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Efficacy of fasting calorie restriction on quality of life among aging men

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ABSTRACT

Calorie restriction (CR) has been promoted to increase longevity. Previous studies have indicated that CR can negatively affect mood and therefore the effect of CR on mood and quality of life (QOL) becomes crucial when considering the feasibility of CR in humans. We conducted a three month clinical trial on CR (reduction of 300 to 500 kcal/day) combined with two days/week of Muslim sunnah fasting (FCR) to determine the effectiveness of FCR on QOL among aging men in Klang Valley, Malaysia. A total of 25 healthy Malay men (age 58.8 ± 5.1 years), with no chronic diseases and a BMI of 23.0 to 29.9 kg/m^2 were randomized to FCR (n = 12) and control (n = 13) groups. Body composition measurements and QOL questionnaires were ascertained at baseline, week 6 and week 12. QOL was measured using the Short-Form 36, sleep quality was determined using the Pittsburgh Sleep Quality Index, the Beck Depression Inventory II was used to measure mood and the Perceived Stress Scale was used to measure depression. The FCR group had a significant reduction in body weight, BMI, body fat percentage and depression ($P<0.05$). The energy component of QOL was significantly increased in FCR group ($p<0.05$). There were no significant changes in sleep quality and stress level between the groups as a result of the intervention. In conclusion, FCR resulted in body weight and fat loss and alleviated depression with some improvement in the QOL in our study and has the potential to be implemented on a wider scale.

1. Introduction

Aging is a non-reversible process, which results in deterioration in organ and functional status. Currently, calorie restriction (CR) is the only non genetic intervention [1] shown to decrease the biological rate of aging. CR has been shown to also produce numerous health and longevity benefits. A randomized controlled study, called CALERIE (Comprehensive Assessment of Long-term Effect of Reducing Intake of Energy) which included a pilot phase, is ongoing to investigate the effect of CR in humans on markers of longevity. The early studies in humans show that CR may reduce the risk of cardiovascular disease and diabetes [2], oxidative stress to DNA [3] and may improve cognitive performance [4]. An alternative to CR, which is called intermittent fasting (IF) or alternate day fasting (ADF) is also suggested to have similar benefits. ADF involves fast days on which subjects need to fast for 20–24 h, followed by feast days on which food intake may be ad libitum [5]. However, this model of controlling eating seems impractical, considering the difficulties of long term adherence to such a regimen.

Fasting is practiced worldwide, usually as part of religion. The Muslim fast is a practice by which all foods and drinks are strictly refrained from dawn to dusk. Ramadan fasting is one of the pillars in Islam, where Muslims fast during the whole month of Ramadan, the ninth month of the lunar calendar. Besides, Muslims also practice Sunnah (the practice of Prophet Muhammad) fasting. Sunnah fasting involves fasting on both Monday and Thursday of each week and six days of fasting in the Shawwal month (the month of Eid festival). Muslim Sunnah fasting is practiced year round and when combined with a moderate CR regimen on the five non fasting days of the week it provides a CR regimen that is both habitual and potentially sustainable. While there are studies about Ramadan fasting in human health [6–9], there is no scientific study done on the Muslim Sunnah fasting combined with a moderate CR regimen as proposed in this study.

We conducted a three month pilot study to investigate the feasibility of this new fasting calorie restriction (FCR) model and its effect on the quality of life (QOL), food intake and body composition in Malay elderly. Malay elderly were chosen as subjects since they are more likely to comply with Sunnah fasting. Further we were interested in determining the feasibility of the FCR regimen and its effects in this population before we extend it to the younger age groups. We hypothesized that three months of FCR will improve both nutritional and QOL status.

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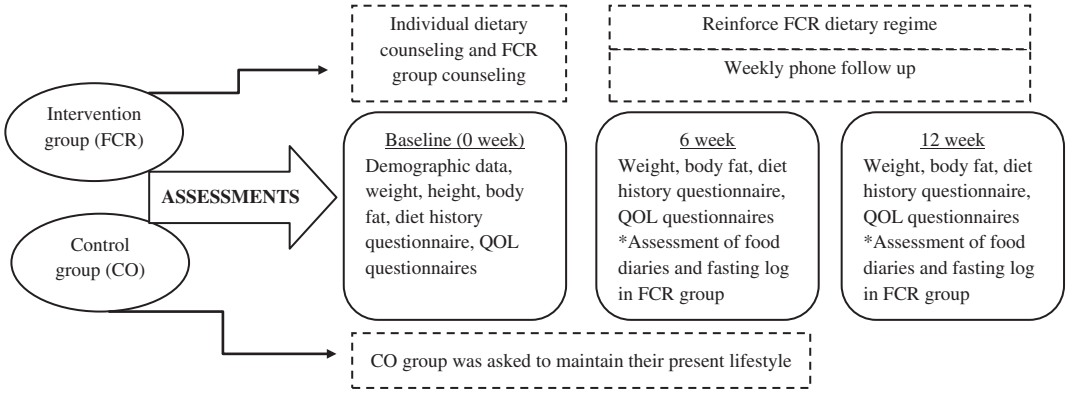

Fig. 1. Trial timeline. FCR: Fasting Calorie Restriction.

2. Methods

2.1. Study design and subjects

Health screening was conducted in the community to identify eligible subjects. This program was advertised through posters and fliers to the residential areas around Klang Valley, Malaysia. Healthy (defined as absence of uncontrolled chronic diseases) Malay men, 50–70 years of age, BMI 23.0–29.9 kg/m², with no history of mental or physical disabilities were eligible to participate in the study. Individuals who regularly practiced Muslim Sunnah fasting for the past three months prior to recruitment were excluded from the study. This study was approved by the Research Ethical Committee of Universiti Kebangsaan Malaysia Medical Centre and written informed consent was obtained from all participants.

The FCR regime consisted of reduction of 300 to 500 kcal/day from their habitual energy intake combined with two days of Muslim Sunnah fasting per week for a three month period. Habitual energy intake at baseline was carefully calculated using Diet History Questionnaire (DHQ) [10] and further analyzed for macronutrient distribution using Nutritionist Pro Software and Malaysian Food Composition. DHQ was administered and analyzed by a dietitian. From their calculated baseline habitual energy intake, a 300–500 kcal/day restriction was prescribed based on body weight status and physical activity level of each participant. The intervention group was instructed to adhere to the FCR regime through individual and group counseling. The control group was asked to maintain their present lifestyle.

Outcomes were measured at baseline, week 6 and week 12 of the study (Fig. 1). Height was measured using Seca-213 Portable Stadiometer (SECA, Hamburg, Germany). Body weight and body composition was assessed using the bioelectrical impedance analysis scale (TANITA BC-418;Tanita Corp., Tokyo, Japan) [11].

Subjects were asked to complete a self administered questionnaire consisting of sociodemographic and quality of life assesments. The Short-Form 36 (SF-36), with its 36 items and eight components is widely used to assess quality of life [12] and was used in this study to measure QOL. The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument to assess the pattern and quality of sleep among aging people. It differentiates between 'good' and 'bad' sleep quality using 19 items in seven components. This questionnaire has a sensitivity of 89.6% and specificity of 86.5% in identifying sleep quality [13] and was used to determine sleep quality in our Malay men. The Beck Depression Inventory II (BDI-II) consists of 21 items which have been tested for content validity, concurrent validity and construct validity to measure mood [14] and was used to assess depression in this study. The Perceived Stress Scale (PSS) developed for community purposes is easy to understand [15] and three types of PSS scales are commonly used i.e. the 4-item, the 10-item and the 14-item. In this study, we used the 4-item scale because it is the simplest method for measuring perceived stress. All of the questionnaires were back to back translated to Malay language.

A food diary (three day diet record) and fasting log was given to subjects at study week 6 and week 12. Subjects were given detailed explanation on how to complete the diary before the commencement of the study. Compliance to the FCR regime was assessed using fasting logs, food diaries, from weekly phone check in logs, and verification of the information obtained using surrogate information obtained from subjects' family members.

2.2. Development of FCR module

Extensive literature review of the CALERIE and ADF study protocols was conducted. Malaysia Dietary Guideline, NCCFN 2010 [16] and Guide for Nutrition in Elderly People Annual Report 2007, MOH Malaysia [17] were used as guidelines in the development of the FCR booklet. Considerations were made for the nutritional and health problems, dietary habits, and lifestyle of Malaysian elderly. The FCR booklet consisted of tips in the following areas: 1. Sunnah fasting on Monday and Thursday. 2. Maintenance of a normal body weight. 3. Variety of food choices. 4. Increasing fruit and vegetable intake.

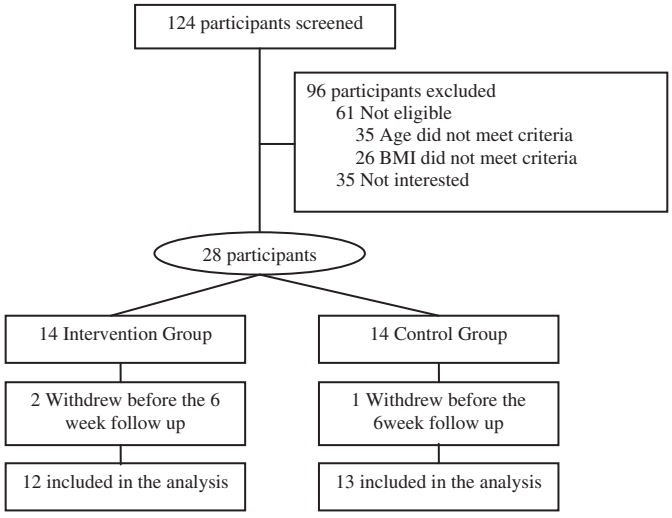

Fig. 2. Subject recruitment.

Table 1
Baseline screening characteristics of subjects who completed the study (n = 25).

Characteristics	Control (n = 13)	Intervention (n = 12)
Age	58.3 ± 6.3	59.3 ± 3.4[a]
Health status		
No disease, n (%)	9 (69.2)	8 (66.7)[b]
Hypertension, n (%)	4 (30.8)	4 (33.3)[b]
Smoking habit		
Not smoking, n (%)	8 (61.5)	10 (83.3)[b]
Smoking, n (%)	5 (38.5)	2 (16.7)[b]
Weight, kg	72.9 ± 8.5	71.6 ± 6.0[a]
BMI, kg/m²	26.5 ± 1.8	27.0 ± 1.7[a]
Body fat,%	25.0 ± 2.9	26.4 ± 3.9[a]

Values are presented as mean (SD).
[a] NS — Non significant using independent sample *t* test.
[b] NS — Non significant using chi square test.

5. Choosing low fat and low cholesterol foods. 6. Choosing whole meal grains. 7. Reducing intake of sugar and sweets. 8. Moderation in food intake. 9. Exercise. A guide on the 7 day menu was also provided. The validity of the module was assessed using a panel of experts including physicians, nutritionists and dietitians.

2.3. Statistical analysis

Analyses were carried out using SPSS version 17.0. Changes from baseline to week 6 and week 12 were analyzed using repeated measures ANOVA with baseline values included as covariates. Results are presented as means and standard deviations with three p values: 1) time effect, to test whether there was a change over time; 2) group effect, to test the difference between both groups throughout the intervention period; 3) time and group interaction, which is the test of intervention effect.

3. Results

3.1. Sample characteristics

A total of 124 Malay men participated in the health screening but only 35 subjects were eligible for participation in this study. Of the 35 subjects who were invited, 28 agreed and consented to participate. Subjects were randomized to the FCR (n = 14) or control (CO) groups (n = 14).

Three subjects dropped out of the study at the 1st follow up, (two subjects from FCR group who were unable to follow the regime) and one subject from CO group (due to personal reasons). Thus, 25 subjects with mean age of 58.8 years and mean BMI of 26.8 kg/m² were able to complete the study as shown in Fig. 2. Both intervention and control groups were comparable with respect to age, BMI and body composition. Table 1 shows baseline screening characteristics of the subjects.

3.2. Food intake and body composition

Table 2 shows subjects' energy and macronutrient intake and body composition variables over time. There was a significant decrease in energy intake in the FCR group as a result of the intervention (baseline energy intake 1681 ± 191 kcal/day, energy intake at 3 months 1371 ± 186 kcal/day; $p<0.01$). The fasting log

Table 2
Changes in food intake and body composition.

Parameter	Baseline (mean ± SD)	Week 6 (mean ± SD)	Week 12 (mean ± SD)	p (partial eta square)		
				Time effect	Group effect	Time × group
Food Intake Energy (kcal)						
FCR (n = 12)	1680.6 ± 190.9	1413.2 ± 105.3	1371.0 ± 186.4	0.057 (0.117)	0.008 (0.270)[a]	0.098 (0.096)
Control (n = 13)	1701.1 ± 290.0	1742.0 ± 220.8	1646.3 ± 491.0			
CHO (g)						
FCR (n = 12)	207.5 ± 34.4	186.0 ± 18.5	189.4 ± 19.6	0.407 (0.038)	0.017 (0.223)[b]	0.516 (0.028)
Control (n = 13)	224.3 ± 49.4	226.8 ± 37.0	214.5 ± 62.4			
Protein (g)						
FCR (n = 12)	56.2 ± 12.9	64.4 ± 8.5	56.9 ± 17.0	0.038 (0.133)[b]	0.065 (0.140)	0.953 (0.002)
Control (n = 13)	64.9 ± 21.9	73.5 ± 11.8	63.8 ± 14.6			
Fat (g)						
FCR (n = 12)	69.5 ± 17.6	44.1 ± 6.6	42.9 ± 10.9	0.004 (0.217)[a]	0.005 (0.293)[a]	0.000 (0.303)[c]
Control (n = 13)	60.4 ± 15.6	60.0 ± 14.4	66.3 ± 13.9			
Body composition body weight (kg)						
FCR (n = 12)	71.6 ± 6.0	69.8 ± 6.3	69.3 ± 6.0	0.057 (0.117)	0.316 (0.044)	0.000 (0.312)[c]
Control (n = 13)	72.9 ± 8.5	73.3 ± 8.7	73.7 ± 8.4			
BMI (kg/m²)						
FCR (n = 12)	27.0 ± 1.7	26.5 ± 1.9	26.3 ± 1.9	0.409 (0.038)	0.938 (0.000)	0.020 (0.157)[c]
Control (n = 13)	26.5 ± 1.8	26.7 ± 1.9	26.8 ± 1.9			
% Body fat						
FCR (n = 12)	26.4 ± 3.9	26.7 ± 4.1	25.3 ± 3.8	0.121 (0.088)	0.532 (0.017)	0.033 (0.138)[b]
Control (n = 13)	25.0 ± 2.9	25.4 ± 2.9	25.5 ± 2.9			
Fat free mass (kg)						
FCR (n = 12)	52.7 ± 3.8	51.4 ± 4.3	52.2 ± 4.1	0.041 (0.130)[b]	0.185 (0.075)	0.108 (0.092)
Control (n = 13)	54.6 ± 5.1	54.5 ± 5.2	54.8 ± 5.2			

[a] $p<0.01$ using repeated measures ANOVA, adjusted for age and body weight.
[b] $p<0.05$ using repeated measures ANOVA, adjusted for age and body weight.
[c] $p<0.001$ using repeated measures ANOVA, adjusted for age and body weight.

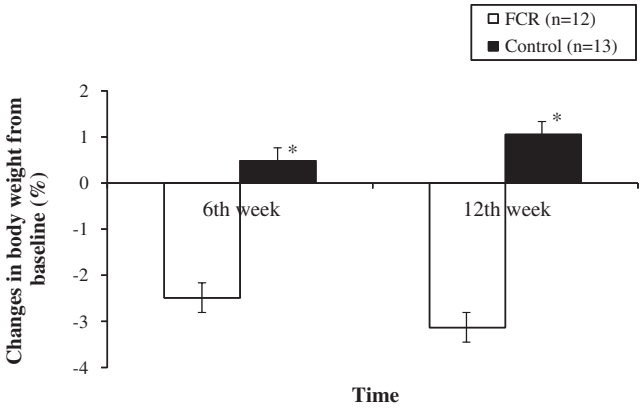

Fig. 3. Percent change in body weight at week-6 and week-12.

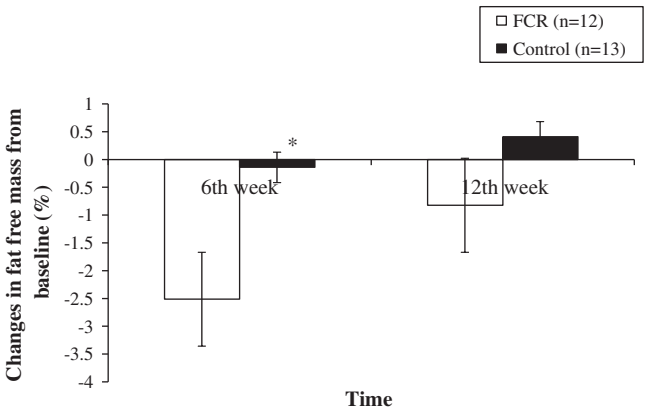

Fig. 5. Percent change in fat free mass at week-6 and week-12.

book, food diaries and weekly phone monitoring systems showed that all subjects in the FCR group were in compliance with the FCR regimen. There was a small non-significant decrease in energy intake in the CO group (baseline energy intake 1701 ± 290 kcal/day, energy intake at 3 months 1646 ± 491 kcal/day). There was a significant reduction in carbohydrate intake in the FCR group compared to the CO group ($p = 0.017$). Fat intake over the course of the intervention was significantly reduced in the FCR group and increased in the CO group ($p<0.01$).

With respect to body composition, there was a significant reduction in body weight ($p<0.001$), BMI ($p<0.001$) and fat mass ($p<0.05$) (Table 2) in the FCR group compared to the CO group, over the 12 week period. Percent weight change from baseline to week twelve was −3.14% in FCR group compared to +1.1% in control group (Fig. 3). Fat mass was reduced by −6.35% in FCR group compared to a +2.7% increase in the control group (Fig. 4). Fat free mass was reduced by −0.9% in FCR group compared to a +0.4% increase in the control group (Fig. 5).

3.3. Quality of life

3.3.1. RAND SF-36

As shown in Table 3, three of the eight components of QOL were significantly increased/improved over time in both FCR and control groups ($p<0.05$); the FCR group showed greater increase in vitality (8.7% FCR vs 5.9% in the control group; $p<0.05$) and improvements in the physical health component, (8.3% in the FCR group as compared to 6.2% in the control group; $p<0.05$). Although both groups showed increases in bodily pain, there were greater increases in body pain in the CO vs FCR ($p<0.05$).

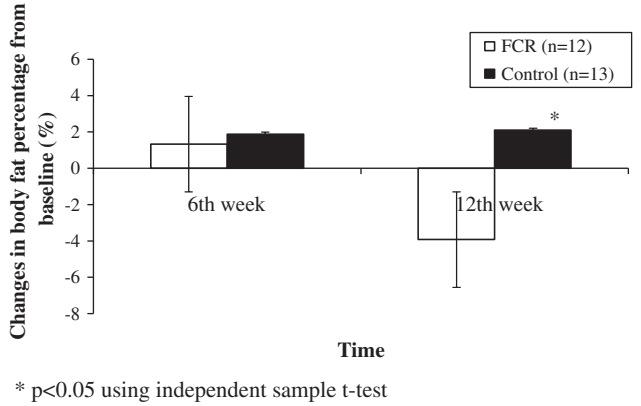

Fig. 4. Percent change in % fat at week-6 and week-12. * $p<0.05$ using independent sample *t*-test.

3.3.2. Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was poor in both groups at baseline (mean score of 5.2 for intervention and 5.1 for control; with a score of 5 or more indicates poor sleep quality). Both groups showed significant improvements in sleep quality over the 3 month period ($p<0.05$), however, no significant difference was observed between the intervention and control groups.

3.3.3. Beck Depression Inventory—II (BDI-II)

Baseline depression scores in our subjects were very low (1.4 in the FCR group and 1.5 for control) and decreased further at the end of the study, however, these changes were not significant within or between groups.

3.3.4. Perceived Stress Scale (PSS)

A decline in PSS scores was observed in both the intervention and control groups but these changes were not significant both within and between groups at the end of the 3 month period.

4. Discussion

Muslim fasting is practiced by believers worldwide and no adverse effects have been reported in healthy adults. However, to our knowledge the Sunnah Muslim fasting although widely practiced has never been examined as a model for CR. This is the first randomized controlled trial to examine this new model of controlling eating, as an alternative and more sustainable lifestyle for achieving CR and benefits of improved health.

Our study showed that in the three months subjects in intervention group were able to reduce their energy intake by −18% from their usual calorie intake. These changes reached the targeted restriction of 300–500 kcal a day. We recognize that during fasting, meal schedule and meal frequency change [18,19], however, subjects in this study were also advised to consume healthy foods during the periods prior to and at the break of the fast to ensure that the nutrient recommendations were met. Subjects in our control group also reduced their energy intake by a modest 3% although they were advised to maintain their usual eating habits and patterns. It must be noted that at baseline our subjects in both groups did not meet the RNI Malaysia [20] recommendations for energy intake. Nevertheless, the mean energy intake reported in our study was comparable to those reported in MANS (Malaysian Adult and Nutrition Survey) study [21].

Table 3
Changes in RAND SF-36.

No.	Component group	Average score (%)					
		Baseline		6th week		12th week	
		FCR	Control	FCR	Control	FCR	Control
1	Physical function	79.2 ± 18	85.0 ± 17	84.6(19)	81.5 ± 24	83.3 ± 23	86.2 ± 16
2	Functional limitation (physical problem)	87.5 ± 25	73.1 ± 44	87.5(25)	78.9 ± 36	89.6 ± 16	80.8 ± 34
3	Functional limitation (emotion)	77.7 ± 36	82.1 ± 36	80.6(33)	84.6 ± 38	77.7 ± 36	69.2 ± 44
4	Vitality*	77.1 ± 14	71.2 ± 19	75.3(18)	73.5 ± 21	83.8 ± 12	75.4 ± 14
5	Emotional health	85.0 ± 11	81.8 ± 19	84.9(19)	82.5 ± 20	81.0 ± 19	80.9 ± 17
6	Social function	80.2 ± 14	74.0 ± 25	80.2(19)	75.0 ± 24	80.5 ± 17	84.6 ± 21
7	Pain*	81.3 ± 21	69.6 ± 18	83.9(24)	77.8 ± 24	84.4 ± 15	85.0 ± 14
8	General health	71.7 ± 19	77.3 ± 19	71.7(21)	77.3 ± 20	81.7 ± 15	80.4 ± 13
	Physical health*	76.9 ± 17	75.6 ± 18	81.1(15)	76.6 ± 18	83.9 ± 12	80.6 ± 13
	Mental health	78.8 ± 15	77.6 ± 19	78.2(19)	75.1 ± 18	80.7 ± 15	78.1 ± 16

*$p<0.05$, significant time effect, two-way repeated measures ANOVA.

In addition there is the recognized limitation of using food diaries to assess energy intake which may have resulted in under or over reporting [22,23] and in our study food diaries that were used to measure compliance to the protocol. We tried to minimize reporting errors by using weekly follow up phone calls and by getting surrogate information from subjects' family members. Further, we believe that the observed findings are valid since this limitation applies to subjects in both the intervention and control groups. Future studies should consider an objective method of determination of compliance and food intake, such as using doubly labeled water technique, which will provide an accurate measure of total energy expenditure [23–25].

The improvements in body composition observed in our study are consistent with other findings on CR [4,26–28], ADF [29] and the Ramadan fasting [30,31] studies. It has long been established that reducing energy intake may result in decreased body weight and that a 300–500 kcal/day energy reduction will help to sustain this effect.

Most geriatric studies highlight the importance of improvements in QOL which is an important factor in the well being among the elderly [32]. It must be noted that the Muslim Sunnah fast is not just refraining from food and drink and involves doing good deeds to attain the best in life [7,33]. There is therefore a general improvement in QOL since individuals report improvements in spiritual and emotional well being [7].

In the present study, there were improvements in both physical health and vitality in the FCR group. Although pain was increased in both the intervention and control groups, it is interesting to note that the increase was very modest in the intervention group compared to the large increases observed in the control group. This suggests that FCR may have mitigated the changes in pain during the study period. Our findings are in agreement with a survey done among older people in Armenia in which improvements in vitality were observed despite increases in bodily pain [34]. Our study showed that vitality component improved in parallel with the weight reduction in subjects. Weight status has been previously linked to vitality; a study done by Lopez-Garcia [35] showed that overweight elderly men had better vitality than those with a normal weight. Another study by Fontaine [36] showed that decreases in body weight improved both mental and physical status in adults. With regards to depression our study results are in line with other CR studies [37]. It should be noted that the classic starvation study by Keys [38] reported an increase in depression following CR but these findings were observed in conditions associated with poor nutritional status and in a starvation state (>45% CR). In addition all of our intervention subjects did not report any unusual feelings of discomfort, instead they felt good knowing that they did something to improve their health.

5. Conclusion

In conclusion, a three month Muslim Sunnah fasting combined with moderate calorie restriction is feasible and was effective in reducing energy intake, body weight and showed improvements in body composition without compromising the quality of life among elderly Malay men in this study. This model needs to be replicated and tested in larger populations and for longer duration.

Acknowledgment

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