

RESEARCH ARTICLE

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# Bowel Preparation Burden, Rectal Pain and Abdominal Discomfort: Perspective of Participants Undergoing CT Colonography and Colonoscopy

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## Abstract

**Objective:** This study aimed to evaluate bowel preparation burden, rectal pain and abdominal discomfort levels and to determine the association between demographic characteristics and those levels among participants undergoing CT colonography and colonoscopy. **Methods:** A cross-sectional survey was conducted in eligible Thai citizens who consented to participate all four visits of a free colorectal cancer screening protocol. Three levels (mild, moderate and severe) of burden, pain and discomfort were used to ask the perspective of participants at the final visit, one week after undergoing those two procedures. **Results:** Data from 1,271 participants completed for analyses - females 815 (64.1%), males 456 (35.9%). The majority of participants experienced mild burden, pain and discomfort. Association between characteristic groups and burden levels differed regarding own income, chronic disease and laxative. Between characteristic groups and pain and discomfort levels differed regarding own income and chronic disease. Participants without their own income rated severe burden lower than those who had ( $p < 0.001$ ), but those without chronic disease rated moderate burden lower than who had ( $p = 0.003$ ). Participants prepared bowel with split-dose of PEG rated moderate burden higher than those who prepared with NaP ( $p < 0.001$ ). Participants undergoing CT colonography without their own income and presenting no chronic disease faced severe rectal pain lower than those who had ( $p < 0.001$  and  $p = 0.04$ ). Participants without their own income rated moderate and severe abdominal discomfort lower than those who had ( $p < 0.01$  and  $p = 0.008$ ). Participants undergoing colonoscopy without their own income and no chronic diseases faced severe rectal pain lower than those who had ( $p < 0.001$  and  $p = 0.007$ ). Participants without their own income and no chronic disease rated severe abdominal discomfort lower than those who had ( $p < 0.001$  and  $p = 0.005$ ). **Conclusion:** Evaluating the perspectives of customers alongside quality improvement and innovation to reduce unpleasant experiences remains needed in CT colonography and colonoscopy to promote CRC screening.

**Keywords:** Abdominal discomfort- bowel preparation- CT colonography colonoscopy- rectal pain

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## Introduction

As colorectal cancer (CRC) is a public health concern worldwide, CRC screening has been studied and approved in many aspects such as cost-effectiveness [1, 2], decreasing disability adjusted life years (DALY) [3] and reducing CRC-specific mortality [4] to motivate public health strategy and people participation. CRC screening guidelines have been proposed based on strengths and weaknesses of approved tests: the guaiac-based fecal occult blood test (gFOBT), fecal immunochemical test (FIT), FIT-DNA test, flexible sigmoidoscopy, colonoscopy and computed tomography colonography [5, 6]. However, the ideal screening test should be noninvasive, safe, readily available, convenient, inexpensive and offer high sensitivity and specificity [6], but none of these tests

covers those topics so far.

Colonoscopy, a type of endoscopic and invasive test, is recommended for CRC screening as the only one-step modality functioning as both diagnosis and treatment by inserting a flexible tube with a light camera through the anus, rectum and into the colon to find and remove abnormal lesions simultaneously. However, physical pain and discomfort have been reported by people experiencing colonoscopy - rectal pain and abdominal discomfort [7-11]. Moreover, bowel preparation before colonoscopy, including dietary restriction, unpleasant taste, high volume of bowel cleansing agent and frequent toilet visits affected and disrupted daily life [12, 13].

Computed tomography colonography (CT colonography) or virtual colonoscopy is a minimally invasive radiologic investigation by creating a two-or

three-dimensional images of the colon. It has been approved in cost and clinical effectiveness to detect colorectal cancer [14-16]. Similar to colonoscopy, bowel preparation with dietary restriction and laxative intake must be adhered before testing and a rectal catheter to inflate air or carbon dioxide in colon is typically used during CT colonography. Experiences of diarrhea, abdominal pain and discomfort with gas insufflation were unveiled [17, 18].

Bowel preparation plays an essential role in those procedures. Adequate bowel preparation increasingly visualizes abnormal lesions contributing to a succession of investigations [19]. Bowel preparation for colonoscopy guidelines have been proposed based on evidences concerning efficacy and safety of validated laxatives [20], while regimens appropriate for CT colonoscopy have been studied [21, 22].

However, bowel preparation was reported as the most burdensome part of colonoscopy leading to inadequate bowel preparation that concealed abnormal lesion, affecting re-examination or cancellation and increasing costs [23, 12, 24]. While the burden of bowel preparation among patients undergoing colonoscopy has been reported, in CT colonoscopy it remains limited.

Though, rectal pain and abdominal discomfort are noncritical complications, these unpleasant experiences in colonoscopy and CT colonography impeded CRC screening [18]. Underestimating moderate/severe pain in outpatient colonoscopy was reported despite the individual's perception being important to improve experience regarding those procedures [18, 10].

In the era of value-based healthcare, the customer's perspective is increasingly recognized as relevant to the effort of improving quality and effectiveness in delivering high value care tailored to each person. Chulabhorn Royal Academy continuously motivates and encourages eligible people for CRC screening. All in all, physical burden, pain, discomfort from procedures related to CRC screening, and data from participants' experiences should be considered to improve quality and increase greater customer satisfaction. Therefore, this study aimed to evaluate the levels of bowel preparation burden, rectal pain and abdominal discomfort and to determine associations between demographic characteristics and burden levels of participants undergoing CT colonography and colonoscopy.

## Materials and Methods

This cross-sectional survey was conducted under the umbrella of a free CRC screening project at Chulabhorn Hospital between 2020 and 2023. Thai citizens aged 50 to 70 years who never presented any cancer types were included by registration on an organizational website. Individual presenting CRC or abnormal CRC symptoms, having a previous CT colonography or colonoscopy, underlying diseases inappropriate for colonoscopy or CT colonography and unable to adhere to the protocol for all four visits were excluded. This study interested in demographic variables including sex (male, female), age (<60, >60), education level (<bachelor's degree,

>bachelor's degree), marital status (unmarried, married), own income (no, yes), income (<30,000, >30,000), chronic diseases (no, yes) and laxative (PEG, NaP). Because in Thailand age at 60 constitutes statutory retirement, educational attainment is higher but average monthly income per household is still low, less than 30,000 THB/month [25, 26]. Married individuals and high income related to screening and chronic diseases might affect cancer screening [27, 28]. Moreover, a meta-analysis showed the split-dose regimens of laxatives increased the quality of colon cleansing and preferable [29].

Bowel preparation burden is defined as difficulty or unpleasantness that a person has to deal with or worry about dietary restriction, taste and high volume of laxative solution and frequent toilet visits. Rectal pain is defined as any pain or discomfort in the anus, rectum, or lower portion of the gastrointestinal (GI) tract related to bowel preparation, insertion of flexible tube during CT colonography and colonoscopy. Abdominal discomfort is the feeling of pressure, bloating, or cramping related to the air insufflation or insertion of flexible tube during those procedures.

The study protocol concerning safety, efficacy and tolerability of bowel preparation, participants received both verbal and written instructions in plain language explaining step-by-step for easy following provided by registered nurses with video presentations. Colon cleansing agent - a two-liter spilt dose of polyethylene glycon (PEG) or sodium phosphate (NaP) was ordered based on underlying diseases and renal function test of each person. Hydration, diet and timing were informed and discussed ensuring individuals understood profoundly.

The date of screening, participants were examined using CT colonography before colonoscopy. During CT colonography, a small flexible tube was placed in the individual's rectum and air was inflated to expand colon for CT scanning without sedation. This procedure was performed by a radiology technician. Following by colonoscopy, directly looking at the entire length of the rectum to the colon, a flexible tube with a small video camera on the tip was inserted through the anus into the colon and air was insufflated to secure adequate visualization by a gastroenterologist or endoscopy surgeon. This procedure needed sedation with a short-acting medication resulting in a decreased level of consciousness.

The study instrument comprised a self-reported questionnaire to measure levels of bowel preparation burden, rectal pain and abdominal discomfort. Three levels – mild, moderate and severe were considered reflecting individual's perception and interference which generally measured clinical and psychological symptoms [30, 31]. Those three levels were also used to assess rectal pain in colonoscopy [10]. The cutoff points of those three scales equal to a subjective measure of the Numerical Rating Scale (NRS) in which individuals rate their burden, pain and discomfort on a ten-point numerical scale – mild (1 to 4), moderate (5 to 6) and severe (7 to 10). Data were collected one week after performing CT colonography and colonoscopy. IBM SPSS, Version 23 Software was employed for analyses. Descriptive statistics were

performed to describe demographic characteristics of participants, levels of bowel preparation burden, rectal pain and abdominal discomfort. The Chi-square test was deployed to determine the association between demographic characteristics and levels of burden, pain and discomfort. Multinomial logistic regression was used to explain the different associations between characteristic groups and burden levels. A p-value less than 0.05 was accepted.

## Results

Data of 1,271 participants were collected for analyses. The majority were female (64.1%) with a mean age of 58.9 years (SD+5.5), married (64.8%), graduated with bachelor's degree and higher (71.4%), earned their own

income (58.9%), obtained incomes less than 30,000 THB monthly (64.1%) and had at least one chronic disease (56.0%). More than 70% of both sexes reported mild burden of bowel preparation. Females rated severe burden lower than males (11.8 vs. 14.7%) However, associations between characteristic groups and burden levels significantly differed regarding own income ( $p<0.001$ ), chronic disease ( $p<0.01$ ) and laxative ( $p=0.003$ ) (Table 1). Individuals without their own income significantly had less severe burden levels than those who had ( $p<0.001$ , OR 0.47, 95%CI 0.33-0.68), while those without chronic disease significantly reported lower moderate burden than those who had ( $p=0.003$ , OR 0.61, 95%CI 0.44-0.84). Individuals who prepared bowel with PEG rated moderate burden higher than those who prepared with NaP ( $p=0.001$ , OR 1.74, 95%CI 1.26-2.40) (Table 2).

Table 1. Participants' Characteristics, Levels of Bowel Preparation Burden and Associations between Characteristics and Burden Levels (n=1271)

Characteristic	Bowel preparation burden level			X <sup>2</sup>
	Mild n(%)	Moderate	Severe	
Sex				0.3
Male	456 (35.9)	323(70.8)	66(14.5)	67 (14.7)
Female	815 (64.1)	604(74.1)	115(14.1)	96 (11.8)
Age min50, max70, mean58.9, SD+5.5				0.66
<60	780 (61.4)	563(72.2)	112(14.3)	105 (13.5)
>60	491 (38.6)	364(74.1)	69(14.1)	58 (11.8)
Marital status				0.9
Unmarried (single/widowed/divorced/separated)	447 (35.2)	329 (73.6)	61 (13.6)	57 (12.8)
Married	824 (64.8)	598 (72.6)	120 (14.6)	106(12.9)
Educational level				0.67
<Bachelor's degree	363 (28.6)	267 (73.6)	54 (14.9)	42 (11.6)
> Bachelor's degree	908 (71.4)	660 (72.7)	127 (14.0)	121 (13.3)
Own income				<0.001
No	523 (41.1)	408 (78.0)	71 (13.6)	44 (8.4)
Yes (working, pension)	748 (58.9)	519 (69.4)	110 (14.7)	119 (15.9)
Income				0.13
<30,000THB/mo	815 (64.1)	609 (74.7)	111 (13.6)	95 (11.7)
>30,000 THB/mo	456 (35.9)	318 (69.7)	70 (15.4)	68 (14.9)
Chronic disease				0.01
No	559 (44.0)	438 (78.4)	62 (11.1)	69 (12.3)
Yes	712 (56.0)	499 (70.1)	119 (16.7)	94 (13.2)
Laxative				0.003
PEG	544 (42.8)	375 (68.9)	94 (17.3)	75 (13.8)
NaP	727 (57.2)	555 (76.3)	80 (11.0)	92 (12.7)

THB, Thai baht; mo, month; PEG, Polyethylene glycol; NaP, Sodium Phosphate; X<sup>2</sup>, Chi-square test

Table 2. Different associations between Characteristic Groups and Bowel Preparation Burden

Characteristic	Bowel preparation burden	B	Std. error	Wald	df	sig	Exp (B)	95%CI
Own income: no	Moderate	-0.19	0.17	1.41	1	0.23	0.82	0.59-1.14
	Severe	-0.75	0.19	16.02	1	<0.001	0.47	0.33-0.68
Chronic disease: no	Moderate	-0.5	0.17	6.61	1	0.003	0.61	0.44-0.85
	Severe	-0.16	0.17	0.82	1	0.36	0.86	0.61-1.20

Reference category is mild

Table 3. Associations between Characteristics and rectal Pain Levels

Characteristic	Rectal pain level								
	CT colonography				X <sup>2</sup>	Colonoscopy			X <sup>2</sup>
	Mild	Moderate	Severe			Mild	Moderate	Severe	
Sex					0.13				0.78
Male	456 (35.9)	318 (69.7)	29 (6.4)	109 (23.9)		318 (69.7)	5 (1.1)	133 (29.2)	
Female	815 (64.1)	595 (73.0)	32 (3.9)	188 (23.1)		607 (74.5)	4 (0.5)	204 (25.3)	
Age					0.78				0.64
<60	780 (61.4)	557 (71.4)	36 (4.6)	187 (24.0)		561 (71.9)	5 (0.6)	214 (27.4)	
>60	491 (38.6)	356 (72.5)	25 (5.1)	110 (22.4)		365 (74.3)	3 (0.8)	123 (43.6)	
Marital status					0.56				0.4
Unmarried	447 (35.2)	327 (73.2)	23 (5.1)	97 (21.7)		328 (73.4)	1 (0.1)	118 (26.4)	
Married	824 (64.8)	586 (71.1)	38 (4.6)	200 (24.3)		598 (72.6)	7 (0.8)	219 (26.6)	
Educational level									0.36
<Bachelor's degree	363 (28.6)	270 (74.4)	10 (2.7)	83 (22.9)	0.09	273 (75.2)	2 (0.7)	88 (24.2)	
> Bachelor's degree	908 (71.4)	643 (70.8)	51 (5.6)	214 (23.6)		653 (71.9)	6 (0.7)	249 (27.4)	
Own income					0.001				<0.001
No	523 (41.1)	406 (77.6)	21 (4.0)	96 (18.4)		413 (79.0)	3 (0.6)	107 (20.4)	
Yes	748 (58.9)	507 (7.8)	40 (5.3)	201 (26.9)		513 (68.6)	5 (0.7)	230 (30.7)	
Income					0.53				0.27
<30,000THB/mo	815 (64.1)	594 (72.9)	37 (4.5)	184 (22.6)		605 (74.2)	6 (0.7)	204 (25.0)	
>30,000 THB/mo	456 (35.9)	319 (69.9)	24 (5.3)	113 (24.8)		320 (70.2)	3 (0.6)	133 (29.2)	
Chronic disease					0.04				0.02
No	559 (44.0)	421 (75.3)	21 (3.8)	117 (20.9)		428 (76.6)	4 (0.7)	127 (22.7)	
Yes	712 (56.0)	492 (69.1)	40 (5.6)	180 (25.3)		319 (44.8)	5 (0.7)	210 (29.5)	

THB, Thai baht; mo, month; X<sup>2</sup>, Chi-square test

Regarding rectal pain, about 70% of both sexes undergoing CT colonography reported mild rectal pain similar to those undergoing colonoscopy. Associations between characteristics and pain levels of both procedures did not differ except concerning own income and chronic disease (Table 3). Individuals undergoing CT colonography without their own income significantly reported less severe pain than who had (p<0.001, OR 0.60, 95%CI 0.45-0.79), while without chronic disease reported significantly less severe pain than who had (p=0.04, OR 0.76, 95%CI 0.58-0.99). Individuals underwent colonoscopy, without their own income reported significantly less severe pain than

who had (p< 0.001, OR 0.58, 95%CI 0.44-0.75), whereas those without chronic disease reported significantly less severe pain than those who had (p=0.007, OR 0.70, 95%CI 0.54-0.91) (Table 4). Moreover, this study found that pain levels were not different between participants undergoing colonoscopy by surgeon or endoscopist

As to abdominal discomfort, the majority of both sexes undergoing CT colonography and colonoscopy reported mild discomfort. Associations between characteristics and discomfort of both tests did not differ except regarding own income and chronic disease (Table 5). Individuals undergoing CT colonography without their own income

Table 4. Different Associations between Characteristic Groups and Rectal Pain

Characteristic	Rectal pain	B	Std. error	Wald	df	sig	Exp (B)	95%CI
Own income: no	CT colonography							
	Moderate	-0.42	0.28	2.31	1	0.13	0.66	0.38-1.13
	Severe	-0.52	0.14	13.47	1	<0.001	0.6	0.45-0.79
Chronic disease: no	Moderate	-0.49	0.28	3.1	1	0.08	0.61	0.36-1.06
	Severe	-0.16	0.17	0.82	1	0.04	0.76	0.58-0.99
Own income: no	Colonoscopy							
	Moderate	-0.01	0.67	0	1	0.99	0.99	0.27-3.73
	Severe	-0.55	0.13	16.5	1	<0.001	0.58	0.44-0.75
Chronic disease: no	Moderate	-0.07	0.67	0.01	1	0.91	0.93	0.25-3.48
	Severe	-0.35	0.13	7.36	1	0.007	0.7	0.54-0.91

Reference category is mild

Table 5. Associations between Characteristics and Abdominal Discomfort Levels

Characteristic	Abdominal discomfort level							
	CT colonography				X <sup>2</sup>	Colonoscopy		
	Mild	Moderate	Severe			Mild	Moderate	Severe
Sex				0.21				0.11
Male	456 (35.9)	320 (70.2)	53 (11.6)	83 (18.2)		317 (69.5)	9 (2.0)	130 (28.5)
Female	815 (64.1)	604 (74.1)	72 (8.8)	139 (17.1)		607 (74.5)	9 (1.1)	199 (24.4)
Age				0.27				0.76
<60	780 (61.4)	556 (71.3)	84 (10.8)	140 (17.9)		562 (72.1)	12 (1.5)	206 (26.4)
>60	491 (38.6)	368 (74.9)	41 (8.4)	82 (16.7)		362 (73.7)	6 (1.2)	123 (25.1)
Marital status				0.79				0.23
Unmarried	447 (35.2)	330 (73.8)	43 (9.6)	74 (16.6)		331 (74.0)	3 (0.7)	113 (25.3)
Married	824 (64.8)	594 (72.1)	82 (1.0)	148 (17.9)		593 (72.0)	15 (1.8)	216 (26.2)
Educational level								0.77
<bachelor's degree	363 (28.6)	272 (74.9)	29 (8.0)	62 (17.1)	0.34	269 (74.1)	5 (1.4)	89 (24.5)
> bachelor's degree	908 (71.4)	652 (71.8)	96 (10.6)	160 (17.6)		655 (72.2)	13 (1.4)	240 (26.4)
Own income				0.003				0.001
No	523 (41.1)	407 (40.7)	40 (7.6)	76 (14.5)		410 (78.4)	5 (0.9)	108 (20.7)
Yes	748 (58.9)	517 (69.1)	85 (11.4)	146 (19.5)		514 (68.7)	13 (1.7)	221 (29.6)
Income				0.68				0.27
<30,000THB/mo	815 (64.1)	599 (73.5)	77 (9.4)	139 (17.1)		601 (73.7)	10 (1.2)	204 (25.1)
>30,000 THB/mo	456 (35.9)	325 (71.3)	48 (10.5)	83 (18.2)		323 (70.8)	8 (1.8)	125 (27.4)
Chronic disease				0.14				0.01
No	559 (44.0)	418 (74.8)	45 (8.0)	96 (17.2)		429 (76.7)	7 (1.3)	123 (22.0)
Yes	712 (56.0)	506 (71.1)	80 (11.2)	126 (17.7)		495 (69.5)	11 (1.5)	206 (28.9)

THB,Thai baht; mo, month; X<sup>2</sup>, Chi-square test

reported significantly less moderate discomfort than who had ( $p=0.01$ , OR 0.60, 95%CI 0.40-0.89) and lesser severe discomfort than those who had ( $p=0.008$ , OR 0.66, 95%CI 0.49-0.90). Individuals undergoing colonoscopy without their no own income reported significantly less severe discomfort ( $p<0.001$ , OR 0.61, 95%CI 0.47-0.80), while those without chronic disease reported significantly less severe discomfort than who those had ( $p=0.005$ , OR 0.69, 95%CI 0.53-0.89) (Table 6).

## Discussion

The perspectives of customers are increasingly recognized as highly relevant to the efforts involved delivering high value person-centered care and improving

the quality and effectiveness of healthcare [32]. This study highlighted the perspective of participants experiencing bowel preparation burden, rectal pain and abdominal discomfort. Classification of levels of burden, pain and discomfort as mild, moderate and severe were based on feelings and symptoms of individual experiences. Whereas a study reported anxiety related to screening procedures [33], this study directly evaluated specific burden, pain and discomfort related to CT colonoscopy and colonoscopy. Moreover, episodes of those experiences were captured one week later; recalling the burden and symptoms might have been difficult. However, a prospective study showed people reported minor adverse events related to colonoscopy after 24 hours until 30 days [8].

Burden of bowel preparation can be a predictor of

Table 6. Different Associations between Characteristic Groups and Abdominal Discomfort

Characteristic	Abdominal discomfort	B	Std. error	Wald	df	sig	Exp(B)	95%CI
Own income: no	CT colonography							
	Moderate	-0.52	0.2	6.43	1	0.01	0.6	0.40-0.89
	Severe	-0.41	0.16	7.01	1	0.008	0.66	0.49-0.90
Own income: no	Colonoscopy							
	Moderate	-0.73	0.53	1.89	1	0.17	0.48	0.17-1.36
	Severe	-0.49	0.14	13.21	1	<0.001	0.61	0.47-0.80
Chronic disease: no	Moderate	-0.31	0.49	0.4	1	0.53	0.73	0.28-1.91
	Severe	-0.37	0.13	8.01	1	0.005	0.69	0.53-0.89

Reference category is mild



nonsuccess of CT colonoscopy or colonoscopy [23, 12, 24]. While this study measured the burden of bowel preparation including receiving a two-liter split-dose of PEG or NaP and reducing dietary intake from soft to clear liquid to nothing by mouth as a whole, another two studies measured hunger, taste, volume, sleep, social, work and adverse events separately [34, 35]. Similarly, a cutoff score at 7 was rated as severe. This study showed females experienced higher burden thresholds than males. Factor associated with severe burden was earning one's own income, while chronic disease was associated with moderate burden. Our results differed from those of one study showing factors associated with severe burden comprised being female, numerous working hours, and previous gastrointestinal and somatic symptoms [24].

Regarding rectal pain, one study showed the moderate/severe pain in colonoscopy was underestimated by endoscopists and endoscopy assistants, and recommended particular attention to male and normal BMI was needed [10]. This study determined moderate rectal pain was higher in CT colonoscopy than in colonoscopy, while severe pain was higher in colonoscopy than in CT colonoscopy. Specific attention to participants earning their own income and having chronic disease was needed. Assessing pain intensity during those procedures should not be neglected. Though reporting rectal pain in CT colonoscopy was limited, rectal perforation during CT colonoscopy was reported [36].

Concerning abdominal discomfort, one study showed more than 50% of people undergoing CT colonoscopy experienced abdominal discomfort from gas insufflation contributing to difficulties completing the investigation [18], and 25% experienced this symptom 24 hours after colonoscopy [8]. Another study showed abdominal pain or discomfort during colonoscopy remained up to seven days and factors associated with discomfort included younger age, lower BMI, difficulty of examination and previous gynecopelvic surgery [37]. Relevant to rectal pain, this study found that moderate abdominal discomfort was higher in CT colonoscopy than in colonoscopy, but severe discomfort was higher in colonoscopy than in CT colonoscopy. Factor associated with moderate and severe discomfort in CT colonoscopy comprised earning one's own income, while factors associated with severe discomfort in colonoscopy were earning's own income and chronic disease.

#### *Strength and limitation*

The high volume of participants' experiences that could be representative of customers undergoing CT colonoscopy and colonoscopy poses a strength. Nevertheless, this study encountered limitations which might have affected those experiences including not evaluating anxiety or other factors related to screening procedures. Additionally, techniques and experiences of healthcare providers might have affected physical and psychological burden, and a lack of inter-rating among them.

In conclusion, at present, colonoscopy and CT colonoscopy are recognized in detecting colorectal cancer

and highly deployed in CRC screening. Bowel preparation plays essential roles in successfully completing those procedures. However, adverse effects can occur at mild to severe levels, i.e., bowel preparation burden, rectal pain and abdominal discomfort. However, the majority of participants experienced mild burdens, moderate and severe levels were observed. Some characteristics need more attention concerning moderate/severe levels, i.e., earning one's own income and chronic disease. Evaluating those experiences alongside improving the quality of optimal techniques and innovation to reduce unpleasant experiences remain needed in those procedures for promoting and improving CRC screening.

#### **Author Contribution Statement**

All authors contributed equally in this study.

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