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EDITORIAL

Modified Traditional Chinese Medicine Formula: Is It Still Effective?

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Traditional Chinese medicine (TCM) is a medical system recorded over 2,000 years ago and it is making a comeback in the 21st century. Basic theories of TCM are based on the Chinese philosophy of *Yin-Yang*, *Qi* and the Five Elements (Ma et al., 2021). In TCM, balance and harmony with the environment (nature) are keys to good health and imbalances will lead to illnesses (Cheung et al., 2020). One of the approaches used by TCM practitioners to treat illnesses is the use of natural medicine derived from plants and animals (Ma et al., 2021). In practice, a combination of two or more medicinal materials (known as TCM formulas), having synergistic effects, is often used to achieve optimal therapeutic efficacy, while attenuating toxicity (Zhang et al., 2017). However, some of the materials derived from animal and plant species, such as the rhinoceros (Rhinocerotidae), tiger (*Panthera tigris*) and caterpillar fungus (*Ophiocordyceps sinensis*), which are traditionally used, are now endangered (Cheung et al., 2020). Besides, the distribution of some plant species and substances derived from these species, including *Ephedra* spp. (Ma Huang), *Aconitum* spp. (Fu Zi and Chuan Wu) and *Aristolochia* spp. (Mu Tong and Fang Ji) are restricted or banned in some countries due to their toxicity (Fleischer et al., 2017). Therefore, a question arises as to whether the modification of TCM formulas to eliminate these ingredients could affect their therapeutic efficacy.

Several studies have shown that modified TCM formulas displayed very similar effects as the original formulations, suggesting that

replacement or removal of certain ingredients is possible without significantly affecting the overall efficacy. A study by Wang et al. (2017) found that the modified Yimusake formula to treat erectile dysfunction displayed similar mechanisms as the original formula, which contained three animal materials (glandular secretion of male musk deer, a faecal product of sperm whale and external genital organs of male cattle). Another study by Fang et al. (2013) also showed a positive outcome from replacing the rare herb, *Forsythia suspensa* in the formula of "the seventh of Sang Ju Yin plus/minus herbs (SSJY)" with the dried bulb of *Fritillaria thunbergia*. In addition, they also successfully simplified two formulas, "the fifth of Du Huo Ji Sheng Tang plus/minus herbs (FDHJST)" and "Fang Feng Tang" (FFT) to a new formula "Fang Feng Du Huo Tang" (FFDHT), which exhibited similar pharmacological effects as the original ones.

Many practitioners nowadays are replacing endangered ingredients with more sustainable alternatives in their formulas. But despite considerable progress, the emergence of new diseases continues to pose a challenge to TCM practitioners, especially in western countries, as they need to find alternatives for the endangered or banned ingredients. Occasionally, the endangered or banned ingredient is one of the main components in the formula. For instance, *E. sinica* is a major herb in TCM prescriptions for the treatment of coronavirus disease 2019 (COVID-19) (Luo et al., 2020) but it is banned in many countries, including Malaysia. To make modifications to the original formulas, thorough studies are essential to assess whether the modified formulas are safe for human consumption and just as effective as the original ones. Simply removing the affected ingredient and labelled as "modified" is not acceptable as this may mislead consumers.

In the 21st century, the modernization of TCM is necessary to unleash its full therapeutic potential through modern technology and modern thought, while preserving its ancient methods. It could also help to protect endangered plant and animal species as well as to ensure the safety of consumers. Since the prevalence of TCM use is increasing worldwide, more basic and clinical research is needed to support this medical system to achieve its ultimate aim of benefiting human health at present.

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REVIEW ARTICLE

A Narrative Review on Technology-enhanced Learning in Undergraduate Medical Education

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ABSTRACT

Technology-enhanced learning (TEL) in medical education is becoming increasingly popular because it reorganizes teaching and learning dynamics, incorporates various learning media for content delivery, and provides synchronous and non-synchronous interactions in group and individual learning. This article aimed to evaluate the usefulness of TEL models in undergraduate medical teaching. In our review of TEL in medical education, we posed three research questions to analyse its effectiveness in undergraduate medical education, which are: (a) What are the TEL modalities used in undergraduate medical education? (b) How does technology-enhanced blended learning impact students' engagement, knowledge gain, skills acquisition, and changes in perception and attitudes? (c) Is e-learning (Moodle) more effective than other technology-assisted online learning platforms in medical education? In the review, we have seen the evolution and development of TEL; its advantages and strength over traditional learning, especially in medical education, have been reiterated. As the various modalities undergo further research and develop more sophisticatedly, TEL learning would play a bigger role as mainstream later to replace the full traditional learning. Thus, educators, institutions and policymakers must be prepared and invested in the necessary financial, time and manpower resources to embrace the coming tide, to ensure successful incorporation.

INTRODUCTION

With the advancement of web-based technologies in education, an innovative type of learning has recently drawn the attention of educators' eye. Blended learning (BL) theory includes the incorporation of traditional classroom methods with technology-enhanced learning (TEL), which involves the use of information and communications technology (ICT) (Garrison & Kanuka, 2004). The use of TEL in medical education is becoming increasingly popular because it reorganizes teaching and learning dynamics, incorporates various learning media for content delivery, and provides synchronous and non-synchronous interactions in group and individual learning. As a result, it allows medical education to be developed, scheduled and conveyed through the integration of physical and virtual instruction. There are many potential benefits in TEL compared to traditional courses. Firstly, it provides more control over students' learning and helps in fostering students' innovative and critical thinking which leads to improved achievements and levels of satisfaction as well as yields a stronger sense of community among students (Al-Qahtani & Higgins, 2013). It can be in a one-on-one or small group instructional setting. Furthermore, the content of learning is selectively customized and suited to each individual so that learners only work on relevant subjects. As a result, TEL combines the best aspects of online and instructor-directed learning.

Many TEL models essentially switch forward and backward without enabling students to make substantial connections (Brooks et al., 2016). For TEL to encourage students' engagement and deeper learning, innovative technology and practices need to complement traditional classroom instruction and vice versa. TEL used in medical schools should not only be viewed as only a teaching strategy that allows greater flexibility and creativity but as one that is far more effective than traditional methods. Hence, this article is aimed to evaluate the different TEL models which are being used in medical teaching for undergraduate medical students. In our review of TEL in medical education, we posed three research questions to analyse its effectiveness in undergraduate medical education, which are: (a) What are the TEL modalities used in undergraduate medical education? (b) How does technology-enhanced blended learning impact students' engagement, knowledge gain, skills acquisition and changes in perception and attitudes? (c) Is e-learning (MOODLE) more effective than other technology-assisted online learning platforms in medical education?

RQ1: What are the TEL modalities used in undergraduate medical education?

Web-based medical education was first reported in 1992, using 30 years of computer-assisted instruction as its foundation (Hungary & Tempus Consortium for a New Public, 1992). Computer-assisted instruction is claimed to exceed traditional educational methods and text-based lectures for various reasons such as control over the flexibility of time and place of learning (Piemme & Blumenthal, 2016), enhancement of learning, reasoning, and efficiency (Clayden & Wilson, 1988; Henry, 1990). In the beginning, blended learning (BL), a rather vague term, was used to broadly describe a variety of technologies and pedagogical methods in varying combinations. With the publication of the first Handbook of BL, the term BL became more concrete. The author challenged the ambiguity of the term's definition and defined "BL systems" as learning systems that "combine face-to-face instruction with computer-mediated instruction" (Bonk et al., 2012; Osguthorpe & Graham, 2003). In medicine, BL is commonly practised as the mixture of e-learning with student-patient-tutor experience (Duque et al., 2006), successfully infusing two archetypal learning environments with expected better end-result in terms of students' learning and

fulfilment. Some of the different modalities that are commonly used in TEL include virtual models, simulations, multimedia and electronic devices.

Virtual model or virtual reality, as suggested by its name, allows user interaction, involving five senses, through a computer-generated real-time simulated environment (Burdea & Coiffet, 1994). From the perspective of medical and healthcare education, simulation is often utilized as a technique, device or activity to teach and enhance the knowledge and skills of students by replicating and imitating real-world experiences and characteristics. Simulation is used to hone a certain set of skills which amplifies its potential as an educational tool (Nagle et al., 2009). Online resources or online learning is another commonly used modality in BL. Online learning is the result of the continuous evolution of computer-assisted instruction (Haag et al., 1999). This modality can be delivered through a variety of multimedia and electronic mediums such as laptops and mobile phones. The Web is used as a platform to deliver teachings in different formats such as texts, graphics, audio, video, animations, email, discussion boards, and testing. Online learning sessions are usually "on-demand" or self-directed, though it is not uncommon to include web-based teleconferencing (audio graphics), synchronous chats or similar technology (Gray & Tobin, 2010). There are several technical advantages of online learning, namely universal accessibility, ease of updating content, and hyperlink functions that allow cross-referencing to other resources (Haag et al., 1999).

Multimedia and electronic devices are other modalities that act as delivery media in BL and technology-enhanced learning curricula. In today's age, handheld mobile devices are the universal norm. Therefore, it is not surprising to learn of the incredible potential that these devices possess and how they can be utilised in the education sector. The term M-Learning or Mobile Learning refers to the utilization of mobile technologies in teaching and learning (Gray & Tobin, 2010). We can infer the term "mobile technologies" in several ways, including some or all of the following gadgets: mobile phones, smartphones, such as either iOS or Android phones, personal digital assistants, netbooks, notebooks and laptops, tablet PCs, MP3 players, e-book readers such as Amazon's Kindle and Sony's e-book (Sharma & Barrett, 2010). With the advancement of the "mobile age", training and studying can be done at any time and any place. Interactive online exercises, such as quizzes, listening to podcasts or watching video podcasts are some examples of training that can be done through this technology. In some cases, the sharing of information is almost instantaneous. Certain technologies that are available in these electronic devices such as Bluetooth can be utilized by educators to transfer and share information with all students (Sharma & Barrett, 2010).

RQ2: How does technology-enhanced blended learning impact students' engagement, knowledge gain, skills acquisition and changes in perception and attitudes?

Technology-enhanced, student-centred learning environments are often conducted in the problem-solving form or an orienting goal that helps to mould interrelated learning themes into meaningful contexts. This method also enables individuals to explore their unique learning interests and needs and provides an interactive medium for them to study multiple levels of complexity and deepen their understanding. Technology is utilised to enable flexible methods that are used in establishing environments that enrich thinking and learning (Hannafin & Land, 1997).

A systematic review conducted by (Ohn et al., 2020) highlighted that TEL is better than traditional learning with regards to knowledge gain and skill acquisition, as well as providing

higher student satisfaction which represents blended learning in a positive and promising light in time. A comparative study (Bock et al., 2021) indicates that blended learning in teaching local anaesthesia improves the learning outcome for theoretical knowledge more than either face-to-face learning or e-learning alone. For acquiring practical skills, blended learning is as effective as other teaching methods.

A study based on survey questionnaires uncovered that students reported the utilization of a blended mode of education, including computer-assisted learning with the use of the internet, multimedia, online lecture notes and quizzes, alongside F2F lectures, group work and practical projects, was beneficial and promoted a better quality of education (Frehywot et al., 2013). It is inferred that BL using technology is an effective medium in the current era of time to foster medical knowledge and enhance practical competencies. Another finding by (Nartker et al., 2010) inferred that BL methods provided professional development that further encourages the retention of current health workers.

Similarly, another study also showed that the majority of students enrolled in a blended drug information and literature evaluation course agreed that the use of technology such as pre-recorded videos, saves time and allowed the space for more useful face-to-face interaction and equal educational value as traditional didactic learning (Suda et al., 2014). In addition, a study by Lapidus et al. (2012) demonstrated positive student feedback in favour of a blended course in comparison to the traditional approach in a drug literature evaluation course. Mirroring the principles of adult education, BL allows for better responsiveness and greater flexibility in the teaching and learning process (Lewin et al., 2009). The incorporation of online instruction further helps to overcome the limitations of time and space and eases teachings that involve complex instructions and have wider reach without increasing resource requirements thus making distance learning possible (Gray & Tobin, 2010). The integration of technology into pedagogy enables flexible, learner-centred teaching and leads to more positive communication between students and educators, thus facilitating better collaboration and relationships (Ellaway & Masters, 2008).

RQ3: Is e-learning (Moodle) more effective than other technology-assisted online learning platforms in medical education?

Online learning or e-learning is an educational format which is driven through computer networks (Kearsley, 1999). The advent of e-learning has opened the world to distance education, allowing global education access and allowing people from the most remote areas to have access to high-quality education materials (Smaldino et al., 2004). The technological weightage of e-learning is undeniable with its universal accessibility, and ease in linking multiple sources and syncing information thus creating an interconnected maze of information (Haag et al., 1999). E-learning addresses the rigidity faced by students in terms of time and place and allows much-needed flexibility by making knowledge available at all times and places (Hannafin, 1984). This allows students to have control of their learning process in accordance with the constructivist learning theory (Chumley-Jones et al., 2002).

Often, the major plus points for online learning are increasing the availability of study materials to those who cannot access it traditionally or to students who choose not to attend traditional lectures, managing the delivery of content in a more cost-efficient manner, and/or providing opportunities for students to train under-qualified instructors who are otherwise inaccessible. Advocates of online learning further argue that this web-based learning medium will be easier and more practical to embrace due to the vast advances in current technology's support in creating an

interactive channel where social networking, collaboration and reflection can be practised to elevate the learning experience to that of a normal classroom environment (Rudestam & Schoenholtz-Read, 2003).

Despite the promising advantages of online learning, it has its share of downfalls as well. Online learning has its limitations in engaging students unless they are self-motivated active learners (Daniels & Moore, 2000) and can organize their study plans well (Oh & Lim, 2005). Furthermore, students may feel isolated and lack a sense of belonging during online learning sessions, leading to an absent communal mentality and obsolete peer relationships. In contrast, BL is propelled towards overcoming these shortcomings of online learning and creating a cohesive and wholesome education plan using various instructional approaches to enhance the student's knowledge, experiences and satisfaction. Some of the reasons why BL is preferred over online learning include improved pedagogy, increased accessibility to knowledge and ease of revision of the contents, and better interactions between students as well as with their trainers due to the personal presence and cost-effectiveness (Osguthorpe & Graham, 2003).

A study by Lim et al. (2007) revealed that student groups that were taught using both the online and BL formats respectively did not show any significant differences in the mean scores for perceived and actual learning and retention, while all students, regardless of teaching format indicated a significant increase in perceived and actual learning before and after the course. It is further elaborated in the study that students in the online learning group reported more workload and less learning support in comparison to their BL peers. This finding further echoes the importance of students' psychological state in a blended and online learning environment in which students may feel like they lack a sense of belonging in the latter learning environment leading them to feel unsupported and burdened with a heavier workload compared to their counterparts in the BL environment. Students also feel that the BL format provides clear instruction due to the presence of a facilitator.

As one of the most widely free open-source e-learning platforms, Moodle enables the creation of a course website that ensures access only to enrolled students, utilizing various modes of knowledge dispersion, communication and student assessment processes (Costa et al., 2012). A modular object-oriented dynamic learning experiment (Moodle) was assessed in a physiology course at the University of Montenegro in 2016. Forty-nine students were recruited for the study. During practical classes, a great number of laboratory exercises were replaced by video clips and laboratory simulations, replacing 45.5% of the total practical classes. Students are still obligated to personally perform those physical examination skills. This learning model increased the interest of students, and attendance of face-to-face lectures and can improve communication among students and course instructors. It diversifies the means of student assessment and allows the instructor to give comments to the students on time and efficiently (Felder et al., 2013; Sun et al., 2008).

A study by Popovic et al. (2018) compared a group of students who attended the physiology course before, with a group of students who attended the physiology course after the Moodle platform was fully implemented as an educational tool. Formative and summative assessment scores were compared between these two groups. The impact of high vs. low Moodle use on the assessment scores was analysed. The satisfaction among Moodle users was assessed by the survey. The study found that attendance at face-to-face lectures had a positive impact on academic performance. The introduction of Moodle in the presented model of teaching increased the interest of students, attendance

of face-to-face lectures, as well as formative and summative scores. High frequency of Moodle use was not always associated with better academic performance, suggesting that the introduction of a new method of teaching was most likely equally accepted by low- and high-achieving students. Most of the students agreed that Moodle was easy to use and it complemented traditional teaching very well, but it could not completely replace traditional face-to-face lectures. The study supports continuing the use of web-based learning in a form of blended learning for physiology, as well as for other courses in medical education.

The findings were in accordance with other reports and might suggest that all students (low and high achievers) accepted the introduction of Moodle with a similar level of interest and motivation (Gazibara et al., 2015; Seluakumaran et al., 2011). It is possible that Moodle use only affects a subset of the student population in the university and the attractiveness of the module decreased with time (Antonoff et al., 2016).

CONCLUSION

In a nutshell, as we have seen the evolution and development of TEL, its advantages and strength over traditional learning, especially in medical education, have been reiterated time and again. As the various modalities undergo further research and develop more sophisticatedly, TEL learning would play a bigger role as mainstream later to replace the full traditional learning. Thus, educators, institutions and policymakers must be prepared, and invest in the necessary financial, time and manpower resources to embrace the coming tide, to ensure successful incorporation. Researchers have an important role to play as well, as more studies should be done to compare and evaluate the strength and weaknesses of the various modalities, thus enabling adaptation and utilization of the individual modalities for maximal benefit in different settings and requirements.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article.

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REVIEW ARTICLE

Gustatory Dysfunction in COVID-19: Solitary or Secondary?

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ABSTRACT

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) causing Coronavirus Disease 2019 (COVID-19) commonly presented with neurological and respiratory disorders. Among the neurological symptoms, headache, myalgia, dizziness, impaired consciousness, cerebrovascular accident (CVA), olfactory dysfunction (OD), and gustatory dysfunction (GD) are typical. GD and OD have been included as new symptoms of COVID-19 infection by the World Health Organization (WHO). Taste disorders varied from dysgeusia to ageusia. Similarly, OD or smell disorder severity went from microsomia or hyposmia to anosmia. The merit of these neurological disorders is an early screening criterion for a COVID-19 patient, especially where the diagnostic resources are limited. Most of the published articles demonstrate these two dysfunctions together. Our concise review aimed to determine whether GD in COVID-19 is a solitary (independent) symptom or a secondary (associated) symptom of OD. Besides, we were looking at the possible transmission pathways of SARS-CoV-2, if it can be an early diagnostic symptom, a predictor of severity, and a prognostic factor for impaired outcome. We have limited our study to publishing articles in English only. Therefore, further evaluation might be recommended to include studies published in other languages.

INTRODUCTION

The current global long-term health crisis is Corona Virus Disease 2019 (COVID-19), caused by a novel virus, Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2). It claimed to become a pandemic after being started in Wuhan, China, in the middle of December 2019. On 11 March 2020, the World Health Organization (WHO) declared the infection a pandemic (Cucinotta et al., 2020). Until November 2021, the deadly virus killed over five million lives worldwide and infected around 260 million people. Early diagnosis is another challenge in COVID-19. The expensive diagnostic kits are also not affordable in many countries. Moreover, the virus changes its character with time, and some new strains have been found in a few countries. In this circumstance, to save lives, besides vaccination and treatment, it is essential to prevent infection through early diagnosis, isolation, and maintaining health hygiene by following the standard operating procedure (SOP) strictly in every sector. Preventive measures will benefit countries that cannot do adequate vaccination for their citizens. Early screening based on the clinical presentation of COVID-19 could be the most cost-effective preventative measure.

Initially, fever, unproductive cough, myalgia, and tiredness are considered early symptoms. The severe symptoms are shortness of breath or breathing difficulty. COVID-19 is commonly presented with respiratory and neurological symptoms. Among the neurological symptoms, headache, myalgia, dizziness, impaired consciousness, and cerebrovascular accident (CVA) have been recorded. Olfactory dysfunction (OD) and gustatory dysfunction (GD) are quite established presentations claimed by many articles and have been included as the new most common symptom of COVID-19 infection by the World Health Organization by June 2021 (WHO Health Topics, 2021). The GD in the quality of life of COVID-19 patients imposed a significant impact reported in clinical practice (Bigiani et al., 2020). It will be helpful if these two symptoms can be scientifically established as early symptoms of COVID-19. Screening of patients will be faster and easier.

Furthermore, it will help ease the isolation of the patient, save expenses, and reduce the rapid spread of this deadly disease. It will be conducive for countries with poor infrastructure of health facilities. It could even be a self-assessment tool for an individual to rush for early expert help. Most of the published articles described both symptoms together. Our primary aim in this short review was to find if the GD in COVID-19 is a solitary (independent) symptom or a secondary (associated) symptom due to OD. In addition, we looked at the possible transmission pathways of SARS-CoV-2 in GD and OD; and whether it can be an early diagnostic symptom, a predictor of disease severity, and an indicator of prognosis for the impaired outcome.

Pathophysiology

The exact mechanism of entry of SARS-CoV-2 into the central nervous system (CNS) is not yet evident. Neurological symptoms are common in COVID-19 patients', but no evidence is found regarding the direct invasion of intracranial inflammation by SARS-CoV-2 (Kabir et al., 2021). Possible explanations are hematogenous spread from systemic circulation (Baig et al., 2020) and trans-synaptic transfer through the cribriform plate and olfactory bulb (Netland et al., 2008). The evidence of spreading to the brain was found in the previous study on SARS-CoV and Middle East Respiratory Syndrome Corona Virus (MERS-CoV), the neurotransmitter pathways, specifically through the serotonergic dorsal raphe system. The study also suggested spreading a virus through the Virchow-Robin spaces (Li et al., 2016). However, research is required if the same theory applies to the spread of SARS-CoV-2. In an observational study, Mao et al. (2020) demonstrated that 36.4 % of COVID-19 patients presented with neurological symptoms. Xiao-Wei et al.

(2020) claimed in their study that 8.9 % of COVID-19 patients presented with symptoms of peripheral nervous system disorder, among which hypogeusia and hyposmia were remarkable with hypoplasia and neuralgia. The SARS-CoV-2 has an affinity for CNS targets (Montalvan et al., 2020). In the nucleus of the ventrolateral medulla and tractus solitarius, a high virus expression was observed (Doobay et al., 2007; Palace et al., 2018). The virus is known to present a particular affinity to nerve tissue, neurotropism, which may contribute to OD and GD (Lechien et al., 2020). The area near the olfactory bulbs in the brain, known as the frontobasal region, is considered the overlapping area between taste and the olfactory system. The vascular pericytes contain angiotensin-converting enzyme 2 (ACE2) receptors. The SARS-CoV-2 has a high binding affinity to this ACE2. Any damage to this brain area by SARS-CoV-2 infection can alter gustatory and olfactory function (Lechien et al., 2020; Walls et al., 2020). Delayed or lack of recovery from GD and OD in many COVID-19 patients also supports the neurological damage due to severe inflammation by SARS-CoV-2. The taste renin-angiotensin system (RAS) can be involved in the GD of COVID-19 patients (Bigiani et al., 2020). An experimental study showing the expression of ACE2 in the taste organs of mice suggested that it may influence the development of GD in COVID-19 patients (Lechien et al., 2020). A previous animal study on rhesus monkeys showed that the early target of SARS coronavirus is the epithelial cells lining salivary gland ducts (Liu, 2020). As both SARS-CoV and SARS-CoV-2 have phylogenetic similarity, alteration of taste function is possible in the COVID-19 patient. ACE2 has been identified as the cellular receptor for SARS-CoV-2 (Zhou et al., 2020). Diffuse expression of the ACE2 receptor was found on the mucous membrane of the tongue and the whole oral cavity (Xu et al., 2020). So, based on this hypothesis, viral infection can disrupt the composition of saliva, the usual transduction of taste, or the continuous normal taste bud renewal process (Wang et al., 2009). Volume and composition alteration of saliva can also disrupt taste sensation (Matsuo, 2020). Numerous studies highlighted the action of ACE2 in regulating taste perception after analysing the chemo-sensitive side effects of angiotensin II blockers and ACE2 inhibitors. The mechanism of action is not yet precise regarding ACE2 inhibitors causing taste dysfunction, but it is not related to the zinc level in serum or saliva (Suliburska, 2012; Tsuruoka et al., 2005). SARS-CoV-2 occupies the binding sites of sialic acid on the taste buds and could accelerate the degradation of the gustatory particles. It may have the ability to bind with sialic acid receptors (Milanetti et al., 2021), which was observed in the MERS-CoV Previously (Park et al., 2019). The fundamental component of salivary mucin is sialic acid. It prevents the premature enzymatic degradation of the glycoproteins inside the taste pores (Witt et al., 1992). Reducing salivary sialic acid increases the gustatory threshold (Pushpass et al., 2019). It is also possible that OD can influence GD. OD can block the perception of the flavour of food due to the intimate relationship between these two chemosensory systems. A chemosensory network called a flavour network is formed by the orbitofrontal cortex, frontal operculum, anterior insula, and anterior cingulate cortex in the chemosensory regions of the brain. The interaction of this network with other heteromodal regions, including the ventrolateral prefrontal and posterior parietal cortex, is responsible for flavour perception (Small et al., 2005). Independent GD cases were reported in 10.2-22.5% of patients (Giacomelli et al., 2020; Lechien et al., 2020; Yan et al., 2020).

DISCUSSION

The GD alters the perception of the taste: sweet, sour, bitter, and salty. In a COVID-19 patient, alteration of the gustatory function could be related to the spread of SARS CoV-2 into the nerve ending of taste buds. Most of the time, the GD is self-reported. Only 5% of pure taste disorders were evaluated in specialized smell

and taste consultation (Bigiani et al., 2020). The prevalence of self-reported taste dysfunction could reach 56.4% of patients (Lechien et al., 2020). COVID-19 patients presented with GD, OD, and other neurological disorders even though the respiratory symptoms were most common (Mao et al., 2020; Wang et al., 2020). COVID-19-related GD is mainly self-reported, which could be unreliable and often confused with loss of perception of aroma due to olfactory dysfunction (Soter et al., 2008). A few recent studies investigated taste function assessment using electrophysiological or psychophysical tools. Even unreliable, based on self-reporting cases hypothetically, it can be assumed that half of the COVID-19 patients should have intact GD (Lechien et al., 2020). The outcome of current studies on self-reported GD in COVID-19 patients suggested the need for future studies to be conducted using electrophysiological or psychophysical taste evaluation. At least evaluation using taste strips or electrogustometry will be reliable (Bigiani, 2020; Pavlidis et al., 2014; Soter, 2008; Vaira et al., 2020).

A systematic review and meta-analysis were conducted, and 24 studies involving 8,438 confirmed diagnostic patients infected with SARS-CoV-2 from 13 countries. Agyeman et al. (2020) described the pooled prevalence of OD and GD were 41.0% and 38.2%, respectively. Of the 24 studies, only five (21%) used objective assessments, and 19 (79%) were self-reported cases. In addition, the author reported the prevalence of GD in 5,649 patients involved in 15 studies, of which only two (13%) used objective assessments and the remaining 13 (87%) based on self-reports. The reported prevalence of GD ranged from 5.6% to 62.7%, and the pooled prevalence was 38.2%.

Lechien et al. (2020), in a multicentre European study involving 417 diagnosed SARS CoV 2 infected patients with mild to moderate symptoms, reported OD and GD in 85.6% and 88.8% of patients, respectively. OD of different severity levels was reported in 357 patients (85.6%), among which anosmia was reported in 284 (79.6%) and hyposmia in 73 (20.4%) patients. The relationship between the appearance of OD with general nasal symptoms was 11.8%, 65.4%, and 22.8% before, after, and simultaneous, respectively. GD was reported by a total number of 342 (88.8%) patients. Among them, 78.9% had reduced taste function, and 21.1% had a distorted ability to taste flavours. Thirty-two patients were confused if they had GD. Twenty out of 43 patients reported OD who did not have GD. The remaining 19 have neither GD nor OD. 53.9% and 22.5% of cured patients reported having residual isolated OD and GD, respectively. Both OD and GD persisted among 23.6% of them. The association between these two disorders was significant ($p<0.001$).

Twenty-four studies from 13 countries with data from 8,438 confirmed COVID-19 patients were included in a study by Agyeman et al., 2020. In their systematic review and meta-analysis, 41.0% of patients presented with OD and 38.2% with GD. Carrillo-Larco et al. (2020) in a systematic review included six studies (n = 2,757) from the UK (n = 1,702), China (n = 214), US (n = 262), Iran (n = 120), Israel (n = 42); in which only two studies reported the association between OD and GD in COVID-19 patients; the review also included data from four European countries (n = 417), chosen from 31 related reports. In their analysis, the range of anosmia was found to be between 22 – 68%. The GD was described as a variable between dysgeusia (33%), ageusia (20%), and taste distortion (21%). There were six-fold and ten-fold higher odds of being COVID-19 positive among the patients who reported OD and GD, respectively.

In a meta-analysis by Hajikhani et al. (2020), 3,739 COVID-19 patients from 15 studies were included. Among them, 1,729 reported GD and 1,354 with OD. The estimated prevalence rates of GD and OD were 49% and 61%, respectively. Dysgeusia and hypogeusia were more common than ageusia, and

similarly, hyposmia was more common than anosmia. Ibekwe et al. (2020) included 32 studies in their systematic review and meta-analysis, among which 27 studies containing data from 20,451 confirmed COVID-19 patients were analyzed, and the prevalence of OD, GD, or both was reported. Twenty-seven studies reported OD in 19,424 (48.47%) patients, 20 studies reported GD in 8,001 (41.47%) patients, and 13 studies reported both symptoms in 5,977 (35.04%) patients.

CONCLUSION

Most studies we reviewed hypothetically supported GD as an independent symptom of SARS-CoV-2 infection. We also noticed that most of the cases of GD in COVID-19 patients are self-reported. Therefore, further studies on taste function assessment using electrophysiological or psychophysical tools are required. Our concise review concludes that GD could indicate a disease-associated symptom. Neither the symptom nor the recovery period has been proven to be the indicator of the severity of the disease. SARS-CoV-2 does not cause permanent damage to gustatory function. Post-mortem forensic pathological analysis is crucial in patients who died of COVID-19 to understand GD's exact nature and location.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article.

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ORIGINAL ARTICLE

Comparing the Ease of Intubation between C-MAC, McGrath, and Conventional Macintosh Laryngoscope in a Simulated Difficult Airway of a Laerdal Mannequin

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ABSTRACT

Tracheal intubation is an essential skill for doctors. Tracheal intubation is done in patients with questionable airway patency, poor respiratory drive, hypercarbia, or hypoxia. The objective of this study was to compare the ease of tracheal intubation using Macintosh Laryngoscopes, C-MAC, and McGrath on a simulated difficult airway mannequin. The rationale of the study was to identify the easiest device to use for tracheal intubation. This randomized clinical trial was done at the Teluk Intan Hospital, Perak, Malaysia, from March 2020 to February 2021. Sixty-five medical officers participated in this study. The results showed that the mean time for tracheal intubation was significantly shorter when the participants were using the C-MAC than the conventional direct laryngoscope and McGrath. (C-MAC: 20.8 seconds, Direct Laryngoscope: 27.7 seconds, McGrath: 34.6 seconds) The results showed that C-MAC and McGrath had a better first-attempt success rate than conventional direct laryngoscopes. C-MAC scored the highest first-attempt success rate, followed by McGrath. (95% compared to 83%) Regarding Cormack-Lehane grading, the C-MAC device showed a better view than McGrath and Direct Laryngoscope. The preferred device by medical officers for tracheal intubation was the C-MAC. (45% compared to other devices) In conclusion, the C-MAC device was superior in first attempt success rate and was the most preferred device compared to

McGrath and direct laryngoscope. However, using the C-MAC device must be accompanied by adequate training and practice.

INTRODUCTION

Tracheal intubation is a vital skill to have as a doctor. Endotracheal intubation involves placing a breathing tube into the lungs. The objective of this is to secure the patient's airway. Tracheal intubation is done in patients with questionable airway patency, poor respiratory drive, hypercarbia, or hypoxia (Alvarado & Panakos, 2020). However, failure of tracheal intubation may lead to an increase in morbidity and mortality (Mort, 2004). Therefore, human resources, devices used, and patients' latest conditions must be optimized to improve the success rate of tracheal intubation (Frerk et al., 2015).

Direct laryngoscopy is a vital component of airway management. The efficacy of a direct laryngoscope relies on the ability of the operator to obtain direct vision between the laryngeal inlet and the eye (McCluskey & Stephens, 2020). It has a high success rate, and hundreds of laryngoscope blades have been developed (Cheyne & Doyle, 2010). However, endotracheal intubation with a direct laryngoscope is not risk-free. The complications of endotracheal intubation with a direct laryngoscope range from minor soft tissue injuries, to lacerations and arytenoid dislocation (Finucane et al., 2010). In recent years, the use of video laryngoscopes has revolutionized airway management. When difficult intubation is anticipated, many doctors use video laryngoscopes as their primary strategy (McCluskey & Stephens, 2020). One advantage of video laryngoscopy is improved laryngeal visualization without aligning three airway axes and easy identification of airway structures (Maldini et al., 2016). Therefore, a video laryngoscope has also been adopted to manage difficult airways (Apfelbaum et al., 2013).

The standard video laryngoscopes currently in use are the C-MAC (Karl Storz, Germany) and McGrath (Aircraft Medical Ltd, UK). The C-MAC was developed in 1999. A colour video camera is attached to a laryngoscope handle with a typical Macintosh blade. The video system is usually installed on a small cart to ease mobility (Aziz & Brambrink, 2011). Studies have shown that the C-MAC can produce a faster intubation time and reduced intubation attempts when this device is used in patients with Mallampati grade three or four (Ng et al., 2012). The McGrath was released in 2012. It is also attached to a Macintosh blade, and the video display is mounted on top of the handle (Arai et al., 2014). Studies have shown that McGrath increased the intubation success rate (Shippey et al., 2007; Shippey et al., 2008).

Each video laryngoscope device has its strengths and weaknesses. The objective of this study was to compare the ease of tracheal intubation among medical officers using Macintosh Laryngoscopes, C-MAC, and McGrath on a simulated difficult airway mannequin. No similar published studies compare these three intubation techniques in a simulated difficult intubation mannequin.

MATERIALS AND METHODS

This study was a randomized cross-over study. Randomization was done using computer software. The study was conducted between March 2020 till February 2021. It was approved by the Ethics Committee (NMRR-19-104-46225). Sixty-five medical officers working in Teluk Intan Hospital, Perak, Malaysia, were randomly recruited for this study.

The C-MAC, Macintosh laryngoscope, and McGrath (Figure 1) used a blade size 3. A 7.5 mm cuffed endotracheal tube was used for tracheal intubation with the help of a plastic stylet. A Laerdal mannequin was used in this study.

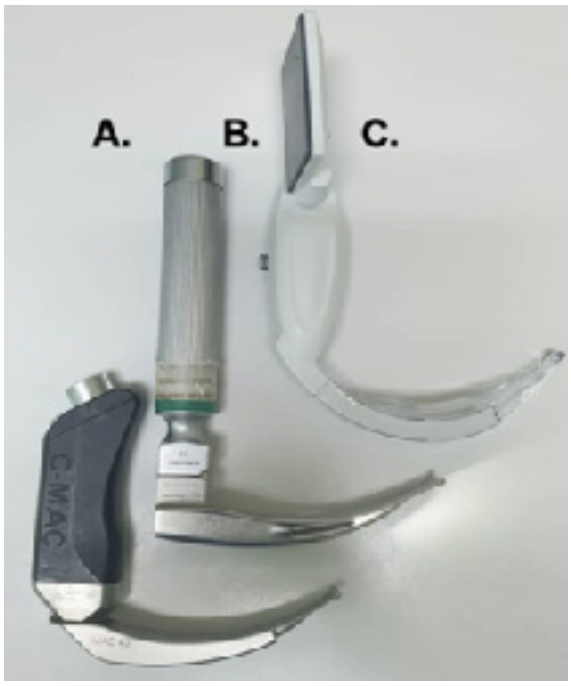

Figure 1 The three intubating devices used in the study; (A) C-MAC, (B) Macintosh laryngoscope, and (C) McGrath

All participants were given a briefing on the steps of tracheal intubation for all devices for 15 minutes. After the briefing session, the medical officers were allowed to try each device for five minutes to familiarize themselves with the devices on standard airway mannequins. The study began when the participants performed tracheal intubation on a simulated difficult airway. A difficult airway on a mannequin was simulated using the application of a cervical collar and forehead strapping on the mannequin. This will obliterate neck movement, including small movements that usually facilitate intubation (Durga et al., 2014). Several studies have shown that tracheal intubation will be difficult in the presence of a cervical collar (Wakeling & Nightingale, 2000; Komatsu et al., 2004; Aoi et al., 2011). All the participants were allowed a maximum of three attempts with each device. They were randomized to receive the first device and subsequently received the second and third devices. Based on the Cormack-Lehane, the participants were asked to grade the laryngeal view during their intubation attempts.

Data collected was the number of attempts for successful tracheal intubation, intubation time, Commack Lehane grading during intubation, and the preferred device used for tracheal intubation. The intubation time was defined as the time from the blade insertion into the oral cavity until the placement of the endotracheal tube into the trachea. Failed intubation was defined as a failure to achieve successful intubation after three attempts (Walls, 2012).

Data were analyzed using the SPSS (Statistical Package for the Social Sciences) software version 24. The one-way-ANOVA test was used to analyze the data.

RESULTS

Sixty-five medical officers were enrolled in this study. All participants performed tracheal intubation using a direct laryngoscope, the C-MAC, and the McGrath video laryngoscope. The results showed that the mean time for intubation was shorter when the participants were using the C-MAC than the conventional direct laryngoscope and McGrath (Table 1). The results are statistically significant ($p<0.05$).

Table 1 Time taken for intubation using Direct Laryngoscope, C-MAC, and McGrath devices

Device	Min (Seconds)	Max (Seconds)	Mean (SD)	95% Confidence Interval (Lower; Upper)	p-value
Direct Laryngoscope	6.04	90.08	27.68 (17.14)	22.59; 32.77	p = 0.03*
C-MAC	3.3	49.2	20.80 (10.57)	18.12; 23.49	
McGrath	3.6	107.5	34.58 (31.38)	25.76; 40.45	

* Significant when $p<0.05$

Our study also showed that three participants had failed intubation while using the direct laryngoscope. The McGrath group had two failed intubation incidences, but during the use of the C-MAC device, there was no failed intubation (Table 2).

Table 2 Successful intubation attempts, Cormack-Lehane grading and preferred device for tracheal intubation

	Direct Laryngoscope (%)	C-MAC (%)	McGrath (%)	X^2, p-value
Successful intubation				
1st attempt	46 (71)	62 (95)	54 (83)	$X^2(6) = 15.27$,
2nd attempt	12 (18)	1 (2)	7 (11)	$p = 0.02^*$
3rd attempt	4 (6)	2 (3)	2 (3)	
Failed intubation	3 (5)	0	2 (3)	
Cormack-Lehane grading				
I	11 (17)	40 (62)	32 (49)	$X^2(6) = 32.05$,
II	39 (60)	23 (35)	26 (40)	$p = 0.00^{**}$
III	9 (14)	2 (3)	5 (8)	
IV	6 (9)	0	2 (3)	
Preference as				
1st choice	8 (12.3)	45 (69)	12 (18)	$X^2(5) = 59.75$,
2nd choice	23 (35.3)	16 (25)	26 (40)	$p = 0.00^{**}$
3rd choice	34 (52.3)	4 (6)	27 (42)	

** significant when $p<0.01$

* significant when $p<0.05$

The result shows that both video laryngoscopes had a better first-attempt success rate than direct laryngoscopes. C-MAC scored the highest first-attempt success rate, followed by McGrath. Regarding Cormack-Lehane grading, the C-MAC device showed a better view than the McGrath device and Direct Laryngoscope. This was statistically significant ($p<0.05$).

The study ended by asking the participants which device they preferred, and most chose C-MAC as their first choice. This was statistically significant ($p<0.05$).

DISCUSSION

Our study showed that in a simulated difficult airway, the intubation time of doctors using C-MAC was shorter than the McGrath and direct laryngoscope devices. Our results echoed a previous study in Australia (Ng et al., 2012), showing the C-MAC had a reduced number of tracheal intubation attempts, quicker intubation time, and greater ease of tracheal intubation compared to the McGrath device and direct laryngoscope.

There have been different findings on the effectiveness of video laryngoscopes. Several studies comparing direct laryngoscope and video laryngoscope in patients with a normal airway revealed that video laryngoscopy can provide a better laryngeal view (Van Zundert et al., 2009; Kaplan et al., 2006; Shimada et al., 2012). In patients with a difficult airway, video laryngoscopes provided shorter intubation time, improved laryngeal view, more successful intubations during the first attempt, and reduced the need for adjuncts (Jungbauer et al., 2009; Aziz et al., 2012). During failed tracheal intubation attempts using the direct laryngoscope, the C-MAC proved to have an improved laryngeal view. This, in turn, made

it possible to achieve a 86% success rate of tracheal intubation during the first attempt of intubation and a 100% successful tracheal intubation (Kilicaslan et al., 2014). There was also a significant reduction in failed intubation during emergencies when a C-MAC was used compared to a direct laryngoscope (Goksu et al., 2016; Sakles et al., 2015; Sakles et al., 2012).

In a study comparing McGrath and C-MAC devices, the C-MAC provided fewer intubation attempts, quicker intubation time, and easier use of intubation in patients with difficult airways compared to the McGrath device (Ng et al., 2012). In addition, compared to flexible fiberoptic scope intubation, the C-MAC used in cervical spine immobilization showed a significant decrease in time to obtain a better laryngeal view to produce successful intubation (Yumul et al., 2016).

The C-MAC is also an excellent tool for teaching tracheal intubation. The C-MAC device can shorten the learning curve, improve the success rate and decrease the rate of failed intubation during teaching (Howard et al., 2008; Herbstreit et al., 2011). The C-MAC also showed that medical officers received it well during tracheal intubation training (Boedeker et al., 2011).

A good view of the airway and vocal cords during tracheal intubation directly affects the safety and morbidity of patients (Cook et al., 2011). The Cormack-Lehane classification is a standard grading used to describe the laryngeal view during tracheal intubation (Cormack et al., 1984). It is the gold standard for airway classification in routine clinical practice (Benumof, 1996; Rosenblattet et al., 2006). In patients with difficult airways, the C-MAC device can achieve a better Cormack-Lehane grading than a direct laryngoscope, producing a higher tracheal intubation success rate and shorter intubation time (Aziz et al., 2012; Jungbauer et al., 2009; Gaszyński, 2014). For emergency airways, the C-MAC device performs better with a Cormack-Lehane grade three or four (Hossfeld et al., 2015; Jones et al., 2013; Sakles et al., 2016; Vassiliadis et al., 2015). Therefore, the C-MAC can be recommended for difficult airway management (Xue et al., 2017). However, it must be noted that no one device is perfect. For example, the C-MAC has proven to provide a better intubation success rate, but it does not give a 100% success rate for tracheal intubation (Akbar & Ooi, 2015; Cavus et al., 2011).

Our study had limitations. The study was performed on mannequins and should not be directly applied to clinical situations. We did this as there was an ethical concern regarding choosing medical officers to perform difficult intubation on actual patients. Besides that, the medical officers were also not blinded to which laryngoscope devices they used. It should also be noted that not all hospitals have video-laryngoscopes and mainly use direct laryngoscopes for their routine tracheal intubation.

CONCLUSION

Video laryngoscopy is a better alternative to direct laryngoscopy. The C-MAC and McGrath showed a decrease in intubation time compared to the conventional Macintosh blade in a difficult airway scenario. In addition, the C-MAC was superior in first attempt success rate and was the most preferred device compared to McGrath and direct laryngoscope. This makes the C-MAC a better device to be used for tracheal intubation. To optimize the use of the C-MAC device, medical officers must be adequately trained and allowed ample practice. Despite this conclusion, doctors should master several different airway devices and techniques and have a contingency plan for failure. This will enhance patient care and safety.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article.

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ORIGINAL ARTICLE

Foreign Body Ingestion among Children of Northern Sarawak: A Retrospective Single Centre Experience

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ABSTRACT

Foreign body ingestion (FBI) is a common problem among children around the world. The management modality may differ according to the materials and clinical presentation. This study aims to assess the clinical, endoscopic, and therapeutic aspects of this FBI among children in a district hospital in northern Sarawak. A single-centre retrospective study was conducted for FBI in children of northern Sarawak from January 2018 until April 2020. A total number of 36 children were admitted during the 28 months duration with a 19:17 ratio of male:female. The children were between the age of 8 months and 10 years old with a median age of 4 ± 0.3 yrs. Coins (52%), fish bones (11%), and batteries (5%) were the most commonly ingested objects. The clinical features included asymptomatic presentation (47%), vomiting (36%), throat pain (8%), and choking sensation (8%). Routine radiological examination ensured the discovery of the FBI in 88% of the cases. Among the 36 children admitted, 19 (52%) children were managed conservatively while 17 (47%) children required endoscopic removal of foreign bodies without operative management. The length of stay in the hospital ranges from 1 day to 9 days (mean 2.52 days). FBI in children is more common at a younger age. Clinical findings depend on the shape of the ingested materials, the patient's age, and the time of referral as they mostly could be managed

conservatively. Upon failure of a conservative approach, a safe and uncomplicated removal should be performed.

INTRODUCTION

Foreign body ingestion (FBI) is a common problem worldwide, most commonly occurring in children after the age of 6 months to preschool age. Various types of foreign bodies can be ingested, which can be divided into sharp-pointed and non-sharp-pointed objects. The most common foreign body ingested is a coin. It has been reported that foreign bodies are usually passed uneventfully in 80 – 90% of patients while 10 – 20% of patients may require endoscopic management for the removal of foreign bodies and 1% of patients may require operative extraction (Diaconescu et al., 2016).

FBI is a common problem around the world, especially among children who presented to the emergency unit (Oobudi et al., 2019; Dipasquale et al., 2022). It commonly occurs in preschool-aged children (mean age 4 years 3 months in our study) which is likely due to the habits of the children who like to explore the environment and insert objects into their mouths. Some of these are inevitably swallowed, especially in infants and toddlers (Khurshid et al., 2019). In this study, we evaluate the clinical, endoscopic, and therapeutic aspects of FBI among children in a district hospital in northern Sarawak.

MATERIAL AND METHODS

A retrospective study was conducted in Miri Hospital, a district hospital with specialist services from January 2018 until April 2020. This study was registered under the National Medical Research Register with an ID number of NMRR-20-2708-54385. All children with documented cases of FBI were included in this study. Patients without complete data in records were excluded from the study. Children's demographics including age, sex, race, ethnicity, type of foreign body, clinical presentation, number of radiological imaging, and length of stay in the ward were collected. Additionally, specific management and outcome of each patient were also reviewed. Data were collected using patients' medical records from Hospital Miri and were tabulated in Microsoft Excel.

RESULTS

A total number of 36 children were encountered in Miri Hospital from January 2018 until April 2020 for FBI. The children aged between 8 months and 10 years old with a median age of 4 ± 0.3 years old were included in the study. Of these 36 children, 19 were boys (52%). Most of the children were of native origin (21, 58%) followed by nine Malays (25%) and six Chinese (16%).

Children with FBI were immediately brought to medical attention after being witnessed by caretakers or with a strong suspicion (75%) or after developing symptoms (25%). The clinical presentations include vomiting (36%), foreign body sensation (8%), and drooling or food refusal (8.3%) (Table 1).

Table 1 Clinical presentation of the children (n = 36)

Clinical presentations	Number of patients	Percentage (%)
Asymptomatic	17	47.2
Vomiting	13	36.1
Foreign body sensation	3	8.3
Drooling and food refusal	3	8.3

A total of 17 children were completely asymptomatic (47%). The length of stay in the hospital ranged from one day to nine days (mean 2 days). Coins (52%) were the most commonly ingested foreign body followed by fishbone (11%), batteries (5%), earrings (5%), plastic toys (5%), thread (2%), beads (2%), building blocks (2.78%), safety pin (2%), ring (2%), peanut (2%), and whelk (2%) (Figure 1).

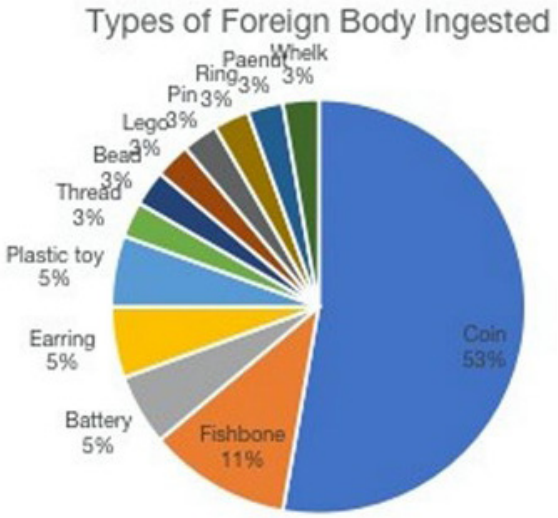

Figure 1 Types of foreign bodies ingested by the children

Routine radiograph examination confirmed the finding of foreign bodies in 88% of the cases. The number of serial radiographs ranged from 1 – 4 with a mean of 2.2. Out of the 36 children admitted, 19 (52%) were managed conservatively whereby 11 children (57%) passed the foreign bodies spontaneously within admission and eight patients (42%) passed the foreign bodies uneventfully after being discharged. A total of 17 children (47%) required endoscopic removal of foreign bodies without operative extraction.

DISCUSSION

Most children were brought to medical attention due to being witnessed or strong suspicion of the FBI by the caretakers. Most of them were asymptomatic. Symptoms may vary depending on the type and size of the foreign body, the age of the patient, and the location of the foreign body lodged (Yalçin et al., 2007). Upon the history of the FBI, the patient should be examined thoroughly. Children are prone to ingestion of multiple objects. The search must be continued even if one has been found.

Attending physicians also should identify high-risk children such as those with pre-existing gastrointestinal tract abnormalities namely congenital malformations and neuromuscular disease. In neuromuscular disease patients, due to impaired dynamics of swallowing, the foreign bodies might lodge in the upper oesophagus or into the airway. Abdul Wahab et al. reported an incident in a congenital myopathy child with a foreign body dislodged in the cervical oesophagus which was successfully removed by direct laryngoscope (Abdul Wahab et al., 2017).

According to Lee, the most commonly ingested foreign body in literature is coins (Lee, 2018). While the most unique FBI in our institution was whelk. Whelk is a type of sea snail that contains high vitamin B12. The shell is usually digestible by enzymes along the gastrointestinal tract, but the side effect of tetraamine is what we need to watch out for. Our patient was observed in the ward for two days following the accidental ingestion and discharged well after being noted to pass out digested shell remnants in the faeces. There are no previous reports on accidental

whelk ingestion in children based on English literature. A few foreign bodies are classified as high risk because of the management complexity. The high-risk foreign bodies include button batteries, large objects (>6 cm long or >2 cm wide), and more than one magnet and lead-based objects (Lee, 2018). Button batteries need immediate removal if lodged in the oesophagus because of the high risk of perforation.

The length of hospital stay in our study ranges from 1 – 9 days with a mean duration of 2.5 days. Most of our patients were from rural areas with medical centres without radiological services. Despite a large number of our patients being managed conservatively, only 60% of them passed foreign bodies spontaneously during a ward stay. This similar rate was reported in many reports due to the inability to determine the transit times of foreign bodies in the gastrointestinal tract (Macgregor et al., 1998). This is one of the disadvantages of conservative management. MacGregor et al. also highlighted that transit time appears to increase with age and it was suggested that oral Cisapride can increase gastric motility after prolonged retention in the stomach (Macgregor et al., 1998).

A single plain radiograph is a useful initial tool in all patients because it can detect foreign bodies even in the asymptomatic child. It can locate the object and characterise its size and shape. Our study managed to get a similar radiograph identification rate from 64% to 96% as reported by Litovitz et al. and Shastri et al. (Litovitz et al., 2010; Shastri et al., 2011). A plain radiograph of the chest should be done in both posterior-anterior and lateral views to well delineate the location of the foreign bodies. Coins that appear "en face" on the PA view are usually lodged in the oesophagus while coins only showing the edge alone is lodged in the trachea. An interval radiograph should be minimised to avoid excessive radiation exposure.

The management of foreign bodies varies according to the severity of clinical presentation, type, and localisation of the foreign bodies. According to the literature, 60 – 70% of ingested foreign bodies passed without any intervention, 20 – 30% would require endoscopic intervention, and approximately 1% would need a retrieval operation (Diaconescu et al., 2016; Guelfguat et al., 2014; Wu et al., 2017). In our study, 52% of the patients passed foreign bodies with conservative therapy (either by close monitoring or prescribed syrup lactulose), 47% patients required endoscopic removal, and none required surgery for retrieval of the foreign bodies. Diaconescu et al. reported higher unsuccessful attempts with endoscopy (Diaconescu et al., 2016). In our study, we overcome this by choosing appropriate endoscopic retrieval devices for the respective objects. Most of the foreign bodies were retrieved using a Dormia basket and Roth net.

CONCLUSION

FBI in children is more common in a younger age group. Clinical findings depend on the shape of the ingested materials, the patient's age, and the time of referral as they mostly could be managed conservatively. Upon failure of a conservative approach, a safe and uncomplicated removal should be attempted by an experienced endoscopist with appropriate ancillary endoscopic equipment.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

FINANCIAL DISCLOSURE

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ORIGINAL ARTICLE

Health Literacy Among Adult Patients with Chronic Diseases in Sabah: HLS-Sabah

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ABSTRACT

Health literacy (HL) sets on the ability and motivation of individuals to appraise, understand, access, and utilise information in ways that promote and maintain good health. Poorer health outcomes and incurs higher healthcare expenditures can be the cause of limited HL. Sabah public health facilities conducted a cross-sectional study between February and October 2020. A 12-item Short-Form Health Literacy Survey (HLS-SF12) comprising three domains (healthcare, disease prevention, and health promotion) was used to measure HL. The HL index score was categorised as 'limited' (0 – 33), 'sufficient' (>33 – 42), and 'excellent' (>42 – 50). Among 337 patients recruited, half were male (51%) with a mean age of 52.6 ± 12.3. The top 3 comorbid were hypertension (84.6%), dyslipidaemia (58.2%), and diabetes mellitus (47.8%). Health information was mainly accessed from television (84.6%), smartphones (75.1%), and radio (47.8%). The median HL index score was 31.94 (IQR 25 – 37.5), with 54.6% of patients having limited HL. The lowest median score was found in disease prevention, 11 (IQR 10 – 13) and 8 (IQR 7 – 9) when judging health information. The HL index was associated with age, educational level, household income, insurance ownership, and accessing health information with a smartphone or computer. In Sabah, the limited HL level observed the need to tailor interventional programmes to

vulnerable groups. Digital platforms should be enhanced in disseminating health-related information and educating the public on critical judgement skills.

INTRODUCTION

Health literacy (HL) is the individual's ability to access, comprehend and use health information to promote and maintain good health (United Nations ECOSOC, 2009). This updated definition by the World Health Organization (WHO, 2016) and the U.S. Department of Human and Health Services (HHS) (CDC, 2021) has shifted the paradigm of HL beyond performing uncomplicated tasks. It is more than reading and understanding health-related materials, making appointments, and adhering to prescribed medical regimens (United Nations ECOSOC, 2009). Instead, it encompasses the ability to acquire actively and critically appraise health information and make informed decisions to improve health status (Institute of Medicine et al., 2004).

HL has been recognised as an integral determinant of health (Abdullah et al., 2020). Paradoxically, the HL level is still low globally regardless of the country's development status. For instance, 60% of the Australian population has scored below the optimal level for health maintenance. About 50% of adults in the United States have difficulties understanding and acting upon health information (Hickey et al., 2018). People with limited HL are less aware of the preventive health measures and the association between their daily lifestyle and health outcomes (UnitedHealth Group, 2020). This results in a higher tendency to overuse healthcare services with a higher rate of hospitalizations and emergency admissions and, consequently, more significant healthcare costs (UnitedHealth Group, 2020; Scott et al., 2002).

Poor HL level contributes to the rising of non-communicable diseases (NCDs) worldwide. More commonly known as chronic diseases, NCDs result from genetic, physiological, environmental, and behavioural factors. Examples are cardiovascular diseases such as heart attacks and stroke, chronic respiratory diseases such as chronic obstructive pulmonary disease, asthma, diabetes, and cancers (WHO, 2021). In addition, studies demonstrated that patients with NCDs and poor HL tend to have less knowledge of their illnesses and management (Abdullah et al., 2020; Nutbeam, 2009). This finding is in line with the outcome of the United Nations General Assembly on the comprehensive review of the prevention and control of NCDs in 2014, which identified the need to promote HL through health education to mitigate NCDs (WHO, 2015).

Being the leading cause of death worldwide, NCDs are also one of Malaysia's most significant disease burdens. While diabetes, hypercholesterolemia, and obesity are increasing, NCDs have accounted for 71% of premature deaths (Institute for Public Health, 2019). Apart from the nationwide HL assessment from the Health and Morbidity Survey (NHMS) commencing 2015, several studies have been carried out in Malaysia to assess the HL level of different target populations with various underlying morbidities. Although these studies generally indicated a moderate to low HL for Sabah, while the general HL figures have been publicized in the NHMS report, not much information has been yielded on the factors contributing to the poor HL status locally, especially among those suffering from NCDs (Institute for Public Health, 2019). Hence, this study aims to overview the HL level among patients with chronic diseases in Sabah and explore the associated sociodemographic factors. The baseline information will help policymakers design a programme tailored to the local needs to improve the HL level.

MATERIALS AND METHODS

A cross-sectional study was conducted in Sabah public health facilities between February and October 2020. Using a "sample size calculator for estimating mean" (Naing & Rusli, 2006), the sample size required was 240 (95% confidence level; the precision of 1; standard deviation for health literacy index score obtained from a study by Duong et al. (2017) is 7.9).

Sabah's public health facilities are categorised into three divisions, i.e., West Coast, East Coast, and Interior. The list of all public hospitals (24 hospitals) and clinics with prescription load above 100/day (36 clinics) within these divisions was obtained from Sabah State Health Department. A total of 22 specialist and district hospitals (excluding Hospital Mesra Bukit Padang and Hospital Wanita dan Kanak-Kanak Sabah due to exclusion criteria below), as well as 30 health clinics (13 clinics from the west coast, 13 clinics from the east coast, and 4 clinics from interior region), participated in this study. Stratified sampling was employed to ensure adequate representatives from respective health facilities. Patients were then recruited based on inclusion criteria: (a) aged 18 and above; (b) have chronic diseases (diseases which are not passed from person to person and generally of long duration and slow progression; last for three months or more and cannot be prevented by vaccines or cured by medication) when they collect their repeat medication supply over the pharmacy outpatient counter. Patients who refused to participate or were incompetent with reasoning and judgement impairment were excluded. All participating patients were required to provide written informed consent.

A data collector was identified from each facility. Before data collection, briefings and training via phone instructions were carried out to ensure uniformity in understanding the questionnaire. Patients were given the option of answering the questionnaire either by themselves or with assistance from the data collector.

Instrument

For the author's consent, HL was measured using a 12-item Short-Form Health Literacy Survey (HLS-SF12) (adapted from Health Literacy Survey European Questionnaire 47 (HLS-EU-Q47). This shorter version of HLS-SF12 has been validated and is a reliable tool among the general public in Asian countries, including Malaysia (Duong et al., 2017). The questionnaire used in this study was available in 3 languages (English, Malay, and Mandarin). It comprised three domains (healthcare, disease prevention, and health promotion) which assessed four areas (the ability to find, understand, judge, and apply health information). It has previously been validated in 6 Asian countries, including Malaysia, with high reliability (Cronbach's alpha = 0.85), good criterion-related validity, satisfactory item-scale convergent validity, and a good model-data-fit throughout the populations in the countries involved (Duong et al., 2017). The perceived difficulty of each item was graded on a 4-point Likert scale (1 = very difficult, 2 = difficult, 3 = easy, and 4 = very easy). The Health Literacy (HL) indices were standardized to unified metrics using the formula [index = (mean − 1) × (50/3)], with the index value 0 being the lowest HL and 50 the highest HL (Sørensen et al., 2015).

The HL index score was categorized into four levels: 'inadequate' (0 – 25), 'problematic' (>25 – 33), 'sufficient' (>33 – 42), and 'excellent' (>42 – 50) health literacy. To identify vulnerable groups, the 'inadequate' and 'problematic' levels were combined into one category, known as 'limited' health literacy (0 – 33) (Sørensen et al., 2015).

Data Analysis

Data collected were entered into SPSS version 24. Descriptive statistics were used to present baseline characteristics and HL levels. Categorical variables were presented in frequency and percentage, whereas continuous variables were presented in

mean (standard deviation, SD) or median (interquartile range, IQR), depending on the data normality. Simple linear regression was performed for each sociodemographic characteristic with an HL score. A $p<0.05$ was considered statistically significant.

Ethics Approval

This study was conducted by the ethical principles outlined in the Declaration of Helsinki and the Malaysian Good Clinical Practice Guideline. The Medical Research and Ethics Committee approved it with the identification code NMRR-13-1803-15923.

RESULTS

Baseline Characteristics

A total of 337 patients were included in this study. Almost half were male (51%), with a mean age of 52.6 ± 12.3. The baseline characteristics of patients summarise in Table 1.

Table 1 Baseline characteristics of patients (n = 337)

Characteristic	Number (%)
Age (years)	
Mean ± standard deviation	52.6 ± 12.3
Age < 60 years old	235 (69.7%)
Age ≥ 60 years old	102 (30.3%)
Gender	
Male	172 (51)
Female	165 (49)
Ethnic	
Dusun	66 (19.6)
Malay	58 (17.2)
Chinese	53 (15.7)
Bajau	47(13.9)
Kadazan	23 (6.8)
Others	90 (26.7)
Marital status	
Single	28 (8.3)
Married	286 (84.9)
Widower	18 (5.3)
Divorce	5 (1.5)
Education level	
None	36 (10.7)
Primary	60 (17.8)
Secondary	156 (46.3)
Tertiary	84 (24.9)
Missing data	1(0.3)
Occupation	
Employed	121 (35.9)
Self-employed	61 (18.1)
Unemployed	68 (20.2)
Retiree	72 (21.4)
Others	13 (3.9)
Missing data	2 (0.6)

History of hospitalization in the past one year		
Yes	72 (21.4)	
No	263 (78)	
Missing data	2 (0.6)	
Health insurance		
Yes	98 (29.1)	
No	236 (70)	
Missing data	3 (0.9)	
Time to the nearest facility (minutes)		
Median, IQR		15 (10 – 20)
Household income (R.M.)		
Median, IQR		2,000 (1,000 – 3,500)
Source of information		
Television	285 (84.6)	
Smartphone	253 (75.1)	
Radio	161 (47.8)	
Computer	116 (34.4)	
Newspaper	113 (33.5)	
Comorbid		
Hypertension	271 (80.4)	
Dyslipidaemia	196 (58.2)	
Diabetes mellitus	161 (47.8)	
Chronic heart disease	41 (12.2)	
Chronic respiratory disease	18 (5.3)	
Chronic kidney disease	13 (3.9)	
Others	42 (12.5)	

About two-thirds (65.6%) of the patients self-administered the questionnaire, while the remaining required assistance from the data collector. Table 2 demonstrates the 12-item Short-Form Health Literacy Survey (HLS-SF12). The median (IQR) health literacy index score was 31.94 (25 – 37.5). Almost half of the patients (54.6%) had limited health literacy (HL index 0 – 33). The domain of disease prevention and the ability to judge health information had the lowest median score of 11 (IQR 10 – 13) and 8 (IQR 7 – 9), respectively.

Table 2 A 12-item Short-Form Health Literacy Survey (HLS-SF12) (n = 337)

Variable	Number (%)	Median, IQR
HL index		31.94 (25 – 37.5)
Category		
Inadequate (0 – 25)	88 (26.1)	
Problematic (>25 – 33)	96 (28.5)	
Limited (0 – 33)	184 (54.6)	
Sufficient (>33 – 42)	114 (33.8)	
Excellent (>42 – 50)	39 (11.6)	
Domain		
Healthcare		12 (10 – 13)
Disease prevention		11 (10 – 13)
Health promotion		12 (10 – 14)

Dimension	
Access to health information	9 (7 – 10)
Understand health information	9 (8 – 10)
Critically appraise health information	8 (7 – 9)
Applying the health information	9 (8 – 10)

Health Literacy

Association Between Health Literacy and Sociodemographic Characteristics

All the sociodemographic variables, age, education level, household income, health insurance, and accessing health information via smartphone and computer were found to have a significant relationship with the HL score. Table 3 elaborates on the association between these sociodemographic characteristics and the HL score.

Table 3 Associated sociodemographic characteristics with the health literacy index

Variables	**Simple linear regression**		
	b[a] (95% CI)	**p-value**	**r^2**
Age	−0.26 (−0.33; −0.18)	<0.001	0.112
Education			
No formal education	1	–	0.155
Primary	NS	NS	
Secondary	7.69 (4.59; 10.79)	<0.001	
Tertiary	11.49 (8.15;14.83)	<0.001	
Income	0.001 (0.0006;0.0014)	<0.001	0.077
Insurance	5.15 (3.02; 7.29)	<0.001	0.064
Source of information			
Smartphone	9.21 (7.13; 11.30)	<0.001	0.182
Computer	6.01 (4.01; 8.01)	<0.001	0.092

[a] Crude regression coefficient
[b] Adjusted regression coefficient
r^2 Coefficient of determination

DISCUSSION

The NHMS 2019 indicated that 40.7% of Malaysians were found to have marginally sufficient HL levels. In contrast, more than one-third of Malaysians (35.0%) had limited HL. Limited HL was most prevalent in Sabah (43.2%) (Institute for Public Health, 2019). In our study, an even higher proportion of patients fell under limited HL (54.6%). Such findings can be translated into a significant barrier in gaining access, understanding, appraising, and applying health-related information for optimal health outcomes among chronic disease patients in Sabah. This could be because subject recruitment for this study took place in healthcare settings, which increased the likelihood of involving individuals with relatively poorer HL at baseline. Such justification is consistent with HL studies conducted in other countries, including Malaysia, where a lower prevalence of limited HL was observed in non-healthcare settings (Rajah et al., 2019). It is also noteworthy that both NHMS and our study adapted the assessment tools (HLS-M-Q18 and HLS-SF12, respectively) from the same source of HLS-EU-Q47. Looking specifically at the HL index score, our study showed a median score of 31.94 (IQR = 25–37.5). Malaysia was involved in the initial research on developing and validating the HL instrument chosen for our study. It demonstrated a similar HL index score using the same instrument (32.7 ± 7.9) (Duong et al., 2017). This further validates that Malaysians, in general, have limited HL (HL index 0-33), and only a minority possess excellent HL (>42-50).

Several studies have been published on HL levels in various Malaysian populations using different tools (Abdullah et al., 2020; Rajah et al., 2019). Prior studies in Asian and Western countries recognized a negative association between age and HL level (Rajah et al., 2019; Sørensen et al., 2015). Similarly, our study demonstrated a significant linear negative relationship between age and HL index (adjusted b: -0.26, $p<0.001$), which was more significant than in European countries with a collective adjusted b of only -0.04 (Sørensen et al., 2015). Some studies discovered a profound decrease in HL among elderly patients. In a cross-sectional survey conducted in England city, elderly aged 65 years and above were 2.5 times more likely to have limited functional HL than those aged between 18 and 34 (Protheroe et al., 2017). In Malaysia, 68% of the elderly aged 75 and above demonstrated limited HL (Institute for Public Health, 2019). This is possibly due to the declining cognitive function associated with the elderly (Geboers et al., 2018). It can be a concerning issue for elderly patients with NCDs who live independently without assistance in their daily lives. Unintentional poor medication adherence and failure to take appropriate measures during a medical emergency may cause undesirable or even fatal consequences.

Education attainment had a significant association with the HL index in our study. This factor was also identified in similar studies conducted in Southeast Asian countries (Rajah et al., 2019). Patients who received tertiary and secondary education scored 11.49 and 7.69 higher, respectively than those who did not have formal education. This implies that education is one of the vital keys to promoting health literacy. Education empowers a person with the knowledge to comprehend and critically evaluate health information, followed by informed decision-making to improve health status.

Chronic disease patients with lower household incomes were found to have more inadequate HL. This finding was supported by a local study by Jaafar et al. (2021), which indicated a prevalence of limited HL among respondents with lower household incomes (49.5%). Similar observations were also found in European countries, whereby a more significant proportion of financially-deprived residents demonstrated limited HL (Sørensen et al., 2015).

Interestingly, our study found that patients who access health information using smartphones and computers generally have a higher HL level. The former demonstrates a robust correlation (adjusted b: 9.21 and 6.01, respectively). With greater smartphone or computer ownership in this digital era, it has become a convenient tool for accessing the internet to look for health-related information. Indeed, as shown in a study conducted by Protheroe et al. (2017), the elderly who had no access to the internet was at least three times more likely to have limited health literacy than those who had access. The significantly positive association between smartphone or computer use and HL is also shown in other studies where individuals with low HL skills are less likely to own a smartphone or use Internet technology (Bailey et al., 2015; Jensen et al., 2010). This could partly be explained by hesitancy and reluctance to adopt less familiar tools or comprehend new knowledge, especially for the older generation (Bailey et al., 2015). Such behaviour may also be associated with lower motivation to improve one's status quo, including health. As mobile devices and the Internet for rapid information dissemination are increasingly pervasive, improving technology literacy and accessibility is another imperative agenda of HL to ensure equity in accessing the information and services provided.

The positive association between health insurance coverage and HL was demonstrated in our study, and this has also been observed among America's adults (Kutner et al., 2003; Sentell, 2012). Generally, people with low HL have a greater likelihood of being uninsured. Those uninsured with limited HL were also found to have more severe underlying conditions (Sentell, 2012). Possession of health insurance can be interpreted as heightened health awareness and having autonomy over one's life. These people are usually more alert to the available information and can act upon them rationally.

There are several limitations to this study. First, the cross-sectional study design cannot establish the causal relationship between contributing factors and health literacy among adults with chronic diseases. Second, the perceived difficulty of each question was self-reported, which may affect the clinical significance of the results. Nevertheless, head-to-head comparison between studies is difficult because of the heterogeneity in the HL assessment tools used.

This study overviewed HL levels among patients with chronic diseases in Sabah. Different approaches to improving healthcare literacy, disease prevention, and health promotion should be carried out, especially targeting the elderly. The educational material needs to be concise and straightforward, using layman's terms to obtain attention and ease for better understanding for those with limited health literacy. Also, considering the affordability of smartphones and the vast amount of health information now available on the Internet, it becomes vital to increase the ability of the public to appraise information and apply it to their health. Visual aids, for example, videos or infographics from reliable approved sources, can help improve patients' health literacy.

CONCLUSION

In conclusion, about half of Sabah's patients with chronic diseases have limited health literacy. It highlighted the need to tailor interventional programmes to improve health literacy among vulnerable groups. In addition, digital platforms should be enhanced in disseminating health-related information and educating the public on critical judgement skills.

CONFLICT OF INTERESTS

The authors declare that they have no competing interests in publishing this article.

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ORIGINAL ARTICLE

Prevalence and Causes of Low Vision and Blind in Ophthalmology Department, Miri Hospital, Sarawak

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ABSTRACT

Prevalence and causes of low vision and blind have been studied nationally and globally. However, similar studies have not been conducted locally in Sarawak. This study aims to identify the prevalence and causes of low vision and blind patients of different gender, age, and race in the Ophthalmology Department, Miri Hospital, Sarawak, for five years from 2016 to 2020. This study is a retrospective observational study. A total of 17,868 patients' clinical records were screened. The clinical records with fulfilled inclusion criteria will be extracted and reviewed. In this study, 269 (1.50%) patients were diagnosed with irreversible visual impairments. The prevalence of low vision and blindness was 0.78% and 0.72%, respectively. Most subjects (187, 69.5%) were more than 50 years old. Furthermore, 151 (56.13%) subjects were male, while 118 (43.87%) were female. Race Iban has a higher prevalence of low vision and blind (88, 32,7%), followed by Chinese (81, 30.1%), Malay (53, 19.7%), and other local natives (17, 5%). The four leading causes of low vision and blind were diabetic retinopathy (68, 25.3%), glaucoma (62, 23.0%), retinitis pigmentosa (26, 9.7%), and age-related macular degeneration (17, 6.3%). Low vision and blind due to diabetic retinopathy, glaucoma, and age-related macular degeneration could be avoided if eye health screening is conducted as early as age

40. For patients diagnosed with low vision and blind, integrated low vision and blind rehabilitation training should be accessible in all public healthcare systems. For the stakeholder, enforcing low vision and blind registry, fortifying low vision rehabilitation services, and precise mechanism of welfare intervention are the measures for more holistic low vision and blind management.

INTRODUCTION

Vision impairment is a major global public health issue affecting individuals, households, and communities, from reduced quality of life and employment to poverty (Marques et al., 2021). National Eye Survey 1996 revealed a prevalence of 2.44% of low vision and 0.29% of blindness in Malaysia (Zainal et al., 2002). In National Eye Survey II, Chew et al. (2018) reported that East Malaysia, which comprises Sabah and Sarawak, has the highest prevalence of visual impairment with poor access to eye care services in Malaysia. Despite ample evidence that primary prevention and early detection may have a better visual prognosis, geographical and logistic limitations remain the barriers affecting patients seeking healthcare services in Sarawak (Alyana et al., 2018; Rahman et al., 2017). Although previous researchers focused on visual impairment amongst preschool and school children in southern Sarawak districts, no study was conducted in northern districts of Sarawak (Bakar et al., 2012; Leng et al., 2021; Premsenthil et al., 2013). Thus, more epidemiological data are needed to understand these regions' vision impairment burden better.

This study is conducted to obtain insight into statistics and profiles of low-vision and blind patients in the Ophthalmology Department of Miri Hospital. Being the only secondary hospital in Northern Sarawak (Latar Belakang, 2022), the Ophthalmology Department of Miri Hospital is the main centre providing 24 hours comprehensive ophthalmology eye care services. The centre accepts patients' referrals from various healthcare professionals, from optometrists, opticians, and physicians, both in the public and private sectors in the northern districts of Sarawak. These northern districts include Lawas, Limbang, Batu Niah, Marudi, and all the suburban towns such as Subis, Beluru, and Telang Usan.

MATERIALS AND METHODS

This study is a retrospective observational study. Five years of clinical records of all Malaysian patients who had undergone eye assessments in the Ophthalmology Department of Miri Hospital from 1st January 2016 till 31st December 2020 were screened and reviewed. Data of subjects who fulfilled inclusion criteria were recorded in an adapted version of the MOH Low Vision and Blind Registry form. The data included age of notification of low vision and blind, gender, race, best corrected visual acuity (BCVA), visual field, ophthalmology diagnosis, and presence of associated systemic diseases. In addition, the patient who was referred for low vision and blind management & rehabilitation from 1st January 2016 till 31st December 2020, a patient with irreversible and permanent visual impairment, and the patient who fulfilled low vision and blind definition according to World Health Organization (WHO) were included in this study. However, patients' clinical records with incomplete eye assessments, patients with reversible and treatable visual impairment, and patients with unexplained or undetermined visual impairment were excluded from the study.

The definition of low vision and blind in this study was based on the World Health Organization (WHO) categories of visual impairment (WHO, 2021). Low vision is defined as visual acuity less than 6/18, but equal to or better than 3/60 or visual field less than 20°, and blind is visual acuity less than 3/60 or visual field less than 10°, in the better eye, with the best correction. Best corrected visual acuity (VA) was measured using Snellen Chart,

Sheridan Gardiner, or Kay Pictures Test. The visual field was assessed using Humphrey Visual Field Analyzer. For patients with multiple ophthalmic diseases, the disease with the most significant effect causing irreversible, permanent visual impairment was recorded and verified by the ophthalmologist. The causes of low vision and blind were classified according to the International Classification of Diseases (ICD), 10th Edition (WHO, 2010). Collected data were analysed using Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 21. The study was performed by the principles of the Declaration of Helsinki and was approved. It was the Medical Research and Ethics Committee (MREC) of the Ministry of Health Malaysia (MOH) [NMRR-21-394-58440 (IIR)].

RESULTS

Out of 17,868 patient records screened, 269 (1.50%) patients were diagnosed with irreversible, permanent vision impairment. The prevalence of low vision and blind in our sample population was 0.78% (139) and 0.72% (130), respectively. Figure 1 shows notifications of low vision and blindness from 2016 to 2020.

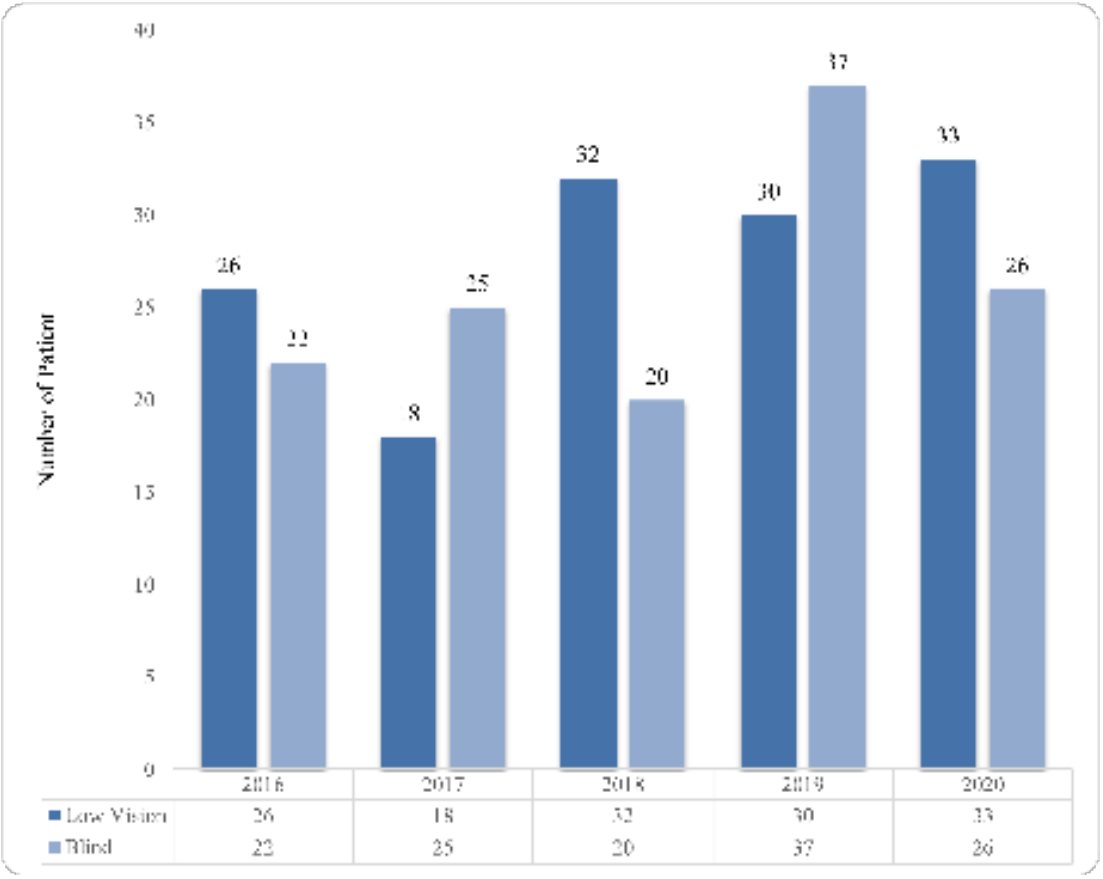

Figure 1 Notification of low vision and blind from 2016 to 2020 (n = 269)

Data were analysed using descriptive and inferential statistics using SPSS version 21 (Table 1). There is a bimodal peak in low vision, with the first peak in the group of ≤10 years old and the second peak in the group of 51 – 60 years old. However, for the patients in the blind category, there was only one peak at the age of 61 – 70 years old. We found that 69.5 % (187) of our permanent visually impaired population were more than 50 years old (Figure 2). The low vision was found more among the Chinese race (47), and blind was found more among the Iban population (44) (Figure 3).

Table 1 Age distribution of low vision and blind in the Ophthalmology Department, Miri Hospital

Age	Low Vision		Blind		Total	
	Number (%)	Mean age (95% CI)	Number (%)	Mean age (95% CI)	Number (%)	Mean age (95% CI)
≤10	10 (7.2)	5.7 (4.2 – 7.3)	0 (0.0)	–	10 (3.7)	5.7 (4.2 – 7.3)
11 – 20	3 (2.2)	12.7 (11.2 – 14.1)	0 (0.0)	–	3 (1.1)	12.7 (11.2 – 14.1)
21 – 30	1 (0.7)	25.0 (–)	8 (6.2)	26.0 (24.0 – 28.0)	9 (3.3)	25.9 (24.2 – 27.6)
31 – 40	12 (8.6)	36.0 (34.2, 37.8)	14 (10.8)	36.1 (34.5 – 37.6)	26 (9.7)	36.0 (35.0 – 37.1)
41 – 50	18 (12.9)	46.2 (44.5, 47.8)	16 (12.3)	46.4 (44.7 – 48.1)	34 (12.6)	46.3 (45.1 – 47.4)
51 – 60	30 (21.6)	55.0 (54.0, 56.0)	25 (19.2)	56.0 (54.7 – 57.3)	55 (20.4)	55.4 (54.7 – 56.2)
61 – 70	29 (20.9)	65.3 (64.3 – 66.3)	27 (20.8)	65.4 (64.2 – 66.6)	56 (20.8)	65.3 (64.6 – 66.1)
71 – 80	23 (16.5)	75.9 (74.8 – 77.0)	24 (18.5)	74.3 (73.1 – 75.4)	47 (17.5)	75.0 (74.3 – 75.8)
≥81	13 (9.4)	84.2 (82.8-85.6)	16 (12.3)	84.9 (83.0-86.8)	29 (10.8)	84.6 (83.4-85.7)
Total	139 (100.0)	55.9 (52.3-59.4)	130 (100.0)	59.7 (56.7-62.6)	269 (100.0)	57.7 (55.4-60.0)

CI: Confidence interval; –: No data available

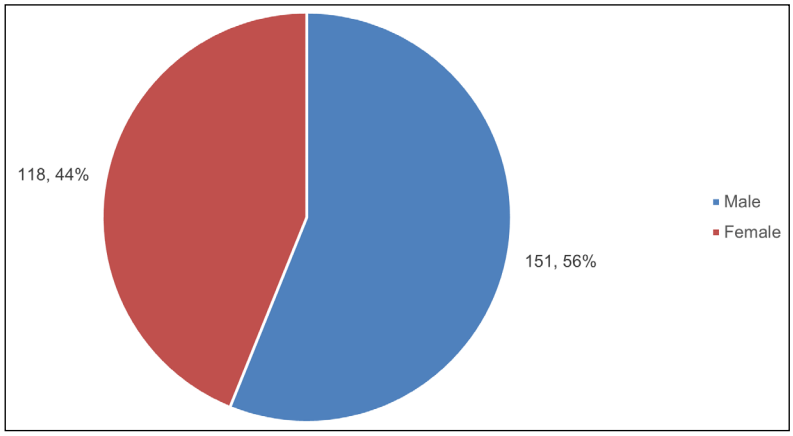

Figure 2 Distribution of gender in low vision and blind (n = 269)

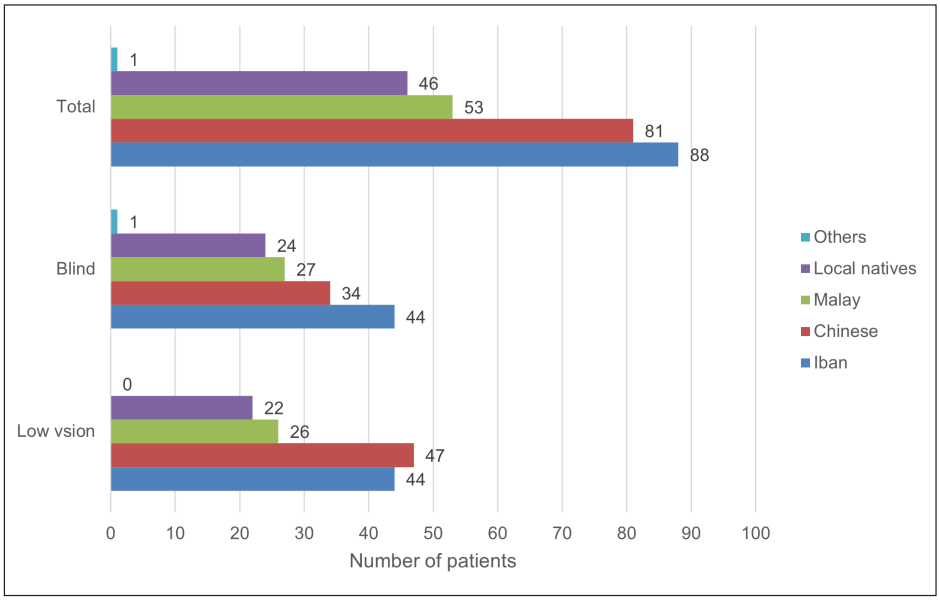

Figure 3 Distribution of races in low vision and blind (n = 269). Local natives: Orang Ulu (Includes Kayan, Lun Bawang, Kelabit, Kenyah, Penan, Sebop, Bisaya, and Berawan), Kedayan, Bidayuh (Includes Salako and Lara) and Melanau; Others: Other races not in the list.

The causes of low vision and blind were divided into three age groups 0 to 29 years old, 30 to 59 years old, and 60 years old and above. In the age group of 0 to 29 years, the most common causes of low vision and blind were congenital nystagmus (18.0%) and albinism (14.0%). In the 30 to 59 years age group, the most common cause of low vision and blind was diabetic retinopathy (37.0%), followed by retinitis pigmentosa (18.0%) and glaucoma (13%). For 60 years old and above, the most common cause of low vision and blind was glaucoma (34.0%), followed by diabetic retinopathy (19.0%) and age-related macular degeneration (12.0%) (Table 2).

Table 2 Main causes of low vision and blindness in different age groups (n = 269)

Age group	Diagnosis/ Causes	Low vision		Blind		Total	
		Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
0 – 29	Congenital nystagmus	5	22.7	0	0.0	5	22.7
	Albinism	3	13.6	0	0.0	3	13.6
	Retinopathy of prematurity	1	4.5	1	4.5	2	9.1
	Other congenital malformations of the eye	2	9.1	0	0.0	2	9.1
	Retinal detachment and breaks	0	0.0	2	9.1	2	9.1
	Chronic uveitis	0	0.0	2	9.1	2	9.1
	Diabetic retinopathy	0	0.0	1	4.5	1	4.5
	Glaucoma	0	0.0	1	4.5	1	4.5
	Corneal scars and opacities	1	4.5	0	0.0	1	4.5
	Amblyopia	1	4.5	0	0.0	1	4.5
	Others	1	4.5	1	4.5	2	9.1
	Subtotal	**14**	**63.6**	**8**	**36.4**	**22**	**100.0**
30 – 59	Diabetic retinopathy	29	26.9	11	10.2	40	37.0
	Retinitis pigmentosa	6	5.6	13	12.0	19	17.6
	Glaucoma	6	5.6	8	7.4	14	13.0
	Degenerative myopia	5	4.6	1	0.9	6	5.6
	Retinal detachment and breaks	0	0.0	4	3.7	4	3.7
	Toxic optic neuropathy	2	1.9	1	0.9	3	2.8
	Stargardt disease	1	0.9	1	0.9	2	1.9
	Rieger anomaly	0	0.0	2	1.9	2	1.9
	Corneal scars and opacities	1	0.9	0	0.0	1	0.9
	Injury of the eye and orbit	1	0.9	0	0.0	1	0.9
	Others	8	7.4	8	7.4	16	14.8
	Subtotal	**59**	**54.6**	**49**	**45.4**	**108**	**100.0**

≥60	Glaucoma	22	15.8	25	18.0	47	33.8
	Diabetic Retinopathy	17	12.2	10	7.2	27	19.4
	Age-related macular degeneration	9	6.5	8	5.8	17	12.2
	Corneal scars and opacities	3	2.2	4	2.9	7	5.0
	Injury of the eye and orbit	5	3.6	2	1.4	7	5.0
	Retinitis pigmentosa	1	0.7	6	4.3	7	5.0
	Degenerative myopia	1	0.7	5	3.6	6	4.3
	Retinal detachments and breaks	2	1.4	3	2.2	5	3.6
	Macula scars on the posterior pole	2	1.4	1	0.7	3	2.2
	Radiation retinopathy	1	0.7	2	1.4	3	2.2
	Others	3	2.2	7	5.0	10	7.2
	Subtotal	**66**	**47.5**	**73**	**52.5**	**139**	**100.0**

Others: Diagnoses not on the list

From the study, the four leading causes of low vision and blind in the Ophthalmology Department at Miri Hospital were diabetic retinopathy (68, 25.2%), glaucoma (62, 23.0%) and followed by retinitis pigmentosa (10.04%) and age-related macular degeneration (6.32%) (Figure 4).

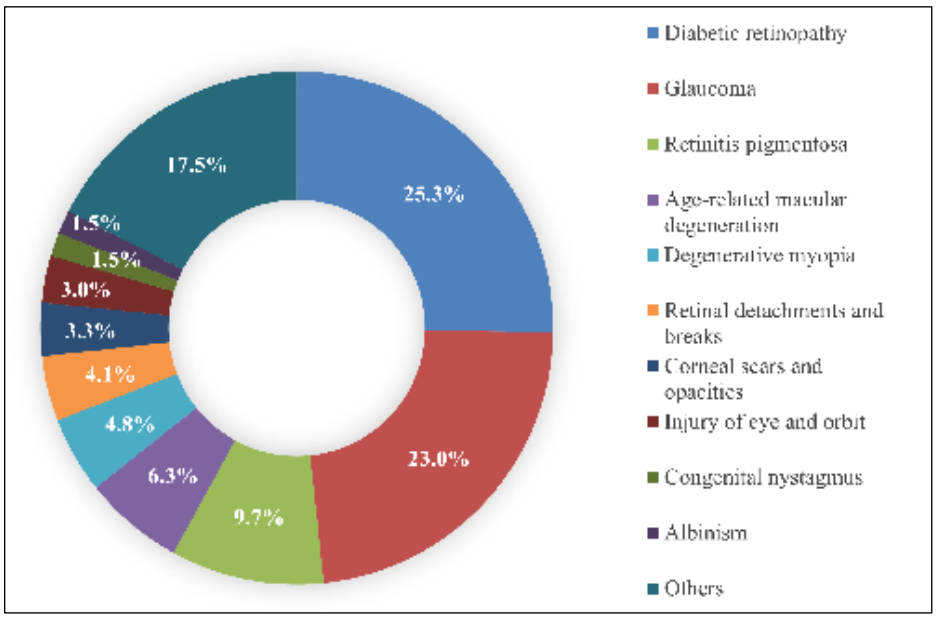

Figure 4 10 Main causes of low vision and blind in Ophthalmology Department, Miri Hospital
Others: Other diagnoses in the list

DISCUSSION

Prevalence of the Visual Impairment in Our Study Population

The prevalence of blindness in our study population was 0.78% which was close to the study reported in another hospital-based population at Universiti Malaysia Medical Centre (UMMC) (0.9%) by SC Reddy (2008) but with a lower prevalence of low vision with 0.72% compared to 9.8% in the study in UMMC. This significant difference in low vision diagnosis could be attributed to underdiagnosed and higher referral thresholds by local practitioners.

Understanding the Profile of the Permanent Visual Impairment in Our Population

In all the population studies in general, the prevalence of low vision and blind would naturally escalate with age, but in our study, there were two peaks of the low vision in our study population, namely in children < 10 years old age group and the adult group at 51 – 60 years of age. This resembles the age profile during the first consultation among the 10 years low vision clinic population (UKM-MAB) in the National University of Malaysia by Mohidin et al. (1998) but with the first peak at 10 to19-year-old and second at 50 to 69-year-old. After the first peak, there was a slope followed by a gradual rise from 3.0% in the 11 – 20 age group, reaching a peak of 21.6% in the 51 – 60 age group. We believe the first peak could be explained by the excellent coverage of the Ministry of Health Malaysia children's active screening initiatives. These initiatives include e child home-based health record programme for 0 to 6-year-old, a student health record book throughout education years, and school health team service activities. Children born in Malaysia are required to be examined at least three times 1-month-old, 18 months old, and four years old) by a medical health officer. As they grow older, they will receive school health services, including eye examinations at standard 1 (7 years old), standard 6 (12 years old), and form 3 (15 years old), as provided by KKM (Buang, 2013). Besides this, the Amblyopia and Visual Impairments Screening Ministry of Health Malaysia (AVIS) programme is another initiative by the Ophthalmology fraternity of the Ministry of Health Malaysia; starting in 2017, the Optometry Profession in the Ministry of Health Malaysia adopted the Prevention of Blindness Strategies Action Plan to target amblyopia and visual impairment among preschoolers through AVIS specifically. The project aims to identify and standardize the appropriate equipment, tests, and procedures for ideal preschool screening based on current literature (AVIS, 2017).

There was a gradual escalation of both low vision and blind populations with age to a second peak at 51 – 60 years, followed by a decline in the number at higher age groups. Our study's mean age of low vision and blind was 58 years old. The majority of low-vision and blind were diagnosed at 50 years old and above. This follows that most people with vision impairment and blindness are over the age of 50 years (WHO, 2021). The aetiologies of vision impairment in this age group were due to eye diseases such as diabetic retinopathy, glaucoma, and retinitis pigmentosa. Vision morbidity corresponds well to the duration of diseases (Wong, 2008). Therefore, the declining number of low-vision and blind patients diagnosed in higher age groups is undoubtedly a result of the natural distribution of the Gaussian curve in any population.

Gender and Race Among Low Vision and Blind

The low vision and blind among the gender and race were by the ratio of the subpopulation in the state. In Sarawak, the male-to-female ratio (1:1.28) was close to the population male-to-female ratio of 1.08:1. However, females were 1.2 times more than the based-on age-adjusted population in Malaysia (Zainal et al., 2002). Iban had the highest prevalence of low vision and blind (32.7%), followed by Chinese (30.1%), Malay (19.7%), and other local natives (17.4%). This result again was consistent with the number of the race population in the state,

with Iban being the majority race (26.5%), followed by Chinese (19.9%), Malay (18.7%), and other local natives (24.1%) (The official Portal of Sarawak Data, 2017). The prevalence of low vision and blindness in various studies too showed that they are race-independent (Rahman et al., 2020; Thevi et al., 2012; Wong et al., 2019; Zainal et al., 2002).

Aetiology of the Low-Vision and Blind

Based on the study, the four leading causes of low vision and blind in our study population were diabetic retinopathy (24.91%), glaucoma (24.54%), followed by retinitis pigmentosa (10.04%), and age-related macular degeneration (6.32%). In addition, other studies in Malaysia generally agreed that diabetic retinopathy, glaucoma, and age-related macular degeneration as the major irreversible causes of low vision and blind (Chew et al., 2018; Reddy et al., 2008; Zainal et al., 2002).

Diabetes retinopathy is the most common cause of low vision in our population, mainly due to the high prevalence of diabetes and prediabetes in the population. As reported in Malaysia National Morbidity Survey 2019, an estimated 3.9 million population over 18 years old (1 in 5 adults in Malaysia) have diabetes in Malaysia (Institute for Public Health, 2020). Another recent meta-analysis published in Jan 2022 also echoed the increased prevalence of diabetes and prediabetes in Malaysia (Akhtar, 2022). In addition, we reported a higher prevalence of low vision and blind among those more than 50 years old. Thus, baseline eye health screening should be conducted many years earlier. This is under the American Association of Ophthalmology (AAO) guideline that recommends eye health screening at the age of 40 in the average population and earlier if the individual has risk factors like diabetes mellitus, high blood pressure, or a family history of eye conditions (Turbert & Whitman, 2022).

Accessibility to eye care services is another important factor, as Miri is situated in the Northern division of Sarawak. Sarawak was one of the few regions with the worst access to eye clinics (Chew et al., 2002). About one-third of the patients in Sarawak need to travel more than 9 km to reach the nearest clinic (Risso-Gillet et al., 2015). Due to the remoteness, the nearest ophthalmology subspecialty like vitreoretinal, glaucoma, and cornea was more than 810 km drive away in Kuching, and the only government women and children hospital with a paediatric subspecialty is in Sabah. Poor access to treatment of diseases like diabetic retinopathy and glaucoma could be one of many factors contributing to the morbidity of these conditions.

Apart from the three leading causes of low vision and blind shared by reports by Zainal et al. (2002) and Reddy et al. (2008), we found a higher prevalence of low vision and blind due to retinitis pigmentosa in our study, which is incoherent with low vision population study by Mohidin (1998). Various studies from other countries like Nigeria, Thailand, Jordan, Pakistan and Turkey reported retinitis pigmentosa as one of the leading causes of low vision and blindness in young adults 15 years old and above (Bakkar et al., 2018; Chotikavanich et al., 2018; Iqbal et al., 2019; Küçük, 2019; Olusanya et al., 2012). In some studies, consanguineous marriage had been identified as one of the factors for the higher prevalence of retinitis pigmentosa (Baarah et al., 2018; Kumaramanickavel et al., 2002; Sheng et al., 2012). Nevertheless, we found no data on the incidence of consanguineous marriage in the region. Land Dayak customs (race Iban) prohibit any near relatives or consanguineous nuptials (Pantang, 2018). Prevention of genetic disease visual impairment could be achieved through pre-marriage medical counselling, implementation of molecular genetics, and management of genetic disease (Baarah et al., 2018).

Permanent Vision Impairment and Implications

Infants with visual impairment due to congenital disorders such as infantile glaucoma and refractive errors can experience

delays in motor, language, emotional, social, and cognitive development, as nearly 75% of learning comes from vision (Gogate, 2011). Therefore, it can directly affect their academic performance during school age (Taylor, 1999). Adults with functional vision loss have limited their choice of occupation. The severity of visual impairment is proportional to the unemployment rate. Thus, they are more likely to be excluded from the labour market. As employment helps visual impairment to be self-sufficient, reduce poverty, and improve physical and psychological health and quality of life (Nispen et al., 2020; Omar, 2010), there is necessary to expand further and improve low vision service in the region. By learning adaptive techniques and skills in the workplace, they will be able to stay in the labour market and thus increase the economic productivity of the country. As they age, especially the elderly with acquired visual impairment, they experience social isolation, difficulty with mobility, and a higher risk of falls and fractures (Wong et al., 2019).

This study is a hospital-based study regarding the prevalence and causes of low vision and blind in Miri Hospital, Sarawak. This study gives us an insight into the prevalence and causes of irreversible low vision and blind in Miri Hospital. It provides information concerning the socio-economic and accessibility of healthcare which will help in the future planning of public health policies, especially in allocating the budget for health services. However, this study has certain limitations. First, the hospital-based study may not represent the number of people with low vision and blind in the Miri population. Undiagnosed patients never present to a health clinic or hospital for eye assessment. Moreover, although not many, there are private hospitals with visiting ophthalmology services where patients can seek treatment and further management. Thus, this would lead to an underestimate of the prevalence of low vision and blindness in the Miri population. Second, patients with incomplete data were excluded in this retrospective study, which may result in lower prevalence. Third, as a secondary hospital with a tertiary ophthalmology setting, Miri Hospital receives a relatively high number of referrals from patients with complex and intransigent ocular conditions. Therefore, the study result may be indifferent if compared with primary care health clinics and other population-based studies, including treatable ocular disorders like cataracts and refractive error as causes of visual impairment.

During the COVID-19 pandemic, accessibility to eye care was compromised, and more low-vision and blind patients could be expected due to future delays in treatment and management. Different studies targeting low vision and blind children could be initiated as low childhood vision, and blind data is much lesser than adults. Aside from studying the prevalence of low vision and blindness, a multidisciplinary service could be conducted to evaluate the outcome of low vision and blind rehabilitation services in Miri Hospital.

CONCLUSION

Our population's leading causes of permanent vision impairment were diabetic retinopathy, glaucoma, retinitis pigmentosa, and age-related macular degeneration. Diabetic retinopathy is the leading cause of low vision, while glaucoma is the leading cause of blindness. Eye health screening as early as age 40 is recommended for patients with systemic disease. With early detection and effective intervention available, morbidity from these conditions can be avoided. For patients diagnosed with low vision and blind, integrated low vision and blind rehabilitation training should be accessible in all public healthcare systems. For the stakeholder, enforcing low vision and blind registry, fortifying low vision rehabilitation services, and transparent mechanisms of welfare intervention are the measures for more holistic low vision and blind management.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article.

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SHORT COMMUNICATION

Factors influencing *Anopheles* larval habitats in Kudat District, Sabah, Malaysia

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ABSTRACT

A longitudinal survey of *Anopheles* larval habitats was conducted in adjoining areas of Kampung Marabahai, Nangka, Paradason and Tuboh in Kudat District, Sabah from May 2015 to April 2016. Ninety-five out of 368 breeding habitats sampled were positive for *Anopheles* larvae. The significant physicochemical factors that were associated with the presence of *Anopheles* larvae were: turbidity, shadiness, presence of water vegetation, surface area, temperature, pH (negative log of the hydrogen ion concentration), and Electrical Conductivity (EC). Thus, this paper highlighted the physicochemical characteristic of larval habitats of *Anopheles* mosquito with emphasis on *An. balabacensis*, the vector of *Plasmodium knowlesi* malaria, could be targeted for surveillance studies and control interventions.

INTRODUCTION

Understanding the physicochemical characteristics of larval habitats is an important consideration to be targeted for the control of mosquito larvae. Immature stages are more vulnerable to human intervention since their location, growth and development are more restricted in time and space, thus, more vulnerable to control.

In an earlier study on the larval ecology of *Anopheles* mosquitoes following land-use changes in Sabah (Aure et al., 2021), six

land-use types, within an area measuring 2 × 3 sq. km, were identified using a drone and verified by ground-truthing (Ground truthing protocol. http://www.missiongroundtruth.com/groundtruth.html). From May 2015 to April 2016, 368 larval habitats located in adjoining areas of Kampung Marabahai, Nangka, Paradason and Tuboh in Kudat District in Sabah, were observed for the presence or absence of mosquito larvae. Larval habitats were assessed for their relative importance as sources of potential vectors of malaria. Kruskal-Wallis H Test by ranks was used to determine if there were significant differences between each aquatic habitat (Kruskal & Wallis, 1952). The physicochemical of larval habitats examined were: water stability, water movement, turbidity, presence of vegetation, shadiness, pH, TDS (Total Dissolved Solids), EC (Electrical Conductivity), temperature, depth, and surface area. The physical and chemical characteristics of the water in each larval habitat sampled were measured with hand-held instruments (Hi9812-5, portable pH/EC/TDS/OC Hanna® Instruments) or noted visually. The association between mean larval density and qualities of the water was analysed by non-parametric methods i.e., Kruskal-Wallis (1952) and Mann-Whitney (Wilcoxon Rank Sum) Tests (Mann & Whitney, 1947).

The distribution of *Anopheles* larvae was not normally distributed and the larvae collected were relatively small. This study revealed significant differences among larval habitats were detected ($\chi 2 = 20.208$, df = 11, $p = 0.043$). Ninety-five among 368 habitats were found positive for *Anopheles* larvae distributed as follows: artificial container, 11/42 or 26%; ditch, 10/27 or 37%; intermittent stream, 46/127 or 36%; pond, 9/35 or 26%; puddle, 5/28 or 18%; river, 9/56 or 16%; and slow-flowing stream, 5/32 or 16% (Table 1).

Table 1 Distribution of anopheline larvae among different aquatic habitat types, Kudat, Sabah, Malaysia

Habitat	No. of habitats sampled	*Anopheles*-positive habitats (%)
Artificial container	42	11 (26)
Borrow pit	1	0 (0)
Ditch	27	10 (37)
Irrigation canal	2	0 (0)
Intermittent stream	127	46 (36)
Leaf axil	3	0 (0)
Pond	35	9 (26)
Puddle	28	5 (18)
Rockpool	1	0 (0)
River	56	9 (16)
Slow flowing stream	32	5 (16)
Tree hole	14	0 (0)
Total (N)	368	95 (26)

Seven habitats with *Anopheles* larvae by rank were, in descending order of frequency: intermittent stream > ditch > pond > artificial container > puddle > river > slow-flowing stream. Five habitats (borrow pit, irrigation canal, leaf axil, rock pool, and tree hole) were negative for Anopheline larvae. Although the numbers were low, a total of 19 habitats were found positive for *An. balabacensis* and collected from an intermittent stream, artificial containers and puddles (Figure 1) (Aure et al. 2021).

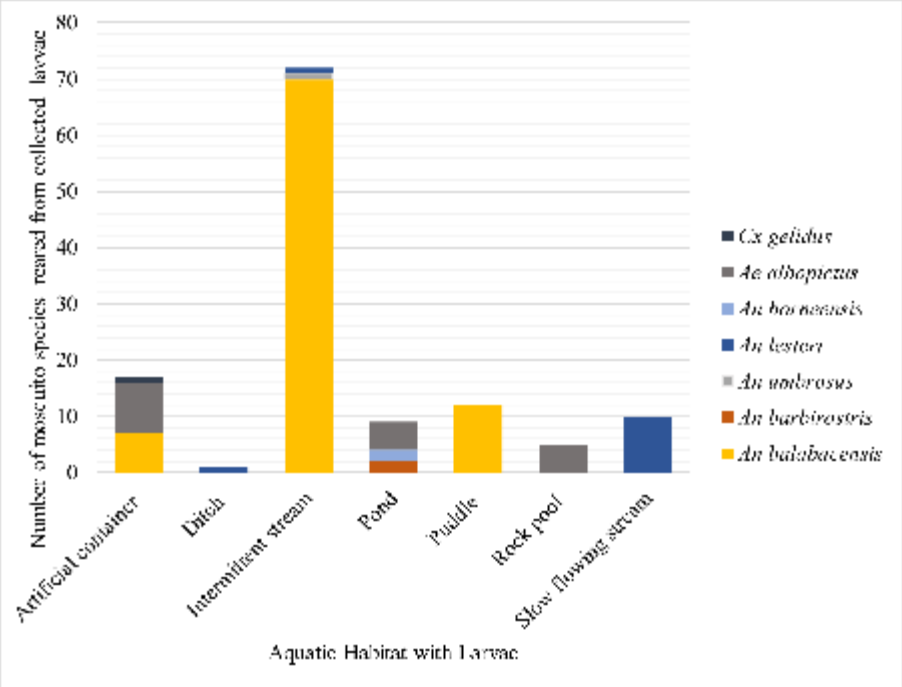

Figure 1 The number of mosquito species from reared larvae collected from aquatic habitats

The result of this study found that the physical characteristics which were significantly associated with *Anopheles*-positive habitats were: partial to full shadiness ($p = 0.04$) and turbidity ($p = 0.03$); pond and the slow-flowing stream had either none or emergent water vegetation ($p = 0.03$); the rest had none. Depth and water stability were not applicable. The surface area (< or >10 sq cm) was significant in a puddle only (Table 2).

Table 2 The Physical parameters (mean + SD) of *Anopheles* breeding habitats in Kudat

Physical characteristics	Larval habitat	Artificial Container	Ditch	Intermittent stream	Pond	Puddle	River	Slow flowing stream	P-values
	Variables	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	
Water Stability	Permanent	0	(NA) not applicable	0.7143 ± 1.11	1.6191 ± 3.11	(NA) not applicable	0.6727 ± 1.86	0.1111 ± 0.33	0.28
	Temporary	1.2439 ± 2.62	1.1111 ± 2.26	1.8917 ± 4.22	1.6429 ± 4.7	2.0357 ± 6.01	0	0.7483 ± 1.16	0.56
Water Movement	Standing/Still	1.2143 ± 2.6	1.3044 ± 2.4	1.961 ± 3.74	1.7273 ± 3.85	2.2 ± 6.34	2.75 ± 3.81	0	0.14
	Fast/Slow moving	NA	0	1.62 ± 4.67	0	0.6667 ± 1.54	0.3125 ± 0.97	0.4286 ± 1.07	0.14
Turbidity	Clear	1.4706 ± 2.83	1.7143 ± 3.68	1.2727 ± 2.89	NA	1 ± 3.16	1.1818 ± 2.59	0.0769 ± 0.28	0.63
	Turbid	0.125 ± 0.35	0.9 ± 1.59	2.25 ± 4.83	1.6286 ± 3.76	2.6111 ± 7.15	0.3235 ± 1.04	0.5789 ± 1.26	**0.03**
Water Vegetation	None	1.275 ± 2.65	1.1579 ± 2.59	1.7788 ± 4.17	0.7391 ± 2.8 [a]	3 ± 7.15	0.5122 ± 1.74	0.25 ± 0.8 [b]	**0.03**
	Grass/Emergent	0	1 ± 1.31	2.2143 ± 3.77	3.3333 ± 4.81 [a]	0	1.0667 ± 2.63	1.25 ± 1.82 [b]	0.11
Shadiness	No Shade	0.375 ± 0.74	2.2 ± 4.38	0.5 ± 0.84	1.7727 ± 4.52	0	0	NA	0.78
	Partial/Full shade	1.4118 ± 2.84	0.8636 ± 1.52	1.8926 ± 4.21	1.3846 ± 2.02	2.5909 ± 6.7	0.6727 ± 1.86	0.375 ± 1.01	**0.04**
Surface Area (m^2)	≤10	1.2439 ± 2.62	1.16 ± 2.34	1.8478 ± 4.47	0.7143 ± 1.49	1.037 ± 2.92 [c]	0.2 ± 0.45	0.4444 ± 1.33	0.28
	>10	0	0.5 ± 0.71	1.7714 ± 3.07	2.2381 ± 4.65	29 ± [c]	0.7059 ± 1.92	0.3478 ± 0.88	0.05
Depth (cm)	≤10	2 ± 3.46	0	2.1379 ± 4.17	3 ± 4.24	4..5455 ± 9.14	0.4286 ± 1.13	0	0.3
	>10	1.1539 ± 2.57	1.3044 ± 2.4	1.7347 ± 4.12	1.5455 ± 3.78	0.4118 ± 1.28	0.6939 ± 1.93	0.3871 ± 1.02	0.12

The superscript letter indicates the significance
NA - not applicable

The significant chemical factors that were associated with the overall presence of *Anopheles* larvae were: temperature (>30 Celsius) ($p = 0.04$) and pH (<6.5) ($p = 0.04$) in all larval habitats. TDS (<100 ppm) was significant in the intermittent stream ($p = 0.02$) and EC (<100 µS/cm) was significant in all habitats ($p = 0.05$) (Table 3).

Table 3 The chemical parameters (mean + SD) of *Anopheles* breeding habitats in Kudat

Chemical characteristic	Larval habitat	Artificial Container	Ditch	Intermittent stream	Pond	Puddle	River	Slow flowing stream	P-values
	Variables	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	(Mean ± SD)	
Temperature (°C)	≥30	1.1143 ± 2.48	1.12 ± 2.3509	1.8413 ± 4.13	1.35 ± 3.1	2.1923 ± 6.22	0.5556 ± 1.66	0.375 ± 1.01	**0.04**
	<30	1.7143 ± 3.3	1	0	2 ± 4.58	0	3.5 ± 4.95	(NA)	0.65
pH	≤6.5	0.3636 ± 1.21	1.3333 ± 3.28	2.9032 ± 6.78	3.5 ± 5.09	1.9167 ± 6.19	0	0.1429 ± 0.38	**0.04**
	>6.5	1.2143 ± 2.7	0.5 ± 1.09	1.394 ± 2.64	1.3044 ± 3.66	2.75 ± 5.5	0.5556 ± 1.8	0.44 ± 1.12	0.45
Total Dissolved Solids (TDS) (ppm)	≤100	1.25 ± 2.66	1.923 ± 3.04	2.3833 ± 4.82 [a]	2.4 ± 4.75	2.4783 ± 6.57	0.6207 ± 1.66	0.7462 ± 1.21	0.14
	>100	0	0.25 ± 0.45	1.1148 ± 3.12 [a]	0.6923 ± 1.38	0	0.7308 ± 2.09	0.1818 ± 0.4	0.51
Electrical Conductivity (EC) (µS/cm)	≤100	1.1842 ± 2.6	1.5882 ± 2.72	1.9 ± 4.25	1.9286 ± 4.13	2.0357 ± 6.01	0.6727 ± 1.86	0.375 ± 1.01	0.05
	>100	0	0.125 ± 0.35	0.1818 ± 0.6	0.6 ± 1.34	NA	NA	NA	0.87

The superscript letter indicates the significance
NA = not applicable

A parallel survey of *An. balabacensis* larval habitats in Kudat District showed a preference for this species to breed in muddy ground pools and tire tracks in plantations and forest fringe (Ahmad et al., 2018). *An. balabacensis* larvae were found in 29 out of 97 breeding sites sampled. However, multiple linear regression analysis indicated no associations between environmental factors and the occurrence of *An. balabacensis* larvae were observed (Ahmad et al., 2018).

Based on the larval ecology study the differences among land-use types were not significant ($\chi 2 = 4.15$, df = 5, p = 0.219). The frequency of the number of *Anopheles* larvae collected in descending order was: rubber tree plantation> coconut plantation > clearing site > oil palm plantation > forest > settlement area (Aure et al. 2021). Mosquito biodiversity by genera was high in all land use types based on Simpson's diversity index, favourable and competitive conditions for different taxonomic groups that could impact their relative abundance. *An. balabacensis*, though mainly a forest dweller, was present in all land use types and was found co-existing with other *Anopheles* species e.g., *An. barbirostris*, *An. lesteri*, *An. borneensis* and *An. umbrosus* in clearing sites and coconut plantations only (Aure et al., 2021).

The composition and abundance of anopheline species according to habitat diversity in Mexico found no significant differences between ALI (absolute larval index) and hydrological types (Villarreal-Treviño et al., 2020). More accurate vector–habitat association could be obtained using aerial remote sensing data that could analyse environmental and spatial risk factors (Byrne et al. 2021). The mentioned vector-habitat association study share the same study population as Aure and colleague (2021). It was confirmed the benefit of remote sensing and Geographic Information System (GIS) mapping in determining the influence of environmental factors on the distribution of malaria vectors in Sudan (Ageep et al., 2009).

In northern Iran, it was noted that interspecific associations between species affect the ecology and development of mosquito larvae because of competition for food, exposure to predators and susceptibility to pesticides (Nikookar et al, 2017). It was also observed that the presence of *Culex* was a risk factor for *Anopheles* breeding (Byrne et al., 2021). A study In Southwest Ethiopia found that anopheline larvae were more abundant in shallow, temporary habitats and the absence of competitors and predators (Mereta et al., 2013). In characterising mosquito larval habitats, claimed that human behaviour and activities accounted for most of the mosquito breeding habitats in Qatar (Alkhayat et al., 2020).

CONCLUSION

The main limitations of this study were the non-parametric distribution of larval habitats and relatively low to nil larval counts. The most prominent breeding sites of *An. balabacensis* were intermittent streams, puddles and artificial containers found in rubber tree plantations and forests. Larval habitats, except large artificial (water storage) containers, were subject to inundation following heavy downpours. The present study indicates a significant relationship between physicochemical parameters such as shadiness, absence of water vegetation, temperature, pH, EC and *Anopheles* larvae distribution and abundance. Some other factors which have not been obtained such as distance to the nearest house, presence of predators, and organic content of the larval habitats may also play a role in defining the associations between the environment and vector populations. Large scale and more systematic methods are needed to fully understand the factors influencing mosquito larval breeding sites for effective planning and implementation of the vector control strategy.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article.

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CASE REPORT

A Case Series of Complex Pelvic Abscesses: Importance of Early Recognition and Institution of Individualised Treatment

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ABSTRACT

Pelvic abscesses are collections of pus localized within the pelvic cavity. It may arise from intraabdominal abnormalities or a cranial extension of deep anorectal sepsis. Early recognition and diagnosis, often challenging, facilitates expedient definitive management of potential life-threatening sepsis. We describe the clinical presentation of three patients diagnosed with pelvic abscesses. The management strategies employed for each patient differed, and we described a patient-centred approach to address the underlying problem. Clinical suspicion and meticulous clinical assessment are essential for accurate and early diagnosis. Radiological and laboratory investigations can be helpful to confirm the diagnosis and aid in planning for its immediate management and subsequent definitive treatments. Meticulous attention should be paid to identifying the problem, as this will determine the best management strategy. By addressing the underlying problem adequately, we would avoid future recurrence. A pelvic abscess can be diagnosed early with a high clinical index of suspicion and confirmed with appropriate investigations. Complex pelvic collections can originate from various sources, and establishing the exact aetiology may often be difficult. A multidisciplinary approach to holistic and patient-centred care effectively achieves good patient outcomes.

INTRODUCTION

Pelvic abscesses are collections of pus localised within the pelvis, and they can be categorized according to their anatomical location relative to the levator ani and intraperitoneal or extraperitoneal compartments of the pelvis. These collections could arise as a sequela of previous surgery. However, they can also occur spontaneously due to inflammatory and infective causes, particularly from the gastrointestinal tract, such as diverticulitis or appendicitis, or gynaecological causes such as pelvic inflammatory disease and tubo-ovarian abscess (Bugg et al., 2016). Such causes typically accumulate in intraperitoneal pelvic recesses such as the Pouch of Douglas, but pelvic abscesses could also result from cranial extension of deep anorectal sepsis. Conversely, abscesses that result from pathology above the pelvic floor or supra-levator compartment can extend to the perineum by tracking through the intersphincteric space or extrasphincteric fistula (Oikonomou et al., 2019). Patients with these deep-seated infections present with vague symptoms and subtle signs that are typically beyond the detection of physical examination. Clinicians, therefore, need to adopt a high index of clinical suspicion for the condition, particularly in high-risk immunocompromised individuals who present septic and systemically unwell, disproportionate to their initial presentation of an apparent localised perianal abscess, as unrecognized cases may result in delayed treatment and could lead to significant morbidity and mortality. Regardless of the underlying pathology causing the formation of the pelvic collection, the priority of management is sepsis control once the patient has been adequately resuscitated. Emphasis should be placed on defining the exact location of the abscess as this provides crucial pointers to the site of the primary pathology and thus allow planning for the type of intervention and the optimal surgical approach.

CASE PRESENTATION

We describe the clinical presentation of three patients diagnosed with pelvic abscesses managed by the colorectal team after initial admission through acute surgical services.

Patient A

A 75-year-old gentleman without previous medical problems presented to us with perianal swelling and pain for one week. He was tachycardic and dehydrated. Perianal examination revealed a tender and swollen right perianal region with overlying soft tissue inflammation. He did not have abdominal pain or tenderness. Blood investigations revealed raised total white count (TWC) and C-reactive protein (CRP). The patient was commenced on second-generation cephalosporin antibiotics and metronidazole with analgesics in the emergency department and underwent surgical treatment in the form of incision and drainage of the perianal abscess the following day. Despite daily irrigation of the wound and dressing changes, there was persistent purulent discharge from the perianal incision. The patient was otherwise well, with normal systemic physiological parameters. With a persistently raised TWC and CRP, we suspected a pelvic collection, and this was confirmed on a contrast-enhanced Computed Tomography (CT) scan, which showed a left paracolic abscess collection with a thickened adjacent colon, as illustrated in Figure 1. There was no evidence of free intraperitoneal gas or visceral perforation. The patient underwent image-guided percutaneous drainage of the localized collection, and he was subsequently discharged from the hospital five days later with oral cephalosporin and metronidazole.

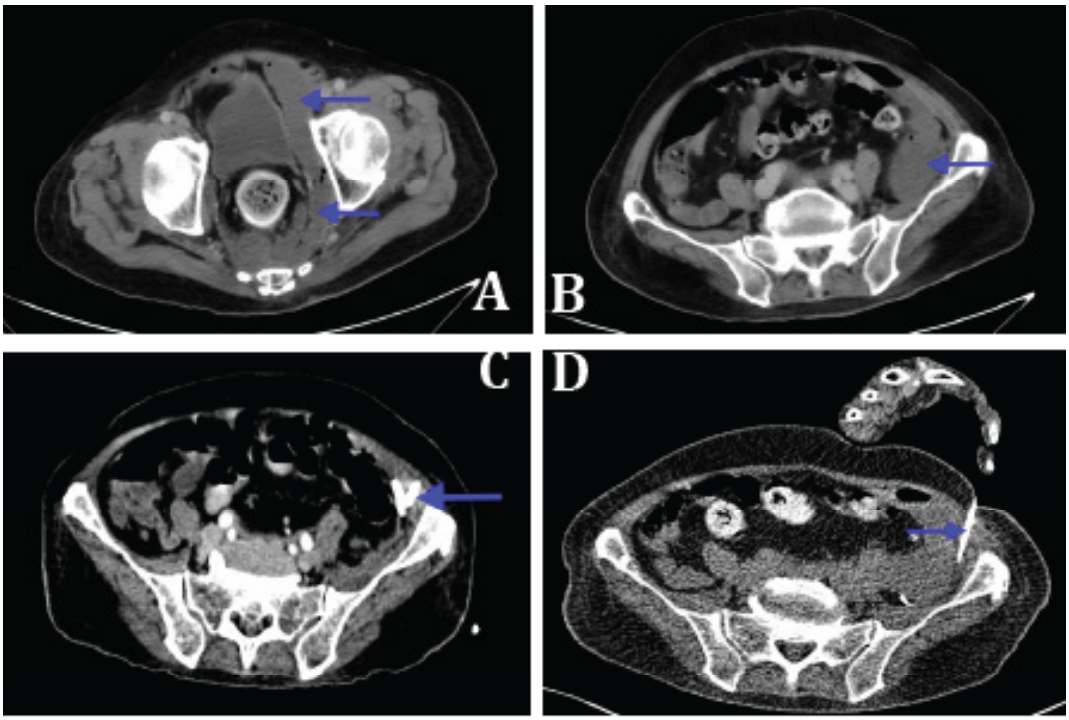

Figure 1 Axial images of CT Abdomen and Pelvis for Patient A. CT performed after noted persistent purulent discharge from the perianal incision. Perianal abscess collection extends into the pelvis and leaves the paracolic region, as demonstrated by blue arrows (A and B). CT- guided approach to drain the intraabdominal collections (C). Resolution of collections prior to hospital discharge (D).

Patient B

A 61-year-old gentleman presented to the Emergency Department with abdominal pain, abdominal distension, and vomiting. He was a poorly compliant insulin-dependent diabetic but was not ketoacidosis at presentation. Physical examination revealed abdominal tenderness and localized guarding over his lower abdomen. His TWC was 13 000 × 10^9/L, and the CRP level was 25 mg/dL. A plain abdominal radiograph showed dilated bowels, and his CT scan showed dilatation of small and large bowels, with a possible transition point to suggest mechanical intestinal obstruction of the descending colon. During laparotomy, the minimal purulent fluid collection was seen in the retroperitoneal space after mobilization of the left colon. A thorough washout was performed, and a drain was inserted. After a few days in the ward, he complained of perineal pain, and upon examination, he had developed a perineal abscess collection. This was treated with open drainage under anaesthesia. Despite multiple courses of antibiotics, he had persistent fever, abdominal pain, distension, and persistently raised inflammatory markers. A contrast-enhanced CT scan revealed a supra-levator pelvic collection that extended caudally to the perianal region (Figure 2). A second planned exploratory laparotomy was performed six weeks later, where the extraperitoneal supra-levator space was explored by dissecting through Waldeyer's fascia, and a large abscess cavity was encountered. The abscess cavity was drained, debrided, and lavaged. The patient had a stormy recovery immediately post-operative due to his deconditioned state with malnutrition, comorbidity, and labile glycaemic control due to sepsis and short-term dependence on parenteral nutrition. Through close multidisciplinary collaboration with infectious diseases specialists, intensivists, endocrinologists, dieticians, and rehabilitation services, the patient eventually made a good recovery, and he was subsequently discharged home following an inpatient hospital stay of 5 months.

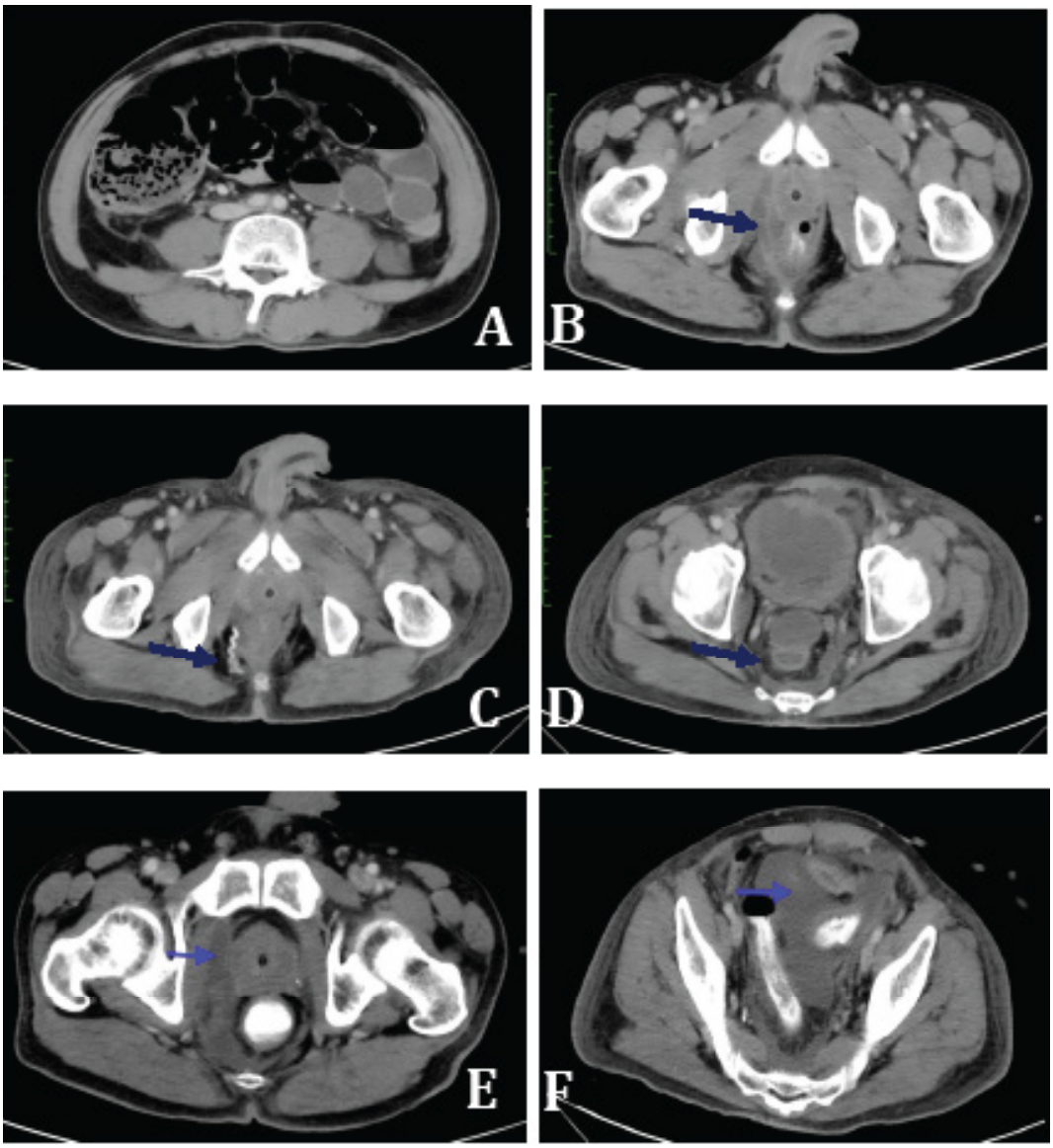

Figure 2 Axial images of CT Abdomen and Pelvis for Patient B. CT scan done upon presentation shows generalized dilatation of small and large bowels (A) with small pelvic abscess (B). Images from repeated CT scans (note the corrugated drain after incision and drainage of the perianal abscess were performed (C) after non-resolved abdominal sepsis, which shows the increased size of the ischiorectal abscess (D+E) with extension to the pelvic cavity (F) as shown by the blue arrows.

Patient C

A young 32-year-old male presented with a complaint of perianal swelling for three days which was associated with high-grade fever and dysuria. Physical examination revealed tenderness and guarding of his lower abdomen. His blood tests showed a TWC of 20 000 × 10^9/L and a CRP level of 20 mg/dL. A CT of the abdomen and pelvis was arranged as there was a clinical suspicion of an abdominal/pelvic collection, and this confirmed an extraperitoneal collection communicating with a high trans-sphincteric fistula (Figure 3). The patient was unwell with systemic sepsis despite antibiotics, and a decision was made for an exploratory laparotomy and drainage of his perianal collection during the same setting. During laparotomy, the rectovesical pouch was bulging and fluctuant. The peritoneum was incised, and pus was drained from a horseshoe-shaped cavity that extended from the space

of Retzius anteriorly to the presacral space posteriorly. The cavity lined with slough was lavaged, debrided, and a pelvic drain was inserted to prevent reaccumulation of fluid. He recovered well post-operatively and was discharged with daily dressings to his perineal wound.

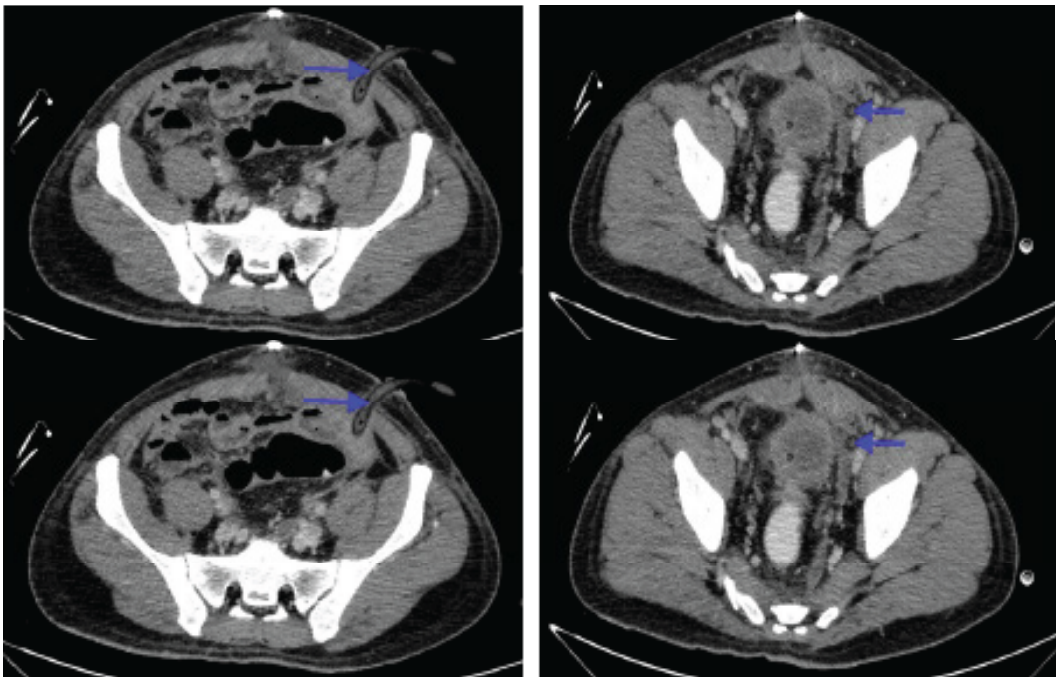

Figure 3 Images of CT Abdomen and Pelvis for Patient C. Axial (A) and coronal (B) image of CT scan during the presentation, which shows left ischiorectal abscess extending to pararectal space. Post-intervention (exploratory laparotomy and washout) as indicated by midline wound staples and drain (blue arrows) image (C+D) showing resolution of abscess before removal of drain and discharge.

Clinical Outcome and Follow-Up of the Patients

All the patients in this series had repeat contrast-enhanced CT imaging to confirm the resolution or absence of pelvic collection two to three weeks following definitive treatment. All patients were discharged when they were systemically well, could tolerate an oral diet, required simple analgesics for pain control, and were self-caring. The patient demographics and their outcomes are summarized in Table 1. Patients A and B subsequently returned three months later for elective colonoscopy. Patient A was found to have diverticular disease, particularly affecting the left side of his colon. Patient B's colonoscopy was routine, and no colonic pathology could have contributed to his illness. Unfortunately, patient C defaulted on all his scheduled outpatient appointments, and he was lost to follow-up.

Table 1 Patient demographics and summary of the three patients presenting acutely with pelvic abscess

	Patient A	Patient B	Patient C
Age	75	61	32
Ethnicity	Chinese	Malay	Indonesian
Diabetes	No	Yes	No
Presentation	Perianal swelling	Abdominal pain	Abdominal Pain and Perianal swelling
Imaging	CT scan after surgery	CT Scan on presentation	CT scan on presentation
Management	Radiologically guided percutaneous drain transabdominal Open drainage transperineal	Surgery- Open drainage of collection via a transabdominal and transperineal approach (2 days apart)	Surgery –, Open drainage of collection via a transabdominal and transperineal approach
Procedure	Percutaneous drainage	–	–
Tuberculosis and Meleidosis workup	Negative	Negative	Negative
Virology screening	Negative	Negative	Negative
Cultures	*E. Coli*, *Enterococcus Faecalis*	*E. Coli* *Klebsiella Pneumoniae*, *Pseudomonas Aeruginosa*	*E. Coli*, *Klebsiella Pneumoniae*, *Enterococcus Faecalis*
Colonoscopy	Diverticular disease	Normal	Not done

Due to the patients' atypical presentations, all three patients in our series had screening tests for Mycobacterium tuberculosis in the form of the Mantoux test, chest radiograph, and three consecutive sputum Acid Fast Bacilli (AFB) cultures. All of these tests yielded negative results. The patients also consented to viral screening for HIV, Hepatitis B, and C, all of which returned negative results. Serum and purulent fluid sent for melioidosis were also negative. The microbiology profile from the pus obtained from all three patients cultured *Escherichia Coli*, whereas *Klebsiella Pneumoniae* was cultured from Patients B and C and *Enterococcus Faecalis* in patients A and C. In addition, *Pseudomonas Aeruginosa* was cultured from patient B.

At the six-month follow-up, patients A and B remained well and resumed their normal daily activities. On physical examination, all surgical wounds have completely healed. There have been no reports of symptom recurrence, and none have had subsequent inpatient readmissions. However, patient C defaulted on all his scheduled follow-up appointments in outpatients, and consequently, we lack further follow-up data.

DISCUSSION

The pelvic abscess is a collection of infected fluid in the pelvic cavity. It is often caused by an infection originating from the pelvic organs, but it could arise from an inflammatory process affecting adjacent structures, such as appendicitis or diverticulitis (Bugg et al., 2016). Literature has also reported pelvic abscesses arising from secondary extension from anorectal sepsis (Oikonomou et al., 2019). Therefore, it is vital to have a high level of suspicion to allow early recognition of such a condition upon a patient's presentation. Aside from the usual signs of fever and lower abdominal pain, subtle symptoms such as diarrhoea or vaginal discharge and elevated inflammatory markers should raise the suspicion of a pelvic abscess (Benigno B. B.,1981). Conversely, some patients may present innocuously with a perianal abscess

and appear clinically well, but persistent discharge, despite initial surgical drainage and raised inflammatory markers, should alert a clinician to the possibility of a concurrent pelvic abscess. Failure to identify and recognise such subtle clinical signs early may lead to high morbidity and mortality.

CT scans are invaluable in establishing a prompt radiological diagnosis and planning non-operative and operative treatment options for these patients. In addition, contrast-enhanced CT scans provide the essential roadmap to guide the best surgical approach to ensure all pre-operatively identified abscess cavities are appropriately managed intraoperatively (Salem et al., 2005). Our case series highlights the importance of paying careful attention to the surgical anatomy based on contrast-enhanced CT findings, particularly in patients B and C, where pre-operative CT guided the surgical team to explore the retroperitoneal and pelvic extraperitoneal spaces during a subsequent laparotomy to manage the pelvic collections appropriately.

The development of pelvic abscesses has been linked to the spread of cryptoglandular perianal infections in the cranial direction. This could be explained by the presence of ischio-anal fat fibres, which have been demonstrated to extend from the perianal skin to the obturator internus and levator ani at the transverse level above pubic symphysis (Zhang et al., 2017). In addition, several reports of patients re-presenting with delayed retroperitoneal collections following surgical drainage of perianal abscesses (Hanley, 1979; Zaveri et al., 1987). In our case series, all of our patients presented concurrently with pelvic and perianal abscesses, suggesting a high likelihood of the presence of an underlying fistula based on the surgical and clinical findings. However, irrespective of fistula formation, we prioritised sepsis control in our management plan for our patients, and this was achieved through thorough and careful intraoperative exploration to ensure all collections were addressed and drained adequately. We believe that achieving sepsis control allowed spontaneous closure of any pre-existent fistulous communication.

Since infections arising from the perianal region can extend cranially, by inference, primary pelvic infections could similarly extend caudally to cause perianal collections. Fistula formation is a known complication of acute diverticulitis, and colo-vesical and colo-uterine fistula is more commonly described (Mitra et al., 2015). Colo-cutaneous fistula is very rare, accounting for about 1% of the fistulous communication arising from colonic diverticular disease. Amor et al. (2015) reported a patient with a colo-cutaneous fistula, where the patient was re-presented with a perianal abscess one month after an initial presentation with acute diverticulitis. In our case series, it is plausible that patient A, who has a left-sided colonic diverticular disease, could have developed the pelvic abscess following an acute attack of diverticulitis. However, we cannot substantiate this further, given that he had no prior hospital admissions.

Various approaches, such as transabdominal, transvaginal, transrectal, and transgluteal routes, have been described to drain pelvic collections depending upon anatomy, the complexity of the pathology, and accessibility (Robert et al., 2013). Drainage procedures commonly performed through laparotomy have been the default management for complex pelvic abscesses in the past, but of late, percutaneous image-guided drainage has been recognised as an effective treatment modality. This was exemplified by Patient A in our case series, who had a complete resolution of his pelvic abscess with image-guided percutaneous drainage. In addition, this modality is beneficial in patients unsuitable for surgical drainage due to the complexity of anatomy, patient frailty, or poor fitness for surgery (Men et al., 2002). There have also been reports of percutaneous drainage being used for immediate sepsis control as a bridge to planned semi-elective

surgery, especially in high-risk and unstable patients (Abbass et al., 2013).

Understanding the virulence and invasive characteristics of the pathogen involved is important to understand the extent of a complex pelvic abscess infection. *Adherent-invasive Escherichia Coli* (AIEC), found even in healthy colonic mucosa, can invade epithelial cells, weaken them, increase their translocation, and exacerbate their pathogenicity (Smith et al., 2013). Meanwhile, hypervirulent *Klebsiella pneumoniae* found first in Asian individuals residing as the gut pathogen is also understandably the cause of invasive abscesses. Multiple cases of tissue invasion and metastatic abscesses have also been reported (Choby et al., 2020). This may be the case in our patients as both these two organisms have been grown in their pus cultures and further highlighting the importance of isolating the pathogen to treat these complex cases successfully.

CONCLUSION

A pelvic abscess can be diagnosed early with a high clinical index of suspicion and confirmed with appropriate investigations. However, complex pelvic collections can originate from various sources, and establishing the exact aetiology may often be tricky. Regardless of aetiology, the priority of managing such patients is sepsis control. A multidisciplinary approach to offering holistic and patient-centred care effectively achieves good patient outcomes.

CONFLICT OF INTEREST

The authors declare that they have no competing interests in publishing this article and that this study has received no financial support.

CONSENTS

The authors have obtained approval from the colorectal unit scientific board as well as written consent from each of the patients involved to publish this case report. A copy of the written consent is available for review by the Chief Editor.

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