Health-related quality of life in patients with colorectal neoplasm and cost-effectiveness of colorectal cancer screening in Hong Kong

CLK Lam *, WL Law, JTC Poon, P Chan, CKH Wong, SM McGhee, DYT Fong

KEY MESSAGES

1. Compared with the Hong Kong general population norm, Chinese patients with colorectal neoplasm (CRN) reported worse physical health-related quality of life (HRQOL) but better mental HRQOL and comparable health preference scores.
2. The CRN stage at diagnosis was the most significant determinant of HRQOL. Colorectal cancer was associated with worse physical HRQOL and health preference scores.
3. Immunochemical faecal occult blood testing every 2 years is the most cost-effective colorectal cancer screening strategy, with an incremental cost-effectiveness ratio of HK$43 660 per quality-adjusted life year gained.

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[1] CLK Lam, [2] WL Law, [2] JTC Poon, [3] P Chan, [1] CKH Wong, [4] SM McGhee, [5] DYT Fong

[1] *Department of Family Medicine and Primary Care, The University of Hong Kong*
[2] *Division of Colorectal Surgery, Department of Surgery, The University of Hong Kong*
[3] *Department of Medicine, Ruttonjee Hospital, Hospital Authority*
[4] *Department of Community Medicine, The University of Hong Kong*
[5] *School of Nursing, University of Hong Kong*

* Principal applicant and corresponding author: clklam@hku.hk

Introduction

The prevalence of colorectal neoplasms (CRN), including both cancer and pre-cancerous polyps, has been estimated to be 21% in Hong Kong Chinese aged >50 years.[1] Screening to detect early-stage CRN can reduce the incidence and mortality of colorectal cancers (CRC), but the cost-effectiveness of CRC screening in terms of quality-adjusted life years (QALYs) has never been evaluated in a Chinese population. This study aimed to determine the health-related quality of life (HRQOL) and health preference (utility) of patients with different stages of CRN and to evaluate the cost-effectiveness of CRC screening from the health care provider perspective in Hong Kong.

Methods

Between October 2009 and July 2010, 566 Chinese adult patients who were diagnosed with different stages of CRN for >6 months were recruited from the Queen Mary Hospital. The six stages of CRN were: (1) low-risk polyps (≤2 adenomas or 3-4 adenomas, all <1 cm), (2) high-risk polyps (≥5 adenomas or ≥3 adenomas, at least one >1 cm), (3) stage I CRC, (4) stage II CRC, (5) stage III CRC, and (6) stage IV CRC. Patients were excluded if they had <6 months of life expectancy, were unable to communicate in Cantonese or too ill to carry out an interview, or had known cognitive impairment.

A total of 553 (97.7%) patients completed an assessment by trained interviewers through telephone or face-to-face interview using a questionnaire that consisted of version 4 of the traditional Chinese (Hong Kong) Functional Assessment of Cancer Therapy-Colorectal Cancer (FACT-C), version 2 of the Chinese (Hong Kong) SF-12 Health Survey (SF-12v2), the Chinese version of the SF-6D Health Survey, and questions on socio-demographic and clinical characteristics.

The HRQOL scores of the six CRN stages were compared using the one-way ANOVA with Tukey's post hoc test. The HRQOL scores between CRN patients and the general population,[2] and among different CRN groups were compared. The FACT-C total, health preference, and physical and mental component scores (PCS and MCS) of SF-12v2 were used as dependent variables in the regression analysis. Multivariate linear regression analysis was used to determine the effect of clinical factors on dependent variables, controlling for the effects of socio-demographic factors. The R^2 and adjusted R^2 representing the total variances of dependent variables explained were reported together with the corresponding regression analyses. A P value of <0.05 was considered statistically significant.

Using the Markov Model, a hypothetical static cohort of 100 000 Hong Kong people aged 50 years and their health histories were simulated by gender groups until 75 years old. The natural history of

CRN was reflected in the model via the transitions between different health states and mortalities. The health states of CRN were divided into four sections: (1) the pre-CRC section (normal colonic epithelium, low-risk polyps, and high-risk polyps), (2) the undiagnosed CRC section (undiagnosed stage I, stage II, stage III, and stage IV CRC), (3) the diagnosed CRC section (diagnosed stage I, stage II, stage III, and stage IV CRC), and (4) the death section (death from CRC, death from screening complications, and death from other causes). All health states were modelled as Markov states with a 1-year cycle. All health states were at risk of progression to a more advanced stage or death, but were prohibited from returning to former health states, except for patients with low-risk or high-risk polyps who could return to normal colonic epithelium following polypectomy. Undiagnosed CRC was at risk of progression to a more advanced stage of CRN and mortality from CRC or other causes. Each year, patients with undiagnosed CRN had a specific probability of being diagnosed that may be altered by screening. It was assumed that the risk of disease progression was eliminated once CRC was diagnosed and treated, but the risk of mortality from CRC or other causes remained.

Thirteen screening strategies were compared using a decision analytic model based on a state-transition Markov process. The strategies were: (1) no screening (control), (2) annual guaiac faecal occult blood test (G-FOBT) [G-FOBT1], (3) annual human haemoglobin immunochemical-based FOBT (I-FOBT) [I-FOBT1], (4) biennial G-FOBT (G-FOBT2), (5) biennial I-FOBT (I-FOBT2), (6) sigmoidoscopy every 5 years (SIG5), (7) sigmoidoscopy every 10 years (SIG10), (8) colonoscopy every 5 years (COL5), (9) colonoscopy every 10 years (COL10), (10) annual G-FOBT plus sigmoidoscopy every 5 years (G-FOBT1+SIG5), (11) annual G-FOBT plus sigmoidoscopy every 10 years (G-FOBT1+SIG10),

TABLE 1. Baseline health-related quality of life and SF-6D preference scores by colorectal neoplasm stages

Scale*	Hong Kong norm	Total (n=515)	Colorectal neoplasm stage						Multiple comparison†
			(1) Low risk (n=85)	(2) High risk (n=66)	(3) Stage I (n=80)	(4) Stage II (n=99)	(5) Stage III (n=109)	(6) Stage IV (n=76)	
Mean±SD Functional Assessment of Cancer Therapy-Colorectal Cancer (FACT-C)									
Physical well-being	-	25.7±3.2	26.6±2.5	26.5±2.2	25.9±2.7	26.2±2.4	25.4±3.3	23.6±4.8	1,2,3,4,5>6
Social well-being	-	19.9±4.3	20.3±3.7	19.3±4.5	20.0±4.0	20.3±4.6	19.9±4.5	19.6±4.1	
Emotional well-being	-	21.3±2.9	22.0±2.3	21.5±2.1	21.3±3.1	22.0±2.3	20.8±3.4	20.5±3.4	1,4>6; 1,4>5
Functional well-being	-	18.9±4.4	19.9±4.0	19.2±3.2	19.1±5.1	19.7±3.7	18.7±4.2	16.5±4.8	1,2,3,4,5>6
Colorectal cancer subscale	-	21.8±3.1	22.3±2.9	22.2±2.2	21.8±2.8	22.3±3.1	21.2±3.4	20.9±3.8	1,4>6
Trial outcome index	-	66.4±8.8	68.8±7.2	67.9±5.9	66.8±8.5	68.2±7.6	65.2±9.1	61.0±11.2	1,2,3,4,5>6
FACT-G	-	85.9±10.7	88.7±8.7	86.6±8.9	86.4±10.8	88.3±9.0	84.7±11.7	80.2±12.3	1,2,3,4>6
FACT-C	-	107.6±12.7	111.0±10.2	108.8±9.9	108.2±12.8	110.6±11.0	105.8±13.8	101.1±15.0	1,2,3,4>6
Mean±SD SF-12 Health Survey									
Physical functioning	86.7±23.0	78.5±29.6	85.0±24.8	84.1±25.8	77.2±30.3	85.1±25.2	75.7±30.7	63.5±34.5	1,2,3,4>6
Role physical	77.6±24.1	76.2±27.6	85.3±21.8	80.9±22.0	76.7±28.8	82.8±23.5	74.1±26.4	55.9±32.8	1>5; 1,2,3,4,5>6
Bodily pain	73.1±26.0	86.7±22.9	88.2±20.6	92.8±16.3	87.2±19.9	90.7±20.4	83.5±25.5	78.9±29.2	2,4>6
General health	45.6±27.6	52.3±25.8	55.4±24.6	49.9±22.6	53.6±27.1	57.9±24.6	52.0±26.0	43.0±27.7	1,4>6
Vitality	62.0±25.1	67.2±19.7	71.2±17.9	69.7±18.9	66.6±22.5	72.2±16.7	65.1±18.0	57.9±22.1	1,2,4>6
Social functioning	79.4±24.9	81.5±28.6	92.1±18.2	84.8±26.3	81.3±27.4	88.6±24.0	78.7±29.4	61.5±34.7	1>5; 1,2,3,4,5>6
Role emotional	73.5±21.8	89.3±19.4	91.9±16.2	91.7±14.8	91.6±17.8	91.4±18.7	88.4±19.4	80.3±25.7	1,2,3,4>6
Mental health	67.9±19.0	79.6±15.6	80.4±14.0	80.1±13.0	81.4±16.3	80.8±15.3	78.9±15.8	75.8±18.5	
Physical component score	50.0±9.2	46.9±10.6	49.7±9.0	49.0±8.7	46.5±10.7	49.9±8.4	45.8±10.9	40.4±12.5	1,2,3,4,5>6
Mental component score	50.1±9.5	57.2±8.0	58.3±6.7	57.4±7.7	58.1±7.4	58.0±7.3	56.9±7.9	54.3±10.2	1,3,4>6
Mean±SD SF-6D Health Survey preference score	0.825±0.13	0.825±0.14	0.871±0.12	0.832±0.12	0.831±0.14	0.858±0.12	0.817±0.13	0.732±0.15	1,2,3,4,5>6

* Higher scores indicate higher levels of functioning or quality of life

† Significant difference between the six colorectal neoplasm stages by Tukey Post-hoc multiple comparisons

(12) annual I-FOBT plus sigmoidoscopy every 5 years (I-FOBT1+SIG5), and (13) annual I-FOBT plus sigmoidoscopy every 10 years (I-FOBT1+SIG10).

The cost-effectiveness analysis was performed using the TreeAge Pro Suite 2009 Release 1.0.2 (TreeAge Software, Williamstown [MA], US). Direct medical costs of CRN care from the health care provider perspective were used in the model. Data were extracted from a Hong Kong study[3] that estimated the local CRN costs for each stage of CRN. The incremental cost-effectiveness ratio (ICER) was calculated by dividing the incremental cost (ΔC) by the incremental effectiveness (ΔE) in terms of life-years (LY) and QALYs gained for a particular screening strategy compared with no screening.

TABLE 2. Clinical and socio-demographic factors associated with health-related quality of life (HRQOL) scores in colorectal neoplasm (CRN) patients (n=515) by multivariate linear regression

Independent variables	FACT-C total score		SF-12 physical component score		SF-12 mental component score		SF-6D	
	Coeff	SE (95% CI)	Coeff	SE (95% CI)	Coeff	SE (95% CI)	Coeff	SE (95% CI)
Constant	89.21*	4.41 (80.57, 97.85)	39.81*	3.78 (32.41, 47.21)	45.40*	2.87 (39.78, 51.01)	0.6436*	0.0478 (0.5500, 0.7372)
Clinical factors								
CRN stage (reference: stage IV)								
Low-risk polyp	9.47*	1.99 (5.57, 13.37)	8.44*	1.66 (5.19, 11.69)	3.82*	1.26 (1.35, 6.28)	0.1248*	0.0210 (0.0837, 0.1659)
High-risk polyp	7.10*	2.08 (3.03, 11.17)	8.02*	1.73 (4.63, 11.42)	2.14	1.31 (-0.44, 4.71)	0.0841*	0.0219 (0.0411, 0.1270)
Stage I	5.79*	2.04 (1.78, 9.79)	5.49*	1.70 (2.15, 8.83)	3.74*	1.29 (1.21, 6.28)	0.0903*	0.0215 (0.0481, 0.1326)
Stage II	8.02*	1.90 (4.28, 11.75)	8.91*	1.59 (5.80, 12.02)	3.10*	1.20 (0.74, 5.46)	0.1143*	0.0201 (0.0749, 0.1537)
Stage III	4.18*	1.84 (0.56, 7.80)	4.89*	1.54 (1.88, 7.91)	2.61*	1.17 (0.33, 4.90)	0.0760*	0.0195 (0.0379, 0.1142)
Months since diagnosis†	0.02*	0.01 (0.00, 0.04)	0.02	0.01 (0.00, 0.03)	0.00	0.01 (-0.01, 0.01)	0.0002*	0.0001 (0.0000, 0.0005)
Primary (reference: sigmoid)								
Colon	-1.04	1.45 (-3.87, 1.79)	-1.74	1.20 (-4.10, 0.62)	0.01	0.91 (-1.78, 1.80)	-0.0073	0.0152 (-0.0372, 0.0225)
Rectum	-1.25	1.43 (-4.05, 1.55)	-2.81*	1.19 (-5.14, -0.47)	-1.15	0.90 (-2.91, 0.62)	-0.0302*	0.0150 (-0.0597, -0.0008)
Family history of colorectal cancer	-0.95	1.39 (-3.67, 1.77)	0.36	1.16 (-1.91, 2.62)	-0.36	0.88 (-2.08, 1.36)	0.0047	0.0146 (-0.0240, 0.0333)
Chronic co-morbidities (present)	-0.74	1.24 (-3.17, 1.68)	-0.18	1.03 (-2.20, 1.84)	-0.30	0.78 (-1.84, 1.23)	-0.0090	0.0130 (-0.0346, 0.0165)
Socio-demographic factors								
Male	-0.24	1.26 (-2.71, 2.24)	0.42	1.05 (-1.64, 2.49)	2.06*	0.80 (0.49, 3.62)	0.0297*	0.0133 (0.0036, 0.0557)
Age†	0.22*	0.06 (0.10, 0.34)	0.04	0.05 (-0.06, 0.14)	0.16*	0.04 (0.08, 0.24)	0.0014*	0.0006 (0.0001, 0.0027)
Education (reference: tertiary)								
No formal schooling	0.51	2.41 (-4.21, 5.24)	-0.33	2.01 (-4.28, 3.61)	0.09	1.53 (-2.90, 3.08)	0.0026	0.0254 (-0.0472, 0.0525)
Primary	-0.49	1.91 (-4.23, 3.26)	0.40	1.59 (-2.72, 3.52)	-1.20	1.21 (-3.57, 1.17)	0.0056	0.0201 (-0.0339, 0.0450)
Secondary	0.44	1.76 (-3.01, 3.88)	-0.43	1.47 (-3.31, 2.44)	-0.23	1.11 (-2.40, 1.95)	0.0032	0.0185 (-0.0331, 0.0395)
Married	1.32	1.29 (-1.21, 3.84)	0.04	1.07 (-2.06, 2.15)	-0.09	0.82 (-1.68, 1.51)	0.0046	0.0136 (-0.0221, 0.0312)
Currently working	1.72	1.54 (-1.31, 4.75)	1.55	1.29 (-0.97, 4.08)	0.77	0.98 (-1.15, 2.68)	0.0311	0.0163 (-0.0008, 0.0630)
Household monthly income ≤HK$20000	-3.06	1.71 (-6.42, 0.30)	-1.89	1.43 (-4.69, 0.92)	-0.65	1.08 (-2.78, 1.47)	-0.0213	0.0181 (-0.0568, 0.0141)
Ever smoking	1.22	1.43 (-1.59, 4.03)	0.75	1.19 (-1.59, 3.09)	-1.11	0.91 (-2.89, 0.66)	0.0209	0.0151 (-0.0087, 0.0505)
Ever drinking	0.28	1.41 (-2.49, 3.05)	0.26	1.18 (-2.05, 2.57)	0.23	0.89 (-1.52, 1.98)	-0.0095	0.0149 (-0.0386, 0.0197)
R^2	**11.6%**		**11.9%**		**10.2%**		**14.8%**	
Adjusted R^2	**8.0%**		**8.3%**		**6.6%**		**11.3%**	

* P<0.05

† HRQOL scores change in coefficient for each unit increase in independent variable

Results

HRQOL of patients with colorectal neoplasms

Of the 553 subjects who completed the HRQOL evaluation at baseline, 479 (86.5%) and 414 (74.7%) completed the survey at 6 months and 12 months, respectively. The subjects' SF-6D preference scores were comparable with the Hong Kong general population norm, except for those with stage III and IV CRC (Table 1). There was a progressive decline in HRQOL and health preference scores from low-risk polyp to stage IV CRC. The FACT-C, SF-12v2 subscores of physical functioning, role physical, general health, vitality, social functioning, PCS, and SF-6D health preference scores were higher (but not significantly) in patients with stage II CRC than with stage I CRC and high-risk polyp.

Factors associated with HRQOL

Clinical and socio-demographic factors accounted for 11.6%, 11.9%, 10.2%, and 14.8% of the total variations, as indicated by R^2, in FACT-C total, PCS, MCS, and health preference scores of patients with CRN, respectively (Table 2). The health preference score was poorer in patients with rectal neoplasms but better in those diagnosed for a longer duration. The MCS and health preference scores were greater in males and older patients. Rectal neoplasms were associated with worse PCS compared to sigmoid neoplasms. The HRQOL score was not associated with chronic co-morbidities or a family history of colorectal cancer, or socio-demographic factors such as educational level, marital status, working status, household income, smoking status, and drinking status.

Cost-effectiveness of CRC screening strategies

The ICER in terms of LY and QALYs gain of each screening strategy was compared with that of no screening (Table 3). The most effective strategy in terms of LY gained and QALY gained was I-FOBT1 and I-FOBT1+SIG5, respectively. Compared with no screening, the most cost-effective strategy was I-FOBT2 at an ICER of HK$2 162 000 per LY gained, and HK$43 660 per QALY gained. Strategy I-FOBT1 was more effective than I-FOBT2 at a slightly higher ICER of HK$51 610 per QALY gained.

Discussion

Patients with CRC reported worse PCS but better MCS. The health preference of Chinese patients with CRN was comparable with that of the general population norm in Hong Kong, except for those with advanced (stage III and IV) cancers. Patients with rectal CRN tended to report poorer HRQOL, as

TABLE 3. Cost-effectiveness for each colorectal cancer screening strategy

Screening strategy*	Cost per person (HK$)	Effectiveness		Incremental cost-effectiveness ratio compared to control	
		Life years	Quality-adjusted life years	$1000/life years	$1000/quality-adjusted life years
No screening (control)	1507.50	15.93831	15.62478	-	-
G-FOBT1	21281.34	15.93953	15.75536	16256.42	151.43
I-FOBT1	13107.12	15.94238	15.84951	2851.50	51.61
G-FOBT2	11978.12	15.93924	15.70582	11241.73	129.20
I-FOBT2	9306.47	15.94192	15.80341	2162.08	43.66
SIG5	19369.06	15.94077	15.74849	7255.27	144.38
SIG10	11229.64	15.93957	15.69496	7697.89	138.52
COL5	24141.55	15.94217	15.79698	5869.72	131.44
COL10	14084.96	15.94065	15.73348	5380.46	115.70
G-FOBT1+SIG5	34923.60	15.94025	15.80462	17236.45	185.81
G-FOBT1+SIG10	29197.56	15.93981	15.77971	18393.31	178.72
I-FOBT1+SIG5	26169.89	15.94217	15.85910	6391.00	105.25
I-FOBT1+SIG10	20086.00	15.94221	15.85368	4760.06	81.16

* G-FOBT1 denotes annual guaiac faecal occult blood test (G-FOBT), I-FOBT1 annual human haemoglobin immunochemical-based FOBT (I-FOBT), G-FOBT2 biennial G-FOBT, I-FOBT2 biennial I-FOBT, SIG5 sigmoidoscopy every 5 years, SIG10 sigmoidoscopy every 10 years, COL5 colonoscopy every 5 years, COL10 colonoscopy every 10 years, G-FOBT1+SIG5 annual G-FOBT plus sigmoidoscopy every 5 years, G-FOBT1+SIG10 annual G-FOBT plus sigmoidoscopy every 10 years, I-FOBT1+SIG5 annual I-FOBT plus sigmoidoscopy every 5 years, and I-FOBT1+SIG10 annual I-FOBT plus sigmoidoscopy every 10 years

measured by the PCS and SF-6D preference scores. More attention should be paid to the rehabilitation of physical health for CRC survivors. The CRN stage at diagnosis was the most significant determinant of HRQOL and health preference, and indicates the importance of early detection of CRC. The SF-6D health preference scores by CRN stage would be useful for estimation of QALYs for cost-effectiveness analysis of interventions in CRN.

For the Chinese population in Hong Kong, strategy I-FOBT2 is the most cost-effective at an ICER of HK$43 660 per QALY gained, well below international thresholds of US$50 000[4] and GBP$20 000.[5] CRC screening strategies that utilised sigmoidoscopy, colonoscopy, or G-FOBT alone were dominated by strategies that include the I-FOBT for population-based screening of CRC in Chinese people. G-FOBT should no longer be the method of choice for CRC screening. Clinicians and health policy makers can take reference of these findings to develop evidence-based guidelines for CRC screening in the Chinese population of Hong Kong.

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