THE JOURNAL OF NUTRITION, HEALTH & AGING©

EFFICACY OF FASTING AND CALORIE RESTRICTION (FCR) ON MOOD AND DEPRESSION AMONG AGEING MEN

N.M. HUSSIN[1], S. SHAHAR[1], N.I.M.F. TENG[1], W.Z.W. NGAH[2], S.K. DAS[3]

1. Dietetic Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia; 2. Biochemistry Department, Faculty of Medicine, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia; 3. Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, MA, USA. Corresponding author: S. Shahar, Dietetic Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

Abstract: *Objective:* An intervention study on the FCR (Fasting and Calorie Restriction) dietary regime was carried out to determine its efficacy in improving mood states and depression status among ageing men. *Subjects:* A total of 32 healthy males (Mean±SD), aged 59.7±6.3 years, with a BMI of 26.7±2.2 kg/m^2 were recruited to the study. *Method:* Participants were randomized to either the FCR group (and were instructed to follow a calorie restricted dietary regime with intermittent fasting) or to the control group (in which individuals were asked to maintain their current lifestyle), for a 3 month period. Mood was assessed using the Profile of Mood States and depression was assessed using Beck Depression Inventory-II and Geriatric Depression Scale-15 at baseline, week 6 and week 12 of the intervention. *Results:* A total of 31 subjects completed the study (n=16, FCR and n=15, control). Significant decreases in tension, anger, confusion and total mood disturbance and improvements in vigor were observed in participants in the FCR group compared to the control group ($p<0.05$). No significant changes in mean depression scores were observed. Weight, BMI and percent body fat were reduced by 3.8%, 3.7% and 5.7% respectively in the FCR group. *Conclusions:* Our findings show that a FCR dietary regime is effective in improving mood states and nutritional status among ageing men.

Key words: FCR, ageing men, depression, mood states.

Introduction

Ageing is a natural biological process that leads to gradual physical, social and psychological changes in the body. Secondary ageing is defined as the deterioration in tissue structure and biological function as a consequence of disease processes and harmful environmental factors (8). Psychological ageing refers to behavioral changes that are correlated to maturity and the capacity to withstand pressures of life (25). Physical well being and mental health in the elderly may be greatly influenced by the challenges imposed by the ageing process and potentially affect mood quality (13). In both industrialized nations of the West and developing countries of Asia, Africa and Latin America, the problem of mental illness including depression among elderly has grown significantly (2) and has been shown to affect up to 35% of the Malaysian elderly depending on whether the elders were community or clinic based. With a rapidly increase ageing population, depression among the elderly has become a critical issue for the mental health and medical communities (10).

Secondary ailments in old age can be prevented or influenced by diet (25). One of the health models associated with delaying biological aging is the calorie restricted diet (CR) (20). CR is a dietary regime that aims to reduce the individual's current calorie intake, while retaining protein, vitamin, mineral and water intake, thereby averting malnutrition (12). A daily CR regime would typically reduce 8 to 25% of the individual's average caloric intake. Another method of CR is through alternate day fasting (ADF). ADF has been proven to be a more sustainable regime than CR (7) and participants report being able to reduce food intake on some days rather than reducing food intake everyday (29).

The question of whether CR has a positive or negative effect on psychological states remains unclear (9). The early studies examining CR effects such as "The Minnesota Semi-Starvation Study" by Keys et al. (11) showed that 45% CR for duration of six months produced negative effects on moods, increased depression, tiredness and sleepiness. Excessive CR can result in negative mood states, impair cognitive skills and thereby, lower one's quality of life (29). However, more recent studies have shown the positive effects of CR on moods. Redman et al. (20) reported that sustained caloric reduction by 25% for a period of six months can reduce depression while producing no significant negative effects on mood. A study from our own group examined the effects of a combination of a calorie restricted diet (CR) and intermittent Sunnah fasting (Muslim fast) on Mondays and Thursdays on ageing Malay men for 3 months on body weight and depression had showed no change in depression scores and significant reductions in body weight, BMI, body fat percentage and some improvement in the quality of life. (27). However, the effect of this regime of fasting and CR (FCR) on mood states was not examined in this phase of the study.

A second phase of the 3 month FCR study with newly enrolled participants allowed us the opportunity to examine FCR effects on mood changes in addition to changes in depression. The intervention was identical to the first phase with a combination of both a calorie restricted diet (CR) and intermittent Muslim Sunnah fasting on Mondays and Thursdays and the effect of a 3 month FCR regime on depression and mood among ageing Malay men was examined. We

Received August 30, 2012
Accepted for publication December 10, 2012

hypothesized that practicing the FCR dietary regime for 3 months would improve mood and decrease depression scores.

Method

Study Design

Healthy Malay men (free from any uncontrolled chronic diseases), 50 to 70 years of age, BMI 23.0 to 29.9 kg/m^2, with no history of mental or physical disabilities were eligible to participate in this study. Please note: It has been shown that by the age of 50 men start to experience tiredness, decrease in muscle strength, decreased testosterone, low libido, lack of memory, etc, what is collectively termed as PEDAM (partial endocrine deficiency syndrome of aging men) (3). Therefore, we recruited Males aged 50-70 years because we felt that it was necessary to begin any intervention for ageing adults starting at the age of 50. Participants were also required to be able to function independently, have some family support to be able to help with their food intake (for the older males) and to be able to read and write. Participants from the Klang Valley were recruited following a health and eligibility screening which was conducted in the community. Klang Valley is an area in Malaysia comprising Kuala Lumpur and its suburbs, and adjoining cities and towns in the state of Selangor. The protocol was reviewed by UKM Medical Centre Research Board and informed consent was obtained for all participants.

Individuals who regularly practiced Muslim Sunnah fasting for the past three months prior to recruitment were excluded from the study. The written informed consent was obtained from all participants. The FCR regime consisted of reduction of 300 to 500 kcal/day from participants baseline energy intake combined with two days of Muslim Sunnah fasting per week and was prescribed for a three month period. Energy intake at baseline and at weeks 6 and 12 were calculated using Diet History Questionnaire (DHQ) (22) and further analyzed for macronutrient distribution using Nutritionist Pro Software and Malaysian Food Composition. The DHQ was administered by a nutritionist and analyzed by a dietitian. From their calculated baseline energy intake, a 300 to 500 kcal/day restriction was prescribed based on energy requirement of each participant. The FCR group was instructed to adhere to the FCR regime delivered through individual and group counseling. The control group was asked to maintain their current lifestyle and came in only for outcome assessments.

All outcomes were measured at baseline and at, weeks 6 and 12 of the study. 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) (18). Participants were asked to complete self administered questionnaires on mood and depression as detailed below.

Profile of Mood States (POMS). Since 1971, POMS has been proven as the best tool for assessing the mood level of an individual. The POMS scale consists of 65 mood states and was developed by McNair et al, (15). Recently, POMS was documented by McNair, Heucher & Shilony (14) for its usage in more than 5000 multi-disciplinary studies. Moods are divided into positive states such as vigor and negative states such as tension, depression, anger, fatigue and confusion. Total Mood Disturbance (TMD) is the number of positive moods subtracted from negative moods (14). The questionnaire was back translated to the Malay language, with a Cronbach's alpha value of 0.821 indicating a high level of internal consistency

Beck Depression Inventory II (BD-II). The BDI-II contains 21 questions and is a reliable and valid measure of depression (1) that has been used in many studies of weight loss, dieting and quality of life (32) including our own previous FCR study (27).

Geriatric Depression Scale (GDS-15). The GDS-30 Scale was summarized into GDS-15 by Sheikh & Yesavage (24). It has been used extensively in the assessment of depression among the older persons, including in Malaysia (23). A shorter version of the GDS in the Malay language which contains 15 items has been validated for use among Malaysians and is comparable with the original 30-item version (26).

Food Intake Measures for Assessment of Compliance. A food diary (three day diet record) and fasting log was given to participants at study week 6 and week 12. Participants 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 participants' family members.

Participants

This study was approved by the Research Ethical Committee of Universiti Kebangsaan Malaysia Medical Centre. Sample size calculations were based on our previous study [26], with 10% probability of dropout factored in. A total of 32 eligible participants were recruited into the study. Participants were randomly divided into 2 groups, namely the FCR group (n=16) and the control group (n=16). During the three-month intervention period, one of the participants from the control group dropped out of the study and did not participate in the follow-up appointment at week 6. Thus, a total of 31 participants, FCR (n=16) and control group (n=15) successfully completed the study (Figure 1).

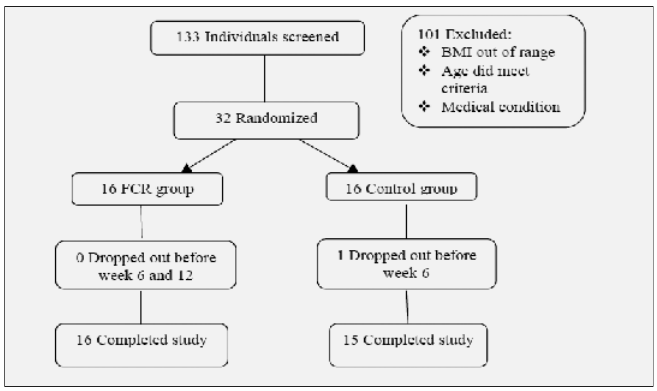
Statistical Analyses

Comparison of baseline characteristics between the FCR and control group was made using independent sample t-tests for continuous variables and chi-square tests for categorical variables. We used repeated measure ANOVA with baseline values included as covariates. The effect of FCR on mood states, depression and nutritional status was examined using a repeated measures model (ANOVA) to test for time effect,

group effect and time by group interactions. Changes from baseline in the measures of mood states and nutritional status were the dependent variables with baseline measures included as covariates. Effect sizes were reported as generalized eta squared. Statistical significance was set at a 2-sided P value of <0.05 and all analyses were performed using SPSS version 19.0 (Licensed materials – Property of SPSS. Incorporation an IBM Company Copyright 1989 and 2010 SPSS).

Figure 1

Illustration of the number of participants from recruitment to the end of the study



Results

Sample Characteristics

As shown in Table 1 no significant difference was observed between the FCR and control group in baseline body weight, BMI, percent fat or other baseline parameters except for participant smoking status (p<0.05) (Table 1).

Table 1

Characteristics of the Study Sample (n=31) at Baseline

Characteristics	FCR (n=16)	Control (n=15)	P value
Age (year)[a]	59.7 ± 6.6	59.7 ± 6.2[a]	0.994
Weight (kg)[a]	74.2 ± 7.8	69.6 ± 7.6[a]	0.107
Height (cm)	166.7 ± 6.9	161.1 ± 8.2	0.054
BMI (kg/m^2)[a]	26.7 ± 1.8	26.8 ± 2.6[a]	0.866
Body fat (%)[a]	26.4 ± 2.4	26.5 ± 2.7[a]	0.912
Smoking habit[b]			
Not smoking, n (%)	13 (81.3)*	7 (46.7)	0.044
Smoking, n(%)	3 (18.8)	8 (53.3)	
Health status[b]			
No disease, n(%)	10(62.5)	12 (80)	0.283
Hypertension, n(%)	6 (37.5)	3 (20)	
Mood states			
Tension	6.7 ± 3.9	9.2 ± 4.5	0.121
Depression	7.5 ± 7.3	10.5 ± 7.8	0.287
Anger	7.4 ± 4.4	9.7 ± 6.6	0.264
Vigor	14.7 ± 3.9	14.8 ± 3.3	0.970
Fatigue	6.6 ± 1.9	7.1 ± 3.0	0.533
Confusion	6.7 ± 2.9	7.4 ± 2.5	0.468
Total mood disturbance	20.1 ± 18.0	29.1 ± 23.7	0.245

Values are presented as mean (SD); a. Analyses using Independent Sample T Test; b. Analyses using Chi Square Test. *p<0.05 using chi-square test

Profile of Mood States

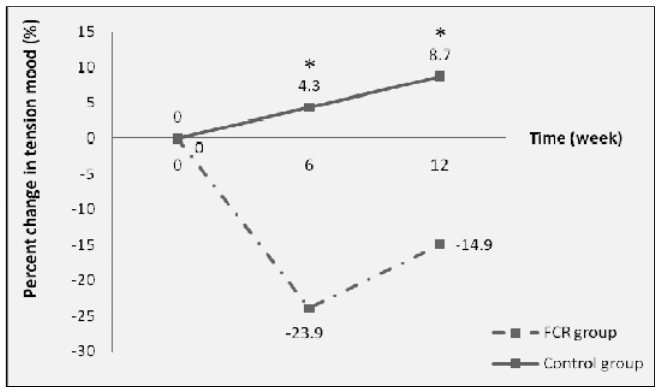
There was a significant change in tension, anger, vigor, confusion and total mood disturbance (TMD) of participants in the intervention group compared to the participants in the control group (Table 2).

Tension Mood

There was a significant difference (p<0.05) in tension mood scores between FCR and control groups with a partial eta square (η^2) value of 0.194 with a difference of t(29) = –2.96, p<0.01 at week 6 and t(29) = –2.58, p<0.05 at week 12. A significant reduction in tension mood scores was observed within the intervention group, with the decrease being –23.9% at week 6 and –14.9% at week 12 (figure 2). On the other hand, tension mood scores were increased in the control group at weeks 6 and 12 of the intervention period.

Figure 2

Percent change in tension mood in 3 months intervention



*p<0.05 using independent sample t-test (week 6, t(29)= –2.96, p<0.01 and week 12, t(29)= –2.58, p<0.05); 95% CI: 6.247 to 9.207

Anger Mood

A significant difference in mean anger mood scores was observed between the FCR and control groups (p<0.05) with η^2 =0.046. A significant difference in mean anger mood scores was seen between the FCR and control groups at week 6, t(29) = –2.42, p<0.05 and week 12, t(29) = –2.32, p<0.05. There was a decrease in anger mood within the intervention group with the decrease being –20.3% at week 6 and –25.7% at week 12 (Figure 3). In contrast, the control group exhibited an increase in anger mood at weeks 6 and 12 of the intervention period.

Vigor Mood

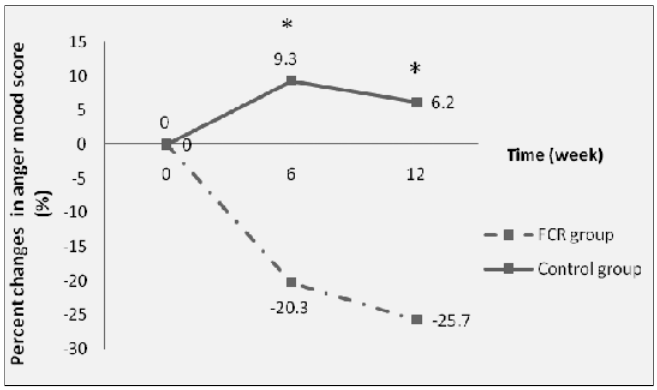
A significant difference (p<0.05) in vigor mood scores was noted in FCR and control groups over time, with a η^2 value of 0.106. The increase in vigor mood scores persisted throughout the three month intervention period (Figure 4). No significant difference was seen in mean vigor mood scores between the FCR and control groups over the three-month intervention period.

Table 2
Changes in Mood

Profile of Mood States (POMS	FCR group (n=16)			Control group (n=15)			P (η^2)		
	Baseline (mean ± SD)	Week 6 (mean ± SD)	Week 12 (mean ± SD)	Baseline (mean ± SD)	Week 6 (mean ± SD)	Week 12 (mean ± SD)	Time effect	Time *group effect	Group effect
Tension	6.7 ± 3.9	5.1 ± 3.1	5.7 ± 4.3	9.2 ± 4.5	9.6 ± 5.2	10.0 ± 4.9	0.826 (0.007)	0.155 (0.064)	0.015* (0.194)
Depression	7.5 ± 7.3	5.2 ± 4.8	5.3 ± 5.6	10.5 ± 7.8	11.0 ± 9.6	12.3 ± 10.3	0.393 (0.033)	0.120 (0.073)	0.054 (0.126)
Anger	7.4 ± 4.4	5.9 ± 3.7	5.5 ± 3.9	9.7 ± 6.6	10.6 ± 6.7	10.3 ± 7.2	0.284 (0.044)	0.112 (0.075)	0.046* (0.135)
Vigor	14.7 ± 3.9	15.8 ± 2.2	16.3 ± 2.0	14.8 ± 3.3	16.1 ± 2.8	16.3 ± 3.3	0.043* (0.106)	0.932 (0.003)	0.900 (0.001)
Fatigue	6.6 ± 1.9	5.4 ± 2.7	4.7 ± 4.3	7.1 ± 3.0	7.3 ± 3.5	7.7 ± 3.3	0.500 (0.023)	0.070 (0.091)	0.084 (0.103)
Confusion	6.7 ± 2.9	5.1 ± 2.3	4.7 ± 2.5	7.4 ± 2.5	7.8 ± 2.6	7.3 ± 3.1	0.537 (0.022)	0.039*(0.109)	0.024* (0.169)
Total Mood Disturbance	20.1 ± 18.0	10.9 ± 14.5	9.7 ± 19.0	29.1 ± 23.7	30.1 ± 24.7	31.3 ± 26.5	0.836 (0.006)	0.029* (0.119)	0.030* (0.158)

*p<0.05 using two-way repeated measures ANOVA test, adjusted for age.

Figure 3
Percent change in anger mood during 3 months intervention



*p<0.05 using independent sample t-test (week 6, t(29)= –2.42, p<0.05 and week 12, t(29)= –2.32, p<0.05); 95% CI: 6.310 to 10.319

Confusion Mood

A significant difference was observed in confusion mood scores (p<0.05) between the FCR and control groups with a η^2 score of 0.169 respectively. In addition there was a significant difference in confusion mood score between the FCR and control groups (week 6, t(29) = –3.02, p<0.01 and week 12, t(29) = –2.55, p<0.05). There was a decrease in confusion mood score in the FCR group which was -23.9% at week 6 and –29.8% at week 12. In the control group confusion mood scores were increased by 5.4% at week 6 followed by a slight decrease (–1.3%) at week 12 (Figure 5).

Total Mood Disturbance (TMD)

A significant decrease (p<0.05 between the FCR and control group was found in the TMD score, with a η^2 value 0.158 respectively. A significant difference in mean TMD scores was noted between the FCR and control groups at week 6, t(29) = -2.66, p<0.05 and week 12, t(29) = -2.62, p<0.05. A significant decrease in TMD was observed within the FCR group (P<0.05, η^2 value = 0.119) both at week 6 and 12, –45.8% and –51.7% respectively. Meanwhile, in the control group, there was increase in TMD of 3.4% at week 6 and 7.6% at week 12 (Figure 6).

Figure 4
Percent change in vigor mood during 3 months intervention

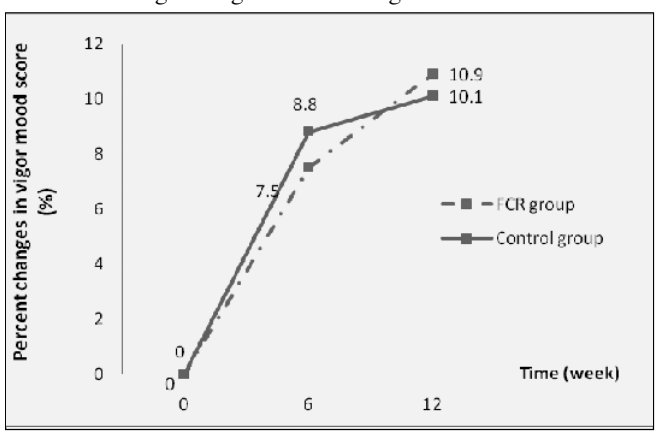
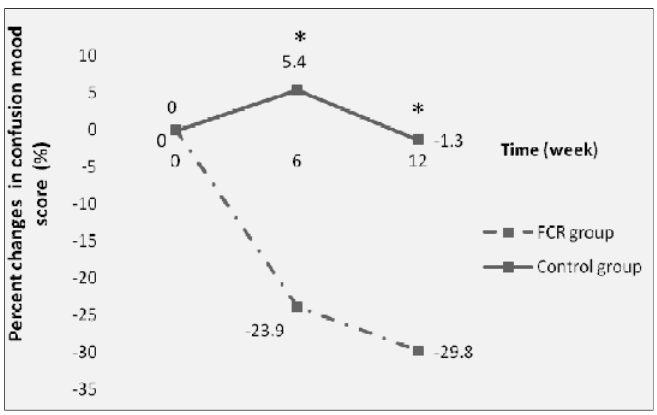


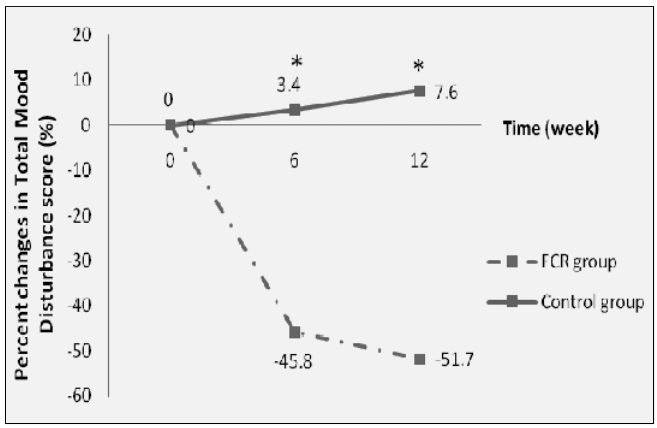
Figure 5
Percent change in confusion mood during 3 months



intervention

*p<0.05 using independent sample t-test (week 6, t(29)=–3.02, p<0.01 and week 12, t(29)= –2.55, p<0.05); 95% CI: 5.641 to 7.348

Figure 6
Percent change in Total Mood Disturbance in 3 months intervention



*p<0.05 using independent sample t-test (week 6, t(29)=–2.66, p<0.05 and week 12, t(29)= –2.62, p<0.05); 95% CI: 14.443 to 29.275

Depression

Beck Depression Inventory-II (BDI-II) and Geriatric Depression Scale (GDS-15)

Results of the ANOVA test showed no significant changes in mean depression scores (BDI-II) at the end of the three-month intervention period (Table 3). A similar trend was observed in GDS scores where no significant differences were noted during the three-month intervention period (Table 3).

Nutritional Status

A significant difference in energy intake was observed between the FCR and control groups ($p<0.05$, η^2 score of 0.452) as shown in Table 4. There was a significant decrease in energy intake in the FCR group as a result of the intervention (baseline energy intake 1666 ± 254 kcal/day, energy intake at 3 months 1494 ± 299 kcal/day; $p<0.05$; η^2 score of 0.113). The fasting log book, food diaries and weekly phone monitoring systems showed that all subjects in the FCR group were in compliance with the FCR regimen. At the same time, there was an increase in energy intake in the control group (baseline energy intake 1788 ± 374 kcal/day, energy intake at 3 months 1955 ± 205 kcal/day). Also, there was a significant difference ($p<0.05$) in intake of carbohydrate, protein and fat in the FCR group compared to the control group with a η^2 score of 0.392, 0.345 and 0.316 respectively. Carbohydrate intake over the course of the intervention was significantly reduced ($p<0.05$) in the FCR group and increased in the control group.

With respect to body composition, there was a significant reduction ($p<0.05$) in body weight, BMI and percent body fat within the intervention group over time with a η^2 score of 0.279, 0.113 and 0.222 respectively (Table 4). Percentage of weight change from baseline to week 12 was –3.8% in FCR group compared to –0.9% in control group. Percent body fat was reduced by –5.7% in FCR group compared to a +1.1% increase in the control group.

Discussion

Our study is the first to show that a FCR dietary regime can significantly reduce negative moods including tension, anger, confusion and total mood disturbance as well as improve positive mood among ageing men. These findings are particularly important since reduction in negative moods and enhancements in positive mood will result in improvements in overall well-being of ageing men. Improvements in mood may also have the potential to improve patient adjustment to illnesses (5, 21) an added benefit in the elderly.

Our study also showed that participants in the FCR group had higher vigor mood scores at the end of the intervention. A study by Michalsen et al. (17) also showed a fasting-induced increase in vigor, emotional balance, global quality of sleep and daytime concentration. Fasting has been reported to be associated with increased brain availability of neurotrophic factors including serotonin, endogenous opioids, and endocannabinoids that may also contribute to mood enhancement (16). It is also possible that religious fasting such as FCR resulted in some beneficial effects on mood due to non food related factors including the spiritual, social and mind-body effects and also by group-related effects of this fasting ritual (28). However, we believe that in this study the

Table 3
Changes in Depression (BDI-II and GDS-15)

Parameter	Baseline (mean ± SD)	Week 6 (mean ± SD)	Week 12 (mean ± SD)	P (η^2) Time effect	Time *group effect	Group effect
BDI-II						
FCR group (n=16)	8.7 ± 6.3	7.1 ± 5.2	4.6 ± 4.8	0.194 (0.057)	0.681 (0.014)	0.284 (0.041)
Control group (n=15)	10.4 ± 7.7	8.7 ± 6.4	7.8 ± 8.0			
GDS-15						
FCR group (n=16)	2.5 ± 2.5	1.8 ± 1.4	1.9 ± 1.8	0.316 (0.040)	0.491 (0.025)	0.354 (0.031)
Control group (n=15)	3.1 ± 2.2	2.7 ± 1.5	1.9 ± 1.3			

NS – Non significant using two-way repeated measures ANOVA test, adjusted for age.

Table 4
Changes in food intake and body composition

Parameter Interval	FCR group (n=16) Baseline (mean ± SD)	FCR group (n=16) Week 6 (mean ± SD)	FCR group (n=16) Week 12 (mean ± SD)	Control group (n=15) Baseline (mean ± SD)	Control group (n=15) Week 6 (mean ± SD)	Control group (n=15) Week 12 (mean ± SD)	p (η^2) Time effect	p (η^2) Time *group effect	p (η^2) Group effect	95% Confidence
Food Intake										
Energy (Kcal/d)	1666 ± 254	1357 ± 304	1494 ± 299	1788 ± 374	1723 ± 280	1955 ± 205	0.836 (0.007)	0.039* (0.113)	0.000* (0.410)	1585 to 1743
CHO (g/d)	222.3 ± 34.4	201.9 ± 50.8	181.7 ± 21.9	238.0 ± 50.4	240.1 ± 32.5	243.9 ± 37.0	0.590 (0.019)	0.063 (0.098)	0.000* (0.392)	211.4 to 231.1
Protein (g/d)	57.7 ± 11.4	53.6 ± 12.3	56.9 ± 9.2	63.4 ± 12.5	65.2 ± 12.3	75.5 ± 14.6	0.262 (0.048)	0.083 (0.088)	0.001* (0.345)	58.9 to 65.2
Fat (g/d)	60.7 ± 12.7	37.3 ± 11.4	59.9 ± 32.9	64.7 ± 18.7	55.8 ± 19.0	75.2 ± 10.0	0.136 (0.074)	0.284 (0.045)	0.002* (0.316)	54.8 to 63.2
Body Composition										
Body weight (kg)	74.2 ± 7.8	72.1 ± 7.4	71.4 ± 7.2	69.6 ± 7.6	69.4 ± 7.6	69.0 ± 7.6	0.509 (0.024)	0.000[a] (0.279)	0.167 (0.067)	68.3 to 73.7
BMI (kg/m^2)	26.7 ± 1.8	26.2 ± 2.3	25.7 ± 1.8	26.8 ± 2.6	26.7 ± 2.6	26.5 ± 2.5	0.455 (0.026)	0.043[a] (0.113)	0.588 (0.011)	25.6 to 27.3
% Body fat	26.4 ± 2.4	25.9 ± 2.5	24.9 ± 2.5	26.5 ± 2.7	26.9 ± 3.1	26.8 ± 3.2	0.995 (0.000)	0.001[a] (0.222)	0.307 (0.037)	25.3 to 27.3

Food intake was obtained from Diet History Questionnaire (DHQ) at baseline, week 6 and 12. The reduction of energy intake at week 6 and 12 was parallel with the aim to reduce 300-500 kcal of energy intake/day; *p<0.05 using two-way repeated measures ANOVA test, adjusted for age and body weight; a. p<0.05 using two-way repeated measures ANOVA test, adjusted for energy intake

contribution from these non-food related factors are somewhat minimal since we recruited individuals who were not regular practitioners of the Muslim Sunnah fast and the intervention and emphasis was on the FCR regimen and no religious rituals were recommended. Of remark however is the increase in vigor mood scores which was also observed in the control group and this may have been due to the feeling of importance that they were participants in a study and albeit at minimum, some social interaction with the researchers during outcome assessments.

Our study also showed that a 3 month FCR intervention resulted in no changes in depression scores. Our finding is consistent with a previous study on FCR from our group (27) and similar results were obtained in Phase 1 of the CALERIE study, which reported that there were no changes in participants' depressive moods after undergoing 6 months of CR, as assessed using the BDI-II (31) suggesting that while CR does not induce depression atleast in the short-term (3-6months), it may not produce benefical changes either. However, Keys et al. (11) reported that a CR dietary regime could increase depression among participants. The Keys study (11) subjects underwent an extreme semi-starvation 45% CR dietary intervention for 6 months, while the present study employed an 18 to 25% CR for 3 months and this may have potentially contibuted to the observed difference in depression scores.

With regards to tools used in the measurement of depression the present study found no intervention effects on depression over the 3 months using three measures, the BDI, GDS and the POMS. Decrease in depression moods in the CR group was reported in Phase 1 of the multi-site CALERIE study (31) using the MAEDS although the results from the BDI-II showed no change in depression scores at this study site. The disparity in results obtained may be potentially attributed to the different tools used for depression measurement, gender and age of subjects, the study duration and type of intervention. Phase 1 of the CALERIE study involved both men and women participants with an average age of 39 years undergoing an intervention of 25% CR for 6 months while the present study was conducted in male participants aged 50 to 70 years who underwent 18% CR combined with fasting for 3 months. Despite the small sample size and short duration, the FCR regime as investigated in our study was able to improve mood states and nutritional status.

Consistent with previous findings on CR and fasting our study showed that CR regime can reduce body weight, BMI, body fat mass and, fat-free mass in humans (4, 6, 7, 19, 20, 27, 30).

In summary, our study showed that FCR dietary regime resulted in reduction of body weight and percent body fat with decreases in tension, anger, confusion and total mood disturbance and improvements in vigor. The FCR dietary regime appears to be promising for lifestyle modification and improvements in quality of life and well being in the elderly.

Conclusion

In conclusion, this study showed that the FCR dietary regime is effective in improving mood states and nutritional status among aging men. There is a need to conduct a larger scale study with longer duration to validate both the present findings and to inform future research. Healthy lifestyle practices including the FCR regime that show promise for improving the health and wellbeing of the aging population should be thoroughly explored.

Acknowledgements: We are grateful to the participants, fieldworkers and others involved in the data collection. Technical support was received from our supervisor to complete this study. We acknowledge the financial support was received from the research university grant of Universiti Kebangsaan Malaysia (UKM-AP-TKP-09-2009).

Reference

1. Beck AT, Steer RA, Brown GK (1996) Manual for the Beck depression inventory-II. San Antonio, TX: Psychological Corporation 1:82.
2. Burke MM, Laramie JA (2000) Primary care of the older adult. Mosby, St Louis
3. Farham B (2008) What is midlife? Continuing Medical Education 24:666.
4. Fontana L, Meyer TE, Klein S, Holloszy JO (2004) Long-term calorie restriction is highly effective in reducing the risk for atherosclerosis in humans. Proceedings of the National Academy of Sciences of the United States of America 101:6659-6663. doi 10.1073/pnas.0308291101.
5. Gillham JE, Reivich KJ, Freres DR, Chaplin TM, Shatté AJ, Samuels B, Elkon AGL, Litzinger S, Lascher M, Gallop R (2007) School-based prevention of depressive symptoms: A randomized controlled study of the effectiveness and specificity of the penn resiliency program. Journal of Consulting and Clinical Psychology 75:9.
6. Heilbronn LK, de Jonge L, Frisard MI, DeLany JP, Larson-Meyer DE, Rood J, Nguyen T, Martin CK, Volaufova J, Most MM, Greenway FL, Smith SR, Deutsch WA, Williamson DA, Ravussin E (2006) Effect of 6-month calorie restriction on biomarkers of longevity, metabolic adaptation, and oxidative stress in overweight individuals: a randomized controlled trial. JAMA : the journal of the American Medical Association 295:1539-1548. doi 10.1001/jama.295.13.1539.
7. Heilbronn LK, Smith SR, Martin CK, Anton SD, Ravussin E (2005) Alternate-day fasting in nonobese subjects: effects on body weight, body composition, and energy metabolism. The American journal of clinical nutrition 81:69-73.
8. Holloszy JO, Fontana L (2007) Caloric restriction in humans. Experimental gerontology 42:709-712. doi 10.1016/j.exger.2007.03.009.
9. Husaini BA (1997) Predictors of depression among the elderly: racial differences over time. Am J Orthopsychiatry 67:48-58.
10. Karel MJ, Ogland-hand S, Gatz M (2002) Assessing and treating late-life depression: A casebook and resource guide. Basic Books
11. Keys A, Brozek J, Henschel A, Mickelson O, Taylor HL (1950) The Biology of Human Starvation. In:University of Minnesota Press, Minneapolis, Minn
12. Masoro EJ (2005) Overview of caloric restriction and ageing. Mechanisms of ageing and development 126:913-922. doi 10.1016/j.mad.2005.03.012.
13. McConville C, Simpson EE, Rae G, Polito A, Andriollo-Sanchez M, Meunier N, Stewart-Knox BJ, O'Connor JM, Roussel AM, Cuzzolaro M, Coudray C (2005) Positive and negative mood in the elderly: the ZENITH study. European journal of clinical nutrition 59 Suppl 2:S22-25. doi 10.1038/sj.ejcn.1602293.
14. McNair D, Heuchert J, Shilony E (2003) Research with the Profile of Mood States (POMS) 1964-2002: A comprehensive bibliography. Toronto. Canada: Multi-Health Systems.
15. McNair D, Lorr M, Droppleman L (1971) BITS manual for the Profile of Mood States. Educational and Industrial Testing Service.
16. Michalsen A (2010) Prolonged fasting as a method of mood enhancement in chronic pain syndromes: a review of clinical evidence and mechanisms. Curr Pain Headache Rep 14:80-87. doi 10.1007/s11916-010-0104-z.
17. Michalsen A, Schlegel F, Rodenbeck A, Lüdtke R, Huether G, Teschler H, Dobos G (2003) Effects of short-term modified fasting on sleep patterns and daytime vigilance in non-obese subjects: results of a pilot study. Annals of nutrition and metabolism 47:194-200.
18. Neovius M, Udden J, Hemmingsson E (2007) Assessment of change in body fat percentage with DXA and eight-electrode BIA in centrally obese women. Med Sci Sports Exerc 39:2199-2203. doi 10.1249/mss.0b013e3181579.38a.
19. Redman LM, Heilbronn LK, Martin CK, Alfonso A, Smith SR, Ravussin E (2007) Effect of calorie restriction with or without exercise on body composition and fat distribution. The Journal of clinical endocrinology and metabolism 92:865-872. doi 10.1210/jc.2006-2184.
20. Redman LM, Martin CK, Williamson DA, Ravussin E (2008) Effect of caloric restriction in non-obese humans on physiological, psychological and behavioral outcomes. Physiology & behavior 94:643-648. doi 10.1016/j.physbeh.2008.04.017.
21. Seligman MEP, Rashid T, Parks AC (2006) Positive psychotherapy. American Psychologist 61:774.
22. Shahar SD, Earland J, Abdulrahman S (2000) Validation of a Dietary History Questionnaire against a 7-D Weighed Record for Estimating Nutrient Intake among Rural Elderly Malays. Malaysian journal of nutrition 6:33-44.
23. Sherina M, Rampal L, Aini M, Norhidayati H (2005) The prevalence of depression among elderly in an urban area of Selangor, Malaysia. The International Medical Journal 4:57-63.
24. Shiekh J, Yesavage J (1986) Geriatric Depression Scale: recent findings and development of a short version. Clinical Gerontology: A Guide to Assessment and Intervention, Brink T (ed.). Howarth Press: New York.
25. Suriah AR (2003) Pemakanan Warga Tua. Dewan Bahasa dan Pustaka, Kuala Lumpur
26. Teh EE, Hasanah CI (2004) Validation Of Malay Version Of Geriatric Depression Scale Among Elderly Inpatients.
27. Teng NI, Shahar S, Manaf ZA, Das SK, Taha CS, Ngah WZ (2011) Efficacy of fasting calorie restriction on quality of life among aging men. Physiology & behavior 104:1059-1064. doi 10.1016/j.physbeh.2011.07.007.
28. Trepanowski JF, Bloomer RJ (2010) The impact of religious fasting on human health. Nutrition journal 9:57. doi 10.1186/1475-2891-9-57.
29. Varady KA, Hellerstein MK (2007) Alternate-day fasting and chronic disease prevention: a review of human and animal trials. The American journal of clinical nutrition 86:7-13.
30. Walford RL, Mock D, Verdery R, MacCallum T (2002) Calorie restriction in biosphere 2: alterations in physiologic, hematologic, hormonal, and biochemical parameters in humans restricted for a 2-year period. The journals of gerontology. Series A, Biological sciences and medical sciences 57:B211-224.
31. Williamson DA, Martin CK, Anton SD, York-Crowe E, Han H, Redman L, Ravussin E (2008) Is caloric restriction associated with development of eating-disorder symptoms? Results from the CALERIE trial. Health Psychol 27:S32-42. doi 10.1037/0278-6133.27.1.s32.
32. Williamson DA, O'Neil PM (2004) Obesity and quality of life. Marcel Dekker, New York