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Weight-loss diet that includes consumption of medium-chain triacylglycerol oil leads to a greater rate of weight and fat mass loss than does olive oil[2]

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Abstract

Background—Clinical studies have shown that consumption of medium-chain triacylglycerols (MCTs) leads to greater energy expenditure than does consumption of long-chain triacylglycerols. Such studies suggest that MCT consumption may be useful for weight management.

Objective—We aimed to determine whether consumption of MCT oil improves body weight and fat loss compared with olive oil when consumed as part of a weight-loss program.

Design—Forty-nine overweight men and women, aged 19–50 y, consumed either 18–24 g/d of MCT oil or olive oil as part of a weight-loss program for 16 wk. Subjects received weekly group weight-loss counseling. Body weight and waist circumference were measured weekly. Adipose tissue distribution was assessed at baseline and at the endpoint by use of dual-energy X-ray absorptiometry and computed tomography.

Results—Thirty-one subjects completed the study (body mass index: 29.8 ± 0.4, in kg/m^2). MCT oil consumption resulted in lower endpoint body weight than did olive oil (−1.67 ± 0.67 kg, unadjusted $P = 0.013$). There was a trend toward greater loss of fat mass ($P = 0.071$) and trunk fat mass ($P = 0.10$) with MCT consumption than with olive oil. Endpoint trunk fat mass, total fat mass, and intraabdominal adipose tissue were all lower with MCT consumption than with olive oil consumption (all unadjusted P values < 0.05).

Conclusions—Consumption of MCT oil as part of a weight-loss plan improves weight loss compared with olive oil and can thus be successfully included in a weight-loss diet. Small changes in the quality of fat intake can therefore be useful to enhance weight loss.

Keywords

Obesity; weight loss; medium-chain triacylglycerols; olive oil; fat mass

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The contributions of the authors were as follows—M-PS-O: study concept and design, analysis and interpretation of data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise, obtained funding, and study supervision; AB: analysis and interpretation of data, critical revision of the manuscript for important intellectual content, and study supervision.

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INTRODUCTION

Dietary fat is often blamed for the rising prevalence of obesity (1). However, all fats are not equal in their metabolic effects. For example, medium-chain triacylglycerols (MCTs), which typically contain fatty acids with chain lengths of ≤10 carbon atoms, are processed differently from long-chain triacylglycerols (LCTs) by the body (2). Because of their chain length, medium-chain fatty acids can be absorbed in the gastrointestinal tract and transported to the liver via the portal circulation without incorporation into chylomicrons. As a result, it is hypothesized that MCTs are oxidized to a greater extent than are LCTs and have less opportunity for deposition into adipose tissue (3). These characteristics of MCTs have been well demonstrated in animal studies, in which rats were shown to have smaller adipose tissue mass if fed MCTs than if fed LCTs (4–7). Human studies have also long shown that MCTs increase fat oxidation and thermogenesis compared with LCTs in short-term feeding studies (8–11). More recently, we showed that this remains the case even over prolonged consumption periods of up to 4 wk (12,13). Furthermore, we showed that when men consume a diet rich in MCTs, they lose more fat mass than when they consume an equicaloric diet rich in LCTs from olive oil (13).

As a result of data showing increased thermogenesis and lower fat deposition with MCT consumption, it has been hypothesized that MCT oil may be a useful adjunct to a weight-loss diet. However, no study to date has examined the effect of MCT consumption as part of a weight-loss diet. Previous human studies were either studies of diet-induced thermogenesis after a single meal containing MCT or LCT (8–10) or were controlled (12,13) or semi-controlled (14,15) weight-maintenance feeding studies. Moreover, some data also suggest that MCTs increase satiety when compared with LCTs (13) and therefore that only free-feeding experiments would capture the combined effect of enhanced thermogenesis and improved satiety that would result from MCT consumption. The purpose of the present study was thus to compare the effectiveness of a free-living weight-loss diet incorporating MCT consumption with one providing LCTs in the form of olive oil on the degree of weight loss and change in body composition in overweight men and women.

SUBJECTS AND METHODS

Subject characteristics

Subjects were recruited from the Birmingham, AL, greater metropolitan area through newspaper advertisements and flyers. Both men and women, aged 19 to 50 y, with a body mass index (in kg/m^2) of 27–33 were recruited. For inclusion in the study, all participants were required to be weight stable for ≥6 mo and to be free of chronic diseases. Individuals undergoing weight loss with drug treatment or taking any medication known to affect body weight were excluded. Persons whose blood pressure, glucose, or lipid levels were under stable, medical control were permitted to participate as long as their medication remained constant throughout the study. Women who were pregnant, planning to become pregnant, or <1 y postpartum or breastfeeding were excluded from the study. All individuals were also required to have a normal score on the Brief Symptoms Inventory questionnaire (16). The study was approved by the University of Alabama at Birmingham (UAB) Institutional Review Board, and all subjects provided informed consent before starting the study.

Protocol

Once the subjects were enrolled in the study, they were randomly assigned to either MCT oil (Neobee 1053; Stepan Company, Northfield, IL) or olive oil (Filippo Berio; Salov North American Corporation, El Paso, TX) consumption. MCT oil contained octanoate and decanoate only (100% saturated medium-chain fatty acids). Olive oil was a blend of ≈14% saturated fatty acids, 72% monounsaturated fatty acids, and 14% polyunsaturated fatty acids. All fatty acids in olive oil were long-chain fatty acids. Subjects received group dietary counseling weekly at the UAB Pittman General Clinical Research Center for 16 wk. The counseling sessions followed the EatRight Weight Management program developed at UAB. Briefly, the EatRight program is a 12-wk program that teaches good nutrition habits and provides tips for better weight control and weight loss. Four lessons were added to the basic program to account for the longer duration of this weight-loss study. The sequence and topics for each counseling session are shown in Table 1. The subjects were provided EatRight materials weekly and discussed the weight-loss principles taught with the dietitian. Body weight and waist circumference were measured at each weekly session by the clinical coordinator (AB). Additional body-composition measurements made by using dual-energy X-ray absorptiometry (DXA) and computed tomography (CT) were obtained at baseline and at the study endpoint to determine fat mass and adipose tissue distribution.

As part of the weight-loss program, the subjects were counseled to reduce their caloric intakes to 1500 kcal/d for women and 1800 kcal/d for men. Within this diet, all subjects received study muffins (either cranberry or blueberry; Krusteaz, Seattle, WA) that contained 10 g of their assigned oil and 8 or 14 g of liquid oil, for women and men, respectively, to incorporate into their foods during cooking. Therefore, all subjects received ≈12% of their prescribed weight-loss energy requirements in the form of the study oil (18 g for women and 24 g for men). This level of oil was chosen because it was found to produce significant increases in energy expenditure (8). The subjects, along with the dietitian and clinical coordinator, were unaware of the oil each person was consuming. Muffins were given to the clinical coordinator in bags labeled with the subject’s study ID code and A or B to designate group. Oil was provided in opaque plastic containers, which were also labeled with the subject’s study ID code and A or B. Neither the dietitian nor the clinical coordinator knew which oil was A and which one was B. The oils did not impart any particular taste to the study muffins. Also, because the subjects were instructed to consume the liquid oil in stir-frying and with foods, it is unlikely that they could identify which study oil they were being provided. Another point of note is that none of the subjects had previously tasted MCT oil and therefore had no point of reference to determine whether it tasted any different from olive oil.

Measurements

Anthropometrics—Body weight was measured to the nearest 0.5 kg with a standard beam scale. Height was measured to the nearest 0.1 cm with a stadiometer. For these measurements, the subjects wore regular street clothes but no shoes. Waist circumference was measured with a nonstretching tape at the level of the navel.

Dual-energy X-ray absorptiometry—Subjects underwent a full-body DXA scan at baseline and at 16 wk. Scans were performed in the Department of Nutrition Sciences at UAB with a GE Lunar Prodigy scanner equipped with adult software (enCORE 2002 version 6.10.029; Prodigy, Lunar Radiation Corp, Madison, WI). The subjects were scanned while dressed in a laboratory gown while lying on their back with their arms to their side. Images were obtained, and the system software provided the mass of lean soft tissue, fat mass, and bone mineral for the whole body and for separate regions. Details of regional body-composition determination are provided elsewhere (17). All scans were performed and analyzed by the same investigator.

Computed tomography—CT scans were performed to assess changes in intraabdominal adipose tissue and subcutaneous abdominal adipose tissue with weight loss. These scans were done in the Department of Radiology at UAB by using a HiLight/Advantage Scanner (General Electric, Milwaukee, WI). The scanner was set at 120 kVp (peak kilovoltage) and 40 mA. A scout was performed to locate the L4–L5 intervertebral space, and image acquisition was set at a level 10 mm above the L4–L5 vertebrae in men and 5 mm above L4–L5 in women. These areas have been found to be highly associated with total visceral adipose tissue and provide the most power to detect changes in visceral adipose tissue (18). Images were analyzed by using the SLICE-O-MATIC software, which is especially designed to assess body compartment areas (Tomovision Inc, Montreal, Canada). All before and after measurements were analyzed by the same investigators (M-PS-O and AB).

Statistical analyses

Data were analyzed by using SAS software for WINDOWS version 9.1 (SAS Institute Inc, Cary, NC). All body-composition data were analyzed by using mixed models analysis of variance with subject ID as a random variable and week and diet as fixed variables. A diet-by-week interaction term was also included in the model. Baseline body weight was included as a covariate. All data presented were analyzed on a completer basis and on a last-observation-carried-forward analysis for anthropometric data only. Data in the text are reported for both analyses; however, graphs and tables show adjusted data on completers only. Because this was an intervention study, we feel it is more compelling to present the completers data because they received the test muffins and oil. DXA and CT data only had 2 time points, baseline and endpoint, and therefore were analyzed only for completers. Change between groups was analyzed by using unpaired *t* tests. Data are reported as means ± SEMs.

RESULTS

A total of 49 subjects were enrolled in the study and 31 completed the study (MCT, $n = 16$; olive oil, $n = 15$). Reasons for dropping out included scheduling conflicts ($n = 8$), food complaints ($n = 5$), injury unrelated to the study ($n = 1$), family emergency ($n = 1$), pregnancy ($n = 1$), and lost to follow-up ($n = 2$). One person in the MCT group who dropped out for food complaints did so because she said the oil made her sick. Other food complaints were not specific to the oils. The characteristics of the subjects at baseline are shown in Table 2. Thirty subjects completed CT measurements (data were missing for 1 subject in the olive oil group).

There was a significant effect of week ($P < 0.0001$) and a trend for a diet-by-week interaction on body weight ($P = 0.1043$). The change in absolute body weight at week 16 compared with baseline, after adjustment for multiple comparisons, was significant in the MCT group (−3.16 ± 0.49 kg; $P < 0.0001$) but not in the olive oil group (−1.41 ± 0.49 kg; $P = 0.117$) (Table 3). Body weight at the study endpoint was lower in the MCT group than in the olive oil group (unadjusted $P = 0.013$). The last observation carried forward analysis showed a significant effect of week ($P = 0.0001$) and a diet-by-week interaction ($P = 0.045$) on body weight.

When percentage change in body weight was analyzed, we found a significant effect of week ($P < 0.0001$) and a diet-by-week interaction ($P = 0.0032$) in the completers analysis. Both groups lost weight (MCT oil, $P < 0.0001$; olive oil, $P = 0.0030$); however, percentage change in body weight at week 16 was significantly greater in the MCT group than in the olive oil group ($P = 0.011$; Figure 1). In the last observation carried forward analysis, there were significant main effects of week ($P = 0.0282$) and diet ($P = 0.0428$) but no diet-by-week interaction ($P = 0.3770$) on percentage change in body weight.

There was no significant effect of diet and no diet-by-week interaction on waist circumference in either the completers or the last observation carried forward analysis. However, there was a significant effect of week ($P < 0.0001$) in both analyses. Anthropometric data are shown in Table 3.

There was a significant effect of week on percentage total body fat (*P* = 0.0037), absolute fat mass (*P* = 0.0013), and absolute trunk fat mass (*P* = 0.0036). There was a trend toward a diet-by-week interaction on absolute fat mass (*P* = 0.071). There was a trend for endpoint percentage total body fat to be lower in the MCT group than in the olive oil group (−0.88 ± 0.46%, unadjusted *P* = 0.063). Changes in absolute fat mass were −0.694 ± 0.589 kg (unadjusted *P* = 0.25) and −2.232 ± 0.571 kg (unadjusted *P* = 0.0005) in the olive oil and MCT group, respectively (Table 4). There was a trend for the change in absolute fat mass to be greater in the MCT group than in the olive oil group (*P* = 0.071; Figure 2). Endpoint absolute fat mass was lower in the MCT group than in the olive oil group (−1.542 ± 0.581 kg; unadjusted *P* = 0.01). Absolute trunk fat mass changed by −0.337 ± 0.365 kg (unadjusted *P* = 0.36) in the olive oil group and by −1.203 ± 0.353 kg (unadjusted *P* = 0.0012) in the MCT group. The difference between groups fell short of being statistically significant (*P* = 0.10). However, endpoint trunk fat mass was lower in the MCT oil group than in the olive oil group (−0.875 ± 0.359 kg; unadjusted *P* = 0.0179). Changes in percentage trunk fat mass were not significant (olive oil: −0.49 ± 0.6%, *P* = 0.42; MCT oil: −1.23 ± 0.85%, *P* = 0.17). There was a trend toward a diet-by-week interaction on total body lean mass (*P* = 0.0921), with endpoint lean mass being lower in the MCT group than in the olive oil group (−0.929 ± 0.408 kg, unadjusted *P* = 0.0267).

Data from our CT analyses showed a trend toward an effect of week (*P* = 0.0658), an effect of diet (*P* = 0.0925), and a diet-by-week interaction (*P* = 0.0753) on muscle area. Muscle area was significantly greater at the study endpoint with olive oil than with MCT oil consumption (0.491 ± 0.197 cm^2; unadjusted *P* = 0.0157). There was a significant effect of week (*P* = 0.0116) but no significant effect of diet (*P* = 0.3327) or diet-by-week interaction on subcutaneous abdominal adipose tissue area (*P* = 0.3313). For intraabdominal adipose tissue area, there was a trend toward a diet effect (*P* = 0.0826) and a week effect (*P* = 0.0819) but no diet-by-week interaction (*P* = 0.1950). Endpoint intraabdominal adipose tissue area after olive oil consumption was higher than after MCT oil consumption (8.89 ± 4.08 cm^2; unadjusted *P* = 0.0336).

DISCUSSION

This study is one of the few studies to examine the effect of MCT consumption on body composition in an ad libitum setting. It is also the longest study to examine the effects of MCT consumption on body composition to date. We have shown that the inclusion of MCT oil in a weight-loss program leads to greater weight loss than does the inclusion of a similar amount of olive oil. However, we were not able to show differences in adipose tissue distribution between the different diets.

In this study, we found that subjects consuming MCT as part of their weight-loss diet lost an average of 1.7 kg more than did subjects consuming olive oil as part of their weight-loss diet. This agrees with our previous data (12) and hypothesis put forth previously concerning the potential for enhanced weight management with MCT consumption (19). In our previous study, we found that women burn ≈45 kcal/d more when consuming medium-chain saturated fats than when consuming long-chain saturated fats (12). In addition, studies have found that subjects consume an average of 62.5 kcal/d less when meals contain MCT instead of LCT (19). The addition of an enhanced thermic effect of food and reduced food intake would result in a lower caloric retention of 107.5 kcal/d. This lower caloric retention, if maintained over a 16-wk period, would lead to an additional loss of 1.55 kg body wt with MCT consumption than with LCT. Our finding of a 1.7-kg difference in weight loss thus agrees with our earlier hypothesis (19).

Our results also agree with those of previous clinical studies (14,15). Tsuji et al (15) found that overweight subjects consuming a diet containing ≈10 g MCT oil/d for 12 wk lost 1.34 kg more than did a group consuming 10 g of an LCT oil (rapeseed oil–soybean oil blend). If their data extrapolate to 16 wk, their subjects could have lost 1.79 kg more with MCT oil consumption than with LCT oil. Similar results were also obtained with subjects consuming 5 g of MCT or LCT oil/d (14). In that study, weight loss over a 12-wk period was enhanced by 1.3 kg, which could extrapolate to 1.7 kg over a 16-wk period. Weight-loss data from these 2 studies, extrapolated to 16 wk, are similar to those obtained in the present study.

In a previous controlled feeding study, we found that men had greater reductions in upper-body adipose tissue after consuming MCT oil for 4 wk than after consuming olive oil for 4 wk (13). In this study, we did not find a significant diet-by-week interaction for any of the adipose tissue subcompartment measurements. Our sample size may have been too small to detect these changes. Our study was originally powered to detect a 1.2-kg difference between groups in change in absolute fat mass. We had estimated requiring 18 subjects/group to detect this difference with 95% confidence and 80% power. We found a difference of 1.5 kg in change in total fat mass between groups with 15 and 16 subjects in each group. A larger sample size may be necessary to detect significant changes in adipose tissue subcompartments. Alternatively, it may be that there are sex differences in adipose tissue mobilization response to MCT. In a previous study of women, we had not found any significant differences in adipose tissue compartment losses between MCT and LCT consumption as part of a weight maintenance diet for 4 wk (12), and we had also proposed a potential sex effect on the basis of a review of the literature (19). In this study, the larger number of women relative to men may have also influenced our results.

A further limitation of the present study is the large dropout rate (36.7%), which was comparable between groups. However, this number is similar to what occurred in a previous 12-wk weight-loss study by our group (20) and similar to that observed by other groups as well (21,22). Moreover, dropouts did not introduce any systematic bias into our sample because there were no differences in body composition or other baseline characteristics among the completers of each group at baseline.

We chose olive oil as a control oil for several reasons: *1*) it has physical properties similar to those of MCT oil (liquid at room temperature and can be satisfactorily used for cooking, baking, and as a salad dressing), *2*) we previously found differences in diet-induced thermogenesis between olive oil and MCT oil consumption, and *3*) it is considered to be a healthy oil and is widely used. However, some studies have found that olive oil consumption can lead to favorable changes in body composition (23,24) and increased fat oxidation (25) relative to animal-derived saturated fats. Piers et al (25) found that postprandial fat oxidation after a meal rich in olive oil was greater than after a similar meal high in saturated fat from cream. In a follow-up study with a small group of overweight men, Piers et al (24) found that consuming a diet rich in monounsaturated fats, mostly from olive oil, led to lower body weight, fat mass, percentage body fat, and trunk fat mass than did consuming a diet rich in saturated fat from animal products for 28 d. They suggested that replacing saturated fat in the diet with monounsaturated fat can result in small but significant reductions in body weight and fat mass. A similar study was recently done examining the effects of 3 diets rich in saturated fat, monounsaturated fat, or carbohydrates on body composition and fat distribution (23). There was no difference in energy intake or resting energy expenditure between diets, but fat oxidation was higher after the subjects consumed the diets rich in monounsaturated fat and saturated fats than after the diet rich in carbohydrates. When they examined body composition, they found higher trunk fat mass and lower leg fat mass after subjects consumed the high-carbohydrate diet than after the high-saturated-fat and high-monounsaturated-fat diets. There was no significant change in total body weight or lean body mass. These authors also suggested that the macronutrient composition of the diets may influence body fat distribution without necessarily affecting total body weight.

From these studies, we may hypothesize that our results are conservative. If olive oil produces favorable body composition relative to an animal-product-derived saturated fat and relative to a high-carbohydrate diet, it is possible that greater differences between groups would have been observed in this study if we had chosen a long-chain saturated fat control or a high-carbohydrate control group. We showed previously that MCT oil enhances diet-induced thermogenesis compared with long-chain saturated fats from beef tallow (12). However, although differences in energy expenditure corresponded to differences in body weight, we did not find significant differences in body composition between diets. Furthermore, the animal-derived saturated fat control was not considered desirable by some subjects and was not well tolerated. It is also impossible to blind subjects to treatment oil when oils have such different properties: MCT oil is liquid at room temperature, whereas animal-derived long-chain triacylglycerol fats are solid. A future study comparing the effects of a weight-loss diet high in MCT oil with one high in carbohydrates may show greater benefits of MCT oil consumption for weight loss.

In conclusion, the results of this study show that a weight-loss diet that incorporates moderate amounts of MCT oil leads to greater losses of body weight and fat mass than does consumption of an equivalent amount of olive oil. Although this study cannot distinguish which side of the energy balance equation played a bigger role in this differential weight loss (enhanced suppression of food intake or enhanced thermic effect of food), these data complement the body of literature concluding that MCT oil can be successfully used in a weight-management program to enhance weight loss. This study also shows that fats have a place in a weight-loss diet and that choosing MCT oil over an LCT oil may provide an additional boost for weight loss.

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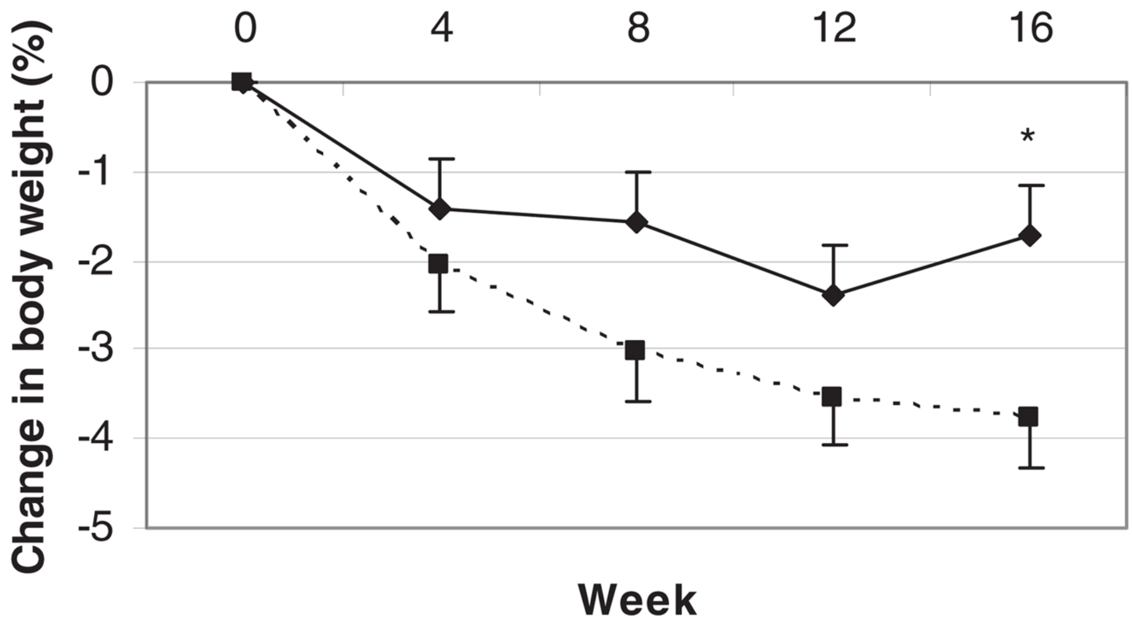

FIGURE 1.
Mean (±SEM) percentage change in body weight over 16 wk during a weight-loss diet with olive oil (solid line, *n* = 15) or medium-chain triacylglycerol (MCT) oil (hatched line, *n* = 16). There was a significant effect of week ($P < 0.0001$) and trends for an effect of diet ($P = 0.0877$) and a diet-by-week interaction ($P = 0.1117$) by repeated-measures analysis of variance. Post hoc analyses showed a significant difference between diets at week 16 (unadjusted $P = 0.011$) and a trend toward greater weight loss with MCT than with olive oil at week 8 (unadjusted $P = 0.063$).

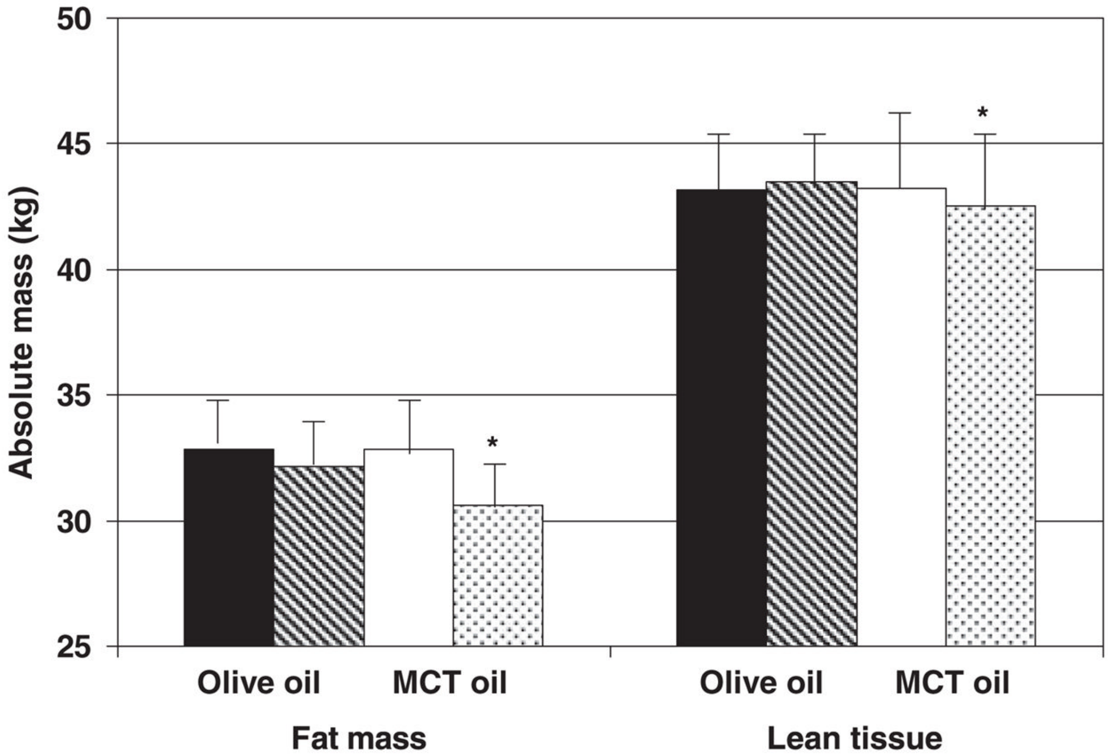

FIGURE 2.

Mean (±SEM) absolute body composition, assessed by dual-energy X-ray absorptiometry, at baseline and at the endpoint of a 16-wk weight-loss program that included either olive oil (baseline = black bars; endpoint = dark gray bars; $n = 15$) or medium-chain triacylglycerol (MCT) oil (baseline = white bars; endpoint = light gray bars; $n = 16$). There was a trend for a diet-by-week interaction on lean tissue ($P = 0.0921$). There was a trend for a diet-by-week interaction on absolute total fat mass ($P = 0.0710$) and fat mass ($P = 0.071$) and a trend for a diet effect on fat mass ($P = 0.0707$). There was a significant effect of week on fat mass ($P = 0.0013$). *Significantly different from endpoint olive oil, unadjusted $P < 0.05$.

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TABLE 1

EatRight weight-loss program study topics by week

Lesson number	Topic
1	Study muffins and oil use; low-fat and fat-free ideas
2	ChooseRight
3	RecordRight
4	Healthy recipes
5	Goal setting
6	PlanRight
7	ShopRight (in class)
8	ShopRight (grocery store tour)
9	HeartSmart
10	CookRight
11	DineRight
12	Healthy fast food choices
13	ThinkRight
14	Stress management
15	StartRight
16	Sharing healthy recipes

TABLE 2

Subject demographics and anthropometric characteristics at baseline[1]

Characteristic	MCT oil, all subjects	MCT oil, completers	Olive oil, all subjects	Olive oil, completers
Sex (M/F)	2/23	2/14	1/23	1/14
Race (W/AA/H)	6/19/0	5/11/0	5/18/1	2/12/1
Age (y)	35.8 ± 1.4[2]	36.5 ± 2.1	36.3 ± 1.7	37.5 ± 2.0
Weight (kg)	81.46 ± 2.36	80.88 ± 3.6	80.28 ± 1.58	78.76 ± 2.13
Height (m)	1.65 ± 0.02	1.65 ± 0.03	1.62 ± 0.01	1.62 ± 0.02
BMI (kg/m^2)	29.7 ± 0.5	29.5 ± 0.6	32.9 ± 0.9	30.0 ± 0.6

[1]MCT, medium-chain triacylglycerol; W/AA/H, white/African American/Hispanic. Data were compared by using unpaired *t* tests. There were no significant differences between groups.

[2]$\bar{x}$ ± SEM (all such values).

TABLE 3

Anthropometric characteristics of the subjects during consumption of either olive oil or medium-chain triacylglycerol (MCT) oil as part of a weight-loss diet for 16 wk[1]

Diet group and week	Body weight	Waist circumference
	kg	*cm*
MCT oil (*n* = 16)		
0	80.4 ± 0.46	94.5 ± 0.7
4	78.7 ± 0.46	94.1 ± 0.7
8	77.8 ± 0.46	92.2 ± 0.7
12	77.2 ± 0.46	92.5 ± 0.7
16	77.2 ± 0.46[2]	92.2 ± 0.7
Change (16–0)	−3.2 ± 0.49	−2.4 ± 0.8
Olive oil (*n* = 15)		
0	80.3 ± 0.47	94.6 ± 0.7
4	79.1 ± 0.47	93.7 ± 0.7
8	79.0 ± 0.47	92.8 ± 0.7
12	78.3 ± 0.47	92.7 ± 0.7
16	78.9 ± 0.47	92.1 ± 0.7
Change (16–0)	−1.4 ± 0.49	−2.5 ± 0.8

[1]All values are adjusted $\bar{x}$ ± SEM. Data for waist circumference include 15 subjects in the MCT oil group and 14 subjects in the olive oil group because of missing data for 1 person from each group. Data were analyzed by using repeated-measures analysis of variance. There was a significant effect of week on body weight and waist circumference (both $P < 0.0001$) and a trend for a diet-by-week interaction on body weight ($P = 0.1043$).

[2]Significantly different from olive oil week 16, $P = 0.013$ (unadjusted *P*).

TABLE 4

Change in adipose tissue compartments, assessed by dual-energy X-ray absorptiometry and computed tomography, during consumption of either olive oil or medium-chain triacylglycerol (MCT) oil as part of a weight-loss diet for 16 wk[1]

Change in body compartment	**MCT oil (*n* = 16)**	**Olive oil (*n* = 15)**
Total fat mass (%)	−1.46 ± 0.45[2]	−0.58 ± 0.46
Total fat mass (kg)	−2.23 ± 0.57[2,3]	−0.69 ± 0.58
Trunk fat mass (%)	−1.23 ± 0.73	−0.49 ± 0.75
Trunk fat mass (kg)	−1.20 ± 0.35[2]	−0.34 ± 0.36
Intraabdominal adipose tissue (cm^2)	−8.85 ± 3.92	−1.32 ± 4.19[4]
Subcutaneous abdominal adipose tissue (cm^2)	−24.76 ± 9.37	−11.29 ± 10.02[4]

[1] All values are $\bar{x}$ ± SEM. Data were analyzed by using repeated-measures analysis of variance, which showed a significant effect of week on percentage total body fat ($P = 0.0037$), absolute fat mass ($P = 0.0013$), and absolute trunk fat mass ($P = 0.0036$).

[2] Significantly different from 0, unadjusted $P < 0.05$ (analysis of variance).

[3] Significantly different from olive oil, $P < 0.05$ (unpaired *t* test).

[4] *n* = 14.