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HEALTH SCOPE²⁰²⁴

The Official Research Book of
Faculty of Health Sciences
Universiti Teknologi MARA



The Official Research Book of Faculty of Health Sciences

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Published by:

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Professional Healthcare Enhancing Life

Healthscope 2024 Volume 7(1)

The Official Research Book of Faculty of Health Sciences

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Preface

Healthscope (e-ISSN: 2735-0649) is a peer-reviewed and evidence-based scientific research book published by Faculty of Health Sciences, Universiti Teknologi MARA, Puncak Alam Campus, Malaysia. The research book's mission is to promote excellence in health sciences and a range of disciplines and specialties of allied health professions. It welcomes submissions from academic and health professionals' community. The research book publishes evidence-based articles with solid and sound methodology, clinical application, description of best clinical practices, and discussion of relevant professional issues or perspectives. Articles can be submitted in the form of research articles, reviews, case reports, and letters to the editor or short communications. The research book's priorities are papers in the fields of Physiotherapy, Occupational Therapy, Optometry, Medical Laboratory Technology, Environmental Health & Safety, Nursing, Nutrition & Dietetics, Medical Imaging and Basic Sciences. Relevant articles from other disciplines of allied health professions may be considered for publication.

Dr. Norhisham Haron

Chief Editor

Healthscope

The Official Research Book of Health Sciences

Universiti Teknologi MARA

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RESEARCH ARTICLE

Evaluating the Impact of Parent-Child Communication on Self-Esteem Among Adolescents with Learning Disabilities

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Abstract:

Parent-child communication plays a crucial role in adolescents' psychological well-being, particularly influencing self-esteem. Adolescents with learning disabilities (LD) often face difficulties in building self-esteem, making effective parental communication vital. This cross-sectional study explored the relationship between parent-child communication and self-esteem in 120 adolescents with LD from the *Program Pendidikan Khas Integrasi (PPKI)* schools in Selangor, Malaysia. Participants were selected using purposive sampling, with inclusion criteria of adolescents aged 13-19, diagnosed with LD, and living with their parents. Adolescents who could not complete the survey or had additional physical disabilities were excluded. Data were gathered using self-administered questionnaires namely the Parent-Adolescent Communication Scale (PACS) and the Malay Version of the Rosenberg Self-Esteem Scale (M-RSES). Parental consent was obtained, and the questionnaires were distributed electronically via WhatsApp, with a one-week submission period. The results showed a statistically significant but weak positive correlation ($r = 0.206$, $p = 0.024$) between effective parent-child communication and self-esteem in adolescents with LD. This finding underscores the importance of fostering supportive communication within families to enhance the self-esteem of adolescents with learning disabilities.

Keywords: Children, Communication, Learning disabilities, Parent, Self-esteem

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1. INTRODUCTION

Adolescence is a transitional phase from childhood to adulthood. In the Malaysian context, the definition of adolescence lacks consistency, often varying across different studies and institutions. While the World Health Organization (WHO) defines adolescents as those aged 10 to 19 years, Malaysian data collection frequently uses narrower age ranges. For instance, the 2017 National Health and Morbidity Survey included adolescents aged 13 to 17 years for the Health and Mental Health surveys, while the Nutrition Survey focused on those aged 10 to 17 years (UNICEF, 2018). This rapid phase of human development involves not only age but also significant physical, neurodevelopmental, psychological, and social changes. The high energy, rapid changes in interests, physical growth, and limited emotional insight characteristic of adolescence can create challenges and emotional problems, heightening the need for social acceptance. For children with learning disabilities, navigating this transitional phase and achieving social acceptance is even more difficult (Pandy, 2012).

In Malaysia, learning disabilities (LD) are defined in broad generic terms (Dzalani & Shamsuddin, 2014). LD

refers to individuals whose intellectual ability does not align with their chronological age and who exhibit significant difficulties in performing daily activities. Conditions included under this category are global developmental delay, Down syndrome, ADHD, autism, intellectual disability, slow learner, and specific learning disability (Dzalani & Shamsuddin, 2014). According to DSM-5, these disorders have a biological basis and manifest early in development, marked by impairments that disrupt normal developmental processes. This leads to delays in personal, social, academic, and occupational functioning. Individuals with learning disabilities consistently face challenges with fundamental academic skills, including listening, spelling, speaking, reading, comprehension, and mathematical reasoning. These difficulties impede their ability to fully function in school, resulting in lower-than-expected academic performance (Dzulkifli, 2023).

This study refers to learning disabilities (LD) throughout, focusing on specific learning challenges that affect academic performance. According to *Data Pendidikan Khas*, approximately 4,711 secondary school students in Selangor have been identified with learning disorders and are enrolled

in the *Program Pendidikan Khas Integrasi (PPKI)*, a special education integration program designed to provide tailored support for students with diverse learning needs (Kementerian Pendidikan Malaysia, 2019).

Apart from facing academic challenges that can negatively impact their self-esteem and make them more susceptible to experiencing failure, adolescents with LD also struggle with expressing their emotions (Abraham, 2010). They often find it difficult to calm themselves, interpret non-verbal cues, and understand body language, which can lead to difficulties in daily social interactions (Abraham, 2010). A few studies have explained that, in addition to adolescents with learning disabilities (LD) experiencing low self-esteem due to poor academic achievement, the low quality of perceived communication within the family is also a factor that contributes to their low self-esteem (King et al, 2002; Ahmad & Ansari 2022).

Previous studies have shown that during adolescence, a child's self-esteem is significantly influenced by how they are treated by others, particularly by their parents (Orth, 2018). According to Bireda & Pillay (2018), open parent-child communication is one aspect of good parent-child relationships that play crucial roles in sustaining the healthy function of children's development. This parental transparency of communication is theoretically linked to increased adjustment in children and youth (Heiman, Zinck, & Heath, 2008). Various studies also suggest that an enhancement in the quality of communication between a child and a parent reduces the risk of low self-esteem among children (Bireda & Pillay, 2018; Alesi, Rappo, & Pepi, 2012; Bulanda & Majumdar, 2009; Heiman et al., 2008). Moreover, the quality of communication within adolescents with a learning disability has a positive influence on their self-esteem.

Self-esteem is an attitude towards oneself that has been considered the highest phenomenon in the psychology area (Lachowicz-Tabaczek & Sniecinska, 2011). Self-esteem is composed of two key elements: knowledge and self-awareness (Petkova, 2018). This includes difficulties in differentiating an individual's perceptions of their abilities, attitudes, strengths, and weaknesses (Ahmad & Ansari, 2022). Moreover, as individuals transition from childhood to adolescence, self-esteem plays a crucial role in adolescent development. Self-esteem is also considered as the basis of self-awareness, where it acts as a key in mental health as well as the goal for achieving the quality of life. In the development of the adolescents, the process of developing and formatting the self-esteem can determine the relationship between the adolescents and the world.

Developing a practical approach will help adolescents become more adaptable in life by building adequate self-esteem. This process can begin within the home environment. For example, parents can support their children in overcoming communication difficulties by providing

honest and clear answers to any questions, even on sensitive, moral, or social issues. Parents play a crucial role in helping adolescents build their self-esteem. When parents communicate effectively with their children, it shows that the parents respect them, and the children will feel heard and understood by their parents. Thus, it can help adolescents improve their self-esteem, where an improvement in self-esteem will influence adolescents' performance and their competency in school (Petkova, 2018).

As children go through adolescence, they are exposed to many different opportunities, stressors, and challenges. A crucial factor in handling these challenges is positive and high self-esteem. Sternke (2010) reported that for adolescents to get the chance of happy and satisfying adulthood, they need to develop positive and high self-esteem. One study found a relationship between open communication between parents and adolescents and the development of self-esteem (Ochoa et al., 2007). The study emphasized that the quality of communication, particularly openness and transparency, plays a crucial role in adolescent psychological adjustment. It demonstrated that adolescents who experienced open, supportive communication with their parents reported higher self-esteem and a stronger sense of self-worth. The researchers highlighted that this positive communication reduced emotional distress and contributed to better adjustment during adolescence, particularly in school and social settings (Ochoa et al., 2007). This supports the idea that effective parent-child communication is integral to the development of self-esteem, especially in vulnerable groups like adolescents with learning disabilities. Communication allows us to communicate with people to develop a mutual and good understanding with each other as communication is an essential human language to receive and send information. Besides, a person's perception of themselves and self-esteem can be affected by communication (Gaseesai & Cha, 2012). Non-verbal communication from family or parents plays a massive role in adolescents' self-esteem. Smiling, a soft touch, or voice are examples of positive non-verbal communication that shows acceptance and security to the other party (Pandy, 2012).

A positive relationship between family functioning, parental support, and adolescent self-esteem has been demonstrated in many studies (Marta, 1997). Research shows that parents are the most influential figures in adolescent relationships (Laursen, 2014). Additionally, adolescents tend to be closer to their mothers, often spending more time and sharing their feelings with them (Steinberg & Silk, 2002). Supportive and encouraging parental involvement has a direct influence on an adolescent's self-esteem, regardless of whether they are diagnosed with a learning disability, as effective family communication helps maintain high self-esteem. Thus, many studies reported that the solution to the problem of negative self-esteem is

positive and frequent family involvement (Delp, 2003; Du et al., 2017; Teoh & Afiqah, 2010; Mulyadi et al., 2016; Pandey, 2012; Sharma, 2014).

The emotional and social difficulties of students with learning disabilities (LD) can be long-lasting, with negative impacts extending into adulthood and affecting their psychological well-being (Kauffman et al., 2017; Pullen & Pullen, 2016). However, there are limited studies in Selangor that investigate parent-child communication and the level of self-esteem among adolescents with learning disabilities. Therefore, this research aims to examine the relationship between parent-child communication and self-esteem in adolescents with learning disabilities. It is hypothesized that there is a significant positive relationship between parent-child communication and self-esteem among adolescents with learning disabilities. Additionally, it is expected that there will be no significant difference in parent-child communication between male and female adolescents with learning disabilities, nor a significant difference in self-esteem between male and female adolescents with learning disabilities.

2. MATERIALS AND METHODS

A cross-sectional survey design was implemented in selected schools with the secondary school, Program Pendidikan Khas Integrasi (PPKI) in the Selangor area. Permission to conduct the research was granted by the Ministry of Education [Reference: KPM.600-3/2/3-eras(6687)], Jabatan Pendidikan Negeri Selangor [Reference: JPN.SPD.600-1/1/2.JLD.4(26)], the Research and Ethics Committee (REC) of UiTM Shah Alam [Reference: REC/666/19], and the Faculty of Health Sciences, UiTM Puncak Alam. Parental consent was required for children to participate in this study because the children are under their parents' care and still need assistance and supervision in making decisions. Parents were asked to fill out an informed consent form. The researcher distributed the questionnaire to parents via the WhatsApp application on behalf of their children, who were the actual participants of the study. The children were required to complete the questionnaire and return it to the researcher within one week. Some participants needed assistance, so the researcher provided clarification over the telephone for any questions they found unclear.

The sample size was calculated using Raosoft software, and 120 adolescents with LD were recruited using purposive sampling, following specific inclusion and exclusion criteria. The inclusion criteria for this study were: adolescents with a specific learning disorder, aged 13-19 years, able to understand and complete the survey in Malay and English, living with their parents, and having parental consent. Adolescents who could not read or write in English and Malay or who had other health conditions such as physical disabilities, blindness, or deafness were excluded.

Parent-child communication was measured using the Parent-Adolescent Communication Scale (PACS) developed by Barnes and Olson (2015). This self-rating questionnaire assesses adolescents' perceptions of communication with their parents and consists of two subscales. The first subscale measures open communication, focusing on factual and emotional information, the degree of understanding, and satisfaction within interactions. The second subscale assesses communication problems, such as reluctance to share information, selectivity, and negative interaction styles. Each subscale contains 10 items rated on a 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree). A higher score indicates better communication in adolescents with learning disabilities. The internal consistency of the subscales is good, with Cronbach's alpha values of .87 for open communication and .78 for communication problems.

Self-esteem was measured using a validated Malay version of the Rosenberg Self-Esteem Scale (RSES) (Abu Bakar & Ismail, 2009), which originated from Rosenberg's study (1979). This 10-item scale measures global self-esteem related to feelings of self-worth and self-acceptance on a 5-point scale (1 = Strongly disagree to 5 = Strongly agree). Higher scores indicate higher self-esteem, while lower scores indicate lower self-esteem. The validated Malay version categorizes self-esteem as low (10-29), moderate (30-39), and high (40-50), with an internal consistency (Cronbach's alpha) of 0.67, compared to 0.77 to 0.88 for the original RSES (Abu Bakar & Ismail, 2009).

Data collected on communication and self-esteem levels among adolescents with LD were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used, and bivariate correlation analysis was conducted to identify the significant association between parent-child communication and self-esteem among these adolescents.

3. RESULTS AND DISCUSSION

3.1. Parent-child communication in LD

Two dimensions of the parent-adolescents communication scale (PACS) was measured using two subscales to measure openness in communication and problem in communication. Descriptive statistics for these items are presented in Table 3.1. Higher scores on the PACS indicate better functioning, openness, and fewer communication problems. The majority of adolescents with a learning disability have an average total score of communication ($M=66.44$, $SD=5.97$).

Table 3.1 Numbers, means and standard deviations for parent-child communication variables

Variables	<i>N</i>	<i>M</i>	<i>SD</i>
PACS			
Openness	120	34.43	7.36

Problematic	120	31.98	5.21
Total Score	120	66.44	5.97

This study result indicates that most adolescents are in the category of average communication with their parents. In both subscales, the openness and problems in communication also suggest an average score. The result supported by the claims of Heiman, Zinck, and Heath (2008) that adolescents with LD reported more problematic communication with their parents, specifically maternal. Heiman et al. (2008) found that adolescents with LD or without LD perceived their mother's involvement in their life is a problem. Their negative perceptiveness might be because they interpreted their parents' interest in their life as an intrusion towards their privacy, thus explained the average score despite having a good parent-child relationship.

3.2 Self-esteem in Learning Disability

Table 3.2 shows the level of self-esteem among adolescents with a learning disability. The interpretation of the score was sub-grouped into three categories for analysis and categorized as 'high': score 40-50, 'moderate': score 30-39, and 'low': score 10-29. Frequencies analysis was carried out to check the frequency level of self-esteem of adolescents, and descriptive analysis data shows that the level of self-esteem of adolescents with LD score ranged from 30-39. The level of self-esteem was non-normally distributed, with skewness of 0.21 (SE = 0.22) and kurtosis of -0.63 (SE = 0.44). The results show a total of 106 (88.3%) adolescents are at a moderate level of self-esteem.

Table 3.2 Frequencies of three level of self-esteem

	Frequency (n=120)	Percentage %
Level of self-esteem		
Low (10-29)	3	2.5
Moderate (30-39)	106	88.3
High (40-50)	11	9.2

Children with LD are often related to and stigmatized with failure, which lowers their self-esteem (Pandy, 2012). According to this study result, adolescents with a learning disability are composed of more moderate self-esteem, with only 2.5% of them in low self-esteem category. Many research has shown that children with LD experienced a lower level of self-esteem due to various factors (Alesi et al., 2012; Delp, 2003; Fozia Shah & Irshad, 2016; Gaetano Rappo, 2014; McArthur et al., 2016; Mulyadi et al., 2016; Parshurami, 2015; Sharaf et al., 2009). Despite those studies, the adolescents with LD in this study are mostly at a moderate level of self-esteem.

The current study found that individuals with LD exhibited moderate levels of self-esteem, which contrasts with previous research that typically reports lower self-

esteem in this population (Alesi et al., 2012). This difference may be due to participants' reluctance or discomfort in sharing their true emotions. Besides, they also have to give an honest answer directly towards the researcher during the telephone interview; thus, the participants preferred to choose neither agree nor disagree as to their answer choice. Hence, the evidence of bias during the data collection might affect the result itself. However, the contrary level of self-esteem of this study with the previous studies, it is still crucial to cater to the issue as prevention from deterioration in the level of self-esteem among the respondents.

3.3 Significant difference between gender and parent-child communication variables among adolescents with LD

The normal distribution of data was determined using the Kolmogorov-Smirnov test. The p -value is 0.0023 ($p < 0.05$) in Kolmogorov-Smirnov test of normality. Based on Table 4.6, the Mann-Whitney U test indicated that the total score of parent-child communication was greater for males ($Mdn = 67$) than females ($Mdn = 65$). The two median total scores of parent-child communications are not significantly different ($U = 1279$, $p = 0.229$). This test failed to reject null hypothesis 3 since p -value > 0.05 ; thus, there is no significant difference between total score parent-child communication and gender among adolescents with LD.

Table 3.3 Mann-Whitney U test on the comparison between gender and total score parent-child communication

Variables	Male (n=85) Median (IQR)	Female (n=35) Median (IQR)	U	Z statistic ^a	P value
PACS					
Total Score	67 (6.50)	65 (8.00)	1279	-1.20	0.229

Many studies state that gender does not make a significant difference between parent-child communications. Expectedly, this study result also accepts the null hypothesis of a significant difference between male and female and parent-child communication among adolescents with LD. The analysis confirms the previous study by Barnes and Olson (2015) that no gender differences between perceived communication with the adolescent's parents despite reports that stated male and female differences in how their parents interacted with them. Other studies by Abraham (2010) also mentioned that there is no significant relationship between parents and LD for adolescents' gender.

The lack of significant differences between male and female adolescents in this study may be explained by developmental psychology theory. Both male and female adolescents, with or without learning disabilities (LD), tend to become more secretive and less open with their parents while increasing disclosure with their friends (Parshurami, 2015). Other than that, the possibility that the parents

communicate with both genders, in the same manner, might be the reason for no significant difference between these two variables.

3.4 Significant difference between self-esteem and gender among adolescents with LD

The normal distribution of data was determined using the Kolmogorov-Smirnov test. The p -value is .035 ($p < 0.05$) in Kolmogorov-Smirnov test of normality. Based on Table 3.4, the Mann-Whitney U test indicated that the total score of self-esteem was greater for males ($Mdn = 35$) than females ($Mdn = 34$) and are not statistically significant ($U = 1380.5$, $p = 0.535$). The test failed to reject the null hypothesis since p -value > 0.05 ; thus, there is no significant difference in the self-esteem total score and gender among adolescents with LD.

Table 3.4 Mann-Whitney U test on the comparison between gender and total self-esteem score

Variable	Male (n=85) Median (IQR)	Female (n=35) Median (IQR)	U	Z statistic ^a	P value
M-RSES					
Total Score	35 (4.00)	34 (5.00)	1380. 5	-0.62	0.535

Throughout many studies conducted, self-esteem and differences in gender also widely discussed. This study suggests that there is no significant difference in the self-esteem score and gender among adolescents with LD. Similar to the study by Abraham (2010), the research found that the level of self-esteem and gender in adolescents with LD were not many differences in the score and was equally affected in both groups. The analysis further supported in a study by Fozia Shah and Irshad (2016), that there is also no significant difference in the level of self-esteem faced by both male and female groups of LD adolescents. The findings might be due to the possibilities of both gender groups experiencing similar difficulties as adolescents with LD. Hence, they might experience similar emotions or feelings too. For example, both males and females with LD had experienced poor academic performance or failure pressure from family or teachers. Thus, clarify the findings between gender and level of self-esteem.

3.5 Association between parent-child communication and self-esteem among adolescents with LD

Based on Table 3.5, the correlation (Spearman's) between parent-child communication and self-esteem is significantly

different from 0 (P -value < 0.05) at a 5% level of significance. Thus, this test rejects the null hypothesis. In other words, there is a significant linear correlation between parent-child communication and self-esteem. The observed correlation coefficient (r_s) is 0.206, which suggests a positive and weak correlation. To conclude, there is a statistically significant, positive, and weak correlation between the two variables among adolescents with LD.

Table 3.5 Correlation between two numerical variables (n=120)

Variables	Level of self-esteem
Parent-child communication	0.206 ^a 0.024 ^b

^a Spearman's rho correlation coefficient

^b P -value

This study result demonstrates a correlation between parent-child communication and the level of self-esteem in adolescents with LD. The analysis confirms the alternative hypothesis of the study that there is a significant association between these two variables. This finding is supported by Delp (2003), who mentioned that the perceptions of significant others, including parents, siblings, and other family members, affect a child's self-esteem and motivation. The study also reported that acceptance of the child's learning disability, along with parents' perceptions, may influence family harmony. Moreover, adolescents or children with LD are concerned with the reactions displayed or communicated by family members (King, et al., 2002). In addition to concern, negative communication, i.e., scowling, shouting, or having an angry facial expression, can make adolescents with LD feel more worthless, fragile, and unloved (Pandy, 2012; Colwell & O'Connor, 2003). The association between parent-child communication and self-esteem in this study shows that expectations portrayed by parents to this vulnerable community might cause them to perform accordingly in building their self-esteem.

4. CONCLUSION

The study provides evidence suggesting that there is a statistically significant positive correlation between parent-child communication and self-esteem in adolescents with LD, with an average score in communication within a family context and a moderate level of self-esteem. The study further discovered that both genders with learning difficulties are equally affected as there is no significant difference in parent-child communication and self-esteem in learning difficulties faced by both gender groups. It is inferred from the study's findings that the quality of parent-child communication is related to an adolescent's well-being. Hence, positive parents' involvement and interaction in adolescents with LD are more likely to be helpful for their proper development into adulthood.

However, it is crucial to transcribe the current study results with several concerns and methodological limitations. First, this study was conducted in a few schools only, and adolescent's views of communication with parents might differ in other contexts, i.e., socially and culturally contextual. Second, as a pandemic (COVID-19) outbreak, the data collection method had to be changed in the halfway through of conducting the study. From being able to present and guide the adolescents holistically, the study was conducted using the telephone interview method. This adjustment was made due to the Movement Control Order (MCO), which the government enforced from 17th March to 9th June 2020, during which the data collection took place. Hence, there may be biases in the self-reported data. Additionally, the study was limited to a small sample of adolescents from a few selected schools. Hence, biases in the self-reported data may be present. Third, the study was limited to a small sample of adolescents from a few selected schools. Lastly, the current sample included adolescents from a specific area in Malaysia. However, some of these study limitations can be beneficial for future research on the same topic. Further research should reexamine these issues with a larger sample size and focus on factors that may influence parent-child communication and self-esteem, such as internal or external factors that could affect the results.

In a nutshell, the results of this study suggest that parent-child communication could play a crucial role in the development of adolescent's self-esteem. As parent's interaction plays a significant role in developing one's self-esteem, Occupational Therapy could suggest family-based intervention as an approach in treatment. Besides, other researchers can use this study as a guidance or a different literature perception regarding parent-child and self-esteem in learning disability adolescents. This study can also be used to determine the adolescents' parent-child communication and self-esteem score; hence, the treatment can be applied accordingly for better intervention programs.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge all the participants and parents of adolescents with LD for their willingness to spend time and participate in this study. Additionally, we extend our gratitude to all the teachers from PPKI for their cooperation, encouragement, and assistance in contacting the parents for this study.

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RESEARCH ARTICLE

Incidence of Low Back Pain Among Janitorial Workers in Hulu Langat, Selangor

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Abstract:

Low back pain (LBP) is a feeling of discomfort or stiffness in the lower back caused by poor work posture, lifting, bending, and other physically challenging tasks. It is one of the musculoskeletal disorders that has been well-studied in various occupational groups, such as farmers, medical staff, truck drivers, and janitors. This study explored the incidence of LBP and how demographic background influences the LBP among janitors in Hulu Langat, Selangor. A cross-sectional study was conducted among 120 janitorial workers in Hulu Langat, Selangor, aged between 25 and 44 years old that was collected through an online questionnaire. Respondents were assessed on a brief working background and the Malay-Standardized Nordic Musculoskeletal Questionnaire. More than half of janitorial workers, ranging 52 to 67 percents suffered LBP with most reported pain areas are at the neck, elbow, and lower back region of the body. To conclude, these body regions were significantly impacted during repetitive activities that involve lifting, flexing, and twisting the trunk during janitorial works. This shows the need to provide ergonomic education and training to improve the workers' awareness about appropriate work hazards and injuries, potentially reducing the deterioration of prolonged LBP and other occupational hazards among janitors.

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Keywords: Janitorial Worker, Low Back Pain, Musculoskeletal Disorder

1. INTRODUCTION

Low back pain (LBP) is a discomfort, pain, or stiffness in the lower back caused by poor work postures, lifting, bending, and other physically challenging job tasks (Kovacs et al., 2003). Depending on the location of the lesion on the spine, this condition is a subset of back pain, defined as an acute or chronic intermittent pain that can transmit to the lower limbs or upper body parts (Yunoos & Dankoly, 2021). Furthermore, it affects the lumbar spine, the third area of the spinal column, also known as the backbone, that provides structural support, protects particular body tissues, supports body weight, and allows for waist bending, extending, and rotation (Alessa & Ning, 2018).

LBP is one of the most severe global public health issues (Erdem, Erken & Aydogan, 2018) which was found to be one of the musculoskeletal disorders that have been well-studied in a range of occupational groups, such as farmers, medical staff, truck drivers, and janitors (Omokhodion, Umar & Ogunnowo, 2000). Sanitation work is physically and mentally demanding, and it frequently exposes workers to physical and psychological dangers that raise the risk of job-related accidents (Teran & van Dommelen-Gonzalez,

2017). A study by Lim et al. (2021) reported that based on their multiple hazardous job duties and frequent non-fatal injuries, janitorial workers are one of the high-risk categories for developing work-related musculoskeletal disorders (WRMSDs).

Janitors are classified as elementary jobs in the Malaysia Standard Classification of Occupations (MASCO-13) since the workers undertake simple and routine chores that mainly demand handheld instruments and, in some cases, are considered physical exertion (Ministry of Human Resources, 2013). The tasks include sweeping, vacuum-cleaning floors and furniture, cleaning and disinfecting toilets and windows, and any other tasks that require manual performance. This exposes the janitorial workers to occupational risk and significant physical workload. Surprisingly, local news reported four out of five janitorial workers will experience LBP at some point in their lives due to usual work practices with improper handling and neglecting potential work hazards (The Star, 2020).

In addition, LBP was reported as the most common cause of activity limitation and work absenteeism among adult workers (Driscoll et al., 2014) and results in a vast medical

burden and significant financial expenses for individuals and employers (Hartvigsen et al., 2018). In Malaysia, there have also been an increasing number of cases among workers over the years. The Malaysian Social Security Organization (SOCSSO) highlighted there were 14 occurrences of musculoskeletal disorder (MSD) affecting lower back pain documented in 2006, and in 2011, there were 268 cases (Murad et al., 2013). Selangor recorded the highest number of workers in elementary occupations in Malaysia (DOSM, 2020), which supports this study's being conducted in Hulu Langat, Selangor. Workers' safety and health may be in danger if they are unaware of potential ergonomic risk factors in their physical surroundings and work practice (Tee et al., 2017).

In terms of the work pattern of janitorial workers, lifting and carrying heavy objects (Gawde, 2018), awkward posture, psychosocial job demands and job dissatisfaction (Zahid et al., 2017), repetitive movement, and static workload (European Agency for Safety and Health at Work, 2008), have all been identified as significant risk factors for LBP. Other factors which are noted to be predictors of LBP too include not doing regular physical exercise, dissatisfaction with the working environment and culture (Beyen et al., 2013), duration of employment, pulling and pushing heavy loads, bending and working with twisted trunks (Zungu, 2015), alcohol consumption, and lack of rest (Wanamo et al., 2017). These findings indicate that janitors are statistically more likely to face an occupational injury, including LBP, due to their physically demanding jobs.

Naik & Khan (2020) also identified a postural risk of musculoskeletal disorders among mopping professionals in India, with musculoskeletal injuries occurring commonly in the right hand, shoulder and wrist, lower back, and left wrist and biceps regions. On top of that, Shukriah et al. (2017) studied musculoskeletal disorders in garage workers who performed vehicle maintenance in Malaysia. Based on the biomechanical findings, psychological, ergonomic, and demographic variables are significant causes of musculoskeletal injury. A high percentage of growth, pain, and discomfort were reported in the shoulders, neck, wrist/hand, feet, low back, and waist region. Plus, there is a strong correlation between LBP and repetitive labor, heavy lifting, and older age groups among workers in chemical fertilizer factories in Kedah (Yasin et al., 2020).

Therefore, this study was carried out to address the incidence of LBP and how demographic background influences the LBP among janitors in Hulu Langat, Selangor.

2. MATERIALS AND METHODS

A cross-sectional study design was adopted in this study to explore the incidence of LBP among janitorial workers in Hulu Langat, Selangor. The Malay-Standardized Nordic Musculoskeletal Questionnaire (M-SNMQ) (Amin et al., 2016) was utilized to obtain the incidence of LBP and pain in the body region affecting the workers, besides getting

several work characteristics that possibly influence this incidence.

Respondents were recruited by using a non-probability purposive sampling method. Purposive sampling was suitable for this study as inclusion and exclusion criteria were needed, which were selected janitorial workers who were employed in Hulu Langat, Selangor, aged 25 to 44 years old, and had been working as janitors for over 6 months. However, janitorial workers who were diagnosed with spinal deformities (such as excessive lumbar or cervical lordosis, increased thoracic kyphosis, and scoliosis), inflammatory disease, or had a history of traumatic injury affecting the musculoskeletal system, pregnant or at the post-menopausal stage have been excluded from enrolment.

The research process commenced by reaching out to various associations and janitor companies in Hulu Langat through email. These communications sought permission to conduct the study among their respective workers. Individuals who provided consent were given a set of self-reported questionnaires through a Google form link. The estimated time required to complete the questionnaire was 15 to 20 minutes, and the collection period was from December 2022 to April 2023.

Ethical approval was obtained from the Research Ethical Committee of Faculty of Health Sciences with reference number FERC/FSK/MR/2022/0272.

Data analysis Using SPSS version 23, demographic data and work information were analysed through descriptive analysis. A chi-square inferential statistical test was performed to determine the difference between the LBP and demographic factors such as gender, marital status, and body mass index, besides testing association in the incidence of low back pain by type of janitorial works with a significance value at $p < 0.05$.

3. RESULTS AND DISCUSSION

3.1. Demographic characteristics of respondents

Table 4.1 shows the demographic data of the participants. The participants were among 120 janitorial workers in Hulu Langat, Selangor. Among them, 73 (60.8%) were men and 47 (39.2%) were women. Respondents were categorized into four groups of body mass index, and 72 (60%) of them were in the overweight category, 28 (23.3%) were in normal weight, 15 (12.5%) were in the obese category, and only 5 (4.2%) were in the underweight group. More respondents ($n = 83$, 69.2%) were already married, whereas only 37 (30.8%) were single. The majority, 51.7% ($n = 62$), had spent 4-6 years on the job, followed by 19.2% ($n = 23$) who had spent 7-9 years on the job, 18.3% ($n = 22$) who had spent 1-3 years on the job, and only 10.8% ($n = 13$) who had spent 10 or more years on the job. Virtually, 88 (73.3%) worked more than 8 hours daily, and only 32 (26.7%) worked less than 8 hours daily. The mean age of the respondents was 36 ± 5 years.

Table 1. Demographic characteristics of respondents

Variables		Frequency	Percentage (%)
Gender	Male	73	60.8
	Female	47	39.2
Body Mass Index (BMI)	Underweight	5	4.2
	Healthy	28	23.3
	Overweight	72	60.0
	Obesity	15	12.5
Marital status	Single	37	30.8
	Married	83	69.2
Years of working	1-3	22	18.3
	4-6	62	51.7
	7-9	23	19.2
	>10	13	10.8
Average working hours per day	<8 hours	32	26.7
	>8 hours	88	73.3
		Mean	SD
Age of respondents (in year)		36	5

3.2. Prevalence of Low Back Pain among Janitorial Workers

The incidence of LBP among janitorial workers in Hulu Langat, Selangor was reported as quite high incidence where more than half respondents reported the pain at almost all of body region were affected with the musculoskeletal complaints. Out of the nine body parts addressed in the questionnaire as illustrated in Table 2, the neck region had the highest complaint of musculoskeletal problems ($n = 81$, 67.5%), followed by the elbow ($n = 76$, 63.3%) and lower back ($n = 71$, 59.2%). Besides, more than half of the respondents experienced pain in the arm ($n = 70$, 58.3%). The upper back region and knee reported the same number of respondents ($n = 69$, 57.5%), respectively. 66 (55%) respondents experienced pain involving the leg, 63 (52.5%) involving the hip and thigh, and the shoulder region reported the lowest prevalence with 49 (40.8%) respondents.

This study indicated the prevalence of LBP was almost as high as the previous most reported pain experienced by janitorial workers, with 59.2% than the study by Wami et al. (2019) with 58.1% of LBP among housekeepers in Gondar town and 56% of LBP among hospital cleaners in Norway (Lasrado et al., 2014). In contrast, other studies among cleaners in Northwest Ethiopia (46.4%) and 28.5% of factory workers in Thailand reported slightly lower incidences than findings from this study (Tomita et al., 2010; Melese et al., 2020). The probable causes include differences in awareness and openness to questions, individual perceptions of pain, cultural differences, workloads, and participant incomes.

Another research done among cleaners at Mikelle University in Ethiopia (Chowdhury et al., 2023) revealed that LBP was the most prevalent among cleaners (34.8%), followed by wrist pain (17.4%). Time pressure, job experience, feeling exhausted, awkward posture, working hours per day, and working more than 2 hours in a sustained position were all

substantially associated with the pain. However, this study finding is lower when compared to a study conducted among Nigerian street cleaners (78.2%) and a study conducted among industrial workers in Dhaka City (62%), which are associated with incorrect body mechanics use, repetitive bending, and continuous long-term sitting risk (Cole & Grimshaw, 2003). One probable explanation is insufficient preventative training in the setting since only half of the workers (50.3%) who participated in the study received job-related health and safety training.

Table 2. Prevalence of musculoskeletal problems among janitorial workers in Hulu Langat, Selangor

Body parts	Frequency (n)	Prevalence (%)
Neck	81	67.5
Shoulder	49	40.8
Elbow	76	63.3
Arm	70	58.3
Upper back	69	57.5
Lower back	71	59.2
Hip and thigh	63	52.5
Knee	69	57.5
Leg	66	55.0

3.3. The Relationship Between Incidence of Low Back Pain and Type of Janitorial Works

Table 3 reveals the relationship between incidence of low back pain with the type of janitorial work through the chi-square test. There was a significant relationship on LBP incidence towards lifting work activity, with $X^2(1, N=120) = 8.420$, $p = 0.004$. Furthermore, this study found a relationship between the incidence of LBP and labor type of work that requires flexing the trunk ($X^2(1, N = 120) = 15.832$, $p = <0.001$), as well as work that requires twisting the trunk, $X^2(1, N = 120) = 17.581$, $p = <0.001$. Finally, this study also discovered that the incidence of LBP had relationship between workers who performed repeated tasks and those who did not: $X^2(1, N = 120) = 7.860$, $p = 0.005$.

According to this study, lifting becomes statistically significant with the prevalence of LBP. This suggests that janitors whose jobs involve lifting are susceptible to developing MSDs, including LBP. This was supported by a study done in Nigeria explained that a typical lifting movement involves two distinct phases: a loading phase in which the subject exerts a vertical force on the object until it moves, and a lifting period in which the mass moves vertically. These lifting movements were frequently performed during janitor works among cleaner that has significant effect on LBP (Yunoos & Dankoly, 2021). Previous study indicated the maximum compressive and shearing pressures are experienced during the early phases of the loading phase, often within the first 0.2 to 0.4 seconds of the lift (Coenen et al., 2013).

During a lift, the body is affected by internal stresses caused by internal pressures, the tautness of surrounding musculature and other passive components, and external stresses caused by the weight of the body segments, the

length of the moment arms, and the load itself. To handle the load's and body parts' combined weight, the worker must generate sufficient internal force to stabilize the trunk and manipulate the load (Coenen et al., 2013). Thus, to lift bigger loads, workers must exert more compressive forces and pressure over the spine and adequate internal forces, putting them at risk of developing LBP.

Although occasionally performed, trunk flexion with a moderate hand load is unlikely to cause immediate injury to the employees' spinal structures. This study demonstrated a strong relationship between repetitive trunk flexion and LBP, consistent (Alessa & Ning, 2018). The human lumbar spine is anatomically divided into two categories of tissues: active tissues (e.g., the contractile component of muscles) and passive tissues (ligaments, fascia, discs, bone, and the non-contractile component of muscles). It has been discovered that during trunk bending, lumbar extensor contraction rapidly diminishes and stops when reaching the bottom range of motion (Ning et al., 2012).

This is related to the flexion relaxation phenomenon (Ning et al., 2012), which signals the complete transition of stress from lumbar active tissues to passive tissues (Shin, D'Souza & Liu, 2009) and is part of the load-sharing synergy between these two types of lumbar tissues. Various factors can influence this load-sharing synergy, including ligament creep produced by prolonged trunk bending (Maurer-Grubinger et al., 2021), the direction and speed of the trunk bending motion, and lumbar muscle exhaustion (Ning et al., 2012). As a result, prolonged and repetitive trunk flexion may cause microdamage to the spinal system, eventually leading to LBP over time (Alessa & Ning, 2018).

Aside from that, this study observed that janitorial workers involved in jobs that needed repetitive twisting of the trunk had a higher risk of experiencing low back discomfort than those who were not (Pataro & Fernandes, 2014; Shan et al., 2013). The possible reason might also be due to non-neutral body postures caused by the occupational twisting involved during cleaning activities such as vacuuming, which forces the erector spinal muscles to contract longer during anterior flexion and extension, reducing the tension ability of passive tissues in the low back area and indicating a higher risk of developing low back pain (Yunoos & Dankoly, 2021).

Table 3. Relationship of low back pain and types of janitorial work

Type of works	Incidence of LBP		X ²	P-value
	Yes n (%)	No n (%)		
Lifting				
Yes	69(63.3)	40(36.7)	8.420(1)	0.004*
No	2(18.2)	9(81.8)		
Trunk Flex				
Yes	68(66.7)	34(33.3)	15.832(1)	<.001*
No	3(16.7)	15(83.3)		
Trunk twist				
Yes	68(67.3)	33(32.7)	17.581(1)	<.001*
No	3(15.8)	16(84.2)		
Repetitive works				

Yes	68(63.6)	39(36.4)	7.860(1)	0.005*
No	3(23.1)	10(76.9)		

Note: Significant value at p=0.05*

3.4. Differences between Demographic Factors with Low Back Pain and Type of Janitorial Works

Table 4 reveals the chi-square test for the difference in the incidence of low back pain with demographic factors. There is a non-significant difference between the incidence of LBP and gender, with $X^2(1, N = 120) = 2.100, p = 0.147$, in which males ($n = 47, 64.4\%$) show a higher prevalence than females ($n = 24, 51.1\%$). Yunoos and Dankoly (2021) observed that males had a higher incidence of LBP than women depending on their capabilities. Men are more likely to be allocated to physically demanding duties such as lifting and gardening than women, who are more typically assigned to sweeping and sedentary home duties. On the contrary, Kahere and Ginindza (2021) discovered female adults in the South Africa (19.8%) had a greater incidence of chronic LBP than males (15.9%). Similar findings by the Spanish National Health Survey (de Pedro-Jiménez et al., 2022), which found that females had a greater prevalence of pain experience that resulted from a greater pain sensitivity among women and are more likely than men to suffer from chronic pain conditions.

Besides, this study found no significant difference between the incidence of LBP and marital status: $X^2(1, N = 120) = 0.002, p = 0.965$. However, the study of Arju et al. (2020) and Ibrahim et al. (2019) showed opposite findings where workers who were married were more likely to develop musculoskeletal disorders, including LBP. The likely cause might be related to their additional responsibility at home of doing household duties besides work demand as janitors. Housework is hazardous and needs a high level of energy compared to other occupational contexts. Arju et al. (2020) described housework entails repeated work and prolonged sitting or standing work in which muscles are contracted for extended periods of time may cause tremendous strain on the human body. Furthermore, excessive posture stretches the posterior longitudinal ligament and causes the pedicles to approach, putting pressure on the nerve roots and desensitizing mechanoreceptors, resulting in a loss of reflex, contraction of stabilizing muscles, and increased load on the spine, all of which contribute to LBP (Arju et al., 2020).

Lastly, for the differences between the LBP and body mass index (BMI), the test was not statistically significant with $X^2(3, N = 120) = 1.350, p = 0.717$, indicating no significant differences between BMI and the incidence of LBP. However, contra findings reported by Siddiqui et al. (2022), which discovered that the majority of LBP cases were found in the obese and overweight categories, besides, a high BMI has a two times greater chance of developing LBP than a person with a normal BMI (Perera et al., 2014). It was evidenced that the spine experiences a greater compressive force due to the increased mechanical load of janitorial work towards their back caused by obesity during various physical activities.

Table 4. Difference in the incidence of low back pain by demographic factors

Variables	Incidence of LBP		X ²	P-value
	Yes	No		
Gender				
Male	47(64.4)	26(35.6)	2.100(1)	0.147
Female	24(51.1)	23(48.9)		
Marital status				
Single	22(59.5)	15(40.5)	0.002(1)	0.965
Married	49(59.0)	34(41.0)		
Body Mass Index				
Underweight	2(40.0)	3(60.0)	1.350(3)	0.717
Normal weight	16(57.1)	12(42.9)		
Overweight	45(62.5)	27(37.5)		
Obese	8(53.3)	7(46.7)		

4. CONCLUSION

This study provides a greater understanding of the occupational hazards that janitorial workers encounter, which exposed them to developing musculoskeletal diseases that include LBP. More than half of janitorial workers suffered LBP with most reported at the neck, elbow, and lower back region of the body, which significantly impacted during repetitive activities that involve lifting, flexing, and twisting the trunk. This shows a need to provide ergonomic education and training to improve their awareness about appropriate work hazards and injuries, potentially reducing the deterioration of prolonged LBP and other occupational hazards among janitors. It also demonstrated the need for a global public health plan for LBP prevention, treatment, management, and research.

Meanwhile, the incidence of LBP is also significant during strenuous work such as lifting, flexing trunk, twisting trunk and repetitive janitorial works. In terms of the influence of demographic factors, this study proved that the gender, marital status and BMI were not significant to the incidence of LBP among janitors.

As the research progresses, it is suggested that future studies widen the scope by including a larger sample size. This adjustment would improve the study's representation of the janitorial workforce and raise the findings' generalizability to a broader population in Malaysia. In addition to the questionnaire, they may consider implementing a physical examination to verify the symptoms and pain stated by the respondents. Given that LBP emerged as a prominent issue in this study, additional research should also be considered into the prevalence of WRMSDs in other body parts. Exploring the occurrence of WRMSDs in regions like the neck, elbows, and arms would provide a more comprehensive understanding of the challenges janitorial workers face and contribute to developing targeted interventions.

ACKNOWLEDGEMENTS

The authors would like to extend gratitude to the janitorial companies and workers for their consent and contribution for this study. The authors express heartfelt gratitude to all individuals who contributed in various ways, whether through moral support or active involvement, to the successful completion of study. The authors declared that there is no conflict of interest involved in this study.

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RESEARCH ARTICLE

Readiness to work after six months post-stroke in Subang Jaya

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Abstract:

The low rate of return to work (RTW) among stroke survivors despite receiving rehabilitation treatment has been documented in few previous studies. This study aims to identify the relationship between demographic profiles and readiness to return to work and also to determine stages of employment readiness to return to work of post-stroke patients after 6 months of intervention. A total of 61 participants of post-stroke patients recruited from five private centers in Subang Jaya participated in the survey with a mean age of 47.57 (SD=5.74), ranging from 36 years old to 55 years old. The LAM Assessment of Stages of Employment Readiness (LASER) is chosen as the main instrument in this study. Chi-square was used to analyze the relationship between demographic data and stages of readiness. Meanwhile, descriptive statistics was used to determine the stages of readiness after 6 months post-stroke. The result showed that the demographic characteristics of gender, marital status, being the sole income of the family, type of stroke, stage of stroke, changes in salary after stroke, age, duration of stroke and duration of therapy received had no significant difference with stages of employment readiness. This study also found that most of the participants are in the pre-contemplation stage (37.7%, n=23) where they might not be ready to return to work yet, followed by the contemplation stage (34.4%, n=21) and lastly, the action stage (27.9%, n=17). In conclusion, health care professions such as occupational therapy should emphasize personalized strategies to address psychosocial barriers, as most stroke survivors remain in early stages of readiness to return to work post-rehabilitation.

Keywords: *post-stroke, readiness to work, return to work (RTW), stroke*

1. INTRODUCTION

In 2019, Powers et al. redefined the definition of stroke based on neuropathological, neuroimaging, and/or clinical evidence of long-term damage. Central nervous system infarction is defined as brain, spinal cord, or retinal cell death associated to ischemia. There are two types of strokes which are ischemic stroke and haemorrhagic stroke. Ischemic stroke specifically refers to central nervous system infarction accompanied by overt symptoms, whereas silent infarction results in idiopathy. Central nervous system infarction occurs across a clinical range. Subarachnoid haemorrhage and intracerebral haemorrhage are likewise generally considered to be stroked (Sacco et al., 2013). Cerebrovascular disease which is another name for stroke is the second most common cause of years lived with a disability worldwide. More than 15 million people worldwide experience the devastating and disabling effects of stroke each year and the spectrum of disability is broad (Roy-O'Reilly & McCullough, 2018). In Malaysia, stroke has become a prominent public health concern, ranking as the third leading cause of death. Disturbingly, statistics from 2019 reveal that there were 47,911 stroke incidents, resulting in 19,928 fatalities, 443,995 prevalent cases, and

512,726 lost Disability-adjusted life years (DALYs) due to stroke (Tan and Venketasubramanian, 2022).

It is noteworthy that strokes are not limited to the elderly population, as young adults between the ages of 18 and 49 account for a significant portion (10% to 15%) of all stroke cases (Egger et al., 2019). Recent studies indicate an increased proportion of stroke patients among younger individuals aged 35 to 44 and 55 to 64, while the number of stroke patients in the 65 to 74 age group has been declining (Hwong et al., 2021). Furthermore, return to work (RTW) rates vary among stroke patients, with different types of strokes exhibiting distinct patterns. Previous study shows that individuals who experienced cerebral infarctions displayed higher RTW rates compared to those with cerebral haemorrhages, indicating the influence of stroke type on employment outcomes (Elloker & Rhoda, 2018).

A study by Schwarz et al. (2017) stated that the rate of post-stroke to RTW is low despite receiving rehabilitation treatment. This statement is supported by a study by Walters et al. (2020) which found most working-age stroke survivors accepted rehabilitation treatments within the first three months, failed to return to work after a year and most reported

low mood and poor quality of life (QoL). On the other hand, a study by Wan Abdullah et al. (2022) found that the RTW rate among injured employees is relatively high, at 60%. However, the study is not specified on the disease, but general musculoskeletal problems and pain caused by their job. However, little research has been conducted specifically on post-stroke employees' readiness to return to work, highlighting the need for further investigation in this area (Wan Abdullah et al., 2022).

This study aims to investigate the stages of employment readiness for RTW in post-stroke patients after six months of intervention, with a particular focus on selected private centers in Subang Jaya. By identifying the relationship between demographic profiles and readiness to return to work, valuable preliminary results can be gained to facilitate successful RTW programs and enhance the overall quality of life for post-stroke individuals.

2. MATERIALS AND METHODS

This was a cross-sectional study where data on the demographic characteristics of a population under study is obtained and analyzed at the same time over certain point in time.

A total of 61 post-stroke survivors from 5 selected private centers within Subang Jaya who agreed and met the inclusion criteria participated in this research study. The inclusion criteria include participants must have undergone treatment or intervention for at least 6 months. Participants must be able to read and understand English well as the questionnaires is only available in English. For the exclusion criteria, the participants who have retired or were unemployed before being diagnosed with stroke are excluded from this study.

There are two sections in the questionnaire forms that the participants must fill in and answered. Section A contains demographic characteristics of the participants which includes age, gender, marital status, the status of sole income of the family, type of stroke diagnosed, stage of stroke, duration of stroke and duration of therapy received.

Section B was the standardized instrument which is LAM Assessment of Stages of Employment Readiness (LASER). The LASER developed by Lam et al. (2010) is to assess a person's psychological readiness to return to work after extended joblessness due in part or entirely by disability. The highest total score in the stages indicates the individual's stage of employment readiness. There are three stages of employment readiness which are Pre-Contemplation, Contemplation and Action Stages. Lam et al. (2010) have explained that in the Pre-Contemplation stage, it is likely most of the time, they don't plan to work anytime soon, for Contemplation Stage, people are aware of the issue and considering the possibilities of change at this point, but they have not yet decided to change meanwhile in Action Stage

they have started acting in ways that indicate they are looking for work, and many of the obstacles to doing so have been eliminated. LASER has utilized 5-point Likert scales which are Strongly Agree, Disagree, Undecided, Agree and Strongly agree. The participants need to choose one of these scales based on how they feel according to the statement.

The data gained from the questionnaires were analyzed by using statistical analysis of the IBM Statistical Package for the Social Sciences (SPSS) Statistics 29 software. Chi-square test was used to identify the relationship between all demographic data and stages of readiness. Kruskal-Wallis test was used to identify the relationship between numerical data of demographic data which is age, duration of stroke and duration of therapy received with stages of readiness to RTW. Descriptive data was used to identify the percentage of stages of readiness of post-stroke patients after 6 months in Subang Jaya.

3. RESULTS

A total of 61 participants who met the inclusion criteria completed the questionnaires. The demographic characteristics of 6-month post-stroke patients are shown in Table 1. Most of the participants were male (59%, n=36), with a mean age of 47.57 (SD=5.74, ranging from 36 to 55) years. Most of the participants are married (86.9%, n=53), followed by single (9.8%, n=6) and divorced (3.3%, n=2). For the stage of stroke diagnosed, the majority is in mild stroke (65.6%, n=40), followed by moderate stroke (26.2%, n=40) and severe stroke (8.2%, n=5). Majority (82%, n=50) is the sole breadwinner of the family. Most participants had ischemic stroke (82%, n=50) followed by haemorrhage stroke (18%, n=11). Most of the participants were diagnosed with mild strokes (65.6%, n=40), followed by moderate stroke (26.2%, n=16) and minority is in severe stroke (8.2%, n=5). For the changes of salary received before and after stroke, majority of participants underwent no changes (54.1%, n=33), followed by lessen compared to before stroke (29.5%, n=18) and lastly not received any salary or unemployed (16.4%, n=10).

Table 1 Demographic characteristics of the participants (n=61)

Characteristic	Frequency (n)	Percentage (%)
Gender		
Female	25	41.0
Male	36	59.0
Marital status		
Married	53	86.9
Divorced	2	3.3
Single	6	9.8
Sole income		
Yes	50	82.0
No	11	18.0
Type of stroke		
Ischemic stroke	50	82.0

Hemorrhage stroke	11	18.0
Stage of stroke		
Mild	40	65.6
Moderate	16	26.2
Severe	5	8.2
Salary before and after stroke		
Lessen	18	29.5
No change	33	54.1
No salary	10	16.4
	Median	IQR
Age	48.00	9
Duration of stroke	2.00	2
Duration of therapy received	1.00	2

3.1. Readiness to Work after 6 months post-stroke

Based on the LASER assessment, the calculation of the score for the three stages of readiness which are pre-contemplation, contemplation and action stages is done. The result showed that most of the participants are in the pre-contemplation stage (37.7%, n=23), followed by the contemplation stage (34.4%, n=21) and lastly, the action stage (27.9%, n=17) as illustrated in Figure 1.

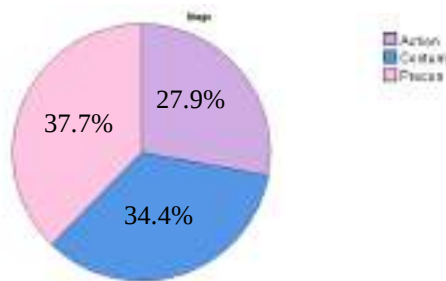


Figure 1. Stages of readiness to Work after 6 months post-stroke

3.2 Association between demographic characteristics with stages of readiness to work after 6 months post-stroke

Table 2 presents the association between various demographic characteristics and the stages of readiness to work (Pre-contemplation, Contemplation and Action Stages) six months post-stroke. Results show that gender across the stages of RTW did not show a significant association ($\chi^2(2) = 0.745$, $p = 0.69$), same goes with marital status ($\chi^2(4) = 1.445$, $p = 0.84$), Income ($\chi^2(2) = 5.135$, $p = 0.08$), type of stroke ($\chi^2(6) = 5.552$, $p = 0.48$), stage of stroke ($\chi^2(4) = 3.53$, $p = 0.47$) and salary change ($\chi^2(4) = 2.032$, $p = 0.73$). These suggested that demographic characteristic of the participants in this study do not have a statically significant association with the stages of

readiness to work.

Table 2 Association between demographic characteristics with stages of readiness to work

Variables	Stages of RTW n (%)			X ² (df)	P- Value
	Pre	Cont	Action		
Gender					
Male	12 (52.2)	13 (61.9)	11 (64.7)	0.74 5	0.69 (2)
Female	11 (47.8)	8 (38.1)	6 (35.3)		
Marital Status					
Married	19 (82.6)	18 (85.7)	16 (94.1)	1.44 5	0.84 (4)
Divorced	1 (4.3)	1 (4.8)	-		
Single	3 (3)	2 (9.5)	1 (5.9)		
Sole Income					
Yes	21 (91.3)	14 (66.7)	15 (88.2)	5.13 5	0.08 (2)
No	2 (8.7)	7 (33.3)	2 (11.8)		
Type of Stroke					
Ischemic	20 (87.0)	16 (76.2)	14 (82.4)	5.55 2	0.48 (6)
Haemorrhage	3 (13.0)	5 (23.8)	2 (17.6)		
Stage of Stroke					
Mild	15 (65.2)	15 (71.4)	10 (58.8)	3.53 (4)	0.47
Moderate	7 (30.4)	3 (14.3)	6 (35.3)		
Severe	1 (4.3)	3 (14.3)	1 (5.9)		
Salary					
No Change	10 (30.3)	13 (39.4)	10 (30.3)	2.03 2	0.73 (4)
Lessen	9 (50.0)	5 (27.8)	4 (22.2)		
No Salary	4 (40.0)	3 (30.0)	3 (30.0)		

For numerical data which are age, duration of stroke and duration of therapy received, the Kruskal-Wallis test was conducted where the median (IQR) for age is [48(9), $p=0.17$], meanwhile, the duration of stroke is [2.0(2), $p=0.12$] and duration of therapy received is [1.0(2), $p=0.29$]. The results indicate no significant differences in age, duration of stroke, and duration of therapy received among different stages of readiness to work.

Table 3 Association between demographic background (age, duration of stroke and duration of therapy received) with stages of readiness to work

Variable	Stage of Readiness to Work, n			Median (IQR)	X ² (df)	P-value
	Pre-contemplation	Contemplation	Action			
Age	23	21	17	48(9)	3.50 (2)	0.17
Duration of stroke (year)	23	21	17	2.0(2)	4.17 (2)	0.12
Duration of therapy received (year)	23	21	17	1.0(2)	2.47 (2)	0.29

3. DISCUSSION

The current study found that most of the participants are in the pre-contemplation stage followed by the contemplation stage and lastly, the action stage. These results are consistent with Wan Abdullah et al. (2021) study, which also found that pre-contemplation was the predominant stage for most post-stroke patients. This might have come about because they failed to know the importance of rehabilitation for stroke recovery. Participants selected the pre-contemplation stage which signifies that early-stage preparation is important in post-stroke rehabilitation.

The current study found that among post-stroke patients, gender is not a significant factor in predicting the stages of readiness to work. There are limited studies comparing gender and stages of employment readiness, however, most of the previous studies related to gender and the possibility of RTW. Fukuzawa et al. (2018) examination of return to work among patients with chronic stroke reported no significant change in the sex ratio toward re-employment. The finding is supported by this study where it was also found that female and male gender have similar return-to-work rates in stroke survivors. Gender differences may thus not have significant impact on employment readiness after stroke, as suggested by these results. As opposed to Palstam et al. (2019), who noticed that being a man was associated with quicker and more frequent RTW, this research failed to find any notable differences between men and women’s RTW rates. In addition, Palstam et al. (2019) have also shown that among males qualified occupation predicted shorter time to RTW but not in women.

In all readiness levels, the percentages of married, single, and

divorced people were similar. This suggests that marital status does not significantly influence returning to work among post-stroke patients. This finding is in contrast with previous research by Schulz et al. (2018) that found the rates of married stroke survivors returning to work are low. In addition, a systematic review found that women, particularly married women, often face more challenges in reintegrating into society following a stroke than males do potentially because of women's differing societal positions and duties (Edwards et al., 2017).

This current study shows that being the sole breadwinner of family does not significantly influence readiness to work. The result is contradicted with a study by Teo et al. (2022) who found that being the breadwinner is positively associated with long-term return to work for stroke patients involved in early supported discharge program. The study highlighted that patients are immensely motivated to overcome their disability and restore their employment capacity because of financial and caregiving duties.

The current study also suggests that the type of stroke does not significantly impact a patient's readiness to return to work. Both ischemic and haemorrhagic stroke patients exhibited similar distributions across the readiness stages. However, a study by Chen et al. (2019) found that individuals who have a cerebral infarction had greater chances to return to work and back to work faster. The research also added that patients with a cerebral infarction had a greater probability of continuing back to work 4 weeks after therapy than those with a cerebral hemorrhage.

Additionally, patients with mild, moderate, and severe strokes showed similar readiness to return to work in this current study. This result is different from a study by Ashley et al. (2019), which found returning to work for stroke survivors is predicted by mild to moderate strokes and is associated with a higher likelihood of stroke survivors returning to their jobs. Additionally, Cain et al. (2022) and Wipahut et al. (2023) discovered similar findings that acute stroke severity and disability levels at three months post-stroke independently predict the likelihood of returning to work after 12 months and within three months of discharge respectively. These findings emphasize the need of early intervention and tailored rehabilitation in improving employment prospects for stroke patients.

The distribution of participants' salaries across the readiness stages was similar regardless of whether they had a pay increase, decrease, or no change. This shows that the preparedness to return to work is not greatly impacted by changes in finances after a stroke. Financial factors may have less of an impact on an individual’s readiness to work than the effects of a stroke on one's own health and functional abilities. A similar conclusion was reported in a New Zealand study by Aarnio et al. (2018) which found that within a year of a stroke, median personal income falls by up to 60%, with larger

decreases for individuals with higher initial wages and those who do not return to work. More research is needed to determine the particular causes of these social class variations in return to work.

Next, no significant difference in median age among the different stages of readiness to work. The result contradicts with that of Westerlind et al. (2019) who found that a successful return to work after a stroke can be predicted by criteria such as younger age. It's because people who are younger tend to be more independent in their daily lives, have fewer neurological disorders, and recover better cognitively after a stroke. Also, Morsund et al. (2020) study revealed that high age was the highest predictor of unemployment at 12 months follow up among those individuals who were employed at baseline. Additionally, Pan et al. (2023) indicated that people between ages 40 years and 50 years were not likely reluctant to working unlike those aged above 50 years old. This could be because of middle-aged individuals in this age group having to provide financial assistance for both their parents and their kids.

The current study found that stroke duration with stages of employment readiness has no significant difference. According to Edwards et al. (2017), RTW rates after a stroke show an upward trajectory over the first few years post-stroke, with median rates of 41% at 0–6 months, 53% at one year, and moves up even more until reaching about 56%-66%, between 1.5-4 years. This indicates that, as time since the stroke increases, so does the probability of a return to work. As supported by Radford et al. (2020) who discovered that 63% of participants went back to work within a year, with a mean 90-day recovery period. Despite this, long-term data indicate a decrease in RTW rates over longer periods, which means stroke victims may face certain challenges.

According to the finding of this study, there was no significant difference in the median duration of therapy received among the different stages of readiness to work ($p = 0.29$). This aligns with the study by Ntaios et al. (2020), which showed that functional recovery and employment preparedness are more reliant on the kind and quality of therapy than its length. They stated that the importance lay in personalized targeted rehabilitation treatments tailored for specific needs and difficulties faced by stroke survivors. Apart from that, Westerlind et al. (2019) research revealed no statistically significant variation in the median stroke duration among the various stages of preparedness for work. This suggests that the amount of time that was spent after the stroke does not have a major impact on one's readiness to resume employment.

4. CONCLUSION

This study findings showed that the demographic characteristics such as age, gender, marital status, the status of sole income of the family, type of stroke diagnosed, stage of stroke, duration of stroke and duration of therapy received did not affect the stages of employment readiness to back to work.

The result also found that most of six months post-stroke patients were in pre-contemplation stage to return to work which also means that they were not ready to back to work soon.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all participants who participate in this study.

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RESEARCH ARTICLE

Nitrate Analysis of Sungai Ulung in Cameron Highlands, Malaysia

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Abstract:

Excessive fertiliser application in agricultural activities, can be washed into the streams and decline the water quality. Nitrate from fertiliser may increase the oxidising activity especially chemical oxygen demand (COD) and also affect the quality of the river. This research aims to determine the relationship between nitrate concentration with COD, Ammoniacal Nitrogen (AN), temperature, Dissolved Oxygen (DO) and pH of a stream flows within the vegetable farm area. This study used a cross-sectional study design and water samples were collected at seven sampling points of Sungai Ulung in Cameron Highland, Malaysia. The concentration for nitrate, AN and COD at downstream was higher than those in the upstream. The results indicated a positive correlation, where an increase in nitrate concentration corresponded with an increase in COD ($r = 0.865^*$, $p = 0.012$), AN ($r = 0.753$, $p = 0.051$), and temperature ($r = 0.847^*$, $p = 0.016$), which can be attributed to the oxygen-dependent decomposition process. Conversely, there were negative correlations, as an increase in nitrate concentration was inversely related to DO ($r = -0.775$, $p = 0.041$) and pH value ($r = -0.126$, $p = 0.788$), likely due to the reduction of oxygen in water during nitrate decomposition. The degradation river quality of Sungai Ulung was probably due to the agricultural activity near the river. Farmers can practice Best Management Practices (BMPs) for their crop to reduce the chance of nutrient losses to the impaired water bodies.

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Keywords: COD, Nitrate, relationship, vegetable farm, water quality.

1. INTRODUCTION

Streams are freshwater bodies that keeps the natural and human systems alive. As a small stream flows downhill, it will feed into a larger stream or river and merge to form many tributaries, which will then end up in the ocean. The upper streams usually are clean and safe compared to the lowland. However, pollutants from anthropogenic activities near tributaries is often creating pollution of the mainstream since the tributaries from upstream to downstream carry all the runoff and pollution.

Agricultural activity accounts for 70% of total water usage worldwide and has become the single-largest cause of non-point-source pollution to surface water and groundwater (Sagasta et al., 2017). This diffuse pollution pose a major problem to sustainability of rivers since it contains various pollutants and the control measures also is hard and costly (USEPA, 2015). Review research on land use's impact on water quality in Malaysia conducted by Camara, Jamil and Abdullah (2019) found that agricultural and forest-related activities show a significant positive relationship to become the main factor that causes physical and chemical changes in the river water quality.

There are three essential plant nutrients in fertilizer include nitrogen (N), phosphorus (P), and potassium (K). Among these nutrients, N is an essential nutrient needed for the production of amino acids that could help the development of plants. Nitrogen applied in fertilizer cannot be taken up directly by the plants. It needs to undergo the process of nitrification by bacteria, which converts nitrogen into nitrate (Dave, 2013 ; Xu et al., 2022). This nitrogen ion is highly leachable and easily wash away into stream water through runoff.

Study found that there are not more than 50% of the nitrogen from fertilisers is used by crops, while others are lost and washed out of the soil and end up in waterways (Bijay-Singh & Craswell, 2021). The excessive use of organo-fertilizers in agricultural activities possible to caused nutrient enrichment in freshwater ecosystems, mainly due to the discharge of nitrogen and phosphorus effluent from the crop (UNEP, 2016). High nutrients in the stream can lead to the water being unable for drinking water purposes and lead to the occurrence of eutrophication (USGS, 2019).

In conjunction with that, recent study done in Cameron Highland found that higher concentrations of nutrients parameter, including total nitrogen (TN), nitrogen-nitrate

(NO₃-N), total phosphorous (TP), and phosphate phosphorous (PO₄-P) in the downstream river catchment within the agricultural area were generally affected by the agricultural runoff. This phenomenon of nutrients runoff from agriculture into surface water may increase the organic loading and affect the river quality (Camara, Jamil & Abdullah, 2019).

Chemical oxygen demand (COD) is an important indicator in assessing water quality as it represents the level of biodegradability. Higher level of COD indicates greater oxidizable organic materials or organic pollutants in the water sample (Ashitha, Rakhimol & Mathew, 2021). In addition, this condition also indicates lower dissolve oxygen (DO) concentration present in the water as many oxygens are used to oxidize the pollutant and organic material.

Nutrient runoff into water bodies may stimulate alga growth, produce excess organic matter, and reduce the concentration of dissolved oxygen (DO) that leads to hypoxia in water bodies (Prambudy, Supriyatin & Setiawan, 2019). Organic matter uses dissolved oxygen in the water as it degrades, which in turn increases the COD values. Thus, the aim of this study is to assess the present status of nitrate in Sungai Ulung as well as its association with water quality parameters.

2. MATERIALS AND METHODS

Study design and data collection

Cameron Highlands is considered a highland area, located in the western part of Pahang state. This district's dynamic topography is crucial for Malaysia's economic development since it supports agriculture activities (i.e., tea plantation and vegetable cultivation) and eco-tourism (Wato & Amare., 2020). Cameron Highlands is divided into three main subdistricts: Hulu Telom, Ringlet and Tanah Rata. This study was carried out in Habu, Ringlet because of its engagement in farming, especially the production of tea and vegetables. Vegetables that have been mostly planted in this agricultural area such as watercress, cabbage, tomatoes, spring onion, carrots, corn, green beans and some areas grown for flowers.

In the agricultural area, there is a stream identified as Sungai Ulung that flows from the tea plantation area upstream to the vegetable farm parts before it reaches the Sungai Bertam stream downstream. It will subsequently flow into the Ringlet reservoir of the Sultan Abu Bakar Dam, which is used only for hydropower and controlling flooding (Razali et al., 2018). According to Jabatan Pengairan dan Saliran Cameron Highlands and Sidek & Luis (2014), the length of the Sungai Ulung is 4.5 km and has about 5.0 m for the width.

A total of 14 grab water samples were collected from the seven (7) different sampling points along Sungai Ulung as shown in Figure 1. The coordinates for each sampling points were described in Table 1. Surface water temperature, dissolved oxygen (DO) and pH were measured using portable HI 9146 Dissolved Oxygen & Temperature Meter and WinLab pH-meter. For chemical oxygen demand (COD),

ammoniacal nitrogen and nitrate analysis, 1000 mL of surface water samples were collected in pre-cleaned amber glass bottles. In the laboratory, the samples were filtered using Whatman filter paper No. 42 and analyzed using the standard methods (APHA, 2012).



Figure 1. Location of water sampling points

Table 1. Coordinates for each sampling points

Sampling Points	Latitude	Longitude
SP 1 (upstream)	4°27'06.1"N	101°24'32.3"E
SP 2 (upstream)	4°27'11.3"N	101°24'19.7"E
SP 3 (middle stream)	4°27'08.2"N	101°24'08.6"E
SP 4 (middle stream)	4°27'02.7"N	101°23'55.7"E
SP 5 (middle stream)	4°27'00.6"N	101°23'50.2"E
SP 6 (downstream)	4°27'04.5"N	101°23'33.9"E
SP 7 (downstream)	4°27'03.1"N	101°23'29.5"E

Data obtained from the analysis were analyzed using IBM Statistical Package (SPSS) version 28.0. The correlation between nitrate concentration and selected water quality parameters concentration in water samples was tested using Spearman correlations. The level of significance was established at $p < 0.05$. Regression analysis was applied to establish the interrelationship between nitrate concentration and COD level.

3. RESULTS AND DISCUSSION

The concentration values for physical and chemical variables at the sampling points of Sungai Ulung are presented in Table 2. There were significant increases in the concentration values of nitrate and COD upstream of the river compared to downstream. The mean concentration of nitrate upstream was 1.5 mg/L, 1.73 mg/L for the middle stream, and 2.0 mg/L downstream. At the same time, the mean concentration of COD upstream was 11.5 mg/L, 13.6 mg/L in the middle stream and 14.0 mg/L downstream. The highest nitrate and COD concentrations in Sungai Ulung were 2.1 and 14, respectively.

Table 2. Concentration value of physical and chemical analysis at the sampling points of Sungai Ulung

Sampling Points Parameter	Upstream		Middle stream			Downstream		Mean, SD
	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7	
Ammoniacal Nitrogen NH ₃ N, mg/L	0.16	0.16	0.16	0.18	0.17	0.17	0.18	0.17 (0.009)
Chemical Oxygen Demand (COD), mg/L	12	11	13	14	14	14	14	13 (1.21)
Dissolved Oxygen (DO), mg/L	8.59	8.21	8.56	7.96	8.51	6.23	7.75	7.97 (0.83)
Nitrate, mg/L	1.6	1.5	1.7	1.8	1.7	2.1	1.9	1.8 (0.12)
pH	6.27	6.91	6.34	6.11	6.22	6.87	6.29	6.43 (0.32)
Temperature, °C	22.5	22.0	22.4	22.9	22.2	23.2	23.4	22.7 (0.52)
Chemical Oxygen Demand (COD), mg/L (Mean, SD)	11.5 (0.7)		13.6 (0.58)			14.0 (0)		-
Nitrate, mg/L (Mean, SD)	1.5 (0.07)		1.73 (0.58)			2.0 (0.14)		-

The river upstream is usually cool and rich in oxygen compared to the downstream. From the study, the DO level also shows a decline after the river flows pass through the agricultural crop, with the higher level being 8.59ppm upstream and decreasing to the lowest level of 6.23ppm downstream of the river. Besides, the temperature has also increased a few degrees in the downstream compared to the upstream and middle streams. The analysis showed that Sungai Ulung was slightly acidic to neutral, where the range of pH value was 6.11 to 6.91. Apart from that, there was also a determination of ammoniacal nitrogen in the river, with a higher concentration of 0.18mg/L.

The deterioration of river quality may due to the anthropogenic activity particularly from agricultural activities at the river bank. As stated by the United States Environment Protection Agency (2015), the agriculture sector significantly impacts water quality, usually due to the runoff of sediment, nutrients, pesticides, and herbicides into the surface water (USEPA, 2015). These circumstances constitute the primary stressors to water quality and contribute to the values increase for important water quality parameters downstream. A study conducted by Masthurah, Juahir and Zanuri (2020) found that applying nitrogen fertilizer to the vegetable crop has caused nitrates pollution on surface water that flows within the vegetable farm areas.

On the other hand, the high concentration of ammoniacal nitrogen, nitrate and COD level detected in the river of this

study were possible consequences of the nutrient load in the river during the rainy season. The water sample in this study was collected in October, which has high of rainfall. Razali et al. (2018) also stated in their study that Cameron Highlands has maximum rainfall (wet season) from October to November and April to May, while minimum rainfall (dry season) is from January to March and June to August. High water flow occurs during the wet season led to the runoff that bring the pollutant from the crop especially nutrients from fertilizer which could impact the water quality (Razali et al, 2018; Mellander et al., 2018).

High concentration of COD parameters is responsible for the depletion of oxygen levels in the river. This could be best explained by the fact that oxygen is required to oxidize organic matter in water which in turn causes the decrease of oxygen level. This was in line with a study conducted by Susilowati et al. (2018) where they reported that high organic pollutants such as nitrate and phosphate released from fertilizer may seep into the stream and result in high COD values and lower DO values.

Generally, it was briefly hypothesized in this study that there was probably a relationship between the nitrate level and COD in stream flows within the vegetable farm area. To test the relationship, the Spearman correlation coefficient was tabulated as shown in Table 3.

Table 3. Correlation between Nitrate level and COD level

Spearman's rho, ρ	COD	Nitrate	
		Correlation Coefficient	0.865*
AN		Sig. (2-tailed)	0.012
		Correlation Coefficient	0.753
Temperature		Sig. (2-tailed)	0.051
		Correlation Coefficient	0.847*
DO		Sig. (2-tailed)	0.016
		Correlation Coefficient	-0.775*
pH		Sig. (2-tailed)	0.041
		Correlation Coefficient	-0.126
		Sig. (2-tailed)	0.788

* Correlation is significant at the 0.05 level (2-tailed)

From the analysis that carried out, these two variables shown a strong and significant positive relationship with 0.865* (p = 0.012), indicated that if nitrate level increase, the level COD in streams also increase. This study also revealed that there is a positive correlation, where an increase in nitrate concentration corresponded with an increase in AN (r = 0.753, p = 0.051) and temperature (r = 0.847*, p = 0.016). Conversely, there were negative correlations, as an increase in nitrate concentration was inversely related to DO (r = -0.775, p = 0.041) and pH value (r = -0.126, p = 0.788). Further analysis was performed using simple linear regression test for

nitrate and COD level. From Table 4 and Figure 2, the regression analysis here shows high correlation with R-Square at 0.62 and to be functioned to the regression equations, $y = 4.82x + 4.67$.

Table 4. Model Summary and Parameter Estimates Dependent Variable: COD

Equation	Model Summary				Sig.	Parameter Estimates	
	R Square	F	df 1	df 2		Constant	b1
Linear	.622	8.22	1	5	.035	4.675	4.819

*Independent variable: Nitrate

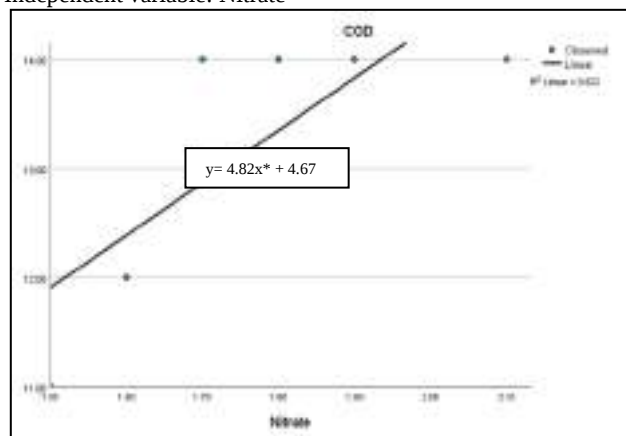


Figure 2. Simple linear regression between Nitrate and COD level

Nutrients such as nitrate is an organic matter from the fertilizer that applied to the crop. Nitrates are nitrogen ions that have high migration in the soil and are loosely bound to the soil (Maghanga et al., 2012). Consequently, it is easily washed into surface water and increases the organic contents. The high organic content in the river may increase oxidation activity, resulting in increased COD levels.

4. CONCLUSION

In this study, there have been nutrients loading in Sungai Ulung possibly due to the excessive application of fertilizer from agricultural activity near the river basin and high runoff of the pollutants during rainy seasons. It marked by the increased of nitrate, ammoniacal nitrogen and COD levels from upstream to downstream of the river. The high concentrations of parameter detected in the river of this study were possible consequences of the high runoff of agricultural pollutants into the streams since the river monitoring were done during the rainy season. Nitrate is considered as organic pollutants from agricultural activities. The increases of nitrate loading will also increase the river's COD level. Therefore,

Farmers can practice Best Management Practices (BMPs) for their crop to reduce the chance of nutrient losses to the impaired water bodies.

ACKNOWLEDGEMENTS

The authors wish to thank and gratitude to every person that involve directly or indirectly and giving extraordinary support in this research process. Thank also to the Department of Irrigation and Drainage, Cameron Highlands for their contribution for providing data related to the study area.

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RESEARCH ARTICLE

Understanding sociodemographic factors influencing behaviour against littering in greenspace in Shah Alam, Selangor

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Abstract:

Despite its scientific relevance and importance for solid waste management and pollution control, studies on littering are incredibly underrepresented in the greenspace in Shah Alam and in most of developing countries. Urban greenspaces like national parks or woodland are subjected to various recreational impacts, including littering. The increased number of visitors to the parks has led to a rise in littering which poses pollution and being a significant environmental threat. To gain insight into people's littering habits, this study examined the relationship between sociodemographic background and littering behavior in Shah Alam, Selangor. An online cross-sectional survey was conducted to obtain information on the response of the public to littering and perception of cleaning responsibilities. Sociodemographic characteristics were found to have a significant relationship with littering. The results provided an overview of the sociodemographic effect on public littering behaviour and highlighted the possibility that an integrated litter prevention plan (social, cognitive, and technological) is the most efficient method to handle the problem of littering in Shah Alam. This study benefited by assisting the government in litter prevention and emphasizing the need to solve the litter problem in Shah Alam. This study highlighted the possibility that an integrated litter prevention plan is the most efficient method to handle the problem of littering in Shah Alam neighborhoods. Integrated techniques include social, cognitive, and technological tactics.

Keywords: Greenspace, littering, social behavior, solid waste

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1. INTRODUCTION

Littering, which is the act of improper disposal of waste, contributes to pollution and poses a significant threat to the environment. It has become a major concern in many countries, particularly in developing ones (Ojedokun et al., 2022). Any solid or liquid household or commercial waste is referred to as litter. This can range from small items to large items, including soft drink bottles, glass, metal, cigarette butts, small pieces of paper, chips, fabrics, candy wrappers, fast-food packaging, plastic straws, food, discarded vehicles, construction or demolition materials, yard waste and trimmings (Arafat et al., 2007). Litter can damage the quality of the habitat in the long run, affect the visual and cause an unpleasant odour in the area. In addition, litter can pollute soil and water, endanger the health of wildlife by increasing the reliance on litter as a food source and threaten the health of visitors by increasing the number of bees, flies, and other pests in the area (Cingolani et al., 2016; Rodríguez-Rodríguez, 2012). According to Abdul Aziz et al. (2019), urban greenspaces have various recreational impacts, including littering. Greenspaces, such as national parks and woodlands, protect biological diversity, resources, landscape formation, inanimate natural components, and landscape beauty or restore damaged and covered natural habitats (Arpin & Cosson, 2015; Grazhdani, 2016).

National parks are accessible to visitors, open to the public, and bring numerous benefits. However, as genuine tourists are increasingly interested in visiting these protected areas, the park management needs some help on resources, infrastructure and enforcement in order to maintain the parks and address problems such as littering. The increase in public littering is caused by several reasons: insufficient infrastructure, habit, laziness, the lack of enforcement, and the dirtiness of the street (Moqbel et al., 2020). These challenges include air and water quality issues, noise pollution, and overcrowding. In addition to the problems, the generation of waste, waste management, disposal, and litter are all directly linked to the increase in the number of visitations concerning park managers. From the perspective of sustainability, waste management in natural areas has become an increasingly popular topic worldwide and has become an increasingly important field of research (Hu et al., 2018; Marion & Reid, 2007; Rodríguez-Rodríguez, 2012). Research has shown that inadequate or non-existent environmental “awareness” may affect individuals’ littering behaviour (Sharp et al., 2010). The follow-up study by Abdul Aziz et al. (2019) found that 46.1% of the respondent’s litter problem is due to insufficient trash cans.

Substantial studies and initiatives to control this issue have been implemented in various countries and locations, such as the beach, mountain areas, and streets. Nevertheless, litter can still be found in most public places ranging from urban to rural areas and significant city residential areas to recreational forests. In addition, some studies also have investigated the types of pro-environmental behaviour within the national park boundaries (Esfandiar et al., 2021). This paper categorises some of the variables that influence littering behaviour in Shah Alam and recommends measures and actions to tackle these problems. Therefore, the aim is to (i) identify the sociodemographic background

and littering behaviour of people in greenspace and (ii) determine the association between littering in greenspace of people with sociodemographic characteristics.

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted at 23 green spaces in Shah Alam, the capital of Selangor. The city is a newly developing town undergoing rapid population growth and industrial and technological development. Its population was estimated in 2021 at around 617 149 people with an area of 290.3 km². The city has many recreational parks and green space areas and has been experiencing major solid waste management problems (Omar, 2008).

2.2. Study Design and Population Size

The study is a quantitative cross-sectional study using an online questionnaire. This study encompasses the Greenspace area located in Shah Alam and involves people residing and visiting the Greenspace in Shah Alam, Selangor. The final sample size of N = 384 was calculated using Raosoft, Inc.’s calculator (2004), using a 95% confidence level and a 5% acceptable error. However, only 250 (65%) questionnaires were successfully collected after two months of data collection.

2.3. Measurement Instruments

The respondents were invited to complete the online questionnaire about littering behaviour, waste disposal, and perception of cleaning responsibilities in the park. A modified and validated questionnaire written in bi-languages (Malay and English) was used as an assessment tool (Abdul Aziz et al., 2019; Arafat et al., 2007). The questionnaire comprises three main parts: (1) the socio-demographic characteristics of the respondents. It included ten questions of independent variables regarding respondents’ age, gender, marital status, number of children, educational level, and monthly income. The second part (2) assesses respondents’ knowledge, attitude, and practice on littering and waste disposal. The final part (3) covers the respondent’s perception of cleaning responsibilities in Greenspace. This section consists of seven questions involving the person thinking about the responsibility of greenspace cleanliness.

2.4. Pilot Study

A pilot study was conducted to determine the feasibility and reliability of the questionnaire was measured using Cronbach’s alpha coefficient with reliability coefficients (α = 0.63). According to Ursachi et al. (2015) α of 0.6 to 0.7 or greater indicates that the reliability was acceptable, and 0.8 or greater is considered excellent.

3. RESULTS AND DISCUSSION

In all 384 residents and visitors of Shah Alam were invited to participate; 250 completed the survey with a 65% response rate. The socio-demographic characteristics of participants are presented in Table 1. Most respondents were females (73.3%), singles, and within the age group of 21-30. In addition, most of the respondents were students and indicated higher educational levels (86.9%).

Table 1. Sociodemographic profile of respondents

Independent group	Number of respondents	Percent (%)
<i>Gender</i>		
Male	67	26.8
Female	183	73.2
<i>Age</i>		
18 – 20	27	10.8
21 – 30	157	62.8
31 – 40	16	6.4
41 – 50	37	14.8
>51	13	5.2
<i>Marital status</i>		
Single	176	70.4
Married	70	28.0
Widowed	4	1.6
<i>Number of children</i>		
No	178	71.2
1 to 2	18	7.2
3 to 5	47	18.8
More than 5	7	2.8
<i>Educational level</i>		
Secondary	14	5.6
Certificate	17	6.8
Higher education	215	86.0
Others	4	1.6
<i>Monthly income (RM)</i>		
No income	135	54.0
Under 1000	22	8.8
1000 – 3000	35	14.0
3001 – 5000	23	(9.2
5001 – 7000	17	6.8
Above 7001	18	7.2

3.1. Littering in the Park

Table 2 presents the survey on littering in the park. Most of the residents and visitors of Shah Alam claimed that they threw litter in the park (76%), but some admitted littering only when there is no nearby dustbin (13.6%), or sometimes (10%) or mostly in the past (0.4%). The most common litter items were beverage containers (40.8%), such as cans, glass, and plastic, followed by food waste (19.6%). The respondents also indicated the main reason for littering in the park as one of the habits or might be due to insufficient availability of dustbins and laziness.

Table 2. Overall respondents' response to the survey question on littering

Question (dependent group)	Answer	Percentage of respondents (%)
Littering in the park (Greenspace)	Never	76.0
	No nearby dustbins	13.6
	Sometimes	10.0
	Most of the time	0.4
Types of litter items usually throw	Beverage container (can, glass, plastic)	40.8
	Cigarette butts	6.0
	Food waste	19.6
	Drinking straw	9.2

Question (dependent group)	Answer	Percentage of respondents (%)
	Chewing gum	5.6
	Tissue	12.0
	Paper	2.8
	advertisements, newspapers, flyers	
	Face mask	4.0
Leading driving cause of people's litter	Availability of dustbin	20.8
	Habit	35.6
	Laziness	18.4
	The dirtiness of the park	8.0
	Lack of enforcement	11.2
	For fun	6.0
Most effective in preventing throwing litter in the park (Greenspace)	Fines	31.6
	Negative image	10.0
	Moral and religious convictions	13.6
	Better street cleanliness	11.2
	Public awareness campaigns	12.4
	Increased availability of dustbins	20.0
	Nothing will stop me from littering	1.2
Greenspace cleanliness responsibility	Citizens	1.2
	Municipality	0.4
	Both	98.0
	Not sure	0.4
Willingness to participate in a public cleaning campaign	Yes	71.2
	No	3.6
	Not sure	22.8
	Such campaigns make no difference	2.4

On the other hand, from our findings, the most influential factors that help prevent littering in the park or Greenspace are fines (31.6%), followed by the increased availability of dustbins (20%). Regarding responsibility for Greenspace's cleanliness, practically all respondents (98%) agreed that the municipality and the citizens are accountable for the cleanliness. On top of that, most respondents also positively decided to volunteer in a general cleaning campaign in the future, while 2.4% argued that such a campaign makes no difference.

3.2. Effect of Gender on Littering

Table 3 shows the finding on littering in the park by gender, revealed two out of five variables have a statistically significant relationship littering frequency has a significant relationship with gender, $X^2(3, N = 250) = 26.447, P < 0.01$. The results indicate that males (7.5%)

littered 'most of the time' than females (0.5%). Other research has generally reported results for littering according to gender from Al-Khatib et al. (2009) and Abdul Aziz et al. (2019) that males are more likely to litter than females. In terms of types of litter items, the test revealed the relationship with gender, $X^2(7, N = 250) = 19.569, P = 0.007$. Based on the survey, males give a higher percentage (14.9%) of throwing cigarette butts than females (2.7%).

According to Chinwong et al. (2018), males (67%) are more likely to smoke every day than females (41.9%), which explains the results. Two opposing findings are shown by publications on the disparities between littering by male and female: males have a higher pregnancy rate than females and littering is unaffected by gender (Moqbel et al., 2019; Schultz et al., 2011). The study's findings could explain some of these discrepancies in literature reporting.

Table 3. Littering in the park by gender (*p value <0.05)

Question	Answer	Percentage of responders (%)		(df)	P-value
		Male	Female		
Littering in the park (Greenspace)	Never	52.2	82.0	26.447 (3)	0.000*
	No nearby dustbins	23.9	10.4		
	Sometimes	16.4	7.1		
	Most of the time	7.5	0.5		
Types of litter items usually throw	Beverage container	41.8	40.4	19.569 (7)	0.007*
	Cigarette butts	14.9	2.7		
	Food waste	19.4	19.7		
	Drinking straw	3.0	11.5		
	Chewing gum	7.5	4.9		
	Tissue	10.4	12.6		
	Paper advertisement, newspaper, flyers	0.0	3.8		
	Face mask	3.0	4.4		
	Availability of dustbin	22.4	20.2		
Leading driving cause of people's litter	Habit	43.3	32.8	7.080 (5)	0.215
	Laziness	17.9	18.6		
	The dirtiness of the park	9.0	7.7		
	Lack of enforcement	6.0	13.1		
	For fun	1.5	7.7		
Greenspace cleanliness responsibility	Fines	31.3	31.7	5.221 (6)	0.516
	Negative image	7.5	10.9		
	Moral and religious convictions	9.0	15.3		
	Better street cleanliness	13.4	10.4		
	Public awareness campaign	13.4	12.0		
	Increased availability of dustbins	22.4	19.1		
	Nothing will stop me from littering	3.0	0.5		
Willingness to participate in a public cleaning campaign	Yes	61.2	74.9	5.602 (3)	0.133
	No	6.0	2.7		
	Not sure	28.4	20.8		
	Such campaigns make no difference	4.5	1.6		

3.3. Effect of Age on Littering

Table 4 shows the overall respondents' response correlating the age of respondents to littering with a significant Pearson's Chi-square test, $X^2(12, N = 250) = 25.649, P = 0.012$. In all age groups, the most common response to the question "have you ever thrown litter in the park (greenspace)?" was never. Interestingly, age had an impact as younger respondents aged 18–20 (59.3%) admitted to littering most of the time than older respondents, older than 41 years (0.0%). These results are consistent with the previous study (Arafat et al., 2007), where only 11% of the older age group, older than 50 years, admitted to 'mostly' throwing litter in the street, compared to 28% of younger

respondents aged 12 to 14 years. For the younger respondents, 18–20 years, moral and religious convictions (25.9%) were the most effective in preventing littering. In contrast, increased availability of dustbins (38.5%) was identified in the older age group over 51 years. Finally, most respondents claimed to be positively willing to participate in the cleaning campaign. This is consistent with a prior finding that age and gender had an impact on attitudes and behaviors related to street littering. Young people litter more because they are more prone to break the law, care less about it and its effects, and are typically unafraid of the punitive measures put in place to reduce littering (Ojedokun et al., 2022).

Table 4. Littering in the park by age

Question	Answer	Percentage of responders (%)					(df)	P-value
		18-20	21-30	31-40	41-50	>51		
Littering in the park (Greenspace)	Never	48.1	72.6	62.5	97.3	92.3	25.649 (12)	0.012*
	No nearby dustbins	25.9	15.3	18.8	2.7	0		
	Sometimes	18.5	10.2	12.5	0	7.7		
	Most of the time	7.4	1.9	6.2	0	0		
Greenspace cleanliness responsibility	Citizens	3.7	1.3	0.0	0.0	0.0	17.485 (12)	0.132
	Municipality	0.0	0.0	6.2	0.0	0.0		
	Both	96.3	98.1	93.8	100.0	100.0		
	Not sure	0.0	0.0	0.0	0.0	0.0		
Leading driving cause of people's litter	Availability of dustbin	18.5	21.0	12.5	24.3	23.1	12.724 (20)	0.889
	Habit	29.6	36.9	31.2	37.8	30.8		
	Laziness	25.9	15.9	18.8	18.9	30.8		
	The dirtiness of the park	14.8	8.9	6.2	2.7	0.0		
	Lack of enforcement	7.4	10.2	25.0	10.8	15.4		
	For fun	3.7	7.0	6.2	5.4	0.0		
	Willingness to participate in a public cleaning campaign	55.6	76.4	62.5	64.9	69.2		
Willingness to participate in a public cleaning campaign	Yes	55.6	76.4	62.5	64.9	69.2	20.433 (12)	0.059
	No	0	3.8	12.5	2.7	0		
	Not sure	44.4	16.6	18.8	32.4	30.8		
	Such campaigns make no difference	0	3.2	6.2	0	0		

3.4. Effect of Marital on Littering

Based on Table 5, the analysis revealed that one of the four dependent variables was statistically significant, $X^2(6, N = 250) = 14.462, P = 0.025$. Overall, the respondent's response to the question related to willingness to participate in a general cleaning campaign in the future was positive for both single (73.9%) and married (68.6%). Interestingly, widows are more determined with their opinion to answer 'not sure' when asked about participation in such a campaign. However, the number of widowed respondents who participated in this study was significantly low, with only

four respondents. The test also revealed that single had admitted to litter "most of the time" (0.6%), compared to married and widowed (0%). This result agrees with previous findings by Abdul Aziz et al. (2019) where they found that singles are more likely to litter than marital status groups. Similar results also have been reported by Al-Khatib et al. (2009) that people who are married and widowed litter less often than single people. Married people and widow(ers), who are often older, are believed to have better levels of social maturity and stability, which will lessen their inclination to litter.

Table 5. Littering in the park by marital status

Question	Answer	Percentage of responders (%)			(df)	P-value
		Single	Married	Widowed		
Greenspace littering	Never	71.6	87.1	75.0	7.857 (6)	0.249
	No nearby dustbins	15.9	7.1	25.0		
	Sometimes	11.9	5.7	0		
	Most of the time	0.6	0	0		
Types of litter items usually throw	Beverage container (can, glass, plastic)	38.1	47.1	50.0	10.535 (14)	0.722
	Cigarette butts	6.8	4.3	0.0		
	Food waste	18.8	21.4	25.0		
	Drinking straw	9.7	8.6	0.0		
	Chewing gum	6.8	2.9	0.0		
	Tissue	12.5	11.4	0.0		
	Paper	2.8	2.9	0.0		
	advertisement, newspaper, flyers					
	Face mask	4.5	1.4	25.0		

Question	Answer	Percentage of responders (%)			(df)	P-value
		Single	Married	Widowed		
Most effective in preventing throwing litter in the park (Greenspace)	Fines	32.4	30.0	25.0	19.263 (12)	0.082
	Negative image	8.5	11.4	50.0		
	Moral and religious convictions	15.3	10.0	0.0		
	Better street cleanliness	13.6	4.3	25.0		
	Public awareness campaigns	12.5	12.9	0.0		
	Increased availability of dustbins	16.5	30.0	0.0		
	Nothing will stop me from littering	1.1	1.4	0.0		
	Yes	73.9	68.6	0.0		
Willingness to participate in a public cleaning campaign	No	3.4	4.3	0.0	14.462 (6)	0.025*
	Not sure	20.5	24.3	100.0		
	Such campaigns make no difference	2.3	2.9	0.0		

3.5. Effect of Number of Children on Littering

Table 6 summarizes the effect of the number of children on littering. Pearson's Chi-square test ($\alpha < 0.05$) revealed no significant relationship between the number of children and littering. The result contradicts the previous study in three national parks in United States of America. The study reported that visitors with children in their groups were 1.51 times more likely to dispose of waste properly than those without children (Mateer et al., 2020). This study falls in line with Larsson et al. (2010) and Gentina and Muratore (2012), where they stated that children might encourage family's pro-environmental behaviors, and people with

children are more concerned about the planet and environment in the future (Dupont, 2004; Laroche et al., 2001). The questionnaire revealed that the majority of the respondents with more than five children admitted to not littering in the park. In contrast, about 0.6% of respondents with no children admitted to litter most of the time. Therefore, one would expect that people with children litter less than people with no children as their behaviors influence the children's development. However, based on Table 1, only seven respondents with more than five children participated in this study. In contrast, the majority of respondents do not have children, limiting the study's ability to establish a definitive relationship.

Table 6. Littering in the park by number of children

Question	Answer	Percentage of responders (%)				(df)	P-value
		No	1 to 2	3 to 5	More than 5		
Greenspace littering	Never	71.3	66.7	93.6	100.0	16.281 (9)	0.061
	No nearby dustbins	15.7	22.2	4.3	0.0		
	Sometimes	12.4	11.1	2.1	0.0		
	Most of the time	0.6	0.0	0.0	0.0		
Leading driving cause of people's litter	Insufficient availability of dustbin	20.8	16.7	19.1	42.9	12.576 (15)	0.635
	Habit	35.4	38.9	36.2	28.6		
	Laziness	18.0	16.7	23.4	0.0		
	Dirtiness of the park	10.1	5.6	2.1	0.0		
	Lack of enforcement	9.0	16.7	17.0	14.3		
Most effective in preventing throwing litter in the park (Greenspace)	For fun	6.7	5.6	2.1	14.3	17.191 (18)	0.510
	Fines	31.5	33.3	34.0	14.3		
	Negative image	9.6	11.1	10.6	14.3		
	Moral and religious convictions	15.2	5.6	10.6	14.3		
	Better street cleanliness	14.0	5.6	4.3	0.0		
	Public awareness campaigns	12.4	5.6	12.8	28.6		

Question	Answer	Percentage of responders (%)				(df)	P-value
		No	1 to 2	3 to 5	More than 5		
Willingness to participate in a public cleaning campaign	Increased availability of dustbins	16.3	33.3	27.7	28.6	8,170 (9)	0.517
	Nothing will stop me from littering	1.1	5.6	0.0	0.0		
	Yes	72.5	83.3	61.7	71.4		
	No	3.4	0.0	6.4	0.0		
	Not sure	21.3	11.1	31.9	28.6		
	Such campaigns make no difference	2.8	5.6	0.0	0.0		

3.6. Effect of Gender on Littering

Based on Table 7, the highest percentage of responses regarding throwing litter in the park was never in all levels of education. The beverage container was the highest category of litter item in all levels of education, followed by food waste in secondary (28.6%) and certificate (23.5%). Analyzing respondents' responses to littering on an educational level educational level of respondent did not show any significant differences. The result was inconsistent with the previous findings, Liu et al. (2020) showed that knowledge has a direct positive impact on visitors' intentions to engage in pro-environmental activities. Another study by Moqbel et al. (2020) indicates that although educational level has a low influence on littering, people with higher education have a better response to anti-littering motivation, consistent with Arafat et al. (2007). In a study done by Nkwocha and Okeoma (2009) observed

that the educational levels often did not correspond with the everyday hygiene practices as seen in the streets. For instance, it was noted throughout the interview that younger individuals had trouble disposing of their trash. This helped to explain why some of them, even the lettered ones, would trash on the streets. All of these findings indicated that three factors—improving civic education among urban inhabitants, changing public attitudes and behaviours beginning at the home level, and stringent enforcement of littering laws—remain crucial in lowering the prevalence of street littering (Nkwocha & Okeoma, 2009). Similar report by Eastman et al. (2013) reported that the majority of individuals with college or graduate school education indicated they never litter, much more than lower education groups, and over half of the participants acknowledged having littered in some fashion (Eastman et al., 2013). This leads to the conclusion that people with some education should practice and display excellent social manners.

Table 7. The relationship between the level of education and littering

Question	Answer	Percentage of responders (%)				(df)	P-value
		Secondary	Certificate	Higher education	Others		
Have you ever thrown litter in the park (greenspace)?	Never	78.6	70.6	76.3	75.0	4.75 0 (9)	0.856
	Only when there are no nearby dustbins	7.1	23.5	13.5	0.0		
	Sometimes	14.3	5.9	9.8	25.0		
	Most of the time	0.0	0.0	0.5	0.0		
In your opinion, greenspace cleanliness is the responsibility of whom?	The citizens only	0.0	0.0	1.4	0.0	0.83 1 (9)	1.000
	The municipality only	0.0	0.0	0.5	0.0		
	Both citizen and municipality	100.0	100.0	97.7	100.0		
	Not sure	0.0	0.0	0.5	0.0		
In your opinion, which of the main driving cause people to litter?	Insufficient availability of dustbin	21.4	11.8	20.9	50.0	9.10 7 (15)	0.872
	Habit	35.7	41.2	35.3	25.0		
	Laziness	28.6	11.8	18.6	0.0		
	Dirtiness of the park	0.0	17.6	7.9	0.0		
	Lack of enforcement	7.1	5.9	6.0	0.0		
	For fun	7.1	5.9	6.0	0.0		
	Yes	57.1	64.7	73.0	50.0		
Are you willing to participate in a public cleaning campaign in the future?	No	0.0	0.0	4.2	0.0	8.21 1 (9)	0.513
	Not sure	42.9	29.4	20.5	50.0		
	Such campaigns make no difference	0.0	5.9	2.3	0.0		

3.7. Effect of Monthly Income on Littering

Table 8 summarizes the overall respondent's response based on monthly income and littering status. Many believe people with high income with higher social and educational levels may influence litter reduction.¹⁵ However, the Pearson Chi-square test revealed no statistically significant differences ($\alpha < 0.05$) between monthly income and littering status. One would expect that high income, which is usually associated with higher social and educational status, should contribute to litter reduction. It is possible to explain this observation based on the “subconscious psychological self-defense” theory (Al-Khatib et al., 2009). This result contradicts the prior study that found that littering is more prevalent in areas occupied by lower-income people (Asmui et al., 2019). Asmui et al. (2019) also found that the association between students' awareness and littering behaviour at higher education institutions was influenced by family income, either from lower or higher income groups. Results showed 5.6% of people with monthly income above RM7001 and 2.2% of people with no income litter most of the time in the park. This shows that monthly income has no significant relationship with littering behaviour among respondents. Moreover, the most littered items usually people throw are beverage containers, followed by food waste and tissue. When asked about participation in general cleaning campaigns, 11.1% of people with income above RM7001 show no interest in such movement.

3.8. Association Between Sociodemographic Characteristics with the Knowledge on Littering

This study investigated the association between sociodemographic background and littering behaviour in greenspace in Shah Alam. However, Survey data shows other helpful information, including the knowledge of sociodemographic factors' impact on littering behaviour. A Pearson's Chi-square test (with $\alpha < 0.05$) was performed to evaluate the respondents' knowledge of littering. Based on Table IX, the analysis revealed that only one dependent variable, marital status was statistically significant, $X^2 (4, N = 250) = 9.427, P = 0.050$ with the knowledge of littering behaviour. The result summarized that Shah Alam people were primarily high in knowledge level. Miller and Burbach (2017) found that understanding environmental theory has a substantial favourable impact on attitudes about conduct.

Similar findings were made by Soares et al. (2021) found that pro-environmental conduct was strongly related with knowledge of the socioeconomic, health, and bio-ecological effects of plastic littering. Smokers may not be aware that tossing small cigarette butts into the environment may have long-term effects since many individuals do not become aware of the effects of littering. Studies suggest that encouraging someone to dispose of their trash in a more suitable container will make them better off. Such a person may also protect their values by engaging their family and neighbors when they see others violating their rights (by littering) (Oguntayo et al., 2019). Thus, this shows that those with greater degrees of knowledge about littering littered less than people with lower levels of knowledge.

Table 8. The relationship between monthly income and littering

Question	Answer	Percentage of responders (%)						(df)	P-value
		No income	Under RM 1000	RM 1000 - RM 3000	RM 3000 - RM 5000	RM 5001- RM 7000	Above RM 7001		
Have you ever thrown litter in the park (greenspace)?	Never	67.4	77.3	71.4	87.0	94.1	88.9	16.006 (15)	0.382
	Only when there is no nearby dustbins	18.5	13.6	14.3	8.7	0.0	0.0		
	Sometimes	11.9	9.1	8.6	4.3	5.9	5.6		
	Most of the time	2.2	0.0	5.7	0.0	0.0	5.6		
Greenspace cleanliness is the responsibility of whom?	The citizens only	1.5	4.5	0.0	0.0	0.0	0.0	19.906 (15)	0.176
	The municipality only	0.0	0.0	2.9	0.0	0.0	0.0		
	Both the citizen and municipality	98.5	90.9	97.1	100.0	100.0	100.0		
	Not sure	0.0	4.5	0.0	0.0	0.0	0.0		

Question	Answer	Percentage of responders (%)						(df)	P-value
		No income	Under RM 1000	RM 1000 - RM 3000	RM 3000 - RM 5000	RM 5001- RM 7000	Above RM 7001		
Are you willing to participate in a public cleaning campaign in the future?	Yes	77.8	77.3	60.0	56.5	64.7	61.1	20.095 (15)	0.168
	No	3.0	0.0	8.6	0.0	0.0	11.1		
	Not sure	18.5	22.7	25.7	39.1	29.4	22.2		
	Such campaigns make no difference	0.7	0.0	5.7	4.3	5.9	5.6		

Table 9. Association between sociodemographic factors with the knowledge level of littering behaviour

Variables	Category	Knowledge, n (%)			(df)	P-value
		Good	Moderate	Poor		
Age group	18 - 20	25 (92.6)	2 (7.4)	0 (0.0)	14.233 (8)	0.076
	21 - 30	120 (76.4)	32 (20.4)	5 (3.2)		
	31 - 40	13 (81.2)	3 (18.8)	0 (0.0)		
	41 - 50	29 (78.4)	6 (16.2)	2 (5.4)		
	>51	6 (46.2)	5 (38.5)	2 (15.4)		
Gender	Male	51 (76.1)	14 (20.9)	2 (3.0)	0.247 (2)	0.884
	Female	142 (77.6)	34 (18.6)	7 (3.8)		
Marital status	Single	141 (80.1)	31 (17.6)	4 (2.3)	9.427 (4)	0.050*
	Married	49 (70.0)	17 (24.3)	4 (5.7)		
	Widowed	3 (75.0)	0 (0.0)	1 (25.0)		
Number of children	No children	141 (79.2)	32 (18.0)	5 (2.8)	6.716 (6)	0.348
	1 to 2	12 (66.7)	6 (33.3)	0 (0.0)		
	3 to 5	35 (74.5)	9 (19.1)	3 (6.4)		
	More than 5	5 (71.4)	1 (14.3)	1 (14.3)		
Educational level	Secondary	12 (85.7)	0 (0.0)	2 (14.3)	10.220 (6)	0.116
	Certificate	14 (82.4)	2 (11.8)	1 (5.9)		
	Higher education	163 (75.8)	46 (21.4)	6 (2.8)		
	Others	4 (100.0)	0 (0.0)	0 (0.0)		
Occupation	Working	64 (77.1)	17 (20.5)	2 (2.4)	14.282 (8)	0.075
	Unemployed	5 (83.3)	1 (16.7)	0 (0.0)		
	Housewife	9 (64.3)	2 (14.3)	3 (21.4)		
	Student	113 (78.5)	27 (18.8)	4 (2.8)		
	Pensioner	2 (66.7)	1 (33.3)	0 (0.0)		
Monthly income	No income	122 (93.8)	6 (4.6)	2 (1.5)	6.201 (10)	0.798
	Under RM1000	19 (95.0)	1 (5.0)	0 (0.0)		
	RM1000 – RM3000	32 (100.0)	0 (0.0)	0 (0.0)		
	RM3001 – RM5000	21 (91.3)	1 (4.3)	1 (4.3)		
	RM5001 – RM7000	17 (100.0)	0 (0.0)	0 (0.0)		
	Above RM7001	17 (100.0)	0 (0.0)	0 (0.0)		

4. CONCLUSION

Although the importance of studying littering in waste management and pollution control cannot be overstated, there is a lack of academic research on this topic, especially in greenspaces in Shah Alam and other developing countries. This study explored the causes and behaviours that contribute to littering, as well as the types of items commonly left behind. The study reveals that there are three important sociodemographic factors that have a significant impact on littering behaviour in Shah Alam: age, gender, and marital status. For example, it was observed that littering was more

common among younger individuals and men. The study's findings highlight the importance of a comprehensive approach to litter prevention, incorporating social, cognitive, and technological methods. As an illustration, cognitive strategies could include public education campaigns aimed at discouraging littering, while social approaches might prioritise stricter penalties for those who litter. In addition, improving the accessibility of trash cans and consistently conducting clean-up initiatives are practical steps to reduce littering. This study offers valuable insights for policymakers in developing more effective litter prevention and waste management strategies, especially in urban greenspaces such as those in Shah Alam.

ACKNOWLEDGEMENTS

The authors want to express their gratitude to all participants who volunteered to take part in this research, along with all university staff for their cooperation during the research.

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RESEARCH ARTICLE

Evaluating Modified Grease Traps with Coconut Coir for Improved Adsorption Efficiency

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Abstract:

Fats, oils, and greases (FOG) from restaurant wastewater can cause significant environmental and infrastructure issues. Grease traps are employed to prevent these pollutants from entering sewer systems. This study investigates the efficiency of conventional and modified grease traps enhanced with coconut coir activated carbon (CCAC) in treating restaurant wastewater. The objectives were to evaluate the effectiveness of both systems in reducing oil, grease, and turbidity levels. In the experimental setup, wastewater from a restaurant was treated using a standard grease trap and a modified trap with CCAC. Results showed that the conventional grease trap achieved an oil and grease removal efficiency of 89.54%, while the modified trap had a lower efficiency of 50.38%. However, the modified trap significantly improved turbidity reduction by 81.86%, compared to 24.64% in the conventional trap. Both systems showed no thermal influence on treatment. Overall, while the conventional grease trap was more effective at oil and grease removal, the addition of CCAC in the modified trap improved water clarity, suggesting a potential for combining both approaches to optimize wastewater treatment. This study emphasizes the importance of improving grease trap technologies to achieve better environmental sustainability in restaurant wastewater management.

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Keywords: Grease Trap, Oil and Grease, Restaurant Wastewater

1. INTRODUCTION

Fats, oils, and greases (FOG) discharged from commercial and domestic kitchens produce several waste materials that have a negative influence on the sewer system (Collin et al., 2020). FOG are byproducts of food processing plants (meat plants, for example), food service establishments (restaurants, for example), and domestic properties (Wallace et al., 2017). Wallace et al. (2017), mentioned that these FOG clogs cause sanitary sewer overflows, property flooding, and sewage contaminating of water bodies. Grease trap has been proven to be able to remove FOG from wastewater (Wong et al., 2007, Wongthanate et al., 2017). Grease traps act as a system that keeps FOG from clogging pipes, overflowing, and polluting the environment by entering the wastewater system. Grease traps protect the wastewater treatment process by removing FOG before it enters the system, which minimizes the need for costly and time-consuming repairs and maintenance. Grease traps also contribute to environmental sustainability by lowering the quantity of FOG released into the environment, which can harm aquatic life and water quality. By making sure of the amount of FOG that is released into the environment the sustainable development goal can be achieved successfully which is good health well-being and life on land.

Depending on the source of generation, FOG can have a wide range of physical and chemical properties. FOG can be liquid or solid and has no colour, odor, or taste in its pure form

(Husain et al., 2014). According to Sultana et al., (2020) studies the treatment of wastewater with excessive amounts of fat, oil, and grease (FOG) produced by an increasing number (annually 2% of FSEs) is a big challenge for water utilities. Sewer clogs are caused mostly by the buildup of FOG deposits in sewer pipes, and sewer management requires an annual supplementary maintenance expense. According to Sello (2021), fats, oils, and grease in wastewater have been discovered to have a variety of negative impacts on the sewer, the wastewater treatment facility, and the environment into which it is discharged. It is also clear that the removal of FOG is primarily determined by the physical and chemical properties of the FOG, environmental circumstances, the performance of the wastewater treatment plant, and the effectiveness of each method used.

In improving the potential of wastewater treatment, several studies have been found to be conducted by using different materials or substances. Examples are by using eggshell (Rozi et al., 2023, Azhar et al., 2018), sugarcane bagasse (Saâ et al., 2016), powdered activated carbon, anthracite, and clay adsorbents (Mueller et al., 2003). A study found that Coconut Coir Activated Carbon (CCAC) showed significant capability to be used as a low-cost, re-generable and eco-friendly adsorbent in oil spill clean-up (Abel et al., 2020). Based on those investigations, this study was designed to investigate the effectiveness of conventional grease traps and modified grease trap with CCAC in removing oil and grease and turbidity in wastewater from restaurants.

2. MATERIALS AND METHODS

The study was conducted at Restaurant A7 Nasi Lemak Kukus in Bandar Baru Jaya Gading, selected for its adequate wastewater supply necessary for the investigation. This experimental and quantitative research requires approximately 50 liters of wastewater samples and a substantial quantity of coconut coir to produce coconut coir activated carbon (CCAC). The experimental setting will use a grease trap with dimensions of 50 cm x 30 cm x 30 cm and a capacity of 42 litres. The experiments was carried out in the laboratory of Centre for Environmental Health and Safety Studies in UiTM Puncak Alam. The experimental design includes two: a control that uses a grease trap device without any adsorbent material, and another setting that uses coconut coir as an adsorbent.

There are various stages involved in preparing the adsorbent. Initially, coconut coir samples are dried in a laboratory drying chamber at 105°C for 24 hours to eliminate volatile components and excess water content. The dried samples are then crushed, sieved, and stored at room temperature before being impregnated into smaller particles (1-2mm). The impregnated crushed coconut coir is then pre-treated with KOH pellets at a 1:2 impregnation ratio before being carbonised in a muffle furnace for two hours in an oxygenless environment. After a 12-hour drying time at 105°C to remove moisture, the mixture is activated for one hour at 800°C in a muffle furnace. The resulting CCAC is cooled, washed with distilled water until the pH reaches 6-7, and then washed with a 0.1 M HCl solution to remove any residual ash. The CCAC is oven-dried at 105°C for 2 hours, crushed, sieved into 63-500 µm particles, and kept in a desiccator until needed for the adsorption experiment.

The Total Oil and Grease (TOG) experiment, adapted from Klemz et al. (2021), uses a liquid-liquid extraction method. In this approach, 30 ml of n-hexane is poured into a separatory funnel and vigorously shaken for at least two minutes before settling. The lower layer is drained into a container, and the water layer is kept for future extractions. Sodium sulphate is used to filter the solvent layer, and the extraction procedure is repeated several times. Finally, the weight of the extracted oil and grease is measured to determine the effectiveness of the adsorption process.

3. RESULTS AND DISCUSSION

3.1. Characterization of Wastewater

All wastewater samples exhibit similar visual characteristics, including a greasy appearance and an unpleasant odor. Contrary to expectations, the color was neither yellowish nor white. The water appeared slightly cloudy with some foam, likely due to the presence of soap mixed with residue from dishwashing. Additionally, floating oil droplets and other foreign particles were observed throughout the wastewater.

3.2. Oil and Grease Efficiency

Table 3.1 Restaurant Wastewater Reading Before and After for Grease Trap

Grease Trap	pH	Turbidity, NTU	Temperature, °C
Before	6.22	82.96	24
After	7.29	62.52	24
Change (%)	17.20	-24.64	0

Table 3. 2 Restaurant Wastewater Reading Before and After for Modified Grease Trap

Modified Grease Trap	pH	Turbidity, NTU	Temperature, °C
Before	6.89	109.8	24
After	10.12	19.92	24
Change (%)	46.87	-81.86	0

Tables 3.1 and 3.2 present the results for three key parameters: pH, turbidity (NTU), and temperature (°C). Table 3.1 displays the values for these parameters in untreated wastewater and after treatment with a conventional grease trap, along with the corresponding percentage of change. In comparison, Table 3.2 illustrates the same parameters, but the grease trap used in this case has been enhanced with coconut coir activated carbon (CCAC). These tables enable a direct comparison of the performance of the standard and modified grease traps in improving wastewater quality.

The comparison between the regular grease trap and the modified grease trap with coconut coir reveals key differences in their efficiency in treating restaurant wastewater. In terms of pH adjustment, the regular grease trap increased the pH by 17.20%, moving the wastewater from mildly acidic (6.22) to near-neutral (7.29), which is ideal for most environmental standards. In contrast, the modified grease trap increased the pH by 46.87%, raising it to 10.12, making the wastewater more alkaline. While this significant increase may be beneficial for certain downstream treatments, it could pose a risk if not carefully managed in systems where neutral pH is preferred.

The most notable difference lies in the turbidity reduction, where the modified grease trap outperformed the regular trap by a large margin. The regular grease trap reduced turbidity

by 24.64%, indicating moderate removal of suspended particles. However, the modified grease trap achieved an 81.86% reduction, substantially improving water clarity and demonstrating superior removal of suspended solids. This suggests that the addition of coconut coir enhances the trap's ability to adsorb fine particles and oils more effectively. Both systems maintained a constant temperature of 24°C, indicating no thermal influence on the treatment process. Overall, the modified grease trap proves to be far more effective, especially in reducing turbidity and improving effluent quality, though its impact on pH must be considered depending on the specific wastewater management needs.

Table 3. 3 The Quantity of Oil and Grease for Grease Trap

Grease Trap	Oil and Grease, g/L
Before	1.1589
After	0.1212
Percentage of removal	89.54%

Table 3. 4 The Quantity of Oil and Grease for Modified Grease Trap

Modified Grease Trap	Oil and Grease, g/L
Before	0.6500
After	0.3225
Percentage of removal	50.38%

Table 3.3 and 3.4 above shows the removal efficiency of oil and grease from the usage of conventional grease trap and the modified grease trap respectively. The table compares the performance of a standard grease trap and a modified grease trap (with coconut coir activated carbon) in removing oil and grease from wastewater. For the standard grease trap, the oil and grease concentration in the wastewater before treatment was 1.1589 g/L, which was significantly reduced to 0.1212 g/L after treatment. This represents a removal efficiency of 89.54%, indicating that the conventional grease trap was highly effective in reducing oil and grease levels.

On the other hand, the modified grease trap started with a lower initial oil and grease concentration of 0.65 g/L. After treatment, the concentration dropped to 0.3225 g/L, resulting in a removal efficiency of 50.38%. Although the modified grease trap was effective in reducing oil and grease, it performed less efficiently than the standard grease trap.

In summary, while both grease traps were able to lower the oil and grease content in the wastewater, the standard grease trap achieved a much higher percentage of removal compared to the modified version. This suggests that the conventional system might be more efficient under the conditions tested,

despite the inclusion of coconut coir activated carbon in the modified system.

3.3. The Capacity of Grease Trap



Plates 3. 1 Restaurant Wastewater in Grease Trap



Plates 3. 2 Restaurant Wastewater in Modified Grease Trap

The removal of oil and grease using grease traps occurs through a purely physical process. This is evident as the wastewater in each compartment undergoes significant changes without the formation of any new substances. The only modification is the separation of oil and grease, which rise to the surface and are removed from the water. Observations of this separation can be seen in Plate 3.1, which illustrates the distinct color changes in the wastewater as it passes through the compartments of the grease trap. Plate 3.2 shows the physical characteristics of the wastewater as it flows through a grease trap containing coconut coir as an adsorbent. The color of the wastewater turns black, reflecting the color of the coconut coir.

Notably, the final wastewater sample collected from the grease trap shows that the coconut coir particles pass alongside the wastewater without dissolving into it. This phenomenon is likely due to the small size of the coconut coir particles, allowing them to pass through the first compartment and into subsequent sections of the grease trap. Physical observations suggest that the total oil and grease content is reduced in the final compartment, as indicated by the

progressive color changes between compartments. The water in the last compartment appears less oily and greasy compared to that in the second compartment. Although it is difficult to distinguish color differences in Plate 3.2 due to the black coloration, the texture of the water from the final compartment is less greasy compared to the control group.

These findings suggest that coconut coir is effective in reducing the total oil and grease in wastewater. Additionally, the total volume of wastewater remained constant between the first and third compartments.

4. CONCLUSION

In conclusion, this study highlights the effectiveness of both conventional and modified grease traps with coconut coir in treating restaurant wastewater, particularly in reducing oil, grease, and turbidity levels. While the conventional grease trap demonstrated a higher oil and grease removal efficiency (89.54%) compared to the modified grease trap (50.38%), the addition of coconut coir activated carbon (CCAC) in the modified trap significantly improved turbidity reduction, achieving a notable 81.86% decrease. These results suggest that while traditional grease traps remain highly effective for oil and grease removal, the use of adsorbents like CCAC enhances overall wastewater quality by improving the clarity of the effluent. Thus, combining conventional and modified approaches can optimize grease trap performance for more comprehensive wastewater treatment. Overall, the study verifies the usefulness of grease traps in oil and grease reduction and calls for additional investigation of modification effects, supporting continuous efforts to improve wastewater treatment. These findings highlight the importance of flexible techniques to ensure sustainable restaurant wastewater treatment following environmental goals, which will guide future improvements in grease trap technology for cost-effective and environmentally friendly solutions.

ACKNOWLEDGEMENTS

We would like to extend our gratitude to everybody who supported and involved this study especially to the Centre for Environmental Health and Safety Study, Faculty of Health Sciences, Universiti Teknologi MARA Kampus Puncak Alam.

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RESEARCH ARTICLE

Health risk assessment of heavy metals in Indian Mackerel (*Rastrelliger kanagurta*) sold in selected wet markets in Hulu Langat District, Malaysia

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Abstract:

Indian Mackerel (*R. kanagurta*) is valued for its nutritional benefits and contribution to a healthy diet. However, increasing anthropogenic activities have raised concerns about elevated concentrations of heavy metals (HMs) in marine ecosystems, which may pose health risks through their accumulation in marine species. This study aimed to assess the concentrations of HMs in *R. kanagurta* and evaluate the associated health risks based on estimated fish intake among Malaysian adults and children. Samples were collected from selected wet markets in Hulu Langat, Malaysia, and analyzed for Cd, Cu, Cr, and Zn using atomic absorption spectroscopy (AAS). The concentrations of HMs in the analyzed fish samples were found to be within acceptable limits set by FAO, WHO and Malaysian Food Regulations 1985, and ordered as Zn > Cu > Cr > Cd. Despite the concentrations being within permissible limits, the Target Hazard Quotient (THQ) values indicated low hazard risks for both groups (THQ<1). The study recommends further investigation, including the analysis of bioavailable metal forms, for a more precise risk assessment. Continuous monitoring of HM levels in *R. kanagurta* is crucial to ensure regulatory compliance, provide data for risk assessment, and serve as an early warning system to ensure consumer safety.

Keywords: *Rastrelliger kanagurta*, Risk Assessment, Target Hazard Quotient, Wet Market

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1. INTRODUCTION

Fish is one of the important sources of protein for consumers in Malaysia (Ahmad et al., 2016; Kamaruddin et al., 2023). Fish does not only provide protein, but also contains various minerals, vitamins, and polyunsaturated omega-3 fatty acids which are able to lower the risk of cardiovascular diseases and some types of cancer (Zhu et al., 2015). Given its high nutritional value, it is recommended to consume one dish of fish per day (MOH, 2020). With an average consumption of at least 46.9 kilograms per person per year, Malaysia ranks second in Southeast Asia for the highest fish consumption (Kamaruddin et al., 2023). However, environmental pollution is becoming more serious in some coastal areas and estuaries with rapid industrial development. These activities have significantly increased the amount of heavy metals (HMs) that naturally occur in the environment, particularly the marine ecology. Worryingly, marine organisms such as fish may store these pollutants in their muscle tissue and pose a threat to human health, especially for individuals who consume large amount of fish (Bosh et al., 2016 ; Han et al., 2021).

HMs have been considered as a serious global environmental threat (Han et al., 2021). The most common HMs found in

aquatic environments include cadmium (Cd), nickel (Ni), zinc (Zn) and copper (Cu) (Han et al., 2021; Luczynska, Paszczyk and Luczynski, 2018; Mangalagiri et al., 2020; Sedeghi et al., 2021; Naji, Khan and Hashemi., 2016; Joseph et al., 2022). These contaminants are concerning because of their difficulty in degrading and high potential for bioaccumulation in the aquatic environment (Chen & Chau, 2016). Consequently, marine fish will absorb toxic metals from the water and soil around them as well as from their food (Han et al., 2021). Previous studies have confirmed that their country's marine fish is contaminated with HMs. For instance, it was discovered that the levels of chromium and arsenic in samples of marine fish collected from sites near Hainan, China, did not meet the food safety standards established by the Joint FAO/WHO Expert Committee on Food Additives (Liu et al., 2015). Arsenic, cadmium, chromium, mercury, and lead were also found in samples of marine fish collected from the coastal areas of Zhejiang, China (Han et al., 2021). Therefore, there is a possibility that marine fish in other countries including Malaysia has been contaminated with heavy metals.

R. kanagurta is one of the marine fish that Malaysians often consume and can be found in most wet markets around the country (Rahman, Hajar & Yunus., 2020). This fish species

is popular among Malaysians because it has a low market price, high abundance and is easy to catch (Rahman & Hafzath, 2012). However, several studies revealed that *R. kanagurta* in their region has been contaminated with HMs (Han et al., 2021; Mangalagiri et al., 2020; Khander et al., 2015; Akila et al., 2022; Mziray & Kimirei 2016). In Malaysia, Yap & Al-Mutairi (2022) identified the presence of Cu and Zn in *R. kanagurta* caught from Setiu, located on the East Coast of Peninsular Malaysia. Foods that contain hazardous metals above the permitted levels are regarded as being potentially harmful to human health. Hence, a health risk assessment was carried out in this study to calculate potential risk posed by the HMs found in the *R. kanagurta* samples. This is concerning because exposure to HMs can have negative consequences on one's health. Once entering the body, HMs are transported and compartmentalized into body cells and tissues, where they bind to proteins and nucleic acids, causing them to be destroyed and disrupting their cellular activities (Azeh et al., 2019). HMs may lead to several consequences in the human body such as mental disorders, damaging the blood constituents, and damage to organs such as the lungs, liver, kidney, and other organs which can lead to several disease conditions (Azeh et al., 2019; Jaishankar et al., 2014). Other than that, accumulation of HMs for a long time may lead to slowing progression of physical, muscular, and neurological degenerative processes which mimic diseases such as Parkinson's disease and Alzheimer's disease (Azeh et al., 2019; Jaishankar et al., 2014; Balali-Mood et al., 2021; Islam et al., 2022; Branca, Morucci & Pacini et al., 2018).

2. MATERIALS AND METHODS

2.1. Study area and sample collection

The study was conducted in three wet markets located in the Hulu Langat district, Malaysia. This district encompasses an area of approximately 829.44 km² and has a population of 1,156,600. The ethnic composition of the population includes Malays (50.73%), Chinese (30.76%), Indians (9.84%), and others (0.99%) (Pejabat Daerah Tanah Hulu Langat, 2018). Hulu Langat is an urban area characterized by commercial buildings, shopping complexes, roads, and private hospitals. The selected wet markets were chosen due to their high population density compared to other areas within the Hulu Langat district. In these markets, there were five stalls that sold Indian Mackerel (*R. kanagurta*). From each stall, three samples of *R. kanagurta* were collected and placed into high-density polyethylene (HDPE) plastic bags. The samples were then transported to the laboratory in ice boxes, where the temperature was maintained at 4°C, in order to preserve their quality. FERC/FSK/EM/2022/0021

2.2. Sample preparation and analysis

Prior to sample preparation, the fish were thoroughly cleaned with distilled water to remove any blood. The fish were then dissected, and approximately 5 grams of muscle tissue were extracted for analysis. The samples were placed in crucibles and heated on a hot plate at 150-200°C until all smoke ceased. Subsequently, the crucibles were transferred to a muffle furnace and ashed at 450°C for 8 hours. After ashing, 5 ml of 1% HNO₃ was added to each ash sample, which was then gently boiled to dissolve the ash. The resulting solution was filtered using a cellulose nitrate filter (Whatman) and diluted to 100 ml with 1% HNO₃ in volumetric flasks (Kalagbor & Opusunju, 2015). The prepared solutions were then analyzed using Atomic Absorption Spectrophotometry (AAS) to determine the concentration of heavy metals (Naji, Khan & Hashemi, 2016; Ishak, Zuhdi & Aziz, 2020).

2.3. Health risk assessment

The data from the findings were used to calculate the target hazard quotient (THQ) for non-carcinogenic risk using the following equation:

$$THQ = \frac{E_{FR} \times Ed \times F_{IR} \times C}{RfD \times B_{Wa} \times AT_n} \times 10^{-3}$$

For adult, the average fish ingestion rate (F_{IR}), exposure frequency (E_{FR}), exposure duration (Ed), body weight (B_{Wa}) and averaging time (AT_n) values was obtained from previous studies (Khandaker et al., 2015; Praveena & Omar, 2017). The values of F_{IR} , E_{FR} , Ed and B_{Wa} for Malaysian adult were 130 g/day, 365 days/year, 74 years and 62.65 kg, respectively. On the other hand, the values of F_{IR} , E_{FR} , Ed and B_{Wa} for Malaysian children were 70 g/day (equivalent to one serving size), 365 days/year, 74 years and 19.5 kg, respectively obtained from studies done by Praveena & Omar (2017) and Ministry of Health (2023). When the $THQ < 1$, the non-carcinogenic health effects are not expected to happen. However, if the $THQ > 1$, adverse health effects are possible to be experienced (Abbas, Ismail & Easa, 2008).

2.4. Ethical consideration

This study was classified as exempt by the Faculty Ethics Review Committee of the Faculty of Health Sciences, Universiti Teknologi MARA (Ref. No.: FERC/FSK/EM/2022/0021).

2.5. Statistical analysis

The data obtained in this study were statistically analyzed using SPSS version 28.0. Comparison of heavy metals concentration on *R. kanagurta* samples from three

different wet markets were verified by the non-parametric test Kruskal-Wallis. The significance level for the analysis was set at 0.05.

3. RESULTS AND DISCUSSION

Table 1 summarized the concentration level of selected heavy metals detected in *R. kanagurta* samples. Based on Table 1, Zn (5.55 ± 2.16 mg/kg) is the highest mean concentration of HMs in the sample, followed by Cu (0.50 ± 0.21 mg/kg), Cr (0.14 ± 0.32 mg/kg) and Cd (0.09 ± 0.12 mg/kg). Thus, the mean of HMs concentration in the sample from all wet markets can be ranked as Zn > Cu > Cr > Cd. When the concentration is compared with the standard limit, only Cd (0.09 ± 0.12 mg/kg) has the concentration which exceeds the permissible limit of FAO and WHO (0.05 mg/kg). However, when the concentration is compared with Malaysian Food Regulations 1985 (1.00 mg/kg), the value is still within the permissible limit. Meanwhile, the concentration of Cu, Cr and Zn in all sample are still within the permissible limit of FAO, WHO and Malaysian Food Regulations 1985. Based on the result, Zn has the highest concentration of HMs as compared to other HMs since it is the second most trace element presents in almost all living organisms including fish (Lall & Kaushik, 2021). The abundance of Zn in the cells assists in biological functions for vertebrates which are catalytic, metabolism, growth function and restraining free radical oxygen in fish (Prabhu, Schrama & Kaushik, 2016). Other than that, Zn also plays an important role in structural function, which involves modifying enzyme activities and stabilizing tertiary structures of enzyme. For example, in Cu-Zn superoxide dismutase, Zn acts as a structure for this enzyme (Muralisankar et al., 2014). Marine fish like *R. kanagurta* are mainly ingesting sea water for their internal body fluid needs, which may also absorb inorganic elements like Zn in their gastrointestinal tracts (Lall & Kaushik, 2021). This explains why the content of Zn is higher than other HMs.

Statistical analysis revealed that only Cd and Zn concentrations were significantly different between wet markets ($p < 0.05$). This could be due to different places where the fish were caught. In the study, sample from M2 is known to be originated from Kuala Sepetang coast which is located in west coast. This area was well-known for its seafood catches such as cockles and fish, but it has declined lately due to some possible factors (Zhi et al., 2017). The factors are due to algal blooms (caused by overabundance nutrient), mariculture and man-made pollution, specifically plastic waste. Illegal dumping has contaminated the village river with rubbish (Chen & Chau, 2016). Cr might be present in plastic waste, since chromium compounds are used in plastic production, as it is resistant to discoloration and corrosion (Ahimbisibwe et al., 2022). Hence, this explains the presence of chromium in fish collected in Kuala Sepetang coast. Next, in the sample from M3, it is known to have originated from Kuala Selangor coast which is also

located on the west coast. A possible source of Cd on the coast might be due to leakage of leachate from Jeram Sanitary landfill. The landfill is connected with Sungai Sembilang which ends in Kuala Selangor coast. A study revealed that Cd is the pollutant present in leachate along with Cr, Cu, Fe, Ni and Pb (Ma et al., 2022). As the river flows until meets the Kuala Selangor coast, it also carries the pollutant onto the coast. The concentration of Cu in the sample is low, it might happen because this trace element has already been diluted by large quantity of rainfall (Karnan et al., 2021). Alongside the river, there are some factories such as latex products and furniture factories which are possible to contaminate the river with its effluent and by product. Hence, this could be the main reason for the presence of Cu on the coast. Last, the sample from M1 was known to have originated from Pangkor Island coast and Kuala Perlis. According to a study, although there is no pollution was detected in Kuala Perlis coast, a high concentration of Zn along with As and Pb were found in the mouth of Kuala Perlis River (Wong & Yong, 2020). The river ends in the coast, which could be the main contributor to the presence of Zn.

Table 1. Concentrations of heavy metals in *R. Kanagurta* samples

Heavy Metals	Wet Market			Mean±SD (mg/kg)	p-value
	Bandar Baru Bangi	Kajang	Semenyih		
	Mean±SD (mg/kg)	Mean±SD (mg/kg)	Mean±SD (mg/kg)		
Cr	BDL*	0.35±0.18	BDL*	0.14±0.32	0.075
Cd	BDL*	0.13±0.06	0.19±0.03	0.09±0.12	0.041**
Cu	0.43±0.08	0.57±0.11	0.48±0.02	0.50±0.21	0.756
Zn	4.28±0.21	7.07±1.15	5.05±0.24	5.55±2.16	0.024**

*BDL - below detection limit (Cr=0.0015 mg/kg;

Cu=0.0015mg/kg; Cd=0.0008 mg/kg; Zn=0.0015 mg/kg)

**p-value is significant at 0.05

Based on Table 2, the THQ for adult and child of all HMs from the wet markets are in the ranged of 2.25×10^{-2} to 6.93×10^{-1} . The values were below 1, which can be considered as safe to consume and no risk of human health effects. Even though the concentration of HMs detected in this study were the permitted limit, there is still a risk of health, especially if higher the amount of contaminated fish with the HMs is consumed. Hence, health effects such as nausea, stomachache, diarrhoea, and kidney issues that are raised from the consumption are expected to happen. Other than these effects, Cd may lead to health problems such liver dysfunction, pulmonary edema, testicular damage, osteomalacia, and adrenal and hematopoietic damage (Tinkov et al., 2018). Ingestion of cadmium can lead to cancers such as bladder, prostate and pancreas cancer, since it has been categorized as a human carcinogen (group I of International Agency for Research on Cancer classification) (IARC, 1997). Besides, excessive exposure of HMs through ingestions may also cause health problems. For example,

copper toxicity which can disrupt normal cell function and acute poisoning may happen from excessive intake amount of Cu (Yap & Al-Mutairi, 2022). Overexposure to zinc may cause dizziness and abdominal pain shortly after the exposure. In addition, chronic effects after long-term exposure to high levels of Zn also cause weakened immune function, low levels of good cholesterol, and copper deficiency (National Institutes of Health, 2022).

Table 2. THQ values for Cd, Cr, Cu and Zn in this study

Wet Market	Group	Cr	Cd	Cu	Zn
WM1	Adult	-	-	2.25×10^{-2}	2.96×10^{-2}
	Child	-	-	3.89×10^{-2}	5.12×10^{-2}
WM2	Adult	2.40×10^{-1}	2.70×10^{-1}	2.96×10^{-2}	4.89×10^{-2}
	Child	4.15×10^{-1}	4.67×10^{-1}	5.12×10^{-2}	8.46×10^{-2}
WM3	Adult	-	4.00×10^{-1}	2.49×10^{-2}	3.49×10^{-2}
	Child	-	6.93×10^{-1}	4.31×10^{-2}	6.04×10^{-2}

4. CONCLUSION

The present study shows that *R. kanagurta* sold in selected wet markets in Hulu Langat do accumulate HMs (Cr, Cd, Cu, Zn). The HMs were found to be in the order of $Zn > Cu > Cr > Cd$. The content of HMs in the samples were within the permissible limit of the FAO, WHO and Malaysian Food Regulations 1985. The calculated THQ for adult and child were found to be less than 1 ($THQ < 1$), which suggested low hazard risks for both groups. This should be concerned as fish is taken daily as source of protein, which may higher the risk of carcinogenic effects by consumers in Malaysia. For more precise risk assessment, the study suggests further investigation, including bioavailable metal form analysis. It is recommended that HMs levels in *R. kanagurta* be continuously monitored in order to ensure the regulatory compliance and guarantee consumer safety.

ACKNOWLEDGEMENTS

The authors would like to thank the facilities and assistance from the laboratory staff at Universiti Teknologi MARA during the completion of this research. The authors have no competing conflicts of interest.

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ORIGINAL ARTICLE

Comparative Analysis of Heavy Metal Concentration of Cu, Ni, Mn in *C. obtusa* and *T. duplicata* Snails and its health risk assessment

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Abstract:

T. duplicata and *C. obtusa* are marine gastropods that serve as valuable bioindicators for assessing heavy metal accumulation in coastal environments. These species, similar to other mollusks, have the capacity to absorb and concentrate heavy metals from their surroundings. The bioaccumulation of these toxic substances within the snails not only threatens marine ecosystems but also poses potential health risks to humans who consume contaminated marine life. This study aimed to investigate the concentration levels of heavy metals, specifically nickel (Ni), manganese (Mn), and copper (Cu), in the two snail species, using Flame Atomic Absorption Spectrometer (FAAS). These particular heavy metals were selected due to their prevalence in coastal environments, often as a result of industrial discharge, agricultural runoff, and urban pollution. The mean heavy metal concentration for both types of samples follows the order Mn > Ni > Cu. The analysis showed that the mean concentrations of heavy metals in both *T. duplicata* and *C. obtusa* followed the order Mn > Ni > Cu. Manganese (Mn) had the highest concentration, ranging from 28.35 to 112.52 mg/kg, followed by nickel (Ni) with 1.63 to 4.47 mg/kg, and copper (Cu) with 1.53 to 3.36 mg/kg. The independent t-test results indicate no significant differences in heavy metal concentrations between *T. duplicata* and *C. obtusa* for any of the metals tested, as all p-values exceeded the significance threshold (P>0.05). Additionally, the THQ and HI values for all collected samples were less than 1, indicating no adverse health effects from consuming these snails.

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Keywords: Snail, intertidal gastropods, heavy metal, health risk assessment (HRA)

1. INTRODUCTION

Intertidal gastropods, including *T. duplicata* and *C. obtusa*, are valuable indicators of environmental quality due to their sedentary nature and capacity to accumulate contaminants such as heavy metal from their surroundings (Samsi et al., 2017). Heavy metals, such as Nickel (Ni), Copper (Cu), and Manganese (Mn), are ubiquitous pollutants in coastal ecosystems, originating from various anthropogenic activities such as industrial discharge, urban runoff, and agricultural practices. The heavy metal contamination of marine environments is a pressing concern globally, with anthropogenic activities contributing significantly to the accumulation of heavy metals in coastal sediments (Bandara et al., 2023).

T. duplicata and *C. obtusa* commonly known as “Siput tuntul” and “Siput Belitung” respectively, are prevalent inhabitants of intertidal zones across tropical and subtropical regions (Oo & Oo, 2019). Their sessile lifestyle and filter-feeding behaviour make them susceptible to the uptake of heavy metals present in sediment and water (Shaari et al., 2016). Furthermore, their abundance and widespread distribution make them ideal

candidates for biomonitoring studies aimed at assessing heavy metal pollution in coastal environments. Despite their ecological importance and potential as bioindicators, limited research has been conducted on the accumulation of heavy metals in *T. duplicata* and *C. obtusa*. Understanding the bioaccumulation patterns and distribution of heavy metals in these gastropods is crucial for evaluating the extent of contamination in their habitats and assessing associated risks to ecosystem health and human well-being (Demir, 2024).

Moreover, this study seeks to address the potential human health implications of heavy metal contamination through the consumption of *T. duplicata* and *C. obtusa* by local communities. These gastropods are frequently harvested for food in some regions, raising concerns about the transfer of accumulated contaminants along the food chain. Therefore, alongside environmental monitoring, this study will incorporate a human health risk assessment to evaluate the potential exposure and health risks associated with heavy metal ingestion through the consumption of these snails. By elucidating the bioaccumulation dynamics of heavy metals in *T. duplicata* and *C. obtusa*, this study aims to provide critical

insights for assessing associated human health risks. These findings will be invaluable for policymakers, public health officials, and local communities, enabling the development of targeted mitigation strategies and promoting the sustainable management of coastal ecosystems to safeguard human health.

2. MATERIALS AND METHODS

Sampling time and location

This study was conducted over a three-month period in 2024, from April to June. Both types of samples were collected in April 2024. The study focused on two types of snails: *C. obtusa* and *T. duplicata*. Both of the sample were collected from Sekinchan, Selangor. These types of snails were selected due to their lifestyle as bottom feeders, their tolerance and bioaccumulation of heavy metals, making them good indicators of heavy metal pollution (Baroudi et al., 2020).

Procedures

The samples of both snails were deshelled and thoroughly washed. Each sample, weighing 2g for each type, was transferred into a silica crucible. A total of 30 samples for both types of snails were selected for analysis of heavy metal concentration. tissues were digested using a dry ashing procedure (Jothi et al, 2018). The samples from the crucible were then transferred into 50ml beakers. To each beaker, 5 ml of 6 M HCl (hydrochloric acid) was added. The beakers containing the samples with acid solution were placed on a hot plate and digested until a clear solution was obtained. After digestion, the final residues were filtered using filter paper and dissolved in a 1% HNO₃ solution. The solutions were then diluted to a final volume of 100 ml and transferred into centrifuge tubes. All 30 samples of *C. obtusa* and *T. obtus* were stored in the laboratory for analysis of heavy metal content using an Flame Atomic Absorption Spectrophotometer (FAAS).

Data analysis.

The data were analyzed statistically using the Statistical Package for the Social Sciences (SPSS) version 29. Analysis of variance for total heavy metal concentrations across different species was conducted using an independent t-test.

Health Risk Assessment (HRA)

Health Risk Assessment (HRA), particularly through metrics like Total Hazard Quotient (THQ) and Hazard Index (HI) as outlined in the equation 1 (Abdullah et al., 2022), is conducted for snails such as *T. duplicata* and *C. duplicata* primarily to evaluate the potential health risks associated with heavy metal contamination in these species.

$$THQ = \frac{C \times EFR \times ED \times FIR \times 10^{-3}}{RfD \times BW \times AT} \quad (1)$$

C represents the concentration of heavy metals in these snail species, measured in mg/kg from sample analysis. EFR stands for exposure frequency, which is 365 days per year, and ED

denotes exposure duration of 70 years, representing the average lifetime. FIR is the food ingestion rate for daily snail consumption, set at 8 grams per day. RfD refers to the reference dose established by the United States Environmental Protection Agency (US EPA), estimated as the daily oral exposure level that does not cause adverse effects over a lifetime. The conversion factor is 10⁻³ (Onuoha et al., 2016). The RfD for Ni, Cu, and Mn are 0.02 mg/kg/day, 0.04 mg/kg/day, and 0.14 mg/kg/day, respectively. BW stands for average adult body weight, assumed to be 60 kilograms. AT represents the averaging time of exposure for non-carcinogenic effects, calculated as 365 days per year multiplied by the number of exposure years.

$$HI = \sum HQ \quad (2)$$

HI represents the cumulative sum of THQs for substances impacting the same target organ or organ system. Hence, the THQ for each parameter are aggregated to determine the overall exposure.

3. RESULTS AND DISCUSSION

Table 1 provides an analysis of the concentrations of three heavy metals Ni, Cu, and Mn in two species of gastropods: *T. duplicata* and *C. obtusa*. The results indicate that both species have relatively low concentrations of Ni and Cu. Specifically, *T. duplicata* exhibits a mean Ni concentration of 2.22 mg/kg and Cu at 2.20 mg/kg, while *C. obtusa* shows slightly higher mean concentrations of 2.34 mg/kg for Ni and 2.27 mg/kg for Cu. In contrast, Mn levels are significantly higher in both species. *T. duplicata* has a notably higher mean concentration of 82.61 mg/kg, compared to *C. obtusa*, which has a mean concentration of 51.11 mg/kg. Additionally, the data reveal substantial variability in Mn levels, particularly in *C. obtusa*, as reflected by the larger standard deviation. The findings indicated these snails (*T. duplicata* and *C. obtusa*) throughout the study area were contaminated with heavy metals, possibly due to factors such as agriculture activities, industrial discharge, mining activities, or other environmental influences (Krishnan et al., 2022).

Table 1: Concentration of Heavy metals in gastropods

Heavy Metals	Gastropods	Heavy metal concentration (mg/kg)		
		Min	Max	Mean ± SD
Ni	<i>T. duplicata</i>	1.84	2.91	2.22 ± 0.27
	<i>C. obtusa</i>	1.63	4.47	2.34 ± 0.74
Cu	<i>T. duplicata</i>	1.53	2.80	2.20 ± 0.37
	<i>C. obtusa</i>	1.64	3.36	2.27 ± 0.50
Mn	<i>T. duplicata</i>	68.48	112.52	82.61 ± 12.12
	<i>C. obtusa</i>	28.35	95.69	51.11 ± 21.21

The analysis of heavy metal concentrations in both gastropods *T. duplicata* and *C. obtusa* reveals relatively differences in the accumulation of Ni, Cu, and Mn between these species. While the levels of Ni and Cu are relatively low, the elevated

concentrations of Mn, particularly in *T. duplicata*, highlight potential environmental and health concerns. These findings are crucial when considering the broader implications for human health, especially in communities that rely on these species as a food source. Heavy metals such as Ni, Cu, and Mn are known to accumulate in marine organisms, which can lead to biomagnification as they move up the food chain (Pund, 2023). Although Cu is an essential trace element necessary for human health, excessive intake can lead to gastrointestinal distress and liver damage (Taylor et al.,2020). Ni, on the other hand, has no known biological function in humans, and prolonged exposure is associated with allergic reactions, respiratory issues, and an increased risk of certain cancers (Genchi et al., 2020). Mn, despite being vital for the functioning of several enzymes (Chen et al., 2018), can also pose risks when consumed in large quantities. Chronic exposure to high levels of Mn can lead to neurological effects, including a condition known as manganism, which resembles Parkinson's disease (Kim et al.,2022). The significantly higher concentration of Mn found in *T. duplicata* (mean of 82.61 mg/kg) compared to *C. obtusa* (mean of 51.11 mg/kg) suggests that consumption of these gastropods, particularly *T. duplicata*, could pose a risk of Mn overexposure.

The Independant t-test analysis of heavy metal concentrations in the gastropods *T. duplicata* and *C. obtusa* reveals that there is no significant difference in the levels of Ni, Cu, and Mn between the two species. This observation is based on data collected from 15 samples of each gastropod species, ensuring a robust dataset for comparison. The mean concentrations of Ni and Cu are quite similar between the species, with *T. duplicata* showing slightly lower levels for both metals compared to *C. obtusa*. Even though *T. duplicata* has a higher mean concentration of Mn than *C. obtusa*, the difference is not statistically significant.

The lack of significant differences in heavy metal concentrations between the two gastropod species could be attributed to several factors. First, both *T. duplicata* and *C. obtusa* might inhabit similar ecological niches or regions where they are exposed to comparable environmental conditions and sources of heavy metal contamination (ref). The uniformity in their diets and feeding behaviors could also lead to similar bioaccumulation patterns (Bienfang et al, 2013). Additionally, the physiological mechanisms for metal uptake and detoxification in these gastropods might be alike, resulting in comparable levels of metal accumulation.

3.2. Health Risk Assessment

The Target Hazard Quotient (THQ) and Hazard Index (HI) are crucial indicators used to assess the potential health risks associated with consuming contaminated food, such as snails, by comparing the exposure level to a reference dose. In this study, the THQ and HI values for the snails *T. duplicata* and *C. obtusa* were both calculated to be less than 1. This outcome

is significant as it suggests that the levels of heavy metals present in these snails do not pose a significant risk of adverse health effects to the population consuming them. Specifically, a THQ or HI value below 1 indicates that the exposure to heavy metals through the consumption of these snails is within safe limits set by health guidelines and does not exceed the threshold that could lead to potential health concerns. Given these findings, it can be concluded that the snails grown in the selected study area are safe for consumption. This is reassuring for the local population, as it suggests that regular consumption of these snails does not contribute to a significant risk of toxicity from heavy metals such as Ni, Cu, and Mn. However, it is essential to maintain ongoing monitoring to ensure that these levels remain safe, as environmental conditions and contamination sources can change over time (Mitra et al., 2022). These results also highlight the effectiveness of current environmental management practices in the study area, which seem to have successfully kept heavy metal contamination within safe limits for human consumption.

Table 2 THQ and HI of heavy metal from *T. duplicata* and *C. obtusa*

Type of snails	THQ			HI
	Nikel (Ni)	Copper (Cu)	Manganese (Mn)	
<i>T. duplicata</i>	0.0345	0.0171	0.1836	0.2352
<i>C. obtusa</i>	0.0364	0.0177	0.1158	0.1699

4. CONCLUSION

This study presented data specifically on the concentrations of heavy metals in *T. duplicata* and *C. obtusa*, respectively. The results show that there is an accumulation of heavy metals in these intertidal gastropods. In both *T. duplicata* and *C. obtusa*, the highest concentration of heavy metals was found to be Mn, followed by Ni and Cu. The Target Hazard Quotient (THQ) and Hazard Index (HI) calculated for the snails *T. duplicata* and *C. obtusa* were less than 1, indicating no significant adverse health effects for the population consuming these snails in the study areas.

ACKNOWLEDGEMENTS

The author sincerely thanks all concerned laboratory assistants of Faculty of Health Sciences, UiTM for their contributions in this research work.

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RESEARCH ARTICLE

Diagnostic accuracy of ultrasound in the detection of malignant breast lesions

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Abstract:

Some small lesions could be missing with mammography, particularly in dense breasts. Therefore, ultrasound is an alternative non-ionizing tool for breast imaging. This study aims to determine the diagnostic accuracy of ultrasound in detecting malignant breast lesions and the association of malignancy status with demographic and clinical factors. A total of 70 medical reports of patients who underwent breast ultrasonography between January and December 2023 were retrospectively reviewed. The lesion malignancy was validated using the biopsy as a reference standard. Diagnostic accuracy test was performed using Bayesian Theorem. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of ultrasound in detecting benign and malignant breast lesions were 97.6%, 27.6%, 65.6%, and 88.9% respectively with overall diagnostic accuracy of 68.6%. The malignancy of lesions was significantly associated with age ($p = 0.015$), family history ($p = 0.004$) and fertility status ($p = 0.004$). The approximately 70% diagnostic accuracy of ultrasound suggests that this non-ionizing imaging modality could not be used independently for a definitive diagnosis of breast malignancy but needs a comprehensive integrated approach with mammography and other diagnostic imaging tools.

Keywords: Benign, breast, diagnostic accuracy, malignant, ultrasound

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1. INTRODUCTION

Breast cancer is the most common cancer diagnosed in women and is usually discovered during routine screening as it evolves silently (Menon et al., 2024). It has become the leading cause of mortality and morbidity among women worldwide (Hanis et al., 2019). The major factors that can increase a woman's risk of developing breast cancer are primarily due to increased hormonal stimulation (Łukasiewicz et al., 2021). According to the Global Cancer Statistics, GLOBOCAN 2020 report, the most common cancer among Malaysian women is breast cancer followed by colorectal cancer and ovarian cancer (Tan et al., 2023).

About 99% of the cases that develop breast cancer were female (Hanis et al., 2019). People over the age of 50 years old may have a high risk of developing breast cancer (Łukasiewicz et al., 2021). BRCA1 and BRCA2 are the most vital genes responsible for an increased susceptibility to breast cancer. Both genes are commonly carried by individuals with a strong family history of breast cancer (Menon et al., 2024). Breast lesions can be classified as benign and malignant, in which benign breast lesions are non-cancerous and very common among women (Stachs et al., 2019). The most common malignant breast lesions that become major life-threatening are invasive ductal carcinoma and invasive lobular carcinoma (Menon et al., 2024).

Mammography is the first-line screening tool for breast cancer as it can detect the tumor at an early stage before clinical symptoms appear (Bhushan et al., 2021). However, some lesions cannot be detected by mammography screening alone due its lower sensitivity in the case of dense breast (Wang et al., 2022). Some breast lesions are indistinguishable in mammography due to being surrounded by fibro-glandular tissues (Gharekhanloo et al., 2018). Mammography performance can be impaired by dense breast tissue masking or obscuring noncalcified cancers because both breast cancer and dense tissue are radiopaque (Brown et al., 2023). As breast density increases, the number of false-positive results rises from 11 per 1000 exams in fatty breasts to 24 per 1000 exams in extremely dense breasts, while the sensitivity of mammography decreases from as high as 93% in fatty breasts to as low as 30% in extremely dense breasts (Kerlikowske, 2011; Weinstein et al., 2021). Therefore, ultrasound imaging is the most preferable adjunct screening tool, especially for dense breasts to detect any missing lesions on mammography and eliminate unnecessary biopsies (Ghaemian et al., 2021). However, ultrasound is a highly operator-dependent imaging modality (Sharma et al., 2021). This diagnostic technique depends mainly on the radiologist's expertise and knowledge which may result in different interpretations and diagnoses (Gharekhanloo et al., 2018). This study aims to determine the diagnostic accuracy of ultrasound in detecting malignancy of breast lesions and the association of malignancy status with demographic and clinical factors.

2. MATERIALS AND METHODS

2.1 Ethics approval

Ethics approval was granted by the Faculty Ethics Review Committee (FERC) of the Faculty of Health Sciences Universiti Teknologi MARA (FERC/FSK/MR/2024/00023) and Medical Research Ethics Committee of Ministry of Health of Malaysia (NMRR ID-24-01183-BBZ).

2.1 Ultrasound findings

This study used a retrospective cross-sectional design. The medical reports of women patients over 18 years old underwent ultrasound scanning between January to December 2023 were reviewed. The radiological findings of the ultrasound were validated against biopsy results as the reference standard. Ultrasound findings without the biopsy report were excluded from the study. The breast ultrasound was performed using a 7MHz probe (Toshiba Medical Systems Corporation). The sonographic findings were characterized based on the Breast Imaging Reporting and Data System (BIRADS) and classified into benign and malignant groups. Patients with BI-RADS assessment category ≤ 3 and assessment category ≥ 4 were classified as benign and malignant, respectively. Specifically, BI-RADS assessment categories were classified as 0 (incomplete), 1 (negative), 2 (benign), 3 (probably benign), 4A (low suspicion for malignancy), 4B (moderate suspicion for malignancy), 4C (high suspicion for malignancy), 5 (highly suggestive for malignancy) and 6 (known-biopsy proven malignancy) (American College of Radiology, 2013).

2.2 Statistical analysis

Diagnostic accuracy test (Bayesian Theorem) was performed to measure the diagnostic accuracy of ultrasound in detecting benign and malignant breast lesions. Demographic and clinical factors were presented as descriptive analysis. The Chi-Square test was conducted to determine the association of lesion malignancy with demographic and clinical factors. The statistical analyses were executed using IBM SPSS Statistics for Windows version 29.0 with $p < 0.05$ was considered statistically significant.

3. RESULTS AND DISCUSSION

3.1 Distribution of breast lesion malignancy

A total of 70 breast ultrasound cases were reviewed including 61 (87.1%) malignant and 9 (12.9%) benign cases. All benign cases were reported with BI-RADS score 3, while among malignant cases, 36 (59.0%), 11 (18.0%), 8 (13.1%) and 6 (9.8%) cases were reported with BI-RADS score 4a, BI-RADS score 4b, BI-RADS score 4c and BI-RADS score 5, respectively. Among these lesions, 41 (58.6%) cases were malignant, and 29 (41.4%) cases were benign. The distribution of breast lesion malignancy based on the BI-RADS assessment category is summarized in Figure 1.

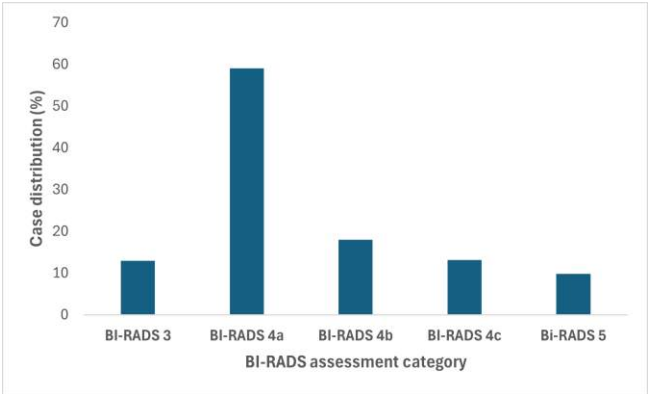


Figure 1. Distribution of breast lesion malignancy based on BI-RADS assessment category

3.2 Diagnostic accuracy of ultrasound in detecting malignancy of breast lesions

The cross-tabulation of Bayesian Theorem between ultrasound and biopsy findings are shown in Table 1.

Table 1. Cross-tabulation between ultrasound and biopsy results

Ultrasound result	Biopsy result		Total
	Malignant (positive)	Benign (negative)	
Malignant (positive)	40	21	61
Benign (negative)	1	8	9
Total	41	29	70

The diagnostic performance of ultrasound in detecting breast lesion malignancy is 97.6% sensitivity, 27.6% specificity, 65.6% PPV, and 88.9% NPV with an overall diagnostic accuracy of 68.6%.

The BI-RADS findings of the present study align with the expected patterns in which benign lesions are more likely to be categorized as BI-RADS 3, while higher BI-RADS scores (4a, 4b, 4c, 5) are highly suspected as malignant. BI-RADS 4 and 5 lesions generally warrant biopsy to obtain a definitive histopathological diagnosis. However, low specificity of ultrasound signifies that some benign lesions may still be incorrectly classified as BI-RADS 4 or 5, leading to unnecessary biopsies. Previous studies suggested biopsy for BI-RADS score ≤ 3 to confirm the breast lesion malignancy (Ghaemian et al., 2021; Nisar et al. 2022). BI-RADS 3 lesions are typically managed with short-term follow-up. The biopsy is considered for BI-RADS 3 lesions based on patient preference, imaging features, or accessibility of the lesion (Nisar et al., 2022). High-risk factors such as strong family history, advanced age, and palpable mass of BI-RADS 3 lesions may undergo a biopsy that may increase the false

negative results (Turk et al., 2020). The variations of reporting standards may impact the diagnostic accuracy.

In this study, ultrasound demonstrated a high sensitivity of 97.6% in detecting malignant breast lesions, indicating its effectiveness in identifying positive cases. However, the specificity was relatively low at 27.6%, suggesting that ultrasound may have a higher rate of false-positive results in identifying benign lesions. The PPV of 65.6% indicates that when ultrasound identifies a lesion as malignant, there is a 65.6% chance that the lesion is truly malignant. The NPV of 88.9% suggests that when ultrasound identifies a lesion as benign, there is an 88.9% chance that the lesions are truly benign. The high sensitivity is useful for screening out malignancy, but most of benign lesions are unnecessarily biopsied based on the ultrasound findings alone as remarked by its low specificity. The low overall diagnostic accuracy of 68.6% suggests that ultrasound is a valuable diagnostic tool for the assessment of breast lesions, but this non-ionizing modality should not be used independently for definitive diagnosis.

The current findings are consistent with the previous studies which reporting that ultrasound has a high sensitivity (> 90%) with diagnostic accuracy of 60-90% in detecting breast lesion (Siu & U.S. Preventive Services Task Force 2016; Quratulain et al., 2024). However, higher specificity (72.1% - 83.6%) was reported by those studies. The variance of diagnostic accuracy among health institutions might be contributed by multiple factors including patient population, utilization of advanced ultrasound techniques, experience of radiologist in diagnosis interpretation and reporting standard.

4.4 Association between lesion malignancy status with demographic and clinical factors

The result showed a significant association between patient's age and lesion malignancy status ($p = 0.015$). This finding is consistent with Gharekhanloo et al. (2018) and Xie et al. (2023) who note that age is a significant determinant for the development of breast cancer. Malignant breast lesions are common in older age groups, while benign lesions are common in younger age groups.

Moreover, family history was significantly associated with lesion malignancy status ($p = 0.004$). Women with inherited genetics tend to develop breast cancer compared to women with no family history. The development of proliferative lesions is associated with family history and tends to develop benign breast lesions among young women with a low tendency among advancing age (Schilling & Silva, 2020).

Furthermore, this study has demonstrated a significant association between fertility status and malignancy status ($p = 0.004$). Breast cancer tends to occur in postmenopausal women compared to young women (Hassen et al., 2022) with a 52% increased risk (Tan et al., 2018). However, no significant association was observed between the location of the lesion ($p = 0.515$) and the involved side of the lesion ($p = 0.814$) with malignancy status., which is consistent with Gharekhanloo et al. (2018). The p-values are 0.515 and 0.814 respectively. This finding suggests that the location of the lesion alone is not a reliable predictor of the nature of the lesion, and other factors such as clinical history and imaging characteristics should be considered in the diagnostic workup.

This study was limited with imbalance number of samples between benign and malignant breast lesions which might affect the low specificity value. Larger number of samples could be recommended to provide more robust and reliable estimates of the diagnostic accuracy of ultrasound in the future. Integrating ultrasound with other imaging techniques such as mammography or Magnetic Resonance Imaging (MRI), may improve the accuracy for the evaluation of breast lesions. Additionally, the application of advanced ultrasound techniques such as color Doppler and shear-wave elastography could be further explored and the consistency of ultrasound interpretation across multiple interpreters should be evaluated to identify the areas of report standardization. By addressing these future recommendations, researchers can build upon the current findings and expand their understanding of the diagnostic capabilities of ultrasound. These recommendations may facilitate more comprehensive and accurate approaches for the management of patients with suspected breast cancer.

4. CONCLUSION

Ultrasound is a valuable adjunct screening tool for breast lesions. However, the approximately 70% diagnostic accuracy of ultrasound suggests that this non-ionizing imaging modality should not be used independently for a definitive diagnosis of breast malignancy but needs a comprehensive integrated approach with mammography and other diagnostic imaging tools.

ACKNOWLEDGEMENTS

The authors would like to thank the radiographers and the involved parties for facilitating the study.

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RESEARCH ARTICLE

Students' perceptions on OSPE in anatomy subject.

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Abstract:

Objective structured practical examination (OSPE) is globally implemented in medical cluster programs as a tool of assessment. OSPE in preclinical subjects, however, focuses on empowerment of theoretical competency. The aim of this study is to evaluate students' perceptions on OSPE in anatomy subject. The study involved 26 undergraduate physiotherapy and occupational therapy students in the first semester. All students were subjected to two OSPEs within one semester. A conventional 30 stations OSPE were conducted in two batches. Survey results indicate that OSPE significantly motivates students to pay closer attention during both theoretical and practical sessions. Most students perceived OSPE as a fair and unbiased assessment method, expressing satisfaction with the marks received and the impartiality of examiners. Positive response on post-OSPE feedback highlights the effectiveness of informative feedback sessions in identifying mistakes and providing guidance for improvement. Despite its benefits, OSPE is associated with stress, and some students reported variability in marking subjective questions. Introducing mock OSPE sessions could alleviate stress and improve preparedness by familiarizing students with the format. In conclusion, while OSPE effectively promotes active learning and fair assessment, continuous improvements in its implementation are essential to address identified challenges and maximize its effectiveness as a robust assessment tool. Future research should focus on standardizing marking criteria for subjective questions, developing more effective feedback mechanisms, and exploring diverse teaching methodologies.

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dralia@uitm.edu.my**Keywords:** anatomy, assessment, OSPE, perception, students

1. INTRODUCTION

The landscape of medical education is in a continuum of evolution with the objective of not only equipping students with foundational knowledge but also ensuring the development of critical practical skills. In the pursuit of creating proficient healthcare professionals, the ability to accurately assess both the theoretical and practical competencies of students is indispensable. Within this context, OSPE has emerged as a transformative approach in preclinical education. OSPE was first introduced (R. M. G. Harden et al., 1975) as a clinical assessment for undergraduate medical students at Dundee University. OSPE grew tremendously popular since then and has been practiced in other preclinical subjects and other faculties like dentistry, midwifery and pharmacy (Saurabh et al., 2021; Sekhon et al., 2023; Vishwakarma et al., 2016). Distinct from traditional assessment methods, which predominantly focus on cognitive recall, OSPEs are designed to systematically evaluate the practical and clinical skills that are vital for future clinical practice (R. M. Harden & Cairncross, 1980). These structured examinations reflect active learning participation, applied knowledge, and an alignment with the realistic demands of healthcare delivery (Yaqinuddin et al., 2013). By mimicking clinical scenarios within a controlled setting, OSPEs offer students an invaluable opportunity to demonstrate and refine their capabilities in a manner that written assessments cannot capture (Zafar et al., 2013).

Beyond OSPE, several other assessment tools are commonly used in preclinical subjects to evaluate students' knowledge and skills. These include the traditional written examination, computer-based assessments, laboratory practical, oral presentation, case-based assessments (CBA), portfolios, self and peer assessments. Each assessment tool serves different educational goals and learning outcomes. For example, written exams emphasize retention and understanding of knowledge (Anderson et al., 2024), CBAs offer a more interactive approach to assessment (Jones & Oh, 2024), laboratory practical measure application of theory into practice (Kimpo & Puder, 2023), oral exams test depth of knowledge and articulation (Theobald, 2021), peer and self-assessments encourage reflective practice and critical evaluation skills (Alqasab et al., 2023), CBAs develop problem-solving in context (Jones & Oh, 2024), and portfolios showcase ongoing development and integration of skills (Sulistyo et al., 2020). OSPEs are distinctive as they place students in a simulated clinical environment to assess practical and clinical competencies in a structured, timed, and standardized manner. They uniquely allow for a holistic evaluation of a student's practical abilities and decision-making in a controlled setting (Yaqinuddin et al., 2013).

Why students' perception is important and what impact will it have? Numerous studies have demonstrated identifying loopholes and improving it will benefit two parties i.e. the learner providers and the students. To learner providers, students' perceptions will reflect the quality of the assessment, guiding them to refine their assessments to better align with the intended course learning outcomes and program's educational outcomes (He et al., 2024; Miles et al., 2024; Sonllela Velasco et al., 2024). Students' perceptions are also beneficial insights into the effectiveness of teaching methods and highlight areas for improvement in instructional design (Caliph & Lee, 2024). Student perceptions correspondingly highlight the need for more guidance, such as clarifications about assessment rubrics, how to provide appropriate answers, or additional feedback sessions (Johansson et al., 2023). This allows learner providers to engage individual weaknesses and help to improve the needs of the students (Nurie Bogale & Wale, 2024).

To students, the outcomes of students' perception allow them to reflect on their motivation, engagement, and learning strategies (Beckham et al., 2024; Navarro et al., 2024; Skura & Wheeler, 2024; Wang et al., 2024; Wolterinck-Broekhuis et al., 2024). If students perceive an assessment as fair, relevant, and aligned with their learning goals, they are more likely to be intrinsically motivated (Day et al., 2018). Positive perceptions can also promote a growth mindset, where students see assessments as opportunities for learning rather than just a judgment of their abilities (Veugen et al., 2021). When students see the value in an assessment, they are more likely to actively participate and invest effort. Engaging assessments often include practical, real-world applications such as OSPE. Perceptions influence the learning strategies students used (Gerritsen-van Leeuwenkamp et al., 2019). For example, if assessments are seen as a genuine measure of understanding, students might adopt deeper learning strategies, such as critical thinking and concept integration, instead of surface strategies, such as rote memorization.

In the faculty of Health Sciences UiTM Puncak Alam, the introduction of OSPE has been implemented as part of curriculum assessment in anatomy subjects, which were taken in two consecutive semesters by both physiotherapy and occupational therapy undergraduate programs. This first-hand execution of OSPE in the faculty was initiated upon faculty's curriculum review in 2015 and was first executed in 2019. OSPE is a part of the summative assessment for anatomy subject, weighing 30% of the subject total score. To rectify the loopholes and for the purpose of continuous quality control pertaining to anatomy teaching-learning process and its assessment, we conducted a small study on students' perception on OSPE, that includes students' perceptions on OSPE as a learning stimulus, OSPE as an assessment tool, the administration of OSPE, the OSPE content and post OSPE feedback given by the examiner. Thus, this paper will examine students' perceptions of OSPE as a learning stimulus and a learning tool. This paper will also reflect on students' perception of the OSPE design, execution and the feedback given to them.

2. MATERIALS AND METHODS

The study involved 59 first-semester full-time undergraduate students from both physiotherapy and occupational therapy programs from the Faculty of Health Sciences UiTM Puncak Alam, upon the ethical approval from the faculty ethical committee. Two OSPEs were conducted for anatomy subject from September 2019 to December 2019. However, for the purpose of this study, only one OSPE was evaluated. At a designated point in the 14-week academic calendar, specifically in week 6, students received comprehensive briefings regarding the arrangement, structure, and content of OSPE, including details about the topics to be covered in each OSPE.

The OSPE was conducted in two batches, with each batch consisting of 30 stations, encompassing 25 active stations and 5 rest stations. Each station was allocated a 3-minute duration. Active stations carried a weightage of 3 marks each. Each of the active stations was designed, verified, and evaluated by the faculty's two trained academic staff as anatomists with more than 5 years of teaching experience in higher education.

A week after the completion of OSPE, the graded answer scripts were returned to the students with marks in percentage. The examiner then had an impactful feedback session the students on their OSPE performances. Students were encouraged to have a two-way discussion and highlighted any issues on the OSPE administration and execution.

Upon completion of the discussion, all participating students were provided with a structured questionnaire, as outlined by Asani et al., (2023). This questionnaire included inquiries pertaining to students' perceptions on OSPE as a learning stimulus, OSPE as an assessment tool, the administration of OSPE, the OSPE content and post OSPE feedback given by the examiner.

Students' perceptions were gauged using a 5-point Likert scale with strongly disagree as the minimum score and strongly agree as the maximum score. It is worth noting that the data collected were entirely based on voluntary responses, and students' identities were not inquired in the process.

Responses obtained from the questionnaire were analyzed descriptively.

3. RESULTS AND DISCUSSION

A questionnaire was administered to 59 students, with 26 (44%) responding. The results revealed that in general, most of the students who gave the feedback perceived OSPE as a stimulating learning experience.

Regarding OSPE as a learning stimulus (Table 1), a significant majority strongly agreed (92.3%) and agreed (7.7%) that OSPE encourages students to pay attention during class and during practical sessions. Students agreed (19.2%) and strongly agreed (80.8%) that it is important not to miss any class in order to score OSPE. For item 4, 30.8% students agreed while 69.2% strongly agreed that it is important not to

miss any practical session in order to score OSPE. The survey results indicate a strong consensus among students regarding OSPE benefits as a learning stimulus. A significant majority consented that OSPE encourages attentiveness during both classes and practical sessions, underscoring its effectiveness in fostering engagement. Furthermore, the majority agreed that attending all classes is crucial for performing well in OSPE, emphasizing the link between regular attendance and achievement. Similarly, the majority agreed that attending practical sessions is vital for OSPE success, highlighting the practical aspect's role in skill development and assessment preparation. These findings underscore the importance of active learning in both classroom and practical sessions for comprehending theoretical concepts (Jat, 2021). In exploring active learning further, two pivotal factors influence student motivation: teaching style and the learning environment (Sekhon et al., 2023). Implementing diverse teaching methodologies to cater to varied learning styles and ensuring a supportive learning atmosphere are crucial (Vishwakarma et al., 2016). This approach not only enhances knowledge acquisition but also promotes retention, thereby optimizing the educational outcomes of OSPE as a learning tool. For example, incorporating case-based discussions in classes can enhance student engagement and understanding (Jones & Oh, 2024). Such methods not only align with active learning principles but also cater to different learning styles, thereby maximizing the educational impact of OSPE (Abdolkarimi, 2021). Creating a conducive learning environment also plays a crucial role in supporting active learning. A supportive learning environment includes factors like access to resources (in this study, the anatomy models available in the anatomy lab and the condition of the anatomy lab itself), encouragement of collaboration among peers, and persistent learner provider assistance during practical session promote continuous improvement (Mitra et al., 2021). Such an environment fosters a positive attitude towards learning and motivates students to actively engage with course materials and prepare themselves for assessments such as OSPE (P & Thomas, 2022).

Table 1. OSPE as learning stimulus

Item	Agree N (%)	Strongly agree N (%)
1 OSPE encouraged me to pay more attention during class	2 (7.7)	24 (92.3)
2 OSPE encouraged me to pay more attention during practical session	2 (7.7)	24 (92.3)
3 It is important not to miss any class to score OSPE	5 (19.2)	21 (80.8)
4 It is important not to miss any practical session to score OSPE	8 (30.8)	18 (69.2)

When examining OSPE as an assessment tool (Table 2), the results reveal a diverse range of perceptions among students. A notable 52% strongly agreed and 32% agreed that OSPE

offers superior assessment compared to traditional methods. Conversely, 4% disagreed and 12% were undecided on this matter, highlighting the mixed views among students regarding the efficacy of OSPE as an assessment tool. A significant proportion of students (46.2% agreed, 46.2% strongly agreed) acknowledged that OSPE effectively minimizes the likelihood of cheating, underscoring its role in promoting academic integrity. However, 7.7% remained undecided on this aspect. Regarding concerns about failure rates, opinions were divided: 20% strongly disagreed, 32% disagreed, 36% were undecided, 4% agreed, and 8% strongly agreed that OSPE increases the risk of failure (item 3). Similarly, perceptions on whether OSPE reduces reliance on luck varied: 11.5% strongly disagreed, 3.8% disagreed, 30.8% were undecided, 38.5% agreed, and 15.4% strongly agreed (item 4). These contrasting views illustrate the complexity of students' perceptions on OSPE's impact on assessment outcomes. This diversity in student opinions underscores the challenge of catering to individual preferences and learning styles when designing assessment methods. Students' educational backgrounds, learning abilities, and personal experiences all influence their perceptions of assessment tools (Jat, 2021). For instance, students who prefer hands-on learning may appreciate OSPE's practical approach, while others who excel in traditional written exams may harbour reservations (Bagchi et al., 2023). In best practice scenarios, to address these varied viewpoints and enhance the effectiveness of OSPE as an assessment tool, learner providers can consider integrating feedback mechanisms that allow students to voice their preferences and concerns (Sil et al., 2023). For example, conducting pre-assessment surveys to gauge student readiness and comfort with OSPE can inform instructional strategies and adjustments. Providing clear guidelines and training sessions on OSPE procedures can help mitigate anxiety and uncertainty among students (Bakkannavar & Nayak, 2021). However, due to constraints in the academic calendar, these tips were not able to be executed. OSPE encourages strengths in promoting engagement, integrity, and practical application of knowledge and adaptation to active learning. Thus, to align with diverse student needs and optimize learning outcomes, learner providers can ensure a supportive learning environment and give continuous feedback-driven improvements in the classroom and particularly during practical sessions (Kamal et al., 2021). With these approaches, OSPE may continue to evolve as a robust assessment tool that meets the needs of today's diverse students' learning styles.

Table 2. OSPE as an assessment tool

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	N (%)	N (%)	N (%)	N (%)	N (%)
1 OSPE is a better method of assessment than traditional assessment		1 (4)	3 (12)	8 (32)	13 (52)
2 OSPE reduces the chance of cheating			2 (7.7)	12 (46.2)	12 (46.2)
3 OSPE increasing the chances of me to fail	5 (20)	8 (32)	9 (36)	1 (4)	2 (8)
4 OSPE reduces the elements of luck	3 (11.5)	1 (3.8)	8 (30.8)	10 (38.5)	4 (15.4)

The administration of OSPE (Table 3) yielded varied responses among students. There was a notable positive sentiment regarding the clarity of instructions before OSPE execution, with 79.2% strongly agreeing, 29.6% agreeing, and 3.8% expressing indecision. Similarly, perceptions of the appropriateness of station arrangements were largely favourable, with 61.5% strongly agreeing, 26.9% agreeing, 3.8% undecided, and 7.7% disagreeing. However, opinions diverged significantly on whether OSPE induces stress, with 11.5% disagreeing, 38.5% undecided, 38.5% agreeing, and 11.5% strongly agreeing. These diverse perceptions on OSPE organization and logistics may stem from students' unfamiliarity with this assessment format, which differs markedly from traditional methods they are accustomed to (Bakkannavar & Nayak, 2021). Notably, the lack of exposure to mock OSPE sessions prior to the scheduled assessment, as outlined in the academic calendar, is identified as a potential area for improvement. Introducing mock OSPE sessions could provide students with valuable firsthand experience, alleviate stress, enhance preparedness, and dispel any misconceptions about OSPE (Alsaif et al., 2022). For instance, a learner provider could simulate OSPE scenarios during practical sessions. By doing so, students gain familiarity with the assessment format and develop confidence in their ability to perform under timed conditions and at various stations. This proactive approach not only reduces anxiety but also equips students with the skills and mindset needed to excel during the actual OSPE (Hultgren et al., 2023). Addressing stress associated with OSPE is crucial, as heightened anxiety can impact performance and ultimately affect assessment outcomes (Alsaif et al., 2022). Learner providers can mitigate

this by fostering a supportive learning environment, providing comprehensive guidance on OSPE expectations, and offering resources for stress management and academic support (Sil et al., 2023). By incorporating mock OSPE sessions into curriculum planning and supporting students through tailored preparatory measures, learner providers can enhance the overall experience and effectiveness of OSPE as an assessment tool.

Table 3. Administration of OSPE

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	N (%)	N (%)	N (%)	N (%)	N (%)
1 The instructions given before OSPE started were clear			1 (3.8)	7 (29.6)	18 (69.2)
2 The arrangement of OSPE was appropriate		2 (7.7)	1 (3.8)	7 (26.9)	16 (61.5)
3 OSPE is stressful		3 (11.5)	10 (38.5)	10 (38.5)	3 (11.5)
4 OSPE is tiring	1 (3.8)	2 (7.7)	13 (50)	9 (34.6)	1 (3.8)

In terms of OSPE content (Table 4), the majority of students expressed positive views. Specifically, 42.3% strongly agreed and 42.3% agreed on the quantity of active stations, while 3.8% disagreed and 11.5% were undecided. This finding correlates with previous observations on the stress levels reported during OSPE (Table 3), suggesting a relationship between the number of questions asked and the perceived stress among students. This insight underscores the importance of carefully balancing the number of active stations and questions (Yaqinuddin et al., 2013) to optimize student performance and alleviate anxiety. Learner providers could adjust OSPE formats by strategically incorporating more rest stations and designing appropriate number of question sets per active station. This approach not only supports students in managing the cognitive load associated with OSPE but also aligns with learning objectives and program educational outcomes (Vishwakarma et al., 2016). Regarding rest stations, students overwhelmingly agreed on their quantity and arrangement, with 42.3% agreeing and 57.7% strongly agreeing. Similarly, the allocated time per station was viewed positively, with 30.8% strongly agreeing, 53.8% agreeing, and 15.4% undecided. These findings underscore the importance of providing adequate breaks with suitable allotted time to enhance student performance and reduce stress during OSPE assessments. Students' perceptions regarding the coverage and weightage of questions in OSPE were largely positive, with 30.8% strongly agreeing, 53.8% agreeing, and 15.4% undecided. However, opinions were

more varied on the difficulty level of questions, with 84.6% agreeing on fairness and distribution, while 15.4% disagreed. This disparity may impact students' overall scores, a topic warranting further exploration in future research. In terms of question clarity and grammar, results varied: 34.6% strongly agreed, 50% agreed on clarity and comprehension, 11.5% were undecided, and 3.8% had difficulty understanding the questions. This diversity reflects students' linguistic backgrounds, English proficiency levels, and familiarity with medical terminology, posing challenges for educators and learners alike in enhancing question clarity and language proficiency (Shrestha, 2022). Addressing these challenges requires collaborative efforts to refine question clarity, enhance language skills in English and medical terminology, and ensure equitable assessment experiences for all students. Providing clear guidelines for question formulation can improve comprehension and fairness in OSPE assessments (Asani et al., 2023).

Table 4. OSPE content

Item		Disagree	Neutral	Agree	Strongly agree
		N (%)	N (%)	N (%)	N (%)
1	The number of questions was appropriate	1 (3.8)	3 (11.5)	11 (42.3)	11 (42.3)
2	The number of rest stations was appropriate			11 (42.3)	15 (57.7)
3	The time allocated for each station was appropriate		4 (15.4)	14 (53.8)	8 (30.8)
4	The questions covered were equally distributed		4 (15.4)	14 (53.8)	8 (30.8)
5	The question difficulty was fair	4 (15.4)		22 (84.6)	
6	The language used in OSPE is easily understood	1 (3.8)	3 (11.5)	13 (50)	9 (34.6)

The post-OSPE (Objective Structured Practical Examination) feedback analysis (Table 5) highlights a diverse range of responses from students, indicating varying degrees of satisfaction and perceived fairness in the assessment process. For item 1, "I am satisfied with the mark given," 42.3% of respondents strongly agreed, another 42.3% agreed, 11.5% were undecided, and 3.8% disagreed. This distribution suggests that while the majority of students were contented with their marks, a significant minority remained undecided or dissatisfied. Such inconsistency could be a result of various

factors, including perceived discrepancies in the marking criteria or a lack of clarity regarding what constitutes a correct or precise answer (Raubenheimer et al., 2016). For item 2, "The examiner provides fair and unbiased marking," the feedback was overwhelmingly positive, with 88.5% strongly agreeing, 7.7% agreeing, and only 3.8% disagreeing. This high level of agreement indicates that most students felt the marking was conducted impartially and fairly. However, the small percentage of disagreement still points to potential areas of improvement in ensuring consistent and transparent assessment methods. In item 6, "I know how to improve myself in the next OSPE," 57.7% of students strongly agreed, 30.8% agreed, 7.7% were undecided, and 3.8% strongly disagreed. This suggests that while a majority of students feel confident about their ability to improve in future OSPEs, there remains a subset of students who are either unsure or lack confidence in their ability to enhance their performance. This uncertainty could be attributed to insufficient or unclear feedback, highlighting the need for more targeted and comprehensive feedback sessions (Sharma et al., 2022). The dissatisfaction observed among some students could stem from inconsistencies in marking subjective questions, where responses might be correct but imprecise (Raubenheimer et al., 2016). Subjective assessments can be challenging due to their reliance on the learner provider's judgment, which can introduce variability (R. M. G. Harden et al., 1975). This issue might be improved by improving question instructions and providing additional feedback to help students understand how to deliver precise answers (Jansen et al., 2024). For example, in an OSPE scenario where a student is asked to identify anatomical structures, an answer like "the arm bone" may be correct but imprecise. To reduce such imprecision, the question could be framed more specifically, and feedback might include detailed explanations of what constitutes a precise answer, such as specifying "the humerus" instead of a general term. Additionally, during feedback sessions, tutors could provide examples of both precise and imprecise answers to illustrate the difference clearly (Watling & Ginsburg, 2019). This approach not only clarifies expectations but also helps students develop a clearer understanding of how to respond accurately in future examinations. A question like "Identify the muscle responsible for arm flexion" could be clarified to "Identify the biceps brachii, the muscle primarily responsible for flexion of the elbow." Feedback on such questions could include diagrams, descriptions of muscle function, and examples of both correct and partially correct answers, helping students to understand the level of detail (Goh & Kiat Tan, 2023).

Table 5. Post OSPE feedback

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	N (%)	N (%)	N (%)	N (%)	N (%)
1 I am satisfied with the marks given		1 (3.)	8 (30.)	7 (26.)	10 (38.)
2 The examiner provides fair & unbiased marking		1 (3.)		2 (7.7)	23 (88.)
3 The examiner informed me of my mistakes				3 (11.5)	23 (88.5)
4 The examiner informed me on how to answer correctly				4 (15.)	22 (84.)
5 I am aware of my weakness after the OSPE was returned				4 (16)	21 (84)
6 I know how to improve myself in the next OSPE	1 (3.8)		2 (7.7)	8 (30.)	15 (57.)

Developing effective question instructions requires significant resources, time, and effort. It also necessitates considering students' perceptions and plentiful potential responses. Learner providers should enumerate all possible correct responses, ensuring they cover a range of acceptable answers (Gomis et al., 2024). However, this approach may still lead to imprecise answers and potentially lower assessment standards if not carefully managed. A detailed rubric that outlines specific criteria for each possible answer can help standardize the marking process and reduce subjectivity (Veugen et al., 2021). Despite these challenges, students showed predominantly positive feedback on item 3 "The examiner informed me of my mistakes", item 4 "The examiner informed me on how to answer correctly" and item 5 "I am aware of my weaknesses after the OSPE was returned", with over 80% strongly agreeing and more than 10% agreeing. These results suggest that learner providers have been effective in conducting informative feedback sessions, which are crucial for student learning and improvement. By identifying mistakes, advising on correct answers, and highlighting areas of weakness, learner providers provide valuable guidance that helps students refine their knowledge and skills (Gomis et al., 2024). However, for significant improvement, students must enhance their learning approaches (Gerritsen-van Leeuwenkamp et al., 2019). This

includes fostering self-motivation, engaging in continuous autonomous learning, and strategically set learning objectives. Self-motivation is essential for students to take initiative in their learning, seek out additional resources, and stay engaged with the material. Continuous autonomous learning involves regular self-assessment and reflection, allowing students to identify areas for improvement and track their progress over time (Miles et al., 2024). Strategically setting learning objectives helps students focus their efforts on specific goals, making their study sessions more efficient and effective. Particularly during practical sessions, such strategies are essential to maximize the educational opportunities provided in anatomy courses. Students could adopt active learning techniques such as group discussions, peer teaching, and hands-on practice to deepen their understanding of anatomical structures and their functions. By actively engaging with the material, students are more likely to retain information and develop a more comprehensive understanding of the subject (Kimpö & Puder, 2023).

4. CONCLUSION

The findings from this study indicate that OSPE serves as an effective learning stimulus and assessment tool, significantly enhancing student engagement and attentiveness in both theoretical and practical sessions. A substantial majority of students strongly agreed that OSPE motivates them to pay closer attention during classes and practical sessions, emphasizing the importance of regular attendance for achieving high scores. This underscores the role of OSPE in fostering active learning and the direct correlation between class participation and academic performance. The survey results reveal that students largely perceive OSPE as a fair and unbiased assessment method, with the majority expressing satisfaction with the marks received and the impartiality of the examiners. However, some students reported dissatisfaction, likely due to inconsistencies in marking subjective questions. This highlights the need for clearer question instructions and more comprehensive feedback sessions to help students understand how to provide precise answers. The positive feedback on post-OSPE assessments indicates that informative feedback sessions were being conducted successfully. These sessions are crucial for student learning and improvement, helping them refine their knowledge and skills.

Despite the overall positive reception, the analysis also identifies several loopholes in the current OSPE implementation. The variability in marking subjective questions and the stress associated with OSPE are areas that require attention. Introducing mock OSPE sessions could alleviate stress and enhance student preparedness by familiarizing them with the assessment format. Meanwhile, improvising instructions is vital in reducing imprecise OSPE responses. This study evaluates OSPE from multiple

perspectives, including its role as a learning stimulus, an assessment tool, and its administration. By highlighting the benefits and challenges of OSPE, this study contributes to the academic discourse on practical assessments in medical education, providing valuable insights for educators and administrators. Future research could explore strategies to standardize marking criteria for subjective questions and develop more effective feedback mechanisms. Additionally, investigating the impact of different teaching methodologies and learning environments on student performance in OSPE could provide further insights into optimizing this assessment tool. Implementing diverse teaching methods that cater to varied learning styles and creating a supportive learning environment will be crucial in maximizing the educational outcomes of OSPE. In conclusion, while OSPE is largely effective in promoting active learning and fair assessment, continuous improvement in its implementation and administration is essential to address the identified challenges and enhance its overall effectiveness as an assessment tool in preclinical subjects. It is vital to note that in this study, the number of students responding to the questionnaire is small, thus, all the findings in this study may not represent the students wholly and may not be a significant. The findings of this study will contribute to the existing literature on assessment practices in education and provide valuable insights into the effectiveness of OSPE as a learning stimulus and assessment tool from the perception of students.

ACKNOWLEDGEMENTS

The author would like to express a great gratitude to all students and faculty members who have been directly and indirectly involved in the study.

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RESEARCH ARTICLE

Knowledge towards first aid among Faculty of Health Sciences students

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Abstract:

Having knowledge related towards first aid in each individual person is important in terms of helping people in emergency situation since injuries are one of the leading causes of morbidity and mortality worldwide. As the occurrence of emergencies has gradually increased in recent years, it is essential to make sure that individuals, including university students, are knowledgeable and adequately trained to deal with such measures. The objective of this study is to determine the level of knowledge towards first aid among students from the Faculty of Health Sciences of UiTM Selangor, Puncak Alam Campus. A quantitative cross-sectional survey with stratified random sampling study was conducted among 313 students. Data were collected using a self-administered questionnaire. A total of 39.78% of participants had a moderate level of first aid knowledge. 61.6% of the participants had experienced taking first aid courses and they significantly have high level of knowledge as $p < 0.001$. There are significant associations between sociodemographic and the level of first aid knowledge in term of gender, courses and first aid training experience. Students from the Faculty of Health Sciences at UiTM Puncak Alam Campus demonstrated a moderate level of knowledge about first aid. The university should take a key role in promoting the importance of first aid education among its students.

Keywords: emergency, first aid, health science, knowledge

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1. INTRODUCTION

First aid is an emergency treatment given to injuries at the occurrence of accidents and various emergency situations before regular treatment from the medical professionals take place. First aid is not a full medical treatment as it only needs some simple equipment. The purpose of first aid is to stabilize the victims which may help prevent the injury from worsening due to infection or other complications. Accidents and injuries are common, and University students are exposed to these injuries through their daily activities such as driving on the road, and during sports and recreational activities. The injuries related to road traffic crashes increase steadily every year although many rules and regulations had been implemented which includes the usage of AES camera technology, and enforcement of speed limit in accident prone areas. To deal with this situation, the implementation of First Aid skills is one of the best solutions.

According to the National First Aid Science Advisory Board, first aid should be learned by every person, for this it is necessary, that first aid training and education should be provided to everyone. Road traffic accidents for example, have become a major cause of mortality among Malaysian populations including university students. People aged between 15 to 44 years old contributes about 48% global road traffic death (WHO, 2022). First aid knowledge is vital for everyone, as it can save lives during emergencies. Injuries are a leading cause of illness and death globally. With the increase in emergencies, it is crucial that

individuals, including university students, are well-trained to respond. This study evaluates the first aid knowledge of students from the Faculty of Health Sciences at UiTM Selangor, Puncak Alam Campus.

2. MATERIALS AND METHODS

2.1 Research design

A quantitative cross-sectional study was applied to describe through numbers, percentages, and averages of the target population in this study as well as to accurately obtain the data and achieve the specific objectives of this research study. The questionnaire was distributed randomly to the students and they were given adequate time to answer all the survey questionnaire regarding knowledge of First Aid.

2.2 Sample selection

The study was conducted among the Health Science students of UiTM Selangor, Puncak Alam Campus. Stratified random sampling was applied in this study to achieve a total of 313 participants.

2.3 Sample size

The sample size (N=315), was calculated based on the previous study, Hong Kong Red Cross (2011) by using Raosoft online calculator. To apply this formula, we chose a 5% of margin error and a 95 % confidence interval.

Furthermore, the response distribution was set at 50%, which gave a larger sample size for this research.

The Raosoft formula used in calculation of the required sample size is as below:

$$x = Z(c/100)^2 r(100-r)$$

$$n = N \times ((N-1)E^2 + x)$$

$$E = \text{Sqrt}[(N - n) \times / n(N-1)]$$

Where,

N: the population size

r: fraction of responses that we interested in

Z(c/100): the critical value for the confidence level c.

2.4 Questionnaire

The questionnaire used in this study consists of two parts. (Jamaludin et.al., 2018) . Which are Part A and Part B. The 5 questions in part A elicited socio-demographic data, and 10 questions in part B were related to first aid knowledge. The levels of first aid knowledge were determined using Three-point Likert scale, which is a powerful assessment tool employed to gauge the intensity of opinions, attitudes, and perceptions within a given survey or research context. Participants were categorized as having high levels of first aid knowledge if their scores were 70% or higher. Participants were classified as having intermediate levels of knowledge if their scores were between 50% and 70% and classified as having low levels of first aid knowledge if their scores were below 50%.

2.5 Data Collection

Each student was given detailed explanation on the structure of this study and all information regarding students was kept confidential. All students agreed and volunteered to participate and provide all the necessary information with honesty. They signed the consent form before they proceed with answering the questionnaire. This study was approved by the Ethics Committee, Faculty Research Ethics Committee (FREC), Universiti Teknologi Mara (UiTM) [FERC/FSK/MR/2019/0013].

2.6 Statistical analysis of the data

Data entry and statistical analysis for this study were calculated using Statistical Package for the Social Science (SPSS) version 21. Descriptive data analysis were used to evaluate and determine the frequency, mean, standard deviation and standard error means. A one-way ANOVA test was used to test level of knowledge and association between gender and levels of first aid knowledge. The results were stated in percentage (%). Alpha of 0.05 was set as the

significant level for this study. The results were considered significant if the p-value was less than 0.05.

3. RESULTS AND DISCUSSION

3.1 Sociodemographic data

Table 1 shows the sociodemographic characteristics of the students. The ages of the students studied are various and ranging between 20 and 40 years old. The majority of the participants were aged from 18 to 22 (207 students, 65.7%) and only 2 participants aged more than 30(0.6%).

Table 1: Demographic characteristic of the students, N = 315

	Variables	Frequency (n)	Percentage (%)
Gender	Male	112	35.6
	Female	203	64.4
Courses	Nursing	42	13.3
	Medical Laboratory Technology	40	12.7
	Environmental Health	44	14.0
	Medical Imaging	41	13.0
	Physiotherapy	40	12.7
	Occupational Therapy	31	9.8
	Optometry	42	13.3
	Nutrition and Dietetic	35	11.1
Level of Education	First year	96	30.5
	Second year	109	34.6
	Third year	63	20.0
	Fourth year	47	14.9
Age	18-22	207	65.7
	23-25	99	31.4
	26-28	7	2.2
	30 >	2	0.6

Taking	Yes	194	61.6
First aid course	No	121	38.4

Participants were also classified by their year of study at UiTM Puncak Alam Campus. This showed that 96 (30.5%) of the participants were year 1 students, 109 (34.6%) were year 2 students, 63 (20%) were year 3 students, and 47 (14.9%) were year 4 students. The majority of the participants were year 2 students, while the minority were year 4 students. From 315 participants 203(64.4%) were female and the rest are male. Undergraduate students were chosen randomly from each course to represent their population.

Participants were also categorized into two group which are those who had taken, or were taking, first aid courses and those who had never attended any first aid courses. Most of the participants had already taken at least one first aid course (194, 61.6%).

3.2 Knowledge of students towards First Aid.

Based on Table 2 , the majority of participants (n=125, 39.7%) had moderate level of first aid knowledge, while 97 (30.8%) had high level of first aid knowledge, and 93 participants (29.5%) had a low level of knowledge.

Table 2: Percentages of students by their level of knowledge towards First-aid

Level of Knowledge	Frequency	Percentage
High (> 70%)	97	30.8
Moderate (50%-60%)	125	39.7
Low (> 50%)	93	29.5

3.3 Association between level of first aid knowledge with Sociodemographic characteristics

One-way ANOVA test was used to test for an association between gender and levels of first aid knowledge (Table 3). Based on the one way ANOVA test, the level of first aid knowledge differed between genders with a p-value of less than 0.05. Thus, at least one pair of means differ significantly. Post hoc testing is not needed for this study because there were only two groups.

Additionally, association between level of first aid knowledge with course of study was also tested. The ANOVA test was performed to look for mean difference between course of study and their level of knowledge.

Table 3: ANOVA table for Level of First Aid Knowledge and Sociodemographic characteristics (n=315)

Sociodemographic characteristic	Mean (SD)			<i>F</i>	Sig
Gender	3.430	1	3.430	5.830	0.016
Male					
Female					
Course	9.932	7	1.419	2.452	0.018
Year of Study	3.012	3	1.004	1.692	0.169
First-aid course experience	18.051	1	18.051	33.334	0.000

The analysis revealed the mean scores and standard deviations of first aid knowledge across different student groups. Nursing students had a mean score of 1.64 (SD = 0.656), while Medical Laboratory Technology students had a mean score of 1.70 (SD = 0.723). Environmental Health students had a mean score of 1.93 (SD = 0.818), and Medical Imaging students had a mean score of 1.85 (SD = 0.760). Physiotherapy students reported a mean score of 1.83 (SD = 0.675), Occupational Therapy students had a mean of 1.94 (SD = 0.854), and Optometry students had a mean score of 2.12 (SD = 0.861). Nutrition and Dietetic students had the highest mean score at 2.20 (SD = 0.719).

Levene’s test for equality of variances indicated that the assumption of equal variances was met (p = .109). The ANOVA test showed a significant difference in first aid knowledge between groups, F (7, 314) = 2.452, p = .018, indicating that at least one pair of means was significantly different. Post hoc analysis using Tukey's test revealed that Nursing students had significantly higher first aid knowledge compared to Nutrition and Dietetic students (p < .05). However, there were no significant differences in first aid knowledge between Nursing students and students from other courses.

These results suggest that while first aid knowledge levels differ among students in different courses, Nursing students possess significantly higher knowledge compared to those in Nutrition and Dietetics. However, no significant

differences were found between Nursing students and students from other health-related programs. This highlights a potential need for targeted educational interventions to improve first aid knowledge, particularly among students in programs like Nutrition and Dietetics.

To investigate the association between year of study and level of first aid knowledge among students, the one way ANOVA was used. Result of the test show no significant difference. The F value was 1.692 and the degrees of freedoms were 3 and 314, with a p-value of 0.169, >0.05 . Regarding the first aid training, most of the participants (61.6%) had taken training before, with mean of 1.71 and standard deviation of 0.721. However, 121 students had not taken first aid training previously, with a mean of 2.20 with 0.760 for standard deviation. The F-value was 33.334 and the degrees of freedom were 1 and 314. The p-value of this test was 0.00, <0.05 . Hence, at least one pair of means differs significantly.

The present study focuses on the knowledge of Faculty of Health Sciences of UiTM Selangor, Puncak Alam Campus students towards First Aid. All the students have successfully completed the questionnaire without difficulty. At present, there are many similar researches that used undergraduate students as their subjects. However, the difference between the participants was in the students' study background or field of study. As an example, study by Al-Khamees targeted knowledge and management of first-aid skills between medical and non-medical students at King Saud University, (Al-Khamees, 2006). In their study it was shown that 44.05% ($n = 89$) of medical students and 32.02% ($n = 64.7$) of non-medical students had a high level of knowledge about first aid, which was considered to be unsatisfactory. A statistically significant association was found between being a medical student and having a high level of knowledge about first aid (Suhail et al., 2022). Assessment of knowledge towards first aid skills of epilepsy among undergraduate health students in Riyadh province of Saudi Arabia concluded that most undergraduate health students demonstrated poor knowledge scores in delivering seizure first aid (Abdulrahman et al., 2024). A study conducted at the International Islamic University of Malaysia (IIUM) used students from health sciences field or medical related students as their subject (Jamaluddin et al., 2018). In another research regarding first aid knowledge conducted by Swetha et al (2015) specifically used nursing students as the subject of study. Khan et al, (2010) used undergraduate students from many types of field as their research subject such as students from Art college, Engineering college, Business college and Medical college. Apart from undergraduate students, study on the level of first aid knowledge was also done to kindergarten teachers (Ameya., 2018) and secondary school students (Mobarak.,

2015). There is also a study that target the school teacher (Joseph., 2015).

For this study, Health sciences students were selected to be the participant. Selection of health sciences students as the subject for this is inspired by a research in IIUM that focused on undergraduate of Nursing, Medicine, Dentistry, Allied Health Science and Pharmacy students. This study showed that most of the student have moderate level of knowledge related to First Aid. Thus, the level of knowledge toward First Aid among undergraduate of Health Sciences student in UiTM Puncak Alam should be tested too. The study in IIUM becomes the main reference because the study at the institution is the only published research related to First Aid knowledge done in Malaysia. Most studies related to first aid knowledge is done in Middle East countries and India where the academic methods and socio demographic data are different from Malaysia.

Knowledge of Students Related to First Aid.

In this study, more than half of the participants were female, reflecting the trend in Malaysian public universities, where female students are over-represented and often outperform male students in exams, leading to higher university enrollment rates (Ismail et al., 2015). Over half of the participants had prior first aid training, likely due to UiTM's policy requiring first-year students to take uniform body courses and Health Sciences students to engage with the Malaysian Red Crescent until their third semester. The study found that 39.7% of students had moderate first aid knowledge, 30.8% had high knowledge, and 29.5% had low knowledge, which aligns with findings from IIUM (Jamaludin et al., 2018). Other studies, particularly in Arab countries and India, reported lower levels of first aid knowledge among students (Khatatbeh et al., 2016; Khan et al., 2010). Although this research did not assess students' attitudes, previous studies suggest that Health Sciences students generally have positive attitudes toward first aid, possibly due to the healthcare-related nature of their courses (Jamaludin, 2018; Khan et al., 2010). However, some research on nursing students in India found negative attitudes toward first aid (Khan et al., 2010).

Association Between Sociodemographic Characteristic and Level of Knowledge Towards First Aid

Khatatbeh et al. (2016) found that several sociodemographic factors, such as having a driver's license, school-level first aid courses, and higher education, were linked to increased first aid knowledge. In this study, gender, course, and first aid training experience significantly influenced knowledge levels, with female students showing greater knowledge, supported by Jamaludin et al. (2018) and Khatatbeh et al. (2016). Nursing students had the highest

knowledge, likely due to their healthcare exposure, as also noted by Swetha et al. (2015). However, no significant difference was found between year of study and first aid knowledge (Joseph et al., 2014). Students with formal first aid training consistently demonstrated better knowledge than those without, echoing findings from Khan et al. (2010) and Jamaludin et al. (2018).

4. CONCLUSION

The students of Faculty of Health Sciences of UiTM Puncak Alam Campus had moderate level of knowledge towards First Aid. The university must play an important role in spreading the value of first aid education among students. Although the subject is already covered in the university curriculum, it is not for all categories of students. This should be a required course for all students in all courses.

ACKNOWLEDGEMENTS

We would like to express our gratitude to Dr. Khairil Anuar Mad Isa for his support in guiding our statistical analysis.

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RESEARCH ARTICLE

Burnout and Job Satisfaction Among Community-Based Rehabilitation (CBR) Workers in Kedah

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Abstract:

Burnout and job satisfaction were often associated with among workers in health care including Community-Based Rehabilitation (CBR) workers. This study aims to identify burnout and worker satisfaction working at CBR in Kedah, Malaysia. The workers who have working experience of at least six months in CBR in Kedah and can understand English were eligible to participate in the study. Maslach Burnout Inventory (MBI) and Minnesota Satisfaction Questionnaire (Short version) questionnaires were the main instruments that was used in this study. Kruskal-Wallis statistical analysis and multiple regression analysis were used to answer the objectives. The results showed a low level of burnout in Emotional Exhaustion (EE) and Personal Accomplishment (PA) subscales while the Depersonalization (DP) showed a moderate level of burnout. The job satisfaction level showed the mean score of 65.32 (SD=16.86) which indicated the high job satisfaction level among CBR workers. Other than that, there was a significant relationship between burnout and job satisfaction among CBR workers while there was no correlation between demographic data and job satisfaction. This study could assist occupational therapists in developing plan and organize the most effective strategy of action to increase awareness regarding burnout and job satisfaction.

Keywords: Burnout, Community-Based Rehabilitation (CBR), job satisfaction

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1. INTRODUCTION

Burnout has become a substantial issue that cannot be seen lightly in various occupations in recent years due to the increasing patterns among workers, which creates significant interest in this topic. Social workers are among the main risk categories that are vulnerable to burnout, as they frequently encounter workplace incidents that could severely impact them (Hombrados-Mendieta & Cosano-Rivas, 2013). Burnout is a clinical condition caused by persistent and chronic stress, resulting in physical, emotional, and mental tiredness (Alrwashdeh et al., 2021). It can be associated with the overuse of energy and resources, resulting in emotions of failure and tiredness in the person itself (Freudenberger, 1986, as cited by Awajeh et al., 2018). It is due to the interaction and participation of the workers with other people daily, which can be associated with social workers. According to Farber (1985), burnout developed due to the perceived imbalance between job effort and reward, which is influenced by organizational, personal, and societal factors. This factor will lead to a decline in the quality of work since they feel a burden to carry out their required jobs.

Within the last decade, most job satisfaction research has emphasized it as an essential measure to quantify service quality and maintain the programme or products provided in

every workplace. Job satisfaction is one of the essential issues needed to understand the aspects that can promote employee satisfaction and the impact job satisfaction will have on an organization's overall success (Mari et al., 2018). Additionally, it was discovered that job satisfaction among workers, particularly among healthcare professionals, helped to prevent staff turnover and guaranteed the sustainability of the services or programmes provided (Hasan & Aljunid, 2019).

The World Health Organization (WHO) started to idealize community-based rehabilitation (CBR) as one of the alternatives with the fundamental goal of providing rehabilitation services to people with disabilities in developing countries (Finkenflügel et al., 2005). CBR refers to local efforts to utilize and strengthen community resources, such as impaired, disabled, and disabled individuals, their families, and the community (Finkenflügel et al., 2005). According to Hasan and Aljunid (2014), the first CBR programme in Malaysia was initiated in 1984 at Batu Rakit, Terengganu. Most CBR's staff members are volunteers willing to contribute their time to assist with tasks that benefit those with disabilities, particularly the trainees. In addition, employees working at the CBR center may be teachers, healthcare professionals, or social workers, and

they are the persons who form the core of the CBR programme itself.

CBR services were initially established by the Ministry of Women, Family, and Community Development's Social Welfare Services in association with the Malaysian Ministry of Health (Hasan et al., 2021). The CBR programme here emphasizes long-term care and serves as a training facility that prepares people with disabilities to enroll in special schools, get jobs, and ultimately live in the community with the best capabilities or maximum independent level (Hasan & Aljunid, 2019). It is a practice used in the growth of local communities for the social inclusion, opportunity equality, training, and rehabilitation of persons with disabilities (PWDs) (Department of Social Welfare, n.d.). The implementation of CBR involves workers' participation, which needs to ensure that the trainees can carry out the rehabilitation activities provided mainly for the center based on which they are attending the CBR center for the session. According to the Department of Social Welfare (n.d.), the acceptance to the center applies to all types of PWD categories so that when attending the rehabilitation at CBR, the workers need to carry out the activities for the trainee such as circle time, exercise, group and individual activities, music and also basic religious instruction which is known as "*fardhu ain*."

In Malaysia, cultural factors such as strong community ties, religious beliefs, and a collectivist mindset influence the work environment of CBR staff. Workers often come from the same communities as the individuals they serve, which can increase their sense of responsibility but also add emotional pressure. Many CBR workers, particularly volunteers, may face challenges balancing their personal and professional lives, as they are often expected to contribute to the well-being of their community in both capacities. Additionally, Malaysia's diverse cultural and religious landscape plays a role in shaping how workers view job satisfaction and burnout. For instance, religious practices such as the teaching of '*fardhu ain*' at CBR centers integrate spiritual duties into their roles, which may affect how workers cope with stress and exhaustion. However, the combination of limited resources, heavy reliance on volunteer staff, and societal expectations can exacerbate burnout, especially in rural areas where CBR services are crucial. These local factors are integral to understanding the unique challenges faced by CBR workers in Malaysia. This current study aimed to identify burnout and worker satisfaction working at CBR in Kedah, Malaysia. The results of this study will be able to assist occupational therapists in developing a suitable intervention plan that could assist these workers.

2. MATERIALS AND METHODS

2.1 Design

This study employed a cross-sectional design. According to Setia (2016), this study design was suitable to be used because it was less expensive and can be completed more quickly compared to cohort study. According to Wang and Cheng (2020), It was simpler to access a significant subject population when cross-sectional investigations were carried out using questionnaires (Wang and Cheng, 2020). Ethical approval was obtained from the Ethical Committee of the Universiti Teknologi MARA on 18th December 2023 (FERC/FSK/MR2023/00312).

2.2 Instruments and measures

This study required a simple demographic data questionnaire that includes questions regarding the participants' age, duration of working experience at CBR centre, duration hours working at CBR per day, number of trainees at CBR, type of trainee's problem which includes cognitive or physical difficulties. There were two main instruments used in this study which were Maslach Burnout Inventory (MBI) and Minnesota Satisfaction Questionnaire (Short version). Other than that, a demographic data questionnaire was also used to obtain additional information from the participants who were involved in the study.

MBI is a type of self-rated questionnaire which consisted of 22 items and was further broken down into three subscales to measure burnout. This instrument was used in order to evaluate the three elements of burnout syndrome which consist of emotional exhaustion (EE), depersonalization (DP), and reduced personal accomplishment (PA) (Zalauett & Wood, 1998). The MBI had three subscales which were EE (9 items), DP (5 items) and also PA (8 items). A high score of burnouts was the outcome of low levels of personal accomplishment or success, high levels of emotional tiredness, and depersonalization. The scores for each item range from 0 (never) to 6 (every day). Each subscale's score was considered separately and was not added together to form a single overall score. Burnout was characterized as a high level of emotional exhaustion and depersonalization and also a low level of personal accomplishment. In the scientific research literature, the MBI had established the gold standard for detecting burnout and had been confirmed to be reliable and valid (Awajeh et al., 2018).

The Minnesota Satisfaction Questionnaire was a self-reported questionnaire in which the respondents could answer the questions individually. The questionnaire was developed as part of the University of Minnesota's "Work Adjustment Project", the underlying theory was based on the assumption that work fit was dependent on the correspondence between individual skills and the reinforcements that exist in the work environment (Weiss & Cropanzano, 1996 as cited by Martins & Proenca, 2012).

According to Ahmadi and Alireza (2007), only 20 of the 100 original items from original version, which was the items that better represented each of the 20 original subscales, were included in the MSQ of short form scale (Martins & Proenca, 2012). The 20 MSQ-short version items were rated on a 5-point Likert scale which the score of 1 being "very dissatisfied with this aspect of my job," 2 being "dissatisfied with this aspect of my job," 3 being "can't decide whether I'm satisfied or dissatisfied with this aspect of my job," 4 being "satisfied with this aspect of my job," and 5 being "very satisfied with this aspect of my job". Item responses were added together or averaged to provide a total score in which the lower the score, the lower the level of work satisfaction (Martins & Proenca, 2012).

2.3 Data Analysis

The Statistical Package for Social Science (SPSS) software version 27 for Windows had been used to evaluate the study's results. Burnout and job satisfaction of the respondents were represented through descriptive analysis. In addition, Kruskal-Wallis statistical analysis was used to analyze the relationship between workers' burnout and job satisfaction among workers at CBR in Kedah. Multiple regression analysis was used to identify the relationship between job satisfaction and demographic data.

3. RESULTS

3.1 Demographic Data of Respondents

A total of 76 participants were involved in this study. Demographic data of the respondents were presented in the Table 4.1 below. From the data obtained, the majority of the respondents were female (82.9%, n=63), with a mean age of 38.12 (SD=9.56, ranging from 21 to 62) years old. All of the respondents involved were Malay and the religion was Islam (100%, n=76). For marital status, most of the respondents were married (61.8%, n=47), followed by single (30.3%, n=23), widowed (5.3%, n=4) and divorced (2.6%, n=2). For the duration of working experience at CBR, the highest number of participants working at range between 1 until 10 years (60.3%, n=46), followed by working between 11 until 20 years (31.5%, n=24) and working between 21 until 30 years (8.2%, n=6). For the duration of working hours at CBR, majority of the respondents worked for 7 hours (38.2%, n=29), followed by 8 hours (30.3%, n=23), 6 hours (22.4%, n=17) and minority claimed that they worked for 9 hours (9.2%, n=7). The participants were also asked to determine the number of CBR trainees under their care. The highest number of respondents answered with the range of 1 until 10 trainees (43.3%, n=33), followed by the range number of 21 until 30 trainees (18.4%, n=14) and from 31 until 40 trainees with the percentage of 11.7% (n=9). Other than that, the range of trainees between 41 to 50 indicated the same value with 51 to 60 trainees with 9.2% (n=7) and finally with the range of trainees between 11 and 20 (7.8%, n= 6). Majority of the workers claimed that the trainee were having both cognitive and physical problems (55.3%, n=42), followed by

cognitive problems (38.2%, n=29) and physical problems (6.6%, n=5). Detailed demographics were presented in Table 1 below.

Table 1: Demographic data of the respondents (n=76)

Variables	N	%
Gender		
Female	63	82.9
Male	13	17.1
Religion		
Islam	76	100.0
Buddha	0	0
Christian	0	0
Hindu	0	0
Others	0	0
Race		
Malay	76	100.0
Chinese	0	0
Indian	0	0
Others	0	0
Marital status		
Married	47	61.8
Single	23	30.3
Widowed	4	5.3
Divorced	2	2.6
Duration Working Experience		
1-10 years	46	60.3
11-20 years	24	31.5
21-30 years	6	8.2
Duration Working Hours		
7 hours	29	38.2
8 hours	23	30.3
6 hours	17	22.4
9 hours	7	9.2
Number of Trainees		
1-10 trainees	33	43.3
21-30 trainees	14	18.4
31-40 trainees	9	11.7
41-50 trainees	7	9.2
51-60 trainees	7	9.2
11-20 trainees	6	7.8
Type of Cognitive Problem		
Both	42	55.3
Cognitive	29	38.2
Physical	5	6.6
	Mean	SD
Age (Year)	38.12	9.56

3.2 Level of Burnout and Worker Satisfaction Working at Community-Based Rehabilitation (CBR) in Kedah

For the burnout level which was being assessed using MBI the burnout was categorized into three subscales which were emotional exhaustion (EE), depersonalization (DP) and personal accomplishment (PA). As shown in Figure 1, the subscale of EE indicated the majority of the respondents obtained the low level of burnout (64.5%, n=49), followed by moderate burnout (21.1%, n=16) and high level (14.5%, n=11). Apart from that, the second subscale which was the DP obtained the highest category of burnout in moderate level (40.8%, n=31), followed by low level of burnout (34.2%, n=26) and also high level (25.0%, n=19). The last component of burnout which was PA also revealed that the majority of the respondents obtained a low level of burnout (67.1%, n=51), followed by moderate level (21.1%, n=16) and high level of burnout (11.8%, n=9). The results obtained shows that the CBR workers in Kedah were having low burnout in EE and PA subscales and also moderate level of burnout in DP subscale while handling the trainees at the CBR in Kedah. The results show that employees were not experiencing burnout, with high degrees of burnout being less common in all three subscales.

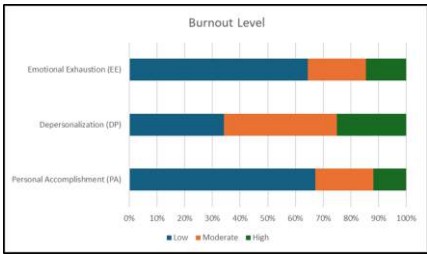


Figure 1: Burnout level of CBR workers according to subscale (n=76)

Other than that, for the job satisfaction level among CBR workers which was being assessed using the Minnesota Satisfaction Scale (Short Ver), the score obtained showed the mean score of 65.32 (SD=16.86). Generally, CBR workers were satisfied working at the CBR with the majority of the workers obtaining the highest score of 79 from the full score of 100 (10.5%, n=8) despite the need to deal with the different types of problems among the trainees.

3.3 Relationship Between Burnout and Job Satisfaction Among CBR Workers

A non-parametric test was chosen to analyze the data because the burnout and job satisfaction scores were not normally distributed ($p<0.05$) using Kolmogorv-Smirnov. Kolmogorv-Smirnov was applied because the sample consisted of more than 50 participants in the study. A Kruskal-Wallis test was used to evaluate whether the burnout and job satisfaction among CBR workers were correlated between each other and the results were shown in Table 2 below. The Kruskal-Wallis test revealed that there was no significant correlation between EE burnout subscales with the job satisfaction $H(2) = 4.69, p = 0.096$. However, there

was a significant correlation between DP subscales and job satisfaction $H(2) = 6.355, p = 0.042$ and PA subscales with job satisfaction $H(2) = 27.508, p = <0.001$. The hypothesis was accepted since the p value was less than 0.05 indicating that there was a relationship between both of the variables although EE subscales of burnout were not correlated with job satisfaction.

Table 2: Kruskal-Wallis test for relationship between burnout and job satisfaction (n=76)

Burnout Subscale	Job Satisfaction		
	Median (IQR)	X ²	P-Value
Emotional Exhaustion			
Low	6.00 (6.00)	4.69(2)	0.096
Moderate	12.00 (7.00)		
High	13.00 (13.00)		
Depersonalization			
Low	3.00 (3.25)	6.355 (2)	0.042
Moderate	8.00 (2.00)		
High	15.00 (9.00)		
Personal Accomplishment			
Low	8.00 (8.00)	27.508 (2)	<0.001
Moderate	3.50 (4.50)		
High	9.00 (8.50)		

3.4 Relationship Between Demographic Data and Job Satisfaction Among Workers At CBR

A multiple regression analysis was performed to evaluate the significant relationship between demographic data and job satisfaction among workers at CBR. The demographic variables considered in the analysis included age, gender, religion, race, marital status, duration of working experience, duration working hours, number of trainees and type of cognitive problem. The demographic variables were separated into two separate regression analyses to obtain more accurate and significant results. The demographic variables were divided into two distinct regression analyses which were basic demographic variables and work-related variables.

This study initially considered age, gender, marital status, religion, and race as demographic variables in the analysis. However, due to the homogeneity of the participants' religion and race 100% Malay and Muslim, these variables were excluded from the regression analysis to ensure stability and interpretability. Below are the results of the multiple regression analysis based on the remaining demographic variables. Table 3 below indicates the results of multiple regression analysis based on the basic demographic variables of the participants.

Table 3: Multiple Regression Analysis test for basic demographic variables (n=76)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.205 ^a	0.042	0.002	0.86295

a. Predictors: (Constant), Marital Status, Gender, Age

Table 4: Multiple Regression Analysis of Job Satisfaction (n=76)

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	2.358	3	0.786	1.056	0.373
Residual	53.617	72	0.745		
Total	55.975	75			

a. Dependent Variable: Overall Job Satisfaction

b. Predictors: (Constant), Marital Status, Gender, Age

Based on the output from Table 3, it was shown that the three independent variables do not significantly influence job satisfaction. Table 3, which was the model summary table showed that R value which was 0.205 indicated a weak correlation between the variables. R² value, which was 0.042 represents that the independent variables explained 4.2% of the total variation in job satisfaction among workers at CBR. Table 4 for the Multiple Regression Analysis of job satisfaction further indicated the p-value was 0.373. Since the $p > 0.05$, this indicates that the model did not have a statistically significant effect on job satisfaction among workers at CBR based on age, gender and marital status. The hypothesis was rejected since the p value had a value greater than 0.05 which indicated that there was no correlation between age, gender and marital status with job satisfaction.

3.5 Work-Related Demographic Variables

The variables considered in the analysis included duration of working experience, duration of working hours, number of trainees and type of cognitive problem. The results for the work-related variables were shown in Table 5 below.

Table 5: Multiple Regression Analysis for work-related variables data (n=76)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.245 ^a	0.060	0.007	0.86087

a. Predictors: (Constant), Trainee's Problem, Working Duration, Working hours, Number of Trainees

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	3.357	4	0.839	1.132	0.348 ^b
Residual	52.618	71	0.741		
Total	55.975	75			

a. Dependent Variable: Overall Job Satisfaction

b. Predictors: (Constant), Trainee's Problem, Working duration, Number of trainees

Based on output from Table 5, it was shown that the four independent variables do not significantly influence job satisfaction. In the model summary, R was 0.245 which indicates a weak correlation between the variables. Other than that, R² value which was 0.060 represents that the independent variables explained 6.0% of the total variation in job satisfaction among workers at CBR. The ANOVA table reports the p-value was 0.348. Since the $p > 0.05$, it indicated that the model did not have a statistically significant effect on job satisfaction among workers at CBR. The hypothesis was rejected since the p value had a value greater than 0.05 which indicated that there was no correlation between duration working experience, duration working hours, number of trainees and type of cognitive problem with job satisfaction.

5. DISCUSSION

5.1 Burnout and Worker Satisfaction Level Working with Community-Based Rehabilitation (CBR) in Kedah

The results of this study showed that, among CBR workers, majority of respondents had low levels of burnout in the EE subscale. Other than that, the DP subscale generated the highest category of burnout at a moderate level, and the PA subscale also showed that most respondents had low levels of burnout. Awajeh et al. (2018) stated that an individual with significant burnout would score high on the emotional exhaustion (EE) and depersonalization (DP) components of the MBI, while scoring poorly on the personal accomplishment (PA) component. The findings indicate that the low prevalence of burnout was not parallel with the research done by Awajeh et al. in 2018 since their results indicated a high level of burnout prevalence among critical care nurses with the percentage of 65.9%. According to the results obtained, it indicated that work overload, a lack of staff, salary, and financial reasons had become the main factors of burnout among the workers (Awajeh et al., 2018). In addition, the results obtained were also in contrast with another study conducted by Alrawashdeh et al. (2021) which indicated the prevalence data of burnout among physicians was recorded at 57.7%. The study also highlighted the factors which were workplace, salary and workload that they had during working. However, the factors stated by the

researchers in their study were not implied to CBR workers who had contributed to the low level of burnout in results.

A study done by De Vasconcelos and De Martino (2018) in which the nurses with high levels of burnout had lower levels compared to the medium and low levels with the prevalence of 14.3% (n=13) which supported the findings of the result. Despite the need to manage the cognitive and physical problem types among the trainees in the CBR for the rehabilitation session, it shows that the workers were not experiencing high levels of burnout.

The level of job satisfaction among the CBR workers using the Minnesota Satisfaction Scale in the current study shows a high mean value of 65.32 (SD=13.86) It is indicated that the majority of the workers showed satisfaction when working at the CBR in Kedah due to the high score obtained. According to Kader et al. (2021), a person may succeed professionally and maintain a healthy work-life balance when they have a steady job. The finding of this current study was not parallel with a study conducted by Akyurt (2021) among radiology technicians in which; participants' job satisfaction level was low. The researcher stated that the factors that contributed to low job satisfaction was due to their workload, pay, and also workplace safety.

5.2 Relationship Between Burnout and Job Satisfaction Among CBR Workers in Kedah

The current study shows that relationship between burnout and job satisfaction was statistically significant for the DP and PA subscales with P value of 0.042 and <0.001 respectively. As stated by F. Wu et al. (2020), job satisfaction acted as a mediator in the relationship between workplace stress and a number of elements of burnout at work which related to the job satisfaction among CBR in Kedah. Another study that was conducted by Akyurt in 2021 stated that the burnout at the workplace was associated with the low job satisfaction among the radiology technicians. The author mentioned that the excessive workload was one of the factors which were contributing to job satisfaction among them. The study was parallel with this study finding that there was a significant relationship between burnout and also job satisfaction. Other than that, a study conducted by Alrawashdeh et al. (2021) found that there was a positive correlation between burnout and job satisfaction levels which indicated the results were parallel with the findings of this study.

5.3 Relationship Between Demographic Data and Job Satisfaction Among Workers at CBR

The demographic data variables which were gender, age, marital status, duration of working experience, duration of working hours, number of trainees and type of cognitive problems among CBR trainees had been analyzed to identify their relationship with job satisfaction among CBR workers

in Kedah. The results indicated that age was not significant with the job satisfaction with the p-value of 0.160. The study findings were parallel with research conducted by Matagi et al. (2022) among local government employees in Uganda which indicated that age was not significantly correlated with job satisfaction. This study was also supported by other research in which there were no age-moderated effects observed in the correlation between work satisfaction and the other personality factors (Topino et al., 2021). Despite that, another variable used which was gender indicated that the results were not significant with job satisfaction (p=0.587). The results were parallel with the longitudinal study conducted by Marini et al. (1996) which revealed that there were no differences in the value placed on demanding work and decision-making involvement, as well as the importance of intrinsic benefits (such as income, status, and security) between males and females.

From the results obtained, it can be concluded that the marital status was not significantly related to the job satisfaction among the CBR workers (p= 0.869). The results contrast from the study conducted by Austrom et. al. (1988) in which the study stated that married workers reported higher levels of satisfaction than single workers. However, the results were parallel with the study by Azim et al. (2013) among the employees in Bangladesh in which they also found that the marital status was not significantly different with the job satisfaction. The study findings were also supported by another study conducted by Raso in 2014 in which the results revealed that there was no correlation between job satisfaction and duration of working among the special education teachers in Johor Bahru.

Apart from that, the variables which were the duration of working hours per day also did not correlated with job satisfaction (p=0.188). The findings of this study did not parallel with a study by Zheng et al. (2023) in which the employees earning a wage report less job satisfaction when they work in the longer hours in China. The study results were also not supported with another study which stated that long working hours affect job satisfaction (Bartoll & Ramos, 2020). Moreover, the variable which was the number of trainees also showed no correlation to job satisfaction (P=0.659). The study findings were not supported by a study conducted by Osifila and Abimbola (2020) in which there was a correlation between the number of students attending the classes with job satisfaction among the lecturers in Nigeria.

The last variable which was the type of problems among CBR trainees indicated that there was no association with job satisfaction (p=0.722). The results showed that the trainees were having problems in both physical and cognitive skills that required assistance from the workers when they attended the CBR. According to Iemmi et al. (2016), CBR had the potential to improve functionality and quality of life for individuals with disabilities and their caregivers, as well as

improve clinical results. Due to that, the workers needed to assist the trainee who went to the CBR for rehabilitation and from the results, it indicated that the CBR workers had high satisfaction when dealing with the trainee. The study findings were in contrast with a study conducted by Rostami et al. (2021) in which the workload among the healthcare workers with job satisfaction was correlated. It was due to their workload of work to deal with their patients with many problems and conditions that had caused low levels of job satisfaction among them.

The findings of this study must be understood within the unique cultural and healthcare context of Kedah, Malaysia. CBR workers in this region often operate within resource-limited settings, relying heavily on community and familial support to manage the rehabilitation of persons with disabilities. The healthcare system in Malaysia, particularly in rural areas like Kedah, is characterized by limited access to specialist services, placing additional demands on CBR workers who are expected to fill gaps in care.

4. CONCLUSION

The study managed to shed light on the level of burnout and job satisfaction among CBR workers in kedah. However, it was necessary to acknowledge a few limitations in this study. First, this study does not fulfill Raosoft's minimum sample size criteria. It is because the participants did not respond to the Email and Whatsapps when reached by the researcher to participate in the research. Additionally, a small sample size may have an effect on the statistical power and the ability to generalize results. Moreover, since the questionnaires given to them were self-rated, some of them may over/underestimate themselves when answering the questionnaire, thus may affect the results obtained due to bias.

Since this study only applied to one state only which is in Kedah, future of the study can be done at another setting in Malaysia to identify the findings since the study location may affect the results obtained. Other than that, the face-to-face interview can also be conducted in the future research since the method would be more efficient to obtain the results since the participants can directly ask with the researcher if there are any inquiries.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all CBR workers who participated in this study.

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RESEARCH ARTICLE

Association Between Cognitive Deterioration and Activities of Daily Living (ADLs) among Community-Dwelling Older People

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Abstract:

Cognitive deterioration causes limitation in Activities of Daily Living (ADLs) performance among older people. However, this problem is often overlooked as an important feature in older people. Therefore, this study aimed to determine the association between cognitive deterioration and ADLs, and the association between cognitive deterioration and socio-demographic variables among community-dwelling older people. A purposive sampling method was used in a cross-sectional study of 115 community-dwelling older people aged more than 60 years old in Malaysia. The Malay Version of Short Informant Questionnaire on Cognitive Decline in the Elderly (MS-IQCODE) was used to measure the cognitive deterioration and the Modified Barthel Index (MBI) was used to measure the dependency in ADLs among the community-dwelling older people. One quarter of the participants have experienced noticeable cognitive deterioration ($n = 31$, 27.00%). A negative correlation was found between cognitive deterioration and ADLs ($p = 0.00$), with a medium effect size ($r = -0.48$). There was also a significant difference between cognitive deterioration with age, marital status, education level, and medical condition ($p = 0.00$). A noticeably large proportion of community-dwelling older people in Malaysia had cognitive deterioration, which further impacted the ADLs. There is a new demand for increasing awareness for healthy living geriatric services to community-dwelling older people.

Keywords: Cognitive deterioration, Activities of Daily Living (ADLs), Older people

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1. INTRODUCTION

Both rich and developing countries around the world are experiencing an increase in elderly population and Malaysia is on track to become an ageing nation by 2030, with 15 percent of the population are aged 60 and up (Rashid et. al., 2016). According to the Department of Statistics Malaysia (2021), Malaysia's population is aged in 2021, when the people aged 65 and up accounted for 7.1 percent of the total population. Malaysia's old population is expected to grow by 269 percent between 2008 and 2040, making it the fourth-fastest-aging country in the world, behind Singapore, Colombia, and India (Rashid et. al., 2016).

One of the most feared elements of being elderly is the progression of cognitive deterioration (Deary et. al., 2009). Because of its link to an increased risk of dementia, disability, and mortality, cognitive deterioration and impairment among older adults are becoming a growing public health problem (Lim et. al., 2020). Cognitive deterioration is a stage that occurs between normal cognitive

function and the onset of dementia symptoms. Early detection of cognitive deterioration is uncommon in Malaysia due to a lack of understanding of the older people population's risk profile. Malaysians had a prevalence of cognitive deterioration of 11% to 22.4%, which was comparable to other populations (Lim et. al., 2020).

The deterioration in physical and cognitive abilities in older people makes it more difficult for them to handle their daily activities independently and to improve their quality of life (Kim et. al., 2022). Cognitive functions, including thinking and planning, motor functions, including balance and dexterity, and perceptual functions, which include sensory abilities, are all required to conduct ADLs. These abilities can be affected by changes in attention, executive functioning, visuospatial skills, and memory in the later stages of dementia (Mlinac et. al., 2016). A higher level of cognitive impairment was linked to a faster drop in ADL performance (Jones et. al., 2020).

It's important to identify the factors that lead to cognitive deterioration in older persons and figure out which ones may be improved to help slow down the deterioration. Therefore, it is important to find out the factors that contribute to individual variability in cognitive ageing in Malaysia (Foong et al., 2016). Therefore, this study aims to identify the cognitive deterioration status and performance of Activities of Daily Living (ADLs) among community-dwelling older adults. Besides this study also attempts to determine the association between cognitive deterioration and Activities of Daily Living (ADLs) among community-dwelling older people.

2. MATERIALS AND METHODS

Data Collection Procedure

This cross-sectional study was executed after being granted ethical approval (FERC/FSK/MR/2022/0357) from the Ethics Committee of the Health Sciences Faculty, Universiti Teknologi MARA (UiTM). A total of 115 (n=115) participants fulfilled the inclusion criteria and were recruited via purposive sampling in this study. The inclusion criteria for this study include; (1) aged more than 65 years old (2) can provide informed consent independently or having verbal assistant by caretakers to answer the questions (3) healthy or having mild medical conditions, while the exclusion criteria include: (1) participants who are mentally unstable (2) having serious illness or condition (3) participants who are bed-ridden. Participants in this study were contacted through online platforms such as WhatsApp, Facebook, Instagram, Twitter and email, and the data were collected using an online questionnaire. After participants had given their consent to take part in the study, an online survey was used to administer a self-reported questionnaire.

Instrument

The questionnaire used in this study consisted of three sections: Section 1: Socio-Demographic Data of participants, Section 2: Malay Version of Short Informant Questionnaire on Cognitive Decline in the Elderly (MS-IQCODE) and Section 3: Modified Barthel Index (MBI). The questionnaire was distributed through several online platforms such as WhatsApp, Facebook, Instagram, Twitter and Telegram using Google Forms. Participants were required to answer all questions as responses for all items in all three sections.

For Section1, the demographic data in this study will be gathered to get the participant's overall characteristics. It will include gender (male and female), age (65 to 74 years, 75 to 84 years and above 85 years), race (Malay, Chinese, Indian), marital status (single, married, widowed, divorced), level of education (primary school education, secondary school education, tertiary school education, no education), medical condition (cerebrovascular accident or stroke, Parkinson disease, myocardial infarction, arthritis), and others.

The Malay version of short IQCODE is a reliable instrument for assessing cognitive deterioration in Malaysian elderly. The MS-IQCODE is a reliable test for assessing cognitive deterioration in Malaysia's older population. The 16 items had a Cronbach's alpha coefficient of 0.94, indicating that they formed a scale with excellent internal consistency. It was determined that the MS-IQCODE had good face and content validity (Othman et. al., 2015).

The Modified Barthel Index is a well-established and extensively used tool for evaluating a person's performance in a set of planned and fixed daily tasks ADLs (Carone et. al., 2017). The MBI uses the 5-category scale which are unable to complete task, attempts task but unsafe, moderate help required, minimal help required, and fully independent. However, for the 5-category scale, there are three scoring methods which are 0, 1, 3, 4, or 5 points for "personal hygiene," "bathing self," and "wheelchair;" "Feeding," "toilet," "stair climbing," "dressing," "bowel control," and "bladder control" are assigned 0, 2, 5, 8, or 10 points, respectively; and "ambulation" and "chair/bed transfer" are given 0, 3, 8, 12, or 15 points. The higher the total scores will indicate a higher degree of independence in ADLs (Yang, et. al., 2020). The MBI had high ICCs in general which is 0.94 for both that indicate high agreement.

Data Analysis

The data gathered was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. To describe the variables derived from the demographic data, the cognitive deterioration status and the ADLs performance, descriptive analysis were carried out. On the other hand, the Pearson Product-Moment Correlation Coefficient were used to determine the association between cognitive deterioration and ADLs among community-dwelling older people. Furthermore, the Independent Sample T-Test and One-way ANOVA was used to identify the association between variables of socio-demographic factors such as gender, age, race, marital status, education level, living status, diseases, work history, and smoking status with cognitive deterioration among community-dwelling older people.

3. RESULTS AND DISCUSSION

3.1 Results

Table 1 shows that 115 respondents participated in this study, as calculated by G-Power. The male-female ratio was similar among the respondents which accounts 47.00% and 53.00% respectively. As shown in Table 2, 64.30% participants are between the age of 65 to 74 years old (n = 74). Of the participants 60.90% are married and the rest are single, divorced, and widowed. Next, majority of the participants are Malay (81.70%) followed by Chinese and Indians (13.00% and 5.20%). Moreover, most of the sample receive education until secondary (41.70%) and primary level (33.00%). Among all samples, 70.30% have disease

and the disease is further divided into 6 categories and most of them have medical condition (37.40%). In addition, the majority of the respondents live with their family 25 (47.00%) and are not smoking (79.10%). Moreover, most of the respondents have work as low-skilled workers (40.90%).

Table 1: Demographic Data of the Sample (n = 115)

Variables	n (%)
Gender	
Male	54 (47.00)
Female	61 (53.00)
Age	
65 to 74 years old	74 (64.30)
75 to 84 years old	37 (32.20)
Above 85 years old	2 (1.70)
Marital Status	
Single	11 (9.60)
Married	70 (60.90)
Divorced	20 (17.40)
Widowed	14 (12.20)
Race	
Malay	94 (81.70)
Chinese	15 (13.00)
Indian	6 (5.20)
Education Level	
Primary school	38 (33.00)
Secondary school	48 (41.70)
Tertiary school	25 (22.60)
No education	3 (2.60)
Medical Condition	
No diseases	34 (29.60)
Musculoskeletal condition	3 (2.60)
Medical condition	43 (37.40)
Neurological condition	5 (4.30)
Musculoskeletal + Medical condition	5 (4.30)
Musculoskeletal + Neurological condition	5 (4.30)
Medical + Neurological condition	20 (17.40)
Living Status	
Spouse	51 (44.30)
Family	54 (47.00)
Alone	10 (8.70)
Work History	
Skilled workers	29 (25.20)
Semi-skilled workers	39 (33.90)
Low-skilled workers	47 (40.9)
Smoking Status	
Smoking	24 (20.90)
Not smoking	91 (79.10)

Most of the respondents have no significant cognitive deterioration (73.00%). Moreover, out of all the respondents

27.00% are reported to have significant cognitive deterioration as shown in Table 2.

Table 2: Malay Version of Short Informant Questionnaire on Cognitive Decline in the Elderly (MS-IQCODE) Scores of the Sample (n=115)

No.	Total Score MS-IQCODE	n (%)
1.	No significant cognitive decline	84 (73.00)
2.	Significant cognitive decline	31 (27.00)

Most of the respondents have moderate dependence level (41.70%). Next, out of all the respondents have severe dependence and slight dependence (20.00% and 20.00%). Lastly, 13.90% and 4.30% of the respondents has independence level and total dependence level as shown in Table 3.

Table 3: Modified Barthel Index (MBI) Scores of the Sample (n=115)

No	Total Score MBI	n (%)
1.	Total dependence	5 (4.30)
2.	Severe dependence	23 (20.00)
3.	Moderate dependence	48 (41.70)
4.	Slight dependence	23 (20.00)
5.	Independent	16 (13.90)

Table 4 shows the relationship between cognitive deterioration and activities of daily living. It was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. There was a medium, negative correlation between the two variables, $r = -0.48$, $n = 115$, $p < 0.00$, with high levels of cognitive deterioration associated with lower levels of activities of daily living (ADLs).

Table 4: Association between cognitive deterioration and activities of daily living (ADLs) among community-dwelling older people

	Mean Score of MS-IQCODE	Total Score of MBI
Mean Score of MS-IQCODE		-0.48
		0.00
		115
Total Score of MBI	-0.48	
	0.00	
	115	

** Correlation is significant at the 0.01 level (2-tailed)

An independent sample t-test was conducted to compare the cognitive deterioration scores for smoking and not smoking. There was a significant difference in scores for smoking (M = 3.05, SD = 0.69) and not smoking, M = 2.58, SD = 0.96; $t(113) = 2.23, p = 0.02$ (two-tailed). The magnitude of the differences in the means (mean difference) = 0.46, 95% CI: 0.51 to 0.88 was very small (eta squared = 0.04) as shown in Table 5.

Table 5: Association between variables of socio-demographic factors e.g., smoking status and cognitive deterioration among community-dwelling older people

Variables	Mean (SD)	t	df	F	Sig. (p)
Smoking Status					
Smoking	3.05 (0.69)	2.23	113	5.46	0.02
Not smoking	2.58 (0.96)				

Table 6 shows the analysis using the One-Way ANOVA test that was conducted to compare the level of cognitive deterioration with age, marital status, education level, diseases, and work history. There was a significant difference at the $p < 0.05$ in cognitive deterioration score for all the socio-demographic factors. The actual differences in the mean score between all variables was large.

Table 6: Association between variables of socio-demographic factors and cognitive deterioration among community-dwelling older people

Variables	Mean (SD)	Sig. (p)
Age		
65 to 74 years old	2.41 (0.83)	0.00
75 to 84 years old	3.13 (0.92)	
Above 85 years old	3.60 (0.57)	
Marital Status	2.17 (0.92)	
Single	2.47 (0.79)	
Married	3.44 (0.91)	0.00
	3.06 (0.92)	
Widowed	3.25 (0.88)	
	2.49 (0.77)	
Divorced	2.19 (0.82)	
	2.79 (1.45)	
Education Level		
Primary school	1.95 (0.64)	0.00
Secondary school	2.04 (0.58)	
	2.57 (0.69)	
Tertiary education	3.61 (0.51)	
	3.40 (0.63)	
No education	3.79 (0.74)	
	3.56 (0.73)	
Diseases	2.13 (0.78)	
No diseases	2.61 (0.75)	
	3.08 (0.96)	
Musculoskeletal		0.00
Medical		
Neurological		
Musculoskeletal + Medical		
Musculoskeletal + Neurological		
Medical + Neurological		
Work History		
Skilled workers		
Semi-skilled workers		
Low-skilled workers		0.00

3.2 Discussion

Cognitive deterioration status and ADLs performance among community-dwelling older people

The results of this study suggest that a significant proportion of the community-dwelling older people population in Malaysia did not exhibit significant cognitive deterioration. Specifically, 73.00% of the community-dwelling older people population did not exhibit significant cognitive deterioration while the remaining 27.00% of the population experienced noticeable cognitive deterioration. These results are consistent with previous studies conducted in similar populations of community-dwelling older people (Tianyi et. al., 2019; Peng et. al., 2019). A study by Bhatia et. al., 2020 and Zhang et. al., 2019 reported that cognitive deterioration may be caused by several factors including lifestyle factors such as diet, drinking, smoking, and exercise.

The results indicate that the majority of respondents exhibited a moderate level of dependence (41.70%), followed by severe dependence and slight dependence (20.00% each). A smaller proportion of respondents demonstrated an independent level (13.90%), while a minority had a total dependence level (4.30%). This result is consistent with a study by Usha et. al., 2020, they found that among the sample population of older patients who were dependent on others, 63.39% had moderate to severe dependency and 2.68% were totally dependent.

Association between cognitive deterioration and ADLs among community-dwelling older people

The results showed a medium, negative connection between these two variables, showing that higher levels of cognitive deterioration were associated with lower levels of ADLs. This result is consistent with previous study by Wu, C. (2021) who found that poor cognitive function had higher the probability of Basic Activities of Daily Living (BADL) disability in elderly people. Moreover, the negative correlation found in this study supports the concept that cognitive deterioration can significantly impact a person's ability to carry out ADLs as daily tasks become more difficult and death risk increases (Wang et. al., 2020). According to Toth et. al., (2022), it has been discovered that cognitive problems in memory, attention, and decision-making processes relate to difficulties carrying out daily tasks such as bathing, feeding, dressing, grooming and others.

Association between variables of socio-demographic factors and cognitive deterioration among community-dwelling older people

Age

The significant difference in cognitive deterioration scores across age groups is consistent with previous research that has reported about concerns regarding cognitive deterioration are becoming increasingly important as the population ages and come up in doctor appointments (Jessen et. al., 2020). There is a noticeable increase in cognitive deterioration as people age which cognitive deterioration had affected 2.18 million people in 2020 and 52 4.66 million people in 2060 which is a rise of 2.48 million (113.80%) over the course of four decades (Rajan et. al., 2021).

Marital Status

The results of the study suggest that there is a significant difference in cognitive deterioration scores among the four groups of participants based on their marital status. This finding aligns with previous research by Zhang et. al., (2019), who reported that widowhood has been associated with a greater risk of dementia and faster decreases in several cognitive abilities, such as verbal understanding, spatial ability, and episodic memory. Further research is needed to study the complex relationship between marital status, cognitive health, and activities of daily living.

Education level

The findings showed a statistically significant difference in cognitive deterioration scores between people with varying levels of education, demonstrating that education has a major effect on cognitive functioning in later age. This study's findings align with the study by Zhang et. al., (2019) which was according to the study, older adults with greater levels of education had less deterioration in cognitive function, which is consistent with earlier research from other nations. Higher levels of schooling may give people cognitive protection against the damaging effects of ageing on cognitive functioning. This is shown from a study which states that education enhances cognitive function and reduces the risk of dementia in old life (Lövdén et. al., 2020).

Diseases

The results of the study showed significant differences in the level of cognitive deterioration across the seven groups classified according to condition. The significant difference in cognitive deterioration scores that was discovered shows that different health issues have different consequences on cognitive ability. This finding is supported by other research that looked at the connection between health issues and cognitive impairment in older people. A study by Beerli et.

al., (2022) found that neurological conditions such as diabetes mellitus, hypertension, and cholesterol were associated with a higher risk of cognitive deterioration compared to people without any conditions.

Work History

There was a significant difference in cognitive deterioration scores across participants with various work histories. The results of this study also showed a significant difference between skilled and low-skilled workers' cognitive deterioration scores. This finding aligns with the study by Mani et. al (2013), which also reported those who worked in low-skilled jobs had a higher risk of cognitive deterioration than those who worked in skilled jobs. Furthermore, the fact that skilled professionals and low-skilled workers had significantly different scores for cognitive deterioration suggests that the complexity and cognitive demands of skilled employment may provide some protection against cognitive decline as people age.

Smoking Status

According to the result of the study, there is a significant difference in cognitive deterioration scores between smoking status among community-dwelling older people. These findings align with prior research that has consistently demonstrated a link between smoking and cognitive deterioration. For instance, research on the relationships between smoking behavior and cognitive function discovered that smoking cigarettes accelerates the deterioration and impairment of cognitive function (Tsai & Chang, 2019). In addition, Tsai & Chang (2019) had shown that cigarette smoking is significantly linked to cardiovascular disease and cognitive impairment since it has been shown to enhance thrombosis, oxidative stress, and inflammation.

This study on the association between cognitive deterioration and Activities of Daily Living (ADLs) among community-dwelling older adults has several limitations. The purposive sampling method restricts generalizability, as the sample may not represent the broader population. Additionally, the cross-sectional design provides only a temporal snapshot, limiting the ability to establish causality between cognitive deterioration and ADLs; a longitudinal approach could better elucidate this relationship. Reliance on self-reported data may also introduce bias due to potential inaccuracies or social desirability. The study's use of the Malay Version of the Short Informant Questionnaire on Cognitive Decline in the Elderly (MS-IQCODE) may not capture all cognitive domains, suggesting that a broader assessment could yield more comprehensive insights. Finally, unmeasured variables like physical health, social support, and activity levels could act as confounders, impacting both cognitive function and ADLs. Addressing these limitations could strengthen future

research findings and enhance their applicability across settings.

4. CONCLUSION

This study reveals that there is an association between cognitive deterioration and Activities of Daily Living (ADLs) among community-dwelling older people. The findings from this study also suggest that cognitive deterioration is influenced by demographic variables including age, marital status, education level, diseases, work history, and smoking status. Occupational therapist can utilize this knowledge to develop evidence-based interventions that prioritize cognitive rehabilitation to improve the independency level in ADLs for older people in Malaysia.

This study brings a potential of future research in cognitive deterioration among community-dwelling older people in Malaysia. Future studies could identify the different types of cognitive abilities in different age groups, and genders among older people. This could improve the provision of interventions, thus increasing the quality of services given to older adults. Next, future studies could determine the severity of the diseases to know which stage hinders cognitive deterioration and investigate the best activities that are suitable for their health.

ACKNOWLEDGEMENTS

The researchers would like to express their appreciation to all participants who agreed to take part in this study. The authors of this research wish to declare that there is no conflict of interest in publishing this research.

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REVIEW ARTICLE

Effectiveness of therapeutic ultrasound for treating carpal tunnel syndrome in women: A systematic review

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Abstract:

Carpal tunnel syndrome (CTS) is a prevalent condition characterized by numbness, tingling, and weakness in the hand due to compression of the median nerve within the carpal tunnel of the wrist. This condition often results in pain during wrist movements and significantly restricts the range of motion, hindering daily activities. CTS disproportionately affects adult women, with increasing prevalence and severity with age. Given its substantial impact on daily functioning and quality of life, effective treatment strategies are essential. This systematic review aimed to evaluate the effectiveness of therapeutic ultrasound in alleviating symptoms and improving quality of life in adult women with CTS. Following PRISMA guidelines, literature searches were conducted in Web of Science, Scopus, PubMed, Medline, and Google Scholar for full-text English-language research articles published between 2014 and 2024. Out of 189 articles, nine met the inclusion criteria. The quality of the included studies was evaluated using the PEDro tool, and data on study demographics, intervention protocols, outcome measures, and results were extracted. The results indicated that therapeutic ultrasound is effective in reducing pain and enhancing daily activities for CTS. This review identified optimal treatment parameters, contributing to improved patient care for adult women with CTS. However, more research is needed to distinguish the specific benefits of therapeutic ultrasound compared to other treatments and placebos.

Keywords: Carpal Tunnel Syndrome (CTS), Therapeutic Ultrasound, pain, Activities Daily Living, Quality of life

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1. INTRODUCTION

Carpal tunnel syndrome (CTS) is a prevalent neurological disorder characterized by numbness, tingling, and weakness in the hand, resulting from the compression of the median nerve as it traverses the carpal tunnel in the wrist (Genova et al., 2020). This syndrome often leads to pain during wrist movements and impairs wrist range of motion, significantly interfering with daily activities such as cooking, writing, and gripping objects. The condition not only affects the physical capabilities of individuals but also extends to emotional and psychological well-being due to the persistent discomfort and functional limitations it imposes. Additionally, the socioeconomic impact is profound, as patients with CTS frequently experience prolonged work absences and decreased productivity (Hulkkonen et al., 2019).

CTS affects a substantial segment of the population, with adult women being particularly susceptible to the condition. Studies have shown that women are approximately three times more likely to develop CTS compared to men, with the

prevalence and severity of symptoms increasing with age (Genova et al., 2020); (Hulkkonen et al., 2019); (Wiperman & Goerl, 2016). The higher incidence in women has been attributed to various factors, including hormonal changes, anatomical differences, and occupational risks (Sevy et al., 2023). The increased susceptibility and greater impact on quality of life in women underscore the necessity for targeted and effective treatment options. Understanding these gender-specific aspects of CTS is crucial for developing and implementing therapeutic strategies that can better address the needs of female patients.

The chronic nature of CTS and its significant impact on daily functioning necessitate effective treatment interventions. Traditional approaches such as splinting, corticosteroid injections, and surgical decompression have been commonly employed. However, there is growing interest in non-invasive modalities that offer symptom relief with minimal side effects. Among these, therapeutic ultrasound has gained attention as a potential treatment for CTS. Therapeutic

ultrasound uses sound waves to penetrate tissues, promoting healing and reducing inflammation (Papadopoulos & Mani, 2020). Its non-invasive nature and ability to target specific areas make it an appealing option for patients seeking relief from CTS symptoms without the risks associated with more invasive procedures.

This systematic review aims to critically evaluate the effectiveness of therapeutic ultrasound specifically in adult women with carpal tunnel syndrome. By examining existing studies and clinical trials, this study aim to provide a comprehensive analysis of the efficacy of this treatment modality. This review was explore various aspects, including the reduction of symptoms, improvement in hand function, and overall quality of life in women undergoing therapeutic ultrasound for CTS. Through this evaluation, we hope to offer insights into the potential benefits and limitations of therapeutic ultrasound, guiding clinicians and patients in making informed decisions about incorporating this treatment into their management plans for CTS.

2. MATERIALS AND METHODS

2.1. Data source and search strategy

This review followed the PRISMA guidelines for systematic reviews and meta-analyses. The literature was evaluated using the PICO framework, focusing on women with carpal tunnel syndrome, therapeutic ultrasound as the intervention, and improvements in functionality and daily activities as outcomes. Article searches were conducted in Medline, Google Scholar, Web of Science (WoS), and Scopus databases between November 2014 and March 2024, specifically looking for randomized-controlled trials. Studies were included if they involved women with carpal tunnel syndrome, used therapeutic ultrasound, and measured improvements in functionality and daily activities. To avoid confusion among reviewers, only articles written in English were considered. The search terms used were "Carpal Tunnel Syndrome," "Women," and "Ultrasound," with Boolean operators "AND" and "OR." The search covered the period from 2014 to 2024. Exclusions included letters to the editor, symposium publications, conference abstracts, books, expert opinions, critically appraised topics, meta-analyses, and literature reviews.

2.2. Study selection

Following the search procedure, the articles that were located underwent the eligibility process, which is the last step. In

order to make sure that every article met the requirements of the articles they were searching for, the researchers manually reviewed every one of them at this phase. Finding keywords associated with the title being searched for is the first step. According to earlier research, the conditions Amyotrophy, Thenar of Carpal Origin and Median Neuropathy, Compression Neuropathy, and Entrapment Neuropathy of Carpal Tunnel can be used to replace Carpal Tunnel Syndrome. Ultrasonic treatment and ultrasound therapy are terms that have been used to describe therapeutic ultrasound. For the intended population, which is women must be used in conjunction with other keywords (Table 1).

2.3. Data extraction and analysis

The authors extracted relevant data from the included literature based on demographic data, therapeutic ultrasound parameters, therapeutic ultrasound effectiveness, outcome measure, and result. The retrieved data was then analyzed to answer the research questions. Finally, the findings were summarized in a narrative synthesis to consolidate the outcomes of the studies.

2.4 Quality assessment

In this review, the PEDro scale was used to rate the quality of the included articles. The PEDro scale is a widely used tool for assessing the quality of randomized controlled trials (RCTs) in the field of physiotherapy and other healthcare interventions. This tool directs reviewers to consider 11 items of methodological quality such as random and concealed allocation, baseline comparability, blinding of participants, therapists and assessors, adequate follow-up (greater than 85%), intention-to-treat analysis, between-group statistical comparisons, and reporting of point measures and measures of variability. If the articles met each criterion outlined in the appraisal guidelines, they received "Yes" (1) for that item, and if they were not met, they received "No" (0). The total PEDro score is the sum of ratings for items 2 to 11, giving a score range of 0 to 10, with a higher score reflecting higher methodological quality. Once quality scores were calculated, these were divided into four quality categories that were poor (score: 0-3), fair (score: 4-5), good (score: 6-8), and excellent (score: 9-10). Each study was assessed by two reviewers, and in the event of a disagreement between the two reviewers, a third reviewer was consulted to determine the final PEDro score (Cashin & McAuley, 2020).

Database	Keyword used	Data range	Refine results
Web Of Science (WOS)	TS=((Carpal Tunnel Syndrome* OR Syndrome, Carpal Tunnel OR Syndromes, Carpal Tunnel OR Amyotrophy, Thenar, Of Carpal Origin OR Median Neuropathy, Carpal Tunnel OR Compression Neuropathy, Carpal Tunnel) AND (Therapies, Ultrasonic OR Ultrasonic Therapies OR Therapeutic Ultrasound OR Ultrasound, Therapeutic OR Therapy, Ultrasonic OR Ultrasound Therapy OR Therapies, Ultrasound OR Therapy, Ultrasound OR Ultrasound Therapies) AND (Women's Group OR Women Groups OR Women's Groups OR Woman))	2014 - 2024	- Article - English language
Scopus	TITLE-ABS-KEY (("Carpal Tunnel Syndrome" OR "Median Neuropathy, Carpal Tunnel" OR "Compression Neuropathy, Carpal Tunnel" OR "Entrapment Neuropathy, Carpal Tunnel" OR "Median Neuropathy, Carpal Tunnel") AND ("women") AND ("Ultrasonic Therapies" OR "Ultrasonic Therapy" OR "Therapeutic Ultrasound" OR "Ultrasound Therapy" OR "Ultrasound Therapies"))	2014 - 2024	- Full text - English language
Medline	((((((((((Carpal Tunnel Syndrome*[Title/Abstract]) OR (Syndrome*, Carpal Tunnel[Title/Abstract])) OR (Amyotrophy, Thenar, Of Carpal Origin[Title/Abstract])) OR (Median Neuropathy, Carpal Tunnel[Title/Abstract])) OR (Compression Neuropathy, Carpal Tunnel[Title/Abstract])) OR (Entrapment Neuropathy, Carpal Tunnel[Title/Abstract])) AND (Therapies, Ultrasonic[Title/Abstract])) OR (Ultrasonic Therapies[Title/Abstract])) OR (Therapeutic Ultrasound[Title/Abstract])) OR (Ultrasound, Therapeutic[Title/Abstract])) OR (Therapy, Ultrasonic[Title/Abstract])) OR (Ultrasound Therapy[Title/Abstract])) OR (Therapies, Ultrasound[Title/Abstract])) OR (Therapy, Ultrasound[Title/Abstract])) OR (Ultrasound Therapies[Title/Abstract]))	2014 - 2024	- Full text - English language - Randomised Control Trial - Female
Google Scholar	Carpal Tunnel Syndromes OR Syndrome, Carpal Tunnel OR Amyotrophy, Thenar, Of Carpal Origin OR Median Neuropathy, Carpal Tunnel OR Compression Neuropathy, Carpal Tunnel OR Entrapment Neuropathy, Carpal Tunnel AND Therapies, Ultrasonic OR Ultrasonic Therapies OR Therapeutic Ultrasound OR Ultrasound, Therapeutic OR Therapy, Ultrasonic OR Ultrasound Therapy OR Therapies, Ultrasound OR Therapy, Ultrasound OR Ultrasound Therapies AND women	2014 - 2024	English language

Table 1 The search string

3. RESULTS AND DISCUSSION

3.1. Literature search

The initial literature search found 197 potential articles. After removing duplicates, 189 articles were left. Each article's title and abstract were evaluated using inclusion and exclusion criteria, leading to the exclusion of 169 articles that did not meet the criteria. The full texts of the remaining 19 articles were then thoroughly reviewed to determine their suitability for inclusion since the title and abstract analysis alone was insufficient. This detailed review excluded 10 articles that did not evaluate VAS as an outcome measure.

All subjects in the included studies had Carpal Tunnel

Syndrome (CTS). Out of the 9 studies, 7 included both males and females, 1 focused only on males, and 1 only on females. Seven studies measured the severity of CTS using the Boston Carpal Tunnel Syndrome Questionnaire (BCTSQ), and four of these also used the Visual Analog Scale (VAS). Additionally, two studies assessed pain levels using the NPRS (Numerical Pain Rating Scale). The BCTSQ included the Functional Status Scale (FSS) to assess daily hand functions and the Symptom Severity Scale (SSS) to measure painful wrist episodes, numbness, weakness, and difficulties with grasping.

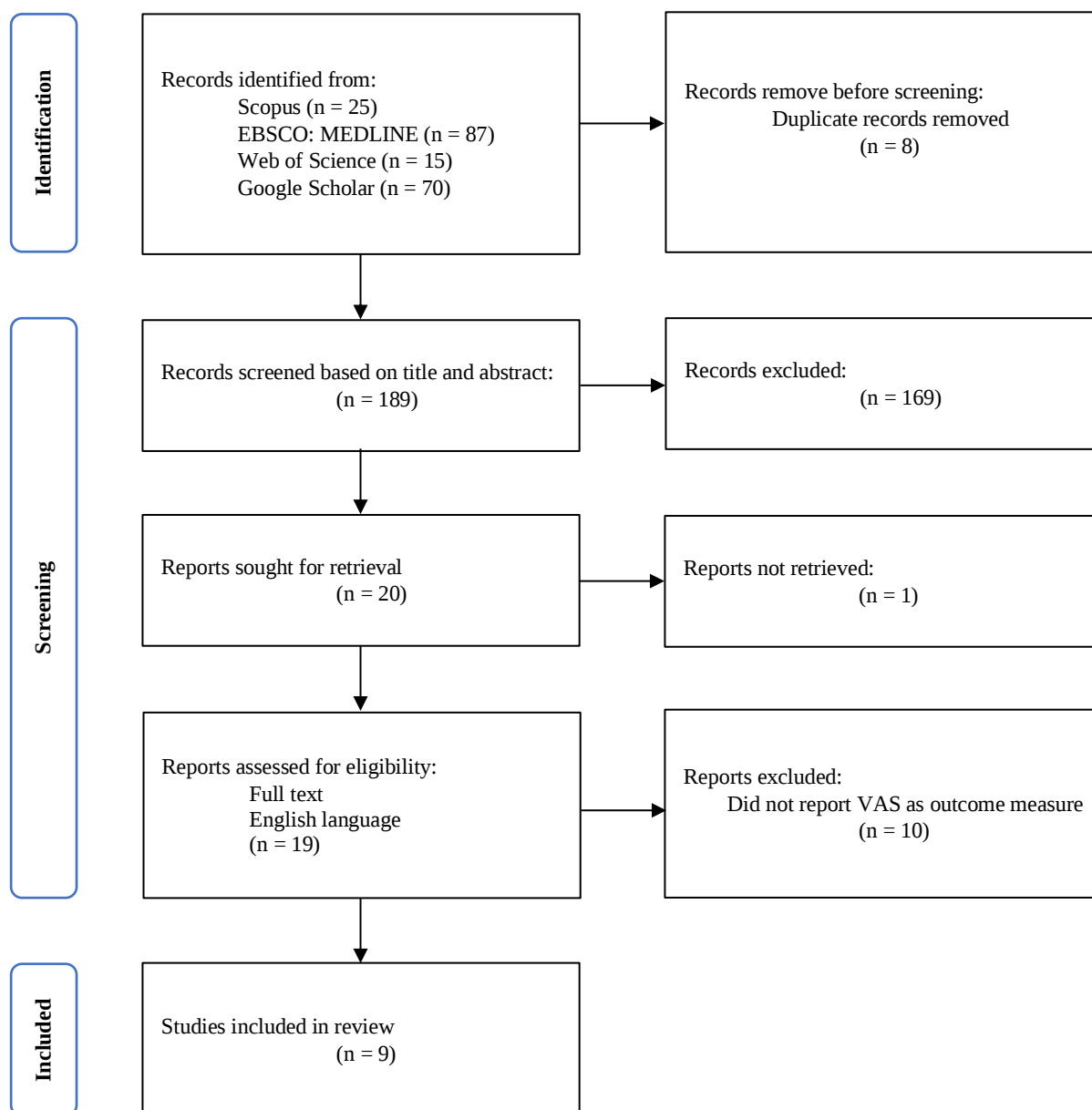


Figure 1 PRISMA flow diagram

The studies employed various methodologies and treatment protocols. While four studies combined ultrasound therapy with exercise, five focused solely on ultrasound therapy. Additionally, the studies varied in ultrasound parameters, including differences in frequency, intensity, and duration of application.

3.2. Risk of bias in included studies

Two reviewers evaluated the methodological quality of included studies (n=9) independently using the Pedro Scale Critical Review Form for Randomized Control Trial. A

discussion with the third reviewer was required to get an agreement on the validity and reliability of the outcome measures, the suitability of the intervention description, and the logic behind the sample size computation.

From a total score of 10, a minimum of 3 and a maximum of 9 were attained, signifying "poor" to "excellent" methodological quality (Table 2). A single study has been rated as excellent, six studies as good, one as fair, and one as poor.

3.3. Effectiveness of therapeutic ultrasound

The nine studies report on pain outcome and Boston Carpal Tunnel Syndrome Questionnaire (BCTSQ) data among participants who have undergone therapeutic ultrasound (Table 3). Chang et al. (2014), reported significant pain reduction in the ultrasound group ($p=0.01$). Awan et al. (2014), Paoloni et al. (2015), and Ansar et al. (2017) demonstrated significant improvements in pain levels for the experimental group, with no significant difference between groups ($p=0.12$, $p=0.72$, $p=0.909$ respectively). Mahmoud (2016) reported significant improvements in pain levels for both groups in mild symptoms ($p<0.05$). However, for those with moderate symptoms, LLLT was more effective than ultrasound in pain reduction ($p<0.05$). Further reinforcing these findings, Lazović et al. (2018) reported that ultrasound combined with exercise significantly reduced pain compared to a sham ultrasound group ($p<0.001$). Elmonem et al. (2024) showed significant decrease of pain in all groups ($p=0.001$).

For BCSTQ, Chang et al. (2014) reported significant improvements in symptom severity scores (SSS) for both ultrasound and paraffin therapy groups, with no significant

difference between them ($p=0.51$). However, functional status scores (FSS) were significantly better in the ultrasound group compared to paraffin therapy ($p=0.04$). Similarly, Mahmoud (2016) found significant improvements in both SSS and FSS in patients with mild and moderate CTS, with ultrasound therapy showing greater effectiveness in improving functional status for moderate symptoms ($p=0.037$). Paoloni et al., (2015) reported significant effect of treatment ($p<0.05$) for SSS in both groups, while there was no significant effect of treatment ($p=0.97$) for FSS. Ansar et al. (2017) also reported significant improvements in both SSS and FSS for ultrasound and local steroid injection groups, with no significant differences between them (SSS: $p=0.773$, FSS: $p=0.335$). Elmonem et al. (2024) also show improvement with significant decrease of BCSTQ values in all groups ($p=0.001$).

Conversely, studies by Çatalbaş et al.(2018) and Jothi & Bland (2019) do not specify data for BCSTQ and pain outcome but they state that all outcome measures are significantly improved in all groups.

Table 2 Assessment of methodological quality by study (PEDro)

Study	Chang et al., 2014	Awan et al., 2014	Paoloni et al., 2015	Mahmoud, 2016	Ansar et al., 2017	Çatalbaş et al., 2018	Lazović et al., 2018	Jothi & Bland, 2019	Elmonem et al., 2024
Eligibility criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random allocation	1	1	1	1	1	1	1	1	1
Concealed allocation	1	1	1	0	1	1	1	1	1
Baseline comparability	1	0	1	0	1	1	1	1	1
Blinded participants	0	0	0	0	0	1	1	1	0
Blinded therapist	1	0	0	0	0	0	1	1	0
Blinded assessor	1	0	1	0	0	1	0	1	0
Adequate follow-up	0	1	1	0	1	1	1	1	1
Intention-to-treat analysis	0	0	1	0	1	0	0	0	0

Between group comparison	1	1	1	1	1	1	1	1	1
Point estimation and variability	1	1	0	1	1	1	1	1	1
Total PEDro Score (/10)	7	5	7	3	7	8	8	9	6
Quality Descriptor	Good	Fair	Good	Poor	Good	Good	Good	Excellent	Good

Table 3 Summary of study

AUTHOR	PARTICIPANTS	INTERVENTION PROTOCOL	OUTCOME MEASURE	RESULTS
Chang et al., (2014) Comparative effectiveness of ultrasound and paraffin therapy in patients with carpal tunnel syndrome: a randomized trial	5 males, 42 females Age : GI : 51.9±8.8 years GII : 48.8±11.2 years Inclusion criteria: - pain and/or numbness in the median nerve distribution of the digits or nocturnal pain - a positive Phalen's sign or Tinel's sign - electrophysiological evidence of CTS.	Group I (GI) : 23 patients - Paraffin Therapy - Twice per week for 8 weeks. - Temperature paraffin: 55°C - Duration: 20 minutes Group II (GII) : 24 patients - Ultrasound Therapy - twice per week for 8 weeks - Parameters : 1 MHz, 1.0 W/cm², Pulsed 1:4, 5 minutes	- BCTSQ : - FSS - Pain scale : VAS - Physical examinations: - The Semmes-Weinstein monofilament sensory test - Palmar pinch strength - Tinel's test - Phalen's test. - Nerve conduction studies (NCs): - MDL - SDL	Primary outcome: Symptom Severity Scores: - Significant improvements were seen in both groups - Effect size is moderate (0.63) - No significant difference between groups (p=0.51). Functional Status Scores: - FSS in the GII > GI (p=0.04)*. - Effect size is small (p=0.38) Secondary Outcome: Pain scale - Significant improvement is only seen in the US group. - Effect size is moderate (p=0.74) - No significant difference between groups (p=0.81). Palmar pinch power - Significant improvement is

				only seen in the US group. • No significant difference between groups (p=0.34). NCSs • No significant difference for both groups. • Distal motor: No significant difference (p=0.06). • Distal sensory: No significant difference (p=0.83).
Awan et al., (2014) Effectiveness of stretching of the flexor retinaculum with ultrasonic therapy in the management of carpal tunnel syndrome	• 50 patients (Both gender) • Age : 26-70 years Inclusion criteria: • Having idiopathic CTS • Positive for Tinel's sign and Phalen's test.	Experimental Group (EG): • 25 patients • Stretching of the flexor retinaculum + ultrasound. • Parameters : 0.75W/cm ² , Pulsed, 5 min Control Group (CG): • 25 patients • Stretching of the flexor retinaculum only.	1. NPRS 2. Paresthesia 3. Muscle Strength	Results show significant improvement in the experimental group only. Pain : • No significant difference between groups (p=0.12). Paresthesia : • No significant difference between groups (p = 0.09). Muscle Strength : • No significant difference between groups (p =0.16).
Paoloni et al., (2015) Extracorporeal shock wave therapy and ultrasound therapy improve pain and function in patients with carpal tunnel syndrome. A randomized controlled trial	• 25 patients (Both gender) • Age: GA : 56.5±9.4 years GB : 54.7±9.2 years GC : 59.1±12.5 years Inclusion criteria: • Mild to moderate CTS • No indication for surgical treatment	Group A (GA): • 13 patients • Therapeutic Ultrasound (US) • 15 sessions (5 sessions/week for three consecutive weeks) • Parameters : 15 min, 1 MHz, 1.0 W/cm ² , Pulsed 1:4. Group B (GB):	1. VAS 2. BCTSQ • FSS • SSS	Pain (VAS) : • Effect of time : Significant (F3=2.81; P<0.05). • Effect of treatment : No significant difference (F2=0.33; P=0.72) • Time*treatment interaction : No significant difference (F6=0.48; P=0.82).

T0: before treatment
 T1: the end of treatment
 T2: 4 weeks after the end of treatment
 T3: 12 weeks after the end of treatment

- 17 patients
- cryo-US + Therapeutic Ultrasound (US)
- 15 sessions (5 sessions/week for three consecutive weeks)
- Parameters :
 15 min, 0°C,
 1 MHz, 1.0 W/cm²,
 Pulsed 1:4

Group C (GC):

- 12 patients
- Extracorporeal Shock Wave Therapy (ESWT)
- 4 sessions over three consecutive weeks
- Type: Low-intensity focused ESWT
- Pulses: 2500 pulses
- Energy: 0.05 mJ/mm²

- Post hoc analysis showed No significant difference.

Paresthesias (VAS):

- Effect of time : significant (F3=4.53; P<0.01).
- Effect of treatment : No significant difference (F2=2.66; P=0.07)
- Time*treatment interaction : No significant difference (F6=0.53; P=0.79).
- Significant reduction in paresthesias at T1 (P<0.05) and T2 (P<0.01) compared with T0.

- FSS :

- Effect of time : significant (F3=3.97; P<0.01).
- Effect of treatment : No significant difference (F2=0.035; P=0.97)
- Time*treatment interaction : No significant difference (F6=0.44; P=0.85).

BCTSQ - SSS :

- Effect of time : significant (F3=11.91; P<0.001).
- Effect of treatment : significant (F2=3.95; P<0.05)

Time*treatment interaction : No significant difference ($F_6=0.42$; $P=0.86$).				
Mahmoud, (2016) Comparison of the Selected Treatment Modalities of Carpal Tunnel Syndrome Depending on Symptom Severity	40 males - Ages: 40-50 years old - Idiopathic unilateral mild and moderate CTS - no indication to surgical treatment	Group I (GI) : 10 patients with mild symptoms - low-level laser therapy (LLLT) Group II (GII) : 10 patients with mild symptoms - ultrasound therapy Group III (GIII) : 10 patients with moderate symptoms - low-level laser therapy (LLLT) Group IV (GIV) : 10 patients with moderate symptoms - ultrasound therapy Therapeutic ultrasound 15 minutes/session - Once daily, 5 times/week for 6 weeks - Parameters : 1MHz, 1.0 W/cm², pulsed 1:4 Low-level laser therapy treatment (LLLT) - Once a day, 5 times a week for six weeks.	1. VAS - pain 2. VAS - paresthesia 3. BCTSQ : FSS	Mild Symptoms Groups : Pain level (VAS) - Significant improvements were seen in both groups ($p<0.05$) - No significant difference between group ($p=0.342$) BCTSQ - FSS - Significant improvements were seen in both groups (GI; $p<0.05$, GII; $p=0.001$) - No significant difference ($p=0.367$) Moderate Symptoms Groups : Pain level (VAS) - Significant improvements were seen in both groups ($p<0.05$) - VAS significantly were higher in the GIII ($p<0.05$) - LLLT > US in improvement of pain level BCTSQ - FSS - Significant improvements were seen in both groups (GIII; $p=0.03$, GIV; $p=0.001$) - FSS significantly were higher in the GIV ($p=0.037$) - US > LLLT in improvement of FSS.

			- low intensity (9J) - Infrared - laser diode at five points (1.8 J/point)	
Ansar et al., (2017) The Comparison of Therapeutic Ultrasound and Local Steroid Injection in Treatment of Mild to Moderate Carpal Tunnel Syndrome: A Randomized Controlled Trial	11 males, 49 females Ages : GA : 44.9±11.6 years GB : 36.8±7.76 years - Mild to moderate CTS Inclusion criteria : - Presence of paresthesia, pain and vasomotor symptoms - positive Phalen's and Tinel's test - Mild to moderate intensity of median nerve lesion in NCs	Group 1 : 30 patients (30 hands) - Therapeutic ultrasound (US) + Median nerve flossing exercise + Wrist range of motion exercise Group 2 : 30 patients (30 hands) - Local steroid injection + Median nerve flossing exercise + Wrist range of motion exercise	- NPRS - BCTSQ : - SSS - FSS	Pain (NPRS) : - Significant improvements in NPRS were seen in both groups - No significant difference between group (p=0.909) BCTSQ - FSS : - FSS found to be on a working level of efficiency for both groups. - No significant difference between group (p=0.335) BCTSQ - SSS : - SSS in Group 1 > Group 2. - No significant difference between group (p=0.773)
Çatalbaş et al., (2018) Ultrasonographic imaging of the effects of continuous, pulsed or sham ultrasound treatments on carpal tunnel syndrome: A randomized controlled study	46 females, 8 males (92 hands) Age : GA : 51.1±10.1 years GB : 46.8±11.2 years GC : 46.2±8.8 years - Mild to moderate idiopathic CTS	Group 1 (G1) : 18 patients, 33 wrist - Continuous US + splint Group 2 (G2) : 19 patients, 33 wrist - Pulsed US + splint Group 3 (G3) : 19 patients, 30 wrist	- VAS - pain - VAS - paresthesia - BCTSQ : - SSS - FSS - Hand grip strength (kgf) - Electrophysiological and ultrasonographic imaging parameters: - MDL (msn) - SDL (msn) - CA (mm2)	Results show No significant difference between all groups. Clinical evaluation parameters: - All clinical parameters significantly improved by the 2nd and 6th weeks in all groups. Electrophysiological parameters: - G1 : MDL improved by the 2nd and 6th weeks.

		Sham US + splint	G2 and G3 : MDL improved only by the 6th week; SDL improved by the 2nd and 6th weeks.
			Ultrasonographic imaging parameters: All groups showed significant improvement in CA by the 2nd and 6th weeks.
Lazović et al., (2018) Effectiveness of combined ultrasound and exercise therapy in the treatment of carpal tunnel syndrome – randomized, placebo-controlled investigation	31 female, 4 male Age: EG : 53.5±8.3 years CG : 52.6±8.7 years Inclusion Criteria : - symptoms (pain and/or numbness) in at least two digits on one hand (digits 1–4) lasting less than one year - no thenar atrophy - mild to moderate CTS	Experimental Group (EG) : 20 patients - Parameters : 1MHz, 1.0 W/cm², pulsed 1:4, 15 min 10 treatments were administered once a day, 5 days a week for 2 weeks, followed by 4 treatments every other day for 2 weeks, and 6 treatments twice a week for 3 weeks. - Nerve and tendon gliding exercise (10 rep/session) Control Group (CG) : 15 patients - US probe was applied without turning the device on - Nerve and tendon gliding exercise (10 rep/session)	- NPRS - Tinel's sign - Superficial sensibility - TPD Test - Electrophysiological analyses - MDL - 2nd finger - SNAP - 2nd finger - SNCV - 2nd finger
			Pain (NPRS) : - NPRS in EG > CG (p < 0.001)* Superficial sensibility : - TPD in EG > CG (p=0.021)* Reduction of Positive Tinel's sign : - EG > CG (p < 0.001)* Reduction of MDL values : - EG > CG (p = 0.009)* Reduction of SNAP values : - EG > CG (p = 0.002)* Reduction of SNCV values : - EG > CG (p < 0.001)*

Jothi & Bland, (2019) Ultrasound therapy adds no benefit to splinting in carpal tunnel syndrome	9 men, 31 women Age: AG : 53.5±10.7 years SG : 58.3±10.8 years - Mild to moderate CTS - Symptoms consistent.	Active Group (AG): 20 patients - US - Parameters : Pulsed mode, 1 MHz, 1.0 W/cm², 15 min/session 20 sessions over 7 weeks - Wrist splint Sham Group (SG): 20 patients - Unpowered US - Wrist splint	Primary Outcome: 1. BCTSQ - SSS at 12 months Secondary Outcome : 1. NCS 2. CSA 3. BCTQ - FSS	- Results show No significant difference between groups. - Both groups showed improvement, but no differences between them.
Elmonem et al., (2024) Effect of low level laser therapy versus pulsed ultrasound on postpartum carpal tunnel syndrome	48 postpartum women Age: GA : 30.4±3.4 years GB : 29.4±3.1 years GC : 31.2±2.8 years - Moderate to severe pain - VAS ≥ 4 - Positive for Tinel sign and Phalen test. - Body mass index (BMI) - 25-30 kg/m²	Group A: 16 patients - Low level laser therapy (LLLT) - Wavelength: 810 nm - Power: 500 MW - Laser beam diameter: 10 mm 3 sessions weekly for four weeks (12 sessions as a total) - Wrist exercises Group B: 16 patients - Parameters : Pulsed ultrasound, 1.0 MHz, 0.13 W/cm² 3 weekly sessions for four weeks, a total of 12 sessions (10 min/session) - Wrist exercises Group C:	1. VAS 2. BCTSQ - FSS - SSS 3. Median NCS 4. Hand grip strength	Effect size is medium (0.556) Pain (VAS) : - Significant decrease of VAS values in all group (p=0.001) BCTSQ (SSS & FSS) : - Significant decrease of BCTSQ values in all group (p=0.001) Hand Grip : - Significant increase of hand grip values in all group (p=0.001) Median NCS : - Significant improvement of DML and MCV in all group (p=0.026) Effect size is medium (0.556).

- 16 patients
- Wrist exercises

Abbreviation: VAS; Visual Analog Scale, NPRS; Numeric Pain Rating Scale, BCTSQ; Boston Carpal Tunnel Syndrome Questionnaire, SSS; Symptom Severity Scale, FSS; Functional Status Scale, NCs; Nerve Conduction Studies, MDL; Motor Distal Latency of median nerve, SDL; Sensory Distal Latency of median nerve, CA; Ultrasonographic measurement of cross-sectional area of median nerve at the level of pisiform bone, SNAP; Sensory Nerve Action Potential, SNCV; Sensory Nerve Conduction Velocity, CSA; ultrasound imaging of the median nerves with measurement of cross-sectional area, TPD; Two-Point Discrimination, GA; group A, GB; group A, GC; group C, US; ultrasound.

3.4. Discussion

The primary aim of this systematic review was to evaluate the effectiveness of therapeutic ultrasound for treating CTS in adult women. The results from the nine studies included in this review provide mixed evidence on the benefits of ultrasound therapy, with seven studies indicating significant improvements in symptoms and functionality, while others show no substantial difference compared to control treatments.

Study by Chang et al. (2014) and Paoloni et al. (2015), reported significant improvements in both symptom severity scores and functional status scores among patients receiving ultrasound therapy. Chang et al. (2014) found that ultrasound therapy significantly improved pain levels and palmar pinch strength compared to paraffin therapy, though no significant differences were found in nerve conduction studies between the groups. This aligns with findings by Mahmoud (2016), where ultrasound therapy led to significant improvements in pain and functional status scores for patients with both mild and moderate symptoms, though the degree of improvement varied based on the severity of symptoms.

Conversely, studies such as those by Jothi & Bland (2019) and Çatalbaş et al. (2018) showed no significant difference between ultrasound therapy and control treatments, including sham ultrasound and wrist splinting. Jothi & Bland (2019) found that while both groups (active and sham ultrasound) improved over time, there was no significant difference between the two, suggesting that ultrasound may not provide additional benefits beyond standard treatments such as splinting. Similarly, Çatalbaş et al. (2018) reported significant improvements in clinical, electrophysiological, and ultrasonographic parameters across all groups, including the sham treatment, which raises questions about the specific efficacy of ultrasound therapy in CTS treatment.

The studies included in this review utilized varying protocols and parameters for ultrasound therapy, which might have influenced the outcomes. The majority of the studies utilized a frequency of 1 MHz, which is effective for targeting deeper tissues within the carpal tunnel region. The intensity of

the ultrasound typically ranged from 0.75 to 1.5 W/cm², with most studies employing 1.0 W/cm². Duration of treatment sessions varied, typically between 5 to 15 minutes, with the 15-minute duration being the most common in studies such as Paoloni et al. (2015), Mahmoud (2016), Lazović et al. (2018), and Jothi & Bland (2019). The mode of ultrasound application was predominantly pulsed, with a duty cycle of 1:4. This pulsed mode likely helps to minimize thermal effects while maintaining therapeutic benefits. The consistency in frequency, intensity, and mode across different studies underscores the potential efficacy of these specific parameters in managing CTS symptoms. Based on the finding it can conclude that the optimum parameters to promote pain reduction are frequency (1MHz), intensity (1.0 W/cm2), mode (pulse) with 1:4 duty cycle as tabulates in *Table 4*.

Interestingly, the combination of ultrasound with other therapies appeared to yield better results in some studies. Ansar et al. (2017) demonstrated that ultrasound combined with median nerve flossing exercises and wrist range of motion exercises provided significant improvements in pain and functional status, comparable to local steroid injections. This suggests that the integration of ultrasound with exercise therapy could enhance treatment outcomes for CTS.

The review also highlights the importance of considering the severity of CTS symptoms when evaluating treatment efficacy. Mahmoud (2016) found that LLLT was more effective than ultrasound in improving pain levels for patients with moderate symptoms, whereas ultrasound was more beneficial for functional status improvements. This indicates that the choice of therapy might need to be tailored to the individual patient's symptom severity and specific treatment goals.

A notable limitation across the studies is the lack of long-term follow-up to assess the sustained efficacy of ultrasound therapy. Most studies, including those by Paoloni et al. (2015) and Elmonem et al. (2024), evaluated outcomes up to 12 weeks post-treatment. Future research should focus on longer follow-up periods to determine the durability of treatment effects.

Table 4 Parameters of therapeutic ultrasound based on studies

Study	Chang et al., 2014	Awan et al., 2014	Paoloni et al., 2015	Mahmoud, 2016	Ansar et al., 2017	Çatalbaş et al., 2018	Lazović et al., 2018	Jothi & Bland, 2019	Elmonem et al., 2024
Frequency (MHz)	1	-	1	1	1	1	1	1	1
Intensity (W/cm ²)	1.0	0.75	1.0	1.0	1.5	1.0	1.0	1.0	0.13
Duration (minutes)	5	5	15	15	5	10	15	15	10
Mode	Pulse	Pulse	Pulse	Pulse	-	Pulse	Pulse	Pulse	Pulse
Duty cycle	1:4	-	1:4	1:4	-	1:4	1:4	-	-

4. CONCLUSION

Therapeutic ultrasound significantly shows its effectiveness in reducing pain and improving activities of daily living in adult women with carpal tunnel syndrome. Our review indicates that therapeutic ultrasound can effectively alleviate pain when administered with optimal parameters: a frequency of 1 MHz, intensity of 1.0 W/cm², in pulsed mode with a 1:4 duty cycle. Future studies should focus on standardizing treatment protocols to enhance reproducibility and clinical applicability. Additionally, integrating therapeutic ultrasound into comprehensive management strategies could potentially optimize outcomes for women suffering from carpal tunnel syndrome.

ACKNOWLEDGEMENTS

The authors acknowledge the contributions of research assistance, and all the individuals that assist in completing this article.

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ARTICLE TYPE (RESEARCH ARTICLE)

Knowledge and Awareness of Ergonomic Posture and Occupational Musculoskeletal Disorders (MSDs) among Office Workers in Klang Valley

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Abstract:

This study examined the association between ergonomics knowledge and awareness and the prevalence of MSDs among office workers in Klang Valley, Malaysia. Three hundred thirty-five participants aged 21-50 completed an online survey. The participants' level of knowledge and awareness of ergonomics posture were analyzed using adopted Knowledge and Awareness of Ergonomics posture questionnaires (NMQ). NMQ questionnaire was used to determine the prevalence of occupational MSDs across body regions in the past 12 months among participants. Results revealed that while office workers had a moderate level of knowledge about ergonomics, their awareness was high. Despite this, 36.4% reported experiencing MSDs in at least one body region, primarily in the shoulders, wrists, neck, upper back, and lower back. A significant positive correlation was found between the level of knowledge and awareness of ergonomics posture and the prevalence of MSDs. This suggests that increasing ergonomic education and awareness can help reduce the occurrence of these disorders among office workers. The findings of this study provide valuable insights for future research and policy development aimed at promoting healthier work habits and practices in office environments.

Keywords: Ergonomics, ergonomics knowledge, ergonomics awareness, occupational MSDs, office workers

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1. INTRODUCTION

Ergonomics studies of human biomechanics focus on posture and comfort in handling tasks (Salvendy et al., 2012). Specifically, applying ergonomic principles is believed to minimize the computer users' ergonomic hazards as it enables 'fitting the task to the worker', which means assessing the fit between the environment and the worker (Khan et al., 2012; Baker & Redfern, 2009). A study by Mani et al. (2018) stated that office workers are prone to develop occupational MSDs. In a report from Mohammadipour et al. (2018), 50% of office workers with frequent computer use (3-5 hours) demonstrated a high prevalence of occupational MSDs in recent years. Commonly reported physical risk factors of occupational MSDs include prolonged sustained standing and sitting posture which puts physical strain on the upper and lower back, the awkward posture of the head, neck, and trunk, and repetitive motion of fingers and wrist (Khan et al., 2015; Loghmani et al., 2013; Sonne et al., 2012). Also, poor workplace ergonomics such as chairs increase the risk of developing pain and discomfort especially in the lower back (Chaiklieng & Krusun, 2015; Matos & Arezes, 2015;

Poochada & Chaiklieng, 2015). MSDs can lead to disability, reduced work performance, and end of career due to the participation restriction in work in the long run (Janga & Akinfenwa, 2012).

Occupational MSDs are usually characterized by discomfort, pain, stiffness, swelling, redness, weakness, tingling, or numbness. It usually affects most body regions, such as the upper back, lower back, neck, shoulder, hand, knees, hips, and ankle (Estember & Huang, 2019). While most studies assess muscular and mental strain, few studies acknowledged eye problems associated with working hazards, which can also occur due to prolonged exposure to the monitor for hours. Eye problems may include eye strain, blurriness, dryness, headache, and difficulty focusing while using a monitor (Robertson et al., 2013; Amick et al., 2012).

Several studies have shown the causal-effect relationship between working postures and the prevalence of MSDs. A cross-sectional study shows that working postures have direct effects on occupational MSDs complaints among office workers (Che Mansor et al. 2013), while Rodrigues et

al. (2017) showed that office workers with MSDs complaints have worse ergonomics posture compared to office workers without MSDs complaints. So far, in Malaysia, studies by Jaafar et al. (2019) and (2021) have assessed knowledge and awareness of ergonomics, however, no association was done with the prevalence of occupational MSDs.

However, studies to assess workplace ergonomics, ergonomic training, and MSDs prevalence are scarce. In addition, the identification of causal for the risk factors of MSDs (i.e., knowledge and awareness of ergonomics) along with the prevalence of MSDs among office workers in Malaysia could determine primary and specific ergonomics training to be incorporated based on the root causes.

This study aims to determine the knowledge and awareness of ergonomics posture and the prevalence of occupational MSDs among office workers in Klang Valley. Also, the study aimed to determine the relationship between sociodemographic characteristics with knowledge and awareness of ergonomics as well as occupational MSDs.

2. METHODS AND MATERIALS

This was an online cross-sectional study of office workers in Klang Valley using a self-administered questionnaire. The participant's information sheet was also attached to the questionnaire to explain the purpose of the study. The number of samples was determined by using Krejcie & Morgan's (1970) table. With an estimation of 100,000 office workers in Klang Valley, the representatives' samples were 384 respondents. The data was collected by distributing the questionnaire in the form of Google Forms to the respondents who were randomly selected through emails, Instagram, Telegram, and WhatsApp contacts. A poster to call for respondents, with study information, a link, and a QR code to the questionnaire was created. The poster was then distributed through social media platforms such as Instagram, Telegram, and WhatsApp contacts. The poster was also distributed offline where eligible participants scanned the QR code in the poster using their device and completed the online questionnaire. The questionnaire was also distributed through the emails of businesses and offices around Klang Valley. The duration of the data collection was three months. Research ethics approval has been obtained from UiTM's Research Ethics Committee (Ref: FERC/FSK/MR/2021/0192, dated 12 September 2022).

The inclusion criteria of the respondents for this study were office workers aged 21-50 years old, working on a computer for a minimum of 20 hours/week, and at least one year of working experience. Participants who were pregnant had a second job, and experienced injuries not caused by occupation were excluded. The knowledge and awareness of ergonomics questionnaire from a previous study among office workers was chosen as a research instrument (Jaafar et al., 2019). The questionnaire is divided into 3 sections, which are sociodemographic data (Section 1), Nordic Musculoskeletal Questionnaire (NMQ) (Section 2), and

Knowledge and Awareness of Ergonomic Questionnaire (Section 3).

Data were analysed by using the Statistical Package for the Social Sciences (SPSS) version 26.0 and statistically described. Descriptive statistics - frequencies, mean and standard deviation (SD) were calculated for data in the study (demographic data, knowledge, awareness, prevalence of MSDs). The relationship between knowledge and awareness of ergonomics posture and the prevalence of occupational MSDs was analysed by using Pearson Chi-square. A p-value less than 0.05 ($p \leq 0.05$) indicates statistical significance.

3. RESULTS

Demographic characteristics

A total of 335 respondents have completed the study. A total of 165 respondents were male with 50.7% of the participants being female. More than half (60%) of respondents were aged 41 years and above (Table 1). The Body Mass Index (BMI) of the respondents was 23.6% underweight, 30.4% normal weight, 25.7% overweight, and 20.3 % obese.

For education, 115 (34.3%) of participants had a Bachelor's Degree followed by pre-university (22.7%), post-graduate (22.4%), and secondary school (20.6%).

Table 1: The demographic characteristics of the participants.

Demographic characteristics	N	%
Gender		
Female	170	50.7
Male	165	49.3
Age (in years)		
21 to 30	86	3.0
31 to 40	47	9.7
41 to 50	202	22.6
BMI (kg/m²)		
Below 18.5	79	3.8
18.5 to 24.9	102	36.3
25 to 29.9	86	42.5
30 or greater	68	17.5
Educational Level		
Secondary school	69	20.6
Pre-University	76	22.7
Undergraduate	115	34.3
Post Graduate	75	22.4
Working Hours		
4 to 6 hours	89	26.6
7 to 9 hours	134	40.0
>9 hours	112	33.4
Working Experience		
1 to 5 years	147	43.9
6 to 10 years	72	21.5
11 to 15 years	51	15.2
≥ 16 years	65	19.4

The Prevalence of Occupational MSDs

A total of 122 (36.4%) respondents declared they have had the symptoms of occupational MSDs in at least one mentioned body region in the past 12 months (Table 2).

Table 2: Prevalence of Occupational MSDs.

Occupational MSDs	N	%
Yes	122	36.4
No	213	63.6
Total	335	100

Table 3 indicates the prevalence of occupational MSDs during the last 12 months in different parts of the body among the 335 respondents. The total prevalence of occupational MSDs across body parts mainly involves shoulders (24.5%) with an almost equal proportion of prevalence of MSDs at the wrist, neck, upper back, and lower back (22%). Ankle/Feet (18.5%) was the least body region affected.

Table 3: Prevalence of Occupational MSDs in different body parts.

Body Parts	N	(%)
Neck	75	22.4
Shoulders	82	24.5
Upper back	74	22.1
Elbow	63	18.8
Wrist/Hands	76	22.7
Low back	73	21.8
Hips/Thighs	72	21.5
Knees	65	19.4
Ankle/Feet	62	18.5

The level of knowledge about ergonomics posture

Figure 1 shows the distribution of the responses based on their ergonomics knowledge. Close to half (48.4%) of the respondents have seen and heard the word ergonomics in various media ($M = 3.19$, $SD = 1.44$), and comparably, more than 48% who have read an issue related to ergonomics ($M = 3.24$, $SD = 1.15$). More than 44% of respondents have attended ergonomics discussions ($M = 3.19$; $SD = 0.83$) while 46% of participants know and understand ergonomics ($M = 3.23$; $SD = 0.95$) which means 2% acquired ergonomics understanding from reading and listening from media. Not more than 25% of respondents have seen the word ergonomics on the notice board in their office ($M = 2.74$, $SD = 1.14$).

Figure 2: Means score of respondents' level of ergonomics posture.

The number of neutral answers is slightly higher with an average of 27.4%. More than half (63.9%) of the participants have an average level of knowledge about ergonomic posture

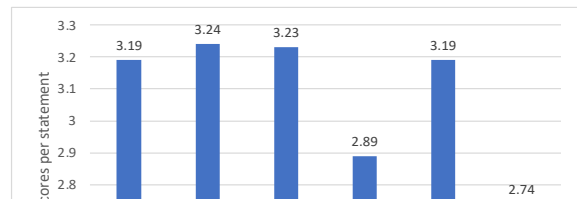
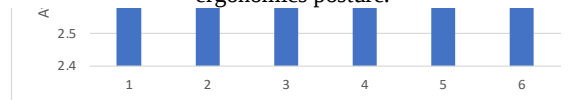


Figure 1: Means scores of participants' level of knowledge about ergonomics posture.



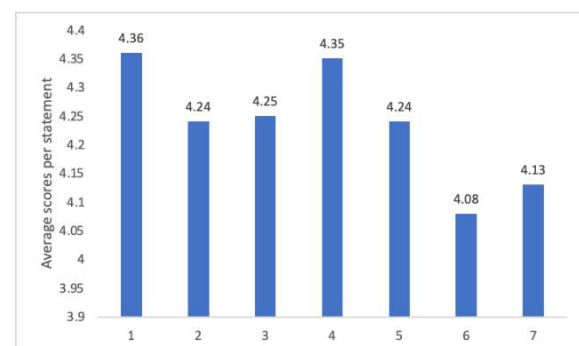
with an overall mean knowledge score of 3.08 ($SD = 1.08$) (Table 4).

Table 4: Level of Knowledge about Ergonomics Posture

Level	N	(%)
Poor (6-12)	41	12.2
Average (13-23)	214	63.9
High (≥ 24)	80	23.9
Mean = 3.08; SD = 1.08		

The level of awareness about ergonomic postures

The awareness of ergonomics posture among the participants was rated based on items as shown in Figure 2. The result showed that the working population in Klang Valley has a high level of awareness of ergonomic posture with an overall mean awareness score of 4.24 ($SD = 0.79$). Most participants agreed inappropriate way of lifting can result in back pain ($M = 4.36$; $SD = 0.72$). Comparably, participants were aware of fatigue caused by discomfort in body position between the chairs and desks and incorrect position between eyes and computers ($M = 4.25$; $SD = 0.73$) and ($M = 4.35$; $SD = 0.71$). Most participants agreed that fatigue caused by lighting in the workplace is either too low or insufficient, like uncomfortable chairs and tables, noisy and poor air conditioning systems can reduce productivity and quality of their work.



The relationship between gender, educational level, and work experience with knowledge of ergonomic posture

Table 5 presents cross-tabulation results between sociodemographic characteristics and the respondents' level of ergonomics posture knowledge. Data suggest that females ($\chi^2 = 8.810$; $p = 0.012$) and/or higher education levels ($\chi^2 = 19.209$; $p = 0.004$) were significantly related to the higher level of knowledge. Thus demographic characteristics can determine their level of knowledge about ergonomic posture. However, no significant relationship was found between respondents' working hours and level of knowledge about ergonomic posture.

Table 5: The relationship between gender, educational level, and work experience with knowledge of ergonomic posture.

Variables	Level of Knowledge of Ergonomics Posture		
	High N (%)	Average N (%)	Poor N (%)
Gender			
Male	50 (62.5)	93 (43.5)	22 (53.7)
Female	30 (37.5)	121 (56.5)	19 (46.3)
χ^2 (df) = 8.810 (2); p-value = 0.012			
Educational Level			
High school	21 (26.3)	34 (15.9)	14 (34.1)
Pre-University	16 (20.0)	46 (21.5)	14 (34.1)
Undergraduate	22 (27.5)	82 (38.3)	11 (26.8)
Graduate	21 (26.3)	52 (24.3)	2 (4.9)
χ^2 (df) = 19.209 (6); p-value = 0.004			
Work Experience			
1 – 5 years	34 (42.5)	97 (45.3)	16 (39.0)
6 – 10 years	19 (23.8)	44 (20.6)	9 (22.0)
11 – 15 years	16 (20.0)	31 (14.5)	4 (9.8)
≥ 16 years	11 (13.8)	42 (19.6)	12 (29.3)
χ^2 (df) = 6.097 (6); p-value = 0.412			

The relationship between gender, educational level, and work experience with the level of awareness of ergonomics posture

Table 6 summarizes the result of the cross-tabulation analysis among sociodemographic characteristics and participants' awareness of ergonomics posture. None of the respondents possessed a poor level of awareness about ergonomic posture regardless of their gender, educational status, and working experience. Nonetheless, the Pearson Chi-Square test revealed no significant relationship between the variables and the level of awareness about ergonomic posture.

Table 6: The relationship between gender, educational level, and work experience with awareness of ergonomic posture.

Variables	Level of Awareness of Ergonomics Posture
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	High N (%)	Average N (%)	Poor N (%)
Gender			
Male	132 (51.8)	33 (41.3)	0
Female	123 (48.2)	47 (58.8)	0
χ^2 (df) = 2.694 (1); p-value = 0.101			
Educational Level			
High school	52 (20.4)	17 (21.3)	0
Pre-University	55 (21.6)	21 (26.3)	0
Undergraduate	93 (36.5)	22 (27.5)	0
Graduate	55 (21.6)	20 (25.0)	0
χ^2 (df) = 2.358 (3); p-value = 0.502			
Work Experience			
1 – 5 years	115 (45.1)	32 (40.0)	0
6 – 10 years	55 (21.6)	17 (21.3)	0
11 – 15 years	41 (16.1)	10 (12.5)	0
≥ 16 years	44 (17.3)	21 (26.3)	0
χ^2 (df) = 3.415 (3); p-value = 0.332			

The relationship between gender, BMI, level of knowledge, and awareness of ergonomics posture with the prevalence of MSDs

Table 7 shows that the prevalence of occupational MSDs was high among male participants compared to female respondents ($p < 0.05$). Similarly, there was a significant difference in the prevalence of occupational MSDs among BMI groups of the participants.

There was a significant relationship between the level of knowledge and awareness about ergonomics posture and the prevalence of MSD in at least one body part ($p < 0.05$)

Table 7: The relationship between gender, BMI, level of knowledge, and awareness of ergonomics posture with the prevalence of MSDs.

Variables	Prevalence of Occupational MSDs		χ^2 (df)	p-value
	Present N (%)	Not Present N (%)		
Gender				
Male	71 (58.2)	94 (44.1)	6.140 (1)	0.013
Female	51 (41.8)	119 (55.9)		
BMI				
Underweight	37 (30.3)	42 (19.7)	26.249 (3)	0.000
Normal	21 (17.2)	81 (38.0)		
Overweight	45 (36.9)	41 (19.2)		
Obese	19 (15.6)	49 (23.0)		
Knowledge				
Poor	21 (10.7)	20 (14.4)	9.757 (2)	0.008
Average	82 (67.2)	132 (62.0)		
High	19 (15.6)	61 (28.6)		

Awareness				
Poor			12.234	0.000
Average	16 (13.1)	64 (30.0)	(1)	
High	106 (86.9)	149 (70.0)		

4. DISCUSSION

Ergonomics ensures all types of equipment and tasks that could impose work hazards such as workstation settings and design, and workers' posture fit each person to reduce physiological stress (Jaafar et al., 2021). An office worker usually works at a computer for an idle long time which requires prolonged static sitting, repetitive motions of hands and wrist, and prolonged glare on screen (Bisht & Bakhshi, 2018). A recent study by Emerson et al. (2021) added that old, malfunctioning, non-adjustable, and ill-fitting equipment could also take a toll on a worker's well-being and health.

The study found that ergonomic posture knowledge among most office workers is average, while awareness is high among those in Klang Valley. This is consistent with previous literature, such as those by Jaafar et al. (2019) and Jaafar et al. (2021). The average level of knowledge may be attributed to factors such as limited employer involvement in promoting ergonomic practices as less than one-third of office workers claimed to see the ergonomics word on posters/notice boards at their workplace. Most office workers claimed to know and understand ergonomics through attending ergonomics discussions, reading, and listening to media. This indicates when employees were allowed to participate in discussions or workshops on ergonomics, they were able to enhance their knowledge levels. Participatory ergonomic interventions, such as in the study of Capadoglio (2022), increased knowledge and awareness of workers' safety, thus reducing the risk of occupational MSDs.

There was also a significant difference in knowledge between demographic variables, with the female gender having better knowledge regarding ergonomics. This result agreed with a study by Kritika et al. (2014) which stated that females are higher at risk of developing MSDs thus they are more cautious than males. Also, higher education levels are positively associated with higher knowledge of ergonomics. However, Sirat et al. (2018) strongly stated education level did not have to do with ergonomics awareness as it was just the level of formal education such as mathematics, science, physics, and other formal subjects. Therefore, the conclusion can be drawn here is a large proportion of participants are from the Undergraduate and Postgraduate level, therefore a significant value was obtained from the data. A study with a larger difference in education level would help determine the reliability of the association found in this study.

Furthermore, there was no positive association between sociodemographic data (gender, education level, working

experience) and ergonomics awareness which is consistent with Sirat et al. (2018).

This study found that over one-third of office workers reported occupational musculoskeletal disorders (MSDs) in at least one body region over the last 12 months. This highlights the prevalence of MSDs among the study group, suggesting a link between the prevalence of MSDs and the high level of awareness exhibited by office workers. Despite the high level of awareness about ergonomic posture principles, a considerable number of office workers still experience musculoskeletal issues. This highlights the importance of effective implementation of ergonomic practices to reduce occupational MSDs among office workers.

The most common body parts found to be affected in occupational MSDs were the shoulders, wrist, neck, upper back, and lower back. Previous literature on the topic suggests that these areas are commonly susceptible to MSDs in office work settings (Russo et al., 2020; Singh et al., 2018). Studies have found that the highest prevalence of MSDs occurs in the lower back, ankle/feet, neck, and shoulders, followed by the lower limb among Italian workers (Russo et al., 2020). Noorozi et al. (2014) also found the highest frequency of occupational MSDs in the back and neck regions. Low back pain ranks as the most frequent condition in years lived with disability caused by occupational MSDs (Hoy et al., 2014).

The study explored the association of the prevalence of occupational MSDs in at least one body part among office workers in Klang Valley with sociodemographic characteristics. The major risks for MSDs were female gender and BMI. Occupational MSDs are higher reported among women, especially in European countries (Farioli et al., 2014). BMI increases the risk of occupational MSDs, with obese and overweight workers being more susceptible to developing them compared to normal-weight workers. The study data also corresponds with Krishnan et al.'s (2021) study on the prevalence and risk factors of MSDs across body parts among nurses which concluded that the frequency of having MSDs at any part of the body increases with age, female gender, high BMI, and job tenure. Furthermore, Shariat et al. (2018) also found a significant association between the prevalence of occupational MSDs across body parts with age, gender, and BMI in a study among Malaysian office workers in Klang Valley.

The study found that higher ergonomic posture knowledge and awareness significantly reduce the prevalence of occupational musculoskeletal disorders (MSDs) in at least one body part. This is consistent with previous studies demonstrating the importance of empowering employees with the right knowledge to promote ergonomic practices and enhance preventive behaviour (Aulianingrum & Hendra, 2022; Damanhuri et al., 2014; Sohrabi & Babamiri, 2021). Studies have shown that implementing ergonomic interventions is effective in reducing MSD prevalence,

especially in the neck and upper limbs. Additionally, a systematic review by Aulianingrum & Hendra (2022) found that workers with poor knowledge of ergonomics have a higher risk of developing MSDs. This finding is consistent with Damanhuri et al. (2014) findings at Putra University Malaysia (UPM), which found a significant relationship between knowledge of ergonomics posture and complaints of MSDs. Almost half of workers with MSDs complaints have a poor knowledge of ergonomics posture while the majority of workers with MSDs complaints did not go for ergonomics training at the workplace. Employers can create a healthier and more productive work environment that minimizes the risk of MSDs and related health issues by providing the employees with the right knowledge and promoting ergonomic practices.

There are several limitations in this study. First, this study population was specifically office workers from Klang Valley. Moreover, this study was done fully online, so researchers cannot determine external bias. Furthermore, the data collection of MSDs symptoms relied on self-reported data from the respondents. Other than that, this study did not delve deeper into specific risk factors to address MSDs prevalence such as working conditions, work-related activities, and disability arising from MSDs symptoms among office workers. Addressing these risk factors could help employers to address the root causes of absenteeism and pain among office workers.

5. CONCLUSION

The survey results showed that only an average level of knowledge about ergonomics posture was possessed by the office workers. One of the factors that contributed to the average level of knowledge was said to be lack of employers' role to promote ergonomics posture in the workplace. Females showed a higher knowledge level of ergonomics posture while a higher education level was associated with a higher level of ergonomic posture. On the other hand, the level of awareness about ergonomics posture was found to be high despite the average level of knowledge which means office workers are concerned with the effect of not practicing ergonomics despite lack of knowledge about the ergonomics posture. Meanwhile, the office workers reported a prevalence of MSDs with primarily reported pain in the shoulders, wrist, neck, upper back, and lower back. Additionally, the result from this study demonstrated a significant positive association between knowledge and awareness of ergonomic posture and the prevalence of MSDs among office workers. Hence, the employers and the policymakers should play their respective roles to leverage office workers' knowledge maximally and efficiently as well as provide safe and healthier workstations and designs for the workers. For instance, employers can begin by including ergonomics training and education program which have been proven effective in increasing workers' ergonomic knowledge and awareness besides reducing the risk of MSDs.

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RESEARCH ARTICLE

Single-centre analysis of common intracranial pathologies among emergency patients using head CT

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Abstract:

Head Computed Tomography (CT) is an essential diagnostic imaging tool for detecting intracranial pathologies. Given the association of CT scans with ionizing radiation, it is crucial to implement appropriate safety measures. CT scan requests should be well justified to avoid unnecessary procedures that could lead to adverse patient effects. This study evaluates the prevalence of common intracranial pathologies and assesses the relationship between clinical indications and CT findings among emergency department patients. A total of 177 radiological CT reports from the emergency department between October and December 2022 were reviewed. Variables including age, gender, clinical indications, and radiological findings were recorded. Statistical analysis was performed using SPSS, with the chi-square test used to assess relationships ($\alpha < 0.05$). Out of the 177 CT reports, 61% were male, and 39% were female, with a mean age of 61 ± 20 years. Normal findings were reported in 55.4% of the studies. The most common abnormal finding was ischemic infarcts, present in 15.3% of reports. There was no statistically significant relationship between CT findings and clinical indications. Most CT studies requested in the emergency department revealed normal findings. Understanding the prevalence of common intracranial findings and their clinical correlations can improve patient management strategies.

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Keywords: Computed tomography, emergency department, intracranial pathologies.

1. INTRODUCTION

Computed tomography (CT) is a significant diagnostic imaging tool as the demanding environment in the emergency department requires the physicians to ensure they come up with accurate diagnostic tests and detailed images to visualize any injuries or pathologies to decide on the management of the patient. (Azman et al., 2019). According to Bellolio et al. (2017), among the identified patients presenting at the emergency department (ED) 17.8% had a CT scan associated with the visit. The ED is responsible for 9% of neurological diseases, and most patients require immediate care and treatment and are potentially fatal. (Mohamed Sheikh Hassan et al., 2023). All types of cerebral haemorrhage, fractures, brain oedema, herniations, and other associated injuries including foreign bodies can be evaluated by head CT scan. (Parizel & Philips, 2020). Common intracranial pathologies that may be identified via CT include cerebral haemorrhage, ischemic infarcts, skull fractures, and brain edema, each of which can pose potentially life-threatening risks if left untreated

Despite the undeniable benefits of CT in diagnosing intracranial pathologies, its widespread use in the ED has

raised concerns about overutilization and the associated risks of ionizing radiation (Mohammaddoust et al., 2020). CT scans expose patients to significant levels of radiation, which, when not justified, can lead to unnecessary health risks. This concern is amplified when considering the frequent use of CT in non-life-threatening cases, which could be managed with alternative diagnostic approaches. (Bellolio et al., 2017). However, these can be avoided if the physicians had taken a complete history and performed a thorough physical examination on the patients. (Nishtar et al., 2019). Guidelines exist to aid in decision-making about when to perform a CT, yet studies have indicated that these guidelines are not always adhered to, leading to a high number of unnecessary scans (Zahabi et al., 2020).

In the context of intracranial pathologies, the ability of CT to accurately correlate with clinical presentations remains a critical issue. For example, while ischemic strokes or haemorrhages may present with clear neurological deficits, other conditions such as headaches, dizziness, or amnesia may not always result in significant findings on imaging. This discrepancy underscores the need to assess the prevalence of common CT-diagnosed pathologies in the ED and the clinical indications prompting these requests.

Furthermore, understanding the correlation between clinical symptoms and CT findings is crucial for improving patient management strategies. By identifying patterns in which clinical presentations align or fail to align with significant imaging findings, clinicians can refine their decision-making processes, ensuring that CT is reserved for cases where it is truly warranted. This not only reduces patient exposure to unnecessary radiation but also helps in managing ED resources more efficiently.

The aim of this study is to evaluate the prevalence of common intracranial pathologies detected by head CT in an emergency setting and to assess the relationship between clinical indications and CT findings. Given the increasing reliance on CT in the ED, understanding these relationships can help improve diagnostic accuracy, optimize resource allocation, and ultimately enhance patient outcomes.

2. MATERIALS AND METHODS

2.1 Study design

A retrospective observational study was done on adult patients referred to the emergency department of Hospital Al-Sultan Abdullah (HASA), UiTM Puncak Alam and received a head CT scan within three months from initial presentation to the department from October 2022 to December 2022. Patient information such as age, gender, medical history, reasons for receiving a head CT scan, and intracranial findings are collected in this study. Clinical indications were divided into several categories: acute focal neurological deficit, altered level of consciousness, amnesia, headache, instability/dizziness, psychiatric symptoms, seizure disorder, and trauma. All the relevant patient data are retrieved from the Picture archiving and communication system (PACS).

2.2 Data Analysis

All the collected data were summarized in a table in Microsoft Excel 2022 and the data were analysed using the Statistical Package for the Social Science (SPSS) software version 28.0.0. To describe the frequency and percentage of age, gender and common clinical indications and intracranial findings as revealed by head CT scan, descriptive analysis was used. Besides that, the Chi-square test was used to calculate the significant relationship between clinical indications and intracranial findings. The p-value was set at <0.05 to evaluate whether there is a significant relationship between clinical indications and intracranial findings. All outcomes of the data analysis were presented in table forms.

2.3 Ethical Consideration

Ethical approval was obtained from Faculty Ethics Research Committee (FREC) of Faculty of Health Sciences, UiTM (FERC/FSK/MR/2023/00089). All collected patient data and information were maintained by anonymization of the collected data.

3. RESULTS AND DISCUSSION

3.1. Demographics

A total of 177 patients' head CT request forms and radiological reports were included in this study. The mean age of the patients presented at the emergency department and received a head CT scan was 61 ± 20 years. Most of the cases (N = 101) were those aged 61 years and above (57.1%), followed by (N = 43), were in the age group of 41-60 years (24.3%), and the least (N = 33) within the age group of 18-40 years old (18.6%). The majority (N =108) of cases were males (61.0%) compared to (N = 69) females (39.0%). The frequency and percentage of the demographic characteristic distributions were presented in Table 1.

Table 1. Frequency and percentage of demographic characteristic distributions

	Frequency	Percentage (%)
Age		
18 – 40 years	33	18.6
41 – 60 years	43	24.3
≥ 61 years	101	57.1
Total	177	100.0
Gender		
Male	108	61.0
Female	69	39.0
Total	177	100.0

The common intracranial findings as revealed by head CT scan among patients presented at the emergency department had no significant abnormality, with 55.4% (N=98) cases reported normal despite patients coming into the emergency department with various complaints. Based on the abnormal findings of head CT scan among patients presented at the emergency department, the most common abnormal findings were ischemic infarcts, 15.3% (N=27). Haemorrhage accounted for 11.4% (N= 20) of the total cases, with the majority of subdural haemorrhage 4.5% (N= 8), and the least was subarachnoid haemorrhage 1.1% (N=2). Besides that, other intracranial CT head findings include the fracture of the skull, facial or nasal bone at 6.1% (N= 11), cerebral atrophy at 4.5% (N = 8), followed by hydrocephalus at 3.4% (N = 6). Both cerebral oedema and sinusitis each accounted for 1.7% out of the total cases (N = 3), The least cases were encephalomalacia, with 0.6% (N=1). The frequency and percentage of common intracranial findings are presented in Table 2, arranged in descending order of prevalence. Most patients had normal CT findings (55.4%), followed by ischemic infarcts (15.3%) and haemorrhage (11.3%). This high frequency of normal findings raises critical questions about the appropriateness of CT scan utilization in the ED and underscores the need for more stringent adherence to clinical guidelines for imaging requests.

Table 2. Frequency and percentage of common intracranial CT findings

Intracranial CT findings	Frequency	Percentage (%)
Normal brain CT	98	55.4
Ischemic infarcts	27	15.3
Haemorrhage		
Subdural	8	4.5
Intracerebral	6	3.4
Epidural	4	2.3
Subarachnoid	2	1.1
Fracture	11	6.1
Cerebral atrophy	8	4.5
Hydrocephalus	6	3.4
Sinusitis	3	1.7
Cerebral oedema	3	1.7
Encephalomalacia	1	0.6
Total	177	100.0

In this study, a Chi-square test (with $\alpha < 0.05$) was used to evaluate whether the CT findings have a significant relationship with each clinical indication. There was no statistically significant relationship between CT finding status and each clinical indication. The association between each clinical indications and CT findings status were presented in Table 3.

Table 3. The association between each clinical indications and CT findings status

	Abnormal findings, N (%)	Normal findings N (%)	χ^2 statistics (df)	p-value
Acute focal neurological deficit	24 (30.38%)	24 (24.49%)	0.768 (1)	0.381
Altered LOC	8 (10.13%)	15 (15.31%)	1.038 (1)	0.308
Amnesia	0 (0.0%)	2 (2.04%)	1.631 (1)	0.202
Headache	7 (8.86%)	8 (8.16%)	0.027 (1)	0.868
Instability/ Dizziness	3 (3.80%)	11 (11.22%)	3.312 (1)	0.069
Psychiatric symptoms	1 (1.27%)	4 (4.08%)	1.263 (1)	0.261
Seizures	6 (7.59%)	8 (8.16%)	0.019 (1)	0.889
Trauma	30 (37.97%)	26 (26.53%)	2.649 (1)	0.104

3.2. Common intracranial CT findings and indications

Most of the intracranial pathologies cases as revealed by head CT had no significant abnormality despite having positive clinical indications to perform the head CT scan. The high number of normal findings with no significant abnormalities despite patients presented at the emergency department with various complaints including headache, history of seizures and minor trauma demonstrates the misuse of the head CT scan among emergency cases. (Nishtar et al., 2019). This may be a consequence of the increased number of patients, insufficient healthcare team, the wide availability of the CT scan, and clinical diagnosis uncertainty by a few physicians in the emergency department. (Nishtar et al., 2019).

Similarly, the study carried out by Ferro et al., (2022), in Pontevedra, Spain which also showed that a significant portion of the examinations had normal scan, is what leads to the excessive use of head CT scan in the emergency department. According to Ferro et al., (2022), the reason for this may be partly due to the well-known fact that the emergency departments are overcrowded, or the trend towards defensive medicine that has emerged in response to the increased patient complaints, the widespread availability of imaging tests in hospitals, and to the recent increase in demand for emergency scans, particularly of the head which has caused the radiology departments to be overcrowded.

Another factor that explains absence of significant abnormalities on head CT findings despite multiple symptoms is because of the CT scan timing. (Schellenberg et al., 2020). The appearance of certain pathologies may not immediately be visible on a CT scan especially in the early phases of development even if the patients had experienced the symptoms of the disease. (Seidel et al., 2019). For instance, brain swelling abnormalities will only be visible on CT with increasing oedema which typically appearing in the next 24 to 48 hours of initial trauma. (Lolli et al., 2016). This results in patient being discharged from the department with no significant abnormalities although the referred clinical indication was appropriate for a head CT.

Nonetheless, it is crucial to keep in mind that even with high number of normal cases, it does not necessarily imply that continued medical attention is not necessary. (Seidel et al., 2019). While a CT scan may not detect some pathologies, other imaging modalities may still help make observations about such pathologies. (Hussain et al., 2022).

For that reason, in this study, the common abnormal intracranial findings as detected by head CT scan among patients presented at the emergency department were ischemic infarcts. In Malaysia, the cases of ischemic infarcts showed a rising trend in 2019 and have become among the leading cause of mortality in Malaysia. (Tan & Venketasubramanian, 2022). A significant number of ischemic infarct cases shown in this study is due to the reason a head CT scan has a high sensitivity in detecting

ischemic infarcts, especially within the first few hours of stroke. (Shafaat & Sotoudeh, 2020).

Intracranial haemorrhage was the most often observed head CT finding in this investigation. Intracranial haemorrhage is a common intracranial pathology among emergency cases due to the history of blunt trauma from a hard material, motor-vehicle-accident (MVA), or sudden onset of stroke symptoms such as headache or focal neurological deficits. (Tenny & Thorell, 2020). The rapid diagnosis that is achievable by CT scans is crucial in deciding the most appropriate treatments for intracranial haemorrhage. (Patel & De Jesus, 2021). The increased rate of haemorrhage in the older group results from the population's weakened blood vessels and balance disorder, while in the younger group is due to the population's involvement in severe events. (Nesselroth et al., 2021).

The most prevailing clinical indication among the patients presented at the emergency department was trauma. Intracranial pathologies can significantly be influenced by traumatic injuries. (National Institute of Neurological Disorders and Stroke, 2023). An immediate head CT scan is necessary to determine the severity of the injury, identify any skull fractures, and assess for intracranial hemorrhages following the traumatic event. (Parizel & Philips, 2020).

Trauma clinical indications is more common in the male population because they are more involved in outdoor activities which increases the risk of head injury. (Patel et al., 2019). Furthermore, certain occupations or activities that require physical effort or exposing individuals to dangers may increase the likelihood of traumatic injuries. (World Health Organization, 2023).

This result corresponds to a study by Nishtar et al., (2019), many patients with positive head CT findings were clinically indicated related to significant trauma such as motor-vehicle-accident (MVA), falls, or physical blows to the head while patients with suspected stroke presented with weakness, amnesia, loss of consciousness with or without focal neurological deficit and had significant abnormalities. In a study by Seidel et al., (2019), positive pathological findings, such as soft tissue damage, fracture, and cerebral haemorrhage, were found in patients who had been referred for an emergency head CT scan for histories of trauma.

The NICE guidelines have stated that a head CT scan should only be performed for those who have suffered severe head injuries and have developed risk factors. (Rawoo, 2018). For traumatic brain injury patients in the emergency room, guidelines such as the Canadian CT Head Rule (CCHR) and the New Orleans Criteria (NOC) are widely recognized. (Ferro et al., 2022).

In this current study, it was found that there was no statistically significant relationship between CT findings and every each of the clinical indications. As most of the CT findings had no significant abnormality, the most common clinical indication was trauma. The small number of

abnormal findings although the clinical indications are rather common can be a target in devising the utilization of the existing clinical guidelines. (Nesselroth et al., 2021). The variability of various clinical presentations may be the reason for the absence of significant relationships, suggesting that CT results may not always correlate with indications due to underlying complexity in disease processes or other reasons. (Balogh et al., 2019). This broad spectrum of underlying symptoms may not directly reveal any relationship between the CT findings and clinical indications. Moreover, certain indication such as syncope or dizziness may not reveal any significant abnormalities in the absence of focal neurological deficit. (Covino et al., 2019).

Nevertheless, the result of the relationship between CT findings and clinical indications in this current study contrasts with the study by Ugwuanyi et al., (2020) in which in that study, has found a statistically significant relationship between the clinical indication and brain CT findings. Ugwuanyi et al., (2020) stated that there was justification for the CT requests because the main complaints are headaches although most of the findings were normal, which is usually the case.

This study has limitations in terms of the nature of the study being retrospective with results from a single centre which only focuses on a specific geographic area. Hence, the findings in this study do not accurately reflect the population. Furthermore, this study could not evaluate the prevalence of abnormal findings in the paediatric population since the population is not included in this study. Besides that, with the limited sample size in this study, the result must be carefully interpreted to assess the associations in several comparisons.

4. CONCLUSION

Most cases in this study population from the emergency department and received a head CT scan were among those in the elderly group. When comparing the two genders, this study found that males from the emergency department were more likely to undergo a head CT scan for a variety of clinical indications compared to females. Many cases revealed no significant abnormalities despite most of them presenting at the emergency department with a various clinical indication before performing a head CT scan. However, although more than half of this study population revealed normal head CT findings, ischemic infarct and intracranial haemorrhage were the typical abnormal head CT findings. This study demonstrated no statistically significant relationship between the head CT findings and the clinical indications.

Results from multi-centres in several different geographic locations could be suggested to achieve a more diverse and representative sample size. As a result, the study's validity can be strengthened, and the findings made more generalizable. Moreover, the paediatric population could also be included to assess the aberrant findings in the paediatric

population. The study can be designed to incorporate a sufficient paediatric population to accurately assess the prevalence of abnormal findings in the paediatric population.

ACKNOWLEDGEMENTS

Highest gratitude to all parties who directly or indirectly involve in this research study.

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RESEARCH ARTICLE

The effectiveness of breast lead shielding on scattered radiation in lumbar spine radiography: a phantom study

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Abstract:

This study evaluates the effectiveness of breast lead shielding in reducing scattered radiation in lumbar spine radiography. Using an anthropomorphic phantom model, an experimental study simulating anteroposterior (AP) and lateral lumbar spine radiography was performed with and without breast shielding. The scattered radiation doses were measured using Radcal ACCU-PRO dosimeter. Significant reductions in scattered radiation dose (42%- 49% reduction) were observed in both AP and lateral projections with the use of breast lead shielding as compared to without shielding ($p < 0.001$). These findings suggest that breast lead shielding effectively reduces radiation exposure in lumbar spine radiography. The study highlights the importance of using breast shielding to protect patients from scattered radiation. Further research should explore the long-term benefits of shielding, its application in other radiographic procedures and potential advancement in shielding materials and technique.

Keywords: Breast shielding, lumbar spine radiography, scattered radiation

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1. INTRODUCTION

X-rays possess intrinsic energy that may be imparted to the matter they interact with. Radiation exposure has three main sources: primary x-rays (the main exposure with the highest dose), scattered radiation, and radiation leakage (Park et al., 2022). Scattered radiation is produced when x-ray photons lose energy due to Compton interactions with objects. This type of radiation primarily arises when ionizing radiation strikes a patient and reflects off the body or tabletop. Scattered x-rays deposit less energy in tissues compared to primary x-rays, as they lose energy during the scattering process (Frane et al., 2023).

The amount of scattered radiation exposure increases as the distance from the x-ray source decreases, following the inverse square law (Frane et al., 2023). Higher primary x-ray doses result in greater scattered radiation doses. The intensity of scatter is influenced by factors like x-ray tube voltage (kVp) and patient thickness. Thicker body parts, which are harder to penetrate, require higher radiation doses to produce clear images, leading to more scattered radiation (Shing et al., 2023). For example, obese patients receive higher radiation doses than thinner patients, even when imaging the same region, due to increased primary and scattered radiation (Park et al., 2022).

Lumbar spine radiography is a standard 2D imaging technique that visualizes bone and soft tissue in the spine, aiding in

diagnosing and treating spine-related diseases (Chen et al., 2022). This procedure exposes patients to high radiation doses, reaching up to 1.5 mSv, due to the dense anatomical region requiring strong x-rays to penetrate pelvic bones (Lai et al., 2020). A study by Hamid et al. (2020) found that the highest radiation doses were recorded in the pelvis and lumbosacral spine, with average entrance skin doses (ESD) of 7.4 and 6.3 mGy, respectively, compared to other body regions.

High radiation exposure is a significant concern for patients with chronic conditions, such as scoliosis, that require frequent imaging (Lai et al., 2020). Adolescent idiopathic scoliosis (AIS) patients undergo repeated whole-spine radiographs throughout their diagnosis and treatment, resulting in cumulative radiation exposure. A study by Luan et al. (2021) found that AIS patients received an average of 16 whole-spine radiographs, with each radiograph delivering a dose of 0.8–1.4 mSv, leading to an annual dose of 2.4–5.6 mSv.

Ionizing radiation in medical imaging can cause deterministic and stochastic effects, which are harmful side effects (Sidi et al., 2020). Lumbar spine x-rays are particularly concerning due to the high radiation dose and exposure of nearby radiosensitive organs, like the breast (Park et al., 2022). Breast shielding is crucial in lumbar spine imaging to reduce the risks posed by scattered radiation. This research investigates the

effectiveness of breast lead shielding in reducing scattered radiation during lumbar spine radiography. Scattered radiation from lumbar spine radiography poses a risk to radiosensitive organs like breast tissue, potentially increasing radiation-induced damage (Shing et al., 2023). This study uses a phantom model to simulate human tissue and measure the effects of breast shielding on scattered radiation in lumbar spine radiography. The study provides quantitative data on the effectiveness of breast lead shielding, offering insights into its practical application in clinical settings and contributing to the ongoing debate on radiation protection. Scattered radiation in lumbar spine radiography is particularly concerning due to the thick body region involved. Studies have shown that the breast, a radiosensitive organ, receives significant doses from scattered radiation during lumbar spine radiography (Eyisi et al., 2021). The use of breast shielding can mitigate these doses, as evidenced by research indicating substantial dose reductions with shielding (Davies et al., 2020). Moreover, systematic reviews have highlighted the long-term health risks of cumulative radiation exposure, further justifying the need for effective shielding practices (Luan et al., 2021).

2. MATERIALS AND METHODS

2.1 Ethical clearance

Due to the nature of experimental study, this study was exempted from ethics review by the Faculty Ethics Review Committee (FERC) with reference number FERC/FSK/EM/2024/00006.

2.2 Experiment procedure

An anthropomorphic phantom is used in this experiment to imitate a human being in a natural clinical setting. The anthropomorphic phantom used was the whole-body phantom PBU-50 which was made from Kyoto, Japan. The phantom material has radiology absorption and Hounsfield number approximate to human body. The soft tissue and organs are made from urethane-based resin while the synthetic bones are made from epoxy resin. The joint attachments in the phantom are made of epoxy and urethane with carbon fiber. The phantom is free from metal as the screws were made from polycarbonate. The material consists of water and SZ-50 with density, effective atomic number and electron density of 1.000 and 1.061, 7.417 and 6.14, 3.343 and 3.258, respectively. The phantom size is approximately 165 cm in height and 50 kg in weight. In addition, to mimic breast tissue on the phantom, a pair of breast implants filled with saline water is utilized and placed within the second and sixth ribs with the medial margin parallel to the sternum's edge (Elshami et al. 2020).

An anthropomorphic phantom was positioned for lumbar spine radiography. Dosimeters were placed at the breast region to measure scattered radiation dose accurately. Radiographs of the lumbar spine were taken in both the anteroposterior (AP) and lateral projections, with and without breast shielding. For consistency, the same imaging parameters were used in both scenarios as shown in Figure 1.



(a)



(b)

Figure 1: The anthropomorphic phantom displaying dosimeter placement underneath breast implant for AP lumbar projection (a) without breast shielding and (b) with shielding

2.3 Dose measurement

The measurement of radiation dose rate was made using Radcal ACCU-PRO dosimeter that with 10x6-6 general purpose ion chamber (Figure 2). The ion chamber has rate specifications of 20 nGy/s – 149 mGy/s with exposure and cine specifications of 100nGy – 516 Gy and 1 nGy/fr – 10

mGy/f, respectively. The auto dose threshold is 19 μ Gy/s with calibration accuracy of $\pm 4\%$ using x-rays @ 60 kVp & 2.8 mm Al HVL. The ion chamber has exposure rate dependence of $\pm 5\%$, 0.4 mR/s to 80 R/s, up to 500 R/s for 50 us pulses and energy dependence of $\pm 5\%$, 30 keV to 1.33 MeV (with build-up material). The ion chamber is a concentric cylinder with polycarbonate walls and electrode constructed with conductive graphite interior coating. The minimum field size is 25x38 mm with 0.05 kg weight and 6cm³ active volume. The dosimeter is positioned at the breast region. The dosimeter provided precise measurements of the scattered radiation dose received by the breasts. Five readings were taken for each condition (with and without shielding), and the mean dose value was calculated to ensure accuracy.



Figure 2: Radcal ACCU-PRO dosimeter

2.4 Statistical analysis

Statistical analysis was conducted to compare the scattered radiation doses between the shielded and unshielded phantoms using SPSS version 28. Paired-sample t-test was employed to compare that scattered radiation dose for the two projections without and with breast shielding with $p < 0.05$ was considered statistically significant.

3. RESULTS AND DISCUSSION

3.1 Scattered radiation dose

The study found that breast lead shielding significantly reduced the scattered radiation dose to the breasts during lumbar spine radiography. For the AP projection, the mean dose rate without shielding was 1.23 mGy/h, while with shielding, it reduced to 0.68 mGy/h. Similarly, for the lateral projection, the dose rate decreased from 2.15 mGy/h without shielding to 1.02 mGy/h with shielding. These results indicate that breast shielding effectively reduces scattered radiation exposure.

Table 1. Dose comparison for both left and right breast with the presence of shielding and without shielding

Projection	Radiosensitive organ	Presence of shielding	Mean dose (mGy/h)	p- value
AP	Left breast	No	17.61 $\pm$ 0.52	< 0.001
		Yes	9.55 $\pm$ 0.18	
AP	Right breast	No	17.23 $\pm$ 0.53	< 0.001
		Yes	9.56 $\pm$ 0.15	
Lateral	Left breast	No	16.06 $\pm$ 0.32	< 0.001
		Yes	9.34 $\pm$ 0.11	
Lateral	Right breast	No	18.93 $\pm$ 0.22	< 0.001
		Yes	9.66 $\pm$ 0.04	

According to the result obtained from this experimental study on the measurement of dose rate on the breast area, there is indeed scattered radiation dose on the breast during lumbar spine radiography procedure. This could be proven by comparing the value of radiation dose rate on the breast area in both projections (AP and lateral) for both conditions without breast shielding and with breast shielding. There were differences in the dose rate value pattern for both conditions as the radiation dose was reduced after the implementation of lead breast shielding.

This study has demonstrated that there was a significant dose reduction to the left breast and right breast in AP and lateral projection of lumbar spine radiography of the anthropomorphic phantom after the utilization of lead breast shielding, respectively. The significant dose reduction to the left and right breasts observed in this study during lumbar spine radiography using an anthropomorphic phantom can be clearly justified by the statistical analysis conducted. The dose rates were reduced for the left breast and for the right breast in the anteroposterior (AP) and lateral projections following the utilization of lead breast shielding. The finding is consistent with other previous studies. For instance, a study by Elshami et al. (2020) found that the use of breast shielding in cervical x-ray reduce the radiation by 99.9% on the breast. A similar study by Eyisi et al. (2021) showed that there was reduction on scatter radiation to the breast during lumbosacral x-ray which was lowest among the age group of 50-59 years old.

A prospective cross-sectional study from Enuke et al. (2021) which intent to quantify the amount of breast scatter radiation that occurs during a lumbosacral x-ray radiography among 60 women in various age and BMI groups indicated that there was evidence of scattered radiation to the breast during lumbosacral radiography as well according to the study with the age group of 50-59 years old had the lowest amount of scattered radiation. However, the study shown that there was no significant distinction in scattered radiation towards the

breast in lumbosacral x-ray between different projections of AP and lateral. Correspondingly, A. Peiro et al. (2021) discussed that patient radiation exposure might rise because of improper radiation shielding, particularly when an incorrect radiation field size has been employed and digital system capabilities are exploited. The study compared between conventional digital and clinically used field sizes which shown that the scattered dosage absorbed by the pelvis differed significantly. However, the primary dose differences did not change significantly (Peiro et al., 2021).

3.2 Application of breast shielding for scattered radiation dose reduction

In lumbar spine x-rays, scattered radiation can expose nearby radiosensitive organs like the breast, particularly in females, increasing cancer risk and potential genetic mutations in future generations. Radiation protection measures, like breast shielding, are widely used to minimize these risks. This experimental study demonstrates that using breast shielding effectively reduces scattered radiation exposure to the breast during lumbar spine radiography. The findings provide a practical approach for practitioners to limit radiation exposure to radiosensitive organs, confirming that breast lead shielding significantly lowers radiation doses to the breast area (Sidi et al., 2020).

This experimental study evaluates the effectiveness of breast shielding in reducing scattered radiation to the breast during lumbar spine radiography. The results confirm that using lead breast shielding reduces radiation doses to this radiosensitive organ with a range of 42% - 49% reduction, offering a practical dose-reduction strategy for protecting patients during x-ray exposure as shown in Table 2 and Table 3.

Table 2. Radiation dose rate in right and left breast during AP lumbar spine radiography

Part	Without Shielding	With Shielding	% dose reduction
	Dose rate (mGy/h)	Dose rate (mGy/h)	
Left breast	17.61 ± 0.52	9.55 ± 0.18	46%
Right breast	17.23 ± 0.53	9.56 ± 0.15	45%

Table 3. Radiation dose rate (mGy/h) in right and left breast during lateral lumbar spine radiography

Part	Without shielding	With shielding	% dose reduction
	Dose rate (mGy/h)	Dose rate (mGy/h)	
Left breast	16.06 ± 0.32	9.34 ± 0.11	42%
Right breast	18.93 ± 0.22	9.66 ± 0.04	49%

Elshami et al. (2020) highlighted the importance of shielding radiosensitive organs like the eyes and breast during cervical radiography to protect against scattered radiation. Their study showed that eye and breast shielding reduced radiation exposure by 91% and 89% for the eyes and 99.9% for the breast. Similarly, Sidi et al. (2020) demonstrated that breast shielding in lumbosacral x-rays reduced scattered radiation doses by 32.2%, with exposure ranging from 1.02 to 3.63 mGy. These findings emphasize the effectiveness of shielding in significantly lowering radiation doses to non-target organs.

Contrary to findings by Elshami et al. (2020) and Sidi et al. (2020), a study by Hurley et al. (2023) found that using lead shielding outside the field of view (FOV) did not significantly reduce the breast’s entrance surface dose (ESD) in various axial skeleton x-ray procedures. This study suggests that shielding areas outside the main ionizing source offers only minimal additional radiation protection for the breast ESD. The contrasting results from various studies may arise from differences in parameters, methods, and analyses. Specifically, the studies by Sidi et al. (2020) and Hurley et al. (2023) yield opposing findings due to their differing approaches: Sidi et al. conducted evaluations with real patients, while Hurley et al. used a phantom study. This discrepancy is attributed to the distinct scatter properties between real patients and phantoms. The current study aligns with the findings of Elshami et al. (2020) and Sidi et al. (2020), demonstrating that breast shielding in radiography can effectively reduce scattered radiation exposure to nearby radiosensitive organs.

These findings corroborate previous research that emphasises the importance of protective measures in radiographic procedures. This aligns with previous research advocating for protective measures to minimise radiation exposure to radiosensitive organs (Bushberg et al., 2012). The study also addresses the gap in literature regarding the application of breast shielding in lumbar spine radiography, providing valuable insights for clinical practice. The significant reduction in radiation dose with breast shielding underscores the importance of incorporating this practice into routine radiographic procedures to enhance patient safety. However, this study has limitations, including the use of a phantom model, which may not fully replicate human tissue characteristics.

4. CONCLUSION

The study confirms that breast lead shielding effectively reduces scattered radiation during lumbar spine radiography. These findings align with the study's objectives, providing strong evidence for the clinical implementation of breast

shielding to protect radiosensitive organs during x-ray imaging. Future research should explore the long-term benefits of shielding, its application in other radiographic procedures, and potential advancements in shielding materials and techniques.

ACKNOWLEDGEMENTS

The author of this study would like to thank the Medical Imaging Laboratory of UiTM Puncak Alam for their kind help in the completion of this study.

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RESEARCH ARTICLE

Understanding university students' recycling behaviours: An analysis using the Theory of Planned Behaviour

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Abstract:

This cross-sectional study aimed to elucidate the determinants of recycling behaviour among university students employing the Theory of Planned Behaviour (TPB) as the analytical framework. Of the 176 participants, 76% (n=134) reported engaging in recycling activities on campus. A significant association was observed between on-campus residency and recycling behaviour ($p=0.01$). No significant association were found between recycling habits and either the students' degree courses ($p=0.12$) or area of origin ($p=0.24$). Attitudes towards recycling emerged as a crucial predictor, with notable findings in the TPB constructs ($p<0.05$). Similarly, subjective norms, reflecting social pressures, also significantly influenced recycling intentions ($p<0.05$). Moreover, perceived behavioral control was also identified as a significant determinant of recycling behaviour among students ($p<0.05$). The study underscores the integral roles of attitudes, subjective norms, and perceived behavioral control in shaping recycling behaviour among university students. The significant link between residency status and recycling suggests that targeted educational and awareness programs could enhance recycling practices. These findings provide a foundation for universities to develop strategic interventions that foster sustainable behaviours, thereby contributing to environmental conservation efforts. In conclusion, the application of the TPB highlights the multifaceted nature of recycling behaviours, offering critical insights for promoting sustainability within academic institutions.

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Keywords: University student, Recycling behaviour, Theory of planned behaviour

1. INTRODUCTION

The escalation in global waste production is primarily driven by expanding populations, economic growth, increased consumption, and a prevailing culture of disposability (Liza et al., 2021). Despite a growing interest in recycling and its pivotal role in sustainable practices, there remains a notable paucity of academic research in this area (Abas, 2019). Universities, with their diverse populations engaged in resource-intensive activities, are regarded as influential communities within society. As hubs of innovation and education, universities are uniquely positioned to lead the way in promoting sustainable waste

management practices. By integrating comprehensive recycling programs and sustainability initiatives into their operations, universities can serve as exemplary models for broader societal change, fostering a culture of environmental responsibility and stewardship.

Developing countries, experiencing rapid population growth, urbanization, and industrialization, often face a significant increase in waste generation. This surge is driven by evolving consumption patterns, accelerated economic development, and insufficient waste management infrastructure. The recycling rates in these nations exhibit considerable variability, influenced by factors such as the

effectiveness of waste management policies, the availability of infrastructure, cultural attitudes towards recycling, and economic incentives. The interplay of these elements creates complex challenges for waste management in developing countries. Effective solutions require a multifaceted approach, encompassing policy reform, investment in infrastructure, public awareness campaigns, and economic incentives to encourage recycling. Addressing these issues is crucial for mitigating environmental impacts and promoting sustainable development in these rapidly evolving regions (Gupta et al., 2015).

In 2019, Malaysia produced over 360 tonnes of electronic waste (e-waste), with a mere 25% being effectively collected and recycled. This leaves a staggering 75% of e-waste untreated, posing significant environmental hazards due to potential heavy metal contamination of groundwater sources (The Star, 2022). The improper disposal of e-waste has long-term detrimental effects on environmental and public health. Malaysia's overall waste generation has been increasing, driven by factors such as population growth, urbanization, and economic development. The latest population estimates indicate that approximately 14 million tonnes of municipal solid waste were generated in 2021 (MHLG, 2015). Household waste constitutes the majority of municipal solid waste at 65%, followed by commercial and institutional waste at 28%, and industrial waste at 7% (GSR, 2012).

Recycling contamination, which occurs when materials are incorrectly sorted or improperly cleaned, leads to a decline in the quality of recycled goods (Rachelson, 2023). Workers in recycling facilities, particularly those handling hazardous substances, face significant health risks from exposure to harmful chemicals such as acids, cadmium, mercury, and lead. The damp environments characteristic of many recycling plants may further exacerbate these risks (Okeme & Arrandale, 2019). Proper sorting of recyclable materials at the household level is crucial to prevent contamination. This practice not only enhances the quality of recycled goods but also makes the sorting process at recycling facilities more efficient and safer. Encouraging accurate sorting at the source can significantly reduce the health risks associated with handling contaminated materials and improve the overall effectiveness of recycling efforts.

Universities, as hubs of learning and innovation, are crucial in fostering sustainable behaviors. By instilling effective recycling practices and promoting proper sorting of materials, universities can enhance the quality of recycled goods and streamline the recycling process. This early education helps students carry these habits into their future communities, preventing issues at recycling facilities and ensuring safer operations. Student engagement in recycling is significantly impacted by the accessibility and availability

of recycling infrastructure. Strategies such as well-placed recycling bins and clear signage can boost recycling rates, while poor accessibility and inefficient collection methods can impede efforts (Dabo, 2023; DiGiacomo et al., 2018).

Despite various initiatives promoting the 3Rs—reduce, reuse, recycle (Brown, 2017)—recycling rates among college students remain low (Omran et al., 2017). This deficiency contributes to significant environmental concerns. Limited awareness and engagement, particularly among youth, underscore the urgency of addressing this issue (Sulaiman et al., 2019). Although university students are often educated on the benefits of recycling, participation rates remain disappointingly low (Wu et al., 2021). The critical role of lifestyle consumption in contributing to climate change makes increased environmental awareness imperative.

Understanding the intricacies of individual decision-making regarding recycling presents significant challenges. One effective approach to decipher this complexity is through psychological models such as the theory of plan behaviour (TPB). Given that behaviour is multifaceted and influenced by a myriad of factors, employing comprehensive models like the TPB is essential for robust analysis. The TPB is a psychological framework used to understand human behaviour. It posits that behavioral intentions are influenced by three main factors: attitudes, subjective norms, and perceived behavioural control. Attitudes refer to an individual's evaluation of a behaviour as positive or negative. Subjective norms involve perceptions of social pressure to perform or not perform a behaviour. Perceived behavioral control relates to the individual's perception of their ability to perform the behaviour. Together, these factors help predict and explain human behaviour across various contexts, including recycling practices (Ajzen, 2011).

This study sought to examine the elements of the TPB in relation to the recycling behaviour of university students, with potential implications for university administration. The outcomes of this investigation could provide insights for the development of effective strategies aimed at reducing littering on campus and fostering a recycling culture among students. To the best of our knowledge, no previous research has specifically addressed this issue. The objectives of this study were to assess the proportion of health sciences students involved in recycling practices, to compare recycling behaviour across health sciences courses, and to investigate the relationship between the TPB and students' recycling practices.

2. MATERIALS AND METHODS

This cross-sectional study, conducted from April 2023 to March 2024, was undertaken at Universiti Teknologi MARA (UiTM) Puncak Alam, Selangor Campus, Malaysia (3°11'53"N 101°26'45"E). The focus was on undergraduate students from the Faculty of Health Sciences to explore their recycling practices and attitudes. The design aimed to capture a snapshot of recycling behaviours and attitudes among students in health-related disciplines during the study period.

Participants included 1,648 undergraduate students across eight programs within the Faculty of Health Sciences: Nursing, Physiotherapy, Nutritional and Dietetic, Environmental Health and Safety, Medical Imaging, Optometry, Medical Lab Technology, and Occupational Therapy. This selection ensured broad representation and minimized biases related to specific program characteristics.

Sample size calculations, using Universiti Sains Malaysia's sample size calculator version 1.7, indicated a recommended sample of 428 to achieve a 95% confidence level with a 10% dropout rate. However, logistical constraints limited data collection to 176 respondents. This reduced sample size may limit generalizability, but still provides valuable insights. Future studies should consider mixed recruitment methods to enhance participation. Prior to survey implementation, ethical approval was secured from the UiTM Ethical Committee.

Undergraduate students were purposely selected, with class representatives facilitating the distribution of questionnaires. Participants were instructed to complete the questionnaires within a set time-frame. To ensure data integrity, measures were implemented to maintain confidentiality and reduce response bias, including anonymity to mitigate social desirability bias.

The structured questionnaire utilized Likert scale responses (strongly agree/agree/neutral/disagree/strongly disagree) and binary (Yes/No) questions. It covered demographic information, recycling behaviors, attitudes, subjective norms, and perceived behavioral control. Standardization of the questionnaire was maintained, and participants were assured of the confidentiality of their responses. Reliability for the questionnaire was considered acceptable.

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) Version 26.0. Descriptive statistics were used to determine proportions, while hypothesis testing employed the Fisher-Exact test due to the categorical nature of the variables. The association between the intention to recycle and actual recycling behaviour was

assessed, with mean and standard deviation used to report Likert scale responses for each of the TPB domain. A significance level (α) of 0.05 was set. Potential outliers were identified and addressed to minimize bias in the analysis.

3. RESULTS AND DISCUSSION

3.1 Demographic characteristics of study sample

A total of 176 students participated in this study, comprising 68% female (n=119) and 32% male (n=57). Participants' ages ranged from 21 to 27 years, with a mean age of 23.13 years (SD = 1.29). Of the respondents, 62% (n=109) resided on the campus, while 38% (n=67) lived off-campus. A statistically significant association was observed between residency status and recycling practices (p = 0.01).

In terms of academic programs, the largest group was from Environmental Health and Safety (34%, n=60), followed by Medical Laboratory Technology (14%, n=25), Nursing (12%, n=21), Physiotherapy (9%, n=15), Nutrition and Dietetics (9%, n=15), Occupational Therapy (8%, n=14), Medical Imaging (7%, n=13), and Optometry (7%, n=13). However, no statistically significant association was found between academic discipline and recycling practices (p = 0.12).

Geographically, 51% (n=89) of participants were from urban areas, while 49% (n=87) were from rural areas. No significant association was identified between area of origin and recycling behaviors (p = 0.24) (Table 1).

Table 1 Demographic Characteristics of Study Sample, (N=176)

Variable	N	(%)	P value
Gender			-
Male	57	(32)	
Female	119	(68)	
Age in Year, M(SD)	23.13	1.29	-
Campus Resident Status			0.01*
Resident	109	(62)	
Non-Resident	67	(38)	
Degree Course			0.12
Nursing	21	(12)	

Physiotherapy	15	(9)
Nutritional and Dietetic	15	(9)
Environment Health and Safety	60	(34)
Medical Imaging	13	(7)
Optometry	13	(7)
Medical Lab Technology	25	(14)
Occupational Therapy	14	(8)
Originality Area	0.24	
Mostly Rural	87	(49)
Mostly Urban	89	(51)

*P <0.05

The demographic profile of the study participants provides valuable insights into recycling behaviors within the university setting. Of the respondents, 68% were female, reflecting the current gender distribution in higher education, where women represent a substantial majority (Frenette et al., 2007; Rodon et al., 2021). However, no direct association between gender and recycling practices was observed, suggesting that other factors may play a more critical role in shaping recycling behaviors. The average age of participants was 23.13 years, aligning with the typical age range of undergraduate students (Krug, 2023), though there is a growing demographic of older students, with 22% now exceeding 30 years of age.

Residency status was found to significantly influence recycling behaviors. On-campus residents exhibited better recycling practices, likely due to improved access to recycling facilities, campus-led initiatives, or heightened environmental awareness (Shipley, 2021). Despite this, no significant association was found between academic programs and recycling behaviors, even though Environmental Health and Safety students were most represented. Similarly, while participants came from both urban and rural areas in roughly equal numbers, no significant differences in recycling behaviors were noted based on geographic origin. This suggests that while urban residents may benefit from better facilities, other factors also significantly influence recycling practices (Cai et al., 2021).

3.2 Student recycling practices in the campus

Out of the participants, 76% (n=134) affirmed their engagement in recycling practices on campus, while 24% (n=42) did not. Among those who recycled, 29% (n=51) did so whenever possible, 18% (n=32) once a week, 17% (n=29) once a month, 7% (n=12) once a year, and 6% (n=10) daily. Plastic bottles were the most commonly recycled material (32%, n=57), followed by paper (20%, n=35), cans (11%, n=20), and glass (9%, n=16). For those who did not recycle, reasons included the lack of available recycling bins (8%, n=15), the time-consuming nature of recycling (6%, n=11), absence of signage for recycling bins (6%, n=11), and the observation that important others do not recycle on campus (4%, n=7). Regarding parental recycling habits, 56% (n=99) reported that their parents/guardians recycle, while 44% (n=77) indicated they do not. Suggestions to enhance on-campus recycling included more accessible recycling bins (30%, n=52), establishing a recycling norm on campus (23%, n=40), increased signage (18%, n=32), and providing more incentives for recycling (18%, n=32) (Table 2).

Table 2 Students Recycling Indicator in Campus, (N=176)

Recycling indicator	N	(%)
Do you recycle on campus		
Recycling in campus	134	(76)
Not recycling in campus	42	(24)
If “Yes”, what degree you recycled on campus?		
Not recycle in campus	42	(24)
Everyday	10	(6)
Once a week	32	(18)
Once a month	29	(17)
Once every year	12	(7)
When possible	51	(29)
If “Yes”, what types of materials do you recycle on campus?		
Cans	20	(11)
Cardboard	6	(3)
Glass	16	(9)
Paper	35	(20)
Plastic	57	(32)
If “No”, why do you not recycle?		
It takes too much time to recycle on campus	11	(6)
Lack of recycling bin available	14	(8)
Lack of signage for recycling bins	10	(6)
Others important to them do not recycle on campus	7	(4)

Do your parents or guardians recycle at home?

Parents or guardians recycled at home 99 (56)

Parents or guardians not recycled at home 77 (44)

What would help increase on campus recycling

Everyone recycles on campus 13 (7)

I am not going to recycle on campus 7 (4)

There was an established norm about on campus recycling 40 (23)

There were more incentives towards recycling 32 (18)

There were more recycling bins accessible 52 (30)

There were more signs influencing me to recycle 32 (18)

The study revealed that 76% of students engage in recycling on campus, indicating a generally positive attitude towards sustainability. This finding aligns with previous research showing high recycling participation among university students (Tiew et al., 2013). The majority of students recycle "when possible," with plastic bottles being the most frequently recycled material, underscoring the need for effective management of plastic waste (Jones, 2020). However, a significant barrier identified was the lack of recycling bins, highlighting the need for improved infrastructure. Moreover, a positive relationship was found between parental recycling behaviour and children recycling practices, indicating the influence of family habits (Lorina, 2023; Matthies et al., 2012). Enhancing the availability of recycling bins emerged as a key recommendation for improving recycling rates (Truelove et al., 2023)

3.3 Factor associated with intention to recycle behaviour

3.3.1 Attitude

Table 3 showing results pertaining to factor associated with intention to recycle behaviour. Regarding attitudes towards recycling, the majority of students "strongly disagreed" that "Recycling does not make a difference" (36% strongly disagree, mean = 3.86, SD = 1.13, $p = 0.005$). Additionally, most students "agreed" that their actions affect the environment (42% agree, mean = 2.11, SD = 0.99, $p < 0.001$) and "strongly agreed" that consuming environmentally friendly products has significant benefits for the environment (39% strongly agree, mean = 1.97, SD = 0.98, $p < 0.001$) respectively.

3.3.2 Subjective Norm

Students were neutral regarding feeling social pressure from peers to recycle on campus (35% neutral, mean = 3.21, SD = 1.11, $p < 0.001$) and whether important others want them to recycle (32% neutral, mean = 3.04, SD = 1.13, $p < 0.001$). However, most "disagreed" that they do not recycle because others on campus do not (43% disagree, mean = 3.73, SD = 1.10, $p < 0.001$).

3.3.3 Perceived Behavioral Control

Students generally "agreed" that recycling on campus is an easy task (42% agree, mean = 2.26, SD = 0.97, $p < 0.001$) and that there are ample bins for recycling (41% agree, mean = 2.53, SD = 1.08, $p < 0.001$). Additionally, the majority "disagreed" that recycling on campus takes too much time (46% disagree, mean = 3.59, SD = 0.99, $p < 0.001$).

Table 3 Individuals' Recycling Behavioural Intention (N=176)

Question	%	Mean	SD	P-Value
Attitude				
Recycling does not make a difference.	36%-strongly disagree	3.86	1.13	0.003*
I regularly think about how my actions affect the planet Earth.	42%-agree	2.11	0.99	<0.001*
Consuming environmentally friendly products have important and direct benefits to the environment.	39%-strongly agree	1.97	0.98	<0.001*
Subjective Norm				
I feel social pressure from peers on campus to recycle.	35%-neutral	3.21	1.11	<0.001*
People who are important to me want me to recycle on campus.	32%-neutral	3.04	1.13	<0.001*
I don't see others recycle so I don't recycle on campus.	43%-disagree	3.73	1.10	<0.001*
Perceived Behavioural Control				
For me to recycle on campus is an easy task.	42%-agree	2.26	0.97	<0.001*
There are ample bins for recycling on campus.	41%-agree	2.53	1.08	<0.001*
Recycling on campus takes up too much time.	46%-disagree	3.59	0.99	<0.001*

* $P < 0.05$

Analysis of the factors affecting students' intention to recycle revealed several key determinants. Positive attitudes towards recycling were a strong predictor of recycling behaviour, with students recognizing its environmental benefits. Subjective norms, or the social pressures to recycle, played a role but were less influential, suggesting that while social expectations may impact recycling practices, individual attitudes and autonomy are more decisive. Perceived behavioural control, which reflects the ease or difficulty of recycling, was also a significant predictor. Most students found recycling on campus to be straightforward and accessible, with few perceiving it as time-consuming. These findings emphasize the importance of both perceived ease and accessibility in promoting recycling behaviours.

4. CONCLUSION

This study offers valuable insights into the determinants of recycling behaviours among university students. By examining the interplay of individual attitudes, social norms, and perceived behavioural control, universities can develop targeted interventions to enhance recycling practices. Strategies should focus on improving infrastructure, increasing awareness, and fostering a supportive social environment to encourage sustainable behaviours. Addressing these factors will contribute to broader sustainability initiatives and environmental conservation efforts.

ACKNOWLEDGEMENTS

We would like to extend our sincere gratitude to all the students who participated in this study. Additionally, we thank the Faculty of Health Sciences for providing us with the opportunity and support to conduct this research.

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RESEARCH ARTICLE

Work motivation among Malaysian occupational therapists

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Abstract:

Work motivation is an individual's willingness to exert effort towards achieving organizational goals while fulfilling personal needs. Acknowledging that low motivation among health professionals poses challenges to healthcare systems. This research aims to assess the level of work motivation among Malaysian occupational therapists, its types and their relationship with demographic variables. Employing a cross-sectional quantitative design, data were collected from 354 respondents through an online survey using the adapted Work Extrinsic and Intrinsic Motivation Scale (WEIMS). Descriptive and inferential analyses were conducted using Statistical Package for the Social Sciences Version 26 to evaluate the levels and types of work motivation and their association with demographic factors. The findings revealed that a substantial majority of respondents 77.4% exhibited a non-self-determined motivation profile, indicating reliance on external factors for motivation, while only 22.6% had self-determined motivation. The average work motivation score was low (1.23, SD=0.418). Significant differences in motivation were also found based on age, gender, and income. The study concluded that Malaysian occupational therapists have a low level of self-determined work motivation, indicating a preference for more controlled forms. This suggests that most occupational therapists are primarily motivated by external factors rather than intrinsic enjoyment or personal fulfillment in their work.

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Keywords: Work Motivation, Occupational Therapy, Malaysian

1. INTRODUCTION

Work motivation is described as the willingness to pursue organizational goals while fulfilling personal needs (Ramlall, 2004). It is the result of the complex relationship between individuals, the work environment, and the culture of society. It is shaped by the alignment of personal and organizational goals, enabling individuals to perform the tasks effectively (Franco et al., 2002; Kjellström et al., 2017). Key factors influencing motivation include individual values, goals, self-concept, and cognitive expectations.

Research by to et al. (2021) highlights that motivation is linked to perceived equity within social exchanges. Employees are more engaged when the person feel a clear understanding of organizational realities, whereas perceived inequality can reduce involvement. Although progress has been made in understanding work motivation, particularly in healthcare, there are still gaps in knowledge, especially regarding occupational therapists (OTs), who focus on enhancing health and quality of life for people of all ages (Izzeddin Sarsak, 2019).

Work motivation among healthcare workers is influenced by individual, organizational, and cultural factors (Kjellström et al., 2017). R. Baljoon et al. (2018) highlighted that work motivation is crucial for healthcare workers' performance. Studies show that motivation impacts job performance, with both organizational and personal factors influencing nurses' motivation. Moreover, low motivation among health professionals is recognized as a major issue affecting healthcare systems (Karaferis et al., 2022). Despite extensive research on healthcare motivation, studies focusing on occupational therapy are limited (Chai et al., 2017), highlighting the need for further exploration in this area.

Occupational therapy involves helping clients with various needs, requiring dedicated staff to provide excellent care. Therapists work closely with clients facing physical and psychological challenges, often in demanding settings (Kim et al., 2020). This study aims to investigate the level of work motivation among Malaysian occupational therapists, examining its types of work motivation and relationships with demographic factors, highlighting its importance for management to boost productivity and organizational goals. Motivated therapists can enhance healthcare quality and increase recognition of the profession.

2. MATERIALS AND METHODS

This research utilized a cross-sectional study design with a purposive sampling method, as collecting data from all occupational therapists in Malaysia was impractical. The sample size was calculated using Raosoft's Sample Size Calculator.

Data were gathered through an online survey using the Work Extrinsic and Intrinsic Motivation Scale (WEIMS), developed by Tremblay et al. in 2009. This tool is to evaluate work motivation levels. The WEIMS includes 18 items that participants rate on a Likert scale from 1 (does not correspond) to 7 (correspond exactly), covering six types of motivation based on Self-Determination Theory.

The score can be calculated using the WEIMS by multiplying the mean of each subscale by values corresponding to the underlying level of self-determination. The W-SDI is calculated using the following:

$$W-SDI = (+3 \times IM) + (+ \times INTEG) + (+ \times IDEN) + (-1 \times INTRO) + (-2 \times EXT) + (-3 \times AMO)$$

The W-SDI has a possible score range of 36 for a 7-point Likert-type scale. This formula's overall score represents individuals' relative level of self-determination. A positive score represents a self-determined profile, whereas a negative score represents a non-self-determined profile.

The data collection procedure began with obtaining ethical approval from UiTM with reference number of the letter was 500-FSK (PT. 23/4) . Respondents were screened based on specific inclusion criteria including occupational therapists in Malaysia work in various clinical settings, either on a contract or permanent basis in both the public and private sectors. Also, of have more than one year of work experience and are able to read and understand English. and informed consent was obtained from those who qualified. The exclusion criteria include occupational therapy academicians or researchers, as well as undergraduate occupational therapy students. An online survey was distributed using Google Forms, divided into three sections: Section A for consent, Section B for socio-demographic data, and Section C for the tool of Work Extrinsic and Intrinsic Motivation Scale (WEIMS) English version. The survey was shared via platforms like WhatsApp, Facebook, and Telegram.

For data analysis, Statistical Package for the Social Sciences version 26 was utilized. Descriptive statistics were used to analyze the demographic characteristic, level and type of work motivation among Malaysian occupational therapists, presenting frequencies and percentages. For inferential analysis, the Chi-Square statistic test and Kruskal-Wallis test were used to assess the relationship between demographics

and work motivation due to the data not following a normal distribution.

3. RESULTS AND DISCUSSION

All of 354 respondents of Malaysian occupational therapists involved in this study.

Table 1. Demographic Characteristics of Respondents

Characteristics	N	Percentage (%)
Gender		
Female	188	53.1
Male	166	46.9
Age		
20-30	97	27.4
31-35	53	15.0
36-40	60	16.9
41-45	97	27.4
46-50	43	12.1
51-55	3	0.8
56-59	1	0.3
Working Sector		
Private	177	50.0
Public	177	50.0
Working Area		
Urban	240	67.8
Suburban	77	21.8
Rural	37	10.5
Work Status		
Permanent	311	87.9
Contract	43	12.1
Current Clinical Practice Area		
Orthopedics/Surgical	41	8.7
Neurology/Medical	51	10.8
Cardiac Rehabilitation	11	2.3
In Patients	41	8.7
General Outpatient	34	7.2
Pediatrics	63	13.3
Psychiatric	73	15.4
Geriatric	9	1.9
Palliative Care	70	14.8
Work Rehabilitation	35	7.4
Health Clinics/Community	33	7.0
Others	12	2.5
Education Level		
Diploma	145	41.0
Bachelor	199	56.2
Master	9	2.5
PhD	1	0.3
Working Experience		
1 years – 5 years	82	23.2
6 years – 10 years	67	18.9
11 years – 15 years	46	13.0
16 years – 20 years	75	21.2
21 years – 25 years	80	22.6
26 years – 30 years	4	1.2
Estimate Income Monthly (RM)		
<3000	79	22.3
3000 – 5000	199	56.2
>5000	76	21.5

Table 1 represents demographic data based on its frequency and percentage. Based on the result, most respondents are female (n=188,53.1%), age between 20 to 37 and 41 to 45 (n=97,27.4%) respectively. There is an equal split of respondents across the public (50%, n=177) and private sectors (50%, n=177). Most respondents (67.8%, n = 240) work in urban areas, with suburban areas (21.8%, n = 77) and rural areas (10.5%, n = 37) following. Of them, 87.9% (n=311) work permanently, while the remaining 12.1% (n=43) are employed under contract. Psychiatry makes up the majority of the respondents' fields of practice (15.4%, n = 73) and most of the respondents (56.2%, n = 199) had bachelor's degrees. In terms of experience, most of them have worked for 1 to 5 years (23.3%, n=82). The largest proportion of respondents, 56.2% (n=199), estimated their monthly income to be between RM3000 to RM5000.

Table 2. Descriptive Analysis for The Level of Work Motivation Among Malaysian Occupational Therapists

Total Score of Work Motivation			
	Frequency(n)	Percent (%)	Mean (SD)
Non-Self Determined Profile	274	77.4	1.23 (0.418)
Self-Determined Profile	80	22.6	

Table 2 represents the level of work motivation based on its frequency, percentage, mean and standard deviation. Majority the respondents showed a non-self-determined profile of motivation with (n = 274, 77.4%) compared to self-determined profile of motivation, (n = 80, 22.6%). The mean work motivation score is 1.23 (SD=0.418).

Table 3. Descriptive Analysis for the Type of Work Motivation among Malaysian Occupational Therapists

Type of Motivation				
	Level of Correspond	Frequency	Percent (%)	Mean (SD)
Intrinsic Motivation	Does Not Correspond	4	1.1	2.60 (0.51)
	Moderate Correspond	134	37.9	
	Correspond Exactly	216	61.0	
Integrated Regulation	Does Not Correspond	2	0.6	2.63 (0.49)

	Moderate Correspond	128	36.2	
	Correspond Exactly	224	63.3	
Identified Regulation	Does Not Correspond	5	1.4	2.39 (0.51)
	Moderate Correspond	203	57.3	
	Correspond Exactly	146	41.2	
Introjected Regulation	Does Not Correspond	5	1.4	2.56 (0.52)
	Moderate Correspond	143	40.	
	Correspond Exactly	206	58.2	
External Regulation	Does Not Correspond	3	0.8	2.64 (0.49)
	Moderate Correspond	123	34.7	
	Correspond Exactly	228	64.4	
Amotivation	Does Not Correspond	23	6.5	2.32 (0.59)
	Moderate Correspond	193	54.5	
	Correspond Exactly	138	39.0	

Table 3 tabulated type of work motivation represented by respondents. The most type of motivation that samples correspond exactly is external regulation with (n= 228, 64.4%) with M=2.64 (SD=0.49) followed by integrated regulation with (n=224, 63.3%), M=2.63(SD=0.49), then introjected regulation with (n=146,41.2%), M=2.56(SD=0.52) and intrinsic motivation (n=216,61.0%), M=2.60(SD=0.51). Identified regulation scored with (n=146,41.2%), M=2.39(SD=0.51). The least type of motivation that samples less correspond exactly is amotivation with (n=138, 39.0%), M=2.32(SD=0.59). These results indicate significant differences in the types of work motivation reported by respondents, with external regulation being the most prevalent and amotivation the least.

Table 4. Inferential Analysis using Chi-Square Test for the relationship between demographic characteristic with work motivation.

Variables	Work Motivation			
	N, (%)			
	Non-Determined Profile	Self-Determined Profile	χ^2	p-value
Age				
20-30	66(68.0)	31(32.0)	14.66	0.023
31-35	44(83.0)	9(17.0)		
36-40	41(68.3)	19(31.7)		
41-45	83(85.6)	14(14.4)		
46-50	37(86.0)	6(14.0)		
51-55	2(66.7)	1(33.3)		
56-59	1(100.0)	0(0.0)		
Working Experience				
1 years-5years	57(20.8)	25(31.3)	27.87	0.00
6 years-10 years	55(20.1)	12(15.0)		
11 year-15 years	31(11.3)	15(18.8)		
16 years-20 years	51(18.6)	24(30.0)		
21 years-25 years	77(28.1)	3(3.8)		
26 years-30 years	3(1)	1(1.3)		
Estimate Income				
<3000	53(19.3)	26(32.5)	11.16	0.004
3000-5000	153(55.8)	46(57.5)		
>5000	68(24.8)	8(10.0)		

Gender				
Female	137(72.87)	51 (27.12)	4.701	0.03
Male	137(82.53)	29(17.46)		
Working Area				
Urban	203 (84.58)	37 (15.41)	21.98	0.00
Suburban	48 (62.33)	29 (37.66)		
Rural	23(62.16)	14(37.83)		
Work Sector				
Private	158 (89.3)	19 (10.7)	28.49	0.00
Public	116(65.5)	61(34.5)		
Working Status				
Permanent	243 (78.13)	68(21.86)	0.78	0.38
Contract	31(72.09)	12(27.91)		
Educational Level				
Diploma	94(64.83)	51(35.17)	22.35	0.00
Bachelor	171(85.93)	28(14.07)		
Master	8 (88.88)	1(11.11)		
Phd	1(100)	0(0.0)		

Table 4 tabulated the data of relationship of demographic variables in work motivation. Based on the result, there is significant difference between variables age, gender, working area, working sector, educational level working experience and estimated income in work motivation whereby p value <0.05. Females showed a high self-determined profile (n=51,27.12%) compared to males (n=29,17.46%). In terms of age, the highest group of age that has a high self-determined profile is at age 20-30 (n=31,38.8%). Then for working area, the highest self-determined profile motivation is from urban area and mostly from public sector with (n=61,34.5%) and from most of them are from diploma education level (51,35/17%) with income RM3000 to RM5000 (46,57.5%). However, the variable of working status shows a significant effect on work motivation, as its p-value is greater than 0.05, with the mean p-value for the permanent and contract working sectors being 0.38.

Table 5. The Kruskal-Wallis Test for The Relationship Between Type of Clinical Practice with Work Motivation

Type of Clinical Practice Area	Level of Motivation	n	Mean Rank	χ^2	p-value
Orthopedics /Surgical	Non-Self Determined Profile	274	173.15	7.13	.008
	Self Determined Profile	80	192.40		
	Total	354			
Neurology /Medical	Non-Self Determined Profile	274	169.44	20.32	.000
	Self Determined Profile	80	205.10		
	Total	354			
Cardiac Rehabilitation	Non-Self Determined Profile	274	177.81	126	.722
	Self Determined Profile	80	176.43		
	Total	354			
In Patients	Non-Self Determined Profile	274	173.15	7.13	.008
	Self Determined Profile	80	192.40		
	Total	354			
General Outpatient	Non-Self Determined Profile	274	172.77	9.93	.002
	Self Determined Profile	80	193.69		
	Total	354			
Pediatrics	Non-Self Determined Profile	274	172.49	6.66	.010
	Self Determined Profile	80	194.68		
	Total	354			
Psychiatric	Non-Self Determined Profile	274	180.41	1.99	0.158
	Self Determined Profile	80	167.55		
	Total	354			

Geriatric	Non-Self Determined Profile	274	176.88	0.61	0.43
	Self Determined Profile	80	179.64		
	Total	354			
Palliative Care	Non-Self Determined Profile	274	187.07	22.29	0.00
	Self Determined Profile	80	144.71		
	Total	354			
Work Rehabilitation	Non-Self Determined Profile	274	172.92	9.08	0.00
	Self Determined Profile	80	193.19		
	Total	354			
Health Clinics/ Community	Non-Self Determined Profile	274	173.27	8.15	0.00
	Self Determined Profile	80	191.98		
	Total	354			
Others:	Non-Self Determined Profile	274	177.96	0.24	0.62
	Self Determined Profile	80	175.93		
	Total	354			

Table 5 represent type of clinical practice area in work motivation using Kruskal-Wallis test. The findings revealed that the most self-determined profile was presented by neurology/medical practice area with mean rank 169.44 compare to others. While, the most non-self-determined motivation was presented by palliative care with mean rank 187.07. Then, there was no significant difference in work motivation across type of clinical practice area of cardiac rehabilitation ($\chi^2 = 126$, $p = 0.72$), psychiatric ($\chi^2 = 1.990$, $p = 0.158$), geriatric ($\chi^2 = 0.607$, $p = 0.436$), and others ($\chi^2 = 0.249$, $p = 0.618$). as those average p-value larger than 0.05. However, compare to other type of clinical practice area including orthopedics/surgical ($\chi^2 = 7.132$, $p = 0.08$), neurology/medical ($\chi^2 = 20.323$, $p = 0.00$), in patients ($\chi^2 = 7.132$, $p = 0.08$), general outpatient ($\chi^2 = 9.929$, $p = 0.002$), pediatric ($\chi^2 = 6.663$, $p = 0.010$), palliative care ($\chi^2 = 22.29$, $p = 0.000$), and health clinics/community ($\chi^2 = 8.154$, $p = 0.004$), there were significant differences in work motivation whereby alpha less than 0.05.

3.1. Level Of Work Motivation Among Malaysian Occupational Therapy

The majority of respondents ($n = 274$, 77.4%) exhibited a non-self-determined motivation profile. This type of motivation is typically driven by external factors, such as rewards, pressure from others, or the avoidance of negative consequences. The prevalence of this motivation profile suggests that a large portion of Malaysian occupational therapists may be primarily motivated by external incentives rather than by intrinsic satisfaction or personal fulfillment in their work.

In contrast, only a small portion of respondents ($n = 80$, 22.6%) demonstrated a self-determined motivation profile. This profile reflects motivation that arises from internal factors, such as personal interest, enjoyment, and a sense of autonomy in one's work. The lower percentage of self-determined motivation indicates that relatively few therapists are driven by these internal factors, which are often associated with higher job satisfaction and sustained engagement.

The mean work motivation score across all respondents was 1.23, with a standard deviation of 0.418. This relatively low mean score indicates that, on average, the therapists' motivation is weak and largely tilted towards non-self-determined forms of motivation. The standard deviation indicates some variability in motivation levels among the respondents, though the overall trend points to a reliance on external motivators.

These results suggest that Malaysian occupational therapists generally have weak work motivation, supporting the null hypothesis of the study. This finding is surprising, especially when compared to the study by Chai et al. (2017), which found strong motivation among occupational therapy graduates. The weaker motivation observed in this study may be linked to Maslow's Hierarchy of Needs Theory, which predicates that individuals must first satisfy basic needs such as safety and health before they can be motivated by higher-level needs, like social connections and personal growth (Bawa, 2017). This may suggest that the occupational therapists in this study are struggling to meet these foundational needs, which could explain their lower levels of self-determined motivation.

The predominance of non-self-determined motivation among the respondents has important implications for both individual therapists and the broader healthcare environment. When motivation is largely driven by external factors, it can lead to less sustainable engagement, as external rewards may not consistently fulfill personal needs. This could also impact the quality of care provided by therapists, as they may be less personally invested in their work.

The findings suggest a need for strategies that can enhance

self-determined motivation among occupational therapists. This could include initiatives that promote professional autonomy, opportunities for personal growth, and the development of a work environment that supports intrinsic motivation. By fostering a more self-determined motivation profile, organizations may see improvements in job satisfaction, performance, and overall well-being among their staff.

3.2. Types Of Work Motivation Among Malaysian Occupational Therapists

The study revealed that external regulation was the dominant form of motivation among respondents, with 64.4% ($n = 228$) scoring a mean of 2.64 ($SD = 0.49$). This high level of extrinsic motivation indicates that Malaysian occupational therapists are primarily driven by external rewards such as salary and job security, rather than by intrinsic factors like personal satisfaction or passion for their work. This finding is consistent with Bawa's (2017) research, which suggests that when external factors are insufficient, it can lead to dissatisfaction and a lack of motivation among employees.

The study also found that the scores for intrinsic motivation, introjected regulation, and identified regulation were moderate, suggesting that these therapists experience a mix of internal and external pressures. While they may have some personal interest in their work, external factors still play a significant role in their motivation. On the other hand, the low score for amotivation indicates that only a small portion of respondents feel disengaged or lack motivation entirely.

These findings are in line with research by Van den Broeck et al. (2021), which highlighted that intrinsic motivation tends to have a stronger and more positive impact on outcomes compared to external regulation. While external motivations can lead to both positive and negative effects, relying too heavily on them might not sustain long-term job satisfaction or performance.

The significant differences across these types of motivation highlight the varying levels of engagement and motivation among Malaysian occupational therapists. The high levels of external regulation suggest that many therapists rely on external incentives, while the moderate levels of intrinsic and identified regulation indicate that internal motivations, though present, are less dominant. The relatively low levels of amotivation suggest that while some therapists may struggle with motivation, it is not a widespread issue. Overall, these findings underscore the diversity in motivational drivers within the profession.

3.3 Work Motivation Among Malaysian Occupational Therapists Related to Demographic Characteristics

The study identified significant differences in work

motivation based on demographic characteristics, revealing diverse motivational patterns among occupational therapists. Females exhibited higher self-determined motivation profiles compared to males, suggesting that women are more motivated by relationships and social connections. This finding aligns with the idea that strong work relationships can enhance motivation, as noted by Hitka et al. (2018). However, this contrasts with a study by Karaferis et al. (2022), where males scored higher in extrinsic motivation, driven by factors like responsibility and resource utilization. Men may be more motivated by external rewards and the opportunity to take initiative.

Therapists aged 20 to 30 showed higher levels of work motivation, likely due to intrinsic factors such as personal growth opportunities and the desire for professional development. Younger professionals may be more driven by internal aspirations and the potential for career advancement. Then, therapists in the private sector demonstrated higher self-determined motivation compared to those in the public sector. This may be attributed to differences in work conditions and benefits. According to Delfgaauw & Dur (2008, as cited in Zullo, 2020), poor benefits and lower job satisfaction in the public sector may contribute to lower motivation levels.

Occupational therapists working in urban areas exhibited the highest self-determined motivation compared to their suburban and rural counterparts. This suggests that urban work environments, despite possibly having higher external control or lower intrinsic motivation, might offer conditions that enhance productivity and self-motivation, as supported by Abdul Basit et al. (2018).

Contract workers showed higher work motivation than permanent employees, likely due to their need for job security and a desire to build a strong professional reputation. This finding is consistent with the study by Eko Yudiantmaja et al. (2017), which also found that contract employees tend to be more motivated than their permanent counterparts. In terms of clinical practice area, therapists working in neurology or medical fields exhibited the highest motivation levels. This aligns with Chiang et al. (2013), who found that physical dysfunction is a popular area of interest among occupational therapy students, likely due to the high demand and rewarding nature of these fields.

Occupational therapists with 1 to 5 years of experience had the highest self-determined motivation compared to more experienced colleagues. This may be because the early years in healthcare are often filled with enthusiasm and energy, but over time, the demanding nature of the job can lead to fatigue and reduced motivation.

Therapists with a diploma showed the highest self-determined motivation, supporting Muntazeri & Indrayanto's (2018) findings that education positively impacts job satisfaction. Higher education may provide individuals with a greater sense

of purpose and fulfillment in their roles. Lastly, those earning between RM3000 to RM5000 demonstrated strong self-determined motivation, likely driven by both intrinsic and extrinsic factors. This supports the research by Abu Hassan Asaari et al. (2019), which found that higher rewards are positively linked to increased employee motivation. The combination of sufficient financial compensation and personal satisfaction seems to enhance overall work motivation.

4. CONCLUSION

This study's findings indicated that the therapists' work motivation is minimally self-determined, with a tendency towards controlled motivation and potential for improvement in fostering autonomous motivation. Extrinsic regulation was the most common type of motivation. Significant differences in work motivation were linked to demographic characteristics. This study investigates the work motivation levels among Malaysian occupational therapists, emphasizing its significance in enhancing healthcare worker performance.

These results highlight the need for strategies to enhance intrinsic motivation among occupational therapists, fostering a more autonomous work environment. The study's implications extend to developing culturally appropriate motivational frameworks that can improve job satisfaction and reduce turnover rates in the healthcare sector. Overall, the findings underscore the importance of addressing motivational factors to optimize the performance and well-being of Malaysian occupational therapists.

The limitations of the study included small sample sizes that impacted data distribution, constraints in data quality and availability, and the virtual format of the study, which may have affected participants' understanding. The study has implications for understanding how motivation theories like Maslow's Hierarchy of Needs apply to Malaysian occupational therapists, helping to create culturally appropriate motivational frameworks, enhancing job satisfaction, and reducing turnover rates. Recommendations for future research include addressing gaps in understanding work motivation, investigating targeted therapies, ensuring balanced recruitment across subgroups, collaborating with healthcare facilities for data collection, and using reminder emails or calls to keep respondents engaged.

ACKNOWLEDGEMENTS

The researcher thanks to the Faculty Ethics Review Committee (FERC) for approving the research and thanks to all respondents who were willing to participate in this study.

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RESEARCH ARTICLE

Nurses' knowledge of perceived thrombophlebitis risk factors and its prevention practice at a teaching hospital in Malaysia

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Abstract:

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Thrombophlebitis is an inflammation of the blood vessel wall related to presence of intravenous access devices. It is vital for nurses to be knowledgeable and practice the preventive measures for thrombophlebitis. The aim for this study is to identify nurses' knowledge on risk factors of thrombophlebitis, nurses' practice on prevention of thrombophlebitis and its relationship at Hospital Al-Sultan Abdullah (HASA). A quantitative cross-sectional study was conducted among 120 nurses in selected ward at Hospital Al-Sultan Abdullah (HASA). A stratified random sampling followed by simple random sampling was used to recruit the samples. A self-administered questionnaire was distributed for data collection via Google form. The researchers used Statistical Package for Social Sciences (SPSS vs.28) to analyze the frequency and percentage for level of knowledge and level of practice of nurses. For the relationship between nurses' perception and practice on prevention of thrombophlebitis, Spearman Rho was used to analyze the data. The mean percentage of nurses' knowledge was good 87.02 %, SD 8.27% and the mean percentage for nurses' practice was also good 85.25 %, SD 8.28%. Besides, there was a significant but weak relationship between nurses' perception and practice on preventing thrombophlebitis with the p-value <0.05. Nurses play a crucial part in preventing thrombophlebitis. Even though the knowledge and practice in this study were good, there are minority of respondents with low scores, thus nurses need to maintain and improve their knowledge and skills periodically to play a crucial role in preventing thrombophlebitis.

Keywords: Perception, Risk factors, Practice, Thrombophlebitis, Prevention, Nurses

1. INTRODUCTION

Intravenous (IV) therapy serves a wide range of purpose such as blood sampling, medication administration and nutritional supplementation. Because it is an invasive therapy, it places the client at a high risk of developing an infection. The infection that commonly occurs may require further treatment, placing the patient in discomfort and pain nevertheless prolonging hospitalization and cost incur. The most common local adverse reaction associated with intravenous therapy is called phlebitis (Phillips & Gorski, 2014).

The clinical manifestations of Phlebitis include palpable venous cord, localized redness, warmth, and swelling. Thrombophlebitis is defined as the inflammation of the vessel wall due to the formation of blood clot (Dwivedi, Singh, & Gaharwar, 2018). Most nursing interventions and preventive strategies, such as placing, observing, and evaluating a peripheral venous catheter site, was part of standard nursing care (Arbaee, 2016). Therefore, nurses holds responsibility for the prevention of thrombophlebitis.

With proper care and maintenance to the hospitalized client, thrombophlebitis could be prevented.

The complications associated with peripheral IV cannula and IV therapy may have a devastating effect on patient's health and quality of life (Dwivedi et al., 2018). Several studies claimed that nurses' understanding of risk factors and application of thrombophlebitis prevention techniques not only lowered the incidence of phlebitis but also lessen the burden of prolong hospitalization (Milutinović, Simin, & Zec, 2015). The quality of care, patient safety, and patient satisfaction ratings could all been improved because of nurses' understanding and early identification of phlebitis risk factors, which could also shorten hospital stays and lowered total healthcare cost (Milutinović et al., 2015). This shows nurses with good knowledge and skill with well planned and implementation of nursing care may improve overall health outcome of the patient.

2. MATERIALS AND METHODS

2.1 Questionnaire instrument

The study utilized an online questionnaire to gather data from the respondents. The questionnaire was adopted with permission from two previous studies: "Perception of Risk Factors for Phlebitis Among Malaysian Nurses" by (Ying, Yusuf, & Keng, 2020) with the Chronbach's Alpha value of 0.8 and "Assess Nurse Knowledge and Practice Towards Care and Maintenance of Peripheral Intravenous Cannulation in Services Hospital Lahore, Pakistan" by (Zonobia, Muhammad, & Robina, 2018) with the Chronbach's Alpha value of 0.9.

2.2 Sample collection

This study employed a stratified sampling involving nurses from various adult care wards such a medical, surgical, orthopedic, psychiatric, ICU, and obstetrics and gynecology wards with the population of (N=152). The required sample size was (n=120). A computer generated simple random sampling name list was then used to select participants to fill the required sample size. Prior to data collection, ethical clearance was obtained from UiTM Research Ethical Committee and from the Department of Research, Innovation & Industrial Linkage of Hospital Al-Sultan Abdullah (HASA). Consent from participants was obtained prior to completing the questionnaire. The link to the questionnaire was made available for each nurse, allowing them time to complete it. The researcher verified the completion of each survey. To ensure participant's privacy and confidentiality, all data were protected using password.

2.3 Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) Version 28. A descriptive analysis of frequency and percentage were applied to identify nurses' perceptions of the risk of thrombophlebitis at HASA and to determine nurses' practice on the prevention of thrombophlebitis at HASA. Spearmen Rho was utilized to determine the relationship between nurses' perception and practice on the prevention of thrombophlebitis.

3. RESULTS AND DISCUSSION

3.1 Socio-demographic characteristics of respondents

Socio-demographic characteristics of the respondents by age, gender, highest level of nursing education, years of clinical experience, and clinical area (Table 1). A total of 120 respondents among staff nurses at HASA aged less than 30 years old to more than 40 years old willingly participated in the present study. 65 out of 120 respondents (54.2%) were from the age group of 30-40 years old. A total of 95% (n=114) of respondents were female. As for their level of

education, 111 of the respondents (92.5%) were diploma holders, 6.7% (n=8) were degree holders and only 0.8% (n=1) of them held a master. 2.5% (n=3) of the respondents had less than 2 years of clinical experience and 55 (45.8%) of them had 5-10 years of experience. For the clinical area, 30% (n=36) are those from medical ward and only 7 respondents out of 120 were from psychiatric ward (5.8%).

Table 1. Demographic data of respondents (n=120)

Variables	Frequency (n)	Percentage (%)
Age (Years)(n=120)		
< 30	52	43.3
30-40	65	54.2
> 40	3	2.5
Gender		
Male	6	5.0
Female	114	95.0
Highest Level of Nursing Education		
Diploma	111	92.5
Degree	8	6.7
Master	1	0.8
Years of Clinical Experience		
<2 years	3	2.5
2-5 years	34	28.3
5-10 years	55	45.8
>10 years	28	23.3
Clinical Area		
Medical Ward	36	30.0
Surgical Ward	19	15.8
Intensive Care Unit (ICU)	27	22.5
Orthopaedic Ward	14	11.7

Psychiatric Ward	7	5.8
Obstetrics & Gynaecology Ward	17	14.2

3.2 Knowledge on thrombophlebitis risk factors among nurses

The level of knowledge, which was categorized as poor, moderate, and good as shown in Table 2 adapted from Ying et al. (2019). There were 105 respondents (87.5%) with a good perception level, followed by 15 (12.5%) with a moderate level of perception. Finally, there was no respondents (0%) who had poor perception level.

Table 2. Score range for level of knowledge (n=120)

Level Of Perception	Score Range (%)	Total Sample, n=120	
		Frequency	Percentage (%)
Moderate	≥50 - <80	15	12.5
Good	≥80-100	105	87.5

*Overall Mean Score (SD): 87.02% (8.27%)

3.3 Nurses’ practice on preventing thrombophlebitis

Table 3 displayed the level of practice, which was divided into three categories: poor, acceptable, and good adapted from Suliman et al. (2018). 7 respondents (5.8%) had an acceptable practice whereas 111 respondents (92.5%) had a good practice. Unfortunately, two of the respondents (1.7%) who had poor practice.

Table 3. Score range for level of practice (n=120)

Level Of Practice	Score Range (%)	Total Sample, n=120	
		Frequency	Percentage (%)
Poor	<50	2	0
Acceptable	≤50-75	7	5.8
Good	>75-100	111	94.2

*Overall Mean Score (SD): 85.25% (8.28%)

3.4 Correlation between knowledge and practice

Table 4 shows the correlation between perception score and practice score. The p-value was 0.017 and the correlation coefficient was 0.217.

Table 4. Correlation between perception and practice score (n=120)

Variables	Practice Score	
	Correlation coefficient (r)	p-value
Perception Score	0.217	0.017*

*Spearman Rho

Majority of nurses had good knowledge on risk factors of thrombophlebitis. Even so, there was a small percentage of nurses who scored moderately. A similar study findings showed that nurse's perception were generally good, but it was less than satisfactory in some area (Chong, Yusuf, & Keng, 2020). On the contrary, other study mentioned that nurses were not knowledgeable on every aspect of IV cannulation (Hossain, 2016).

This study findings also revealed that majority of the respondents in HASA had good levels of practice and a minority of them reported moderate and poor levels. This was supported in an earlier study by Osti et al. (2017) whereby most of their respondents were following the right procedures. In contrast, a different study by Zonobia et al. (2018) showed that their nurses only practice at a very low level. The researcher further elaborated that the findings indicate that nurses generally follow the procedures but fall short in applying them.

In concise, this study showed a very good results on nurses’ practice on prevention of thrombophlebitis. With only 20 patients per ward, nurses are likely to have sufficient time to observe and care for each patient effectively. Additionally, the age demographic of the nursing staff, with the majority under 40 years old, may have contributed positively to their performance. As a result, their combination of time availability and relatively young age may facilitate further improvements in their practices for preventing thrombophlebitis.

This study found that there was significant positive weak relationship between nurses’ perception on risk factors of thrombophlebitis and its prevention practice. This elaborates that the more knowledgeable staff nurses are about thrombophlebitis risk factors, the better their practices will be.

Conversely, the relationship between these two variables appears to be weak. This illustrates that having good knowledge does not necessarily correlate with excellent nursing practices. Knowledgeable nurses may reduce the risk factors of thrombophlebitis

still malpractice and ignorance of the minority of the respondents with modest knowledge could lead to decrease quality of care (Khosro et al., 2021).

4. CONCLUSION

The high rates of thrombophlebitis are concerning as it is the most common occurring complication related to cannulation. Nurses play a crucial part in the prevention of thrombophlebitis. This study found a significant association between nurses' perceptions and their practices regarding IV cannulation, although the correlation analysis revealed a positive but weak relationship. Despite the significant relationship, there is a need for new approaches and corrective actions to ensure that nurses receive specialized training. Such training would enhance their knowledge and confidence in IV cannulation and care, ultimately reducing the risk of complications that could jeopardize patient safety.

ACKNOWLEDGEMENTS

Authors would like to acknowledge both UiTM and HASA with special thanks to all professional and health care workers in HASA for supporting this study.

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