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Dietary manipulation and energy compensation: does the intermittent use of low-fat items in the diet reduce total energy intake in free-feeding lean men?

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OBJECTIVE: The effect of two low-fat treatments on *ad libitum* energy intake (EI) was investigated in five lean men living within a metabolic facility.
DESIGN: Diet was controlled over two consecutive periods of 12 d when either, i) all foods eaten or ii) only a single (lunch) meal, was manipulated to increase the fat content from 20, 40 to 60% of energy, and *ad libitum* EI measured.
RESULTS: *All foods*: EI increased from 8.6 (2.9 s.d.)–14.8 (3.1 s.d.) MJ/d and energy density (ED) from 4.1 (0.8 s.d.)–7.7 (1.6 s.d.) kJ/g as fat content increased from 20–60% ($P < 0.0001$). There was no decrease in weight of food eaten across diets ($P > 0.05$) and hence no energy compensation. *Lunch meal*: EI (20%:13.1 MJ/d, 40%:13.8 MJ/d, 60%:14.8 MJ/d) and ED (6.03 kJ/g, 5.89 kJ/g, 6.41 kJ/g) increased but not significantly across treatments ($P > 0.05$). There was partial energy compensation on the low-fat 20% diet (due in part to compensatory increase in fat intake), but no compensation for the high-fat 60% diet.
CONCLUSIONS: Changes in total dietary fat and ED result in concomitant changes in EI; low fat diets reducing EI. However, the dietary strategy of intermittent use of low- and high-fat items fail to significantly alter ED, and hence EI, in free-feeding lean men. Whilst there is a trend towards reduction in intake, manipulation of the fat content of a single meal may not be sufficient to induce significant long-term weight loss.

Keywords: energy intake; energy density; low-fat; compensation; *ad libitum*

Introduction

Treatment of obesity is notoriously difficult. Whilst in principle it is an easy task, requiring the overweight individual to achieve a negative energy balance by either a reduction in energy intake (EI) or an increase in expenditure, in practice, this is rarely achieved on a long term basis. The conscious reduction in EI may leave the person feeling poorly satiated and constantly hungry, resulting in poor compliance over a long time period. An increase in physical activity may also fail to achieve the desired weight loss, perhaps through inadequate compliance.

An alternate method of reducing intake and achieving weight loss may be through a change in dietary composition, specifically the fat: carbohydrate (CHO) ratio, rather than conscious energy restriction. There is considerable evidence to show that when all dietary components are provided, the introduction of a low fat, low energy diet results in weight loss.[1–4] The reduction in the fat:CHO ratio and energy density (ED) of the diet, spontaneously reduces hunger and hence food intake. Subjects feel fuller and eat less without any conscious need to restrict dietary intake.[5–7] Long term use of such diets should therefore result in gradual weight loss. Conversely, studies where a high fat diet is provided, and subjects continue to eat to appetite, consistently show overconsumption and high-fat, high-energy hyperphagia.[3,8–10] High fat diets might therefore be expected to be associated with weight gain. A number of epidemiological studies support this hypothesis.[11,12]

There remains considerable controversy, however, as to whether low-fat diets are of practical use in weight control, since not all metabolic studies show a reduction in EI when fat content is reduced.[13–16] We have previously suggested[17] that it is the inability to reduce the total fat content and hence ED of the diet that fails to reduce EI. For example, studies introducing individual low-fat products or meals into a diet that is otherwise of free-choice,[13–16] commonly fail to show a reduction in EI. When surrounded by a range of foods of varying composition, subjects tend to select a diet that maintains EI at its normal high level. Since dieters commonly include individual low-fat foods in their diet, it is of considerable practical importance to determine whether they reduce overall EI and hence aid weight loss.

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We hypothesise that the dichotomy between fat dilution studies may be the failure of individual low-fat foods or meals to reduce the total daily fat and/or ED of the diet, rather than the ability of low-fat diets *per se* to maintain satiety at a lower level of EI. We suggest that to achieve gradual weight loss, subjects must ensure that there is an absolute decrease in daily fat intake (and hence ED) and not simply introduce small quantities of low-fat foods into portions of their diet. To test this hypothesis we investigated the differential effects of low-fat foods on EI in five lean men over two consecutive periods of 12 d. Diet was manipulated either i) throughout the entire day, whereby subjects had no choice in dietary composition selected or ii) at only a single meal, whereby subjects were able to choose freely from a wide variety of foods throughout the remainder of the day.

Methods

Subjects

Six lean (body mass index, BMI $< 25\,kg/m^2$) male subjects, aged between 20–45 y, were recruited to the study. One subject was excluded retrospectively for non-compliance, the remaining five subjects completing both arms of the intervention successfully (Table 1). In the excluded subject EI was calculated to be less than $0.8 \times$ basal metabolic rate ($0.8 \times$ BMR; in turn calculated from Schofield *et al*,[18] using body weight, height, age and gender), throughout the entire study. The failure of this subject to lose body weight, indicated that replacement foods were being consumed during absentee periods from the unit. All subjects provided written consent and were informed that the entire nature of the study could not be revealed. The study was approved by the Dunn Clinical Nutrition Unit's ethics committee.

Study design

All subjects lived within the confines of the metabolic facility throughout the study. They were required to sleep and eat breakfast, lunch and dinner within the facility, but were allowed to leave during the day for study and work. Only foods provided by the unit were permitted to be consumed by the subjects. All other, food stuffs and alcoholic beverages were prohibited. The study comprised two 12 d intervention periods during which either i) all foods eaten or ii) only a single meal (lunch) were manipulated to alter the fat:CHO ratio. The percentage of energy from protein was unaltered as far as possible. *Ad libitum* EI of the subjects was covertly assessed by weighing all foods before and after each meal and snack. Foods were served in excess and were freely available at all times of the day and night. The two intervention periods were separated by a break of three days, when subjects were allowed to leave the unit and dietary restrictions were removed. Subjects were not informed that EI was the primary outcome of the study. To maintain the covert nature of the study, subjects were asked to collect both urine and faecal samples intermittently throughout the period of study and were informed that nitrogen excretion and gut transit times were the primary outcome variables.

Dietary manipulations

All foods. All foods provided were manipulated to comprise either 20%, 40% or 60% energy from fat (Table 2). Subjects were asked to eat as much or as little as they chose, from the range of meals and snacks available throughout the day. Whilst the weight of food eaten and hence EI was determined by individual subjects, the macronutrient composition of the diet remained fixed at all times. Each of four *ad libitum* dietary periods lasted for three consecutive days (see Figure 1). Day 1–day 3: baseline diet (40.3%, 0.4 s.d.); day 4–day 6: low-fat diet (20.2%, 0.3 s.d.); day 10–day 12: high-fat diet (60.0% 0.6 s.d.). Low-fat and high-fat interventions were separated by a three-day washout period, when subjects were provided with a 40% fat diet.

Single meal. The macronutrient composition of the lunch meal alone was manipulated to provide either 20%, 40% or 60% of energy as fat (Table 3). Dinner,

Table 1 Subject characteristics

Subject	*Age (y)*	*Weight (kg)*	*BMI (kg/m²)*	*BMR* (MJ/d)*
1	26	75	22	7.5
2	28	72	24	7.4
3	32	74	25	7.2
4	44	70	23	7.0
5	45	65	22	6.8
mean	35	71.2	23.2	7.2
s.d.	8.9	4.0	1.3	0.3

BMI = body mass index; *Predicted basal metabolic rate (BMR), calculated from Schofield *et al*, 1985.

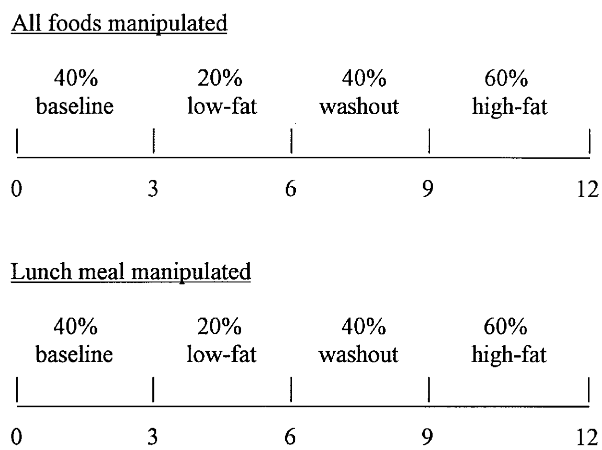

Figure 1 Study protocol.

Table 2 Three-day rotating menu: all foods manipulated (CHO, carbohydrate; ED, energy density, kJ/g)

		Low-fat (%)				Baseline (%)				High-fat (%)			
Meal	*Food Item*	*fat*	*CHO*	*protein*	*ED*	*fat*	*CHO*	*protein*	*ED*	*fat*	*CHO*	protein	ED
Day 1													
Breakfast	Weetabix™	20.3	66.1	13.2	4.11	40.2	46.0	13.6	5.72	59.2	28.4	12.3	11.89
Lunch	Cheese and potato pie	20.9	64.2	13.4	4.23	40.9	44.5	13.8	5.25	60.8	26.8	12.2	6.66
Dinner	Ratatouille	20.5	63.9	13.8	1.32	39.9	47.4	13.1	1.45	60.1	27.3	13.6	1.92
	Blackcurrant fool	20.1	66.4	13.1	2.95	40.2	46.1	13.4	4.14	60.1	27.6	12.1	5.90
Snack	Carrot cake	20.8	65.6	13.6	9.40	40.9	45.4	13.4	9.87	60.7	26.8	12.4	13.35
Day 2													
Breakfast	Porridge	20.2	66.1	13.5	4.09	39.5	47.1	13.1	6.13	59.9	27.5	12.4	10.52
Lunch	Tomato soup	20.8	63.1	15.9	1.33	40.8	46.5	12.6	1.78	59.3	28.6	12.7	3.09
	Fruit loaf	19.9	65.9	13.8	7.70	40.4	44.1	12.7	9.55	60.1	29.0	12.9	11.73
Dinner	Spaghetti bolognaise	20.6	65.0	13.9	3.96	40.4	47.7	13.3	4.58	60.8	27.9	13.2	5.68
	Raspberry fool	21.0	66.6	12.3	3.02	40.9	45.4	13.7	3.63	59.2	28.6	12.1	5.29
Snack	Cheese scones	19.9	66.2	12.6	9.98	40.2	45.7	13.7	13.14	59.3	27.9	12.5	16.05
Day 3													
Breakfast	Weetabix™	20.3	66.1	13.2	4.11	40.2	46.0	13.6	5.72	59.2	28.4	12.3	11.89
Lunch	Rice pilaff	20.1	66.2	13.3	4.24	40.1	46.7	13.0	5.69	59.4	27.7	12.8	8.55
Dinner	Chicken rissotto	20.5	64.5	13.9	7.65	40.0	45.6	13.9	7.97	60.2	27.8	12.1	11.04
	Apricot fool	20.7	66.3	12.7	3.00	39.7	47.0	13.1	3.97	60.7	27.1	12.1	6.12
Snack	Carrot cake	20.8	65.6	13.6	9.40	40.9	45.4	13.4	9.87	60.7	26.8	12.4	13.35
Mean		20.5	65.5	13.5	5.0	40.3	46.0	13.3	6.2	60.0	27.8	12.5	8.9
S.d.		0.4	1.0	0.8	2.8	0.5	1.0	0.4	3.2	0.6	0.7	0.4	4.1
Freely available	Milk	19.4	47.2	33.4	1.65	39.9	34.9	24.8	2.19	60.4	22.9	16.4	3.22
	Salad garnish	0.1	1.5	0.7	0.51	0.1	1.5	0.7	0.51	0.1	1.5	0.7	0.51

Table 3 Composition of lunch-time meals (CHO, carbohydrate; ED, energy density; %, percentage by energy)

	Energy (kJ)	*Fat*		*CHO*		*Protein*		*ED (kJ/g)*
		(g)	*(%)*	*(g)*	*(%)*	*(g)*	*(%)*	
Day 1 (spaghetti bolognaise)								
20% fat	1737	10	20.7	75	67.0	13	12.3	4.83
40% fat	3033	33	41.1	99	50.7	14	7.5	8.52
60% fat	3845	61	58.9	79	31.9	21	9.3	10.10
Day 2 (chicken rissotto)								
20% fat	1715	9	20.8	68	62.1	17	16.4	3.51
40% fat	3083	33	40.3	88	44.4	20	11.0	5.53
60% fat	4010	62	58.2	70	27.4	28	11.8	6.48
Day 3 (cheese and potato pie)								
20% fat	1682	9	20.1	71	65.7	13	12.7	3.51
40% fat	3225	35	40.8	95	45.8	24	12.6	5.71
60% fat	4431	70	59.7	83	29.1	28	10.5	8.36
Mean (%, sd)								
20% fat	1712 (27)		20.5 (0.4)		64.9 (2.5)		13.8 (2.3)	3.95 (0.8)
40% fat	3114 (99)		41.7 (0.4)		46.9 (3.3)		10.4 (2.6)	6.58 (1.7)
60% fat	4096 (301)		58.9 (0.8)		29.4 (2.3)		10.5 (1.3)	8.31 (1.8)

breakfast and snacks throughout the day were *ad libitum* and comprised a wide range of products designed to allow the subjects a wide choice of dietary composition (Appendix 1). Each of the four intervention periods lasted for three consecutive days (see Figure 1). Day 1–day 3: 40% fat diet (baseline = medium fat); day 4–day 6: 20% fat diet (low fat); day 7–day 9: 40% fat diet (washout period); day 10–day 12: 60% fat diet (high fat). The lunchtime meal was supervised to ensure that it was entirely consumed by the subjects. Throughout the remainder of the day, subjects were free to eat as they chose from the available food menu.

The effects of fat dilution and supplementation were calculated as the difference between baseline (40% fat) and low-fat (20% fat) and high-fat (60% fat) intervention periods. All data during the wash-out period were excluded from the analyses.

Statistical analyses

The effect of fat dilution and supplementation on energy and macronutrient intake were assessed using one-way analysis of variance (ANOVA) and Scheffe's *post-hoc* test, using the Data Desk version 4.0 program (Odesta Corporation, Northbrook, IL). Results were analysed including both subject and treatment effects and are presented in the text as mean ± s.d.

Results

All foods manipulated

There was a highly significant ($F = 23.18$, $P < 0.0001$) increase in *ad libitum* EI from 8.6 (2.9 s.d.) MJ/d, 11.5 (3.2 s.d.) MJ/d and 14.8 (3.1 s.d.) MJ/d, when the macronutrient composition of all items in the diet was manipulated between 20%, 40% and 60% of energy from fat (Figure 2). Subjects did not compensate for the manipulations made in dietary fat content and hence were hyperphagic when provided with a high-fat, high-energy diet. Fat dilution from a baseline of 40% fat to a low-fat 20% diet, resulted in a decrease in *ad libitum* energy intake of 2.9 MJ/d, and hence intake on the 20% diet was equivalent to only 75% of daily baseline intake. Fat supplementation from 40% to a high-fat 60% diet resulted in an increase in daily energy intake of 3.3 MJ/d, equivalent to 129% of daily baseline intake.

When the volunteers were allowed to eat *ad libitum* throughout the day, choosing both the composition, amount and time of day at which they ate, there was no significant change ($P > 0.05$) in the weight of food consumed per day across any of the three treatments.

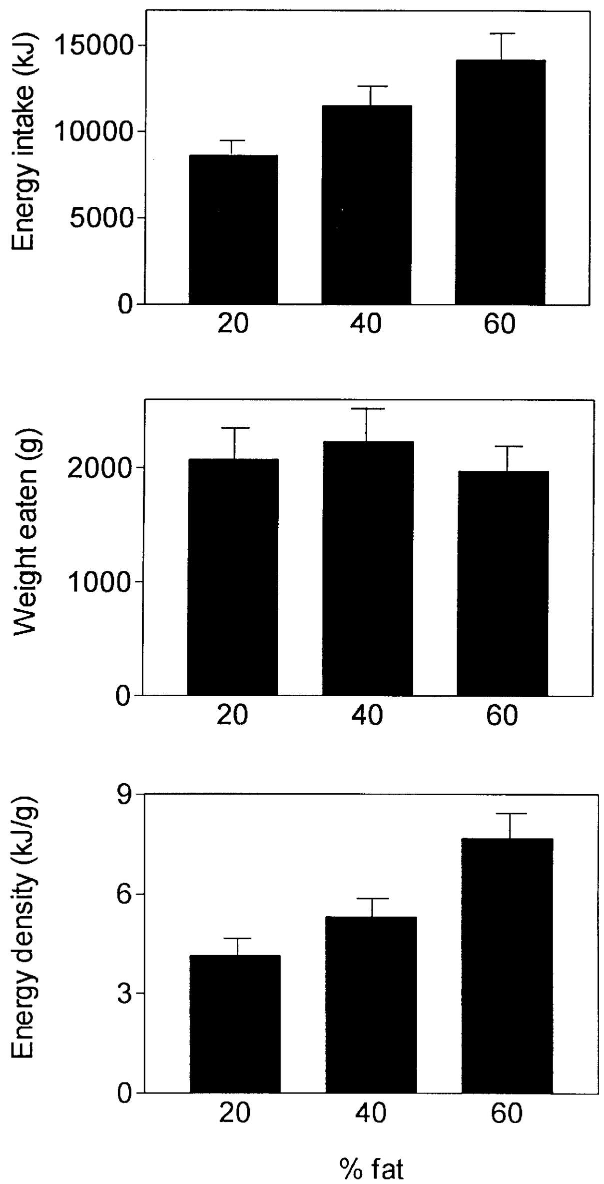

Figure 2 Manipulation of all foods. *Ad libitum* energy intake, weight of food consumed and energy density in five lean men consuming 20%, 40% and 60% fat diets (mean ± s.e.m.).

The subjects ate an average of 2072 (512 s.d.) g/d, 2227 (676 s.d.) g/d, 1973 (418 s.d.) g/d on the 20%, 40% and 60% diets, respectively. Since the ED increased with the fat content of the foods offered (see Table 2), there was a significant increase in the ED of foods eaten between the three diets ($F = 37.2$, $P < 0.0001$; 20% fat: 4.14, 0.8 s.d., 40% fat: 5.31, 0.9 s.d., 60% fat: 7.68, 1.6 s.d. kJ/g; see Figure 2). Fat dilution significantly reduced the ED of foods consumed by 1.17 MJ/d ($P < 0.05$, Scheffe's *post-hoc* test) and fat supplementation increased the density of foods eaten by 2.37 MJ/d ($P < 0.001$, Scheffe's *post-hoc* test) relative to the 40% fat baseline diet. It is this gradual increase in the ED of the diet that, in the face of a relatively constant weight of food consumed, results in overconsumption or hyperphagia on the high-fat, high-energy diet. Conversely, the reduction in ED that occurred on the low-fat diet, in the absence of an increase in the weight of food consumed, resulted in hypophagia and a reduction in EI.

Lunch meal manipulated

When the lunchtime meal alone was both diluted and supplemented with additional dietary fat, there was no significant change in the total daily energy intake of the subjects relative to the 40% baseline meal, although daily EI did increase from 13.1 MJ/d to 13.8 MJ/d to 14.8 MJ/d as fat content increased from 20% to 40% to 60%, respectively ($F = 2.59$,

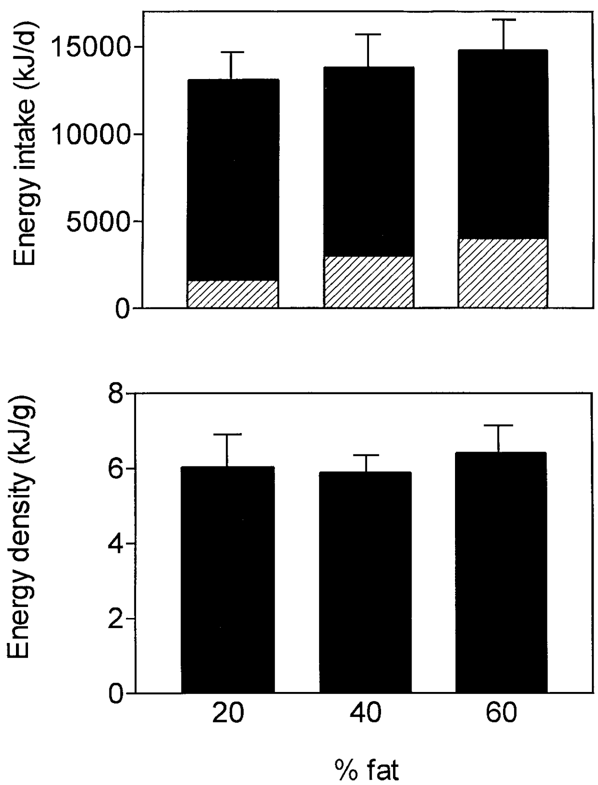

Figure 3 Manipulation of a lunchtime meal. 24 h energy intake and energy density of foods consumed in lean men fed 20%, 40% and 60% fat lunches (mean ± s.e.m.). Top panel: 24 h intake = lunch (▨) + *ad libitum* dinner, breakfast and snacks (■).

$P > 0.05$; Figure 3). During lunchtime fat dilution, free food consumption increased from 10.7–11.4 MJ/d. There was partial compensation for the decrease in lunchtime fat content, and total daily EI was 95% of the baseline (40% fat) diet. During lunchtime fat supplementation the free food consumption failed to decrease, remaining constant at 10.7 MJ/d. Total daily EI was 107% of baseline intake. Hence partial compensation in response to the alteration of lunchtime fat content occurred only during fat dilution and not during fat supplementation, when subjects failed to respond to the increase in lunchtime fat content by decreasing the foods eaten at other times.

Calculation of the ED of the total daily intake, comprising lunch, dinner and breakfast, plus all additional snacks, showed that the lunchtime manipulations were of insufficient magnitude to significantly alter the density between low-fat and high-fat treatments (see Figure 3). ED over 24 h varied only slightly between 6.03 (1.6 s.d.) kJ/g, 5.89 (0.9 s.d.) kJ/g and 6.41 (1.5 s.d.) kJ/g on the 20%, 40% and 60% lunchtime diets, respectively ($F = 1.48$, $P > 0.05$).

Figure 4 shows the effect of altering the lunchtime fat content on free food and total macronutrient intake over the following 24 h. In response to fat dilution at the lunch meal, where fat content was reduced from 34 (1 s.d.) g to 9 (0.5 s.d.) g, there was a compensatory increase in *ad libitum* fat consumption from other meals and snacks from 111 (33 s.d.) g at baseline to 124 (38 s.d.) g on the 20% diet. Total daily fat intake increased to 133 (38 s.d.) g/d and was not significantly different from the 145 (33 s.d.) g/d fat intake at baseline ($F = 0.56$, $P > 0.05$). Following lunchtime fat supplementation, there was no compensatory decrease in *ad libitum* fat intake, rather an increase of 4 g above baseline, to 115 g. Hence, following supplementation, total daily fat intake was significantly greater than baseline (179, 38 s.d. g/d; $F = 7.06$, $P < 0.01$).

Discussion

The main advantage of a low-fat diet in relation to a 'low calorie' or 'calorie-counting' diet, lies in the principle that the dieter can eat to appetite on the low-fat diet and yet maintain a negative energy balance and hence gradually lose weight. The first part of this study demonstrates, as have numerous previous

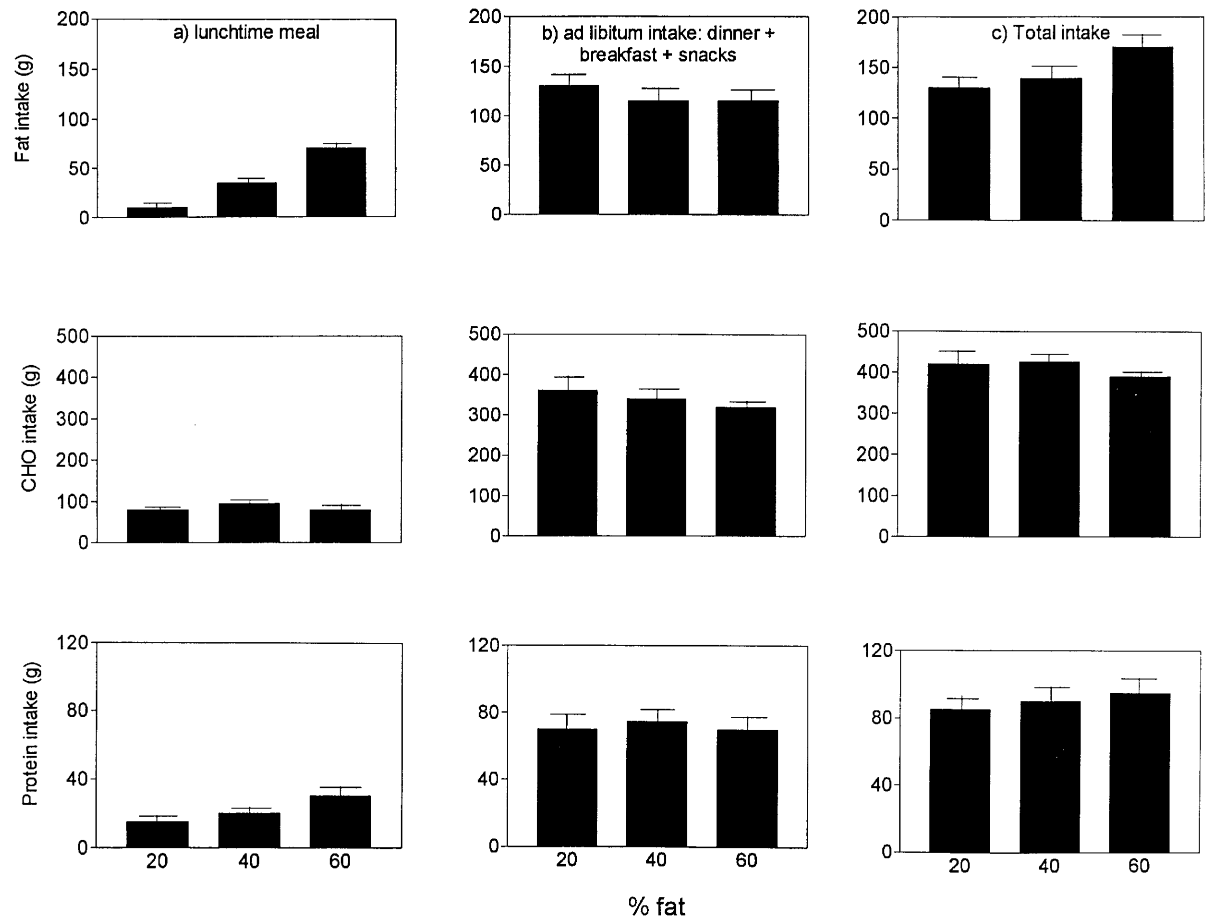

Figure 4 Manipulation of a lunchtime meal. Fat, carbohydrate (CHO) and protein intake from a fixed lunchtime meal (left hand panels), subsequent *ad libitum* intake (middle panels) and total 24 h intake (= lunch + *ad libitum* intake; right hand panels, mean ± s.e.m.).

studies,[3,5–8,19] that when individuals are allowed to eat *ad libitum*, EI will increase as both the fat content and the ED of foods increase. If a high-fat, high-energy diet is chosen, either consciously or sub-consciously, only a considerable reduction in the weight of food eaten can prevent EI from rising. This reduction in the amount of food eaten throughout the day rarely seems to occur, being a strongly entrenched human feeding behaviour. Conversely when a low-fat, low-energy diet is chosen, EI spontaneously falls. Dieters do not need to consciously restrict their intake, but may eat freely, providing they maintain the integrity of the dietary composition and hence maintain the low-fat nature of the diet. In our current study, subjects were provided with a 20% fat diet which, since all foods available to them during the treatment period were of fixed low-fat composition, resulted in a reduction in EI. If this were maintained over a long period, we would predict that weight loss would ensue.

There are a number of possible reasons why dietary fat enhances EI. There is a large body of evidence to show that a high-fat high-energy diet is less satiating than either a high CHO or protein diet[20–25] and is highly palatable.[26,27] It has also been shown that the critical factor controlling EI is not actually macronutrient composition *per se*, but the inter-relationship between composition and ED.[28,29] A high fat diet is also an energy dense diet. If this association is broken, then the effect upon EI is also broken. One metabolic study conducted by Stubbs *et al*[29] maintained ED at a constant level and altered the fat:CHO ratio of the diet alone. When ED remained unchanged, so did EI, even when fat composition was altered dramatically from between 20–60% of energy content. Hyperphagia and, perhaps more relevant to the dieting situation, hypophagia, will only occur on a high-fat high-energy or low-fat low-energy diet in individuals allowed to eat to appetite. One of the major factors directing the response of the subjects in our current study, whereby they spontaneously reduced intake on the low-fat diet, was the parallel reduction of the ED with the reduction in fat content.

If it is accepted that a reduction in the fat (and hence ED) content of the diet is the primary cause of a reduction in EI, then it would seem eminently sensible that all dieters follow this strategy and introduce low-fat items into their diet. It was this pattern of dieting that the second arm of our current study intended to replicate, and where a low-fat lunch was provided followed by free intake during the following 24 h. This part of the study showed that reducing the fat composition of a single meal during the day (that represented 23% of baseline daily EI) was insufficient to reduce the overall daily EI significantly. Total EI decreased by only 0.7 MJ/d. There was partial compensation for the alteration of the lunch meal and *ad libitum* food intake increased in response by 0.7 MJ/d. This study also showed that increasing the fat content of lunch by 20% of energy did not significantly increase daily EI ($\delta = +1.0$ MJ/d), although unlike dilution, for fat supplementation there was no change at all in the intake of freely available food and hence no evidence of even partial compensation. One explanation for the lack of effect may be that the ED of the diet over 24 h also remained substantially unchanged at 6.03 kJ/g, 5.89 kJ/g and 6.41 kJ/g, despite the various lunch manipulations.

As with previous metabolic studies,[13–16], we have shown partial compensation for fat dilution within a single meal. The inability to significantly alter daily EI by introducing a limited number of low-fat items into the diet suggests that this may be an unsuccessful dieting strategy. It is possible that individuals may subconsciously select specific foods that re-establish ED at or above that of the 40% baseline diet, although in this study this was not achieved by selection of high fat foods alone, since only an additional 13 g of fat was consumed during the *ad libitum* period in response to the 25 g removed during fat dilution of the lunch. Even in the total absence of compensation, EI would not have decreased significantly relative to the 40% fat diet. Whilst any decrease in the energy or fat intake of the diet must be considered positive in an individual attempting to lose weight, this must further strengthen the question as to whether manipulations made in the fat content of small portions of the diet, such as the single meal of this study, can hope to achieve significant long-term negative fat and energy balance and hence weight loss. However, perhaps overweight individuals actively monitoring food composition and intake in order to lose weight would have entirely different food choices during the *ad libitum* portion of the day to the lean, non-dieting individuals in this study, who were unaware of the covert fat manipulations made. Despite this query it seems unlikely that significant weight loss can be achieved by such small dietary alterations.

Conclusion

We can conclude a number of things from this study. Firstly, in accordance with previously published studies, a low-fat diet will spontaneously reduce EI and a high-fat diet increase intake and induce hyperphagia. One of the primary causes appears to be the concurrent change in density of the foods eaten which, due to the strongly entrenched behaviour maintaining a relatively constant amount (= weight) of food consumed per day, also changes total EI.

Secondly, a significant reduction in the fat content and ED of the total diet may not be achieved when only a portion of the diet is low-fat. In our study, foods chosen during the remainder of the day, when subjects were given access to a wide range of food types, compensated in part for the reduction achieved by the low-fat items. The partial compensation was achieved by an increase in both fat and CHO intake from the *ad libitum* foods.

Thirdly, when a portion of the foods eaten are high-fat, high-energy, there is no evidence of a reduction in the energy content of foods eaten during the rest of the day and hence there is a trend towards an increase in total EI.

Fourthly, it may be inadvisable to use the 10% cut-off point to classify good and poor energy compensation, as has been suggested previously.[16,17] Even in the total absence of any energy compensation, the manipulation of a single meal, even between 20–60% fat content, is barely large enough to have a statistically significant effect overall. In our current study, if the *ad libitum* portion of the diet had remained totally unchanged then EI would vary between only 90–107% of baseline intake, for dilution and supplementation, respectively.

Finally, we conclude that under the specific conditions of this study, a low-fat, low-density diet will reduce EI and aid weight loss, provided the dietary composition is maintained. However, a reduction in total dietary fat may be difficult to achieve by the introduction of a limited number of low-fat items into the diet, and hence the manipulation of a single meal may be insufficient to induce substantial long-term weight loss.

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Appendix 1 *Ad libitum* foods for dinner, breakfast and snacks

Food items	*ED (kJ/g)*	*CHO (g/100 g)*	*fat (g/100 g)*	*protein (g/100 g)*	*% fat*
Dinner					
Beef goulash and rice	3.81	13.1	2.0	5.2	19.8
Beef stew and dumplings	6.11	9.5	7.5	10.1	46.2
Carrots (frozen)	0.80	4.2	0.3	0.5	14.1
Chicken supreme	3.51	11.0	1.8	5.8	19.3
Chowmein stir fry	3.93	14.1	2.8	3.2	26.8
Cottage pie	4.60	10.9	5.0	5.3	40.9
Fisherman's pie	4.10	11.9	3.5	4.6	32.1
Lasagne	7.32	11.8	10.7	7.8	55.0
Microwave fries	11.42	34.6	13.2	3.9	43.5
Peas (frozen)	2.27	11.3	1.5	6.9	24.9
Potato (raw)	3.72	17.2	0.2	2.1	2.0
Roast beef platter	4.64	12.6	2.9	8.7	23.5
Roast chicken platter	5.23	9.7	5.5	9.1	39.6
Salad	0.51	3.2	0.0	0.0	0.0
Smoked cod with butter	4.06	0.1	2.9	17.6	26.9
Spaghetti bolognaise	4.23	11.8	3.3	6.0	29.4
Vegetable rice	4.31	21.6	0.3	3.4	2.6
Apple and blackberry sponge	7.66	19.6	10.5	2.4	51.6
Spotted dick and custard	8.33	23.8	10.2	3.1	46.1
Breakfast					
Brown bread	9.48	41.8	2.7	8.8	10.7
Butter	30.41	0.0	100.0	0.4	123.8
Corn flakes™	15.67	85.1	1.6	8.6	3.8
Jam	11.14	60.5	0.1	0.6	0.3
Marmalade	11.14	69.5	0.0	0.1	0.0
Mayonnaise	29.52	4.0	73.6	1.2	93.9
Rice crispies™	15.84	89.7	0.9	6.1	2.1
Semi-skimmed milk	1.95	5.0	1.6	3.3	30.9
Sugar	16.8	105.0	0.0	0.0	0.0
White bread	9.91	49.7	1.7	7.8	6.5
Snacks					
Apples	1.51	9.2	0.0	0.2	0.0
Choc fingers	21.97	67.4	27.6	5.7	47.3
Choc ices	11.93	28.1	17.5	3.5	55.2
Club biscuits	21.97	61.9	25.8	5.4	44.2
Crisps	22.24	49.3	35.9	6.3	60.8
Diet Coke™	0.0	0.03	0.0	0.06	0.0
Ice lollies	0.5	3.2	0.0	0.0	0.0
Maltesers™	18.53	71.0	16.6	3.8	33.7
Mars bar™	18.53	69.6	17.5	4.0	35.6
Oranges	1.13	6.4	0.0	0.6	0.0
Peanuts	23.64	11.4	49.3	24.7	78.5
Pears	1.25	9.2	0.0	0.2	0.0
Ripple bar™	21.97	64.8	29.2	4.7	50.0
Yoghurts	3.42	17.9	1.0	4.8	11.0

ED = energy density; CHO = carbohydrate.