

Commentary

The Effectiveness of Medical Nutrition Therapy Delivered by Registered Dietitians for Disorders of Lipid Metabolism: A Call for Further Research

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Cardiovascular disease is the leading cause of death in the United States. Approximately 80% of patients with coronary heart disease have at least one of the four major risk factors—hypertension, dyslipidemia, diabetes, and smoking—that can be modified through lifestyle changes (1,2). Trained in biological and food science as well as nutrition counseling and behavioral skills management, registered dietitians (RDs) are uniquely qualified to tailor help for these patients to effectively modify their diets and reduce their risk for cardiovascular dis-

ease. The evidence that supports the effectiveness of this approach and what data are needed to further establish medical nutrition therapy for managing disorders of lipid metabolism and potentially prevention of cardiovascular disease is discussed in this commentary.

MEDICAL NUTRITION THERAPY FOR DISORDERS OF LIPID METABOLISM

RDs provide individualized nutrition counseling, termed *medical nutrition therapy*. “Medical Nutrition Therapy (MNT) is a specific application of the Nutrition Care Process in clinical settings that is focused on the management of diseases. MNT involves in-depth individualized nutrition assessment and a duration and frequency of care using the Nutrition Care Process to manage disease” (3). The Nutrition Care Process is defined as “a systematic problem-solving method that dietetics professionals use to critically think and make decisions to address nutrition related problems and provide safe and effective quality nutrition care. The Nutrition Care Process consists of four distinct, but interrelated and connected steps: (a) nutrition assessment, (b) nutrition diagnosis, (c) nutrition intervention, and (d) nutrition monitoring and evaluation” (3).

The American Dietetic Association (ADA) developed the Disorders of Lipid Metabolism Evidence-Based Nutrition Practice Guidelines to standardize the MNT process for registered dietitians (4-6). MNT is currently supported by third-party payers in cases of diabetes and renal disease but not for disorders of lipid metabolism. The purpose of this paper is to summarize the studies conducted to assess the effectiveness of medical nutrition therapy by RDs in reducing low-density lipoprotein (LDL) cholesterol. Based on the studies published at the time of this review, MNT is effective in reducing LDL cholesterol.

AVAILABLE RESEARCH REGARDING THE EFFECTIVENESS OF MNT

An expert panel was formed to identify and evaluate current research on nutrition therapies for dyslipidemia to develop the ADA’s Disorders of Lipid Metabolism Evidence Analysis Library (4). A comprehensive literature search was conducted using PubMed, the Database of Abstracts of Reviews of Effects, and the Agency for Healthcare Research and Quality database. The search was limited to human adult subjects, the English lan-

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guage, and articles published from 1991-2006. The primary inclusion criteria was that the MNT had to be provided by an RD. Articles were excluded if the sample size was less than 10 in each treatment group, if the dropout rate was more than 20%, if the nutrition counseling was provided by someone other than an RD, or if the intervention was not individualized.

ADA evidence analysts extracted research data and assessed the quality and validity of all research papers. Quality and validity were assessed by one analyst using the quality criteria checklist developed by the ADA. Papers were assigned a quality rating of either positive (+), neutral (∅), or negative (-) (Figure). Study results were summarized and presented to expert panel members who wrote and graded conclusion statements according to the ADA grade definitions (Figure).

The search yielded 23 articles. After reviewing the articles for relevance, 15 studies were excluded and eight studies were accepted for inclusion. Studies were excluded because either the dropout rate was more than 20% (one study), the intervention did not appear to be MNT (11 studies), the studies did not examine the impact of dietary changes on lipids (one study), or the outcomes data were not relevant to the question being reviewed (two studies). Of the accepted studies, four received a rank of positive and four of neutral quality. The papers ranked as positive-quality are discussed in the subsequent paragraphs, starting with the most current, and all papers are summarized in Table 1. All eight papers provide the evidence for the graded conclusion statements.

Dalgard and colleagues (7) conducted a randomized clinic trial in which 44 subjects with ischemic heart disease were randomly assigned to either a 10-minute brief counseling group (22 subjects) or comprehensive counseling group (22 subjects). Subjects in the comprehensive counseling group received a 50- to 60-minute individually tailored consultation with an RD. Twelve weeks later, patients each received an additional 40- to 50-minute counseling session. The goal of the education was to reduce dietary cholesterol and limit dietary fat to less than 30% of energy and saturated fat to less than 10% of energy. Specific information about limiting fat and saturated fat; preferred choices of spreads and oils; and information about the importance of eating fish, fruits, and vegetables was given. Diet was assessed at weeks 0, 12, and 52.

Thirty-six subjects completed the study: 17 in the brief counseling group and 19 in the comprehensive counseling group. Comparing baseline values with week 52, the comprehensive counseling group had a 14.7% reduction in percentage of energy intake from fat (from 32.7% to 27.9% of energy intake, $P < 0.005$), a 21.8% reduction in percentage energy from saturated fat (from 11.9% to 9.3% of energy intake, $P < 0.005$), and a 7.5% increase in percentage energy from carbohydrate (from 50.6% to 54.4% of energy intake, $P < 0.05$). All changes were significantly different from the brief counseling group. There were no statistically significant changes in intake of any nutrients from baseline to week 52 in the brief counseling group. Thus, in this study two sessions of MNT over 12 weeks resulted in greater dietary changes at 1 year compared with a single brief (10-minute) counseling session (7).

Sikand and colleagues (8) conducted a retrospective

Quality Rating	
Positive (+)	If most of the answers to the validity questions ^a were designated “yes,” including the questions regarding inclusion/exclusion, bias, generalizability, intervention, and data collection.
Neutral (∅)	If questions regarding inclusion/exclusion, bias, generalizability, intervention, and data collection do not indicate the study is exceptionally strong.
Negative (-)	If most of the answers to the validity questions were designated “no.”
Grade Definitions	
Grade I: Good	The evidence consists of results from studies of strong design for answering the question addressed. The results are both clinically important and consistent with minor exceptions at most. The results are free of serious doubts about generalizability, bias, and flaws in research design. Studies with negative results have sufficiently large sample sizes to have adequate statistical power.
Grade II: Fair	The evidence consists of results from studies of strong design answering the question addressed, but there is uncertainty attached to the conclusion because of inconsistencies among the results from different studies or because of doubts about generalizability, bias, research design flaws, or adequacy of sample size. Alternatively, the evidence consists solely of results from weaker designs for the questions addressed, but the results have been confirmed in separate studies and are consistent with minor exceptions at most.
Grade III: Limited	The evidence consists of results from a limited number of studies of weak design for answering the questions addressed. Evidence from studies of strong design is either unavailable because no studies of strong design have been done or because the studies that have been done are inconclusive due to lack of generalizability, bias, design flaws, or inadequate sample sizes.
Grade IV: Expert Opinion Only	The support of the conclusion consists solely of the statement of informed medical commentators based on their clinical experience, unsubstantiated by the results of any research studies.
Grade V: Not Assignable	There is no evidence available that directly supports or refutes the conclusion.

Figure. American Dietetic Association Quality Rating and Grade Definitions (5,6). ^aValidity questions have sub-questions that identify important considerations for varying study designs. The answers to these sub-questions help identify a yes/no answer to the validity question, thus providing more weight based upon study design.

chart review of 73 male Veterans Affairs patients with combined hyperlipidemia (high LDL cholesterol and triglycerides) who were noncompliant with prescription niacin therapy and were invited to participate in a statin drug trial. As part of this trial, patients were assigned to an 8-week dietary lead-in intervention. Each patient was assigned to receive two to four, 30- to 70-minute RD visits over an 8-week period and was instructed on the National Cholesterol Education Program (NCEP) step 1 diet (9). The NCEP step 1 and 2 diets, which were replaced by the NCEP therapeutic lifestyle changes in 2002 (10), are described in Table 2.

Complete data were available for 43 of the 73 individuals. Reasons for the dropouts were: conflicts with personal life schedule ($n=20$), conflicts with work schedule ($n=5$), and discomfort about participating in a clinical trial using an experimental lipid-lowering medication ($n=5$). Mean intervention time with the RD was 2.7 sessions during 6.5 weeks of MNT. The initial visit was 70 minutes, the first follow-up at week 4 was 70 minutes, and the two remaining follow-up visits at weeks 6 and 7 were 30 minutes each. For the 43 individuals completing the study, total cholesterol decreased by 11% (29 mg/dL [0.75 mmol/L]) ($P<0.001$), LDL cholesterol by 9% (15.9 mg/dL [0.41 mmol/L]) ($P<0.001$), triglycerides by 22% (97.5 mg/dL [1.10 mmol/L]) ($P<0.0001$), and body mass index by 2% (0.7 units) ($P<0.0001$) and high-density lipoprotein (HDL) cholesterol increased by 4% (0.8 mg/dL [0.021 mmol/L]) (not significant) compared with baseline, but no control group was available for comparison. Fifteen of 30 subjects no longer needed lipid-lowering medications after MNT. Annual cost savings was estimated to be \$638.35 per patient (in 1996 dollars) by avoiding the use of statin medications (8).

Hebert and colleagues (11) randomly assigned 1,162 patients with hyperlipidemia from 12 practice sites to one of three treatment groups: physician usual care, physician trained in lipid intervention, or physician trained in lipid intervention plus office support. Trained physicians plus those trained with office support provided nutrition education to patients over four visits. On the first physician visit, if a subject's LDL cholesterol was more than the 90th percentile, they were referred to an RD-based program. Remaining patients were referred to the RD if their LDL cholesterol was more than their NCEP goal after further physician visits. Patients referred to the RD received an initial 45-minute individual session, followed by two 2-hour group sessions, and a final individual session over a 6-week period. The nutrition education focus was to reduce the intake of total and saturated fat and cholesterol and to follow an NCEP step 1 or step 2 (9) diet as individually indicated. The program emphasized practical skills and family support.

Baseline values were assessed before entering into physician-delivered care. Dietary data were available for 645 patients, and paired serum lipids and weight were available on 555 and 404 patients, respectively. After 1 year, patients who attended three to four RD sessions reported dietary reductions of 22.7% in percentage of energy from total fat (from 36.2% to 28% of energy intake), 22.1% in percentage of energy from saturated fat (from 12.2% to 9.5% of energy intake), accompanied by reductions of 6.5% (16.6 mg/dL [0.430 mmol/L]) in total

cholesterol, 10.4% (18.5 mg/dL [-0.48 mmol/L]) in LDL cholesterol, 5.6% (4.47 kg) in body weight, and 5.3% (1.56 units) in body mass index vs baseline. These changes were significantly different from those of the control group that was never referred ($P<0.05$), but because their baseline blood cholesterol levels were also less than the referred group ($P<0.05$), strict comparisons were unwarranted. Impact on HDL cholesterol and triglycerides was not reported. LDL cholesterol was significantly lower in subjects who attended three to four sessions (10.4% reduction, 18.5 mg/dL [0.479 mmol/L] decrease) than in those who attended fewer than three sessions (2.8% reduction, 5 mg/dL [0.130 mmol/L] decrease) and those without a referral (0.5% reduction, 0.8 mg/dL [0.021 mmol/L] decrease) ($P<0.05$) (11).

A nonrandomized comparative study by Dallongeville and colleagues (12) assigned 104 patients with hypercholesterolemia (LDL cholesterol >158.3 mg/dL [4.10 mmol/L]) and 113 with hypertriglyceridemia (triglycerides >230 mg/dL [2.60 mmol/L]) to a 45- to 60-minute session of dietary counseling and a one-time follow-up visit, both by an RD. Both visits occurred within two months. The patients with hypertriglyceridemia and hypercholesterolemia were instructed to follow an NCEP step 1 and step 2 diet, respectively. In addition, patients with hypertriglyceridemia were told to restrict their intake of concentrated sweets (sweetened beverages, candy, and most desserts) and to limit alcohol to 30 mL/day. During the education sessions, the RD used food models and products, provided tips for cooking and eating out, and planned sample menus to fit into the patient's lifestyle. Family support was encouraged. A group of control patients, including 72 patients with hypercholesterolemia and 80 patients with hypertriglyceridemia, were asked to remain on their current diet for 8 weeks. During this time their baseline lipids were measured and their lipid values at 8 weeks were compared with the dietary counseling group's 8-week (2-month) values. In the hypercholesterolemia dietary counseling group, significant reductions were observed in total cholesterol (5.7%), LDL cholesterol (7.3%), and body weight (2.4%) after 2 months compared with baseline ($P=0.001$), whereas the control group did not have significant reductions. There was a nonsignificant increase in triglycerides (8.6%) and no change in HDL cholesterol (0.0%) compared with baseline in the counseling group. In the hypertriglyceridemic patients, reductions were observed in total cholesterol (4.8%), triglycerides (20.7%), very-low-density lipoprotein cholesterol (19.5%), and body weight (2.8%), as were increases in LDL cholesterol (8.5%) and HDL cholesterol (5.5%) after 2 months compared with baseline ($P<0.05$). The control group did not have significant changes in these variables (12).

The four neutral-quality studies (two randomized clinical trials and two chart reviews), found results similar to the positive-quality studies (Table 1). One study examined changes in dietary intake and found a significant reduction in saturated fat and dietary cholesterol after an MNT intervention compared with the control group ($P<0.001$) (13). This study, including the others, found significant reductions in total cholesterol after MNT intervention compared with baseline or control groups (13-16). In addition, studies found that increased time spent

Table 1. Summary of reviewed medical nutrition therapy for disorders of lipid metabolism studies

Citation	Sample size/study design	Quality ^a	Intervention (dietary goal)	Major findings
Dalgard and colleagues (2001) (7)	44 randomized; 36 completed (17 brief counseling; 19 comprehensive counseling)/ randomized clinical trial	+	10-minute brief counseling vs 50-60 individualized counseling with 40- to 50-minute follow-up 12 weeks later (total fat <30% and saturated fat <10% of energy) Intervention duration: 12 weeks, 1 year study	At week 52: <ul style="list-style-type: none"> • % of energy from total fat ↓ 14.7% with MNT^b vs ↑ 5.3% in control group ($P<0.005$) • % of energy from saturated fat ↓ 21.8% with MNT vs ↑ 10.1% in control group ($P=0.002$) • % of energy from carbohydrates ↑ 7.5% with MNT vs ↓ 3.6% in control group ($P=0.012$)
Sikand and colleagues (2000) (8)	73 (complete data available for 43)/chart review (before-after study)	+	Two to four MNT visits ranging from 30 to 70 minutes (step 1 diet) Intervention duration: 8 weeks	At week 6 or 7 compared to baseline: <ul style="list-style-type: none"> • TC^c ↓ 11% ($P<0.001$) • LDL-C^d ↓ 9% ($P<0.001$) • HDL-C^e ↑ 4% (NS^f) • TG^g ↓ 22% ($P<0.001$) • BMI^h ↓ 2% ($P<0.0001$) • 50% (15 out of 30) of eligible subjects did not require lipid-lowering medications after MNT
Hebert and colleagues (1999) (11)	1,162 (dietary information: 645, paired serum lipids: 555, weight: 404)/randomized clinical trial	+	No RD ⁱ visit vs two individualized MNT visits (including a 45-minute initial visit) plus two 2-hour group visits over a 6-week period (step 1 or 2 as indicated) Intervention duration: 6 weeks	At 1 year: <ul style="list-style-type: none"> • % of energy from total fat ↓ 22.7% with MNT vs ↓ 1.9% in control group ($P<0.05$) • % of energy from saturated fat ↓ 22.1% with MNT vs ↓ 2.5% in control group ($P<0.05$) • TC ↓ 6.5% with MNT vs ↓ 0.2% in control group ($P<0.05$) • LDL-C ↓ 10.4% with MNT vs ↓ 0.5% in control group ($P<0.05$) • LDL-C lower in group that attended 3 to 4 sessions vs those that attended fewer than 3 sessions and those without a referral ($P<0.05$) • Weight ↓ 5.6% (4.47 kg) with MNT vs ↓ 1.3% (1.05 kg) in control group ($P<0.05$)
Dallongeville and colleagues (1994) (12)	369 (hypercholesterolemia: 104 intervention, 72 control; hypertriglyceridemia: 113 intervention, 80 control)/nonrandomized comparative study	+	No counseling vs 45- to 60-minute MNT visit plus a one-time follow-up visit (step 1 diet for hypertriglyceridemic plus alcohol and concentrated sweet restriction and step 2 diet for hypercholesterolemic patients) Intervention duration: 2 months	At 2 months compared with baseline: <p>Hypercholesterolemic patients:</p> <ul style="list-style-type: none"> • TC ↓ 5.7% (17.4 mg/dL) ($P=0.0001$) • LDL-C ↓ 7.3% (56.7 mg/dL) ($P=0.0001$) • HDL-C +0.0% (NS) • TG ↑ 8.6% (NS) • Weight ↓ 2.4% (2 kg) ($P=0.0001$) <p>Hypertriglyceridemic patients:</p> <ul style="list-style-type: none"> • TC ↓ 4.8% (13.5 mg/dL) ($P=0.0001$) • LDL-C ↑ 8.5% (7 mg/dL) ($P=0.001$) • HDL-C ↑ 5.5% (1 mg/dL) ($P=0.001$) • TG ↓ 20.7% (112.5 mg/dL)^k ($P=0.0001$) • Weight ↓ 2.8% (2 kg) ($P=0.0001$)

(continued)

Table 1. Summary of reviewed medical nutrition therapy for disorders of lipid metabolism studies (continued)

Citation	Sample size/study design	Quality ^a	Intervention (dietary goal)	Major findings
Delahanty and colleagues (2001) (13)	90 (45 MNT, 45 usual care)/ randomized clinical trial	∅	Usual care by physician or 2-3 MNT visits in 2-3 months and an additional 2-3 visits over the next 3 months if lipids were not at goal (step II diet) Average time spent: 90 minutes at 3 months and 30 minutes during the second 3 months Intervention duration: 6 months	At 6 months: <ul style="list-style-type: none"> • % of energy from total fat ↓ 21.9% with MNT vs ↓ 6.5% in control group ($P<0.01$) • % of energy from saturated fat ↓ 36.4% with MNT vs ↓ 9.1% in control group ($P<0.001$) • Dietary cholesterol ↓ 29.8% with MNT vs ↓ 1.2% in control group ($P<0.05$) • TC ↓ 6.8% with MNT vs ↓ 2.1% in control group ($P<0.05$) • LDL-C ↓ 7.2% with MNT vs ↓ 2.6% in control group (NS) • HDL-C ↓ 6.6% with MNT vs ↓ 4.4% in control group (NS) • TG ↑ 0.7% with MNT vs ↑ 8.2% in control group (NS) • Weight ↓ 2.3% with MNT vs 0% in control group ($P<0.001$) • ↑ time with RD at 3 months correlated with ↓ TC ($r=-0.47$, $P=0.001$) and LDL-C ($r=-0.39$, $P=0.008$)
Henkin and colleagues (2000) (14)	136 (66 RD counseling, 70 usual care) (at 3 months 64 RD counseling, 68 usual care)/randomized clinical trial	∅	Usual care by physician vs 2-4 nutrition counseling sessions (step 1 or 2, as indicated) Intervention duration: 3 months	At 3 months: <ul style="list-style-type: none"> • TC ↓ 9% with MNT vs ↓ 5% in control group ($P<0.05$) • LDL-C ↓ 12% with MNT vs ↓ 7% in control group ($P<0.05$) • HDL-C ↑ 0% with MNT vs ↑ 2% in control group (NS) • TG ↑ 1% with MNT vs ↑ 4% in control group (NS) • TC/HDL-C ↓ 9% with MNT vs ↓ 5% in control group (NS)
Sikand and colleagues (1998) (15)	95 (complete data available for 74)/chart review (before-after study)	∅	Two to four MNT visits ranging from 30 to 60 minutes (step 1 diet) Intervention duration: 6-8 weeks	At end of study (week 6, 7, or 8) compared with baseline: <ul style="list-style-type: none"> • TC ↓ 13.4% ($P<0.001$) • LDL-C ↓ 14.2% ($P<0.001$) • HDL-C ↓ 4.4% ($P<0.05$) • TG ↓ 10.8% ($P<0.05$) • TC/HDL-C ↓ 9.4% ($P<0.001$) • LDL-C ↓ 21.9% with 4 RD visits and ↓ 12.1% with 2 RD visits ($P<0.027$) • 51% (33 out of 67) of eligible subjects did not require lipid-lowering medications after MNT
McGehee and colleagues (1995) (16)	474 (complete data available for 285)/chart review of various sites (before-after study)	∅	≥2 MNT visits at various hospitals or health maintenance organizations (diet goals not noted) Intervention duration: varied due to various settings	Compared with baseline (length of intervention is unknown): <ul style="list-style-type: none"> • TC ↓ 8.6% (significance not reported) • TC correlated with ↑ time spent with an RD ($r=0.118$, $P<0.001$)

^aPapers were assigned a quality rating of either positive (+), neutral (∅), or negative (-).

^bMNT=medical nutrition therapy.

^cTC=total cholesterol.

^dLDL-C=low-density lipoprotein cholesterol.

^eHDL-C=high-density lipoprotein cholesterol.

^fNS=nonsignificant.

^gTG=triglycerides.

^hBMI=body mass index.

ⁱRD=registered dietitian.

^jTo convert mg/dL cholesterol to mmol/L, multiply mg/dL cholesterol by 0.0259. To convert mmol/L cholesterol to mg/dL, multiply mmol/L by 38.7. Cholesterol of 193 mg/dL=5.00 mmol/L.

^kTo convert mg/dL triglycerides to mmol/L, multiply mg/dL triglycerides by 0.0113. To convert mmol/L triglycerides to mg/dL, multiply mmol/L by 88.6 Triglycerides of 159 mg/dL=1.80 mmol/L.

Table 2. Dietary goals of the National Cholesterol Education Program step 1 and 2 diets and the Therapeutic Lifestyle Changes diet^a

	Step 1	Step 2	Therapeutic Lifestyle Changes
Total fat (% of energy)	≤30%	≤30%	25%-35%
Saturated fatty acids (% of energy)	8%-10%	<7%	<7%
Polyunsaturated fatty acids (% of total energy)	≤10%	≤10%	≤10%
Monounsaturated fatty acids (% of total energy)	≤15%	≤15%	≤20%
Cholesterol (mg/day)	<300	<200	<200
Carbohydrates (% of total energy)	≥55%	≥55%	50%-60%
Protein (% of total energy)	~15%	~15%	~15%
Total energy	To achieve and maintain a desirable weight	To achieve and maintain a desirable weight	To achieve and maintain a desirable weight
Physical activity			Enough moderate exercise to expend at least 200 calories/day
Optional			Plant sterols/stanols: 2 g/day Soluble fiber: 10-25 g/day

^aData from references 9 and 10.

with the dietitian correlated with reductions in total cholesterol ($P=0.001$) (13,16) and further reductions in LDL cholesterol were achieved with four RD visits compared with two RD visits ($P<0.027$) (15).

DISCUSSION

Based on existing data from a limited number of both high- and neutral-quality studies, RD-delivered MNT (with two to six planned visits) for patients with hypercholesterolemia yielded reported dietary reductions of 15% to 23% in total fat (from 32%-36% to 25%-28% of energy intake), and 22% to 36% in saturated fat (from 11%-12% to 7%-9% of energy intake). This was accompanied by reductions of 6% to 13% in total cholesterol and 7% to 14% in LDL cholesterol. Decreases in triglycerides and changes in HDL cholesterol were inconsistent. MNT included an initial scheduled visit ranging from 45 to 90 minutes and scheduled follow-up visits ranging from 30 to 60 minutes over 6 weeks to 6 months. Data on long-term adherence and sustained lipid response are unavailable (7,8,11-16) (Grade I).

Data suggest greater decreases in total cholesterol and LDL cholesterol occur as the number of MNT visits and time spent with a dietitian increases, but there is insufficient evidence to be conclusive (11,15) (Grade III).

The optimal duration and frequency of follow-up visits by an RD are not known (Grade V).

No studies have specifically determined whether intensive MNT can reduce or replace the need for lipid-lowering medication. Two small studies comparing cost-benefit of MNT involving retrospective chart review in male veterans suggested that dietary intervention could potentially obviate the need for lipid-lowering medications, but data from randomized clinical trials are needed to draw meaningful conclusions (8,15) (Grade III).

Despite a limited database, the strength of the conclusions regarding the effectiveness of MNT for disorders of lipid metabolism is enhanced by the inclusion of only studies involving individualized diet counseling provided

by an RD, rather than mixing in other studies using more generalized group counseling and/or involving non-RD interventionists.

Conclusive findings are limited by the lack of available research. Limitations include not only the small number (total of eight) of published studies available, but also that only half of these studies were assessed as being of high quality. Not all studies provided dietary data, nor did they all report the type of assessment method, including whether dietary questionnaires used were validated. In addition, the goals of MNT varied among the studies; one of the four high-quality studies recommended an NCEP step 1 diet, one of the four recommended a step 2 diet, and two of the four recommended either a step 1 or 2 diet. The varying dietary goals in conjunction with what the subjects achieved could explain the ranges reported for lipid and lipoprotein responses, especially HDL cholesterol and triglycerides, which were the most variable.

Additional high-quality research is needed to more comprehensively evaluate the benefits of MNT in improving lipid/lipoprotein cardiovascular disease risk factors. A direct comparison of RD-delivered MNT with other approaches including comparing RD-delivered MNT to the care provided by other health care professionals. The optimal duration and frequency of visits needed to achieve and sustain maximum cholesterol reduction requires further investigation. Whether identifying “poor dietary responders” or “dietary failures” reflects a lack of MNT or a biological basis for nonresponse to diet modification remains an important target of further investigation. Likewise, the optimal theoretical counseling framework for providing MNT to yield maximal improvement in cardiovascular risk needs to be evaluated.

CONCLUSIONS

The eligible studies reviewed show that MNT is an effective approach to changing dietary intake and reducing total and LDL cholesterol and body weight.

Research support for evaluating and documenting the potential benefits of MNT provided by RDs should continue to be high priority for ADA and its partners. These preliminary data that show clear benefits of MNT are promising, but more carefully controlled studies including well-documented dietary assessment methodology, objective lipid outcomes, and standardized interventions with measurable behavior and adherence data are required.

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