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Health-Related Quality of Life in Colorectal Cancer Patients Undergoing Faecal Occult Blood Test and Genetic Testing

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ABSTRACT

Early detection of Colorectal Cancer (CRC) is becoming increasingly important in maintaining quality of life. Therefore, understanding the quality of life is a must in health system planning. Hence, this study aimed to determine the health-related quality of life (HRQoL) of CRC patients and its associated factors. This cross-sectional study was conducted among CRC patients between September 2018 and November 2019 at three tertiary hospitals in Malaysia. The EuroQol EQ-5D-5L was used to measure the HRQoL of the participants. Statistical analyses were performed using Mann-Whitney U test, Kruskal-Wallis test and chi-square test with a significance level of 0.05. A total of 222 patients were involved as respondents in this study, of which 164 (73.9%) were CRC patients undergoing Faecal Occult Blood Test (FOBT) and 58 (26.1%) were CRC patients undergoing genetic testing. The highest problem rate was reported in the pain/discomfort dimension with 51.4% of the total problems reported by patients. Significant factors related to the EQ-5D-5L utility score were ethnicity (p=0.027), employment status (p=0.035), monthly income (p=0.018), education level (p=0.018) and cancer level (p=0.002). While the significant factors related to Visual Analogue Scale (VAS) score are monthly income (p=0.035), education level (p=0.019) and cancer level (p=0.001).. The model for utility scores confirmed that an important predictor of lower EQ-5D-5L scores was low level of education (p <0.05). Health-

related quality of life measurements among patients found that significant differences in pain / discomfort dimension problems were identified between the two CRC screening methods. Those with low education were important predictor factors in the EQ-5D-5L score model and VAS score.

INTRODUCTION

Colorectal cancer (CRC) is the third most common cancer globally (WHO 2021). According to global cancer statistics, CRC is the second largest contributor to cancer-related deaths in 2018 after lung cancer (9.2%, n = 880,792) (Ferlay et al., 2018). In Malaysia, CRC is second most common cancer and the third leading cause of cancer-related death. According to the Malaysian Cancer Registration Report 2012-2016, about 3000 new patients with CRC every year (Azizah et al., 2019).

Malaysia is heading toward becoming an aging nation by 2030 and the aging population is expected to contribute to an increased incidence of CRC, as 80% of cases are diagnosed in individuals aged 50 years and above (Lim et al., 2008; Yusoff et al., 2014). In Asia, many CRC cases are diagnosed at advanced stages, resulting in higher treatment costs and reduced quality of life (Ezat et al., 2013; Wan Puteh et al., 2013). CRC accounts for 13% of the total disability-adjusted life years in Malaysia (Veettil et al., 2017).

Because of this, early detection of CRC is very important and the need for a screening program is very urgent. Once the risk of CRC is already known, it will affect monitoring and detection as well as early treatment before becoming advanced stage of CRC. In the absence of effective screening programs, lack of knowledge and awareness of this disease, especially among susceptible populations, it contributes to the lower identification rate. It is expected that the rate would be much lower for countries without active disease screening and effective preventive programs for CRC (Sazali et al., 2021; Sazali et al., 2022). The lack of effective preventive strategies and screening programs results in delayed presentation to care, at an advanced stage of disease. Poor linkage to care following diagnosis and poor retention in care is a major obstacle to optimal CRC care (Amir et al., 2022).

The absence of timely screening contributes to delayed treatment initiation and poor linkage to care, ultimately impacting patient survival and health-related quality of life (HRQoL) (Cummings et al., 2018). The definition of HRQoL for each CRC patient is different according to the stage of the cancer (Huang et al., 2018). Previous studies have shown that reduced quality of life among CRC patients were associated with the severity of disease, sociodemographic profiles, responses to treatment, background comorbidities among others (Amir et al., 2022; Cummings et al., 2018). Advanced disease stages are usually associated with severe clinical symptoms and poor responses to treatment which contribute to poorer HRQoL (Huang et al., 2018; Ramdzan et al., 2021).

Early detection of CRC is becoming increasingly important to ensure timely initiation of treatment, early linkage to care and in maintaining HRQoL (Natrah et al., 2012). Therefore, understanding the HRQoL among the patient is crucial to improve the health system planning and care among CRC patients in Malaysia. Early initiation of treatment could slower the disease progression and hence, it helps to control healthcare costs across the CRC care continuum and increase their life expectancy with good quality of life (Ratjen et al., 2018). Early screening as well as leading to early treatment can help maintain a patient's level of performance to survive with a good quality of life. There has been limited local research on HRQOL scores among patients in various stages of disease of CRC in Malaysia. Hence, the objective of this study was to determine the HRQoL of CRC patients and its associated factors. Research on HRQOL scores

among patients with various stages of CRC disease is essential to optimize CRC patient management in Malaysia.

MATERIALS AND METHODS

Study population and data collection

This cross-sectional study was conducted among CRC patients between September 2018 and November 2019 at three tertiary hospitals in Malaysia – Kuala Lumpur General Hospital, Penang General Hospital and Canselor Tuanku Muhriz Hospital. These hospitals were purposively selected as they are the main referral centres for colorectal cancer in the state, ensuring access to a representative sample of CRC patients undergoing both FOBT and genetic testing services. A convenience sampling method was used to recruit CRC patients undergoing FOBT or genetic testing. The inclusion criteria were Malaysian adults aged 18 to 85 years who could comprehend the questionnaire in English or Malay, while exclusion criteria were physical or mental unfitness and unwillingness to participate.

Study instrument

Data on sociodemographic characteristics were collected using validated questionnaires and health-related quality of life was assessed using the EQ-5D-5L instrument, validated for use in Malaysia (Arifin et al., 2020; Shafie et al., 2019). The EQ-5D-5L comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The Visual Analog Scale (VAS) measured patients' perceived health status on a scale of 0-100, with higher scores indicating better HRQoL (Rabin et al., 2001). Participants were asked to mark the scale describing their current health status (Van Reenen et al., 2015).

Statistical analysis

Descriptive statistics summarized demographic and clinical characteristics. Continuous variables were reported as means and standard deviations (SD) or medians and interquartile range (IQR), while categorical data were expressed as frequencies (%). Bivariate analyses were conducted using Mann-Whitney U, Kruskal-Wallis, and chi-square tests. Variables with $p < 0.05$ in bivariate analyses were included in a multiple linear regression model to identify predictors of HRQoL scores. All analyses were performed using SPSS Software version 27.0 (IBM, Armonk, NY, USA).

Ethical clearance

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Universiti Kebangsaan Malaysia (UKM) (approval number: UKM PPI/111/8/JEP-2016-531) and the Medical Research Ethics Committee (MREC), National Medical Research Register (NMRR) of Malaysia (approval number: NMRR-18-725-39826, IIR).

RESULTS

Of the 222 colorectal cancer (CRC) patients included in the study, 164 (73.9%) underwent the current screening method, while 58 (26.1%) underwent genetic testing. The majority of participants were male (55.0%), aged 50 years and below (36.0%), of Malay ethnicity (70.3%), married (78.4%), had up to secondary-level education (58.6%), were employed (72.5%), and earned a monthly income between RM1500–RM3500 (46.4%). The overall mean age was 52.9 years (SD = 15.8). Patients undergoing the current screening method were older on average (mean age 54.9 years, SD = 15.3) compared to those undergoing genetic testing (mean age 47.2 years, SD = 16.2) , as shown in Table 1.

Health-related Quality of Life

Table 2 shows the health status of patients in the EQ-5D-5L. The pain/discomfort was the most frequently reported issue, affecting 51.4% of patients, while self-care difficulties were the least reported, affecting 30.2%. Only 33.3% of patients had perfect health status in this study.

Table 1: Socio-demographic characteristics of participants (n=222).

Characteristics	Total patients n (%)	FOBT n (%)	Genetic testing n (%)	*p*-value
Age in years, mean (SD)	52.9 (15.8)	54.9 (15.3)	47.2 (16.2)	0.159[a]
Age group in years				0.009[b]
≤50	80 (36.0)	49 (29.9)	31 (53.4)	
51 – 60	54 (24.3)	45 (27.4)	9 (15.5)	
61 – 70	65 (29.3)	52 (31.7)	13 (22.4)	
≥71	23 (10.4)	18 (11.0)	5 (8.6)	
Gender				0.235[a]
Male	122 (55.0)	94 (57.3)	28 (48.3)	
Female	100 (45.0)	70 (42.7)	30 (51.7)	
Ethnicity				0.113[b]
Malay	156 (70.3)	120 (73.2)	36 (62.1)	
Chinese	42 (18.9)	25 (15.2)	14 (24.1)	
Indian	24 (10.8)	19 (11.6)	8 (13.8)	
Current working status				<0.001[a]
Yes	161 (72.5)	149 (90.9)	38 (65.5)	
No	61 (27.5)	15 (9.1)	20 (34.5)	
Monthly household income (RM)*				0.036[b]
<1500	85 (38.3)	67 (40.9)	18 (31.1)	
1500 – 3500	103 (46.4)	68 (41.5)	35 (60.3)	
>3500	34 (15.3)	29 (17.6)	5 (8.6)	
Education level				<0.001[b]
No education	19 (8.6)	10 (6.1)	9 (15.4)	
Primary	33 (14.9)	18 (11.0)	15 (25.9)	
Secondary	130 (58.6)	111 (67.7)	19 (32.8)	
Tertiary	40 (18.0)	25 (15.2)	15 (25.9)	
Marital status				0.043[a]
Single	48 (21.6)	30 (18.3)	18 (31.0)	
Married	174 (78.4)	134 (81.7)	40 (69.0)	
Insurance coverage				0.629[a]
Yes	31 (14.0)	24 (14.6)	7 (12.1)	
No	191 (86.0)	140 (85.4)	51 (87.9)	
Family history of cancer				<0.001[a]
Yes	123 (55.4)	65 (39.6)	58 (100.0)	
No	99 (44.6)	99 (60.4)	0 (0.0)	
Stage of cancer				<0.001[b]
1	16 (7.2)	10 (6.1)	6 (10.3)	
2	61 (27.4)	28 (17.1)	33 (56.9)	
3	104 (46.8)	88 (53.6)	16 (27.6)	
4	41 (18.5)	38 (23.2)	3 (5.2)	
Treatment				0.218[b]
Surgery	221 (99.5)	164 (100)	57 (98.3)	
Radiotherapy	24 (10.8)	8 (4.9)	16 (27.6)	
Chemotherapy	173 (77.9)	142 (86.6)	31 (53.4)	

[a]Mann Whitney U test; [b]Kruskal-Wallis test; *1 USD equals RM 4.14 at the time of study; FOBT: fecal occult blood test; SD: standard deviation.

Table 2: Patients health status in EQ-5D-5L (n=222).

Level of problem	Mobility (%)	Self-care (%)	Usual activities (%)	Pain/ discomfort (%)	Anxiety /depression (%)
1 No	62.6	69.8	61.3	48.6	55.9
2 Slight	21.1	15.3	23.7	33.7	23.4
3 Moderate	9.5	9.5	8.6	7.7	15.3
4 Severe	3.6	4.5	5.0	9.5	0.9
5 Extreme	3.2	0.9	1.4	0.5	4.5
Mean utility score (SD)					0.786 (0.27)
Mean VAS score (SD)					73.6 (18.5)
***Perfect health (11111): n (%)**					74 (33.3)

Perfect health (11111)" refers to a health state in the EQ-5D-5L instrument where a respondent reports 'no problems' in all five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each digit represents the level of severity for a dimension, with '1' indicating no problems.

Table 3: Health status of EQ-5D-5L for patients undergoing FOBT and genetic testing (n=222).

Attribute	Total patients n (%)	FOBT n (%)	Genetic testing n (%)	*p*-value
Dimensions				
Mobility	83 (37.4)	60 (36.6)	23 (39.7)	0.678[a]
Self-care	67 (30.2)	49 (29.9)	18 (31.0)	0.869[a]
Usual activities	86 (38.7)	67 (40.9)	19 (32.8)	0.277[a]
Pain or discomfort	114 (51.4)	71 (43.3)	43 (74.1)	<0.001[a]
Anxiety or depression	98 (44.1)	70 (42.7)	28 (48.3)	0.461[a]
Utility score, mean (SD)	0.787 (0.273)	0.801 (0.264)	0.744 (0.296)	0.121[b]
VAS score, mean (SD)	73.58 (18.47)	73.10 (17.28)	74.93 (21.59)	0.288[b]

[a]Chi-square test ($\chi 2$); bMann Whitney U test

Health status of EQ-5D-5L for patients undergoing FOBT and genetic testing

Table 3 shows the ratio of patients undergoing FOBT and genetic testing reporting problems in EQ-5D-5L. Among patients who underwent the current screening method (FOBT), pain/ discomfort was the most commonly reported issue (43.3%), and similarly, it was the most frequently reported problem among those who underwent genetic testing (74.1%). While the lowest reported problem rate was observed in the self-care dimension, 29.9% for patients undergoing the current screening method and 31.0% for patients undergoing genetic test screening. There were significant differences in reported problems between patients undergoing FOBT and genetic testing on the pain / discomfort dimension ($p < 0.001$) with 43.3% and 74.1% of patients reporting problems, respectively.

Utility and VAS scores for patients undergoing FOBT and genetic testing

The mean EQ-5D-5L utility score among all patients was 0.787 ± 0.273. Patients undergoing FOBT had a slightly higher mean score (0.801) compared to those undergoing genetic testing (0.743), although the difference was not statistically significant ($p = 0.121$). The mean EQ-VAS score among all patients was 73.58 ± 18.47, with patients undergoing the current screening method (FOBT) reporting a mean score of 73.10 ± 17.28 and those undergoing genetic testing scoring slightly higher at 74.93 ± 21.59. However, the difference was not statistically significant ($p = 0.288$). No significant differences were observed between the two screening groups for either the EQ-5D-5L utility scores or VAS scores (Table 4). When compared to the general Malaysian adult population, both scores were lower. Among the general population, the mean (SD) EQ-5D index was 0.93 (0.13) and the median (IQR) was 1.00 (0.15), while the EQ-VAS mean (SD) and median (IQR) scores were 82.22 (14.08) and 85.00 (15.0), respectively. A

Table 4: Utility and VAS scores for patients undergoing FOBT and genetic testing (n=222).

Score	Total patients (n=222)	FOBT (n=164)	Genetic testing (n=58)	*p*-value
Utility score				0.121[a]
• Mean (SD)	0.787 (0.273)	0.801 (0.264)	0.744 (0.296)	
• Median (IQR)	0.886 (0.322)	0.892 (0.303)	0.847 (0.336)	
• Minimum, Maximum	-0.362, 1.000	-0.362, 1.000	-0.218, 1.00	
VAS score				0.288[a]
• Mean (SD)	73.58 (18.5)	73.10 (17.3)	74.93 (21.6)	
• Median (IQR)	80.0 (30.0)	80 (30.0)	80.0 (48.0)	
• Minimum, Maximum	25, 100	25, 100	40, 100	

[a]Mann Whitney U test

Spearman correlation test revealed a strong and statistically significant positive correlation between the EQ-5D-5L utility scores and VAS scores ($r = 0.742$, $p < 0.001$).

Bivariate analysis

Table 5 shows the health-related factors related to quality of life. Based on bivariate analysis between categorical independent variables and continuous dependent variables, there were significant associations between the EQ-5D-5L utility score and ethnicity (p-value = 0.027), household income (p-value = 0.018), education level (p-value = 0.018) and stage of cancer (p-value = 0.002). The subsequent Mann-Whitney test showed a significant difference in EQ-5D index score between the working and unemployed groups (p-value = 0.035). For the factors related to the VAS score, there were statistically significant associations with household income, education level, and stage of cancer (all p-values < 0.05).

Multivariate analysis

Multivariate analysis was subsequently conducted on variables that were statistically significant in the bivariate analyses ($p < 0.05$). First, simple linear regression analysis was performed for each of the significant independent variables in the previous bivariate analysis. For the EQ-5D-5L scores, the variables included ethnicity, employment status, household income, education level, family history of cancer and stage of cancer. For EQ-VAS scores, the variables included household income, education level and stage of cancer. The model for EQ-5D-5L scores (Table 6) confirmed that a low level of education was a significant predictor of lower EQ-5D-5L scores ($\beta = 0.045$, 95% CI: −0.197 to −0.009, $p = 0.032$). This factor was also a significant predictor in the VAS score model, with a beta coefficient of −9.537 (95% CI: −15.931 to −3.138, $p = 0.004$) (Table 7).

DISCUSSION

This study highlights HRQoL differences between CRC patients undergoing FOBT and genetic testing. Standard diagnostic procedures like colonoscopy are invasive and carry risks, including colon perforation, which can adversely affect quality of life. Deaths due to colorectal cancer (CRC) can be reduced through effective screening, as early detection is key to improving survival rates. However, public acceptance of screening methods remains critical for the success of national CRC screening programmes (Mahmood et al., 2018). In this context, assessing health-related quality of life (HRQoL) among individuals undergoing different screening modalities provides valuable insight into patient-centred outcomes, which in turn can influence screening uptake. HRQoL data can help determine which methods are more acceptable and sustainable for population-wide use, rather than relying solely on opportunistic screening. Despite evidence that 65% of CRC cases in Malaysia are

Table5: Bivariate analysis (n=222).

Variables	Utility score, mean (SD)	*p*-value	VAS score, mean (SD	*p*-value
Method		0.121 [a]		0.288 [a]
iFOBT, n = 164	0.801 (0.264)		73.10 (17.29)	
GT, n = 58	0.743 (0.296)		74.93 (21.59)	
Age group in years		0.298 [b]		0.682 [b]
≤ 50, n = 80	0.803 (0.292)		75.087 (19.91)	
51 – 60, n = 54	0.751 (0.298)		72.814 (17.03)	
61 -70, n = 65	0.792 (0.248)		73.400 (17.34)	
≥71, n = 23	0.793 (0.209)		70.652 (20.36)	
Gender		0.601 [a]		0.591 [a]
Male, n = 122	0.772 (0.287)		73.32 (17.25)	
Female, n = 100	0.804 (0.254)		73.90 (19.96)	
Ethnicity		0.027 [b]		0.312 [b]
Malay, n = 156	0.810 (0.260)		74.71 (18.56)	
Chinese, n = 42	0.784 (0.246)		70.71 (17.20)	
Indian, n = 24	0.643 (0.358)		71.25 (20.08)	
Current working status		0.035 [a]		0.806 [a]
Yes	0.796 (0.278)		73.38 (18.67)	
No	0.743 (0.244)		74.66 (17.64)	
Household income (RM)		**0.018 [b]**		0.035 [b]
<1500, n = 85	0.730 (0.300)		69.27 (20.39)	
1500 – 3500, n = 103	0.809 (0.266)		76.91 (17.05)	
>3500, n = 34	0.857 (0.187)		74.26 (15.72)	
Education level		**0.018 [b]**		**0.019 [b]**
No education, n = 19	0.733 (0.263)		69.79 (18.05)	
Primary, n = 33	0.756 (0.278)		73.27 (20.14)	
Secondary, n = 130	0.778 (0.282)		71.97 (17.86)	
Tertiary, n = 40	0.863 (0.235)		80.88 (18.05)	
Marital status		0.15 [a]		0.114 [a]
Single, n = 48	0.812 (0.277)		76.19 (21.56)	
Married, n = 174	0.779 (0.273)		72.86 (17.53)	
Insurance coverage		0.577 [a]		0.434 [a]
Yes, n = 31	0.809 (0.293)		76.65 (15.70)	
No, n = 191	0.783 (0.270)		73.08 (18.88)	
Family history of cancer		0.082 [a]		0.828 [a]
Yes, n = 123	0.765 (0.277)		73.66 (19.20)	
No, n = 99	0.813 (0.267)		73.48 (17.63)	
Treatment				
Surgery, n = 221	0.786 (0.273)	0.676 [a]	73.69 (18.45)	0.203 [a]
Radiotherapy, n = 24	0.743 (0.277)	0.200 [a]	69.58 (23.34)	0.426 [a]
Chemotherapy, n = 173	0.785 (0.281)	0.562 [a]	74.57 (80.0)	0.162 [a]
Stage of cancer		**0.002 [b]**		**0.001 [b]**
1, n = 16	0.919 (0.117)		77.82 (20.36)	
2, n = 61	0.715 (0.326)		70.36 (19.55)	
3, n = 104	0.829 (0.242)		78.11 (16.20)	
4, n = 41	0.746 (0.271)		65.20 (18.76)	

[a]Mann Whitney U test; bKruskal-Wallis test

diagnosed at stages III and IV, the country has yet to implement a population-based screening programme. Currently, CRC screening remains largely opportunistic, dependent on existing resources (Arunah et al., 2020). Therefore, evaluating HRQoL using validated tools such as the EQ-5D-5L is essential to support the design of more effective and acceptable screening strategies.

In this study, the quality of life of the respondents was assessed using the survey form EQ-5D-5L as a tool to obtain the value of utility score and VAS score based on the

Table 6: Predictor for lower utility score using multiple linear regression.

	Simple linear regression			Multiple linear regression		
Variables	**b**	**(95% CI)**	***p*-value**	**b**	**(95% CI)**	***p*-value**
Ethnicity (Malay: 0, Non-Malay: 1)	0.043	(-0.033-0.119)	0.265			
Education level (Tertiary: 0, Others: 1)	-0.092	(-0.186-0.001)	0.045	-0.103	(-0.197- 0.009)	0.032
Working status (Yes: 0, No: 1)	-0.053	(-0.152-0.046)	0.294			
Household income (≥RM1500: 0, <RM1500: 1)	-0.082	(-0.182-0.018)	0.107			
Family history of cancer (No: 0, Yes: 1)	-0.050	(-0.123-0.022)	0.173	-0.061	(-0.134-0.011)	0.098
Stage of cancer (Early: 0, Advanced: 1)	0.043	(-0.033-0.119)	0.265			

Adjusted r2 = 0.02.
Backward linear regression method applied.
Only variables that were included in the final model are presented in the table.
Multicollinearity and interaction term were checked and not found.
Hosmer–Lemeshow test (p = 0.292) and classification table (overall correctly classified percentage = 92.6%), thus the fit of this model is achieved.

Table 7: Predictor for lower VAS score using multiple linear regression.

	Simple linear regression			Multiple linear regression		
Variables	**b**	**(95% CI)**	***p*-value**	**b**	**(95% CI)**	***p*-value**
Education level (Tertiary: 0, Others: 1)	-8.897	(-15.16- -2.634)	0.047	-9.535	-15.931-3.138	0.004
Household income (≥RM1500: 0, <RM1500: 1)	-0.807	(-7.608-5.993)	0.815	3.317	-3.429- 10.063	0.334
Stage of cancer (Early: 0, Advanced: 1)	1.387	(-3.756-6.530)	0.596			

Adjusted r2 = 0.02.
Backward linear regression method applied.
Only variables that were included in the final model are presented in the table.
Multicollinearity and interaction term were checked and not found.
Hosmer–Lemeshow test (p = 0.302) and classification table (overall correctly classified percentage = 93.2%), thus the fit of this model is achieved.

screening method passed by the respondents. The EQ-5D is a standard health status level developed by the EuroQoL group as a non-specific standard instrument for any disease to describe and value health-related quality of life (Brooks et al., 1996). According to Brazier et al. (2017), EQ-5D is one of the most used generic questionnaires to measure health-related quality of life. It is simple, flexible, easy to use and answered by the respondents themselves. It consists of a descriptive system and a visual analog scale (VAS). Scoring algorithms are generated from large surveys of the general public to obtain values for health level choices or better-known value sets (Brazier et al., 2017).

The EQ-5D-5L was used in this study because it is a status-based measure of priority choice that provides a simple and generic health measure for clinical and economic evaluation. The use of five response levels aims to reduce the potential for ceiling effects and the limitations encountered in the three-level version (Brazier et al., 2017). Arifin et al. (2020) found that the 5L version of the EQ-5D instrument performed better than the 3L version in his study in terms of measurement and scoring, thus supporting the use of 5L as a health-related quality of life measurement tool (Arifin et al., 2020). Moreover, Shafie et al. (2019) have produced a set of values for the EQ-5D-5L descriptive system for economic assessment use in Malaysia (Shafie et al., 2019). The presence of this Malaysian EQ-5D-5L value set facilitates its use in health technology research and evaluation.

Descriptive, bivariate and multivariate analyzes were performed on patient responses on five dimensions in the EQ-5D-5L and EQ-VAS survey forms to determine the factors influencing quality of life among CRC patients. In this study, mean utility scores were high among CRC patients either undergoing current screening methods or genetic testing. Previous studies reported that the utility scores values of CRC patients by cancer stage ranged from 0.35–0.87 (Jeong et al., 2016; Naik et al.,

2015; Shiroiwa at al., 2009; Stein et al., 2014). In this study, the high utility score obtained may occur because the Malaysian set of values is used in measuring utility scores where this set of values has a higher value. There are differences in the set of values developed in different countries and each has a different weight value. For example, 22221 yields 0.7275 using the Malaysian set of values, 0.648 using the United Kingdom set of values and 0.493 using the Thai set of values. These differences occur because there are methodological differences in assessment studies and cultural differences between countries (Knies et al., 2009). Also, the structure of the healthcare system including the health finance and healthcare expenditures plays crucial factors that influence the HRQOL.

In this study, there were no statistically significant differences for EQ-5D-5L utility score values and VAS scores between patients undergoing genetic test screening and patients undergoing current screening methods. This is similar to the study of Burton-Chase et al. (2018) who conducted a study to look at differences in the quality of life of patients with Lynch syndrome and sporadic CRC (Burton-Chase et al., 2018). However, quality of life did not show clear differences in CRC patients either sporadically or Lynch syndrome. Several factors may explain this outcome. One key limitation is the relatively small sample size, which may have reduced the statistical power to detect significant differences. Additionally, restricting data collection to only three hospitals may have limited the variability and representativeness of the findings.

Statistically significant differences in pain/ discomfort dimension problems were identified between the two CRC screening methods in this study where patients undergoing FOBT screening were lower than patients undergoing genetic test screening (43.3% vs. 74.1%, $p < 0.001$). This is due to patients undergoing genetic testing screening being referred after meeting Amsterdam criteria and Bethesda guidelines having slowed down the diagnosis and treatment process (Vasen et al., 2013). The low availability of genetic testing in Malaysia, especially in terms of logistical factors, has caused its use to be slow and less widespread. Moreover, there is a lack of awareness to perform screening despite having a family history of cancer in the community (Mahmood et al., 2018).

The highest rate of problems reported by patients in the pain/ discomfort dimension is a concern. It can be seen in both CRC screening methods in this study. Pain or discomfort has been shown to affect the overall quality of life in cancer patients. There are many factors that can cause pain either acute or chronic in CRC patients (Bours et al., 2016). Most patients are diagnosed with advanced stage cancer because the patient is present when they already have signs and symptoms. Complications from invasive screening methods such as colon perforation occurring during colonoscopy also contribute towards pain. In fact, treatment methods such as surgery, chemotherapy and radiotherapy give discomfort to the patient (Amir et al., 2022).

Huang et al. (2018) found that CRC patients had a low health -related quality of life where pain/ discomfort and anxiety/ depression were frequently reported problems (Huang et al., 2018). However, the study of Färkkilä et al. (2013) showed that the health -related quality of life of CRC patients is as good as almost the same as the general population except for palliative stage CRC patients (Färkkilä et al., 2013). Studies conducted in Malaysia also found that quality of life studies related to the health of CRC patients also showed that pain, fatigue and dyspnea are worse among CRC patients, especially women (Natrah et al., 2012).

This study found a decline in health-related quality of life according to the stage of cancer. Advanced stages have a lower quality

of life than early stages of CRC. The findings of this study are in line with the results of studies in Australia and several European countries (Paika et al., 2010; Rinaldis et al., 2010; Sulivan et al., 2017). Natrah et al. (2012) also noted that quality of life deteriorates with advanced stages of CRC at the time of diagnosis (Natrah et al., 2012).This suggests a systematic screening program to detect cases as early as possible is very important to run. However, Wong et al. (2013) reported worse health-related quality of life in patients with stage II cancer compared with stage III and IV patients (Wong et al., 2013). This is due to the study got the acceptance and emotions of advanced cancer patients are better than those of stage II cancer patients. In general, complications that worsen when they are at an advanced stage cause their quality of life to be affected.

The multivariate findings further support the low level of education ($p < 0.05$) as a key determinant of HRQoL outcomes in CRC patients. These factors are also equally important predictors in the VAS score model. Although in a survey study by Marventano et al. (2013) stated that education level is not a major determining factor for health -related quality of life, however employment status and monthly income depend on education level (Marventano et al., 2013). With respect to monthly income, there is evidence that low income correlates with dimensions of physical, social and emotional health as well as lower quality of life (Grosek et al., 2019; Xia et al., 2019).

Some of the statistically significant patient characteristics related to health-related quality of life in this study were ethnicity, employment status, monthly income, education level and cancer level. This situation is clear because there are studies reporting that socioeconomic status is related to health-related quality of life such as the findings of previous studies conducted in China & several other countries (Huang et al., 2016; Wang et al., 2016).This low health-related quality of life was found to be associated with the level of serious illness and the low socioeconomic status of patients (Huang et al., 2018). In Färkkilä et al. (2013) found that health -related quality of life -related factors besides age and cancer symptoms, financial problems also have a negative impact on health -related quality of life (Färkkilä et al., 2013). This should be taken into account to support the quality of life related to the health of CRC patients.

This study has certain strengths and limitations. A notable limitation is the use of convenience sampling from three tertiary hospitals, which may reduce the generalizability of findings. The sample of this study was only taken from the referral hospital and resulted in more patients with advanced stage of cancer being sampled. Because only Kuala Lumpur Hospital has a Genetics Department, patients who undergo genetic testing are only available from this department. This makes the sampling process quite challenging. However, the number of patients sampled is still within the minimum requirement as this genetic clinic is a reference point for undergoing genetic testing nationwide. Additionally, as a cross-sectional study, it cannot determine causality. These findings provide health utility score values for CRC patients that can be used to calculate quality-adjusted life year (QALY), serving as a basis for cost-effectiveness analyses. Despite slightly higher utility scores, the clinical significance should be interpreted cautiously, especially given the statistically insignificant differences between screening groups. It is worth noting that the adjusted R^2 values in Tables 6 and 7 are low (0.02), indicating that only a small proportion of the variance in health-related quality of life (HRQoL) was explained by the variables included in the models. This suggests the presence of other unmeasured factors influencing HRQoL, which may need to be explored in future research. This is acknowledged as a limitation of the current study.

Ongoing planned studies of the health-related quality of life of CRC patients will enable an assessment of the quality of life response over time. The results of the study will provide a better estimate of health utilities and can be used for QALY calculations for cost-effectiveness analysis (Ramdzan et al., 2021). Furthermore, studies using cohort design allow a causal relationship to be assumed. The study of barriers to genetic testing needs to be studied and refined in the context of developing Malaysia and communities that still do not have awareness of CRC genetic testing (Aizuddin et al., 2021; Aizuddin et al., 2021). This needs to be looked at carefully so that these barriers can be overcome as well as the use of genetic testing can be expanded. Studies investigating the prevalence of hereditary colorectal cancer (CRC) mutations in the Malaysian population are necessary, as evidence suggests that the prevalence of genetic variants may exceed 5–10% in some populations (Dong et al., 2012). Understanding the local burden of hereditary CRC can provide critical data to support the design of targeted genetic screening programmes, enable risk stratification, and inform national policies on population-based screening. Such evidence would also justify resource allocation for genetic counselling services and early intervention strategies, ultimately contributing to improved outcomes and cost-effective cancer prevention in Malaysia.

CONCLUSION

Health-related quality of life measurements among patients found that significant differences in pain / discomfort dimension problems were identified between the two CRC screening methods. Those with low education were important predictor factors in the EQ-5D-5L score model and VAS score. It can help policymakers and healthcare planners allocate resources better, particularly in prioritizing early screening initiatives and addressing education-related disparities in HRQoL outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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