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RESEARCH
Review

Effectiveness of Dietetic Consultations in Primary Health Care: A Systematic Review of Randomized Controlled Trials

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ABSTRACT

Background A dietetic consultation is a structured process aimed at supporting individual patients to modify their dietary behaviors to improve health outcomes. The body of evidence on the effectiveness of nutrition care provided by dietitians in primary health care settings has not previously been synthesized. This information is important to inform the role of dietitians in primary health care service delivery.

Objective The aim of this systematic review was to evaluate the evidence of the effectiveness of individual consultations provided exclusively by dietitians in primary care to support adult patients to modify dietary intake and improve health outcomes.

Study design ProQuest Family Health, Scopus, PubMed Central, Medline, the Cumulative Index to Nursing and Allied Health Literature, and Cochrane databases were searched for English language systematic reviews or randomized controlled trials published before October 2016. The key terms used identified the provision of nutrition care exclusively by a dietitian in a primary health care setting aimed at supporting adult patients to modify dietary behaviors and/or improve biomarkers of health. Interventions delivered to patients aged younger than 18 years, in hospital, via telephone only, in a group or lecture setting, or by a multidisciplinary team were excluded. The methodologic quality of each study was appraised using the Cochrane Risk of Bias tool and the body of evidence was assessed using the Academy of Nutrition and Dietetics Evidence Analysis Manual.

Main outcome measures Outcomes included the effectiveness of dietetic interventions in terms of anthropometry, clinical indicators, and dietary intake. A statistically significant between-group difference was used to indicate intervention effectiveness ($P<0.05$).

Results Twenty-six randomized controlled studies met eligibility criteria, representing 5,500 adults receiving dietetic consultations in a primary care setting. Eighteen of 26 included studies showed statistically significant differences in dietary, anthropometric, or clinical indicators between intervention and comparator groups. When focusing specifically on each study's stated aim, significant improvements favoring the intervention compared with control were found for the following management areas: glycemic control (four out of four studies), dietary change (four out of four studies), anthropometry (four out of seven studies), cholesterol (two out of eight studies), triglycerides (one out of five), and blood pressure (zero out of three) studies.

Conclusions Dietetic consultations for adults in primary care settings appear to be effective for improvement in diet quality, diabetes outcomes (including blood glucose and glycated haemoglobin values), and weight loss outcomes (eg, changes in weight and waist circumference) and to limit gestational weight gain (Grade II: Fair evidence). Research evaluated in this review does not provide consistent support for the effectiveness of direct dietetic counseling alone in achieving outcomes relating to plasma lipid levels and blood pressure (Grade III: Limited evidence). Therefore, to more effectively control these cardiovascular disease risk factors, future research might explore novel nutrition counseling approaches as well as dietitians functioning as part of multidisciplinary teams.

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NUTRITION-RELATED CHRONIC DISEASES SUCH AS obesity, cardiovascular disease (CVD), and type 2 diabetes mellitus place an increasingly significant burden on population health and health care systems.[1] Given the ability of dietary modification to improve biomarkers of chronic disease, dietary behavior change is recognized as a first-line approach to optimal management of chronic disease.[2-7] Referral to nutrition and dietetics practitioners is recommended, in particular, to dietitians[3-8] because they are the only members of the health workforce specifically trained in facilitating dietary behavior change by providing nutrition care.[9] Dietetics workforces have grown considerably in developed countries, including the United States, the United Kingdom, and Australia,[10-14] increasing the opportunity for dietitians to contribute to improvements in the health behaviors of populations.

An aim of dietetic consultations is to assist individual patients to modify dietary behaviors to improve health outcomes. Dietetic consultations follow the structured Nutrition Care Process of nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation.[9] The primary health care sector is a key provider of dietetic consultations, with significant growth occurring in this area.[10,14] Primary health care refers to care delivered as a first point of contact, outside of the acute care setting of a hospital, usually delivered by individual consultations between patients and health professionals.[15] A systematic review of randomized controlled trials (RCTs) investigating dietary interventions in primary health care found patient adherence to be low and concluded the interventions were unlikely to be cost-effective.[16] However, the interventions included in the review were broad in nature and did not limit the inclusion of studies based on the health professional's background. Another systematic review of RCTs found that nutrition care provided by any health professional, including dietitians, had the potential to support improvements in dietary behaviors of patients.[17] However, the interventions under review were multidisciplinary. It was not possible to determine the effectiveness of nutrition care provided by dietitians alone in either review. Although guidelines strongly support the role of dietitians in multidisciplinary teams for CVD risk reduction, weight management, and health promotion,[3-7] it is important to the profession to provide evidence for the effectiveness of dietitians independent of multidisciplinary teams.

The literature investigating the effectiveness of nutrition care provided exclusively by dietitians in primary health care has not previously been synthesized. Such evidence has the potential to inform dietetics practice in the expanding area of primary health care.[10,14,18] The aim of this study was to critically appraise the body of evidence on the effectiveness of individual consultations with dietitians in primary health care settings to support dietary modification and improvements in anthropometric and clinical indicators. Systematic reviews of RCTs and RCTs comparing individualized nutrition care (ie, dietetic consultations) provided to adults by dietitians in primary health care settings, to usual, minimal, or no care were evaluated.

METHODS

A systematic review was conducted following preferred reporting items for systematic reviews and meta-analyses guidelines.[19] Systematic reviews of RCTs and RCTs were chosen to provide the highest possible level of evidence.

EXAMPLE SEARCH STRATEGY (September 2015)
Source: Medline (Ovid)

1. *'patient' or 'client' or 'client-centred' or 'participant' or 'adult'*
2. *'dietitian' or 'dietetic'*
3. *'consult*' or 'referral' or 'practice' or 'counselling' or 'interview' or 'advice' or 'outpatient' or 'clinic'*
4. 1 and 2 and 3
5. Limit 4 to English language and humans and 'all adult (18 plus years)'

*Asterisk used in database search to capture multiple word endings (eg, consult, consultation).

Figure 1. Example search strategy for systematic review of the effectiveness of dietetic consultations in primary health care.

Search Strategy

A search of the peer-reviewed literature, supported by an experienced health librarian, was conducted in September 2015 of the following databases: ProQuest Family Health, Scopus, PubMed Central, Medline, the Cumulative Index to Nursing and Allied Health Literature, and Cochrane databases. All studies with at least one search term in the title or abstract from the following three categories were included for consideration: *patient* OR *client* OR *client-centred* OR *participant* OR *adult* AND *dietitian* OR *dietetic* AND *consult** OR *referral* OR *practice* OR *counseling* OR *interview* OR *advice* OR *outpatient* OR *clinic* (see Figure 1 for example search strategy). Cross-matching reference lists and forward citation searching were conducted to identify additional studies for consideration. Articles were limited to human beings, adults (patients aged $\geq$18 years) and published in the English language. No date restriction was applied. This same search strategy was repeated in October 2016 to capture any relevant studies published since September 2015.

Eligibility Criteria

Studies were selected using defined eligibility criteria according to the patient population or problem, intervention (treatment or test), comparison (group or treatment), outcomes, and setting criteria as outlined in Figure 2. Systematic reviews of RCTs and RCTs were included when they had at least one intervention arm that examined the provision of individualized nutrition care provided exclusively by a dietitian and compared this with a control group comprising minimal or usual care or no intervention in a parallel group design (that included multiple-arm trials). Studies needed to include a primary outcome measure of chronic disease risk, including anthropometric measurements, clinical indicators, or dietary intake. The dietetic consultation was defined as at least one face-to-

*Asterisk used in database search to capture multiple word endings (eg, consult, consultation).

Domain	Inclusion criteria
Population	Adult patients (aged ≥18 y) who have received an individual face-to-face dietetic consultation within a primary health care setting
Intervention	Nutrition care consultation provided to an individual exclusively by a dietitian, with evaluation of dietetic care as the stated aim
Comparator	Usual care, where patients received usual medical care (not including nutrition care from another health professional or health program); minimal care (nutrition-related print material, or a one-time general nutrition seminar) or control (no intervention)
Outcome	Anthropometric measures (weight, body mass index, waist circumference, waist-to-hip ratio, and skinfold thickness); clinical indicators (blood pressure; serum measures, including cholesterol, triglycerides, and sodium; and blood glucose measures); and dietary behavior change
Study design	Systematic reviews of randomized control trials and randomized control trials using parallel design

Figure 2. Summary of systematic review inclusion criteria of the effectiveness of individual dietetic consultations on health outcomes according the preferred reporting items for systematic reviews and meta-analyses framework.[19]

face consultation aimed at supporting an individual patient to modify their dietary behaviors and could include any or all components of the Nutrition Care Process (ie, nutrition assessment, nutrition diagnosis, nutrition intervention, and nutrition monitoring and evaluation).[9] The interventions were limited to adult patients due to the direct relationship between patient and dietitian in the individualized care model. Interventions delivered to patients in hospital, via telephone only, in a group or lecture setting, or by a multidisciplinary team were excluded.

Study Selection

The study selection process is illustrated in Figure 3. A quality-control training procedure was conducted by the research team on the first 250 abstracts of articles identified to ensure consistency of coding between reviewers. Four members of the team reviewed each of the 250 abstracts independently and coded them as "exclude" when they did not meet the criteria, including the ineligibility reason (applied in the hierarchy of study design, intervention, population, or outcome), or "retrieve" when the full text of the article was desired (Figure 2). Agreement between reviewers was obtained for the coding of 241 out of 250 abstracts (97%). Where the coding differed, consensus was achieved through group discussion. The remaining abstracts were divided between two groups for independent duplicate coding. Full articles were retrieved for all studies meeting the inclusion criteria or requiring more information than was provided in the abstract to inform a decision. There was strong agreement for exclusion or retrieval for further review within both groups of coders (κ=0.751 and κ=0.872, respectively). Disagreements between coders were considered by a separate researcher and resolved via group discussion. Reference lists from all systematic review articles retrieved but not included were cross-checked to identify additional articles not captured in the original search and subjected to identical abstract review.

Data Extraction

Data from all included articles were extracted independently by two researchers using an electronic spreadsheet developed specifically for this review. Information extracted included country; stated aim; study design (RCT arms); eligibility; setting; intervention arm description (duration and intervention intensity); control arm description (usual, minimal, or no care); participant characteristics (age, sex, weight, body mass index [BMI], and common health conditions); outcome measures; statistical methods; conclusions; and study limitations (stated and perceived). Outcome measures included anthropometry (weight, BMI, waist circumference, waist-to-hip ratio, and skinfold thickness); clinical indicators (blood pressure; serum measures, including cholesterol, triglycerides, and sodium; and blood glucose measures); and dietary behavior change. Evidence of effectiveness of interventions was summarized as outcome measures significantly better in the intervention group than the comparator at the end of the intervention using an intention to treat (ITT) approach where available. Differences in data extraction were discussed as a group until consensus was achieved.

Summary Measures and Analysis

Mean difference, standard deviation (SD), and *P* value between the intervention and comparison for each outcome variable over time were extracted or calculated when not reported. If studies reported standard error or 95% CIs rather than SD,[20,21] SD was calculated using the method provided in the Cochrane Handbook.[22] Social Science Statistics online tool for paired sample *t* test[23] was used to calculate the *P* value within each study group for studies not reporting the mean difference over time.[20,21,24-28] Where studies did not report the between-group differences, mean difference (with SD) and *P* value between the intervention and comparison for each study was calculated using the Open Source Epidemiologic Statistics for Public Health version 3.03a online tool.[29] A statistically significant between-group difference was used to indicate intervention effectiveness for dietary intake, anthropometric measurements, and clinical indicators (significance level was set at $P<0.05$). ITT data were used where available.

Data Quality and Risk of Bias

Each study was independently assessed in duplicate using the Cochrane risk of bias tool.[22] Where ratings differed,

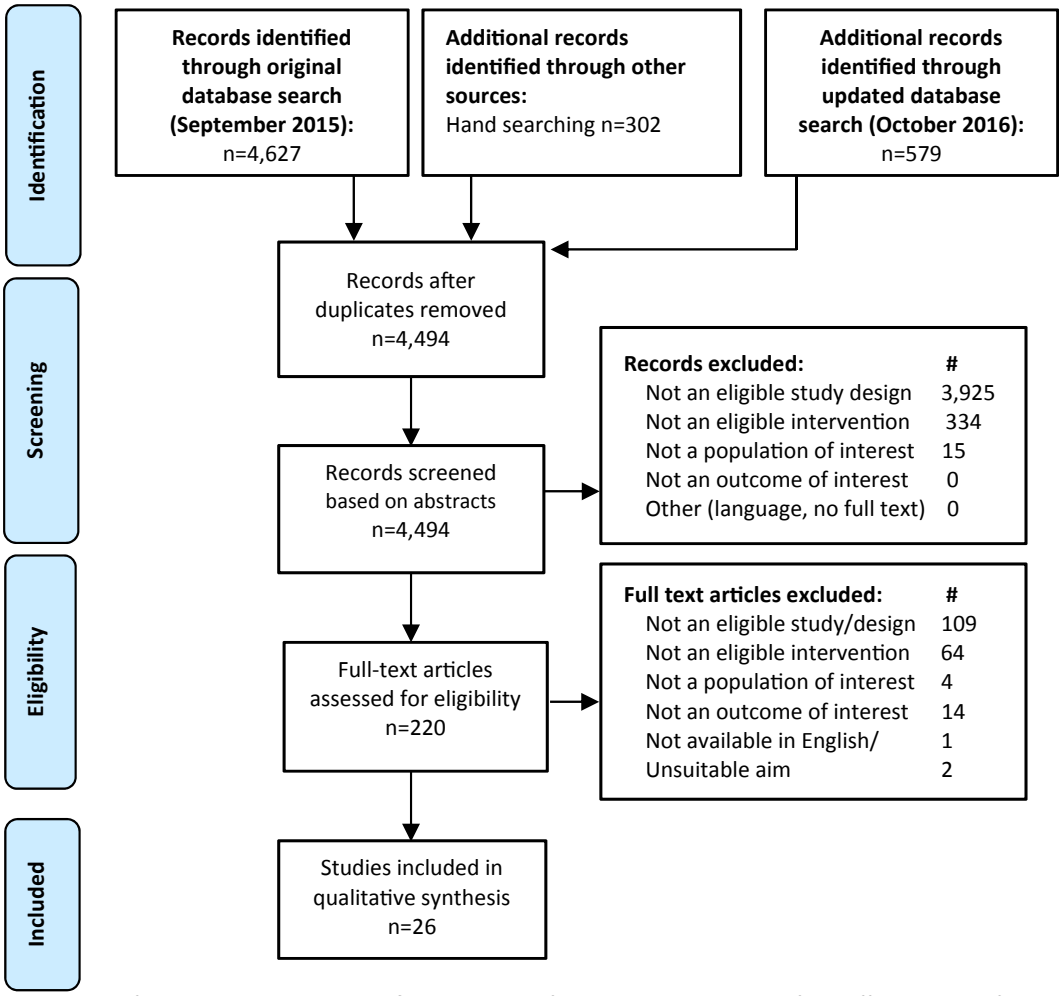

Figure 3. Flow diagram of the literature search and filtering results for a systematic review of the effectiveness of individual dietetic consultations on health outcomes.

researchers discussed the study until agreement was reached. Rather than focusing solely on methodologic quality, the Cochrane risk of bias tool evaluates risk of bias for the results of each study.[22] Six domains of bias were considered: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias. For this review, each domain was rated as low risk, unclear risk, or high risk in line with the user guide.[22] If studies did not provide sufficient detail in their article to adequately classify as low risk or high risk, they were classified as having unclear risk. The overall study rating was allocated at the level of the highest criterion risk of bias score (eg, when a study scored high for at least one criterion, then the overall risk of bias was rated as high). Studies were not excluded based on risk of bias.

Grading of Evidence

The body of evidence was assessed using the Academy of Nutrition and Dietetics Evidence Analysis Manual.[30] The strength of evidence is determined by quality, consistency, quantity, clinical influence, and generalizability.[30] Gradings range from I to V, where Grade I=good, Grade II=fair, Grade III=limited, Grade IV=expert opinion only, and Grade V=not assignable due to no available evidence.[30]

RESULTS

Overview

The initial database search in September 2015 identified 4,627 publications, with the updated search in October 2016 identifying an additional 579 articles published since the original search. Although 11 systematic reviews of RCTs were identified in the search, none met the inclusion criterion of evaluating the effectiveness of advice provided exclusively by a dietitian. However, 302 potentially eligible RCTs were identified from these reviews and added to the pool of articles for consideration. After excluding duplicate copies of articles, the main reasons for excluding publications were due to a non-RCT study design (n=3,925) or not an eligible dietetic intervention (n=334), as outlined in Figure 3, leaving 26 RCTs eligible for inclusion.[20,21,24-28,31-49] For each of the six included studies with multiple intervention arms, two arms (intervention and control) met the inclusion criteria, whereas

the third arm did not.[20,27,36,37,44,45] Only data from applicable arms were extracted for data tables.

Characteristics of Included Studies

The characteristics of the 26 studies included in the review are outlined in Table 1. Most studies were conducted in single-site outpatient primary health care settings and recruited individuals with at least one risk factor for chronic disease (such as high BMI or high serum cholesterol level), or with a diagnosis of a health condition (such as human immunodeficiency virus, peripheral vascular disease, or type 2 diabetes mellitus). Most studies were conducted in North America (nine studies)[21,24,25,28,32,38,41,43,46] or the United Kingdom/Europe (seven studies),[27,39,40,42,44,45,47] with fewer from Australia or New Zealand (three studies),[20,34,37] Asia (five studies),[26,35,36,48,49] the Middle East (one study),[33] and South America (one study).[31] The 26 studies contributed baseline measures for 5,500 adults (median n=86). Dropout rates between baseline and follow-up ranged from 0% to 35% (median=7.5%). Four studies recruited women only,[25,33,41,47] whereas none recruited men only. Comparison groups included control groups receiving no intervention (10 studies)[20,26, 27,31,39,40,42,45,47,48]; usual care, including medical care that did not include nutrition care from any health professional (nine studies)[24,32,33,35,36,38,41,43,49]; or minimal care, including attendance at a single general nutrition session or provision of a diet sheet (seven studies).[21,25,28,34,37,44,46]

INTERVENTION DESCRIPTION

The majority of studies were conducted in outpatient clinics attached to a hospital.[20,21,24,26,27,32-42,44,46-49] Intervention duration varied. The durations were categorized as <3 months,[24,27,45,49] 3 months,[25,26,33,34,39,43,46] 4 to 5 months,[42,48] 6 months,[20,28,32,41,47] 12 months,[21,31,35,36,40] or not specified.[37,38,44] The number of dietitian consultations received per participant was reported for all but two studies,[40,44] and ranged from one to 19 (mean=5.6). The total time spent in consultations per participant for the 13 studies reporting these data ranged from 25 to 600 minutes.[24-27,32,35,36,42,43,46-49] Whereas all studies delivered at least one dietitian consultation, it was not possible to calculate a total dose of dietitian time due to the number of studies that failed to report the consultation length[20,21,28,31,33,34,37-41,44,45] or total number of consultations.[40,44]

Results of Individual Studies

The aim, intervention intensity, risk of bias, study outcome measures, significant difference between groups, and evidence of effectiveness of intervention of each included study is outlined in Table 2. Anthropometric variables were the most commonly measured outcomes, including weight (14 studies),[20,21,24,28,31-33,37,38,41,42,44,47,48] BMI (11 studies),[20,26-28,31,36,42,45,46,48,49] waist circumference (four studies),[20,28,31,42] and waist-to-hip ratio (1 study).[26] Seven of 14 studies measuring weight reported a primary focus of weight management: three aimed to reduce weight,[20,38,42] (two of these demonstrating significant benefit of the intervention)[20,42] two aimed to prevent unwanted weight gain as a result of medical treatment[28,41] (neither demonstrated significant differences between groups), and two aimed to limit gestational weight gain[33,47] (both showed significant benefit of the intervention). Of eight studies focusing primarily on lipid management, six also measured anthropometric variables, two of which resulted in significant benefits to the intervention in terms of weight[32] or BMI,[46] whereas four did not.[26,27,37,49] However, weight management was only a stated aim for two of these studies.[46,49] Two of the studies primarily focusing on blood pressure had a joint stated aim related to anthropometric variables, one showing a significant benefit of the intervention on anthropometric outcomes compared with the control[44] and the other did not.[49]

Improvement in cardiovascular risk markers was a primary aim of 10 studies, including cholesterol,[26,27,32,34,37,40,46,49] triglycerides,[26,32,37,46,49] and blood pressure.[39,44,49] Significant reductions in these markers in intervention groups compared with control groups was only able to be demonstrated for two out of eight studies for cholesterol,[32,34] one out of five studies for triglycerides,[46] and zero out of three studies for blood pressure.

Blood glucose was reported in six studies,[28,31,35,36,43,47] with significant improvements compared with control found in two studies.[35,47] Glycated haemoglobin was reported in four studies,[28,35,36,43] with significant improvements compared with control in two.[36,43] All four studies focusing on achieving glycemic control[35,36,43,47] showed significant differences between intervention and control groups for at least one of these measures. Ravasco and colleagues[45] focused on the influence of diet counseling on nutrition-related symptoms and quality of life in cancer patients, and were able to show significant benefits for the former but not the latter.

Twelve of 26 studies included measures of dietary intake, using a variety of methodologies, with some studies using multiple methods. Food records were used by seven studies (3-day,[24-26] 4-day,[21,41] and 7-day food record[46,47]), food frequency questionnaires used by two studies (calcium 81-item[48] and modified Block-National Cancer Institute Food Frequency Questionnaire[21]) and 24-hour recalls used by six studies.[21,28,31,32,40,48] Eight of 12 studies showed significant improvements in intervention groups compared with control groups in at least one dietary variable.[21,24,25,32,41,46-48] There were no significant differences between groups in any dietary intake variables for the other four studies that measured diet.[26,28,31,40] Energy intake was reported in 10 studies,[21,24-26,28,31,41,46-48] three of which showed significant differences between groups.[24,41,47] Fat intake or proportion of energy as fat was assessed in seven studies,[21,24,31,32,40,46,47] four of which showed a significant decrease in fat intake in intervention groups compared with the control group,[21,32,46,47] whereas one study showed a significantly more favorable decrease in the control group.[24] Protein intake or proportion of energy as protein was reported in seven studies,[21,24,31,40,46-48] significant differences for the intervention group compared with control group were reported in two of these.[21,47] Carbohydrate intake or proportion of energy as carbohydrate was reported in five studies,[21,24,31,46,47] with significant improvement compared with control in three studies.[21,46,47] Sodium intake was measured in two studies and was significantly reduced compared with the control group in both.[24,25] Fiber intake was assessed in five studies,[21,25,26,31,32] and found to be significantly improved compared with the control group in two.[21,25] Calcium intake significantly increased in the intervention group compared with control group for both studies

Table 1. Characteristics of included randomized controlled trials assessing the effectiveness of individual dietetic consultations within a primary health care setting

Authors, y, reference	Country	Setting	Population	Participants		
				Baseline (n)	Analyzed (n)	Dropout %
Almeida and colleagues, 2011[31]	Brazil	HIV[a] clinic	20-59 y; HIV; under highly active antiretroviral therapy regimen for ≥12 mo; without metabolic syndrome, cancer, or pregnancy	53	42	20.8
Arcand and colleagues, 2005[24]	Canada	OPC[b]	50-67 y; stable heart failure (left ventricular ejection fraction <35%); furosemide ≥20 mg/d; without DM[c] requiring insulin or significant renal dysfunction	50	47	6.0
Ash and colleagues, 2006[20]	Australia	OPC	19-74 y; BMI[d] ≥27 without cognitive impairment	129[e]	119	8.0
Delahanty and colleagues, 2001[32]	United States	OPC	21-65 y; Chol[f] 201-341 mg/dL[g]; without dietitian contact previous 12 mo, medical conditions/ medications influencing lipid levels	90	87	3.3
Deveer and colleagues, 2013[33]	Turkey	Maternity OPC	18-41 y; pregnant (at 24-28 wk gestation) with positive 50 g glucose challenge test and negative 100 g oral glucose tolerance test; without pre-existing DM or gestational DM, history of stillbirth, multiple gestation, or chronic disease	100	100	0.0
Francis and colleagues, 2009[25]	United States	Community home visits	54-83 y; literate women receiving home care services	58	58	0.0
Heller and colleagues, 1989[34]	Australia	Vascular OPC	38-75 y; peripheral vascular disease; total Chol <348 mg/dL[g]	59	45	23.7
Huang and colleagues, 2010[35]	Taiwan	DM OPC	30-70 y; physician diagnosed T2DM[h] without pregnancy, dialysis, amputation, blindness, cancer, or cardiovascular disease	181	154	14.9
Imai and colleagues, 2008[36]	Japan	OPC	42-86 y; diagnosed T2DM without significant comorbidity: heart failure, hepatic dysfunction, renal failure, or serious physical and mental conditions	59[e]	59	0.0
Johnston and colleagues, 1995[37]	Australia	OPC	24-81 y; BMI >20; Chol levels 213-309 mg/dL[g]; without history of coronary artery disease, DM, uncontrolled hypertension, pregnancy, appetite suppressants, or lipid-lowering drugs	126[e]	91	26.8

(*continued on next page*)

Table 1. Characteristics of included randomized controlled trials assessing the effectiveness of individual dietetic consultations within a primary health care setting (*continued*)

Authors, y, reference	Country	Setting	Population	Participants		
				Baseline (n)	Analyzed (n)	Dropout %
Kesman and colleagues, 2011[38]	United States	OPC	18-75 y; BMI ≥30-<40; without pregnancy, cancer, recent surgery or treatment for psychiatric illness, history of or planned gastric bypass, anorexia nervosa or bulimia nervosa, weight loss medications or program.	65	65[i]	35.4
Koopman and colleagues, 1990[39]	Netherlands	OPC	28-64 y; BMI ≤27 without insulin-dependent DM, renal impairment, oral contraceptive pill, or antihypertensive agents 6 wk prior. Excluded during trial in cases of DBP[j] >110 mm Hg on 3 occasions, body weight increase 5% above baseline, coronary heart disease signs or symptoms	35	30	14.3
Lanza and colleagues, 2001[21]	United States	OPC	35-89 y; ≥1 histologically confirmed large-bowel polyp; <150% recommended body weight, without history of colorectal cancer, bowel resection, polyposis syndrome, irritable bowel syndrome, dietary restrictions, or medical conditions limiting participation, use of lipid-lowering drugs	2,079	1,961	5.7
Lawrence and colleagues, 1995[40]	Great Britain	OPC	20-70 y; hyperlipidemia (Chol ≥131 mg/dL[g], TG[k] ≥44 mg/dL[l]); transplant patients; BMI ≥19 (women), 20 (men); without DM, proteinuria >3.0 g/24 h	38	38	0.0
Lim and colleagues, 2008[26]	South Korea	OPC	23-63 y; fasting serum Chol ≥200 mg/dL[g]; TG ≥150 mg/dL[l]; without glycosuria, medications, signs of coronary heart disease, vitamin B supplements	40	40	0.0
Loprinzi and colleagues, 1996[41]	United States	Oncology OPC	26-57 y; premenopausal women with resected localized breast cancer scheduled for adjuvant systemic chemotherapy; without special diet for medical reasons, weight gain due to disease, severe renal, cardiac, hepatic dysfunction associated with fluid retention; stimulant/depression meds; weight >20% below ideal body weight	109	107	1.8

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Table 1. Characteristics of included randomized controlled trials assessing the effectiveness of individual dietetic consultations within a primary health care setting (*continued*)

Authors, y, reference	Country	Setting	Population	Participants		
				Baseline (n)	Analyzed (n)	Dropout %
Naldi and colleagues, 2014[42]	Italy	OPC	18-80 y; BMI ≥25; history chronic plaque psoriasis (Psoriasis Area Severity Index score=10+); without other psoriasis diagnosis, weight reducing diet or medication, pregnant/lactating, other chronic disease	303[e]	303[i]	6.9
Neil and colleagues, 1995[27]	Great Britain	OPC	35-64 y; hyperlipidemia (Chol 251-348 mg/dL[g]); without total Chol-to-HDL-C[m] ratio <4.0, LDL-C[n] <135 mg/dL[g], TG >496 mg/dL[l], DM, hypothyroidism, renal disease, use of lipid-lowering drug, pregnant/lactating, hospital admission for severe illness within 3 mo prior	205[e]	205[i]	9.7
Niswender and colleagues, 2014[28]	United States (multi-national)	Not stated	36-76 y; BMI=25-45; T2DM >6 m poorly controlled on metformin (HbA1c[o] 7%-9%); never taken insulin; without use of weight affecting medications, medical conditions, or pregnant	611	478	21.8
Parker and colleagues, 2014[43]	United States	Clinical trials medical centre	18-80 y; BMI >25.0; impaired fasting glucose or HbA1c 5.7%-6.4% without history or treatment for T2DM, >30 min/d physical activity, medication influencing glucose metabolism or weight loss, pregnant or lactating, hospital admission for heart disease, stroke, or transient ischaemic attack 6 month prior, mental incapacity, language barrier	81	76	6.2
Ramsay and colleagues, 1978[44]	Great Britain	OPC	Age range not stated; with overweight or obesity (clinical judgment); attending BP[p] clinic; no dietitian visit during 6 mo prior, no need for special diet for medical reasons	40[e]	29	26.9
Ravasco and colleagues, 2012[45]	Portugal	Not stated	28-88 y; ambulatory patients with colorectal cancer referred for radiotherapy. Without renal disease, DM	74[e]	74	0.0

(*continued on next page*)

Table 1. Characteristics of included randomized controlled trials assessing the effectiveness of individual dietetic consultations within a primary health care setting (*continued*)

Authors, y, reference	Country	Setting	Population	Participants		
				Baseline (n)	Analyzed (n)	Dropout %
Rhodes and colleagues, 1996[46]	United States	OPC	30-65 y; LDL-C >160 mg/dL[g] or >130 mg/dL[g] + other risk factors; without pregnancy, DM, TG >250 mg/dL, other liver conditions, lipid-lowering medications during past 2 mo, seen by dietitian within 2 y	104	97	6.7
Wolff and colleagues, 2008[47]	Denmark	Maternity OPC	19-45 y; BMI ≥30; singleton pregnancy; nonsmokers; without complications affecting fetal growth	66	50	24.2
Wong and colleagues, 2004[48]	Hong Kong	OPC	50-97 y; presenting to regional hospital for osteoporotic fractures of forearm, vertebrae, or hip	189	150	20.6
Wong and colleagues, 2015[49]	Hong Kong	OPC	40-70 y; newly diagnosed grade 1 hypertension; without antihypertensive medication; medical conditions requiring dietary control	556	504	9.4

[a]HIV=human immunodeficiency virus.
[b]OPC=outpatient clinic.
[c]DM=diabetes mellitus.
[d]BMI=body mass index.
[e]Only the participant numbers from included participant arms are included here.
[f]Chol=cholesterol.
[g]To convert mg/dL cholesterol to mmol/L, multiply mg/dL by 0.026. To convert mmol/L cholesterol to mg/dL, multiply mmol/L by 38.6. Cholesterol of 193 mg/dL=5.00 mmol/L.
[h]T2DM=type 2 diabetes mellitus.
[i]Intention to treat approach use.
[j]DBP=diastolic blood pressure.
[k]TG=triglyceride.
[l]To convert mg/dL triglycerides to mmol/L, multiply mg/dL by 0.0113. To convert mmol/L triglycerides to mg/dL, multiply mmol/L by 88.6. Triglyceride of 159 mg/dL=1.80 mmol/L.
[m]HDL-C=high-density lipoprotein cholesterol.
[n]LDL-C=low-density lipoprotein cholesterol.
[o]HbA1c=glycated hemoglobin.
[p]BP=blood pressure.

Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Weight management										
Ash and colleagues, 2006[20]	To compare 8-wk cognitive behavior therapy group dietetic intervention to individual dietetic care and written information	11 over 6 mo; N/S[b]; 6 mo	Control (1 intervention N/A[c])	Unclear	Weight[d]*; BMI[e]; % body fat; WC[df]***	NM[g]	NM[g]	Yes (weight; WC)	—	—
Loprinzi and colleagues, 1996[41]	To test whether prospective registered dietitian counseling could prevent unwanted weight gain in women receiving adjuvant chemotherapy for resected breast cancer	3 over 6 mo; N/S[b]; 6 mo	Usual care	High	Weight	NM	Energy weekends* energy weekdays	No	—	Yes (weekend energy)
Naldi and colleagues, 2014[42]	Assess influence of dietary intervention with exercise for weight loss on improving psoriasis in overweight or obese patients	5 over 20 wk (15-20 min each); 75-100 min; 20 wk	Control	Unclear	Weight***; WC***; BMI**	% Reduction of Psoriasis Area Severity Index score*	NM	Yes (weight; WC; BMI)	Yes	—
Kesman and colleagues, 2011[38]	To assess effectiveness of diet counseling for weight loss in obese patients in a general medicine primary care practice	4 over unstated period (60 min face to face + 3 telephone); N/S; 6 mo	Usual care	High	Weight	NM[g]	NM[g]	No	—	—

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Niswender and colleagues, 2014[28]	Determine influence of dietary intervention on weight change when initiating insulin in overweight patients with T2DM[h]	6 over 6 mo; N/S; 6 mo	Minimal care	Unclear	Weight; BMI; WC	HbA1c[i] responders (% participants <7%); FPG[j]; postprandial glucose	Energy	No	No	No
Gestational weight management										
Deveer and colleagues, 2013[33]	To examine effect of diet on birth outcomes and GWG[k] in patients with positive 50 g glucose challenge test and negative 100 g oral glucose tolerance test	10 over 10-15 wk; N/S; Prepregnancy to delivery (~9 mo)	Usual care	High	GWG***	NM	NM	Yes (GWG)	—	—
Wolff and colleagues, 2008[47]	To investigate whether dietary consultations in obese women can limit GWG and pregnancy-induced increases in insulin, leptin, and glucose	10×60 min over 24 wk; 600 min; weight: 40 wk; diet and glucose: 15-36 wk gestation	Control	High	GWG**	Serum insulin*; serum leptin; serum fasting glucose*	Energy***; protein***; fat***; CHO[k]; alcohol	Yes (GWG)	Yes (insulin; fasting glucose)	Yes (energy; protein; fat; CHO)
HIV										
Almeida and colleagues, 2011[31]	To evaluate influence of nutrition counseling on diet and prevention of highly active antiretroviral therapy-related morphologic and metabolic changes in patients with HIV[m]	6 over 12 mo; N/S; 12 mo	Control	High	Weight; BMI; WC; skinfolds (bicep, triceps, subscapular)	Serum Chol[n]; glucose; BP[o]	Energy; CHO; protein; fat; saturated fatty acids; Chol; fiber	No	No	No

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Cardiovascular, including lipids and BP[o]										
Delahanty and colleagues, 2001[32]	To compare influence of cholesterol-lowering protocol by registered dietitian with physician advice	2-6 over 6 mo (1-3: 60-140 min, optional 4-6: 30 min); 60-170 min; 6 mo	Usual care	Unclear	Weight***	Serum Chol*; LDL-C[p]; HDL-C[q]; TG[r]; physical activity	Fat**; fiber	Yes (weight)	Yes (serum Chol)	Yes (fat intake)
Johnston and colleagues, 1995 [37]	To compare efficacy of 3 diet and lifestyle interventions in lowering plasma lipids	3 over unstated period; N/S; 6 mo	Minimal care (1 intervention N/A)	High	Weight	Total Chol; HDL-C; LDL-C; TG	NM	No	No	—
Heller and colleagues, 1989[34]	To compare registered dietitian advice to New South Wales Department of Health diet fact sheet, in reducing blood cholesterol in patients with peripheral vascular disease	2 over 3 mo; N/S; 3 mo	Minimal care	High	NM[g]	Serum Chol*; serum HDL-C	NM	—	Yes (total Chol[n])	—
Koopman and colleagues, 1990[39]	To study effects on BP of intensive dietary counseling	3 over 3 mo; N/S; 3 mo	Control	Unclear	NM	DBP[s]; SBP[t]; mean arterial pressure; serum LDL-C*; 24-h sodium excretion (creatinine corrected)	NM	—	Yes (LDL-C)	—

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Lawrence and colleagues, 1995[40]	To examine effect of dietary intervention on diet and hyperlipidemia in patients with renal disease	NS over 12 mo; N/S; 12 mo	Control	High	NM	Serum lipids	Fat	—	No	No
Lim and colleagues, 2008[26]	To investigate the effect of intensive medical nutrition therapy tailored to Korean hyperlipidemia patients on serum lipid and plasma homocysteine levels	5 over 12 wk. (30 min initial, 40 min reviews); 190 min; 12 wk	Control	Unclear	BMI; body fat %; waist-to-hip ratio	Serum lipids; total-Chol; TG; LDL-C; HDL-C	Energy; carbohydrate/protein/fat ratio; fiber; folate; Vit[u] B-6; Vit B-12	No	No	No
Neil and colleagues, 1995[27]	To determine relative efficacy of dietary advice provided by a dietitian, practice nurse, or diet leaflet in reducing cholesterol and LDL-C	2 over 8 wk (30-min initial, 10-min review); 40 min; 6 mo	Control (1 intervention N/A)	Unclear	BMI	Total Chol; LDL-C; HDL-C	NM	No	No	—
Ramsay and colleagues, 1978[44]	To compare efficacy of advice by a dietitian or diet sheet on weight loss for reducing BP	N/S; N/S; 12 mo	1 minimal care (1 intervention N/A)	High	Weight*	DB; SBP	NM	Yes (weight)	No	—

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Rhodes and colleagues, 1996[46]	To compare effect of medical nutrition therapy by dietitians with usual care on nutrition knowledge, attitudes, and intake; BMI; and lipid levels in the initial management of hypercholesterolemia	3 over 3 mo (initial 60 min, review 30 min); 120 min; 3 mo	Minimal care	Unclear	BMI**	Total Chol; LDL-C; HDL-C; TG**	Energy; CHO**; fat**; protein; Chol[n]*; nutrition knowledge**; self-efficacy**	Yes (BMI)	Yes (TG)	Yes (CHO; fat; Chol; knowledge; Self-efficacy)
Wong and colleagues, 2015[49]	To investigate implementation of Dietary Approaches to Stop Hypertension diet with dietitian counseling compared with usual care on blood pressure, fasting lipid profile, and BMI	1; 25 min; 6 mo	Usual care	Unclear	BMI	DBP; SBP; Total Chol; TG; LDL-C; HDL-C	NM	No	No	—
Glycemic control										
Huang and colleagues, 2010[35]	To compare effect of registered dietitian led self-management education program on glycemic control and macronutrient intakes to routine care for patients with T2DM	4 (30-60 min each) over 12 mo; 120-240 min; 12 mo	Usual care	High	NM	HbA1c; FPG*	NM	—	Yes (FPG)	—

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Imai and colleagues, 2008[36]	To investigate effect of individual dietetic counseling on glycemic control in patients with T2DM	12 (20-30 min each) over 12 mo; 240-360 min; 12 mo	Usual care (1 intervention N/A)	High	BMI	FPG; HbA1c**; Total Chol; TG; HDL-C; LDL-C	NM	No	Yes (HbA1c)	—
Parker and colleagues, 2014[43]	Investigate effect of medical nutrition therapy on diabetes measures in overweight/obese adults with prediabetes compared with usual care	4 over 12 wk (60 min initial, 30-45 min reviews). 150-195 min; 12 wk	Usual care	Unclear	NM	FPG; HbA1c**; serum Chol; HDL-C; LDL-C; diabetes risk*.	NM	—	Yes (HbA1c, Diabetes Risk)	—
Nutrition status with cancer										
Ravasco and colleagues, 2012[45]	To investigate influence of dietary counseling during radiotherapy on nutritional status and QoL[v] in cancer patients	7 over 6 wk; N/S; 3 mo	Control (1 intervention N/A)	Unclear	BMI	Nutrition impact symptoms*; QoL	NM	No	Yes (nutrition impact symptoms)	—
Diet quality										
Arcand and colleagues, 2005[24]	To compare dietitian counseling to written materials, for adherence to sodium-restricted diet in ambulatory patients with stable heart failure	2 (45 min + 30 min) over 6 wk; 75 min; 3 mo	Usual care	High	Weight	Serum sodium, BP	Sodium*, fluid; energy*; CHO; protein; fat[w]*	No	No	Yes (sodium and energy intake)

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Francis and colleagues, 2009[25]	To evaluate whether Social Marketing Theory-based, dietitian-led, in-home, cardiovascular disease-targeted diet-education program improves diet in community-residing women compared with mailed education materials	4 over 90 d; 135 min; 90 d	Minimal care	High	NM	Mini Nutritional Assessment	Sodium*; Chol; fiber*; energy	—	No	Yes (sodium and fiber)
Lanza and colleagues, 2001[21]	To determine whether polyp prevention trial intervention plan could effect change in 3 dietary goals (related to energy, fat, and fiber) and to examine intervention effects on intake of other food groups and nutrients	19 over 12 mo N/S[b]; 12 mo	Minimal care	High	Weight	Plasma Chol; serum carotenoids*	Energy M[x]/F[y]; protein %energy M***/F; CHO %energy M***/F***; fat %energy M***/F***; polyunsaturated: saturated fat M/F; Total fiber M***/F***; Vit E M/F; Vit C M***/F***; total carotenoids M***/F***; calcium M***/F; fruit and vegetable intake M***/F***	No	Yes (serum carotenoids)	Yes (M: protein and calcium. M/F: CHO; fat; fiber; Vit C; carotenoids; fruit and vegetable intake)

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Table 2. Details of intervention outcomes for included randomized controlled trials in a systematic review of dietetic consultations in primary care (*continued*)

Authors, y, reference	Study aim	Intervention: No. of dietitian consultations; total consultation time; data end point	Comparator	Risk of bias	Study Outcome Measures			Evidence of Effectiveness[a]		
					Anthropometric	Clinical	Dietary intake	Anthropometric	Clinical	Dietary intake
Wong and colleagues, 2004[48]	To test dietary intervention on dietary intake (calcium, protein, and energy) in patients presenting with osteoporotic fracture	3 over 4 mo (initial 45 min, review 15 min); 75 min; 4 mo	Control	Unclear	Weight, BMI	NM	Calcium*; protein; energy	No	—	Yes (calcium)

[a]In relation to achievement of aims and change in primary outcomes.
[b]N/S=not stated.
[c]N/A=This arm not analyzed because it did not met inclusion criteria.
[d]Between-group differences calculated by statistician using Open Source Epidemiologic Statistics for Public Health.[29]
[e]BMI=body mass index.
[f]WC=waist circumference.
[g]NM=not measured.
[h]T2DM=type 2 diabetes mellitus.
[i]HbA1c=hemoglobin A1c.
[j]FPG=fasting plasma glucose.
[k]GWG=gestational weight gain.
[l]CHO=carbohydrate.
[m]HIV=human immunodeficiency virus.
[n]Chol=cholesterol.
[o]BP=blood pressure.
[p]LDL-C=low-density lipoprotein cholesterol.
[q]HDL-C=high-density lipoprotein cholesterol.
[r]TG=triglycerides.
[s]DBP=diastolic blood pressure.
[t]SBP=systolic blood pressure.
[u]Vit=vitamin.
[v]QoL=quality of life.
[w]Significant improvement in favor of comparison.
[x]M=male.
[y]F=female.
*$P<0.05$ for intervention group relative to comparator group.
**$P<0.01$ for intervention group relative to comparator group.
***$P<0.001$ for intervention group relative to comparator group.

in which it was assessed.[21,48] The four studies focusing primarily on compliance with dietary prescriptions were able to show positive significant differences compared with control for at least one measure of dietary intake.[21,24,25,48]

The risk of bias for each of the included studies is summarized in Table 3. Twelve studies received an overall rating of unclear risk of bias due to unclear or inadequate reporting for at least one of the eight criteria.[20,26-28,32,39,42,43,45,46,48,49] Fourteen studies received a high risk of bias rating as at least one of the eight criteria was considered to contribute significant bias to the study design.[21,24,25,31,33-38,40,41,44,47] No study reached an overall rating of low risk, although all studies received at least one low risk rating across the eight criteria.

The randomization sequence was adequately conducted and reported for nine studies.[24,27,32,34, 35,42,45,47,49] The allocation was adequately concealed in four studies,[35,38,42,45] with the remainder reporting an inadequate allocation,[24,33,34] or not describing it in sufficient detail to allow the evaluation.[20,21,25-28,31,32,36,37,39-41,43,44,46-49] Bias was most commonly introduced around the blinding of participants and personnel (21 studies made no comment for blinding of participants or personnel). Of studies that did make a statement on the challenges of blinding participants and personnel, all but one[49] received a high risk of bias for that criterion.[21,28,35,38] Blinding of outcome assessors was described in only four studies, all of which were considered to be low risk for that criterion.[32,35,37,42] All included studies adequately addressed incomplete outcome data caused by participant attrition. No studies received a high risk rating for incomplete data in the short term, but nine studies received a high risk rating for the long term due to a dropout rate of more than 20%.[21,24,31,34,35,37,38,44,47]

In terms of the alignment of aims and outcomes of included studies, 21 reported all specified study outcomes in adequate detail.[20,21,24,26-28,31,32,34,36-44,47-49] One study was rated as high risk because reported outcomes did not match study aims,[35] whereas the remaining studies provided insufficient information to address this criterion.[25,33,45,46] Ten studies appeared free of other potential sources of bias.[21,26,28,32,34,39,43,46,47,49] At least one other significant risk of bias was identified in one study, specifically poor study design and description.[36]

DISCUSSION

This review is the first synthesis of evidence evaluating individualized nutrition care provided exclusively by dietitians to adults in primary health care settings. Eighteen of 26 included studies demonstrated a positive effect of dietetic intervention through statistically significant differences in dietary, anthropometric, or clinical indicators between intervention and comparator groups. There was evidence for the effectiveness of the dietetic consultation in 11 out of 21 studies for at least one clinical indicator (blood pressure, blood lipid and glucose levels, serum carotenoid levels, psoriasis severity score, nutrition-related symptoms, and mini-nutrition assessment), for seven of 20 studies reporting anthropometric data (weight, BMI, and waist circumference), and for eight of 12 studies reporting dietary data (energy, carbohydrate, protein, fat, sodium, calcium, vitamin C, and carotenoids). Effectiveness was demonstrated among studies with a primary focus on weight management, in particular regarding reducing weight or limiting gestational weight gain, with two out of three and two out of two, respectively, showing significant benefits of intervention. However, the benefit of preventing undesirable weight gain resulting from pharmacologic treatment was unable to be demonstrated. Effectiveness of dietetic interventions on glycemic control was consistently demonstrated when this was the primary focus. Outcomes for cholesterol, triglycerides, and blood pressure were less consistent between studies. Both studies focusing primarily on diet quality were able to show positive significant differences compared with control for at least one measure of dietary intake. Eight studies reported no between-group differences for any of the outcomes under examination.

Systematic reviews investigating nutrition care provided exclusively by dietitians in primary care settings are limited. Reviews conducted on the broader provision of nutrition care have included studies of dietetics care.[16,17,50-52] Sun and colleagues[52] demonstrated that interventions delivered by dietitians may be more effective than those not delivered by a dietitian; however, this was not specific to primary care settings. Thompson and colleagues,[51] in their systematic review of seven studies, found no evidence that dietitians were more effective in reducing blood lipid levels than self-help materials.[51] Another two reviews found that compared with no care, dietitians elicited modest positive change in some serum biomarkers of CVD.[16,50] More recently, a systematic review investigating nutrition care provided by any primary health professional suggested that there is capacity to support patients in this environment to have healthy dietary behaviors.[17] It is important to recognize that these systematic reviews[16,17,50,51] did not standardize the dietary advice provided, with advice variously provided by doctors, nurses, dietitians, and in some cases by lay people in church and other community settings or written advice in the form of pamphlets or posters. Given the different discipline backgrounds of these groups, and lack of professional training for some, it is likely that the nutrition care varied substantially, reflected in the high heterogeneity of the results.

A key focus of dietetic consultation is to support patients in making dietary behavior change to improve health outcomes over time, and this analysis examined dietary, anthropometric, and clinical indicators. Interestingly, some studies demonstrated substantial dietary change without change in biomedical or anthropometric outcomes, and no study reporting multiple outcomes found significant differences for all measures. These apparent discrepancies may represent the lack of the level of substantial change that may be necessary to achieve a change in all outcomes and acknowledges the difficulty of achieving substantial lifestyle behavior change and risk reduction in adults. Many studies failed to cite one specific primary outcome measure, which could mean that some studies were underpowered to measure all outcomes. Inconsistent results may also reflect the methodologic limitations of the studies. Dietary intake measurement is subject to error[53] and the dietary assessment tools may have been too blunt to measure relevant dietary improvements or specific nutrients, and qualitative improvements to the diet may not have been assessed. The high dropout rates seen in some studies may have reduced the

Table 3. Evaluation of risk of bias of included randomized controlled trials assessing the effectiveness of individual dietetic consultations within a primary health care setting for eight study criteria using Cochrane Risk of Bias Tool[22]

	Randomization		Blinding		Incomplete Data				
Authors, y, reference	Sequence generation	Allocation concealment	Participants and personnel	Outcome assessment	Short term	Long term	Selective reporting	Other sources of bias	Total risk of bias
Almeida and colleagues, 2011[31]	xx[a]	xx	xx	xx	x[b]	xxx[c]	x	xx	xxx
Arcand and colleagues, 2005[24]	x	xxx	xx	xx	x	xxx	x	xx	xxx
Ash and colleagues, 2006[20]	xx	xx	xx	xx	x	xx	x	xx	xx
Delahanty and colleagues, 2001[32]	x	xx	xx	x	x	x	x	x	xx
Deveer and colleagues, 2013[33]	xxx	xxx	xx	xx	x	x	xx	xx	xxx
Francis and colleagues, 2009[25]	xx	xx	xx	xxx	x	x	xx	xx	xxx
Heller and colleagues, 1989[34]	x	xxx	xx	xx	xx	xxx	x	x	xxx
Huang and colleagues, 2010[35]	x	x	xxx	x	xx	xxx	xxx	xx	xxx
Imai and colleagues, 2008[36]	xx	xx	xx	xx	xx	x	x	xxx	xxx
Johnston and colleagues, 1995[37]	xx	xx	xx	x	xx	xxx	x	xx	xxx
Kesman and colleagues, 2011[38]	xx	x	xxx	xx	xx	xxx	x	xx	xxx
Koopman and colleagues and colleagues, 1990[39]	xx	xx	xx	xx	x	x	x	x	xx
Lanza and colleagues, 2001[21]	xx	xx	xxx	xx	xx	xxx	x	x	xxx
Lawrence and colleagues, 1995[40]	xx	xx	xx	xx	x	x	x	xxx	xxx
Lim and colleagues, 2008[26]	xx	xx	xx	xx	x	x	x	x	xx
Loprinzi and colleagues, 1996[41]	xx	xx	xx	xx	x	x	x	xxx	xxx
Naldi and colleagues, 2014[42]	x	x	xx	x	x	x	x	xx	xx
Neil and colleagues, 1995[27]	x	xx	xx	xx	x	x	x	xx	xx
Niswender and colleagues, 2014[28]	xx	xx	xxx	xx	x	x	x	x	xx
Parker and colleagues, 2014[43]	xx	xx	xx	xx	x	x	x	x	xx
Ramsay and colleagues, 1978[44]	xx	xx	xx	xx	xx	xxx	x	xx	xxx
Ravasco and colleagues, 2012[45]	x	x	xx	xx	x	x	xx	xx	xx
Rhodes and colleagues, 1996[46]	xx	xx	xx	xx	x	x	xx	x	xx
Wolff and colleagues, 2008[47]	x	xx	xx	xx	xx	xxx	x	x	xxx
Wong and colleagues, 2004[48]	xx	xx	xx	xx	x	xx	x	xx	xx
Wong and colleagues, 2015[49]	x	xx	x	xx	x	x	x	x	xx

[a]xx=unclear risk.
[b]x=low risk.
[c]xxx=high risk.

power to detect small but significant changes. Longer-term lifestyle interventions >1 year with monthly or more frequent contact have been shown to enhance weight loss and reduce weight regain.[4,7] Therefore, insufficient length of follow-up potentially influenced the achievement of significant change in the biomedical outcomes, particularly given only 10 of 26 studies were of at least 6 months' duration, and only five of these lasted 12 months. The effect of change on chronic disease risk was difficult to conclude due to the lack of common end points and effect sizes reported across the included studies. For example, anthropometry was assessed because weight in some studies and in others by BMI or waist circumference. Whereas these methodologic limitations may have an influence on the strength of results, eligibility criteria were not amended to exclude these potentially lower-quality studies because this review was designed to be a comprehensive analysis of the available RCTs in this area. The study design and methodology of RCTs require greater quality and consistency in reporting.

The included studies were restricted to RCT design to provide the highest available level of research evidence. Defining the dietetic consultation as at least one, individualized, face-to-face session allowed the review to evaluate a relatively homogenous intervention. The evidence for effectiveness of a dietetic consultation was based on this intervention achieving more desirable clinical end points than the comparator. Best practice guidelines regarding dietary change indicate that involvement of nutrition and dietetics practitioners, such as dietitians, are recommended.[4,7,8] Future research should include a synthesis of the literature for high-quality RCTs assessing nutrition counseling delivered by dietitians as part of a multidisciplinary team in addition to dietitian-only interventions considering the economics of each approach.

Limitations of the review include the restriction of studies to only those published in the English language and the publication period searched. Although the lack of date restriction allowed the identification of all studies ever published on the topic, it also meant the inclusion of articles published before publication of the first consolidated standards of reporting trials standards for reporting of RCTs in 1996 and the updated guidelines in 2010.[54,55] Unsurprisingly then, the included RCTs published before this period tended to have higher risk of bias scores, and were more difficult to clearly identify as using an RCT design. Restricting the inclusion criteria to published peer reviewed literature may have resulted in publication bias, whereby interventions that showed significant positive results may have been more likely to be published than interventions that did not. This may have overemphasized the overall findings of the review.[56] A limitation of the review was that it only included studies providing at least one face-to-face consultation rather than online or telephone consultations. Although it is recognized that technology is used to deliver consultations, exclusion of online and telephone consultations enhanced the homogeneity of this review. It is acknowledged that interventions delivered by teams of practitioners of different health disciplines are recommended to optimize patient care.[3-7] However, multiprofessional intervention delivery has not been standardized, and outcomes do not elucidate the effectiveness of dietitians within the team.

Several methodologic limitations in the evidence base were identified by this review. Details of methods used to blind participants and assessors were generally not well described, which meant no study achieved a low risk of bias rating. Lack of detailed reporting about the number and length of consultations made it impossible to determine an effective dose of dietitian time. The varied outcomes reported by studies in this field highlight the need for a minimum dataset with consistent end points for comparison. Future research could reduce potential bias by ensuring and clearly reporting: randomization of participants and allocation concealment, blinding for data collection and outcome assessment, detailed intervention delivery, and data reporting.[22] It is also important to acknowledge that many clinical guidelines recommend that care is provided in multidisciplinary teams, with referral to dietitians if teams are not available. Therefore, the effectiveness of multidisciplinary teams is also important to understand. Studies of longer than 12 months duration are required for the evaluation of long-term effects. It is important that studies clearly state primary outcome measures that are relevant to reduction of chronic disease risk through dietary change, and are sufficiently powered to be able to demonstrate between-group differences in ITT analyses for these measures.

This systematic review synthesized data from 26 RCTs. Dietetic consultations for adults in primary care settings appear to be effective for improvement in diet quality, diabetes outcomes (including blood glucose and glycated hemoglobin levels) and weight loss outcomes (changes in

PRACTICE IMPLICATIONS

Current Knowledge on this Topic

Evidence of the effectiveness of nutrition care provided by dietitians practicing apart from a multidisciplinary team in a primary health care setting has potential policy implications but has not previously been synthesized.

How this Research Adds to the Knowledge on this Topic

This review shows there is fair evidence (Grade II) to support the effectiveness of dietitians to improve diet quality, diabetes outcomes, weight loss outcomes, and to limit gestational weight gain for adults in primary health care settings. The evidence is limited (Grade III) for outcomes related to plasma lipids and blood pressure.

How this Knowledge Might Influence Current Dietetics Practice

This systematic review should be used to advocate for dietitians in primary care and identify opportunities for further research.

weight and waist circumference) and to limit gestational weight gain (Grade II: Fair evidence). Research evaluated in this review does not provide consistent support for the effectiveness of direct dietetic counseling alone in achieving outcomes relating to plasma lipids and blood pressure (Grade III: Limited evidence). Therefore, to more effectively control these cardiovascular disease risk factors, future research might explore novel nutrition counseling approaches as well as dietitian functioning as part of multidisciplinary teams. This study has key implications for researchers and professional associations. Studies need to consistently collect and report data to highlight factors influencing the effectiveness of dietetic consultations and enhance the overall grade of evidence.

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