

ORIGINAL ARTICLE

**OUTCOMES ON PSYCHOSOCIAL FACTORS AND
NUTRITION-RELATED QUALITY OF LIFE:
EVALUATION OF A 10-WEEK NUTRITION EDUCATION
INTERVENTION IN UNIVERSITY STUDENTS**

Wan Putri Elena Wan Dali, Mohd Razif Shahril*, Pei Lin Lua**

***Centre for Community Development & Quality of Life (CCDQ), Faculty of
Medicine and Health Sciences, Universiti Sultan Zainal Abidin (UniSZA),
Kampus Kota, Jalan Sultan Mahmud, 20400 Kuala Terengganu, Malaysia.**

Abstract

Objective: The purpose of this study was to evaluate the effectiveness of nutrition education intervention among university students in terms of social, psychological factors and nutrition-related Quality of Life (NQoL) outcomes after receiving a 10-week nutrition education. Longitudinal and randomised study design was adopted for the study. **Methods:** A total of 417 respondents from four public universities in Terengganu were randomly assigned to either intervention group (IG = 205) or control group (CG = 212). The IG received nutrition education through three tools; 1) conventional lecture, 2) brochures and 3) text messages via short messaging system (SMS) while the CG not received any intervention. Students completed the Malay version of NQoL (6 domains; 49 items; Likert-type responses=1-5) and SF-36 (8 domains; 36 items) at pre-intervention and post-intervention. Data analysis was carried out by using SPSS 16.0 utilising descriptive and parametric statistics. **Results:** Ninety-one percent of participants (IG = 178; CG = 202) completed the study (age = 19.1±1.1 years; female = 87.6%; Malay = 98.2%). After controlling for possible confounders (eg. weight, waist, hip circumferences and pre-intervention scores for each domain), IG possessed relatively higher NQoL score in *Food Impact* ($p = 0.001$), *Social / Interpersonal* ($p = 0.008$), *Physical Functioning* ($p = 0.011$) and *Overall NQoL* ($p = 0.001$). However, *Psychological Factors* did not show any significant difference for both groups. **Conclusion:** Although the intervention did not generate significant impact in the psychological component over a period of 10 weeks, significant positive impacts in Social/Interpersonal aspects and NQoL were clearly shown. *ASEAN Journal of Psychiatry, Vol. 15 (1): January – June 2014: 39-53.*

Keywords: Nutrition Education, Quality of Life, Nutrition Lecture, Brochure, Text Messaging

Introduction

The psychological well-being of university students is a very crucial component in the training and development of future intellectuals. The more psychologically healthy the university students are, the more likely they will be productive and successful in their academics [1]. However, Barker and

Galambos (2007) [2] discovered that university students are at risk of unhealthy eating behaviors as a result of the pressures of independence and hurried lifestyles in university. Another study showed that university students also experience stress during university life that may negatively influence their diet and hence have a negative impact on their nutrition-related quality of life

(NQoL) [3]. In relation to this, the psychological consequences of stress could in turn affect eating habits as they tend to eat more as a way of coping with such stress, hence contributing to weight gain and obesity [4]. It is expected that what we eat will affect our quality of life (QoL) since our identification of self, social interactions and psychological well-being are usually influenced by our food intake [5]. The inclusion of NQoL as an outcome measure for health-related quality of life (HRQoL) in association with dietary habits has not been extensively studied among university students [6]. Interestingly, a recent review provides encouraging evidence that cognitive, behavioral and mindfulness based interventions were effective in reducing psychological problems compared to psycho-educational and arts-based interventions [7]. In spite of this, little is known on whether nutrition education based interventions could reduce the psychological problems among Malaysian university students.

Nutrition education is defined as any set of learning experience designed to facilitate voluntary adoption of eating and other nutrition-related behaviour conducive to health and well-being [8]. It is recognised as an important component in programmes and interventions related to health promotion and disease prevention and it was widely employed in various populations such as school children, adolescents, young adults, older adults, pregnant women, infants and young children [9-13]. It has been proven to be effective in improving nutrient intakes, general knowledge about food and nutrition, as well as psychosocial variables such as self-efficacy and self-esteem among these populations [14]. Although numerous nutrition education interventions have been implemented previously, relatively few efforts have been targeted among university students [6, 15]. However, several previous studies have shown that class-based nutrition education improved fruits and vegetables consumption among university students [16]. Similarly, class-based nutrition education has been used to enhance nutritional knowledge among university students with the goal to decrease soft drinks and to increase milk and milk products consumption [11].

The most recent version of the Malaysian Dietary Guidelines (MDG) 2010 was launched on 25th March 2010 with the newly modified edition consisting of 14 key messages to replace the first version published in 1999 [17]. A variety of media channels have been used to disseminate information from the previous version of MDG to the public such as roadshows, exhibitions, leaflets and websites. However, a study conducted by Norimah and co-members (2010) [18] unfortunately showed that about 63% of the respondents from 773 adults (aged between 18 to 59 years) were not even aware of its existence although the previous guideline was published 10 years ago. Thus, a study by Tee (2011) [19] suggested that there should be other innovative ways to disseminate the current MDG 2010 through new media channels/ technologies such as usage of SMS in the future.

Text messaging, otherwise known as short message service (SMS), has become an important modality for mobile communication. Text messaging consists of the nearly immediate delivery of synchronous short messages (160 characters maximum). An estimated 2.25 trillion text messages were sent in 2011, an increase from 1.68 billion in 2006, showing remarkable growth in wireless communication [20]. Text messaging is a widely accessible, relatively inexpensive tool for health behavior change and numerous studies proved that text messaging have positive short-term behavioral outcomes [21-22]. Besides that, young people are fast adopters of new technologies and the largest users of text messaging making it one of the best choices as means of intervention delivery. Mobile interventions have the ability to interact with the individual with much greater frequency and in the context of the behaviour compared to internet interventions delivered to computers [23]. Text messaging also might be useful as a reinforcement tool for nutrition education along with other conventional methods such as delivering through classes and brochures in a multimodal intervention setting.

Thus, the purpose of this study was to evaluate the effectiveness of a 10-week nutrition education intervention among university

students in improving social, psychological and NQoL outcomes.

Methods

This longitudinal study was carried out in four public universities in Terengganu, Malaysia starting September 2011 until February 2012. The lists of all available classes (also called as clusters) were gathered from the heads of department of each university. From these lists, a total of 16 classes were selected randomly using simple random sampling to represent the target population of this study. All the randomly selected clusters were then randomised into intervention group (IG) and control group (CG) by drawing sealed

envelopes containing group assignment. Included participants were Malaysian university students aged between 18 to 24 years; actively using a mobile telephone; in first or second year diploma / degree of management studies; generally healthy and able to read, write, speak and understand Malay or English language. Respondents were excluded if their age was below or above the stated age (< 18 years or > 24 years); did not have mobile phones; were in the final year and in other studies; have been diagnosed with any diseases and were unable to read, write, speak or understand Malay or English. At the end of this study, 417 university students agreed to participate (IG = 205, CG = 212). However, only 380 students completed the entire study (IG = 178, CG = 202) (Figure 1).

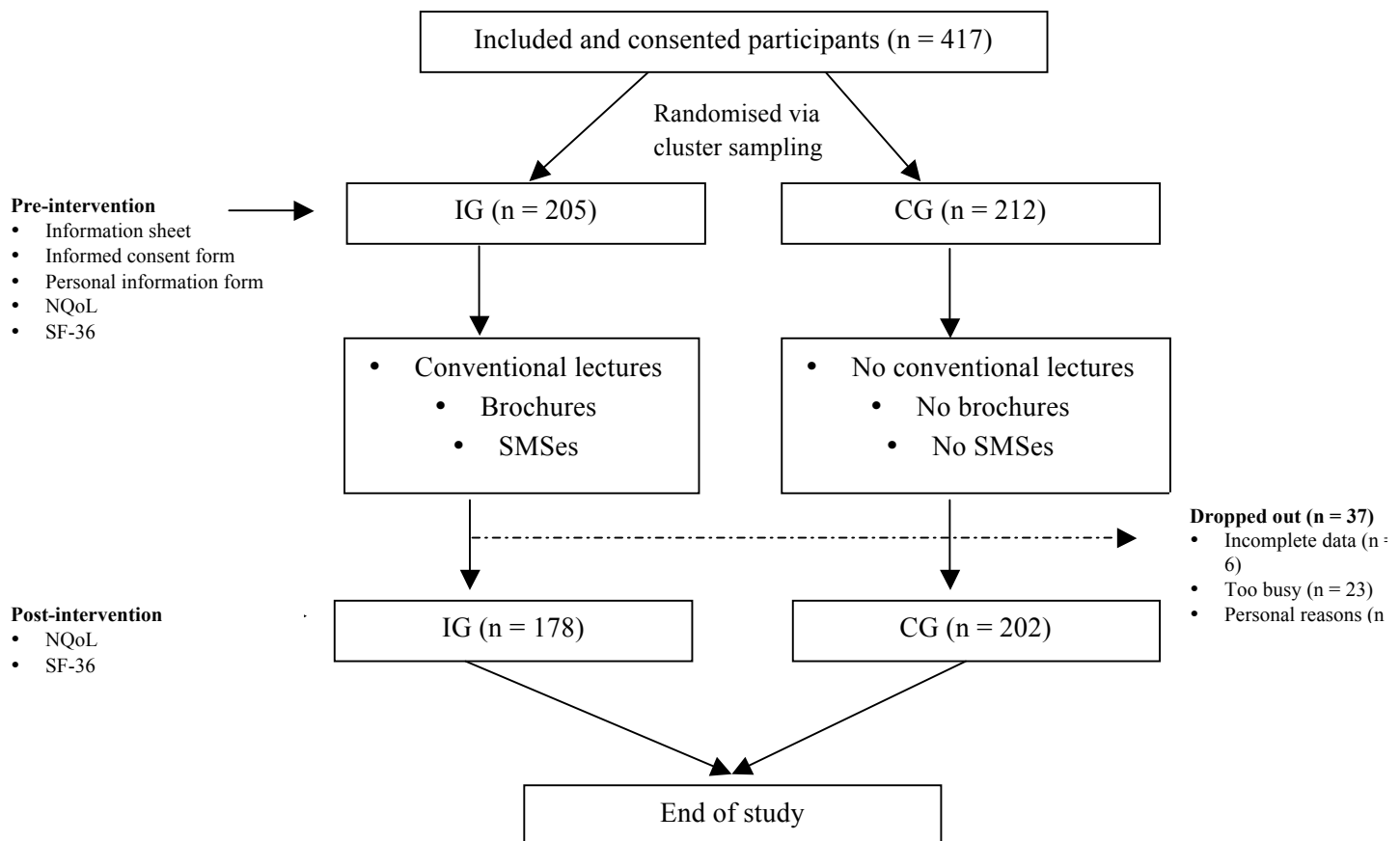


Figure 1: Flowchart of respondent's recruitment

Description of Intervention

The nutrition education intervention employed was based on the latest MDG 2010 which comprised 13 out of 14 nutrition topics (Table

1). Messages which deliberated on the *Practise Exclusive Breastfeeding from Birth until Six Months and Continue to Breastfeed until Two Years of Age* were excluded due to their irrelevance to the current participants

who were undergraduates and who were mostly unmarried. The rest of the messages were divided into three different modules; 1) Always be healthy (3 messages), 2) Eat moderately (5 messages) and 3) Live for the future (5 messages).

All included messages were delivered through three modes; 1) conventional lecture, 2) brochures and 3) text messages via SMS which were provided for IG only within 10 weeks after recruitment. Conventional lecture was carried out in which all key messages in the guidelines were compiled into a 64-slide multimedia Microsoft PowerPoint presentation. The slides used were clearly visible for approximately 100 students with appropriate font sizes. Attractive graphics and suitable combination of colors were additionally used to stimulate their interest on the topics delivered. Brochures were designed to enhance their understanding and memory after the lecture, containing *Key*

Recommendations and *How to Achieve* the recommendations for each message with three different modules. Three brochures were developed, each representing the same three modules as presented in the conventional lecture. The information was displayed on coloured art papers (size 35.8 cm x 25 cm) in four-folded format as well as double-sided printed. Pictorial graphics which includes food pictures, cartoon pictures and symbols were used to attract the readers. The text language was kept simple with black 12-sized font. Text messages via SMS were sent manually through the *Mobile Nutritional Education System (MNES)* which was developed by Mobile Content and Services Provider based in Kuala Lumpur, Malaysia. Text messages can be delivered through all types of cellular telephone with a limitation of 152 characters for each thirteen messages. As the national language, Malay language was used in all the lecture, brochures and SMSes and abbreviations were avoided to prevent misunderstanding of the information received.

Table 1. The modules and key messages incorporated in the nutrition education module

Modules	Messages
1) Always be healthy	<ul style="list-style-type: none"> - Eat a variety of foods within your recommended intake - Maintain body weight in a healthy range - Be physically active everyday
2) Eat moderately	<ul style="list-style-type: none"> - Eat adequate amount of rice, other cereal products (preferably whole grain) and tubers - Eat plenty of fruits and vegetables everyday - Consume moderate amounts of fish, meat, poultry, egg, legumes and nuts - Consume adequate amounts of milk and milk products - Drink plenty of water daily
3) Live the future	<ul style="list-style-type: none"> - Limit intake of foods high in fats and minimise fats and oils in food preparation - Choose and prepare foods with less salt and sauces - Consume foods and beverages low in sugar - Consume safe and clean foods and beverages - Make effective use of nutrition information on food labels

Content validity and face validity of these three modes were initially evaluated by two qualified researchers experienced in nutrition and dietetics and were then pre-tested among 116 university students for clarity and readability as well as the overall content of intervention [24]. Subsequently, the contents in these three modes were modified based on the inputs and feedbacks obtained from

respondents recruited during the pre-test. Throughout the pre-testing of intervention, majority of them (91.3%) rated the slides as comprehensible, ranked the presentation as “interesting” (73.2%) while, 64.7% of them ranked the information included as adequate. Other than that, the brochures were considered to be at least “good” with regard to its pictorial graphics (85.3%) and languages

(81.9%). Most of the students were also generally contented with the information given through the SMS (86.2%). Overall, 94.0% of the students believed that nutrition education delivery through a variety of methods can enhance their awareness and knowledge.

Outcome Measurements

Short Form 36 health survey (SF-36) instrument [25]

This instrument was one of the most extensively used instruments in health care, having been widely translated and tested worldwide. The SF-36 was a multi-purpose, short form health survey containing 36 questions. It generated an eight-scale profile of scores; *Physical Functioning* (10 items), *Role-Physical* (4 items), *Bodily-Pain* (2 items), *General-Health* (5 items), *Vitality* (4 items), *Social-Functioning* (2 items), *Role-Emotional* (3 items) and *Mental-Health* (5 items). An additional item examined changes in health status compared to one year ago. The Malay translated version of SF-36 health survey questionnaire was administered at the pre- and post test measures for both IG and CG. Each domain was scored independently from 0 (lowest level of function) to 100 (highest level of the function). Higher scores on each scale signified a better health state. The developers have also methodically documented the validity and reliability of this instrument in other countries [26-27]. The Malay translated version of SF-36 has also been tested for their psychometric properties among the general population in Malaysia which consequently contributed to its generally acceptable internal consistency and validity [28].

Nutrition Quality of Life (NQoL) instrument

Nutrition-related QoL was measured via the Malay version of NQoL instrument, which consisted of 49 items (1 item deleted due to its irrelevance for this population – “my food-related condition has caused problems with sexual relations”). This Malay translated version was produced based on the English NQoL Survey version 1.4 [29] which was developed as a tool to monitor the impact of medical nutrition therapy (MNT), a nutrition-based treatment that involves selecting the appropriate food. The original questionnaire of NQoL was initially forward translated into

Malay and later back translated into English. This instrument assesses six domains i.e. *Food Impact* (9 items), *Self-Image* (6 items), *Psychological Factors* (10 items), *Social / Interpersonal Factors* (6 items), *Physical Functioning* (9 items) and *Self-Efficacy* (9 items). Examples of the items for each domain were; *I ate enough food to be satisfied* (*Food Impact*); *Liked the way I look* (*Self-Image*); *Rewarded myself with food* (*Psychological Factors*); *My family/ friends have nagged me about food I ate* (*Social / Interpersonal Factors*); *Walking at a moderate pace for 30 minutes* (*Physical Functioning*) and *Knew what type of food I should have been eating for my healthy lifestyle* (*Self-Efficacy*). For each item, the responses were based on five-point Likert-type scales whereby; 5 = all of the time, 4 = most of the time, 3 = some of the time, 2 = a little of the time and 1 = none of the time. The *Overall NQoL* was derived from the total mean of all the six domains. The frame of reference for all questions was the preceding two weeks. Scores for 27 out of 49 items were transposed so that higher scores indicated better NQoL. Only for one domain i.e. *Self-Efficacy* the scores were not transposed as all the questions were already positively-worded. Since this was a newly-developed questionnaire and has not yet been tested among the current population, an established generic instrument of SF-36 has thus been used as a reference. For the current study, the internal consistency reliability (Cronbach's α) and Pearson's rank correlation coefficient (convergent validity and divergent validity) were utilised respectively for the purpose of reliability and validity tests. Most domains of the Malay NQoL and SF-36 exhibited between moderate to excellent internal consistencies (0.437 - 0.874; 0.504 - 0.813 respectively) which indicated that both instruments possessed acceptable internal consistency reliability. This can be seen in *Self-Image*, *Self-Efficacy*, *Physical Functioning* and *Overall NQoL* while for SF-36, it can be seen in all domains except for *Bodily-Pain* and *Social Functioning*. The evidence of convergent validity was shown by the significant correlations between all NQoL domains and *Overall NQoL* ($r_s = 0.272-0.561$; $p < 0.05$). Most of the domains in SF-36 correlate weakly with *Overall NQoL*, confirming that these generic and specific

instruments measured distinct HRQoL constructs.

Procedures

The NQoL and SF-36 questionnaires were co-administered to the IG and CG before and after the nutrition education intervention. The participants were informed verbally and via the 'Information Sheet' about the purpose of this study and their written consents were obtained prior to data collection. All included participants were met either in their lecture rooms or in lecture halls. The research assistant (RA) was available to assist them during the data collection. Throughout these 10 weeks, the IG received nutrition education in three modes: 1) conventional lecture, 2) brochures and 3) SMS. Participants in IG underwent a second slot of 1.5-hour nutrition lecture a week after baseline by the RA who possessed basic knowledge in food and nutrition. This lecture was conducted after the appointment dates were set according to the time and place agreed with the class representatives. The brochures were distributed once the lecture was completed. After that, all of them received thirteen reminder SMSes (once for every 5 days) through our MNES. During the intervention period, respondents from CG did not receive any classes, brochures or SMSes and were instructed to maintain their normal daily activity. All respondents were thanked for their contribution and help rendered during this study.

Ethical Approval

Ethical approval was granted by the Institute of Health Behavioral Research (IHBR), Clinical Research Centre (CRC) and Ministry of Health Research and Ethics Committee (MREC), Malaysia. Apart from that, permission to conduct the study in each participating university was also obtained from the vice chancellors and heads of department prior to the data collection process. Permission to use the latest MDG 2010 was also approved by Nutrition Division, Ministry of Health Malaysia.

Data Analysis

Initial normality test was carried out utilizing the age and the mean scores of *Overall NQoL* domain as dependent variables. The overall outcomes complied with normality requirements in which the Kolmogorov-Smirnov statistics emerged as $p > 0.05$. The IG and CG were compared descriptively with respect to socio-demographic characteristics. All data analyses were performed using SPSS for Windows version 16.0. Analysis of covariance (ANCOVA) was utilised to examine the changes in NQoL and SF-36 scores from pre- to post-intervention between IG and CG with potentially confounding factors (weight, waist, hip and pre-intervention scores) included as covariates. Adjusted effect sizes using Cohen's interpretation were also added (adjusted mean difference $\div \sqrt{\text{mean square error}}$). The values of adjusted effect sizes between 0.20 to 0.49 were considered as "small" effect, 0.50 to 0.79 as "medium" effect while a "large" effect was indicated if the values were greater than 0.80 [30]. Significance was set a priori at $p < 0.05$.

Results

Demographic characteristics

Overall, there were 417 randomly-selected respondents who met the inclusion criteria and were then randomised to either IG (n=205) or CG (n = 212). Of these, 380 undergraduates completed the study (91.1% response rate), 178 and 202 were in IG and CG respectively. Another thirty-seven respondents (8.9%) were dropped for uncompleted data (n = 6) refusing participation because they were too busy with their studies, examinations and curriculum activities (n = 23) and some stated "personal reasons" (n = 8). The average age of the respondents was 19.1 years (range = 18-24) and height was 157.2 cm. For both groups, most were females; were living with friends, who studied in the first year and their studies were funded either by the National Higher Education Fund Corporation (*Perbadanan Tabung Pendidikan Tinggi Nasional / PTPTN*) or *Majlis Amanah Rakyat (MARA)*. Less than 50% of the respondents consumed breakfast three times a week for both groups. Bed-time was between 12:00 midnight to 2:00 am and

total sleeping hours were 6 to 8 hours per day among most of them in both IG and CG (Table 2).

NQoL assessment

The pre-intervention and post-intervention of unadjusted mean scores for NQoL between IG and CG are presented in the Table 3. In NQoL

domains, improvements were found in IG for *Food Impact, Self-Image, Physical Functioning, Self-Efficacy* and *Overall NQoL* between pre-intervention and post-intervention. On the other hand, after 10 weeks of nutrition education intervention, the mean scores of most NQoL domains (*Food Impact, Self-Image, Psychological Factors, Self-Efficacy* and *Overall NQoL*) remained almost constant in the CG.

Table 2. Demographic and background variables of the respondents

Variable	CG (n=202)	IG (n=178)
Age (year)*	19.2 ± 1.1	19.0 ± 1.2
Height (cm)*	157.8 ± 7.2	156.5 ± 7.1
Weight (kg)*	53.6 ± 12.3	51.9 ± 9.5
Waist circumference (cm)*	68.8 ± 11.2	67.6 ± 9.9
Hip circumference (cm)*	90.0 ± 10.2	89.9 ± 9.6
Gender^a		
Male	35 (17.3)	12 (6.7)
Female	167 (82.7)	166 (93.3)
Living arrangement^a		
Alone	2 (1.0)	9 (5.1)
With family	17 (8.4)	27 (15.2)
With friends	183 (90.6)	142 (79.8)
Academic year^a		
First year	129 (63.9)	114 (64.0)
Second year	73 (36.1)	64 (36.0)
Funding status^a		
Funded	149 (73.8)	130 (73.0)
Not funded	52 (25.7)	48 (27.0)
Breakfast habit^a		
Everyday	54 (26.7)	54 (30.3)
3 times a week	91 (45.0)	80 (44.9)
5 times a week	23 (11.4)	14 (7.9)
Never	34 (16.8)	30 (16.9)
Bed time^a		
Before 12:00 midnight	28 (13.9)	17 (9.6)
12:00 midnight – 2:00 am	135 (66.8)	137 (77.0)
After 2:00 am	39 (19.3)	24 (13.5)
Sleeping hours (/day)^a		
< 6 hours	67 (33.2)	70 (39.3)
6 – 8 hours	131 (64.9)	106 (59.6)
> 8 hours	4 (2.0)	2 (1.1)

*Data expressed as mean ± SD;

^aData expressed as n (%)

The results of ANCOVA for NQoL scores from pre- to post-intervention between IG and CG were also demonstrated in Table 3. Among the NQoL domains, IG reported significantly higher NQoL compared to CG particularly in *Food Impact* ($p = 0.001$), *Social*

/ Interpersonal ($p = 0.008$), *Physical Functioning* ($p = 0.011$) and *Overall NQoL* ($p = 0.001$) after controlling for potential confounders such as weight, waist circumference, hip circumference and pre-intervention mean for each domain. There

were no significant differences found in *Self-Image*, *Psychological Factors* and *Self-Efficacy* for both groups. The *Overall NQoL* has the relatively largest adjusted effect size (0.44) which was nonetheless still considered as a small change based on Cohen's interpretation (Table 3).

HRQoL assessment

Table 3 also shows the pre- and post-intervention unadjusted mean scores for HRQoL domains between IG and CG. Scores at pre-intervention were comparable between IG and CG. At post-intervention, respondents

in IG expressed improvements in HRQoL domains except for *Mental Health* and *Vitality*. Similarly, respondents in CG also showed increments in most HRQoL domains except for *Physical Functioning* and *Vitality*. However, the mean differences between pre and post-intervention in majority of HRQoL domains did not differ to a large extent in both IG and CG.

After controlling for the possible confounders, there were no significant differences in all HRQoL domains over-time between IG and CG ($p > 0.05$). The adjusted effect sizes for all HRQoL subscales ranged from negligible to small (0.01 to 0.11) (Table 3).

Table 3. ANCOVA analysis between two groups after controlling potential confounders.

Variables	Mean ± SD		Adj. mean (95% CI) ^a	Adj. mean diff. (95% CI) ^b	F-stat (df)	p value ^a	Adjusted effect size (Cohen's d)
	Pre-intervention	Post-intervention					
Malay NQoL							
<i>Food Impact</i> Control Group	3.2 ± 0.3	3.2 ± 0.3	3.2 (3.1, 3.2)	0.1 (0.1, 0.2)	16.3 (1, 374)	0.001	0.42 (S)
Intervention Group	3.2 ± 0.5	3.3 ± 0.4	3.3 (3.3, 3.4)				
<i>Self-Image</i> Control Group	3.3 ± 0.5	3.3 ± 0.5	3.3 (3.3, 3.4)	0.0 (-0.1, 0.1)	0.1 (1, 373)	0.717	0.04 (N)
Intervention Group	3.3 ± 0.5	3.4 ± 0.5	3.4 (3.3, 3.4)				
<i>Psychological Factors</i> Control Group	3.4 ± 0.4	3.4 ± 0.4	3.3 (3.3, 3.4)	0.1 (-0.0, 0.1)	2.2 (1, 374)	0.143	0.15 (N)
Intervention Group	3.4 ± 0.4	3.4 ± 0.4	3.4 (3.3, 3.5)				
<i>Social / Interpersonal</i> Control Group	3.8 ± 0.3	3.6 ± 0.4	3.6 (3.6, 3.7)	0.1 (0.0, 0.2)	7.0 (1, 374)	0.008	0.28 (S)
Intervention Group	3.8 ± 0.4	3.8 ± 0.4	3.8 (3.7, 3.8)				
<i>Physical Functioning</i> Control Group	3.1 ± 0.9	3.0 ± 0.9	3.0 (2.9, 3.1)	0.2 (0.1, 0.4)	6.5 (1, 374)	0.011	0.26 (S)
Intervention Group	3.1 ± 0.9	3.2 ± 0.8	3.2 (3.1, 3.3)				
<i>Self-Efficacy</i> Control Group	3.4 ± 0.6	3.4 ± 0.7	3.4 (3.4, 3.5)	0.1 (-0.0, 0.2)	1.3 (1, 374)	0.254	0.12 (N)
Intervention Group	3.4 ± 0.7	3.5 ± 0.6	3.5 (3.4, 3.6)				
<i>Overall NQoL</i> Control Group	3.4 ± 0.2	3.4 ± 0.3	3.3 (3.3, 3.4)	0.1 (0.1, 0.2)	17.9 (1, 374)	0.001	0.44 (S)
Intervention Group	3.3 ± 0.3	3.4 ± 0.3	3.4 (3.4, 3.5)				
SF-36							
<i>Physical Functioning</i> Control Group	93.5 ± 19.1	92.1 ± 12.7	91.5 (89.7, 93.3)	1.3 (-1.3, 3.9)	0.3 (1, 374)	0.326	0.10 (N)
Intervention Group	89.4 ± 13.3	92.2 ± 14.4	92.8 (90.9, 94.7)				
<i>Role-Physical</i> Control Group	90.3 ± 29.8	93.4 ± 26.9	93.5 (89.8, 97.2)	0.2 (-5.3, 5.7)	0.0 (1, 373)	0.941	0.01 (N)
Intervention Group	90.7 ± 21.8	93.8 ± 26.8	93.7 (89.7, 97.7)				

<i>Bodily Pain</i>										
Control Group	77.9 ± 16.6	78.9 ± 16.9	86.4 (79.5, 93.3)	-4.1 (-14.3, 6.0)	0.6 (1, 374)	0.423	0.08 (N)			
Intervention Group	78.9 ± 82.6	82.6 ± 15.5	82.2 (74.9, 89.6)							
<i>General Health</i>										
Control Group	66.5 ± 16.3	70.9 ± 33.0	71.2 (67.4, 74.9)	-1.7 (-7.2, 3.9)	0.3 (1, 374)	0.558	0.06 (N)			
Intervention Group										
<i>Vitality</i>										
Control Group	67.6 ± 24.3	65.8 ± 16.0	65.8 (63.8, 67.9)	-1.2 (-4.2, 1.9)	0.6 (1, 374)	0.453	0.08 (N)			
Intervention Group	66.9 ± 18.3	64.7 ± 17.1	64.7 (62.5, 66.9)							
<i>Social Functioning</i>										
Control Group	82.4 ± 36.6	87.1 ± 36.0	87.1 (83.1, 91.1)	-2.6 (-8.4, 3.3)	0.8 (1, 374)	0.386	0.09 (N)			
Intervention Group	79.3 ± 17.5	84.6 ± 17.0	84.5 (80.3, 88.8)							
<i>Role-Emotion</i>										
Control Group	73.9 ± 36.2	79.2 ± 41.6	79.4 (74.1, 84.6)	-2.0 (-9.8, 5.8)	0.3 (1, 374)	0.615	0.05 (N)			
Intervention Group	72.8 ± 37.5	77.5 ± 36.6	77.4 (71.7, 83.0)							
<i>Mental Health</i>										
Control Group	67.1 ± 14.9	68.9 ± 15.5	69.4 (67.3, 71.5)	-1.6 (-4.7, 1.5)	1.1 (1, 374)	0.298	0.11 (N)			
Intervention Group	68.6 ± 17.4	68.3 ± 18.9	67.7 (65.5, 70.0)							

^a Adjusted mean using ANCOVA after controlling for weight, waist, hip and pre-intervention for each variable

^b Bonferroni adjustment for 95%CI for difference

Adjusted effect size (N = Negligible, S = Small); SD = Standard deviation; Score range: NQoL (1-5); : SF-36 (0-10)

Discussion

The present investigation assessed the effectiveness of a 10-week nutrition education intervention which contained MDG 2010 as intervention and delivered through three tools (conventional lecture, brochures and SMSes) in terms of NQoL and HRQoL outcomes. Overall, this research has provided evidence on the benefits of MDG 2010 as a nutrition education tool for better dietary outcomes among Malaysian university students [31]. Although it takes time and effort to make healthy eating become part of a daily routine among university students, it is still important to educate them about healthy eating patterns when they are young in order to diminish the high risk of chronic diseases in later life [32].

At the completion of nutrition education intervention, results have significantly reflect positive changes notably among IG in NQoL subcomponent scores; *Food Impact, Social / Interpersonal, Physical Functioning* and *Overall NQoL*. These enhancements were statistically significant compared to CG. The NQoL's *Food Impact* domain emphasised on the impact of food or nutrition on a person's physical, mental (mind) and social well-being in which better scores for dietary practices can improve their QoL. Previous studies have suggested that a loss of control during eating was central to lower QoL which were indicated in the samples of adolescents and women with type II diabetes [33-34]. Results showed no significant difference in *Self-Efficacy* for both groups. As the intervention in this study was carried out over merely 10 weeks, it is rather difficult to show any significant effects on the development of one's *Self-Efficacy* since longer period is usually required for alteration of this aspect [35-36]. However, relatively higher outcomes among IG compared to CG were generated at the end of intervention. The *Self-Efficacy* questions measured how confident the respondents were in their choice of the amount of healthy food. However, it is assumed that respondents in the IG were exposed to health information from the MDG 2010 and this has increased their confidence level to choose more healthy food with the right amount. A previous study investigating the effectiveness of a 4-month intervention using stage-based newsletters,

computer-based communication, and motivational interviewing conducted by Richards et al., (2006) [15] also reported that in measuring *Self-Efficacy*, both fruits and vegetables intake were significantly greater in IG than CG at the completion of intervention among college students. Another study demonstrated that HRQoL among forty-seven free-living elderly people improved after completing nutrition education programme which consisted of issues related to healthy eating, prevention and diet therapy of obesity, diabetes, cardiovascular disease and osteoporosis [37]. Based on the findings of both the current and previous studies, it could be confirmed that nutrition education intervention has positive impacts in improving QoL.

Even though our programme did not include performing physical activities, the reported *Physical Functioning* among respondents in IG improved compared to CG. It could be that the information from MDG 2010 itself has provided a lot of benefits to them with specific information on how to be physically active daily. Encouragingly, a previous study among Korean female college students showed that nutrition education coupled with physical exercise significantly decreased body weight and body fat as well as significantly increased HRQoL in terms of *Physical Functioning, Vitality* and *General Health* [38]. The variety type of tools employed in delivering such nutrition education (i.e. conventional lecture, brochures and SMS) could have been appealing and beneficial as well as contributing to the positive outcomes in NQoL status especially in IG. Previous investigations have confirmed that providing class-based nutrition intervention in other population such as children imposed positive effects on nutrition knowledge, attitude, practice and students' choices of food among primary school children and high school teenagers [32, 39]. Providing SMSes (one SMS in five days) as reminders to IG may also be an effective reinforcement approach that can potentially change their NQoL. A review conducted by Fjeldsoe, Marshall and Miller (2009) [40] contended that weekly SMS-delivered interventions have positive short-term behavioural outcomes among healthy adults,

patients with bulimia nervosa, diabetic patients and hypertension.

The results of this research had also indicated that there was a significant increment in *Social Functioning* domain of NQoL for IG compared to CG. Culturally, family and relatives played a fundamental role in people's lives and Malaysians would not generally consider using health problems to evade social, let alone family gathering, which might be a factor of increased of social functioning domain [29]. Interestingly, our study found that *Psychological Factors* did not exhibit significant differences in comparison with previous study [4], which somehow seemed to suggest that *Psychological Factors* were not important outcomes of eating habits despite the administration of nutrition education intervention among this intervention cohort. Having a high BMI could produce distress particularly among women [41]. However, our additional analysis (not specifically shown in the results) demonstrated that our respondents were in the normal-weight range, indicating that their current weight status had little or no influence on their emotion or stress. The reasons for this phenomenon is not clear here but attending university or college could usually be a stressful experience for many college students, of which these psychological or emotional stressors became crucial to the development of obesity [42]. The lack of significant differences in all HRQoL components could be due to the intervention which was more focused on nutrition per se, hence specifically improving QoL related to nutrition rather than the psychological components of the sample.

Limitations of the study included the short length (10 weeks) of the intervention and not targeting the food intakes and physical activities which were important determinants of behavioral changes in NQoL. Whether the positive effects of QoL outcomes would persist or being attenuated in the long run was beyond the scope of this study. Thus, future research should be directed towards longitudinal studies to examine the long-term effect of nutrition education intervention on the outcomes of NQoL. In addition, the actual food intakes of university students in the current cohort should be assessed since this

study was rather focused on the nutrition-related QoL and the intervention itself emphasised heavily on nutrition. The sample of respondents was also rather unbalanced between genders due to difficulty in recruiting males compared to females, a common trend in the universities in Malaysia and the same trend is believed to have also occurred elsewhere [43-44]. Furthermore, the percentage of drop out was quite high among males compared to female respondents (male = 16.1%; female = 7.8%). Anyhow, the strength of our study included the use of reliable and validated questionnaires as well as the inclusion of large samples to substantiate the findings. Yet, this nutrition education intervention should be planned differently for students of other critical courses such as medical and nursing students who generally possess a comparatively high prevalence of psychological problems such as depression and stress [1].

Conclusions

In spite of the indifferent psychological outcomes, our present study still managed to exhibit that the nutrition education intervention conducted over a period of 10 weeks has a positive impact on social and NQoL elements among university undergraduates. The implementation period of the intervention, its contents and delivery modes might have been the critical factors contributing towards the outcomes of the intervention. This represented a practical and inexpensive way which has the potential not only to improve the NQoL for the youths, but for their future generation as well.

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Declaration of conflicting interests

The authors have no conflict of interest or relevant financial relationships in this study.

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Corresponding author: Prof. Dr. Pei Lin Lua, Lecturer, Centre for Community Development & Quality of Life (CCDQ), Faculty of Medicine and Health Sciences, Universiti Sultan Zainal Abidin (UniSZA), Kampus Kota, Jalan Sultan Mahmud, 20400 Kuala Terengganu, Malaysia.

Email: peilinlua@unisza.edu.my

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