-19 vaccines: Comparison of biological, pharmacological characteristics and adverse effects of Pfizer/BioNTech and Moderna vaccines. *European Review for Medical and Pharmacological Sciences, 25*(3), 1663–1669. https://doi.org/10.26355/eurrev_202102_24877

32. Oliver, S. E., Gargano, J. W., Marin, M., Wallace, M., Curran, K. G., Chamberland, M., … (2020). The Advisory Committee on Immunization Practices' interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine—United States, December 2020. *MMWR. Morbidity and Mortality Weekly Report, 69*(50), 1922–1924. https://doi.org/10.15585/mmwr.mm6950e2

33. Collie, S., Champion, J., Moultrie, H., Bekker, L.-G., & Gray, G. (2021). Effectiveness of BNT162b2 vaccine against Omicron variant in South Africa. *New England Journal of Medicine*. https://doi.org/10.1056/NEJMc2119270

34. Meng, B., Kemp, S. A., Papa, G., Datir, R., Ferreira, I. A. T. M., Marelli, S., … (2021). Recurrent emergence of SARS-CoV-2 spike deletion H69/V70 and its role in the Alpha variant B.1.1.7. *Cell Reports, 35*(13), 109292. https://doi.org/10.1016/j.celrep.2021.109292

FOR PROOF READING

35. Yadav, P. D., Sapkal, G. N., Ella, R., Sahay, R. R., Nyayanit, D. A., Patil, D. Y., … (2021). Neutralization of Beta and Delta variant with sera of COVID-19 recovered cases and vaccinees of inactivated COVID-19 vaccine BBV152/Covaxin. *Journal of Travel Medicine, 28*(7), taab104. https://doi.org/10.1093/jtm/taab104

36. Schmidt, T., Klemis, V., Schub, D., Mihm, J., Hielscher, F., Marx, S., … (2021). Immunogenicity and reactogenicity of heterologous ChAdOx1 nCoV-19/mRNA vaccination. *Nature Medicine, 27*(9), 1530–1535. https://doi.org/10.1038/s41591-021-01464-w

37. Barda, N., Dagan, N., Cohen, C., Hernán, M. A., Lipsitch, M., Kohane, I. S., … (2021). Effectiveness of a third dose of the BNT162b2 mRNA COVID-19 vaccine for preventing severe outcomes in Israel: An observational study. *The Lancet, 398*(10316), 2093–2100. https://doi.org/10.1016/S0140-6736(21)02249-2

38. Borobia, A. M., Carcas, A. J., Pérez-Olmeda, M., Castaño, L., Bertran, M. J., García-Pérez, J., … (2021). Immunogenicity and reactogenicity of BNT162b2 booster in ChAdOx1-S-primed participants (CombiVacS): A multicentre, open-label, randomised, controlled, phase 2 trial. *The Lancet, 398*(10295), 121–130. https://doi.org/10.1016/S0140-6736(21)01420-3

39. Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8*(1), 19–32. https://doi.org/10.1080/1364557032000119616

40. Böröcz, K., Kinyó, Á., Simon, D., Erdő-Bonyár, S., Németh, P., & Berki, T. (2023). Complexity of the immune response elicited by different COVID-19 vaccines, in the light of natural autoantibodies and immunomodulatory therapies. *International Journal of Molecular Sciences*, 24(7), 6439. https://doi.org/10.3390/ijms24076439

41. Csoma, E., Nagy Koroknai, Á., Sütő, R., Szakács Szilágyi, E., Pócsi, M., Nagy, A., et al. (2023). Evaluation of the diagnostic performance of two automated SARS-CoV-2 neutralization immunoassays following two doses of mRNA, adenoviral vector, and inactivated whole-virus vaccinations in COVID-19 naïve subjects. *Microorganisms*, 11(5), 1187. https://doi.org/10.3390/microorganisms11051187

42. Braeye, T., Cornelissen, L., Catteau, L., Haarhuis, F., Proesmans, K., De Ridder, K., et al. (2021). Vaccine effectiveness against infection and onwards transmission of COVID-19: Analysis of Belgian contact tracing data, January–June 2021. *Vaccine*, 39(39), 5456–5460. https://doi.org/10.1016/j.vaccine.2021.08.060

43. Paris, C., Perrin, S., Hamonic, S., Bourget, B., Roué, C., Brassard, O., et al. (2021). Effectiveness of mRNA-BNT162b2, mRNA-1273, and ChAdOx1 nCoV-19 vaccines against COVID-19 in healthcare workers: An observational study using surveillance data. *Clinical Microbiology and Infection*, 27(11), 1699.e5–1699.e8. https://doi.org/10.1016/j.cmi.2021.06.043

44. Poukka, E., Baum, U., Palmu, A. A., Lehtonen, T. O., Salo, H., Nohynek, H., et al. (2022). Cohort study of COVID-19 vaccine effectiveness among healthcare workers in Finland, December 2020–October 2021. *Vaccine*, 40(5), 701–705. https://doi.org/10.1016/j.vaccine.2021.12.032

45. Self, W. H., Tenforde, M. W., Rhoads, J. P., Gaglani, M., Ginde, A. A., Douin, D. J., et al. (2021). Comparative effectiveness of Moderna, Pfizer-BioNTech, and Janssen (Johnson & Johnson) vaccines in preventing COVID-19 hospitalizations among adults without immunocompromising conditions—United States, March–August 2021. *Morbidity and Mortality Weekly Report*, 70(38), 1337–1343. https://doi.org/10.15585/mmwr.mm7038e1

46. Terpos, E., Karalis, V., Ntanasis-Stathopoulos, I., Evangelakou, Z., Gavriatopoulou, M., Manola, M.

FOR PROOF READING

S., et al. (2022). Comparison of neutralizing antibody responses at 6 months post vaccination with BNT162b2 and AZD1222. *Biomedicines*, 10(2), 338. https://doi.org/10.3390/biomedicines10020338

47. Vitek, M. G., Klavs, I., Učakar, V., Serdt, M., Mrzel, M., Vrh, M., et al. (2022). Vaccine effectiveness against severe acute respiratory infections (SARI) COVID-19 hospitalisations estimated from real-world surveillance data, Slovenia, October 2021. *Eurosurveillance*, 27(1), 2101110. https://doi.org/10.2807/1560-7917.ES.2022.27.1.2101110
48. Goldblatt, D., Fiore-Gartland, A., Johnson, M., Hunt, A., Bengt, C., Zavadska, D., et al. (2022). Towards a population-based threshold of protection for COVID-19 vaccines. *Vaccine*, 40(2), 306–315. https://doi.org/10.1016/j.vaccine.2021.12.006
49. Kwok, S. L., Cheng, S. M., Leung, J. N., Leung, K., Lee, C.-K., Peiris, J. M., et al. (2022). Waning antibody levels after COVID-19 vaccination with mRNA Comirnaty and inactivated CoronaVac vaccines in blood donors, Hong Kong, April 2020 to October 2021. *Eurosurveillance*, 27(2), 2101197. https://doi.org/10.2807/1560-7917.ES.2022.27.2.2101197
50. Ukey, R., Bruiners, N., Mishra, H., Mishra, P. K., McCloskey, D., Onyuka, A., et al. (2022). Dichotomy between the humoral and cellular responses elicited by mRNA and adenoviral vector vaccines against SARS-CoV-2. *BMC Medicine*, 20, Article 1–7. https://doi.org/10.1186/s12916-022-02252-0
51. Anand, P., & Stahel, V. P. (2021). The safety of COVID-19 mRNA vaccines: A review. *Patient Safety in Surgery*, 15, Article 1–9. https://doi.org/10.1186/s13037-021-00291-9
52. Oster, M. E., Shay, D. K., Su, J. R., Gee, J., Creech, C. B., Broder, K. R., et al. (2022). Myocarditis cases reported after mRNA-based COVID-19 vaccination in the US from December 2020 to August 2021. *JAMA*, 327(4), 331–340. https://doi.org/10.1001/jama.2021.24110
53. Raman, R., Patel, K. J., & Ranjan, K. (2021). COVID-19: Unmasking emerging SARS-CoV-2 variants, vaccines and therapeutic strategies. *Biomolecules*, 11(7), 993. https://doi.org/10.3390/biom11070993
54. Klugar, M., Riad, A., Mekhemar, M., Conrad, J., Buchbender, M., Howaldt, H.-P., et al. (2021). Side effects of mRNA-based and viral vector-based COVID-19 vaccines among German healthcare workers. *Biology*, 10(8), 752. https://doi.org/10.3390/biology10080752
55. Schultz, N. H., Sørvoll, I. H., Michelsen, A. E., Munthe, L. A., Lund-Johansen, F., Ahlen, M. T., et al. (2021). Thrombosis and thrombocytopenia after ChAdOx1 nCoV-19 vaccination. *The New England Journal of Medicine*, 384(22), 2124–2130. https://doi.org/10.1056/NEJMoa2104882
56. Bruxvoort, K. J., Sy, L. S., Qian, L., Ackerson, B. K., Luo, Y., Lee, G. S., et al. (2021). Effectiveness of mRNA-1273 against delta, mu, and other emerging variants of SARS-CoV-2: Test negative case-control study. *BMJ*, 375, e068848. https://doi.org/10.1136/bmj-2021-068848
57. Collier, D. A., Ferreira, I. A. T. M., Kotagiri, P., Datir, R. P., Lim, E. Y., Touizer, E., et al. (2021). Age-related immune response heterogeneity to SARS-CoV-2 vaccine BNT162b2. *Nature*, 596(7872), 417–422. https://doi.org/10.1038/s41586-021-03739-1
58. Mahase, E. (2021). COVID-19: Longer interval between Pfizer doses results in higher antibody levels, research finds. *BMJ*, n1861. https://doi.org/10.1136/bmj.n1861
59. Mbaeyi, S., Oliver, S. E., Collins, J. P., Godfrey, M., Goswami, N. D., Hadler, S. C., et al. (2021). The Advisory Committee on Immunization Practices' interim recommendations for additional primary and booster doses of COVID-19 vaccines—United States, 2021. *Morbidity and Mortality Weekly Report*, 70(44), 1545–1552. https://doi.org/10.15585/mmwr.mm7044e2
60. Sahin, U., Karikó, K., & Türeci, Ö. (2014). mRNA-based therapeutics—Developing a new class of drugs. *Nature Reviews Drug Discovery*, 13(10), 759–780. https://doi.org/10.1038/nrd4278

FOR PROOFREADING

61. Pardi, N., & Weissman, D. (2017). Nucleoside modified mRNA vaccines for infectious diseases. In *RNA vaccines: Methods and protocols* (pp. 109–121). https://doi.org/10.1007/978-1-4939-6481-9_6

62. Khoshnood, S., Arshadi, M., Akrami, S., Koupaei, M., Ghahramanpour, H., Shariati, A., et al. (2022). An overview on inactivated and live-attenuated SARS-CoV-2 vaccines. *Journal of Clinical Laboratory Analysis*, 36(5), e24418. https://doi.org/10.1002/jcla.24418

63. Soiza, R. L., Scicluna, C., & Thomson, E. C. (2021). Efficacy and safety of COVID-19 vaccines in older people. *Age and Ageing*, 50(2), 279–283. https://doi.org/10.1093/ageing/afaa274

64. Vukčević, M., Šerović, K., Despot, M., Nikolić-Kokić, A., Vujović, A., Nikolić, M., et al. (2024). Humoral and cellular immune response after three doses of Sinopharm [Vero Cell]-inactivated COVID-19 vaccine in combination with SARS-CoV-2 infection leads to hybrid immunity. *Pharmaceuticals*, 17(1), 122. https://doi.org/10.3390/ph17010122

65. Goel, R. R., Painter, M. M., Apostolidis, S. A., Mathew, D., Meng, W., Rosenfeld, A. M., et al. (2021). mRNA vaccines induce durable immune memory to SARS-CoV-2 and variants of concern. *Science*, 374(6572), abm0829. https://doi.org/10.1126/science.abm0829

66. Uddin, M. N., & Roni, M. A. (2021). Challenges of storage and stability of mRNA-based COVID-19 vaccines. *Vaccines*, 9(9), 1033. https://doi.org/10.3390/vaccines9091033

67. Light, D. W., & Lexchin, J. (2021). The costs of coronavirus vaccines and their pricing. *Journal of the Royal Society of Medicine*, 114(11), 502–504. https://doi.org/10.1177/01410768211053006

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CASE REPORT

Rapid postural improvement in mixed diagnosis of recurrent vestibulopathy and posterior BPPV: A Case Study

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ABSTRACT

Benign paroxysmal positional vertigo (BPPV) is a condition caused by otoconia that cause spinning. Recurrent vestibulopathy is characterized by several episodes of vertigo lasting minutes to hours, which last longer than six months and are devoid of neurological or auditory symptoms. The triggering factors for mixed BPPV and recurrent vestibulopathy include head trauma, inner ear disease, and prolonged immobilization following cerebrovascular infarction. In this case, we evaluated the improvement of recurrent vestibulopathy and posterior BPPV case using BPPV manaeuvre and Intensive Balance Rehabilitation specifically looking at postural control. A 51-year-old female patient, with a history of asthma, allergic rhinitis, migraine, and vertigo for three years was diagnosed to have recurrent chronic vestibulopathy. Vestibular Rehabilitation using the Bal Ex exercise was applied to promote adaptation to and substitution for various aspects of deficits related to a wide variety of balance disorders.

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1. INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is an inner ear disorder that is characterized by short episodes of rotational vertigo that happen suddenly due to changes in head positions like lying down or turning in bed, leading to sudden vertigo – a feeling that the room is spinning. 1.2 BPPV occurs when the canalith particles (otoconia) break loose and fall into the wrong part of the semicircular canals of the inner ear. The otoconia displacements induce a short duration of intense spinning vertigo especially when the patients lie down, turn the head to the side, or rise from a prone position. BPPV may involve multiple semicircular canals, such as the anterior and posterior canals.

The mixed-canal type of BPPV frequently involves canals on the same side. Traumamay increases the risk of mixed-canal BPPV. The triggering factors for the risk of BPPV include head trauma, inner ear disease prolonged immobilization following cerebrovascular infarction, and others.

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Acute unilateral vestibulopathy is characterized by a spinning sensation of acute onset that lasts for at least 24 hours, accompanied by oscillopsia, a tendency to fall, and nausea. 3 Recurrent vestibulopathy is an illness with no known origin that causes recurrent episodes of vertigo that last anywhere from five minutes to twenty-four hours and are accompanied by no neurological or auditory symptoms.

In cases of BPPV and recurrent vestibulopathy, accurate treatment is important since it can jeopardize the patient's quality of life. Recently, new evidence suggested that a specific maneuvre based on the Bal Ex modules offers curative therapy in the majority of BPPV cases applied in our setting. The Bal Ex module is one of the balance exercise therapies, developed with the combination of customized Cawthorne Cookseey Exercise and Muslim prayer movement, currently used in our hospital (Hospital USM, Malaysia) to treat vestibular disorders cases.6 Vestibular Rehabilitation Therapy (VRT) is a specific form of physical therapy designed to promote adaptation and substitution for various aspects of deficits related to a wide variety of balance disorders. Exercise in the Bal Ex module that includes head and neck movements are essential in stimulating and retraining the vestibular system. The Bal Ex module consists of twenty movements divided into three levels. This physical exercise module has many advantages for many cases of balance problem cases such as BPPV and recurrent vestibulopathy (Fig. 1)

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Fig. 1 Home-based Bal Ex (balance exercise) module

Source: Muhammad Munzir Zuber Ahmadi et al (2026)

Table 1 Movements in the Bal Ex (balance exercise) Module

Level 1	Level 2	Level 3
Movement of head in all directions with/without closed eyes	Movement of body like movement in prayer, up and down	Movement while walking in one place and in direction
Movement of head in all directions with the eyes focused at center		Increase the postural control
		Return to normal walk, running and use a stair

Source: Muhammad Munzir Zuber Ahmadi et al (2026)

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2. CASE PRESENTATION

A female patient, age 51, who has been receiving treatment for over two years for underlying asthma, allergic rhinitis, and migraine, has been suffering from vertigo and dizziness for three years, which have gotten worse when she moves her head. She also complained of sudden attacks of vomiting, a floating sensation, and nausea during the episode. The most severe attack was four months ago with positional vertigo which was described as a spinning sensation when waking up from sleep, which was then partially resolved after treatment by the otorhinolaryngology team. During severe attacks, mild anxiety was reported intermittently. She has previously experienced similar symptoms for the past 2 weeks but is now improving well. The majority of attacks occur with a severe headache followed by vertigo and dizziness. On examination, the patient is conscious and alert. A neurological examination was done and the result was normal. The patient was evaluated using three questionnaires administered before and after treatment. There are Malay version of the Vertigo Symptom Scale (MVVSS), Beck Depression Inventory (BDI), and Beck Anxiety Inventory (BAI). (Table 2). She was diagnosed with posterior left BPPV.

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Table 2. Subjective measures Pre and Post treatment

Component	Pre session	Post 3 sessions
Malay Version of vertigo symptom scale (MVVSS)	moderate	moderate
Beck Depression Inventory (BDI)	mild	mild
Beck Anxiety Inventory (BAI)	mild	mild

Indicator:

i. Malay Version of vertigo symptom scale (MVVSS) - range: Mild:10-19 1 (1.5). Moderate 20-29 9 (13.8). Severe: 30-39 8

ii. Beck Depression Inventory (BDI) - Range of severity: 0-10 point is not depressed, 11-17point is Mild to moderately depressed and 18-63 point is depression

iii. Beck Anxiety Inventory (BAI), range, 8-15 is mild, 16-5 is moderate, and 26-63 is severe.

To evaluate postural control pre-and post-therapy for patients with a mixed diagnosis of BPPV and recurrent vestibulopathy we apply the Bal Ex therapy module, and the use of special foam called the Bal Ex Foam Test (Figure 2). This Bal Ex Foam Test is adapted from the Bal Ex module. Bal Ex Foam Test has a structured scoring foam that is divided into seven sections. (Table 3) All the findings is shown in Table 2. A positive Fukuda test has been identified (Table 3). Interpretation of the Bal Ex Foam Test is considered normal if the score is more than 10 seconds in every step.

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Fig. 2 Bal Ex Foam

Table 3. Bal Ex Foam Test structured scoring components

Level	Description	Pre therapy	Post balance rehabilitation therapy
1	Stand on the floor with arms across your chest and feet together and hold for 30 seconds (eyes open)	Normal	Normal
2	Stand on the floor with arms across your chest and feet together and hold for 30 seconds (eyes closed)	< 3 seconds	< 7 seconds
3	Stand on the floor with arms across your chest, toe touching the other side of heel and hold for 30 seconds (eye open)	Normal	Normal
4	Stand on the floor with arms across your chest, toe touching the other side of heel and hold for 30 seconds (eyes closed)	< 2 seconds	< 6 seconds
5	Stand on a 3-inch-high density foam cushion with your arms crossed, feet together and hold for 30 seconds (eyes opened)	Normal	Normal
6	Stand on a 3-inch-high density foam cushion with your arms crossed, feet together and hold for 30 seconds (eyes closed)	< 3 seconds	< 5 seconds
7	Fukuda test	Abnormal (Deviated to left side about 60 degree)	Abnormal (Deviated to left side about 70 degree)

Source: Muhammad Munzir Zuber Ahmadi et al (2026)

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3. DISCUSSION

The symptoms associated with a mixed diagnosis of BPPV and recurrent vestibulopathy include head motion–induced vertigo, such as non-spinning vertigo, positional vertigo, and orthostatic vertigo. Attacks are generally mild and may be accompanied by palpitations. In this case, the patient reported sudden episodes of dizziness associated with nausea, vomiting, and a floating sensation. Previous studies have shown that episodic vertigo may be related to migraine, while other possible causes include recurrent vestibular neuritis.

Following the intervention, a rapid and marked improvement in postural control was observed after the application of the Gans Canal Repositioning Manoeuvre and intensive balance rehabilitation using BalEx–VRT (Bal Ex Quick Balance Therapy) (Table 3) with the use of Bal Ex foam (Figure 2). The Gans Canal Repositioning Manoeuvre is an effective intervention for resolving BPPV. The patient reported approximately 60% improvement in vertigo and imbalance symptoms after three BalEx–VRT sessions using Bal Ex foam, completed within a single day.

This improvement was considered rapid, as noticeable effects were experienced within one day of balance therapy and by the second day following the Gans manoeuvre. However, subjective outcome measures, including MVVSS, BDI, and BAI, showed minimal change after three therapy sessions, indicating no significant difference in vertigo severity, anxiety, or depression levels.

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4. CONCLUSION

In conclusion, managing a mixed diagnosis of Benign Paroxysmal Positional Vertigo (BPPV) and recurrent vestibulopathy presents a complex challenge that demands careful attention to effectively alleviate symptoms and enhance patients' quality of life. Further, research is necessary to yield more significant results, as a larger sample size would provide deeper insights into the optimal management strategies for such cases. By continuing to investigate and refine treatment approaches, healthcare professionals can better address the needs of individuals grappling with these intertwined vestibular disorders, ultimately improving outcomes and patient well-being.

5. CONFLICT OF INTEREST

Author declares none.

6. ACKNOWLEDGEMENT

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7. AUTHOR'S CONTRIBUTIONS

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8. REFERENCES

1. Merck Manual Consumer Version. (2021). Benign paroxysmal positional vertigo. https://www.merckmanuals.com/home/ear-nose-and-throat-disorders/inner-ear-disorders/benign-paroxysmal-positional-vertigo

2. Lindell, E., Finizia, C., Johansson, M., Karlsson, T., Nilsson, J., & Magnusson, M. (2018). Asking about dizziness when turning in bed predicts examination findings for benign paroxysmal positional vertigo. Journal of Vestibular Research, 28(5–6), 339–347. https://doi.org/10.3233/VES-180648

3. Strupp, M., Dlugaiczyk, J., Ertl-Wagner, B. B., Rujescu, D., Westhofen, M., & Dieterich, M. (2020). Vestibular disorders. Deutsches Ärzteblatt International, 117(17), 300–310. https://doi.org/10.3238/arztebl.2020.0300

4. Rutka, J. A., & Barber, H. O. (1986). Recurrent vestibulopathy: Third review. Journal of Otolaryngology, 15(2), 105–107.

5. Zainun, Z. (2020). Bal Ex module for balance rehabilitation.

6. Rosminah, M., Selvy Arcynie, F., & Normani, Z. (2019, November). Home-based video module for balance exercise (Bal Ex): A cost-effective tool for peripheral vestibular disorders patient. In Proceedings of the 5th International Conference on Health Sciences (ICHS 2018).

7. Bayat, A., Pourbakht, A., Saki, N., Zainun, Z., Nikakhlagh, S., & Mirmomeni, G. (2012). Vestibular rehabilitation outcomes in the elderly with chronic vestibular dysfunction. Iranian Red Crescent Medical Journal, 14(11), 705–708. https://doi.org/10.5812/ircmj.3507

8. Dlugaiczyk, J., Lempert, T., Lopez-Escamez, J. A., Teggi, R., von Brevern, M., & Bisdorff, A. (2021). Recurrent vestibular symptoms not otherwise specified: Clinical characteristics compared with vestibular migraine and Menière's disease. Frontiers in Neurology, 12, 674092. https://doi.org/10.3389/fneur.2021.674092

9. Zainun, Z. (2017). Update on latest BPPV manoeuvre for benign paroxysmal positional disorder patients. In International Conference on Aesthetic Medicine and ENT: Scientific Tracks Abstracts – Otolaryngology. https://doi.org/10.4172/2161-119X-C1-019

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CASE REPORT

An Abscess of Thyroid Remnant in a Positive Coronavirus Disease 2019 Patient

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ABSTRACT

Thyroid abscess is rare due to the unique anatomy and physiological features of the thyroid gland. The underlying thyroid disorder, thyroidectomy, immunocompromised conditions, and congenital third or fourth branchial arch anomalies are among the known risk factors. The association of coronavirus disease 2019 (COVID-19) with thyroiditis is recently reported and the inflammation of the thyroid gland may predispose to the abscess formation, especially in combination with other risk factors. The principle of management is by the combination of broad-spectrum antibiotics and evacuation of the abscess, with careful monitoring of thyroid hormone status. Serial aspiration is preferred in localized or less extensive cases to avoid possible complications like thyroid storm secondary to manipulation of the gland or precipitated by the stress of surgery and anaesthesia. We present a unique case of thyroid abscess arising from the remnant of thyroid isthmus or pyramidal lobe in an immunocompetent patient with a history of total thyroidectomy and recently infected with COVID-19, successfully treated with serial aspiration and antibiotic.

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INTRODUCTION

Thyroid abscess is extremely rare, and accounts for less than 1% of all thyroid lesions [1]. The thyroid gland is resistant to infection due to the presence of the capsule as an anatomical barrier and physiologically it has an abundant blood supply, lymphatic drainage, and iodine content [2]. The risk factors include pre-existing thyroid disorder, diabetes mellitus, or other immunocompromised conditions and underlying congenital third or fourth branchial arch anomalies [1,2]. Recently, several literatures have reported on the association of coronavirus disease 2019 (COVID-19) with thyroiditis and thyroid dysfunction [3-5]. The inflammation of the thyroid gland may lead to abscess formation, especially in cases with underlying thyroid disease or a history of thyroidectomy. We present a unique case of thyroid abscess arising from the remnant of thyroid isthmus or pyramidal lobe in an immunocompetent patient with a history of total thyroidectomy and recently infected with COVID-19.

CASE PRESENTATION

A 50-year-old lady presented with painful anterior neck swelling for a one-week duration. It was progressively increasing in size and associated with fever. There was no shortness of breath, hoarseness, noisy breathing, dysphagia, rhinorrhea, cough, hyperthyroid or hypothyroid symptoms, insect bite, or local trauma. She had a history of total thyroidectomy done five years ago for multinodular goitre, but not on any thyroid hormone or calcium supplements. The surgery was uneventful, and the histopathology examination revealed nodular hyperplasia. She had no other medical comorbidities.

Upon examination, the patient is alert and conscious without signs of respiratory distress. There was a swelling at the midline and lower part of the neck measuring 5 cm x 6 cm, erythematous overlying skin, firm in consistency and tender on palpation (Figure 1). The previous total thyroidectomy scar was seen at the lower part of the swelling. The swelling moved superiorly with deglutition, but not with tongue protrusion. There was no other swelling or cervical lymph node palpable and other ear, nose, and throat examinations including flexible nasopharyngolaryngoscopy were unremarkable. The patient was detected to have COVID-19 positive by a routine antigen rapid test kit prior to ward admission. An urgent ultrasound neck was performed and revealed midline anterior neck collection with moving debris within, arising from thyroid isthmus, measuring 2.2 cm x 2.6 cm x 4.3 cm (Figure 2). The bilateral thyroid lobes were not visualised in keeping with the previous surgery. Blood investigations showed leucocytosis with neutrophilia, otherwise, other blood parameters including blood sugar and thyroid function test were within normal range.

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Figure 1 Swelling at the midline and lower part of the neck measuring 5 cm x 6 cm with erythematous overlying skin, firm in consistency and tender on palpation. The previous total thyroidectomy scar was seen at the lower part of the swelling (arrow)

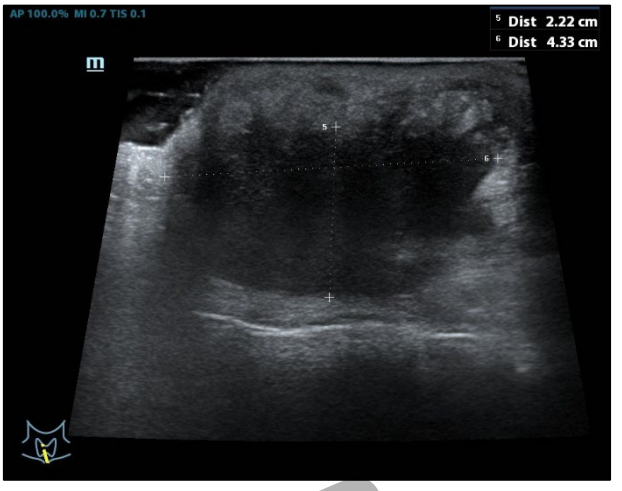

Figure 2 Ultrasound neck shows midline anterior neck collection with moving debris within, arising from thyroid isthmus, measuring 2.2 cm x 2.6 cm x 4.3 cm. The bilateral thyroid lobes were not visualised in keeping with the previous surgery

She was admitted to the isolation ward and started on intravenous amoxicillin-clavulanate. A total of 3 serial bedside aspirations of thyroid abscess were performed every day over 3 days. The amount of the pus aspirated was reduced in trend from 10 ml on the first day (Figure 3) to 3 ml on the second day and less than 1 ml on the third day. We decided to perform aspiration instead of incision and drainage to avoid the spread of the coronavirus to other healthcare workers and to minimise manipulation of the thyroid gland which may exacerbate thyroid storm. The pus showed growth of Staphylococcus aureus and was sensitive to amoxicillin-clavulanate. The patient was discharged upon completion of intravenous antibiotics for 10 days. The neck swelling improved markedly (Figure 4), and she was given an outpatient clinic appointment in one week. After two months of follow-up, the neck swelling had completely resolved.

FOR PROOFREADING

Figure 3 10ml pus aspirated from the thyroid abscess

Figure 4 The swelling markedly improved after serial aspiration and 10 days of intravenous antibiotics

DISCUSSION

Thyroid abscess is a rare but potentially fatal condition due to catastrophic complications such as septicaemia, deep neck or mediastinal extension, tracheal or oesophageal perforation, thyroid storm, and upper airway obstruction [2]. The immunocompromised state of the patient is the main risk factor, similar to abscess formation in other parts of the body. In an immunocompetent patient without branchial arch anomaly, pre-existing thyroid pathology or surgery may be the only risk factor. In the present case, the patient underwent total thyroidectomy for multinodular goitre, however, there was still a remnant of thyroid tissue which could be part of the thyroid isthmus or pyramidal lobe. Lack of capsule as an anatomical barrier and disturbance of blood supply and lymphatic drainage secondary to surgery possibly predisposed patient to the infection.

In addition, in the era of the COVID-19 outbreak, the virus infection can result in thyroiditis and subsequently may predispose to secondary bacterial infection. Other viruses that have been reported to be associated with thyroiditis are coxsackievirus, mumps, Epstein–Barr virus, cytomegalovirus, and influenza virus [6]. Interestingly, thyroid abscess is the only presenting symptom of COVID-19 in our presenting case without other concomitant respiratory symptoms.

The definitive treatment of our thyroid abscess required a combination of the evacuation of the abscess and the administration of intravenous antibiotics. The abscess formation can be evacuated by either serial aspiration or incision and drainage may be needed in complicated cases. The risks and benefits of each method should be weighed cautiously. The aspiration method is less invasive, can be performed at the bedside, and is usually preferred in cases of localised and non-extensive diseases but usually requires multiple sessions. Another reason that we considered this procedure was the COVID-19 status of the patient. The majority of cases with thyroid abscess have normal thyroid function tests [2], however, thyroid storm may develop during incision and drainage due to manipulation of the gland or precipitated by the stress of surgery and anaesthesia.

FOR PROOFREADING

Multiple pathogens have been implicated in the formation of thyroid abscesses, mainly Staphylococci especially Staphylococcus aureus as seen in the present case, and streptococci (40%), followed by gram-negative organisms (25%) and anaerobes (12%) [7]. Therefore, the principle of antibiotic administration is usually to start with a broad-spectrum antibiotic and then change to a more directed antibiotic once culture and sensitivity results are available.

Follow-up is crucial to look for resolution of infection and early detection of residual thyroid enlargement which may be suggestive of underlying malignancy or chronic inflammatory disorder. This should be applied to all cases with extra caution to the cases with underlying thyroid pathology or a history of thyroidectomy. Ultrasound is considered the primary first-line investigation of thyroid disorders and fine-needle aspiration cytology should be performed based on the thyroid imaging reporting and data system score. In the present case, no extra investigation was performed due to the complete resolution of infection and swelling. However, the patient was advised to return early if any thyroid enlargement is observed.

CONCLUSION

Thyroid abscess is rare and usually occurs in the immunocompromised patient. Recently, in the era of the COVID-19 outbreak, this virus has been shown to be associated with thyroiditis and predisposes to the abscess formation even in immunocompetent patients as seen in the present case. Other risk factors are underlying thyroid disorder and thyroidectomy. The management is based on a case-by-case basis and a less invasive serial aspiration is preferred in the localised abscess.

CONSENT

Informed consent was obtained from the patient for case write up including permission for publication of all photographs and images.

CONFLICT OF INTEREST

Author declares none.

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AUTHOR'S CONTRIBUTIONS

V Sha Kri Eh Dam drafted the article and was involved in critical revision and final approval.

REFERENCES

1. Falhammar H, Wallin G, Calissendorff J. Acute suppurative thyroiditis with thyroid abscess in adults: Clinical presentation, treatment and outcomes. BMC Endocr Disord. 2019;19(1):130. doi:10.1186/s12902-019-0458-0.

2. Vengathajalam S, Retinasekharan S, Mat Lazim N, Abdullah B. Salmonella Thyroid abscess treated by serial aspiration: Case report and literature review. Indian J Otolaryngol Head Neck Surg. 2019;71(Suppl 1):823-826. doi:10.1007/s12070-019-01654-6.

FOR PROOFREADING

3. Feghali K, Atallah J, Norman C. Manifestations of thyroid disease post COVID-19 illness: Report of Hashimoto thyroiditis, Graves' disease, and subacute thyroiditis. J Clin Transl Endocrinol Case Rep. 2021; 22:100094. doi: 10.1016/j.jecr.2021.100094.

4. Khatri A, Charlap E, Kim A. subacute thyroiditis from COVID-19 infection: A case report and review of literature. Eur Thyroid J. 2021;9(6):324-328. doi:10.1159/000511872.

5. Lisco G, De Tullio A, Jirillo E, Giagulli VA, De Pergola G, Guastamacchia E, Triggiani V. Thyroid and COVID-19: A review on pathophysiological, clinical and organizational aspects. J Endocrinol Invest. 2021;44(9):1801-1814. doi:10.1007/s40618-021-01554-z.

6. Trimboli P, Cappelli C, Croce L, Scappaticcio L, Chiovato L, Rotondi M. COVID-19-Associated subacute thyroiditis: Evidence-based data from a systematic review. Front Endocrinol (Lausanne). 2021; 12:707726. doi:10.3389/fendo.2021.707726.

7. Yedla N, Pirela D, Manzano A, Tuda C, Lo Presti S. Thyroid abscess: Challenges in diagnosis and management. J Investig Med High Impact Case Rep. 2018; 6:2324709618778709. doi:10.1177/2324709618778709.

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CASE REPORT

Dual malignancies in Lynch Syndrome: A rare case of synchronous colorectal and ovarian cancer highlighting the potential role of immunotherapy

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ABSTRACT

We report a 35-year-old woman with dual malignancies associated with Lynch Syndrome, diagnosed with Stage IIIC sigmoid colon adenocarcinoma and Stage IIA left ovarian serous papillary adenocarcinoma. Germline testing revealed MSH2 gene mutation, particularly exon 7 deletion. This case highlights the importance of early detection, germline testing and individualized management strategies for Lynch Syndrome patients. It also underscores the potential of immunotherapy as an effective therapy for recurrent Lynch-associated cancers, emphasizing the need for continuous research into novel therapeutic modalities.

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1. INTRODUCTION

Lynch Syndrome, the leading cause of hereditary colorectal cancer, arises from pathogenic variants in DNA mismatch repair (MMR) genes, which include MLH1, MSH2, MSH6, PMS2, and EPCAM [1]. Of all MMR genes, PMS2 has the highest prevalence, followed by MSH6, MLH1 and lastly MSH2 [2].

Approximately 3% of colorectal cancer and 2% of endometrial cancer cases worldwide are attributed to Lynch Syndrome [1]. Lynch-associated ovarian cancer has a much lower incidence, responsible for 0.7% cases. It is also implicated in small bowel, biliary tree, urothelial system, brain, prostate and skin malignancy [1].

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Early diagnosis is essential to allow timely interventions and eliminate possible cancer risks. Although professional guidelines for screening and treatment exist, more studies need to be carried out given the rarity of this syndrome. This case aims to investigate the genetic results, diagnostic approach, screening and prophylactic strategies, with special emphasis on the increasingly important role of immunotherapy in managing Lynch Syndrome.

2. CASE PRESENTATION

This case demonstrates a 35-year-old woman under the diagnosis of dual malignancies secondary to Lynch Syndrome. She was first diagnosed at the age of 23 with high-risk Stage IIIC sigmoid colon adenocarcinoma based on the 8th American Joint Committee on Cancer (AJCC) Cancer Staging System. Subsequently, she completed 8 cycles of adjuvant XELOX chemotherapy consisting of capecitabine (Xeloda) and oxaliplatin.

At 32 years old, she was diagnosed with Stage IIA left ovarian serous papillary adenocarcinoma based on the FIGO (International Federation of Gynecology and Obstetrics) system. She had undergone left salpingo-oophorectomy with lymph node dissection, followed by 6 cycles of carboplatin and paclitaxel chemotherapy.

Unfortunately, she experienced pelvic recurrence a year later and underwent secondary cytoreductive surgery. Following that, she received 8 cycles of oral cyclophosphamide, pembrolizumab and bevacizumab with subsequent maintenance therapy for 2 years. PET-CT (Positron Emission Tomography-Computed Tomography) after treatment showed no evaluable disease. Genetic testing later revealed a pathogenic variant in the MSH2 gene, particularly exon 7 deletion, inherited from the paternal side.

3. DISCUSSION

3.1 Pathogenesis

Lynch Syndrome is a hereditary cancer caused by germline mutations in DNA mismatch repair genes, as opposed to most sporadic neoplasms which are caused by somatic mutations. Germline mutations occur in reproductive cells before fertilization, making them inheritable and present at birth [3] . Such mutations affect all cell lines, thus causing multiple primary tumors formation [3].

Approximately 75% of colorectal cancers (CRC) are sporadic, while familial and hereditary causes account for 15–20% and 6% respectively [4]. Familial CRCs involve multigenic inheritance, where multiple genes contribute to cancer development [4]. There is no clear and validated DNA test to identify a single high-penetrance gene responsible for the cause. Therefore, risk estimates are usually based on family history and counselling focuses on broader interventions and population-level screenings. In contrast, hereditary cancers like Lynch Syndrome are monogenic, where a single mutation in one of the DNA MMR genes is sufficient to cause cancer [4]. Thus, genetic counselling can be more targeted, as family members of affected individuals have a 50% risk of inheriting the mutation. Carriers can then be informed of their increased risk of extra-colonic cancers and advised on individualized screening or prophylactic measures.

DNA MMR genes maintain genomic stability by repairing nucleotide mismatches such as erroneous insertion, deletion or duplication during DNA replication [5]. Errors are most likely to occur in microsatellites, which are stretches of short repetitive sequences [5]. Defective MMR genes secondary to Lynch syndrome result in microsatellite instability (MSI), which is characterized by the expansion or contraction of these sequences due to uncorrected mismatches [5]. This results in proliferation of aberrant microsatellites within tumor suppressor genes and proto-oncogenes, resulting in cancerous growth [1].

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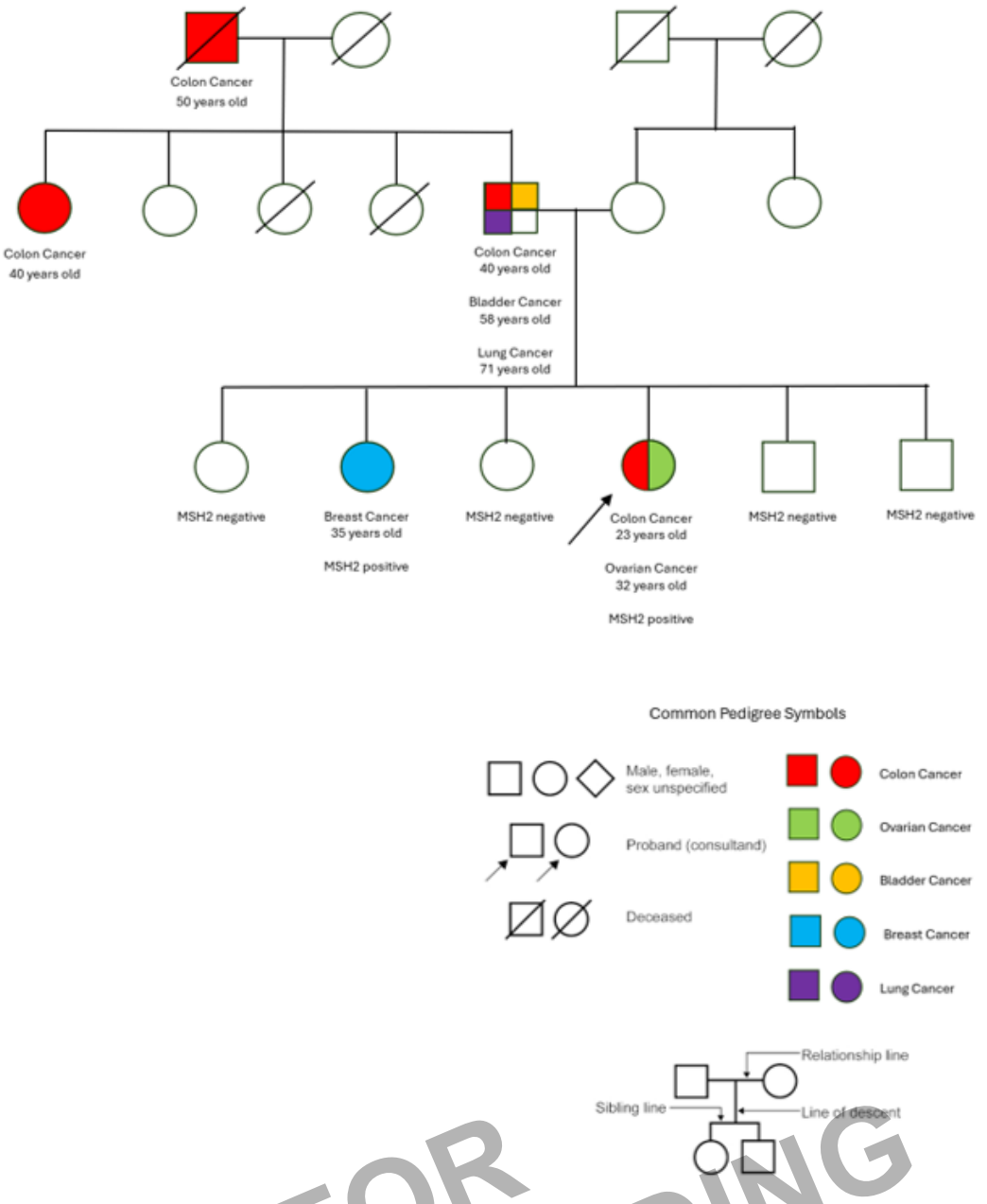

Fig. 1 Family pedigree of the patient

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3.2 Genotype-phenotype correlation

The lifetime cancer risk in Lynch Syndrome varies by pathogenic variant (PV) [6]. MLH1 and MSH2 carriers have higher colorectal cancer (CRC) risks (44–53% and 42–46%, respectively) than MSH6 (12–20%) or PMS2 (3%) [7]. MSH2 also poses the highest risk for gynecological cancers, with 46% for endometrial and 17% for ovarian cancers [7]. Lifetime risk of endometrial and ovarian cancers of other pathogenic variants: MLH1 (35%, 11%), MSH6 (41%, 11%) and PMS2 (13%, 3%) respectively [6]. This patient's MSH2 mutation explains her early-onset colorectal and ovarian cancers. Her family history, including relatives diagnosed with early CRC, aligns with evidence that MSH2 mutations significantly increase CRC risk.

3.3 Diagnosis

To diagnose Lynch Syndrome, Amsterdam Criteria and Bethesda Guidelines have been introduced to identify patients at risk based on detailed family history [8]. Suspected cases should then proceed with tumor testing for microsatellite instability (MSI) or immunohistochemistry (IHC) [8]. MSI testing detects microsatellite expansion or contraction, termed "MSI-High" (MSI-H), while IHC detects the absence of MMR proteins [8].

A positive IHC or MSI-H result suggests MMR deficiency but has yet to confirm the diagnosis of Lynch Syndrome, as such tumors may arise from germline MMR pathogenic variants (PVs), biallelic somatic inactivation of MMR, or promoter hypermethylation of MLH1 in sporadic causes [1]. In Lynch Syndrome, individuals tend to inherit germline mutation from parents for one allele only, with the second allele inactivated later due to somatic mutation, loss of heterozygosity or epigenetic silencing via promoter hypermethylation [1]. In sporadic cancers, MMR gene inactivation primarily results from promoter hypermethylation, often with the presence of BRAF mutation, which does not occur in Lynch Syndrome [1].

To confirm Lynch Syndrome, patients with MSI-H tumors require genetic testing through MMR gene panel testing to identify germline mutations [7]. In cases where no germline mutation could be detected, MLH1 promoter methylation or BRAF mutation testing can help identify sporadic causes [7]. In rare instances, when all tests prove to be negative, tumor DNA sequencing to identify biallelic somatic inactivation of MMR genes may be necessary [7].

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3.4 Management

Management of Lynch Syndrome patients consist of two components, screening and prophylactic strategies. In this case, the patient with MSH2 mutation presents a concerning risk for colorectal and gynecologic cancers.

Colorectal cancer (CRC) screening is recommended to begin between 20–25 years old or five years prior to the earliest family diagnosis, whichever comes first [9]. Annual or biennial colonoscopy can effectively identify and remove adenomatous polyps, reducing CRC risk [9]. Besides, the National Comprehensive Cancer Network (NCCN) and the American College of Obstetricians and Gynecologists (ACOG) recommend women aged 30 – 35 years old to undergo endometrial biopsy and transvaginal ultrasound every 1–2 years to screen for endometrial cancer [10-12]. However, routine ovarian cancer screening, like CA-125 testing or transvaginal ultrasound, has no proven efficacy in decreasing mortality and hence it is not formally recommended [8].

Prophylactic measures vary depending on cancer type and patient factors. Generally, prophylactic colectomy will not be necessary since routine colonoscopy with polypectomy can effectively prevent CRC [6]. However, in cases where CRC cannot be adequately managed with endoscopic surveillance, colectomy with ileorectal anastomosis (IRA) may be preferred, given the high risk of metachronous CRC in Lynch Syndrome patients [9]. Studies have shown that patients who had segmental resections rather than extensive

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colectomies experienced higher metachronous CRC rate of 16% at 10 years, rising to 62% at 30 years [9]. The risk of metachronous cancer is substantially reduced if extensive colectomy is performed (0–3.4%) [9]. This patient had chemotherapy for Stage IIIC sigmoid adenocarcinoma and later required an ileostomy for pelvic recurrence.

For gynecological cancers, hysterectomy and bilateral salpingo-oophorectomy (BSO) may serve as risk-reduction options to be discussed with patients in their early 40s or after childbearing [10]. While BSO negates ovarian cancer risk, early surgical menopause may lead to increased risks of osteoporosis, cardiovascular disease, as well as cognitive or sexual dysfunction [8]. Moreover, certain variants like PMS2 may not necessitate oophorectomy due to negligible gynecologic cancer risk [8]. Therefore, NCCN recommends that the decision to have BSO should be individualized based on completion of childbearing, menopausal status, medical comorbidities and specific pathogenic variants [8].

This patient underwent left salpingo-oophorectomy and chemotherapy, preserving her fertility and hormonal function. Hysterectomy and right salpingo-oophorectomy may be considered in the future, particularly as she approaches her 40s while considering various factors mentioned above.

Previously, treatment for sporadic and Lynch-associated colorectal, endometrial, and ovarian cancers was the same, regardless of Lynch status. Recent studies have demonstrated classic findings of dense T-lymphocytes infiltration and cytokine-rich microenvironment which mounts antitumor immune activity in MMR-deficient tumors [13]. Concurrently, high expression of immune checkpoint ligands, including PD-1 and PD-L1, which allows tumours to evade immune attacks have been observed within the same microenvironment [13]. These recent insights have led to the development and application of Pembrolizumab, an anti–PD-1 antibody, which blocks these immune checkpoints, reactivating cytotoxic T-cell responses [13]. This explains why MMR-D tumors, including those linked to Lynch syndrome, respond better to immunotherapy than to traditional chemotherapy [14].

While immunotherapy is not yet the standard of care for Lynch-associated cancers due to limited studies in this population, emerging evidence supports its use in recurrent or progressive MMR-deficient endometrial and ovarian cancers [15]. In fact, Pembrolizumab, was the first drug granted accelerated FDA approval for a tumor-agnostic indication, approved for all non-colorectal, MMR-deficient/MSI-H tumors [15]. The largest research to date, KEYNOTE-158, enrolled 233 patients with advanced MSI-H/MMR-deficient non-colorectal cancers who had failed previous interventions [15]. Among 27 tumor types, endometrial and ovarian cancers contributed to 49 and 15 cases respectively [15]. The objective response rate (ORR) defined as ≥30% tumor reduction without disease progression was 34.3% [15]. Overall, 57.1% experienced some tumor shrinkage, with 44.2% had reductions of ≥30% [15]. Particularly, among 47 patients with endometrial cancer, 70% (37 patients) had tumor reductions >30%, highlighting the potential of immunotherapy in this subgroup [15].

Combining immune checkpoint inhibitors with antiangiogenics like bevacizumab enhances effectiveness of immunotherapy. Tumors produce vast amounts of proangiogenic factors like VEGF which promote chaotic vasculature and hypoxia, further creating an immunosuppressive microenvironment [16]. Excessive VEGF may also reduce cytotoxic T-cell proliferation, increase PD-L1 expression by tumors, and promote endothelial dysfunction which impedes immune cells infiltration [16]. Therefore, antiangiogenics works by blocking VEGFs to ensure transient normalization of the chaotic tumor vasculature, improving oxygenation and immune cell infiltration [16]. They may also downregulate PD-L1 expression, producing synergistic effects with immune checkpoint inhibitors [16].

Metronomic oral cyclophosphamide enhances antitumor immunity by depleting regulatory T cells, complementing VEGF inhibition and PD-1 blockade [17]. In a cohort of 40 women with recurrent ovarian cancer, including platinum-resistant cases, the combination of pembrolizumab, bevacizumab, and cyclophosphamide showed an ORR of ~47%, clinical benefit in 95%, and durable responses (>12 months) in 25% of patients [17]. These promising results offer us an effective future treatment strategy for recurrent ovarian cancer.

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The patient was treated with maintenance pembrolizumab and bevacizumab for two years following a pelvic recurrence. Although the recurrence occurred within one year—typically suggestive of platinum sensitivity—platinum rechallenge was avoided due to the potential risk of cumulative neurotoxicity. More significantly, the identification of MSH2 mutation confirmed Lynch syndrome and MMR-deficiency, indicating a high likelihood of response to immune checkpoint inhibitors. The addition of cyclophosphamide and bevacizumab was intended to synergize with immunotherapy by modulating the tumor microenvironment and enhancing immune activation. Her most recent PET-CT showed no evaluable disease, demonstrating excellent response to the immunotherapy regimen.

4. CONCLUSION

In conclusion, this report emphasizes the importance of early detection and individualized management in Lynch Syndrome patients, particularly those with dual malignancies. Continuous genetic counselling coupled with regular screenings for patients and their families remains essential to reduce future cancer risks and guide further management. The patient's positive response to immunotherapy has proven its potential efficacy for recurrent Lynch-associated cancers. This case adds to the growing evidence for personalized treatment strategies in Lynch Syndrome, especially with novel therapeutic modalities like immunotherapy.

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5. CONFLICT OF INTEREST

Author declares none.

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8. AUTHOR'S CONTRIBUTIONS

All authors have made substantial contributions to the conception and design of this manuscript. Ng Kai Jian drafted the manuscript, while Mohammad Qisti Khairi and Low Qin Jian provided critical revisions for intellectual content. All authors have read and approved the final version for submission.

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9. REFERENCES

1. Bhattacharya, P., Leslie, S. W., & McHugh, T. W. (2024). Lynch syndrome (hereditary nonpolyposis colorectal cancer). StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK431096/
2. Win, A. K., Jenkins, M. A., Dowty, J. G., Antoniou, A. C., Lee, A., Giles, G. G., & Hopper, J. L. (2017). Prevalence and penetrance of major genes and polygenes for colorectal cancer. Cancer Epidemiology, Biomarkers & Prevention, 26(3), 404–412. https://doi.org/10.1158/1055-9965.EPI-16-0693
3. Mahon, S. M. (2020). Germline and somatic variants: What's the difference? Oncology Nursing Society. https://www.ons.org/publications-research/voice/news-views/01-2020/germline-and-somatic-variants-what-difference
4. Winawer, S. J., Fletcher, R. H., Miller, L., Godlee, F., Stolar, M. H., Mulrow, C. D., Woolf, S. H., Glick, S. N., Ganiats, T. G., Bond, J. H., Rosen, L., Zapka, J., Olsen, S. J., Giardiello, F. M., Sisk, J. E., Van Antwerp, R., Brown-Davis, C., Marciniak, D. A., & Mayer, R. J. (1997). Colorectal cancer screening: Clinical guidelines and rationale. Gastroenterology, 112(2), 594–642. https://doi.org/10.1053/gast.1997.v112.agast972594
5. De Angelis, G. L., Bottarelli, L., Azzoni, C., De Angelis, N., Leandro, G., Di Mario, F., & Ghidini, O. (2018). Microsatellite instability in colorectal cancer. Acta Bio Medica: Atenei Parmensis, 89(9-S), 97–101. https://doi.org/10.23750/abm.v89i9-S.7872
6. Idos, G., & Valle, L. (1993–2024). Lynch syndrome. In M. P. Adam et al. (Eds.), GeneReviews®. University of Washington. https://www.ncbi.nlm.nih.gov/books/NBK1211/
7. Haraldsdottir, S., Hampel, H., Tomsic, J., Frankel, W. L., Pearlman, R., De La Chapelle, A., & Pritchard, C. C. (2014). Colon and endometrial cancers with mismatch repair deficiency can arise from somatic, rather than germline, mutations. Gastroenterology, 147(6), 1308–1316.e1. https://doi.org/10.1053/j.gastro.2014.08.041
8. Underkofler, K. A., & Ring, K. L. (2023). Updates in gynecologic care for individuals with Lynch syndrome. Frontiers in Oncology, 13, 1127683. https://doi.org/10.3389/fonc.2023.1127683
9. Syngal, S., Brand, R. E., Church, J. M., Giardiello, F. M., Hampel, H. L., & Burt, R. W. (2015). ACG clinical guideline: Genetic testing and management of hereditary gastrointestinal cancer syndromes. American Journal of Gastroenterology, 110(2), 223–262. https://doi.org/10.1038/ajg.2014.435
10. Chen, L. M., Cohn, D. E., Fishman, D. A., Gibb, R. K., Mutch, D. G., Olawaiye, A. B., & others. (2014). Lynch syndrome. National Comprehensive Cancer Network. (No DOI available.)
11. National Comprehensive Cancer Network. (2024). Genetic/Familial high-risk assessment: Colorectal, endometrial, and gastric. https://www.nccn.org/professionals/physician_gls/pdf/genetics_ceg.pdf
12. American College of Obstetricians and Gynecologists. (2014). Practice bulletin no. 147: Lynch syndrome. Obstetrics & Gynecology, 124(5), 1042–1054. https://doi.org/10.1097/01.AOG.0000456326.51099.13

FOR PROOFREADING

13. Le, D. T., Uram, J. N., Wang, H., Bartlett, B. R., Kemberling, H., Eyring, A. D., Skora, A. D., Luber, B. S., Azad, N. S., Laheru, D., Biedrzycki, B., Donehower, R. C., Zaheer, A., Fisher, G. A., Crocenzi, T. S., Lee, J. J., Duffy, S. M., Goldberg, R. M., de la Chapelle, A., … Diaz, L. A. Jr. (2015). PD-1 blockade in tumors with mismatch-repair deficiency. New England Journal of Medicine, 372(26), 2509–2520. https://doi.org/10.1056/NEJMoa1500596

14. Duraturo, F., Liccardo, R., De Rosa, M., & Izzo, P. (2019). Genetics, diagnosis and treatment of Lynch syndrome: Old lessons and current challenges. Oncology Letters, 17(3), 3048–3054. https://doi.org/10.3892/ol.2019.9925

15. Marabelle, A., Le, D. T., Ascierto, P. A., Di Giacomo, A. M., De Jesus-Acosta, A., Delord, J. P., Geva, R., Gottfried, M., Penel, N., Hansen, A. R., Piha-Paul, S. A., Doi, T., Gao, B., Chung, H. C., Lopez-Martin, J., Bang, Y. J., Frommer, R., Shah, M., Ghori, R., & Ott, P. A. (2020). Efficacy of pembrolizumab in patients with noncolorectal high microsatellite instability/mismatch repair-deficient cancer: Results from the phase II KEYNOTE-158 study. Journal of Clinical Oncology, 38(1), 1–10. https://doi.org/10.1200/JCO.19.02105

16. Jain, R. K. (2014). Antiangiogenesis strategies revisited: From starving tumors to alleviating hypoxia. Cancer Cell, 26(5), 605–622. https://doi.org/10.1016/j.ccell.2014.10.006

17. Zsiros, E., Lynam, S., Attwood, K. M., Wang, C., Chilakapati, S., Gomez, E. C., Liu, S., Akers, S., Lele, S., & Odunsi, K. (2021). Efficacy and safety of pembrolizumab in combination with bevacizumab and oral metronomic cyclophosphamide in recurrent ovarian cancer: A phase 2 nonrandomized clinical trial. JAMA Oncology, 7(1), 78–85. https://doi.org/10.1001/jamaoncol.2020.5945

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EMERGING TRENDS IN MEDICAL IMAGING: FROM PATIENTS TO PIXELS SYMPOSIUM, 19 JUNE 2025

ORAL PRESENTATION

ET004

Identification of Gender in Adult Population Using Pelvic CT Morphometry Approach

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Introduction: Identification of gender is fundamental in forensic science, anthropology and medico-legal investigations. Among various anatomical structures, pelvis is widely recognized for its substantial sexual dimorphism. Anatomically, men and women have different pelvic characteristics of diameter size and pubic angle. Conventional measurement techniques such as calipers may have limitations that lead to lower reliability. This study aims to identify gender characteristics based on Computed Tomography (CT)-based pelvic bone morphometry. **Methods:** A total of 100 adult pelvic CT images (n=50 male, n= 50 female) aged from 18 to 78 years old were retrospectively reviewed from PACS of a health institution. Three morphometry parameters were quantified from each pelvic CT image of both male and female patients including pelvic inlet diameter, left innominate height, and subpubic angle using the volume rendering method. **Results**: Significant changes of morphometry parameters were demonstrated between male and female in pelvic inlet diameter (10.72 ± 0.79 cm vs 12.16 ± 0.78 cm), left innominate height (19.83 ± 0.88 cm vs 18.37 ± 0.94 cm) and subpubic angle (69.06 ± 7.90 vs 91.69 ± 26.10) with $p < 0.001$ for all parameters. **Conclusions:** The results reveal significant variation between males and females based on CT-based pelvic bone morphometry. Pelvic CT imaging is a feasible tool for gender identification in adult population. Gender identification is a crucial process for personal identification; hence this approach could be potentially useful in forensic science, anthropology and medico-legal investigations.

Keywords: adult, gender, morphometry, pelvic CT

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ET011

Knowledge and Practice of Radiation Protection Among Medical Professionals in Interventional Radiology at Private Hospitals in Ipoh

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Introduction: The increasing use of interventional radiology (IR) procedures has raised concerns on radiation exposure awareness among medical professionals (MPs) in hospitals. The aim was to determine association between knowledge and practice score with MPs demographic data in IR procedures at private hospitals in Ipoh, Perak. **Methods**: A cross-sectional study was conducted in two private hospitals in Ipoh, Perak, involving 90 medical professionals including specialists, radiographers, and nurses. The questionnaire consists of three sections which are demographic, knowledge and practice of radiation protection and was shared online through Google Forms. Data were analysed using the Pearson chi-square test, with a significance level of $p < .05$. **Results:** The results indicated that statistically significant and strong association between knowledge and radiation training, χ^2 (2, N=90) 44.950, $p < .001$ but not statistically significant between practice and radiation training, χ^2 (2, N=90) = 5.254, p = .072. Level of education also shown statistically significant and strong association for knowledge χ^2 (2, N=90) 24.18, $p < .001$ as well as practice, χ^2 (2, N=90) 30.49, $p < .001$.**Conclusions**: These results show that participation in radiation training is factor to improve knowledge in radiation protection. Level education is also a contributing score for radiation protection where the entry level of education for radiographers and nurses is diploma while specialist is up to master's degree. This result emphasizes a need for regular radiation training for MPs to update and improve knowledge and application in any procedure involving ionising radiation.

Keywords: interventional radiology, medical professionals, radiation protection

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ET012

The Efficacy of Personal Computer (PC) AI Image Enhancer Software on Low and High Contrast PA Chest Radiograph: An Experimental Study

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Introduction: Medical imaging is critical in modern healthcare because it provides diagnostic information about internal anatomical structures. Chest radiographs (CXRs) are commonly used to assess thoracic anatomy, although visualisation issues continue, particularly in low-contrast CXRs. This study compares the effectiveness of various personal computer (PC) AI image enhancer software in visualising the anatomy of high and low-contrast PA CXRs. **Methods**: An experimental investigation was undertaken using five PC AI image enhancer programs to visualise the thoracic anatomy. Experts examined the radiographs using visual grading analysis (VGA), which involves visualising 16 common chest anatomical features. Nine radiological experts assessed the VGAs. The data was examined using SPSS version 20 and a non-parametric technique called the Wilcoxon Signed Rank technique. **Results**: High-contrast CXR improves anatomical visualisation significantly ($p<0.05$), particularly in the hilum ($p=0.03$), descending thoracic aorta ($p=0.04$), and right heart border ($p=0.05$). Significant improvements were observed in low-contrast CXR structures such as the carina ($p=0.05$) and costophrenic angles ($p=0.05$). **Conclusions:** The findings highlight the effectiveness of AI software deep learning in visualising anatomical elements in CXR. Future research should concentrate on improving AI algorithms for consistent performance across different X-ray examinations and studying radiological diagnostic acceptability. This work requires additional clinical testing on a population to determine the feasibility of transferring this preliminary study to a clinical environment of radiological image viewing.

Keywords: artificial intelligence, image enhancement, radiography

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ETJ001

Pixels, Practice, and Policy: Assessing Radiation Therapists' Compliance with Malaysia's Allied Health Act 774

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Introduction: The Allied Health Professions Act 2016 (Act 774) was established to regulate allied health professions in Malaysia, including radiation therapists, with the aim of ensuring professional accountability, patient safety, and standardized practice. Despite its importance, the level of understanding and compliance among radiation therapists remains insufficiently understood. This study aimed to assess the knowledge, attitudes, and practices (KAP) of Malaysian radiation therapists regarding Act 774, and to identify factors influencing regulatory adherence. **Methods:** A cross-sectional quantitative survey was conducted among 164 registered radiation therapists across Malaysia using a validated KAP questionnaire. Descriptive statistics were used to evaluate levels of awareness, perception, and compliance. Inferential analysis explored associations between KAP domains and demographic variables. **Results:** While most respondents demonstrated basic awareness of Act 774, notable deficits were observed in specific areas such as the registration process, penalties for non-compliance, and perceived benefits of the Act. Attitude scores reflected a generally positive outlook, with a majority recognizing the Act's role in enhancing professional standards and patient safety. However, practice scores were relatively low, revealing a significant gap between attitude and behavioral compliance. Years of experience showed a significant association with practice levels. A moderate correlation between attitude and practice suggested the presence of external barriers, including limited institutional support and enforcement challenges. **Conclusions**: These findings highlight the need for targeted education, structured enforcement strategies, and policy enhancements to strengthen compliance with Act 774. Bridging the gap between regulation and practice is critical for elevating radiation therapy standards in Malaysia.

Keywords: radiation therapy practice, Act 774, clinical compliance, professional regulation, workforce education

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ETJ002

Transforming Breast Health Education in a Society 5.0 Framework

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Introduction: Breast health literacy, encompassing awareness of risk factors, symptom recognition, and proficiency in self-examination, is crucial for women to adopt proactive health practices that improve outcomes. Recently, digital health tools have gained prominence as innovative means to enhance health knowledge and empower individuals in managing their well-being. The Breast Imaging Education Bot (BieBot©) is an interactive chatbot created to provide detailed educational content on breast health, with a focus on breast cancer and its screening techniques. The development of BieBot© as a conversational platform reflects a progressive strategy aligned with Society 5.0 principles within healthcare. Utilizing advanced chatbot technology, this project aims to empower women by delivering accessible, trustworthy information about breast cancer and examination procedures. **Methods:** BieBot© supports both Malay and English languages and incorporates engaging visuals and videos consistent with guidelines from the Malaysian Ministry of Health. The content, carefully reviewed by breast cancer and imaging specialists, was pilot tested with 100 women during a breast awareness event in January 2025. **Results:** The responses were highly positive, with users praising its ease of use and informative nature. Participants particularly appreciated the interactive features and visual aids, which facilitated comprehension and sustained engagement. **Conclusions:** This innovative educational approach exemplifies the essence of Society 5.0 by enhancing digital health literacy, providing personalized learning experiences, and applying state-of-the-art technology to improve healthcare delivery and patient empowerment. Ultimately, it fosters a shift towards a human-centered, technology-enhanced healthcare system that prioritizes education, accessibility, and patient involvement.

Keywords: breast health literacy, breast cancer, breast imaging

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ETJ004

Scattered Radiation Dose Mapping Using Personal Electronic Dosimeter in Mobile Fluoroscopy Imaging

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Introduction: Mobile fluoroscopy, particularly utilizing C-arm imaging systems, is indispensable for guiding complex diagnostic and interventional procedures, yet it inherently exposes personnel to significant radiation doses. The aim of this paper was to determine the amount of scattered radiation dose for the mobile fluoroscopy c-arm imaging using dose mapping. **Methods:** A Siemens Siremobil Compact L mobile fluoroscopy system was used to scan the CIRS Model 903 Radiography/Fluoroscopy QA Phantom. The Personal Electronic Dosimeter was fixed at five different distances (0.25, 0.5, 1.0, 1.5 and 2.0 m) at eight different angles around the x-ray tube (0º, 45º, 90º, 135º, 180º, 225º, 270º and 315º). The phantom was exposed using the tube voltage 74 kVp and Automatic Exposure Control (AEC) fixing a 20 cm source to image distance (SID), simulating an AP and lateral projection hip imaging procedure. **Results:** The highest scatter radiation dose was at a distance of 0.25m from the x-ray tube for both, AP and lateral projection. Meanwhile, the lowest scattered dose was at an angle of 0º. The scattered radiation dose mapping indicated that the radiation workers will receive a dose of 20 mSv/year at a distance of 0.28 m, students is 6 mSv/year at a distance of 0.6 m while public is 1 mSv/year at a distance of 1.29 m from the x-ray tube. **Conclusions:** The measured scattered radiation doses were within the acceptable annual dose limits according to the Atomic Energy Licensing Act 1984 (Basic Safety Radiation Protection) Regulations 2010, fostering a more informed and proactive radiation safety culture.

Keywords: mobile fluoroscopy, C-arm imaging systems, personal electronic dosimeter, scattered radiation, dose mapping

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ETJ006

Influence of Subject Specific Factors on Myocardium Native Longitudinal Relaxation Time (T1) Values: A Retrospective Study

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Introduction: Native myocardial T1 is a sensitive biomarker in CMR that reflect tissue changes and can vary with biological factors. This retrospective study explores how subject-specific factors influence these values. **Methods:** 60 CMR datasets acquired using 3.0 Tesla (3T) scanner were retrospectively analyzed. Using IntelliSpace Portal (ISP) software, the T1 measurement were performed based on American Heart Association (AHA) 17-segment model. Patient demographic data (e.g., age, gender, BSA), cardiac function parameters (e.g., LVEF, LVMI) and myocardial native T1 values were collected. Global and septal native T1 values were analyzed in relation to age, gender, LVEF and BMI. **Results:** Global T1 were higher in males than females (1303.10±55.86ms vs 1280.50±46.23ms), but not statistically significant (p=0.154). For septal T1 (female>male: 1290.62±64.95ms vs 1287.32±80.56ms, p=0.903). Global T1 showed a moderate negative correlation with LVEF (r = -0.59), and a moderate positive correlation with LVMI (r = 0.55), which stronger in female (r = -0.74 vs. r = -0.51, and r = 0.63 vs. r = 0.45, respectively). Septal T1 also correlated with global T1 (r = 0.53), LVMI (r=0.29), and showed a weaker negative correlation with LVEF (r = -0.36). **Conclusions:** Native myocardial T1 values are moderately influenced by heart function and muscle mass, with stronger association in females**.**

Keywords: myocardial T1 mapping, cardiac magnetic resonance (CMR), subject-specific factors, 3T MRI, Left ventricular function

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ETU001

Analysis of Dees Radius Changes to the Energy Produced by Cyclotron as a Proton Accelerator Using Python Programming

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Introduction: Proton radiotherapy is a cancer treatment that minimizes damage to healthy tissue. Currently, cyclotrons are the most commonly used proton accelerators. Designing a cyclotron requires determining parameters such as dees radius, magnetic field strength, and electric potential to achieve the desired energy. This study examines the relationship between dees radius and the energy produced by a cyclotron proton accelerator using Python programming. **Methods**: This study employed an in silico approach with Python in Jupyter Notebook Integrated Development Environment. Control variables included proton charge, mass, voltage, magnetic field strength, and dees plate distance. The independent variable was dees radius; the dependent variable was kinetic energy. **Results:** Proton motion generated energies of 0.4426 MeV, 1.644 MeV, 3.941 MeV, 7.246 MeV, and 11.10 MeV for dees radii of 0.1–0.5 m. An increase in the dees radius leads to more proton rotations, causing more frequent gap crossings, which in turn raises the proton speed and kinetic energy. **Conclusions:** The size of the cyclotron dees radius can be adjusted according to the energy requirements needed to kill cancer cells

Keywords: python, proton radiotherapy, cyclotron

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ETU005

The Differences Between BM3D And NLM Denoising Techniques to Improving Thoracic Image Information in Low Field MRI

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Introduction: The modality can be used for thoracal MRI examination is low field MRI machine. Its weakness is that it produces low signal & noise. If the signal and noise is high, the SNR value is low. Denoising technique is the right solution to remove noise. BM3D & NLM denoising techniques are able to increase SNR. BM3D technique has better capability than NLM technique.The research objective is to analyze the difference in image quality and anatomical information on Thoracal MRI images with low field MRI Machine before and after the application of BM3D and NLM denoising techniques. **Methods**: Quasi-experimental research on thoracal MRI images before and after the application of BM3D and NLM denoising techniques. BM3D and NLM denoising techniques totaling 15 samples. BM3D and NLM denoising and assessment of Thoracal MRI images, including SNR, CNR, MSE, PSNR. **Results:** There is a difference in image quality, MSE, PSNR values, and anatomical information of thoracal MRI image before and after denoising technique, with p-value <0,001. **Conclusions:** The BM3D denoising technique is more optimal in improving image quality and anatomical information on thoracal MRI image; a study on low field MRI.

Keywords: low field MRI, BM3D, NLM, denoising, thoracal

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ETC009

Effects of Ionizing Radiation on *Escherichia Coli (E. Coli)* Bacteria

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Introduction: This study delves into the intricate relationship between ionizing radiation and *Escherichia coli* (E. coli), a bacteria vital for digestion, nutrient absorption, immune system support and protection against harmful pathogens. While many studies have examined radiation's impact on gut microbiota, few focus specifically on X-ray effects on *E. coli*. Understanding this is crucial for improving treatment planning and minimizing tissue damage in medical settings. This research was conducted to determine the effects of ionizing radiation on E. coli bacteria, focusing on morphological changes before and after exposure to varying technical factors such as kVp, mAs, and SID over a designated period. **Methods:** An experimental research method was employed, observing both a control group and a radiation-exposed group under increasing technical factors with immediate and five-day post-exposure assessments. Moreover, a quantitative approach was used for analysis, with data collection facilitated through systematic tabulation. The study examined four cultured strains of E. coli, including two assays of E. coli ATCC 25922 and two derived from a stool culture. **Results:** The results of the study revealed that higher intensities of radiation might lead to delayed morphological changes in the bacteria, including alterations in shape, size, surface, and margin. **Conclusions:** The study concludes that ionizing radiation does not immediately affect E. coli colony viability, however, gradual changes in colony morphology were observed three days after being exposed to ionizing radiation. Consequently, studying the effects of ionizing radiation on *E. coli* benefits radiologic technologists and others by advancing understanding in radiation biology and microbiology.

Keywords: *Escherichia Coli*, morphology, colony, ionizing radiation, normal flora

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e-POSTER PRESENTATION

ET009

Assessment of Image Quality Using Standard Contrast Injection and Weight-Based Contrast Injection Protocols in Coronary CT Angiography

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Introduction: Optimal contrast enhancement is crucial in Coronary Computed Tomography Angiography (CCTA) for accurate visualization of coronary arteries and cardiovascular disease diagnosis. The standard protocol employing a fixed contrast volume, may result in excessive contrast for smaller patients and insufficient enhancement for larger patients, thus leading to the risk of contrast-induced nephropathy and compromising diagnostic accuracy. This study assesses the image quality of CCTA images using a weight-based contrast injection protocol against a standard protocol. **Methods:** A retrospective image analysis was performed on CCTA examination which was acquired using weight-based injection (n=50) and standard injection (n=50) protocols. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) were measured in the region of interest of the left coronary artery (LCA) and right coronary artery (RCA). The mean SNR and CNR were compared using independent t-tests. **Results**: The weight-based protocol demonstrated significantly higher SNR (LCA: 8.83 ± 4.03 vs. 4.09 ± 1.70, $p < 0.001$; RCA: 8.42 ± 6.21 vs. 4.14 ± 2.27, $p < 0.001$) and CNR (LCA: 10.35 ± 4.76 vs. 4.31 ± 1.99, $p < 0.001$; RCA: 9.42 ± 6.46 vs. 4.31 ± 2.79, $p < 0.001$) in both coronary arteries compared to the standard protocol. Overall, the weight-based protocol demonstrated 7.96% reduction of contrast volume relative to standard protocol. **Conclusions**: The weight-based contrast injection protocol significantly improves the CT image quality. This technique may offer a cost-effective strategy by optimizing contrast media dose for individual patients, hence leading to improved diagnostic accuracy in CCTA.

Keywords: coronary computed tomography angiography, contrast media, image quality, weight-based protocol

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ET013

Knowledge And Awareness of Magnetic Resonance Imaging Safety Among Healthcare Workers in A Single Medical Centre

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Introduction: Magnetic resonance imaging (MRI)-related incidents reported to the U.S. Food and Drug Administration (FDA) between 2008 and 2017 indicated that 59% involved serious thermal injuries, followed by 11% traumatic events, 9% projectile-related accidents, and 6% acoustic injuries. Locally, a medical centre in Klang Valley recorded three projectile-related MRI incidents between 2015 and 2023 that involved both clinical and non-clinical staff. Despite these occurrences, no official study in Malaysia has assessed healthcare workers' knowledge and awareness of MRI safety protocols. Given their critical role in ensuring a safe MRI environment, this study aimed to evaluate the level of MRI safety knowledge and awareness among healthcare workers at a single medical centre. **Methods:** A descriptive cross-sectional study was conducted using a structured questionnaire distributed electronically from August to October 2024. A total of 268 healthcare workers from various departments voluntarily participated. Scores were categorised as high, moderate, and low levels of knowledge and awareness. **Results**: Associations with demographic factors were analysed using the chi-square test. The results indicated that most participants demonstrated good knowledge and awareness of MRI safety. Significant associations were found between professions and both knowledge and awareness. However, no statistically significant associations were observed with gender or age. Although education and work experience were not significantly associated with knowledge levels, both were significantly associated with awareness. **Conclusions:** This study provides the first local baseline data on MRI safety knowledge and awareness, highlighting the need for role-specific training and supporting policy development to enhance MRI safety practices.

Keywords: awareness, knowledge, MRI safety, healthcare workers

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ET014

Awareness of Hospital-Acquired Infections and Hand Hygiene Practices Among Patients and Public Attendees at the Radiology Department

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Introduction: Hospital-acquired infections (HAIs), or nosocomial infections, occur within 48 hours of care or 30 days post-discharge. Affecting 1.7 million patients annually, HAIs cause over 98,000 deaths. Hand hygiene plays a vital role in transmission. The World Health Organization (WHO) defines infection control practices (ICP) as methods to reduce infection risks in healthcare settings through prevention and hygiene measures. A better understanding of patients' knowledge and attitudes enhances intervention effectiveness. However, limited research exists on patients' education about ICP and their awareness of HAIs remains underexplored and insufficiently assessed. Therefore, this study aimed to evaluate the HAIs awareness level and hand hygiene practice's level. **Methods:** 145 outpatients and visitors to the radiology department participated in this cross-sectional study. Information on sociodemographic, awareness and knowledge, and hand hygiene practices was gathered using a self-administered questionnaire. A mean score interpretation and correlation coefficient interpretation were used to assess the degree of correlation and awareness between sociodemographic, practice, and awareness factors. **Results:** The descriptive analysis revealed that the mean awareness score for patients and public attendees was very low (1.46), while the mean practice score was medium (3.15). The results of the Pearson correlation test showed a significance value of 0.002 and r = -0.25. This suggested that the relationship between awareness and practice was weak but statistically significant. **Conclusions**: In summary, the study revealed that awareness has a negligible effect on the degree of practice of patients and public attendees.

Keywords: hospital-acquired infections, infection control practices, hand hygiene practices, radiology department

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ETJ005

3D Cine for the Assessment of the Heart: A Systematic Literature Review

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Introduction: Cardiac CINE MRI is used to obtain cardiac morphology and function. Conventional CINE MRI, a 2D CINE MRI, shows several drawbacks, which are not feasible for the patient and require multiple image acquisitions, resulting in increased planning and scanning time. 3D CINE MRI has been introduced to improve the performance of CINE imaging, along with algorithms and techniques to obtain the best cardiac information and give superior comfort to the patient. Therefore, this aims to analyse the image acquisition in CINE imaging, then explore the algorithms and techniques used in the 3D CINE MRI and the diagnosis by the 3D CINE MRI. **Methods:** This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) using electronic databases, PUBMED and SCOPUS. **Results:** Ten papers within five years of publication (2019 – 2024) are included in this review. Image acquisition of the CINE imaging is done in two modes: the free-breathing and breath-holding series. Most of the studies were done in free-breathing mode to provide the best comfort to the patient. The algorithms and techniques approach with the 3D CINE MRI help improve image acquisition and reconstruction. The use of 3D CINE MRI varies among healthy individuals and patients with cardiovascular diseases. The differences in ventricular measurements can be analysed for each condition of the heart. **Conclusions**: The approaches by the studies have their own strengths and limitations, but most of them are able to give superior comfort to the patient.

Keywords: 3D CINE, cardiac assessment, algorithm, cardiovascular disease

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ETU011

Analysis of Dose History and Health of Radiation Workers in Radiology Installation of PKU Muhammadiyah Hospital Bantul and Panti Nugroho Hospital Sleman

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Introduction: The Radiology Department is a vital unit in hospitals that provides diagnostic and interventional services. However, exposure to ionizing radiation poses health risks for radiation workers. To ensure their safety, regular radiation dose monitoring and health examinations are necessary. This study aims to analyze the radiation dose history and health status of workers in the Radiology Department of RS PKU Muhammadiyah Bantul and RS Panti Nugroho Sleman. **Methods:** This study employed a qualitative method with a descriptive approach. Data were collected through observation, interviews, literature studies, and documentation from 12 radiographers and 1 radiologist at RS PKU Muhammadiyah Bantul, and 6 radiographers at RS Panti Nugroho Sleman. Data analysis was conducted through data reduction, data presentation, and conclusion drawing. **Results:** The radiation doses received by workers at both hospitals remain within the safe limits as regulated by BAPETEN Regulation No. 13 of 2013 (maximum 20 mSv/year). However, not all workers have consistently undergone dose monitoring, particularly those not yet permanent employees. Health examinations showed normal hemoglobin levels, but some workers experienced elevated leukocyte levels, impaired liver function (SGOT/SGPT), and leukocyturia in urine tests. **Conclusions**: Radiation doses received by radiology workers in both hospitals are within safe limits. Dose monitoring is carried out periodically but is not yet consistent for all staff. Health examinations are generally normal, although some indicators of potential health issues were observed in several workers.

Keywords: occupational safety, dose monitoring, health monitoring, radiology

ADDITIONAL ABSTRACTS

ET005

Scattered Radiation and Exposure Dose Mapping of Micturating Cystourethrogram and Barium Swallow in the Fluoroscopy Room: A Phantom Study

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Introduction: Scatter radiation is inevitable in fluoroscopy procedures, particularly interventional fluoroscopy procedures. Proper awareness of positioning within the fluoroscopy room is crucial to minimizing radiation exposure. This study aims to map the distribution of scattered radiation and determine exposure levels during pediatric Micturating Cystourethrogram (MCUG) and Barium Swallow procedures at the Radiology Department of Hospital Sultan Abdul Halim (HSAH). **Methods:** Scattered radiation levels were measured using survey meters placed around a water phantom. Measurements were taken at eight angles (0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315°) and two distances (0.5 m and 1.0 m) from the phantom. The height of the fluoroscopy table was kept constant. A total of 48 positions were assessed, with each measurement repeated three times to determine the mean and standard deviation of scatter doses. The data was placed into the initial sketch of the distances and angles of the survey meter accordingly. **Results:** Statistical analysis revealed that both the angle and distance of the survey meter significantly influenced scatter radiation levels ($p < 0.05$). There is no significance between the two variables, indicating their independent effects on scatter radiation dose. The lowest radiation levels were recorded at the 315° angle and 1.0 m distance from the phantom, suggesting this position is safest for staff during both procedures. **Conclusions:** Scatter radiation levels vary based on position in the fluoroscopy room. Mapping dose distribution helps identify safer zones, guiding staff to minimize radiation exposure during MCUG and Barium Swallow procedures.

Keywords: scattered radiation, mapping dose, fluoroscopy, micturating cystourethrogram, barium swallow

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ET015

Determination of Scattered Radiation on General X-Ray Tabletop Using Dose Mapping Technique

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Introduction: Scatter radiation is an essential parameter to be measured in diagnostic imaging, as it can degrade image quality and increase radiation exposure to both patients and healthcare personnel. Due to the invisible nature of X-rays, scatter radiation cannot be directly visualized and must be quantified using indirect measurement techniques such as dosimetry during patient exposure. This study investigates the distribution of scatter radiation on a general X-ray tabletop using a dose mapping technique, with a specific focus on the examination couch area where the patient is positioned during the imaging procedure. **Methods**: Scatter doses were recorded at 15 locations on the general X-ray tabletop using nanoDot™ optically stimulated luminescence dosimeters, arranged in a grid with 50 cm horizontal and 25 cm vertical spacing. An anthropomorphic upper body phantom was positioned centrally to simulate patient attenuation. Standard chest X-ray exposures with proper collimation were performed at three exposure settings: 60 kVp/2.0 mAs, 70 kVp/2.5 mAs, and 80 kVp/3.2 mAs. Dosimeters were analyzed using MicroStar reader and the data were processed in Microsoft Excel to generate 3D graphs illustrating the scatter dose distribution. **Results**: Results showed that scatter radiation was most intense along the central axis of the X-ray beam. As a result, scatter radiation is concentrated near the beam's central axis. **Conclusions:** The method effectively maps scatter radiation across the general X-ray tabletop and identifies intensity variations associated with the heel effect. Furthermore, awareness of scatter radiation distribution is essential for the effective implementation of radiation safety procedures**.**

Keywords: scattered radiation, mapping technique

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ETJ003

Quantitative Assessment of Entrance Surface Doses for Trauma Patients During Multifield Plain Radiography Procedures: A Phantom Study

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Introduction: Trauma patients often require several radiographic examinations, leading to increased exposure to ionizing radiation. Optimizing imaging parameters is essential to ensure patient safety while maintaining diagnostic accuracy. This study aims to compare entrance surface doses (ESDs) between standard guideline-recommended imaging parameters and those used in clinical practice to support radiation dose optimization. **Methods:** The ESDs were directly measured using thermoluminescent dosimeter (TLD) chips placed on a whole-body PIXY® phantom. For the indirect method, ESDs were estimated using data on the X-ray tube radiation output and exposure parameters (kVp and mAs), following the guidelines of the International Atomic Energy Agency (IAEA) Technical Report Series No. 457. Measurements were performed across five different X-ray anterior-posterior (AP) projections, including skull, chest, abdomen, pelvis, and lumbar. Exposure settings were selected based on two approaches: standard and clinical exposure conditions. **Results**: The analysis showed notable differences in X-ray exposure parameters between standard guidelines and clinical practice. For standard exposures, mean ESDs (direct method) ranged from 0.22 mGy (chest) to 1.35 mGy (skull), while clinical exposures showed a wider range, from 0.20 mGy (chest) to 2.46 mGy (abdomen). Similar trends were observed with the indirect method. Overall, the ratio of clinical to standard ESDs ranged from 0.51 to 1.00. **Conclusions:** The findings highlight significant differences in ESDs between standard and clinical imaging protocols, underscoring the need for greater adherence to guideline-recommended parameters. This comparison supports efforts toward radiation dose optimization, promoting safer and more consistent radiographic practices.

Keywords: entrance surface dose, radiography, exposure factor, TLD, quality control

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ETU002

Image Analysis of Radiographic Cranial Examinations Using Analog Grid and AI-Based Grid

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Introduction: Cranial radiography is a critical diagnostic procedure that demands high-quality imaging to accurately visualize complex anatomical structures within the skull. Traditionally, manual grids have been employed to reduce scattered radiation and enhance image contrast, thereby improving overall image quality. However, these physical grids often present limitations in clinical settings due to their cumbersome nature, increased radiation dose requirements, and reduced workflow efficiency. In response to these challenges, digital radiography systems have introduced software-based virtual grids, such as AI-enhanced grids, which aim to replicate the benefits of physical grids while improving dose efficiency and workflow flexibility. **Methods**: Despite their growing use, comprehensive clinical validation and comparative analysis between manual and virtual grids—especially in cranial applications—remain limited. This study aims to evaluate cranial image quality using both manual (analog) and AI-based virtual grids under varying exposure conditions. The evaluation criteria include contrast, sharpness, anatomical detail, and artifact presence, along with an assessment of radiation dose efficiency. Data were obtained through an experimental approach using a head phantom in the radiology laboratory at Universitas 'Aisyiyah Yogyakarta. **Results:** showed that the AI Grid at a lower exposure (80 kV, 200 mA, 10 mAs) achieved the highest average image quality score of 4.88, compared to the Analog Grid (4.47) and AI Grid at standard exposure (3.82). **Conclusions:** These findings suggest that low-dose AI Grid technology not only maintains but may even improve image quality while significantly reducing patient radiation exposure.

Keywords: radiography cranium, grid manual, virtual grid

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ETU003

Uniform Whole Body Immobilization Device for Radiotherapy

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Introduction: Radiotherapy is a treatment modality that utilizes radiation, either from radioactive sources or generated by a Linear Accelerator (Linac). To ensure precise targeting and protect surrounding healthy organs, accurate and stable patient immobilization is essential. Immobilization devices vary by treatment area—such as the head, head and neck, thorax, and pelvis—but are typically limited to one unit per type, posing challenges when treating multiple patients with similar conditions simultaneously. This study aims to evaluate the accuracy of a newly developed immobilization tool called UNIMOB (Uniform Whole Body Immobilization Device), designed as an affordable and flexible alternative. **Methods:** The research follows experimental design, constructing the UNIMOB using an 11 mm-thick acrylic baseplate, a vacuum-formed headrest, and a thermoplastic mask for individualized immobilization. The UNIMOB's performance is compared to standard immobilization equipment in terms of positioning accuracy, reproducibility, and safety. **Results**: Show that the vacuum headrest, filled with moldable styrofoam beads, adapts precisely to the shape of the patient's head, while the acrylic baseplate offers safe attenuation during irradiation. UNIMOB meets the clinical criteria for consistent and reproducible positioning. Moreover, verification tests demonstrate low setup error values, supporting its effectiveness. **Conclusions**: The UNIMOB device enhances treatment precision and offers a cost-effective solution for radiotherapy departments, especially those with limited resources or in scenarios requiring simultaneous treatment for multiple patients with similar anatomical sites.

Keywords: immobilization device, uniform whole body immobilization device, accuracy

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ETU004

BNO–IVP Examination Procedure with Clinical Ovarian Cyst

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Introduction: The ovarian cyst is a fluid-filled lump in the ovary which is a reproductive disorder in women during the reproductive period. Examination at the hospital uses a lateral projection which is carried out after post-micturition so it is necessary to know the purpose of the examination. This study aims to determine the examination procedure and reasons for additional lateral projection in RSUD dr. Loekmono Hadi Kudus. **Methods:** This research is qualitative with a descriptive method and a case study approach. The research was conducted at the Radiology Installation of RSUD dr. Loekmono Hadi Kudus from October 2023 to June 2024. The research subjects were 2 radiology specialists and 3 radiographers. Data were collected by means of observation, interviews, documentation, and literature review. The data analysis included data reduction, data presentation, and drawing conclusions. **Results:** The results of the study showed that the BNO – IVP examination procedure started with preparing the patient for 2 days and fasting for approximately 6-8 hours before the examination, using a plain AP plain abdominal projection, then inserting the water-soluble iodine contrast media using a 10 and 20 cc syringe via the intravenous injection, AP post contrast 5 minutes, 15 minutes, 45 minutes projection, AP supine post micturition, and lateral projection. **Conclusions**: The examination begins with a plain abdominal radiograph, AP post contrast 5 minutes, 15 minutes, 45 minutes projection, AP supine post micturition, and lateral projection. The reason for using lateral projection was to see if the mass was pressing against the ureter**.**

Keywords: ovarian cyst, BNO–IVP, lateral projection, radiography

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ETU009

Apron Leak Testing using Detectors in The Radiology Installation of The General Hospital Dr. Soehadi Prijonegoro Sragen

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Introduction: Aprons are radiation protective equipment that require good care and maintenance to prevent damage to internal fractures. In storage, the apron should not be folded, hung, and stacked because it will reduce the effectiveness of radiation protection. The frequency of apron testing is carried out periodically, namely once every 12-18 months to ensure optimal protection when used. In the Radiology Installation of Dr. Soehadi Prijonegoro Sragen Regional General Hospital, aprons were found to be stored in an improper manner, namely unfolded and stacked, and the last test was conducted in 2022. This study aims to determine the testing procedures, test results, and maintenance of aprons in the installation. **Methods**: This study used a mix-method approach with quantitative data from test results and qualitative data from interviews, documentation, and secondary sources such as laws and articles. Data collection was carried out in October 2024-April 2025 at the Radiology Installation of Dr. Soehadi Prijonegoro Sragen Regional General Hospital. **Results:** The results showed that the three aprons were stored stacked and cleaned using wet wipes or alcohol. Tests showed no leaks, but there were waves, dents and creases on the aprons. **Conclusions:** The third test of the apron was carried out by radiographic method, for the test results there were no leaks but there were visible waves and indentations or folds on the apron, the indentations on the apron were caused by improper storage such as being stacked.

Keywords: apron, test, maintenance

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ETU012

Analysis of X-Ray Radiation Exposure Safety in the Radiology Installation of Panti Nugroho Hospital Sleman

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Introduction: Radiology plays a vital role in early diagnosis and risk assessment through real-time imaging. However, ensuring radiation safety is essential to protect patients, healthcare workers, and the public from excessive ionizing radiation exposure. This study aims to analyze the safety of X-ray radiation exposure in the Radiology Installation of Panti Nugroho Hospital, Sleman. **Methods**: This research used a mixed-methods approach with an explanatory design conducted from August 2024 to January 2025. Quantitative data were obtained by measuring radiation levels at 10 points, each measured three times. The results were calculated using standard formulas and compared to the dose limits set by BAPETEN Regulation No. 5 of 2016. Qualitative data were gathered through interviews with a radiation protection officer who also serves as the unit head. **Results:** The highest radiation exposure from the conventional X-ray unit was found at Point 5 (operator glass) with 0.33 µSv/h. For the panoramic unit, the highest value was also at Point 5 with 0.03 µSv/h. Safety procedures such as room management, provision of PPE, routine exposure testing, TLD usage, equipment maintenance, and health monitoring have been implemented consistently. **Conclusions:** Radiation exposure levels remain within safe thresholds (≤2.28 µSv/h for workers and ≤0.11 µSv/h for the public). Operating two modalities in the same room does not significantly increase radiation levels if not used simultaneously. Continued monitoring and periodic evaluation of room layout are recommended to ensure ongoing safety and efficiency.

Keywords: radiation exposure, radiation workers, public safety, dose limit, risk assessment

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ETU013

Comparative Analysis of Abdominal Image Information Using Physical Grid and Virtual Grid

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Introduction: Abdominal imaging requires a high exposure factor due to its thickness, causing scattered radiation that can degrade radiographic image quality. The use of grids is essential to enhance image clarity. Virtual grid, which integrate scattered and primary radiation, improve image quality by reducing scatter and increasing the proportion of primary radiation captured, unlike physical grid that introduce noise. This study aims to compare abdominal image information quality between physical and virtual grid usage. **Methods:** A quantitative experimental research design was employed, conducted between September 2024 and April 2025. Collecting data through a structured questionnaire, validated by one radiology specialist, and completed by three radiology specialists with a minimum of ten years of clinical experience. Statistical analysis was performed using SPSS software, employing the Wilcoxon test. **Results:** Analysis obtained an Asymp. Sig. (2-tailed) value of 0.034, which is below the significance threshold (p-value) of 0.05. Thus, the alternative hypothesis (H_1) is accepted, indicating a statistically significant difference in image information between abdominal radiographs obtained using physical and virtual grids. Virtual grid can enhance anatomy visualization better than physical grid. **Conclusions**: Abdominal images show differences in information when utilizing physical grids compared to virtual grids, with virtual grids enhancing anatomy visualization, making them preferred over physical grids**.**

Keywords: image information, abdomen, physical grid, virtual grid

ETU014

The Use of 3D Reconstruction in CT Scan Examination of Elbow Joint with Dislocation Cases at Surakarta Orthopedic Hospital

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Introduction: Patients with elbow joint dislocations had CT scans with 2D and 3D reconstructions, in some studies, it is sufficient to examine the elbow joint using conventional radiography with anteroposterior and lateral projections. However, in some cases that cannot be evaluated using conventional radiography, a CT scan can facilitate diagnosis, particularly when enhanced with multiplanar and 3D imaging to provide better assessment. **Methods**: This study employed a descriptive qualitative methodology utilizing a case study approach to examine CT scans of elbow joint dislocations at the Radiology Installation of Prof. Dr. R Soeharso Orthopedic Hospital Surakarta, conducted from September 2024 to March 2025. **Results:** A CT scan of the elbow joint exhibiting clinical dislocation was performed with standard preparation. The patient was positioned supine on the examination table with feet oriented first, utilizing 2D and 3D reconstruction, covering a scanning area from 1/3 distal humerus to 1/3 proximal antebrachia. The reason for employing 3D reconstruction is that the dislocation has persisted for over 24 hours and is categorized as severe. 3D reconstruction helps radiologists in visualizing indicators that are challenging to assess with traditional radiography, such as microfractures. It facilitates communication among doctors regarding the assessment and treatment plans for patients with dislocations. **Conclusions:** The utilization of 2D and 3D reconstruction in CT scan evaluations of the elbow joint facilitates diagnoses that are unattainable through conventional radiography, prompting researchers to support these techniques in dislocation cases.

Keywords: CT scan, elbow joint, 2D and 3D reconstruction

ETU019

Thorax Radiography Examination Procedure in Dengue Haemoragic Fever (DHF) Cases at the Radiology Installation of Roemani Muhammadiyah Hospital Semarang

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Introduction: Dengue Hemorrhagic Fever (DHF) is a fatal dengue fever, the supporting action taken is a thorax examination. Thorax examination in cases of pleural effusion is performed using AP, PA and Lateral Dicubitus projections with patient preparation for 5 minutes (Long et al, 2016). While at Roemani Hospital Semarang, thorax examination in DHF cases uses AP and RLD (PA) projections with patient preparation for 30 minutes. **Methods:** using qualitative research with a case study approach conducted at Roemani Hospital Semarang in December 2024-May 2025, data collection was carried out by observation, interviews and documentation. **Results**: The results of the study showed that in thorax examination of DHF cases in the RLD projection using a waiting time of 30 minutes the reason is so that fluid can collect more optimally below and in thorax examination using AP and RLD (PA) projections the reason for using RLD projection in the PA position is to minimize fixation devices and device factors. **Conclusions:** Thorax examination procedure of DHF cases in the Radiology Installation of Roemani Hospital Semarang was carried out with AP projection and RLD PA position. Patient preparation was carried out with a waiting time of 30 minutes. The reason for the 30-minute waiting time on the RLD projection is so that the fluid can collect maximally below and on the RLD projection using the PA position is to make it easier for the patient and minimize fixation devices and device factors.

Keywords: thorax,dengue haemoragic fever, pleural effusion

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ETU020

Use of Pitch in Head CT Scans for Trauma Cases at Banyumas Regional General Hospital

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Introduction: Banyumas Regional General Hospital examination head CT scans for trauma cases. The use of pitch parameters in CT scans is crucial for producing high-quality images while minimizing the radiation dose received by the patient. However, there are variations in the application of optimal pitch usage in head CT scans at RSUD Banyumas. This study aims to determine the procedure for head CT scans in trauma cases, the appropriate pitch usage, and the resulting image quality. **Methods:** This type of research is using descriptive qualitative with a case study approach. The author explains in general about the Use of Pitch in Head CT Scan Examination in Trauma Cases at Banyumas Regional Hospital. **Results:** The head CT scan procedure for trauma at RSUD Banyumas follows the standard head CT scan trauma protocol, with the patient positioned supine head first, and a pitch parameter of 0.55 is used. A lower pitch can improve image detail and noise, albeit with the risk of a higher radiation dose. Noise is determined by the standard deviation used. The standard deviation used at RSUD Banyumas is 21 HU. The resulting image quality meets diagnostic standards, with assessment by a radiologist indicating that the images produced are sufficiently informative for diagnosis. **Conclusions:** the appropriate use of pitch in head CT scans for trauma at RSUD Banyumas significantly influences the resulting image quality. Therefore, it is important for medical personnel to understand and optimally apply this parameter to improve diagnostic outcomes and patient safety.

Keywords: pitch, image quality, CT head trauma

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ETC001

Patient's Perception of Radiation Safety Protocols in Radiation Therapy Facility in Batangas

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Introduction: Patient education on radiation safety is crucial in minimizing anxiety and ensuring compliance during radiation therapy. However, the extent to which patients understand these protocols remains underexplored. This study aimed to assess patient's perceptions of radiation safety before and during treatment in hospital in Batangas. **Methods**: A descriptive design was employed among 27 patients undergoing radiation therapy. An adapted questionnaire was administered to gather data on demographic variables and perceived understanding of safety measures. Statistical analyses were performed to identify relationships between demographic factors and patient understanding. **Results**: Findings revealed most respondents were aged 41–50 years, female, and held at least a bachelor's degree. Cervical cancer was the most common diagnosis. Participants reported high perceived understanding of safety protocols before and during treatment, with strong agreement on awareness and communication experiences. No significant relationship was found between understanding and age, sex, or cancer type. However, educational attainment showed a significant inverse correlation with understanding in the pre- treatment phase, suggesting that higher education levels don't guarantee better comprehension of radiation safety. **Conclusions:** These findings emphasized the need for clear patient education regardless of educational background. The development of standardized informational materials is recommended to enhance patient comprehension and ensure safety across diverse populations. This study highlighted the need for healthcare facilities to identify and address communication gaps in the implementation of radiation safety protocols. By enhancing the delivery of information and education strategies, facilities can strengthen patient trust and improve their overall treatment experiences.

Keywords: radiation therapy, radiation safety protocols, patient perception

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ETC002

Clinical Education Assessment of Radiologic Technology Interns of CEFI In Computed Tomography

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Introduction: Computed tomography (CT) has emerged as a crucial imaging modality, necessitating radiologic technology interns to prove high levels of competency prior to complete clinical practice. This study aimed to evaluate and compare the competency levels of interns in CT as rated by CT technologists and interns. This study aim to identify the competency levels of radiologic technology interns in patient care and management, image production, and radiation safety. **Methods:** The participants of the study includes twenty-three (23) Radiologic Technology Interns, and one (1) CT Technologists from each affiliated hospital. A quantitative, comparative design was utilized, employing the Wilcoxon Signed-Rank test to compare the differences between the two assessment sets. **Results**: Results indicated that interns rated themselves higher in all areas than CT technologists' ratings, with significant differences found in patient care and management ($p = 0.002$), image production ($p = 0.001$), and radiation safety ($p = 0.023$), reflecting a gap between intern self-perception and clinical findings. **Conclusions**: The findings emphasize the effectiveness of existing academic training while highlighting calls for improved clinical mentorship and radiation safety reinforcement, playing a role in curriculum development and advocacy for strategies to improve student self-perceptions relative to subsequent clinical performance.

Keywords: computed tomography, competency, radiologic technology interns, CT technologist

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ETC003

Difficulties Encountered by Computed Tomography Scan Technologist in Handling Traumatic Brain Injury Patient

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Introduction: Traumatic Brain Injury (TBI) poses unique challenges in diagnostic imaging, especially for Computed Tomography (CT) scan technologists who managed difficulties related to patient positioning, communication, cooperation, and time constraints. This study aimed to identify the specific challenges encountered by CT technologists when handling TBI patients and examine whether demographic variables influence these challenges. **Methods:** Using a descriptive quantitative method, the researchers surveyed 33 CT technologists working in hospitals and clinics around Lucena City. Data were analyzed using frequency and percentage, weighted mean, Spearman's rho, and Mann-Whitney U test. **Results:** The results indicated that patient cooperation was the most significant challenge, followed by difficulties in positioning and communicating with disoriented or aggressive patients. Time constraints during emergency scans also notably impacted workflow. A significant difference was found in positioning difficulties between male and female technologists, while age and caseload showed no significant effect. **Conclusion:** The study recommends targeted training, institutional support, and improved trauma imaging protocols to enhance technologists' preparedness and ensure better care for TBI patients in emergency settings.

Keywords: CT technologists, traumatic brain injury, emergency setting

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ETC005

Exploring Glutinous Rice Flour as an Alternative to Ultrasound Gel: Efficacy, Safety, and Practicality

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Introduction: The research examined the use of glutinous rice flour (GRF) as a substitute to commercially available ultrasound gel because of the scarce supply and expensive costs of regular gels in low-resource health care facilities. A quantitative experimental contrast of GRF and commercial gel was done by researchers and assessed by seven professionals, three sonographers, three sonologists, and one dermatologist. **Methods**: Abdominal organs scanned by evaluators consisted of liver, gallbladder, pancreas, spleen, kidneys and urinary bladder on researchers with three various body habitus namely hypersthenic, sthenic and asthenic. The sonographers and sonologists rated the quality of the images in terms of penetrability, echogenicity, and the resolution. **Results**: GRF gel was very effective as the weighted mean scores were 3.78, 3.63 and 3.63 in penetrability, echogenicity and resolution respectively. The skin test of the gel performed by a dermatologist indicated no allergic reactions, redness, and discomfort. GRF gel was of suitable viscosity and simple to spread, which allowed movement of transducers and provided consistent image quality. At refrigerated conditions with phenoxyethanol, the gel was stable and usable within one month. Its physical properties were suitable to ultrasound imaging. GRF gel was cheaper than Aquasonic, retailed at 1,460.00 ($26.23) per liter. **Conclusions:** GRF gel is a cost-effective, safe, and practical alternative to commercial ultrasound gel, especially in resource-limited settings where affordability and access are crucial.

Keywords: penetrability, echogenicity, resolution, viscosity, transducers

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ETC006

Empowering Communities: A Multifaceted Approach to Raising Awareness for Ionizing Radiation in Diagnostic Imaging

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Introduction: The people are the reason why a community is of being. It is important to consider that in order to create a better tomorrow, knowledge and awareness is of value. The study is concerned on assessing and revamping the awareness of the community about ionizing radiation in diagnostic imaging as a community health education. **Methods:** The researcher, now equipped with information, desires to promulgate ionizing radiation in terms of its benefits and risks to give back to the community. The research is led by a descriptive design which is complimented by a quantitative approach. There are four barangays selected, namely, Halayhayin, Munting Ambling, Poblacion, and Tipunan in the Municipality of Magdalena, Laguna, in which 375 respondents participated in the study. **Results:** Through the implementation of interventions that included a seminar, handing out pamphlets, posting of posters in conspicuous places, and through social media, there is a significant increase in the perceived awareness of the residents. The contrast of pre- and post-test described that despite being somewhat aware, they became fully aware of the benefits and risks of ionizing radiation particularly in diagnostic imaging as expressed by Wilcoxon Signed Rank Test. **Conclusions**: The differences of the effectiveness of the approaches are determined by the formula of Kruskal-Wallis H wherein the seminar being at the top.

Keywords: awareness, community health education, ionizing radiation

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ETC007

Factors That Influence the Program Choice of Freshmen Students of the Bachelor of Science in Radiologic Technology: A Quantitative Study of Motivations

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Introduction: Upon choosing their courses, freshmen students rely on several motivations which can help select the appropriate program for each of them. Intrinsic factors include emotions, thoughts, achievements, psychological power, self-realization, and fields of interest. Extrinsic factors include social background, family, environment, education, and socio-economic phenomena of the individual contribute to the formation of internal motivations. **Methods**: The study was conducted with the objective to determine which of the extrinsic and intrinsic factors influenced the freshmen students of Bachelor of Science in Radiologic Technology (BSRT) upon choosing their program and to examine whether it varied among their demographic profile and Senior High School Program strand. A self-made survey questionnaire was utilized by the researchers to gather data from the respondents; the freshmen students enrolled in the BSRT program of Calayan Educational Foundation Inc. during the academic year 2023-2024. Necessary data were collected from a sample of 66 respondents from a population of 75 students upon conducting the survey. **Results:** According to the results of the study, intrinsic factors were the most significant motivating factor. Overall, the students were motivated by Job Opportunities, Personal Interests, Desire to Serve, and Cognitive Skills. On the other hand, Social Influences and Program Advertisements were not considered to be significant factors by the students. **Conclusions:** Furthermore, the program choice of the students is not significantly associated with their demographics**.**

Keywords: intrinsic factors, extrinsic factors, program choice

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ADD001

Knowledge And Awareness of Radiation Protection and Diagnostic Reference Level among Radiographers in Western Coast Region Sabah Hospital

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Introduction: Computed Tomography (CT) is a crucial diagnostic imaging modality which exposes patients to high amounts of ionising radiation. However, knowledge and awareness of radiation protection and diagnostic reference level (DRLs) among radiographers remain inconsistent. This study determines the knowledge and awareness of radiation protection and DRLs among CT radiographers in government hospitals at Western Coast Region of Sabah. **Methods:** This research used a cross-sectional study conducted in three hospitals which involved 71 radiographers who work with CT scan. The questionnaire consists of three sections which are demographic information, knowledge and practice of radiation protection and DRLs. The questionnaires were distributed through Google Forms and shared via online platforms. Total scores for each section were calculated and the results of knowledge and awareness were divided into three levels. **Results:** Findings indicate that 62.0% (n = 44) of radiographers demonstrated high knowledge on radiation protection and DRLs, while 19.7% (n = 14) had moderate knowledge, and 18.3% (n = 13) had poor knowledge. However, awareness levels towards the issue were significantly lower, with 50.7% (n = 36) demonstrating poor awareness, 36.6% (n = 26) moderate awareness, and only 12.7% (n = 9) high awareness. **Conclusions:** These findings show a high knowledge but poor awareness on radiation protection and DRLs among radiographers who involve in CT examination. Strengthening the need for structured training programs and continuous medical education could help to enhance and update radiographer's knowledge and indirectly help to improve awareness and practice when dealing in CT examination.

Keywords: Diagnostic Reference Levels (DRLs), computed tomography (CT), radiographers, knowledge and awareness levels, Western Coast Region of Sabah

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ADD002

Diagnostic Reference Level (DRL) of Cardiac Angiography: A Single Centre Study

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Introduction: Coronary arteriography is the gold standard for diagnosing coronary artery disease. This procedure involves the utilisation of continuous X-radiation exposure to provide visual aid for an accurate localisation of the coronary vasculature stenosis. As the X-ray imposed stochastic and non-stochastic effects, the dose delivered to the patient should be scrutinised. The Diagnostic Reference Level (DRL) is a regulatory guideline in radiation dose optimisation, where Malaysia has its reference for the Malaysian population. In angiography, kerma-area product (KAP) is the dosimetry quantity measured to indicate the total amount of radiation delivered to the patient. Therefore, this study was conducted to establish a local DRL for a teaching hospital in Selangor to ensure the dose delivered to patients is within the limit. **Methods:** A retrospective cross-sectional study was conducted to establish a local DRL (LDRL) for a teaching hospital in Selangor. 355 adult coronary angiography data were retrieved, dated from January to December 2024. The KAP value generated by the system was recorded. The reference level is set at the 75^{th} percentile value of the distribution, defining the value that should not be routinely exceeded in standard practice. **Results:** The study quantified an LDRL for adult coronary angiography of 2.88 $mGy.m^2$, which is lower than the national DRL of 5.44 $mGy.m^2$. **Conclusions:** The establishment of LDRL helped align the patient dose with the national guideline, upholding best practices and care of the patient.

Keywords: Air Kerma-Area Product (KAP), Diagnostic Reference Levels (DRLs), angiography, coronary arteriography.

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ADD003

Accuracy Of Ibreast-Exam (IbE) in Detection of Breast Lesion

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Introduction: The Malaysia Cancer Registry Report 2017-2021 presented that breast cancer remains the most common cancer affecting Malaysians, with the incidence rate of 39% in females. A greater incidence rate of breast cancer is observed at the age of 40 to 74, the prime age at which a citizen should seek clinical breast examination. The report highlighted that 51% were diagnosed at late stages, urging the need for fast and accurate detection of breast abnormalities as an initiative to reduce mortality. Mammography is the gold standard of breast lesion detection, yet it is inaccessible in rural areas. iBreast-Exam (iBE) is a radiation-free, portable breast tumour detection device used to scan the breasts and visualise the variations of tissue density. The innovation aims to provide a reliable clinical breast examination tool, replacing the conventional palpation method. Therefore, this study was conducted to determine the accuracy of iBE in differentiating normal and abnormal breast tissue. **Methods**: A retrospective cross-sectional study was conducted involving 80 Sabahan women aged 40 years and above who underwent both iBE scan and mammography. The McNemar test was used to measure the sensitivity and specificity while the Receiver Operating Characteristics (ROC) is analysed to measure the accuracy of the diagnostic tests. **Results:** Upon investigation, iBE accurately identified 70 breast abnormalities with a sensitivity of 89% and specificity of 50% with mammography as the reference standard. **Conclusions:** iBE is a reliable complementary test for clinical breast examination to initiate more comprehensive breast imaging investigations.

Keywords: iBreast-Exam, handheld breast scanner, clinical breast examination

ADD004

Comparative Evaluation of Computed Tomography Severity Score and Quantitative Computed Tomography in Covid-19 Pneumonia Assessment

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Introduction: At the end of 2019, Coronavirus disease 2019 (COVID-19), caused by the novel SARS-CoV-2 virus, emerged as a global health crisis, prompting the urgent need for effective tools to assess disease severity. High-resolution computed tomography (HRCT) has played a pivotal role in evaluating pulmonary involvement, traditionally interpreted using the radiologist-dependent Computed Tomography Severity Score (CTSS). However, CTSS is subjective and time-consuming. Quantitative computed tomography (QCT), utilizing automated software, offers a faster and potentially more objective alternative. **Methodology:** This retrospective study was conducted at a Covid-19 centre in Klang Valley, on patients with confirmed category 4 or 5 COVID-19 who underwent HRCT between June 4 and September 30, 2021. **Results:** The relationship between CTSS and QCT was evaluated using Spearman's correlation coefficient, revealing a strong positive correlation. Cohen's Kappa demonstrated substantial agreement, reinforcing QCT's reliability. Statistical analysis using SPSS version 27.0 further examined associations with comorbidities and demographic factors. Diabetes showed a significant association with increased lung severity, while hypertension and heart disease did not. These findings suggest that QCT not only correlates well with CTSS but also enhances efficiency by providing quicker, consistent assessments of lung involvement. **Conclusions:** In pandemic conditions where rapid triaging is essential, QCT proves to be a valuable tool in clinical decision-making. Thus, QCT may serve as a reliable and efficient alternative to CTSS in evaluating lung severity among COVID-19 patients.

Keywords: Covid-19, quantitative computed tomography, Computed Tomography Severity Score, high-resolution computed tomography.

ADD005

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Evaluating Magnetic Resonance Imaging Sequences for the Detection of Multiple Sclerosis Lesions

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Introduction: Multiple sclerosis (MS) is a chronic inflammatory demyelinating disease of the central nervous system (CNS), where early diagnosis is crucial for effective treatment. Magnetic resonance imaging (MRI) plays a key role in detecting inflammatory changes, and the use of advanced sequences such as Double Inversion Recovery (DIR), Short Tau Inversion Recovery (STIR), and Fluid-Attenuated Inversion Recovery (FLAIR) can enhance lesion detection, particularly in infratentorial and subcortical regions. **Methods:** This retrospective cross-sectional study evaluated the diagnostic performance of these sequences in 51 patients with relapsing-remitting MS (RRMS) at Ghazi Hariri Specialized Surgery Hospital, Iraq, between January and December 2019. Patients underwent MRI scans using axial DIR, STIR, and FLAIR sequences with 2 mm slice thickness. Signal intensities of MS lesions were measured and compared across sequences. Statistical analysis, including one-way ANOVA and Chi-square tests, were performed using SPSS version 20 to assess lesion load, sensitivity, specificity, and gender-based lesion prevalence. **Results:** Results revealed that DIR demonstrated significantly higher contrast ratios than both FLAIR and STIR ($p < 0.05$). DIR showed superior sensitivity and specificity in detecting infratentorial lesions (88% and 50%) and subcortical lesions (95% and 67%), respectively. Gender analysis indicated a higher prevalence of lesions in females, with DIR detecting the most pronounced differences. The findings underscore the diagnostic advantage of DIR over conventional sequences, particularly in regions often missed by standard protocols. **Conclusions:** In conclusion, the DIR sequence offers enhanced sensitivity for MS lesion detection and should be incorporated routinely in MRI protocols to improve diagnostic accuracy in MS, especially for infratentorial and subcortical plaques.

Keywords: multiple sclerosis, Double Inversion Recovery, magnetic resonance imaging, infratentorial and subcortical plaques.

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ADD006

The Impact of Screen Time Usage Towards Academic Performance Among Medical Imaging Students in Public University

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Introduction: Students at universities now live almost entirely with smartphones, which have been used for everything. The prevalence of smartphone ownership among college students sparked curiosity about how using a smartphone affected every aspect of their lives, especially in their academic performance. This study investigates the relationship between screen time usage and academic performance among Medical Imaging students. **Methods:** This research used a cross-sectional study involving 115 students at UiTM Puncak Alam. The screentime questionnaire and academic performance scale (APS) were distributed through Google Forms and shared via online platforms. The questionnaire consists of three parts: demographic data, screen time questionnaire and academic performance scale (APS). **Results:** The Pearson's correlation test was used, and the statistical significance level was set at $P < .05$. There was a weak, negative correlation between the screen time usage and academic performance, $r = –.05$, $n = 115$, $p = .57$. Therefore, there is no sufficient evidence to conclude that there is a true linear relationship between variables in the population. **Conclusions:** Most of the university students are prone to have higher screen time, either for study purposes or social purposes. A smartphone can be a useful tool for balancing study and leisure time, which reduces study time and, however as a result, lowers marks for some students. This study shows that screen time usage is not the pure factor affecting academic performance, but it could provide a baseline data to assist for any intervention for screen time usage and academic performance.

Keywords: academic, performance, screentime

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ADD007

Establishing Local Diagnostic Reference Level for Paediatric Fluoroscopic Examination in Micturating Cystourethrography

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Introduction: Micturating Cystourethrography (MCUG) is a common procedure performed in pediatrics. This procedure is associated with high radiation dose due to continuous screening to the patients. Therefore, dose optimisation is very important as their developing organs and tissues are more sensitive compared to an adult. However, Malaysia has not yet established the DRLs for MCUG procedure. **Methods:** In this retrospective study, a total of 93 samples data from patients' age of 5 years old and below were retrieved from March 2018 until March 2022 from a tertiary hospital in Kuala Lumpur. The group of patients were divided into two which are (< 1 year) old and between 1-5 years old. Dose value, Air Kerma-Area Product (KAP) was measured using a KAP meter build in fluoroscopy machine. Reference level is set at 75th percentile value and calculated for each group. An independent sample t-test was used, and the statistical significance level was set at $P < .05$. **Results:** The result is a statistically significant difference ($P = 0.012$) of KAP between the (< 1 year) old and the 1-5 years old. While, finding in fluoroscopic screening time shows there was no statistically significant difference ($P = 0.080$). The local diagnostic reference level (LDRL) for first age group (< 1 year) was 0.016 $mGy.\ m^2$ and shows 3 times lower than second age group (1 – 5 years), 0.040 $mGy.\ m^2$. **Conclusions:** This study found that LDRL helped in the optimisation of radiation dose and enabled best practices by giving feedback to the healthcare professionals.

Keywords: Air Kerma-Area Product (KAP), Diagnostic Reference Levels (DRLs), fluoroscopy, micturating cystourethrography (MCUG), pediatric

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ADD008

Evaluation Of Radiographers' Knowledge, Attitude and Practice (KAP) On The Radiation Protection During General Radiographic Procedures

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Introduction: Radiation protection is vital in radiologic practice to safeguard both patients and healthcare workers from the adverse effects of ionizing radiation. This study evaluated the knowledge, attitude, and practice (KAP) of radiation protection among radiographers in eight tertiary hospitals in Johor Bahru, Malaysia. **Methods:** A cross-sectional survey was conducted using a structured, self-administered questionnaire distributed to 78 radiographers. The questionnaire assessed socio-demographic data and respondents' KAP regarding radiation protection. **Results:** Results revealed that 97.4% of participants had high knowledge, 93.6% demonstrated a positive attitude, and 88.5% reported good practices related to radiation protection. However, knowledge gaps were noted in areas such as dose limits and unit measurements, and inconsistent use of protective equipment like lead gloves and goggles was observed. Significant associations were found between knowledge and religion ($p=0.041$), attitude and age ($p=0.046$), gender ($p=0.006$), education level ($p=0.022$), and training ($p=0.012$). Practice was significantly influenced by prior radiation hazard training ($p=0.014$). Correlation analysis showed a weak positive relationship between knowledge and attitude ($r=0.24$, $p=0.031$), as well as between attitude and practice ($r=0.25$, $p=0.029$), indicating that a more positive attitude correlates with better knowledge and safer practices. However, no significant correlation was found between knowledge and practice ($r=0.103$, $p=0.370$). **Conclusions:** In conclusion, while the overall KAP levels were satisfactory, targeted education and structured training are essential to address specific deficiencies. Incorporating radiation protection principles early in radiography curricula is recommended to reinforce safe practices and ensure long-term occupational safety.

Keywords: radiation protection, radiographers, radiation safety training

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ADD009

Involvement And Perspectives on Research Activities Trend Among Radiographers at Tertiary Hospitals in Johor

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Introduction: Research is essential in advancing evidence-based practice in radiography. This cross-sectional study aimed to assess the involvement and perspectives of radiographers toward research activities in tertiary hospitals in Johor, Malaysia. **Methods:** A total of 145 radiographers participated in the study, with data collected via a structured questionnaire and analysed using SPSS Version 20. Most respondents were female (71.7%) and Diploma holders (61.4%), with the majority having less than five years of work experience. **Results:** Findings revealed that although 91.7% of radiographers agreed research is necessary for advancing radiographic practice, only 2.76% reported involvement in research projects. Respondents generally expressed positive perceptions, with over 80% agreeing that radiographers should lead or initiate research. However, actual research engagement was minimal. Key barriers identified were a lack of research culture in the workplace (80.6%), insufficient time during work hours (80.1%), and inadequate funding or support from colleagues and management. Conversely, factors that could promote research participation included organizational recognition (mean rank = 3.28), access to funding and resources (3.08), and support from supervisors and colleagues (3.01). Despite positive attitudes, the low engagement in research suggests a disconnect between perception and practice. Strengthening research culture, allocating dedicated time, and offering structured support and recognition may enhance radiographers' research participation. **Conclusions:** These findings provide insight for policy-makers and healthcare leaders aiming to integrate research into clinical radiography and foster a culture of inquiry within diagnostic imaging departments.

Keywords: evidence-based practice, radiography research, research engagement, research barriers

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ADD010

Knowledge of Nosocomial Infection and Practice of Infection Control among Medical Imaging Students in Three Malaysian Public Universities During Their Clinical Practice

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Introduction: Nosocomial infections (NI) present a critical challenge in healthcare settings, particularly within radiology departments. This cross-sectional study aimed to assess the knowledge and infection control practices among 235 medical imaging students from three Malaysian public universities (UiTM, UniSZA, and UKM) during their clinical placements. **Methods:** Over the course of three months, from April to June 2023, data were gathered from 235 medical imaging students using a cross-sectional survey approach. A structured questionnaire with 45 items that were modified from validated instruments was used in the investigation. **Results:** The findings showed a high degree of infection control practice (mean = 3.87) and knowledge (mean = 3.79). Knowledge and practice showed a weak but statistically significant positive connection (r = 0.34, p 0.001). Knowledge gaps were identified in areas like hand hygiene without obvious contamination and the dangers of wearing jewelry or clothing outside of clinical settings, despite the generally good ratings. Lower adherence to procedures such as cleaning X-ray equipment and rubbing hands before providing patient treatment was also noted. According to the study, students' compliance with infection control procedures was also greatly influenced by peer pressure, clinical demonstrations, formal instruction, and staff observation. **Conclusions:** These results highlight how crucial it is to incorporate thorough infection control instruction within the curriculum for medical imaging. To strengthen proper practices and fill in current knowledge gaps, practical, simulation-based learning and ongoing professional development are advised. The results highlight the necessity of focused educational initiatives and practical instruction to enhance infection control practices for aspiring radiologists.

Keywords: nosocomial infection, infection control practice, medical imaging students, clinical practice

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ADD011

Local Diagnostic Reference Levels for Paediatric CT Brain

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Introduction: High radiation doses from Computed Tomography (CT) scans are the major concern for paediatric patients as they are more susceptible to radiation risk. Hence, diagnostic reference level (DRL) has been implemented to revise CT dose optimization. This study is aimed to determine local DRL of paediatric patients undergoing CT brain examination and compare the proposed DRL with the previously established reports. **Methods:** A total of 164 paediatric patients undergoing CT brain examination were retrospectively reviewed and categorized into five age groups: 0-2 years (Group 1), 3-5 years (Group 2), 6-12 years (Group 3), 13-16 years (Group 4), and 17-18 years (Group 5). CT dose index volume ($CTDI_{vol}$), dose length product (DLP) and effective dose (ED) were calculated for the third quartile to establish the local DRL. The DRLs were compared with the previously established DRL reports. **Results:** The results demonstrated DRL values ranged from 29.9 mGy - 59.4 mGy, 453.6 mGy.cm – 1051.3 mGy.cm, and 1.7 mSv – 3.9 mSv for $CTDI_{vol}$, DLP and ED. The doses were significantly varied among the age groups ($p < 0.001$). The present DRL was found to be higher than most of the other published DRLs in paediatric CT brains. **Conclusions:** The established DRL indicates dose variance in age groups among paediatric patients and higher than the established DRL reports in paediatric CT brain examination. The current CT brain protocol and practice should be reviewed to achieve dose optimization in paediatric CT.

Keywords: CT brain, diagnostic reference level, paediatric