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Dark Chocolate Consumption on Anxiety, Depression and Health-Related Quality of Life of Patients with Cancer: A Randomised Clinical Investigation

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Abstract

Objective: **Anxiety and depressive symptoms are common among cancer patients and have been shown to adversely affect their health-related quality of life (HRQoL). Dark chocolate is popular for its beneficial effects on mood regulations. This study aimed to assess the effects of dark chocolate consumption on anxiety and depressive symptoms and the HRQoL status among cancer patients.** ***Methods:*** **A sample of 133 cancer patients was recruited from 3 public hospitals in the East Coast Peninsular of Malaysia. The anxiety and depressive symptoms was assessed by the Malay Hospital Anxiety and Depression Scale (HADS) while HRQoL was measured via the Malay McGill Quality of Life questionnaire (MMQoL). Patients were randomly assigned to Study Group (SG) and Control Group (CG) whereby dark chocolate (50g) was administered to SG while CG consumed mineral water for 3 consecutive days.** ***Results:*** **Specifically, the anxiety and depressive symptoms was significantly reduced after dark chocolate consumption. The HRQoL score was also significantly increased in SG at post-intervention.** ***Conclusion:*** **These findings indicated that a 3-day dark chocolate consumption may reduce anxiety, depressive symptoms and thus also improved the HRQoL status in hospitalised cancer patients.**

Keywords: Dark Chocolate, Anxiety, Depressive, Cancer, Health-related Quality of Life

Introduction

Cancer often progresses with symptoms that contribute to enormous suffering which would negatively affects patients' health-related quality of life (HRQoL). Patients with cancer are at increased risk of psychological problems which impact upon almost one quarter of the cancer population[1]. Moreover, cancer patients simultaneously experience physical symptoms such as insomnia, pain, fatigue and anorexia which also possessed a greater risk of psychological morbidity[2]. Undoubtedly, greater psychological morbidity among cancer patients is also likely to hasten death[3].

Anxiety and depression are the most common psychological problems among early diagnosed cancer patients and those who are under treatments. However, depression and anxiety disorders in this population are often unrecognized and untreated. Published data had also suggested that depression and anxiety often present in up to 40% of cancer patients[4]. Interventions which could reduce anxiety and depressive symptoms that can simultaneously improve HRQoL are therefore consistently needed.

Evidence on the behavioural effects of chocolate consumption is well documented in the literature. It is always associated with craving, enjoyment and pleasure. Chocolate has been commonly claimed to have the power of lifting up spirits, inducing 'feel good' condition and producing a better mood state[5]. A review on atypical depression stated that the capacity of carbohydrates in chocolate could comfort and promote 'feel good' sensations by releasing multiple gut and brain peptides[6]. In seasonal affective disorder (SAD), chocolate has been perceived to be an "antidepressant". Chocolate-eating is also known as a form of self-medication among the chocolate cravers[5]. Similarly, in a personal marker study, chocolate was also considered to be a good food for depression, anxiety and irritability during stress among chocolate cravers[7]. A small amount of chocolate consumption has shown improvement in negative mood promptly and somewhat depends on the palatability[8].

Dark chocolate is believed to bring tangible benefits for health since ancient times in which its consumption may beneficially impact the metabolism of people who experience high level of stress[9]. Individuals with higher anxiety traits indicated a distinct metabolic phenotype marked by differences in energy, hormonal metabolism and gut microbial activities. Martin and colleagues (2009) discovered that daily dark chocolate consumption for 2 weeks could exert positive impact on stress-associated metabolic among stressed individuals[10]. Many dark chocolate studies had been conducted among healthy participants. Yet, there are still limited trials assessing the health outcomes of dark chocolate among patients. To our knowledge there are no other reports examining the effects of dark chocolate consumption specifically on HRQoL in cancer patients. Ingestion of dark chocolate among the cancer patients is hypothesized to create improved HRQoL status by reducing anxiety and depressive symptoms. This experimental study was designed to primarily compare the effects of a 3-day dark chocolate consumption on the anxiety and depressive symptoms and HRQoL status among in-patients with cancer.

Methods

Study design and sample selection

This study was approved by the Medical Research and Ethics Committee (MREC) and Clinical Research Centre (CRC) of the Ministry of Health Malaysia (MOH) (reference number: KKM/NIHSEC/08). The intervention study was based on a parallel, randomized and open-labeled study design. Dark chocolate was chosen due to its palatability and the lower carbohydrate content compared to other types of chocolate. The present study was a controlled two-armed randomized study including a post study follow-up period of 3-days. Cancer patients who were hospitalized at Hospital SultanahNurZahirah, Terengganu (HSNZ), Hospital TengkuAmpuanAfzan, Pahang (HTAA) and Hospital Raja PerempuanZainab II, Kelantan (HRPZ II) were consecutively invited to represent

patients from the East Coast of Peninsular Malaysia. They were enrolled during their admission in the oncology, surgical or palliative wards within a period of 16 months. For this typical study which involved two groups, a power of 0.80 and α error at 0.05 for significance was used to estimate the number of patient per group for each instrument[11]. The sample size was determined according to prospective study formula. According to the formula at least 44 patients per arm was required to detect changes.

Formula for sample size calculation:

$n = 2Z + Z^2\sigma^2((\mu - \mu))$ n = required sample size; $Z\alpha$ = value of the standard normal distribution cutting off probability the α; $Z_ß$ = value of the standard normal distribution cutting off probability ß; σ = postulated difference in the population from pilot study; (μ1 – μ2) = Standard error of the sample difference[12]. Calculation:

$$n = \frac{2(1.96 + 0.84)^2 \times (1.67)^2}{12}$$

$$n = 44$$

All included patients had to be 18 years old and above, cognitively capable of completing in the questionnaire, Malay-literate, permitted to participate by their physician or medical staff, have no difficulties in swallowing, not diabetic, not on anxiolytic medication or any psychological treatments, and were not allergic to chocolate. Patients who were eligible to participate were required to score ≥ 8 for either subscale in HADS to confirm them as anxiety and/or depressive cases. On the other hand, patients with unpredictable changes of condition such as those with life expectancy of less than 6 months, not cognitively capable of completing questionnaires, or with possessed mental disturbances/comorbidities which limit meaningful contribution of information were excluded from the study.

Instruments

The Malay Hospital Anxiety and Depression Scale (HADS)[13]

The HADS had been extensively utilised for screening purposes, in diverse range of clinical and non-clinical populations. The HADS possesses good psychometric properties and is suitable in assessing anxiety and depression disorders in a wide range of population [14].Furthermore, this instrument had also been validated against the official psychiatric classification systems Diagnostic and Statistical Manual-IV (DSM-IV) diagnoses and it had also demonstrated fair associations with mood disorders [15].In this study, the Malay validated and translated HADS was the instrument of choice [16,17]. This instrument was appropriate for screening of psychiatric problems in patients with cancer due to its 14-item bidimensional scale; namely, anxiety (HADS-A) and depression (HADS-D) [14]. The items were rated on a four-point scale from 0 (not present) to 3 (considerable). The item scores were summed, giving both sub-scale scores from 0 (no symptoms) to 21 (high level of symptoms). Summated scores from 0 to 7 for each subscale was categorized as "non case", 8 to 11 as "mild", 12 to 15 as "moderate" and above 15 was “severe”. In this study, HADS was utilized to measure the anxiety and depression level at baseline and at 3-day post consumption. A subscale total score ≥ 8 (either HADS-A or HADS-D) was set as the inclusion criteria. This cut-off level (≥ 8) has been shown to give an optimal balance between sensitivity and specificity on Receiver Operating Characteristic curves [14]. Cases defined by HADS subscales basically indicated that patients were experiencing symptoms and they were in need of clinical concern.

The Malay McGill Quality of Life Questionnaire (MMQoL)[18]

The Malay validated and translated of McGill Quality of Life Questionnaire was employed in this study[12]. This scale had fewer items than other similar scales and was intended to reduce the burden on patients with deteriorating physical strength, making it suitable and relevant for cancer patients. The MQoL was designed by Cohen *et al*. (1995) to examine the HRQoL of patients with life-threatening illness by exploring five domains: Physical Symptoms (items 1 to 3), Physical Well-Being (item 4), Psychological Well-Being (items 5 to 8), Existential Well-Being (items 9 to 14) and Support Issues (items 15 and 16)[18]. This instrument consisted of 16 items, a global QoL question and an opened ended question for patients to qualitatively describe factors affecting their HRQoL. Both the sub-scale scores and Total MMQoL Score (mean of all five domains) could range from 0 to 10. A score of 0 for each item indicated the "least desirable" and 10 represented the "most desirable" situation. The first three questions allowed the patients to record three main physical symptoms that create the most problems which could affect their HRQoL. For items 1 to 3 and items 5 to 8, the scores were transposed so that the 0 represented the "most desirable situation" and 10 was indicator for "least desirable" situation. The reference of frame of "the past two days" was employed due to the unpredictable nature of patient condition. This instrument has also been proven to possess established use and good psychometric properties[19]. Furthermore, this instrument has been shown to be able to detect differences between good, average, or bad days among palliative care patients[20].

Procedure

At the first meeting, identified cancer patients were approached by the trained research assistants. The research assistants explained about the study to the potential patients followed by invitation to participate. Once patients' agreement was obtained, they were provided with Patient Information Sheet to enhance their understanding about the study. Eligible patients who agreed to be participants were then instructed to complete the Informed Consent Form, Personal particulars form, the Malay HADS and the MMQoL. All patients were prohibited from consuming any chocolate products at least 3 days before the study began. Patients who met the all the inclusion criteria and completed the baseline assessments were randomized to either the Study Group (SG) or the Control Group (CG). Eligible patients were randomized by selecting a number from a box which contained 150 numbers labeled from 1 to 150. The even numbers were provided to SG and odd numbers represented the CG. Each SG member was provided with a bar dark chocolate, Vochelle@TM (50g; 275 kcal) daily for 3 consecutive days. On the other hand, the CG was instructed to consume a bottle of mineral water (350 ml) for 3 consecutive days. The main intention using mineral water as control was to mimic a "placebo" (i.e.nothing) as close as possible. Mineral water was utilised because it contains no cocoa derivatives and sugar which could potentially confound our outcomes and it had also been utilised in previous study[8,21]. Both dark chocolate and mineral water was administered to the patients only for three consecutive days because the average time of hospitalisation for majority of the patients was between 3 to 7 days except for those scheduled to undergo surgery[22,23].

Patients were also required to abstain from food for at least 4 hours before chocolate consumption. The patients were additionally advised not to swallow the dark chocolate hurriedly, but to consume each piece slowly and mindfully. Both interventions were administered to hospitalised patients with cancer between 11 am to 1 pm or between 3 pm to 5 pm during their admission in the oncology, surgical wards or palliative wards within the study period. All patients were re-assessed at follow-up, using the Malay HADS and MMQoL. Once the complete sets of instrument have been collected, a token of appreciation was distributed to each participating patients.

Statistical analysis

Statistical analyses were carried out with licensed SPSS 17.0 for Windows. Socio-demographic data was analysed descriptively and presented as frequencies and percentages. Testing of data normality was initially performed. The Kolmorogov-Smirnov statistics generated values of lesser than 0.05, indicating that the assumption of normality test has been violated. Subsequently, score comparisons were performed using the non-parametric alternatives; 1) Mann-Whitney U test (between-groups differences) 2) Wilcoxon Signed Rank Test (within-groups changes). For all statistical tests, $p < 0.05$ was considered as significant. Effect sizes usingCohen's (1988) interpretation were also computed for SG and CG between the two assessment time points whereby values of 0.2 to 0.49 = small effect, 0.5 to 0.79 = medium effect, and ≥ 0.8 = large effect[11].

Results

A preliminary pilot exploration had found that the internal consistency reliability for both HADS and MMQoL domains was between moderate to high. Majority of the Cronbach's α coefficient for both instruments exceeded 0.70 (Physical Symptoms = 0.701, Psychological Well-Being = 0 .865, Existential Well-Being = 0.817, Support Issues = 0.619, Total MMQoL Score = 0.659, HADS-A = 0.801, HADS-D = 0.739).

Demography

Of 221 eligible patients who were approached, 65 (29.4%) were excluded at baseline and 23 (10.4%) later dropped out of the study. Among the reasons for exclusion were due to not fulfilling inclusion criteria (n = 32), not interested (n = 25), too ill (n = 3), considered unsuitable by staff (n = 5), declined participation (n = 2), and did not complete follow-up (n = 21). A total of 133 eligible patients had finally completed the baseline and follow-up phases in this intervention study and were therefore included for analysis (HSNZ = 46, HTAA = 41, HRPZ II = 46). Over 50.0% of the patients had completed PMR education (equivalent to lower secondary level), were not employed, liked chocolate, have been diagnosed with cancer for less than 2 years. As to the types of cancer, the largest proportion was suffering from breast cancer (30.1%), followed by colorectal (27.1%) and gynaecologic cancers (15.0%). More than half of the patients also received various treatments such as chemotherapy (47.4%), surgery (2.3%) or radiotherapy (5.3%) during the study period. The more comprehensive socio-demographic data of the recruited patients was presented in Table 1.

Table 1. Patient characteristics by group assignment (N = 133).

	All patients	*p* value*	SG	CG	*p* value^{+}
	n (%)		n (%)	n (%)	
Mean age (years)	49.9		50.2	49.6	
Gender					
Male	65 (48.9)	> 0.05	30 (46.2)	35 (51.5)	> 0.05
Female	68 (51.1)		35 (5.3.8)	33 (48.5)	
Marital Status					
Married	119 (89.5)	< 0.001	58 (89.2)	61 (89.7)	> 0.05
Single/Divorce	14 (10.5)		7 (10.8)	7 (10.3)	
Living arrangement					
Alone	3 (2.3)	< 0.001	2 (3.1)	1 (1.5)	> 0.05
With family/partner	130 (97.7)		63 (96.9)	67 (98.5)	
Race					
Malay	114 (85.7)	< 0.001	59 (90.8)	55 (80.9)	> 0.05
Others	19 (24.3)		6 (9.2)	13 (9.1)	
Level of education					
> PMR	87 (65.4)	< 0.001	38 (58.5)	49 (72.0)	> 0.05
< PMR	46 (34.6)		27 (41.5)	19 (28.0)	
Occupation					
Employed	49 (36.8)	< 0.001	27 (41.5)	22 (32.3)	> 0.05
Not employed	84 (63.2)		38 (58.5)	46 (67.7)	
Monthly salary					
< RM 500	78 (58.6)	< 0.001	33 (50.8)	45 (66.2)	> 0.05
> RM 500	55 (41.4)		32 (49.2)	23 (33.8)	
Duration since diagnosis	89 (66.9)	< 0.001	47 (72.3)	42 (61.8)	> 0.05
Up to 1 year	44 (33.1)		18 (27.7)	26 (38.2)	
More than 1 year					
Staging of cancer					
Unknown/Stage 0- 1	59 (44.4)	< 0.05	32 (49.3)	27 (39.7)	> 0.05
Stage 2-4	74 (53.6)		33 (50.7)	31 (60.3)	
Chocolate-liking					
Yes	90 (67.7)	< 0.001	52 (80.0)	38 (55.9)	< 0.05
No	43 (32.3)		13 (20.0)	30 (44.1)	

*χ^2 tests for goodness of fits for distribution of categorical variables, SG = study group, CG = control group, $^{+}$ χ^2 tests for relatedness, $p < 0.05$ = significant.

Score comparisons

Between-Group Score Comparisons (anxiety, depression and HRQoL). With respect to the key variables shown in Table 2, there was no significant difference between the groups at baseline for all the domains of the HADS and MMQoL (all p > 0.05). When baseline anxiety and depressive symptom scores were compared with follow-up ratings for each group, there were statistically significant changes (p < 0.05) (Table 2). Although similar significant differences were discovered between two groups, patients in SG scored significantly better on HADS-A and HADS-D after consuming the dark chocolate. Similarly, SG respondents also reported relatively higher scores for all MMQoL domains compared to CG at the end of the study.

Table 2. Comparisons of anxiety, depressive symptoms and Health-related quality of life (HRQoL) profiles (between-group) (N = 133).

	Baseline			Follow-up		
	SG	CG	*p*	SG	CG	*p*
	Median (IQR)	Median (IQR)	value*	Median (IQR)	Median (IQR)	value*
HADS-A	8.0 (15.0)	8.0 (11.0)	> 0.05	4.0 (11.0)	7.5 (17.0)	< 0.001
HADS-D	10.0 (6.0)	10.0 (9.0)	> 0.05	4.0 (12.0)	8.0 (8.0)	< 0.001
Physical symptoms	7.0 (8.3)	7.3 (7.7)	> 0.05	9.0 (4.6)	8.3 (7.3)	< 0.01
Physical Well-Being	5.0 (9.1)	6.0 (7.2)	> 0.05	7.0 (9.3)	6.0 (8.0)	< 0.05
Psychological Well-Being	4.0 (8.8)	4.9 (10.0)	> 0.05	5.3 (7.5)	5.0 (8.8)	< 0.05
Existential Well-Being	7.5 (7.2)	7.5 (5.0)	> 0.05	8.5 (7.9)	8.2 (5.0)	< 0.05
Support Issues	9. 5 (8.0)	9.0 (8.0)	> 0.05	10.0 (3.7)	9.3 (3.0)	> 0.05
Total MMQoL Score	6.5 (3.7)	6.8 (5.1)	> 0.05	7.9 (3.1)	7.3 (3.3)	< 0.001

*Mann-Whitney U test, IQR = interquartile range, $p < 0.05$ = significant.

Within-Group Score Comparisons (anxiety, depression and HRQoL). For anxiety and depressive symptoms, SG patients also showed significant improvements at follow-up (p < 0.05). However, greater statistically significant mean change was detected for SG patients

when compared to CG respondents. The over-time effect sizes of both HADS subscales also demonstrated statistically significant improvements in SG respondents ($p = < 0.001$). Overall, statistically significant differences in all MMQoL domains were also exhibited across the study period except for Support Issues among these respondents ($p < 0.05$). Within the domains in MMQoL, the SG reported its largest change in Psychological Well-Being and Physical Symptoms (both $d = 0.80$). At follow-up, CG patients also showed significant improvements ($p < 0.05$) in all HADS domains. Similarly, significant differences in all MMQoL domains except for Support Issues and Physical Well-being were detected among CG respondents between baseline and follow-up (Table 3). However for these control respondents, the biggest mean change was found in the Physical Symptoms domain only ($d = 0.48$) apart from the Total MMQOL Score. Specifically, larger effect sizes were demonstrated for all MMQoL domains within SG ($d = 0.27 – 0.84$) compared to CG respondents ($d = 0.20 – 0.62$) (Table 3).

Table 3. Mean change and effect size for domains in Malay Hospital Anxiety and Depression Scale (HADS) and the Malay McGill Quality of Life (MMQoL) questionnaire (N = 133).

	SG			CG		
	Mean change	*p value**	Effect sizes	Mean change	*p value**	Effect size
HADS-A	- 4.3	< 0.001	0.83	- 1.0	< 0.05	0.25
HADS-D	- 6.5	<0.001	0.87	-2.0	<0.001	0.73
Physical symptoms	2.1	< 0.001	0.80	1.0	< 0.001	0.48
Physical Well-Being	1.2	< 0.001	0.52	0.3	> 0.05	0.21
Psychological Well-Being	1.5	< 0.001	0.80	0.3	< 0.01	0.31
Existential Well-Being	1.0	< 0.001	0.78	0.6	< 0.01	0.40
Support Issues	0.3	> 0.05	0.27	0.4	> 0.05	0.20
Total MMQoL Score	1.2	< 0.001	0.84	0.5	< 0.001	0.62

SG = study group, CG = control group, *Wilcoxon Sign Rank test, $p < 0.05$ = significant, Effect size: small = 0.20 – 0.49, medium = 0.50 – 0.79, large effect = ≥ 0.80.

Discussion

Anxiety, depressive symptoms and HRQoL were significantly improved in the group of in-patients who consumed dark chocolate for 3 consecutive days compared to those who did not. This suggested that there may be mood-elevating effects of dark chocolate particularly in alleviating anxiety and depressive symptoms and thereby enhancing

HRQoL among the hospitalized patients with cancers. Previous studies among cancer patients had revealed that psychological stress factors can affect HRQoL which is always related to the onset and progression of cancer[24]. In conjunction with that, reviews of the literature concerned with improving HRQoL in cancer patients had also indicated that employing interventions is the foremost method to improve HRQoL and help to reduce suffering among cancer patients[25]. Interventions to improve emotional well-being should be incorporated especially during admission and; before and during receiving treatments such as chemotherapy, surgery and radiotherapy as these situations may cause emotional distress particularly anxiety and depression.

This exploration study evaluated the effects of a 3-day dark chocolate consumption on anxiety, depressive symptoms and HRQoL among hospitalised cancer patients from East Coast Peninsular Malaysia. Although patient's daily food intake was not controlled in this study, they were instructed to abstain from food for at least4hours before the intervention study to avoid possible food interaction effects. No significant difference in domain scores for HADS and MMQoL at pre-consumption indicated that the sample overall was comparable in terms of anxiety, depressive symptoms and HRQoL levels before interventions were administered. At the beginning of the stay in the hospital, it was noted that anxiety and depression levels were more than normal, showing that beyond the disease and the treatment themselves, the shock of being confronted with the diagnosis, the unfamiliar hospital situation in the, and worries about impending surgery or chemotherapy might have been contributory. Patients on radiotherapy and chemotherapy treatment were especially depressed at the baseline substantiating the fact that anxiety and depressive symptoms are normal responses to traumatic events especially during cancer treatment[26].

In agreement with previous studies, this trial also has demonstrated better mood states and improvement of HRQoL level after a dark chocolate intervention[8,27]. A study using dark chocolate consumption for two weeks demonstrated decrements of physiological indicators of anxiety and stress among healthy volunteers[10]. Over-time, patients who consumed dark chocolate and those that did not similarly experienced beneficial changes in their anxiety and depressive symptoms scores. However, the changes were more profound in patients with dark chocolate intervention. The greatest changes in terms of effect sizes were also observed in the psychological aspects including anxiety, depressive symptoms and psychological well-being domain. These findings once again reinforce the stress reduction benefits of dark chocolate consumption.

Accumulating evidences from the chocolate studies had further convinced researchers that chocolate consumption may suppress anxiety and depressive symptoms by multiple paths [28]. According to other studies, interventions that can lower blood pressure, pulse rate and respiratory rate could excite the improvement of anxiety[29].Dark chocolate could possibly produce similar benefits by creating a declining effect on blood pressure (one of the physiological indicators of anxiety) due to the high flavonoid and arginine contents which helps to regulate blood pressure and inflammation through dilation of blood vessels.

The oro-sensory properties of dark chocolate were also perceived to be the main

contributor of mood regulation. The oro-sensory aspects were mediated by dark's chocolate palatability and its unique combination of sweetness and aroma. This represents the most popular explanation for creating better mood states among chocolate lovers[27]. Since dark chocolate is a palatable food and its consumption is thought to stimulate the release of endorphins (which produce feel-good sensation) this potentially increases appetite and mood[30]. Apart from the endorphins, the contents of sugars and fat in chocolate may result immediate increase of energy, alertness and mood by initiating the release of tryptophan and serotonin[31]. These psychoactive substances are helpful in producing comforting effects to the emotional state during chocolate consumption. In addition, there is a close relationship between carbohydrate contents, brain serotonin and depressed mood. The elevation of serotonin levels would relieve depressive symptoms[32].

In addition, chocolate ingestion has also been suggested to affect mood through their nutritional components which evoke psychophysiological sensation[33,34]. The contents of cocoa butter (fat) and sugars in chocolate have been reported to result in subsequent immediate increases of energy and alertness. Furthermore, a number of specific serotonergic contributions to chocolate eating have been suggested and the associations between serotonin, mood and craving have been identified as the contributors of emotional eating[35]. Stress commonly stimulates the secretion of mineralcorticoids and glucocorticoids which resulted in the decrease of magnesium level in the body. Magnesium in lower level can lead to selective depletion of dopamine (a neurotransmitter that transmits signal of satisfaction and euphoria in the central nervous system) followed by decrease of serotonin. The high concentration of magnesium (520mg/100g) in chocolate is proposed to elevate mood[5]. Salsolinol (SAL) is one type of the tetrahydroisoquinolines that found in chocolate which has also been deemed to be one of the main psychoactive compounds present in chocolate products. The compound may binds to dopamine receptors which are specifically responsible for reinforcement and reward by suppressing the breakdown of serotonin and extending their duration of action[36]. SAL may also influence the production of endorphins and the amount of SAL ingested in 100g of chocolate has been shown to be adequate to interact with the dopamine receptors[37].

The findings in our study illustrated the negative relationships between anxiety and depressive symptoms with HRQoL status suggested that the presence of psychological problems seemed to reduce HRQoL. Perhaps any intervention which suppresses anxiety and depressive symptoms would be sufficient to produce greater HRQoL levels among hospitalized cancer patients. Encouragingly, as anxiety and depressive symptoms were ameliorated, the HRQoL status had also improved at post-intervention among the cancer patients. This suggested parallel outcome with previous interventional studies, indicating that intervention which reduced anxiety and depressive symptoms would indirectly improve the HRQoL status in cancer patients[38]. Furthermore, a cohort study had also proven that chocolate consumption and preference was associated with better health, optimism and better psychological well-being among old adults who were in their old age[28]. However, our findings could not compare with any data from past research as to our knowledge none of the chocolate research had conducted among cancer patients.

There were a few factors that imposed limitations on our study. The effects of dark chocolate on anxiety and depressive symptoms are known to be influenced by situational variables. The availability of the intervening food and the pleasure derived from dark chocolate consumption were also perceived to alter emotional states. All of the hospitalized patients included in our study were experiencing a mixture of emotions. During periods of low mood, the preference for junk food such as chocolate usually increases[39].For example, the preference for sweet food such as chocolate is increased during bad mood among women. The consumption of chocolate is thought to be partly attributed to better mood states[40]. Additionally, the provision of dark chocolate might have been viewed as a self-gift by hospitalized patients - thereby possibly influencing the findings of this study[41]. Essentially, this might have made the patients felt "happier". Moreover, the majority patients stated that they felt better and happier particularly during discharge because they were going home to be with their family, this again potentially explaining the positive outcomes. Although treatment such as chemotherapy would have also been capable of exerting bias in our study outcomes, no significant difference in anxiety, depressive symptoms and HRQoL was found between patients on chemotherapy and those not on such treatment, confirming the absence of treatment influences. But most importantly, chocolate preference would have been a vital extraneous variable confounding our results as indicated by the more significant proportion of chocolate lovers in the SG in relation to CG respondents. There were possible response biases due to prior perception that dark chocolate consumption may alleviate anxiety and depression levels. Perhaps liking chocolate or not will influence the outcomes. Nonetheless, we did not distinguish the chocolate-loving respondents from non-chocolate-loving respondents. The short duration of dark chocolate administration was also an additional limitation in our study. Dark chocolate was administered to the patient only for 3 consecutive days to suit the average duration of hospitalisation (between 3 to 7 days) depending on the type of treatments and their health conditions[22,23]. This also was planned to ensure the compliance of dark chocolate by each patient within the study period. Another limitation of this was due to the apparent lack of blinding between the interventions. Nonetheless, we attempted to minimize this limitation inherent in an open-label design by having similar packaging for both interventions and randomisation was also incorporated in our study to minimise bias in group allocation. Studies in the future should possess more uniformed and indistinguishable presentation for intervention and control in which placebo (with no cocoa derivative) for dark chocolate shall be used as control intervention. In addition, future studies with longer study period, along with diagnostic interviews and biophysiological factors examinations are also recommended.

Conclusions

Despite the limitations, it was concluded that anxiety and depressive symptoms and HRQoL were significantly improved in the group of patients who consumed dark chocolate for 3 consecutive days compared to those who did not. This suggests that there were mood-elevating effects of dark chocolate consumption particularly in alleviating anxiety and depressive symptoms and HRQoL among the hospitalized cancer patients. Because other external attributes may also be influential on anxiety, depressive symptoms and HRQoL, further

extensive studies with different types of chocolate, longer consumption periods along with affirmative clinical diagnostic interviews and the biophysiological factors examination are necessary before it could be recommended as a practical remedy for hospitalised patients with cancer.

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