Effect of conjugated linoleic acid supplementation on weight loss and body fat composition in a Chinese population

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A B S T R A C T

Objective: Conjugated linoleic acid (CLA) has several benefits, including body fat reduction, as proved in animals. However, the results of CLA-induced body composition alterations in humans are inconsistent, and no related data are available for Chinese populations. This study aimed to determine whether CLA affects body weight (BW) loss and body composition of overweight and obese Chinese subjects.

Methods: In this randomized, double-blind, placebo-controlled trial, subjects with a body mass index (BMI) of 24 to 35 kg/m^2 randomly received 1.7 g of *cis*-9,*trans*-11 and *trans*-10,*cis*-12 CLA ($n = 30$) or placebo (salad oil; $n = 33$) in 200 mL of sterilized milk twice daily for 12 wk. Changes in body composition were determined by bioimpedance measurements.

Results: Sixty-three subjects completed the study (CLA, $n = 30$). After 12 wk, compared with the baseline, the BW, BMI, total fat mass, fat percentage, subcutaneous fat mass, and waist-to-hip ratio decreased in the CLA group ($P < 0.05$). The CLA group was stratified by BMI and gender. The BW, BMI, subcutaneous fat mass, and waist-to-hip ratio decreased in 27 subjects with a BMI $\geq$ 27, and these indices, except subcutaneous fat mass, were lower in female subjects. The levels of total cholesterol, triacylglycerol, low-density lipoprotein, and plasma fasting glucose increased, whereas those of high-density lipoprotein decreased after 3 mo of CLA treatment. The changes were not significantly different from the baseline values.

Conclusion: The supplementation of CLA for 12 wk in overweight and grade I obese Chinese subjects yielded lower obesity indices, with no obvious adverse effects.

Introduction

Obesity is associated with an increased risk of death from cardiovascular disease, diabetes, kidney disease, and obesity-related cancers (colon, breast, esophageal, uterine, ovarian, kidney, and pancreatic) [1]. Adults who were overweight but not obese were at a significantly increased risk of developing numerous health conditions. [2]. According to a study in the United States, from 1976–1980 to 2007–2008, the obesity prevalence increased from 15% to 34% in adults and from 5% to 17% in children and adolescents [3,4]. From 2007 through 2008, the age-adjusted prevalence of obesity was 33.8% overall (32.2% in men and 35.5% in women) [3].

Using the criteria defined by the Department of Health in Taiwan for adults, overweight and obesity were defined as a body mass index (BMI) greater than or equal to 24 and 27 kg/m^2, respectively. The age-adjusted obesity prevalences were 10.5% and 15.9% for men and 13.2% and 10.7% for women in 1993–1996 and 2000–2001, respectively [5]. A strong positive relation exists between a high BMI and increased medical care expenditure in Taiwan, although the expenditure varies according to sex, age, and socioeconomic status [6]. Thus, coping with obesity is an important public health issue in Taiwan. Patients often try different methods, including dietary supplements, to lose weight before seeking professional obesity treatment. There are many

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dietary supplements sold in Taiwan, including conjugated linoleic acid (CLA).

Conjugated linoleic acid is a mixture of linoleic acid isomers with conjugated double bonds. It is not produced naturally by the human body and is obtained through food. This fatty acid is, however, produced naturally in the rumen of ruminant animals by the biologic hydrogenation of linoleic acid, and it can even be produced synthetically [7]. In ruminant animals, the predominant CLA isomer produced (>90%) is *cis*-9,*trans*-11. However, the *trans*-10,*cis*-12 isomer also seems to play an important role because it has been found to affect body composition alterations in animal models [8]. In addition, CLA can decrease the amount of atherosclerosis biomarkers, cancer risk, and inflammation and improve the immune response and body composition in animal models [9–11].

Although numerous studies in animals have shown that CLA supplementation results in changes in body composition, such as a decrease in body fat mass (BFM) and an increase in lean body mass (LBM) [12–16], studies on humans have yielded different results [17–21]. This might be related to the differences in the form and doses of CLA, the treatment duration, and a subject's body weight (BW) among the different studies.

In the present study, we tested the effect of a 50% mixture of the two active CLA isomers (*cis*-9,*trans*-11 and *trans*-10,*cis*-12; Tonalin and NaturSlim, Kuang Chuan Dairy Co. Ltd., Taiwan) on BW, body composition, and biochemical parameters in overweight and obese Chinese subjects whose work required relatively less physical strength. This is the first trial of this kind in a Chinese population. We also evaluated the changes in hepatic and renal functions, side effects reported by the subjects, and changes in blood pressure to determine the safety of CLA in Chinese persons.

Materials and methods

Subjects

We performed a randomized, double-blinded, placebo-controlled dietary intervention trial from March 1, 2009 through May 31, 2009 in the E-DA Hospital and I-Shou University. All participants were members of the company staff. The study included 26 men and 54 women 18 to 60 y old with a BMI of 24 to 35 kg/m^2. They needed to have a stable weight, defined as a BW variation of less 5%, in the 3 mo before the study. Exclusion criteria included cancer, severe infection, thyroid disease, diabetes mellitus, Cushing's disease, drug addiction, and alcoholism. Pregnant and lactating women also were excluded. Moreover, subjects with dietary variations greater than 10% in daily kilojoules or changes in their exercise behavior during the study were excluded.

Ethics

The study was approved by the ethical research board of the E-DA Hospital (Institutional Review Board No. EMRP10097N). All participants provided informed consent.

Study design

The subjects were randomized to receive 1.7 g of CLA (a mixture of the bioactive isomers 50% *cis*-9,*trans*-11 and 50% *trans*-10,*cis*-12; Tonalin, $n = 40$) in 200 mL of sterilized milk (NaturSlim; nutritional amounts presented per 100 mL: calories, 27; protein, 0.5 g; fat, 1.2 g; carbohydrates, 3.5 g) or placebo (200 mL of sterilized milk with salad oil, $n = 40$) twice a day for 12 wk. The milk was obtained from Kuang Chuan Daiy Co. Ltd.

Clinical assessments

Subject characteristics and demographic data were recorded when the subjects entered the study (week 0). Their body composition, vital signs, dietary control, and discomforts after joining the study were recorded at each monthly visit, i.e., at weeks 0, 4, 8, and 12. At weeks 0 and 12, fasting blood samples were obtained and analyzed in accredited laboratories. Serum samples were examined for glutamate oxaloacetate transaminase, glutamate pyruvate transaminase, creatinine, plasma fasting glucose (Glu-AC), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) cholesterol, total cholesterol (TC), triacylglycerol (TG), white blood cell counts, red blood cell counts, and thyroid function. Poor compliance was defined as an inability to drink the provided supplement more than five times during the study. Those showing poor compliance or for whom the data could not be assessed on time were excluded.

Adverse events

Any unexplainable unfavorable events were recorded by the subjects as adverse events (AEs). The symptoms, severity, frequency, and duration of the AE were recorded. The investigator reviewed the recorded events at each visit. If the subject had severe AEs, he/she could immediately visit the outpatient department or emergency room for treatment. The subject could quit the study if the symptoms of the AE were concerning or if the doctor considered the subject unsuitable for the study.

Diet and exercise

The dietary record was used to analyze the caloric intake of the subjects before and after the study. The diet was assessed from 3-d dietary records that were completed according to standardized research protocols [22]. The subjects would write down the details of their daily food intake and give this record to the dietitian at each visit. We gave the subjects an assessment to evaluate their exercise habits [23].

Measurement of body composition and BW

Bioimpedance was used to determine body composition. The X-scan Plus II body composition analyzer (Jawon Medical Co. Ltd., Kyungsan-city, Korea) was used in the present study and a study by Ryouichi et al. [24]. From this measurement, the BW, height, BMI, BFM, internal organ fat mass, subcutaneous fat mass (SFM), body fat percentage, waist-to-hip ratio (WHR), and LBM were determined.

Statistical analysis

Statistical analyses were performed using SPSS 15 (SPSS, Inc., Chicago, IL, USA). Before beginning the study, we used the chi-square test to examine qualitative variables. Student's t test was used to assess differences in continuous variables. Categorical variables were analyzed using the Fisher exact test, and the paired t test was used to evaluate the changes in anthropometric and analytical variables from week 0 to week 12 in each group. The differences in gastrointestinal (GI) symptoms between the two groups were tested by the McNemar test. The Wilcoxon matched-pairs signed-rank test was used to evaluate the overall effect of CLA supplementation and the interaction between CLA and the other parameters. A significance level of 5% was used in all tests, and all tests were two-tailed.

Results

Study subjects

Sixty-three of the 80 subjects (78.75%) completed the study. Ten participants (five in the CLA group and five in the control group) withdrew during the intervention period for personal reasons. Seven participants (five in the CLA group and two in the control group) were excluded from the analysis because their data were incomplete. Thus, the main analyses were conducted with 63 participants (CLA group, $n = 30$; control group, $n = 33$; Fig. 1).

The baseline characteristics of the two study groups are summarized in Table 1. A female predominance (66.7%) was noted among the 63 participants. Few study subjects (4.8%) exercised regularly. There were no differences in sex, mean age, marital status, daily caloric intake, exercise habits, alcohol use, tobacco use, betel nut chewing, and GI symptoms at baseline. Further, no between-group differences were found in weight, BMI, body fat mass, LBM, blood pressure, and blood examination findings at baseline (Table 2).

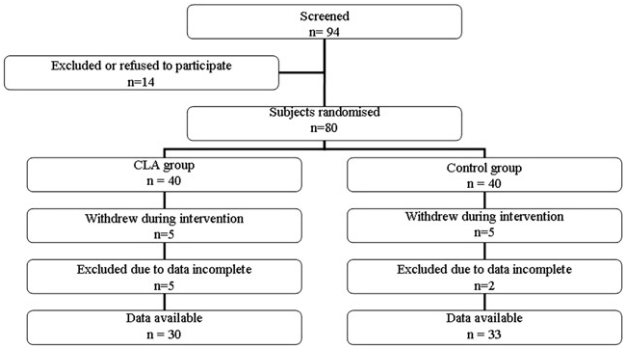

Fig. 1. Study flow chart.

Effects of CLA on BW and body composition

After 12 wk, compared with the baseline, BW ($\Delta = -0.70 \pm 1.71$ kg), BMI ($\Delta = -0.31 \pm 0.65$ kg/m^2), total fat mass ($\Delta = -0.58 \pm 1.18$ kg), fat percentage ($\Delta = -0.58 \pm 1.19\%$), SFM ($\Delta = -0.53 \pm 1.11$ kg), and WHR ($\Delta = -0.01 \pm 0.16$) decreased in the CLA-supplemented subjects (Table 3). There was no significant change in LBM after taking CLA for 12 wk (Table 3). On stratifying the subjects in the CLA-supplemented group by BMI at week 0 (BMI <27 kg/m^2, $n = 17$; BMI $\geq$ 27 kg/m^2, $n = 13$), we found that, compared with the baseline, the BW($\Delta = -1.18 \pm 1.70$ kg), BMI ($\Delta = -0.50 \pm 0.66$ kg/m^2), SFM ($\Delta = -0.52 \pm 0.80$ kg), and WHR ($\Delta = -0.01 \pm 0.19$, $P < 0.05$) decreased in subjects with a BMI of at least 27 kg/m^2 (Table 4). Further, on stratifying the subjects in the CLA-supplemented group by gender (male, $n = 11$; female, $n = 19$), female subjects had greater total fat mass and fat percentage than males (female versus male, 24.86 ± 5.22 versus 21.45 ± 1.56 kg, $P = 0.014$; $35.13 \pm 3.10\%$ versus $26.44 \pm 2.22\%$, $P < 0.001$, respectively; data not shown). However, no between-group difference was found in BMI (female versus male, 27.73 ± 2.90 versus 27.26 ± 1.48 kg/m^2, $P = 0.624$; data not shown). Compared with the baseline, we observed that the BW ($\Delta = -0.79 \pm 1.38$ kg), BMI ($\Delta = -0.38 \pm 0.60$ kg/m^2), total fat mass ($\Delta = -0.58 \pm 0.97$ kg), fat percentage ($\Delta = -0.55 \pm 0.98\%$), and WHR ($\Delta = -0.01 \pm 0.01$) decreased ($P < 0.05$) in female subjects (Table 4).

Effects of CLA on clinical laboratory findings

We found that the levels of glutamate oxaloacetate transaminase, glutamate pyruvate transaminase, Glu-AC, TC, TG, and LDL increased, whereas those of HDL decreased after 3 mo of CLA treatment. The changes in these levels were slight, within the normal range, and not significantly different from the baseline values. No statistically significant differences were found among the subjects in the CLA group (Table 5).

Adverse events

Ten participants reported AEs (CLA group, $n = 3$, 10%; control group, $n = 7$, 21.2%). There was no significant difference in the percentage of GI symptoms between the two groups. The GI symptoms reported included gas, acid regurgitation, diarrhea, nausea, and vomiting. No serious AEs were reported. Subjects who withdrew from the study did not report any AE as the reason for withdrawal.

Discussion

To our knowledge, this is the first randomized, double-blinded, placebo-controlled clinical trial to evaluate the effect

Table 1
Baseline characteristics of the study population

	Total	CLA group ($n = 30$)	Control group ($n = 33$)	P
Sex[*]				0.593
Male	21 (33.3)	11 (36.7)	10 (30.3)	
Female	42 (66.7)	19 (63.3)	23 (69.7)	
Age (y)[†]	32.8 ± 0.8	33.1 ± 1.1	32.5 ± 1.1	0.735
Marital status[*]				0.276
Single	30 (48.4)	13 (43.3)	17 (53.1)	
Married	32 (51.6)	17 (56.7)	15 (46.9)	
Total intake				0.785
kJ/d	7425.1 ± 1122.3	7383.3 ± 1252.0	7462.8 ± 1011.8	
kcal/d[†]	1773.8 ± 268.1	1763.8 ± 299.1	1782.8 ± 241.7	
Tobacco use[‡]				
No	63 (100.0)	30 (100.0)	33 (100.0)	
Yes	0 (0.0)	0 (0.0)	0 (0.0)	
Alcohol use[‡]				0.730
No	61 (96.8)	29 (96.7)	32 (97.0)	
Yes	2 (3.2)	1 (3.3)	1 (3.0)	
Betel nut use[‡]				
No	63 (100.0)	30 (100.0)	33 (100.0)	
Yes	0 (0.0)	0 (0.0)	0 (0.0)	
Exercise[*,§]				0.612
No	60 (95.2)	29 (96.7)	31 (93.9)	
Yes	3 (4.8)	1 (3.3)	2 (6.1)	
GI symptoms[*]				0.614
No	50 (79.4)	23 (76.7)	27 (81.8)	
Yes	13 (20.6)	7 (23.3)	6 (18.2)	

CLA, conjugated linoleic acid; GI, gastrointestinal Values are presented as number of subjects (percentage) or mean ± SD

[*] Two-tailed chi-square test, $\alpha = 0.05$.

[†] Two-tailed Student's t test, $\alpha = 0.05$.

[‡] Two-tailed Fisher exact test, $\alpha = 0.05$.

[§] "Yes" for exercise indicates a frequency of at least three times per week and at least 30 min per time.

Table 2
Data on the study population at week 0

Category	CLA group	Control group	*P*
Weight (kg)	74.40 ± 9.73	75.03 ± 10.45	0.807
BMI (kg/m^2)	27.56 ± 2.45	28.04 ± 2.94	0.486
LBM (kg)	46.54 ± 8.04	45.99 ± 7.27	0.778
BFM (kg)	23.61 ± 4.54	24.80 ± 5.46	0.356
BFM (%)	31.94 ± 5.08	33.00 ± 4.93	0.406
WHR	0.855 ± 0.043	0.857 ± 0.054	0.880
Internal organ fat mass (kg)	3.13 ± 0.80	3.34 ± 1.05	0.387
SFM (kg)	20.52 ± 3.91	21.12 ± 4.33	0.568
SBP (mmHg)	126.86 ± 13.21	125.42 ± 12.58	0.659
DBP (mmHg)	78.63 ± 10.09	77.87 ± 10.24	0.743
GOT (IU/L)	23.93 ± 7.76	27.94 ± 16.79	0.237
GPT (IU/L)	27.73 ± 17.30	37.21 ± 38.72	0.222
TC (mg/dL)	176.46 ± 22.13	189.69 ± 31.31	0.060
TG (mg/dL)	111.80 ± 104.98	106.21 ± 62.52	0.796
HDL-C (mg/dL)	47.17 ± 10.05	48.09 ± 8.32	0.691
LDL-C (mg/dL)	103.30 ± 25.26	115.55 ± 28.61	0.078
Glu-AC (mg/dL)	94.67 ± 19.58	95.27 ± 12.76	0.884

Two-tailed Student's *t* test, $\alpha = 0.05$
BFM, body fat mass; BMI, body mass index; CLA, conjugated linoleic acid; DBP, diastolic blood pressure; Glu-AC, fasting glucose; GOT, glutamate oxaloacetate transaminase; GPT, glutamate pyruvate transaminase; HDL-C, high-density lipoprotein cholesterol; LBM, lean body mass; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; SFM, subcutaneous fat mass; TC, total cholesterol; TG, triacylglycerol; WHR, waist-to-hip ratio

Table 3
Body composition of subjects taking CLA or placebo at weeks 0 and 12

Category	CLA group ($n = 30$)	Control group ($n = 33$)
Weight (kg)		
Week 0	74.40 ± 9.73	75.03 ± 10.45
Week 12	73.71 ± 10.07	74.94 ± 10.42
P	0.034	0.727
BMI (kg/m^2)		
Week 0	27.56 ± 2.45	28.04 ± 2.94
Week 12	27.24 ± 2.47	28.02 ± 3.06
P	0.013	0.880
LBM (kg)		
Week 0	46.54 ± 8.04	45.99 ± 7.27
Week 12	46.48 ± 8.13	46.05 ± 7.27
P	0.783	0.676
BFM (kg)		
Week 0	23.52 ± 4.59	24.80 ± 5.46
Week 12	23.03 ± 4.85	24.70 ± 5.57
P	0.011	0.575
BFM (%)		
Week 0	31.94 ± 5.08	33.00 ± 4.93
Week 12	31.36 ± 5.25	32.80 ± 5.11
P	0.012	0.225
WHR		
Week 0	0.855 ± 0.043	0.857 ± 0.054
Week 12	0.847 ± 0.046	0.856 ± 0.053
P	0.009	0.636
Internal organ fat (kg)		
Week 0	3.13 ± 0.81	3.34 ± 1.05
Week 12	3.03 ± 0.84	3.31 ± 1.03
P	0.062	0.441
SFM (kg)		
Week 0	20.52 ± 3.91	21.12 ± 4.33
Week 12	20.00 ± 4.09	21.36 ± 4.64
P	0.014	0.509

Two-tailed Student's *t* test, $\alpha = 0.05$
BFM, body fat mass; BMI, body mass index; CLA, conjugated linoleic acid; LBM, lean body mass; SFM, subcutaneous fat mass; WHR, waist-to-hip ratio

of CLA on body fat composition in a Chinese population. The consumption of milk supplemented with CLA (3.4 g/d for 12 wk) significantly decreased the BW, BMI, BFM, fat percentage, SFM, and WHR in overweight and grade I obese subjects.

The observation of a lower BFM in the CLA group than in the placebo group was similar to that reported in previous studies involving the same CLA form [19,20,25] but was different from others [21,26]. This discrepancy may be related to differences among these studies in the type of subjects enrolled, the detection tool used for body composition changes, and the CLA dose. Further, the CLA form and treatment period may have influenced the results [27–30].

Our results showing that the BW and BMI decreased after subjects drank CLA in sterilized milk contradict those of Smedman and Vessby [20]; their 3-mo-long, placebo-controlled, randomized, double-blinded study of subjects with a BMI of 20 to 25 kg/m^2 showed no differences between the CLA (4.2 g of CLA) and placebo groups. Experiments in humans have not shown a significant effect of *cis*-9,*trans*-11 or *trans*-10,*cis*-12 CLA on BW [31–34]. We hypothesize that the reason our study showed better results concerning BW loss than that by Smedman and Vessby is that our participants had a higher BMI than their participants.

On stratifying the subjects in the CLA group by BMI, we found that the BW, BMI, SFM, and WHR decreased in subjects with a high BMI and a high body fat content. These findings differ from those of Laso et al. [35], in which the consumption of milk supplemented with 3 g of CLA for 12 wk resulted in a significant decrease in the fat mass of overweight but not obese subjects. The lack of any effect of CLA on the BFM of obese subjects is believed to be related to the short duration of the study [35]. Gaullier et al. [36] used CLA 3.4 g/d or placebo for 6 mo. They found that CLA significantly decreased the BFM in months 3 and 6 compared with placebo. Fat mass loss was mostly in the legs and in women with a BMI higher than 30 kg/m^2 [36]. We believe that we found changes in the BFM in obese participants because we used a higher dose than that used by Laso et al.; our dose was nearly similar to that in the study by Gaullier et al.

We stratified the subjects in the CLA group by gender and found that the obesity indices decreased in female subjects. These subjects had a higher baseline BFM than the male subjects did. The results of the stratification experiment indicated that CLA in milk affected changes in body composition in those with a high BFM.

Conjugated linoleic acid might tend to increase the LBM [19,20,26]. Blankson et al. [19] reported that overweight/obese subjects exhibited a 0.88-kg increase in LBM after taking CLA 6.8 g/d for 12 wk. However, this group had also intensified their physical activity during the intervention period; therefore, it was unclear whether the increase in LBM was related solely to CLA or to the intensified physical activity. Similarly, Steck et al. [37] found that the LBM of subjects who consumed CLA 6.8 g/d for 12 wk increased by a mean of 0.64 kg. However, these subjects significantly decreased their physical activity during the intervention period. Thus, the increase in LBM in this study was definitely related to the CLA supplementation and not to physical activity. In our study, we did not observe an increase in LBM. Not all our participants exercised regularly, and their work in the hospital required less physical strength. Further, the dose of CLA in our study was different from those in previous studies. These reasons might explain the final outcome with regard to the change in LBM.

All the AEs were related to GI function, as in previous studies [19,38]. There were no differences between the CLA and control groups in terms of the AEs reported. Further, the hepatic function and vital signs of the CLA group did not change significantly. All these observations prove the safety of milk supplemented with CLA for humans.

Table 4
Results of X-scan analysis at weeks 0 and 12 and stratification of subjects in the CLA group by BMI and gender at week 0

Category	BMI (kg/m^2)		Gender	
	<27 (n = 17)	≥27 (n = 13)	Male (n = 11)	Female (n = 19)
Weight (kg)				
Week 0	70.60 ± 9.75	79.37 ± 7.40	81.31 ± 4.70	70.40 ± 9.70
Week 12	70.28 ± 10.39	78.19 ± 7.92	80.78 ± 4.82	69.61 ± 10.11
P	0.448	0.036	0.563	0.028
BMI (kg/m^2)				
Week 0	25.90 ± 0.66	29.72 ± 2.25	27.26 ± 1.48	27.73 ± 2.90
Week 12	25.73 ± 0.90	29.22 ± 2.49	27.06 ± 1.46	27.35 ± 2.93
P	0.267	0.031	0.385	0.023
LBM (kg)				
Week 0	45.36 ± 8.82	48.07 ± 6.91	55.19 ± 4.42	41.53 ± 4.59
Week 12	45.58 ± 9.13	47.65 ± 6.78	55.27 ± 4.15	41.39 ± 4.73
P	0.103	0.169	0.721	0.485
BFM (kg)				
Week 0	21.22 ± 1.55	26.79 ± 5.51	21.45 ± 1.56	24.86 ± 5.22
Week 12	20.68 ± 2.34	26.10 ± 5.60	20.87 ± 2.35	24.28 ± 5.50
P	0.098	0.059	0.213	0.022
BFM (%)				
Week 0	30.49 ± 3.90	33.84 ± 5.93	26.44 ± 2.22	35.13 ± 3.10
Week 12	29.84 ± 4.16	33.35 ± 6.00	25.80 ± 2.70	34.57 ± 3.27
P	0.079	0.141	0.247	0.048
WHR				
Week 0	0.843 ± 0.035	0.871 ± 0.050	0.887 ± 0.043	0.837 ± 0.032
Week 12	0.839 ± 0.041	0.858 ± 0.051	0.879 ± 0.049	0.829 ± 0.034
P	0.178	0.010	0.288	0.003
Internal organ fat mass (kg)				
Week 0	2.77 ± 0.50	3.61 ± 0.91	3.20 ± 0.46	3.09 ± 0.97
Week 12	2.65 ± 0.58	3.53 ± 0.88	3.04 ± 0.53	3.02 ± 0.98
P	0.140	0.199	0.170	0.129
SFM (kg)				
Week 0	18.56 ± 1.78	23.09 ± 4.49	18.60 ± 1.71	21.64 ± 4.41
Week 12	18.02 ± 1.92	22.57 ± 4.78	17.82 ± 1.83	21.25 ± 4.53
P	0.127	0.050	0.075	0.081

Two-tail paired t test, $\alpha = 0.05$
BFM, body fat mass; BMI, body mass index; CLA, conjugated linoleic acid; LBM, lean body mass; SFM, subcutaneous fat mass; WHR, waist-to-hip ratio

Previous clinical studies have shown that the effects of CLA on blood lipids are diverse and include a decrease in HDL cholesterol [19,21] and a decrease in very LDL cholesterol, with no effect on HDL or LDL cholesterol [39]. CLA even has been found to have no effect on cholesterol lipids [38]. In the present study, we found that the levels of TC, TG, and LDL increased, whereas those of HDL decreased after 3 mo of CLA treatment. The changes in these levels were slight, within the normal range, and not significantly different from the baseline values.

Contradictory results have been reported on the effects of CLA on carbohydrate metabolism in humans. Riserús et al. [21] found that insulin resistance increased in a male population with metabolic syndrome after 12 wk of treatment with the *trans*-10,*cis*-12-CLA isomer. However, other studies have shown that neither *cis*-9,*trans*-11 CLA nor *trans*-10,*cis*-12 CLA has any significant effect on the plasma glucose or insulin levels, insulin sensitivity, or insulin resistance [20,32,39]. In our study, as in the study by Laso et al. [35], the Glu-AC in the CLA group did not change significantly. Riserús et al. [21] found that the effect of increased insulin resistance was not observed when a mixture of isomers (the Tonalin mixture used in this study and the study by Laso et al.) was used. This might be the reason we did not find a CLA-induced increase in the plasma glucose level.

According to the recommendations for the management of obesity from the National Heart, Lung, and Blood Institute, advice on diet, physical activity, and/or behavioral therapy can be given to people concerned about their BW. Pharmacotherapy and bariatric surgery can be considered in obese adults who are unable to achieve an adequate weight loss after available conventional lifestyle modifications and who have no absolute contraindications. People often try other methods, including unproved drugs, herbal preparations, and dietary supplements, to lose weight before seeking professional obesity treatment. Dietary supplements are probably considered safe because they are classified as food. According to one cross-sectional study performed from July 2004 through June 2005 to determine the prevalence and patterns of antiobesity medicine use in subjects seeking obesity treatment in Taiwan, 22.4% of subjects indicated that they concurrently used dietary supplements [40]. However, patients sometimes do not inform their physicians about the use of dietary supplements. Herb–drug and drug–drug interactions may occur after the concurrent consumption of multiple weight-loss products [41,42]. Therefore, we must pay attention to dietary supplements to achieve a good communication with our patients.

Conclusions

We found that supplementation with CLA 3.4 g/d for 12 wk in healthy overweight and grade I obese subjects resulted in a decrease in obesity indices, with no obvious adverse effects. These changes were noticeable in grade I obese women. The levels of TC, TG, LDL, and Glu-AC increased, whereas those of HDL deceased after 3 mo of CLA treatment. The changes in these levels were slight, within the normal range, and not significantly different from the baseline values.

Table 5
Blood examination results and vital signs of subjects taking CLA or placebo at weeks 0 and 12

Category	CLA group ($n = 30$)	Control group ($n = 33$)
GOT (IU/L)		
Week 0	23.93 ± 7.76	27.94 ± 16.79
Week 12	25.13 ± 9.55	30.18 ± 23.20
P	0.409	0.196
GPT (IU/L)		
Week 0	27.73 ± 17.30	37.21 ± 38.72
Week 12	30.93 ± 25.64	39.94 ± 47.38
P	0.279	0.328
TC (mg/dL)		
Week 0	176.46 ± 22.13	189.69 ± 31.31
Week 12	182.96 ± 36.63	185.39 ± 29.41
P	0.199	0.105
TG (mg/dL)		
Week 0	111.80 ± 104.98	106.21 ± 62.52
Week 12	130.73 ± 161.00	129.21 ± 91.91
P	0.370	0.018
HDL-C (mg/dL)		
Week 0	47.17 ± 10.05	48.09 ± 8.32
Week 12	46.50 ± 9.74	47.09 ± 7.71
P	0.591	0.158
LDL-C (mg/dL)		
Week 0	103.30 ± 25.26	115.55 ± 28.61
Week 12	106.80 ± 35.24	111.91 ± 27.05
P	0.356	0.186
Glu-AC (mg/dL)		
Week 0	94.67 ± 19.58	95.27 ± 12.76
Week 12	95.23 ± 12.23	97.27 ± 18.42
P	0.758	0.437
SBP (mmHg)		
Week 0	126.86 ± 13.21	125.42 ± 12.58
Week 12	123.20 ± 13.91	126.03 ± 13.52
P	0.073	0.706
DBP (mmHg)		
Week 0	78.63 ± 10.09	77.87 ± 10.24
Week 12	76.20 ± 12.12	76.36 ± 11.10
P	0.255	0.254

Two-tailed paired *t* test, $\alpha = 0.05$
CLA, conjugated linoleic acid; DBP, diastolic blood pressure; Glu-AC, fasting glucose; GOT, glutamate oxaloacetate transaminase; GPT, glutamate pyruvate transaminase; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TG, triacylglycerol

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