A Systematic Review of the
Effectiveness of Nutrition Counselling
Interventions by Dietitians in Outpatient
and in Workplace Settings

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A Systematic Review of the Effectiveness of Nutrition Counselling Interventions by Dietitians in Outpatient and in Workplace Settings

Prepared by:
Dawna Royall, MSc, RD

Reviewers:
Alexandra Anca, MHSc., RD
Kim Arrey, RD
Noelle Martin, HBSc., RD

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SUMMARY

BACKGROUND
A marked increase in the incidence of chronic disease is occurring in Canada (notably diabetes and hypertension), which is largely attributed to rising obesity rates. Overall chronic health conditions cost the Canadian economy an estimated $80 billion each year, of which 60% of these costs represent indirect costs attributed to early death, and loss of productivity and income. According to the World Health Organization (WHO), 80% of heart disease, stroke and type 2 diabetes and 40% of cancers globally could be prevented by lifestyle interventions including: eating healthy, getting more physically active and stopping smoking.

Registered Dietitians (also called Dietitians or Professional Dietitians) are regulated health professionals uniquely trained to advise on diet, food and nutrition. Dietitians provide expertise in nutrition therapy consisting of nutrition assessment, diet modification and individual or group counselling designed to achieve nutritional goals and health outcomes. Nutrition therapy provided by dietitians may improve the health of individuals and decrease associated costs. Consumers express an interest in nutrition to prevent and manage disease, but many have limited access to dietitians’ services. A recent Canadian survey found that 93% of consumers feel that nutrition is an important factor influencing their food choices and 87% express that ‘maintaining good health’ has a major influence on the food choices they make (CCFN, 2008). Furthermore, 82% of Canadians surveyed believe that dietitians are the most credible source of nutrition information (CCFN, 2008). Despite these findings, the Health Council of Canada reports that only 17% of Canadians with a chronic health condition has another health care professional such as a dietitian working with their family doctor involved in their care (HCC, 2008).

Consulting dietitians operate their own private consulting practices or businesses and provide expertise in nutrition therapy to individuals, institutions and businesses. Access to dietitian counselling services may be limited because these services are not covered by all insurance companies that provide health benefit packages to employers and by employee assistance/benefit plans. In order to increase awareness of the benefits of nutrition counselling by Registered Dietitians, a systematic literature review was conducted to evaluate the effectiveness of nutrition counselling for the prevention and treatment of major chronic conditions.

The research questions that guided the review were:
- What is the effectiveness of nutrition interventions by a dietitian in an outpatient setting for the prevention or treatment of the major chronic conditions – obesity, diabetes, cardiovascular and kidney disease?
- What is the effectiveness of health promotion interventions by dietitians in the workplace?

Interventions were considered that focused on improvement in clinical outcomes and reduced health care costs, and reduced employer costs (including reduction in absenteeism or disability or improvement in productivity).
METHODS
Medline, CINAHL, Cochrane and Web of Science databases were searched to identify systematic literature reviews, meta-analyses, clinical practice guidelines and narrative reviews (from 2000 - 2008) and primary research articles (1995 – 2008 articles not included in literature reviews). The search was restricted to English language articles examining nutrition interventions in adults relevant to a Canadian outpatient setting (e.g. community health centre, ambulatory medical clinic) or workplace setting.

FINDINGS
The systematic review identified evidence for the effectiveness of nutrition interventions for the prevention and treatment of the following chronic conditions.

Obesity
- To prevent weight gain and obesity among non-obese adults a recent systematic review found fair evidence (‘B’ grade) to recommend dietary interventions consisting of individual and small group counselling regarding a reduced energy diet and increased exercise. In contrast, lower intensity interventions (e.g. counselling by mail and financial incentives) were not recommended as they have not been shown to be effective.

- For the treatment of overweight and obesity in adults a recent clinical practice guideline found good evidence (‘A’ grade) to recommend a comprehensive lifestyle intervention that combines behaviour modification techniques and cognitive behavioural therapy with increasing activity and dietary counselling. Fair evidence was found to recommend that dietary counselling be provided by a dietitian designed to achieve weight loss and decrease obesity-related symptoms. Despite these recommendations, the challenges of long-term weight loss maintenance suggest that more effective strategies are required to support sustained behaviour change.

- Only one randomized controlled trial was identified that examined the cost-effectiveness of dietitian interventions to support weight loss, which found limited evidence (‘C’ grade) to suggest that services to promote weight loss were most cost-effective if delivered by a dietitian, rather than a physician.
**Diabetes**

- One recent Canadian clinical practice guideline and one systematic review found good evidence to support the effectiveness of intensive lifestyle interventions, including a combination of diet and exercise, for preventing diabetes in high risk individuals (individuals with impaired glucose tolerance or metabolic syndrome). The long-term effectiveness of lifestyle interventions was reported in follow-up results from two of the trials, which found that lifestyle interventions continued to decrease diabetes risk several years after the intervention stopped.

- The cost-effectiveness of preventing diabetes with lifestyle intervention was reported in two clinical trials which found that these interventions were cost-effective from the perspective of the health care system and costs were lower than medication costs to prevent diabetes. One recent narrative review also reported that of five published analyses conducted in several countries (including Canada), four of these studies found that intensive lifestyle intervention to prevent diabetes was cost-saving or resulted in modest expenditures per year of quality adjusted life year gained (QALY).

- The effectiveness of nutrition counselling by a registered dietitian to treat individuals with diabetes was reported in one clinical practice guideline which found fair evidence to recommend dietitian counselling for individuals with type 2 diabetes, as this has been shown to lower glycated hemoglobin (AIC) levels, and improve clinical and metabolic outcomes.

- The cost-effectiveness of diabetes education in individuals with diabetes was examined in one narrative review which found that diabetes self management education (including skills training, coping strategies, problem solving and case management for diet and other lifestyle behaviours) was likely to be cost-effective. The same review examined nutrition therapy provided by a dietitian for individuals with diabetes and identified two clinical trials which demonstrated the cost-effectiveness of the dietitian-led intervention.

**Cardiovascular Disease**

- Two clinical practice guidelines and 2 recent systematic reviews support the effectiveness of dietary interventions for primary and secondary prevention of cardiovascular disease (CVD) and hypertension. Nutrition interventions have produced substantial reductions in total and LDL cholesterol levels and in blood pressure.

- The cost-effectiveness of nutrition therapy provided to treat individuals at increased risk for CVD was reported in two reviews. Both reviews include data on costs predominantly from the providers’ rather than the users’ perspective, but overall results provide weak evidence to support that dietitian interventions can be delivered at a reasonable cost and are cost-effective compared to medication costs.
Kidney disease

- One clinical practice guideline for nutrition and chronic kidney disease was identified. The guideline recommends (based on expert opinion) that dietary counselling by a dietitian be provided to individuals with chronic kidney disease to prevent or treat malnutrition. This is based on evidence that malnutrition increases morbidity and mortality in this population.

- One clinical trial was identified that supports the effectiveness of additional diet counselling by a dietitian to improve laboratory values in patients with chronic kidney disease which can ultimately slow the progression of kidney failure. One systematic review was identified that supports the efficacy of a low protein diet in patients with chronic kidney disease, to delay disease progression and reduce the risks of renal death.

- No studies were identified examining the cost-effectiveness of nutrition therapy to treat individuals with chronic kidney disease.

Nutrition interventions in the workplace

- Several literature reviews have examined worksite health promotion programs and report that such interventions can lower absenteeism costs. Many of these are multicomponent interventions that include individual or group education on dietary behaviour change as one component of the program. One systematic review was identified examining the effectiveness of worksite interventions for weight control, which identified 11 multicomponent interventions. Overall higher intensity interventions in particular (face-to-face contact with participants at least once/month) showed benefits on weight loss and modest improvements in serum lipids and blood pressure; however none of the interventions evaluated costs. Most of the studies did not evaluate long-term effects of weight loss.

- Two narrative reviews provide illustrative examples of positive health outcomes associated with dietitian health promotion interventions in the workplace, but describe the challenges of conducting costly controlled trials and obtaining data related to costs and employee productivity.

- Four primary studies were identified examining outcomes of dietitian interventions in the workplace targeting high-risk individuals. All of the interventions showed improved health outcomes; however only one trial provided data on provider costs, which were reported to be U.S. $50/participant for nutrition therapy.
CONCLUSIONS

Nutrition interventions that include nutrition counselling by a registered dietitian targeting at-risk groups, have been demonstrated to improve health outcomes and be delivered at a low cost or be cost-effective. The strongest evidence was identified for diabetes in which intensive lifestyle intervention programs (including a combination of diet therapy and exercise to achieve weight loss), have been demonstrated to be effective at reducing diabetes risk in high-risk individuals and are cost-effective.

Nutrition therapy provided by dietitians for the treatment of chronic diseases involves nutrition assessment, diet modification and counselling to achieve nutrition goals and health outcomes. Nutrition therapy by dietitians has been demonstrated to effectively decrease body weight and several metabolic measures (notably blood lipid levels, AIC levels and blood pressure) in individuals who are overweight or diagnosed with diabetes, dyslipidemia and/or hypertension. Despite the effectiveness of nutrition therapy by dietitians, there is limited evidence examining cost-effectiveness as the long-term economic benefits of reduced risk factors and decreased disease complications was not collected in many studies. Limited evidence suggests that dietitian interventions can improve health outcomes and be delivered at a reasonable cost.

In the workplace, individuals with chronic conditions have higher health-related absenteeism and report reduced productivity than their peers without chronic conditions. Worksite health promotion programs have shown decreases in medical and absenteeism costs. Although dietitians are involved in a number of worksite health promotion programs, it has been a challenge to collect data on health outcomes and costs (i.e. absenteeism and productivity) as employers prefer to invest money in the intervention than the costs of a controlled trial. Despite this challenge, limited evidence from controlled trials demonstrates that dietitian interventions in a workplace setting targeting individuals at increased risk for cardiovascular disease can improve health outcomes and be delivered at a reasonable cost.

Additional high quality research is needed to evaluate the costs of nutrition interventions against the long-term economic benefits, with consideration given to costs from participants, payers and providers.
Registered Dietitians (also called Dietitians or Professional Dietitians) are regulated health professionals uniquely trained to advise on diet, food and nutrition. Consulting dietitians provide expertise in nutrition, diet therapy and food service to individuals, institutions, business and the media. They operate their own private consulting practices or businesses (Dietitians of Canada, 2008a). Specifically, consulting dietitians in private practice may:

- Develop and evaluate nutrition care plans and provide direct counselling to individuals.
- Provide health promotion, disease prevention treatment and services to individuals and groups.
- Develop, implement and evaluate media interviews and presentations.
- Develop, implement and evaluate nutrition-related resources.
- Develop, implement and evaluate health promotion programs.

Consulting dietitians may also be involved in other areas such as:

- Adult education
- Community needs assessments and development
- Cookbook development, cooking classes and food demonstrations
- Corporate health and wellness programs
- Distance/web based education
- Grant, proposal and/or medical writing and/or authoring books
- Advocacy/Issues management
- Mentoring or coaching
- Training of peer support workers and caregivers.

Counselling services by Registered Dietitians in Canada are not covered by all insurance companies that provide employee health benefit packages and employee assistance and benefit plans. There are instances in which medical insurance companies cover services of a non-regulated health professional rather than a regulated health professional i.e. Registered Dietitian. Furthermore, at least one provincial health care policy (Manitoba as of 2008), does not recognize Registered Dietitians as medical practitioners and as such, dietitian services are not eligible as a medical expense for individual personal tax claims through Canada Revenue Agency.

In an effort to raise the profile and awareness about the benefits of nutrition counselling by Registered Dietitians, the Dietitians of Canada Consulting Dietitians Network (CDN), conducted a systematic literature review to assess the effectiveness of nutrition interventions by dietitians for the treatment and prevention of major chronic conditions – obesity, diabetes, cardiovascular and kidney disease. CDN had previously completed a similar project in 2005 entitled, “The Cost-Effectiveness of Registered Dietitians Services – a Review of the Research” (Dietitians of Canada, 2005). The current initiative represents an update and a more in-depth look at this type of research by applying a systematic review of the literature.
The Consulting Dietitians Network anticipates using the findings of the literature review to promote the services of consulting dietitians to, in particular, major Human Resources and Medical Insurance sectors for the purpose of encouraging decision makers in these sectors to incorporate nutrition counselling by dietitians into their employees’ benefits package. The CDN also aims to support ongoing efforts of Dietitians of Canada to promote dietitians as the most reliable and credible source of nutrition information and to support better access to dietitians for Canadians.

**RESEARCH QUESTIONS**

The questions that guided the review were:

1. **What is the effectiveness of nutrition interventions by a dietitian for the prevention or treatment of the major chronic conditions – obesity, diabetes, cardiovascular and kidney disease?**

   Interventions were considered that focused on the following outcomes:
   - Reduction of health care costs
   - Reduction in absenteeism, disability and turnover
   - Improvement in employee productivity
   - Improvement in clinical outcomes (e.g., fasting blood sugar level, blood cholesterol and LDL-cholesterol values) at a lower total per-patient cost compared to cost of pharmaceutical therapy per patient.

2. **What is the effectiveness of health promotion interventions by dietitians in the workplace?**

   Interventions were considered that focused on the following outcomes:
   - Improvement in employee morale/satisfaction and productivity
   - Reduction in employee absenteeism
   - Improvement in company image

**Methods**

The search for published studies was conducted in the medical literature (using Medline, CINAHL and the Cochrane database) and the social sciences literature using Web of Science database (includes science citation index expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI))

A filtered search was conducted to first identify systematic literature reviews, meta-analyses, clinical practice guidelines and narrative reviews (from 2000 to Sept., 2008) followed by primary research articles (1995 to 2008 and not included in the retrieved reviews). Additional research was identified by checking references in the literature retrieved. The search was restricted to English language articles and adults (excluding children and adolescents). To be eligible, the nutrition intervention had to be relevant to an outpatient setting in Canada (e.g. community health centre, ambulatory medical clinic, primary health care clinic) or workplace setting; however all such interventions were included whether they reported positive, negative or neutral outcomes.
The key search terms used were the mesh terms “diet therapy” or “nutrition therapy” combined with environment (work, worksite, workplace, occupation) or condition (diabetes, cardiovascular, cardiac, obesity, renal, kidney) or outcome (cost, cost-effective, economic, absenteeism, productivity). When no results were returned, the search was broadened to include: condition and outcome; or environment AND outcome; or environment AND condition.

Primary studies were appraised using a hierarchy of study designs with only good or fair studies included when available (Centre for Health Evidence, 2008); for systematic literature reviews, study ratings were reported as identified in the review.

RESULTS

A. NUTRITION THERAPY FOR PREVENTION OR TREATMENT OF CHRONIC CONDITIONS

According to the Health Council of Canada (HCC), currently about 9 million Canadians indicate that they have been diagnosed with a chronic health condition, including joint problems, heart disease and cancer (HCC, 2007a). Furthermore, the latest population health projections indicate an alarming increase in the incidence of chronic disease, including diabetes and hypertension (HCC, 2007b). Rising obesity rates are cited as the main factor behind the growing incidence of chronic disease, with nearly 60% of adults and 26% of children in Canada in 2004 identified as being overweight or obese (Stats Canada, 2005). Chronic diseases are responsible for 67% of total direct costs in healthcare and 60% of total indirect costs ($52 billion) as a result of early death, loss of productivity and foregone income (PHAC, 2005). Overall chronic health conditions cost the Canadian economy an estimated $80 billion each year (HCC, 2007a). This review focuses on obesity, diabetes, cardiovascular disease and kidney disease.

According to the World Health Organization (WHO), 80% of heart disease, stroke and type 2 diabetes and 40% of cancers globally could be prevented by lifestyle interventions: eating healthy, getting more physically active and stopping smoking (WHO, 2005). The WHO’s Global Strategy on Diet, Physical Activity and Health supports an integrative collaborative approach to chronic disease prevention stating that the responsibilities for action to bring about changes in dietary habits and patterns of physical activity rest with many stakeholders from public, private and civil society over several decades (WHO, 2004).
A1. OBESITY

Obesity is a major health problem in North America, with the incidence of obesity increasing dramatically in the past two decades. In 2004, 8% of Canadian children and 23% of adults were obese; approximately double the rate of obesity observed 25 years earlier (Stats Canada, 2005). Obesity is associated with an increased number of health problems including type 2 diabetes, hypertension, dyslipidemia, coronary artery disease, stroke, osteoarthritis and some cancers (Obesity Canada, 2007).

Obesity Costs

A recent review of the literature examining the indirect costs of obesity identified 31 studies (Trogdon et al, 2008). Overall, results showed that obesity has a negative impact on workforce productivity and costs. Substantial indirect costs resulting from obesity were due to increased work days missed resulting from increased absenteeism and disability compared to non-obese workers. The Canadian study included in the review reported that overall costs associated with obesity in 2001 were $4.3 billion, representing $1.6 billion in direct health care costs and $2.7 billion in indirect costs (defined as value of activity days lost due to short- and long-term disability plus years of life lost due to premature death) (Katzmarzyk et al, 2004).

Obesity Prevention

It is acknowledged that obesity prevention requires a multisectoral approach with efforts invested in all life cycle groups in addition to addressing lifestyle, policy and environmental factors (Obesity Canada, 2007).

One recent Canadian systematic review, published by the Canadian Task Force on Preventive Health Care and Obesity Canada was identified that examined the effectiveness of strategies to prevent weight gain and obesity among non-obese adults (Obesity Canada, 2007; Reeder et al, 2006). The following recommendations were made based on the evidence described:

- There is fair evidence (i.e. ‘B’ grade) to recommend intensive individual and small group counselling on a reduced calorie or low fat diet to prevent obesity. This is based on 3 studies in which dietary counselling (regarding a low calorie/fat diet) showed positive changes in diet and body weight in men and women after 1 to 2 years follow-up.
- There is fair evidence (‘B’ grade) to recommend an intensive individual or small group program of a combined low fat/reduced calorie diet and endurance exercise intervention to prevent obesity. This is based on 2 studies which reported reductions in weight for up to 4 years in normal weight and overweight adults who received an intensive individual or small group program of a combined low fat/reduced calorie diet and endurance exercise intervention.
- There is fair evidence (‘B’ grade) to recommend against low-intensity interventions using telephone, mail support or financial incentives to promote a low calorie diet and endurance exercise to prevent obesity. This is based on 2 studies of educational interventions for overweight adults that failed to reduce body weight, despite favourable changes in weight-related behaviours.
**Obesity Treatment**

To optimize health, an American Dietetic Association position states that successful weight management requires “a lifelong commitment to healthful lifestyle behaviors emphasizing sustainable and enjoyable eating practices and daily physical activity” (Cummings et al, 2002).

For the treatment of overweight and obese adults, one recent Canadian clinical practice guideline was identified (Obesity Canada, 2007). For the treatment of obesity, the guideline found good evidence (‘A’ grade) to recommend a comprehensive lifestyle intervention that combines behaviour modification techniques and cognitive behavioural therapy with increasing activity and dietary counselling. Fair evidence (‘B’ grade) was identified to recommend that dietary counselling be provided by a dietitian designed to achieve weight loss and decrease obesity-related symptoms (Obesity Canada, 2007). As no specific dietary intervention was found to be superior to others (i.e. high protein, low fat) a nutritionally balanced energy-reduced diet was recommended with fat and protein intake within the range recommended for healthy individuals. Authors of the review acknowledge that lifestyle weight loss interventions suffer from low levels of sustained weight loss (Anderson et al, 2001). This was confirmed in a recent meta-analysis examining the effect of dietary counselling (advice to change dietary patterns) on weight loss compared to usual care (minimal intervention such as general verbal or written advice given at baseline only) (Dansinger et al, 2007). Of the 46 clinical trials evaluated, dietary counselling resulted in an average 6% weight loss (5 kg) at 1 year; however half of the weight lost was typically regained after 3 years. The results did not identify any particular intervention that offered improved benefits on weight loss or preventing weight regain.

**Cost effectiveness**

A systematic review examining the cost-effectiveness of dietitian interventions identified only one randomized controlled trial examining the effectiveness of a weight loss intervention in individuals with obesity (Pavlovich et al, 2004). The intervention compared a physician-led weight loss intervention to a dietitian control group; however both groups received dietitian counselling over 1 year (Pritchard et al, 1999). The results showed that both interventions achieved weight loss; however from a program cost perspective alone, the dietitian group achieved weight loss at a lower cost than the physician-led group (dietitian only group = AUS$7.30/kg vs. physician-led group = AUS$9.76/kg). The review concludes that there is limited evidence (‘C’ grade) to support the cost-effectiveness of dietitian services in reducing body weight (Pavlovich et al, 2004).
A.2 DIABETES

According to a 2007 report from the Health Council of Canada (HCC), about one in 10 Canadians have type 2 diabetes or prediabetes (a precursor to diabetes) (HCC, 2007b). This represents an almost doubling in the incidence of diabetes compared to a decade ago. If current trends in the prevalence of diabetes continue, it is projected that the number of Canadians with diabetes will double again over the next 10 years and the cost of treating these individuals will increase by 50% (HCC, 2007b).

Diabetes contributes significantly to comorbidity. According to the Canadian Diabetes Association (CDA), diabetes is the leading cause of blindness, end-stage renal failure and non-traumatic amputation in Canada (CDA, 2008). In addition, individuals with diabetes have a two- to fourfold increased risk of cardiovascular disease, which is the leading cause of death in individuals with diabetes. Individuals with diabetes are four times more likely to be admitted to a hospital or nursing home and 3 to 5 times more likely to see a health care provider (HCC, 2007b).

Diabetes costs

It is challenging to identify direct, indirect and induced costs for treating diabetes; however in 2005 an estimated $5.6 billion in acute healthcare costs was spent by federal, provincial and territorial governments to treat the estimated 1.8 million people with diabetes and its complications (CDA, 2008). From U.S. data in 2007, the total estimated cost of diabetes for the 17.5 million Americans diagnosed with the condition was $174 billion, of which one-third of these costs were indirect costs related to reduced national productivity (American Diabetes Association (ADA), 2008). The indirect costs included increased absenteeism ($149 million/1 million people diagnosed with diabetes), reduced productivity at work ($1.1 billion/1 million diagnosed), reduced productivity for those not in the work force ($45.7 million/1 million diagnosed), unemployment from disease-related disability ($0.4 billion/1 million diagnosed) and lost productive capacity due to early mortality ($1.5 billion/1 million diagnosed).

Absenteism and work productivity

Based on a review of four studies, people with diabetes have on average 0.8% higher health-related absenteeism (range 0.5-1.2%) than their peers without diabetes – equivalent to 1.9 missed workdays/year (Goetzel et al, 2004). Collecting data from the 2006 National Health Interview Survey (NHIS), and controlling for hypertension in individuals with diabetes, the American Diabetes Association (ADA) reports that lost number of workdays per year for individuals with diabetes ranges from 0.9 for 18-34 year olds to 2.5 days for 45-54 year olds (ADA, 2007).

People with diabetes also report reduced work productivity compared with their peers without diabetes (e.g. loss of concentration, repeating a task, working slower than usual, fatigued at work or unable to do their work). Based on a review of four studies, the average annual health-related at work productivity loss associated with diabetes was 9.2% (range 1.9-21.8%) (Goetzel et al, 2004). Since individuals with hypertension in addition to diabetes, report greater declines in productivity, controlling for hypertension, the ADA calculated a productivity loss associated with diabetes of 6.6% – equivalent to 14 days/year (ADA, 2007).
Diabetes prevention

Preventing diabetes and its associated complications would be expected to substantially improve or maintain health and reduce the direct and indirect costs of treating diabetes.

The literature search identified a Canadian clinical practice guideline and systematic review, both published in 2008 examining the effectiveness of lifestyle interventions to prevent diabetes. Lifestyle interventions support healthy eating, exercise and achieve weight loss and are generally delivered by dietitians to individuals at risk for diabetes.

- For the prevention of diabetes, a 2008 Canadian Diabetes Association clinical practice guideline recommends that for individuals with impaired glucose tolerance (prediabetes) a structured program of lifestyle modification should be implemented that includes moderate weight loss and regular physical activity (CDA, 2008). This recommendation is based on high quality evidence from randomized controlled trials which have shown that an intensive and structured lifestyle intervention delivered by dietitians that supports healthy eating, exercise and achieves a weight loss of about 5% (approximately 4 kg) delivered over three to six years can reduce the risk of developing type 2 diabetes by almost 60% in individuals at risk for diabetes (Tuomilehto et al, 2001; Knowler et al, 2002).

- A 2008 Cochrane review examining the effectiveness of lifestyle interventions (diet and/or exercise) to prevent diabetes, identified 8 randomized controlled trials (including close to 6000 participants) that included exercise and diet (mainly focused on calorie restriction, reduced fat intake and increased fibre intake) and included a behavioural component (e.g. participant feedback, goal-setting) (Orozco et al, 2008). For most of the interventions, the facilitator was a dietitian and/or exercise physiologist. The interventions lasted from one to six years and were delivered in both individual and group settings with contacts ranging from 5 to 51. Overall results showed that lifestyle interventions resulted in a 37% reduced risk of diabetes (95% CI, 0.49-0.79) and were associated with reductions in body weight and waist circumference. Beneficial effects on blood pressure were also demonstrated (weighted mean difference -4 mmHg) with only modest effects on blood lipids. The authors conclude that lifestyle interventions, including a combination of diet and exercise are effective at decreasing the incidence of diabetes in high risk individuals (individuals with impaired glucose tolerance or metabolic syndrome) (Orozco et al, 2008). A companion Cochrane review examining the effect of a diet-only intervention on diabetes prevention identified only two randomized controlled trials that met their inclusion criteria (12 months or longer) (Nield et al, 2008). Both studies included dietary advice to decrease intake of energy and simple sugars and increase intake of fruit and vegetables and showed beneficial effects on risk factors for diabetes prevention (Pan et al, 1997; Torjesen et al, 1997). Due to different outcome measures, it was not possible to determine the best dietary advice or frequency of support and guidance required to achieve optimal diabetes prevention and the authors recommend that additional high quality dietary intervention studies be conducted (Nield et al, 2008).
Long-term effectiveness

Maintaining the effects of lifestyle behaviour change is challenging and the average length of the lifestyle intervention used in clinical trials in the above analyses was 3 years (range 1 to 6 years) (Orozco et al, 2008). However, follow-up results from two of the trials have shown that lifestyle interventions continue to decrease diabetes risk for several years after the intervention stopped (Lindstrom et al, 2006; Li et al, 2008).

Cost-effectiveness of Diabetes Prevention

From the literature review documenting the effectiveness of lifestyle interventions for preventing diabetes (Orozco et al, 2008), two of the clinical trials published a within trial cost-effectiveness analysis and both concluded that the interventions were cost-effective from the perspective of the health care system (Knowler et al, 2002; Ramachandran et al, 2006 and 2007). In particular, the Diabetes Prevention Program (DPP) from the U.S. showed that lifestyle programs are associated with modest increased costs compared with the placebo group and were lower than costs of medication to prevent diabetes (DPP, 2003). The Markov simulation model, which tracks disease progress, costs and quality adjusted life years (QALY) showed that the delay in the development of diabetes and its associated complications using lifestyle intervention was highly cost-effective in all age groups (Herman et al, 2005). Compared with placebo, the cost per QALY was ~$1100 for lifestyle intervention and $31,300 for the metformin intervention.

A recent narrative review was identified that examined the cost-effectiveness of diabetes prevention (Urbanski et al, 2008a). Five published analyses of lifestyle interventions based on the Diabetes Prevention Program (i.e. intensive diet and behavioural modification for overweight adults with impaired glucose tolerance, including counselling with 2-3 years follow-up) were identified (See Table 1). Four of the five analyses found that compared with usual care, lifestyle intervention was cost-saving or resulted in a modest expenditure per life year of QALY gained. In particular, a Canadian evaluation of the DPP lifestyle intervention extended over 10 years reported that lifestyle intervention was cost-effective with a cost per life year gained calculated at $750 compared to no treatment (Caro et al, 2004).

The review also examined the cost-effectiveness of diabetes prevention compared with diabetes treatment (Urbanski et al, 2008a). Of the four studies identified, diabetes prevention was shown to be more cost-effective than intensive glycemic treatment.
Table 1: Cost-effectiveness of lifestyle intervention for the prevention of type 2 diabetes
(Adapted from: Urbanski et al, 2008a)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Intervention</th>
<th>Time Frame</th>
<th>Cost per life year</th>
<th>Cost per QALY gained¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segal et al 1998</td>
<td>Interventions based on Diabetes Prevention Program (DPP) - Intensive diet and</td>
<td>25 years</td>
<td>Cost-saving to AUS $2,600 (U.S. $1,659)</td>
<td>NA</td>
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<tr>
<td>(Australia)</td>
<td>behavioural modification for obese adults with IGT³; includes counselling with</td>
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<td></td>
<td>2-3 years follow-up</td>
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<tr>
<td>Palmer et al, 2004</td>
<td>Diabetes Prevention Program</td>
<td>Lifetime</td>
<td>Cost-saving to Euro 6,400 (U.S. $8,056)</td>
<td>NA</td>
</tr>
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<td>Germany, Switzerland,</td>
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<td>10 years</td>
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¹ QALY – quality adjusted life years. QALY is the difference in costs and the difference in benefits between interventions. Although no standard definition exists to evaluate the cost-effectiveness of interventions, it has been suggested that when QALY is <$20,000 it is an appropriate way to use resources; when QALY is $20,000 to $100,000, the use of resources is probably appropriate; and for interventions with QALY >$100,000 it may be an inappropriate use of resources (Herman, 2000).

² Life-year gained - calculated as the incremental cost of one treatment relative to another divided by the incremental health benefits

³ IGT - impaired glucose tolerance
DIABETES MANAGEMENT

Self Management Education

Self management education (SME) includes skills training, coping strategies, problem-solving and case management with the goal to increase an individual’s involvement in, confidence with, and motivation for control of their diabetes (CDA, 2008). Current clinical practice guidelines for the management of diabetes recommend that SME, incorporating knowledge and skills development, should be implemented for all individuals with diabetes (CDA, 2008). This is based on evidence from several clinical studies which have demonstrated that SME can lower glycated hemoglobin (AIC) levels and enhance quality of life. For example a meta analysis of randomized controlled trials examining the effect of SME on adults with type 2 diabetes reported that the intervention decreased AIC by 0.76% more than controls at immediate-follow-up and by 0.26% at more than 4 months follow-up (Norris et al, 2002a). Nutrition therapy, that includes counselling by a registered dietitian, incorporates SME when providing information on diet and other lifestyle behaviours, individualized according the patient’s metabolic stability, learning style, ability, and motivation (CDA, 2008). [The effectiveness of nutrition therapy is discussed in the next section.]

A 2008 review of the cost-effectiveness of diabetes education, identified three systematic reviews and four primary studies (not included in the systematic reviews) examining SME and related costs in adults with type 2 diabetes (Urbanski et al, 2008b). The diabetes SME studies provided different amounts of education by various healthcare providers. Although studies did not include a full economic analysis, most identified that diabetes SME was likely to be cost-effective, particularly when provided to individuals with the poorest glycemic control.

Nutrition Therapy

Current clinical practice guidelines for the management of diabetes found fair evidence to recommend that individuals with diabetes receive nutrition counselling by a registered dietitian to lower glycated hemoglobin (AIC) levels, which can improve clinical and metabolic outcomes (CDA, 2008). This recommendation is based on evidence from a clinical trial which demonstrated that nutrition therapy provided by dietitians can improve glycemic control by reducing AIC levels by 1.0 to 2.0% in individuals with type 2 diabetes (Franz et al, 1995).
Cost-effectiveness of Diabetes treatment

A 2008 review of the cost-effectiveness of diabetes education, identified three systematic reviews and four primary studies (not included in the systematic reviews) examining diabetes SME and related costs in adults with type 2 diabetes (Urbanski et al, 2008b). The diabetes SME studies provided different amounts of education by various healthcare providers. Although studies did not include a full economic analysis, most identified that diabetes SME was likely to be cost-effective, particularly when provided to individuals with the poorest glycemic control. The only review (commissioned by the U.S. Task Force on Community Preventive Services) to examine the effectiveness of diabetes SME interventions that included worksite settings, identified only one eligible study; however because no control group was used the authors of the review indicate that evidence was insufficient to assess the effectiveness of diabetes SME at the worksite (Norris et al, 2002b).

In the same review examining the cost-effectiveness of diabetes education provided by dietitians, the authors note that although evidence supports the effectiveness of medical nutrition therapy provided by dietitians to improve metabolic control, only two studies were identified that examined the costs of medical nutrition therapy in individuals with diabetes (Urbanski et al, 2008b). Medical nutrition therapy involves nutrition assessment, diet modification and counselling by a dietitian to achieve nutritional goals and health outcomes (American Dietetic Association, 2008). The two studies are:

- Franz et al (1995a, 1995b) conducted a 6-month randomized controlled trial of 179 individuals with type 2 diabetes who received basic nutrition care or nutrition care according to the American Dietetic Association practice guidelines provided by dietitians in outpatient clinics. The mean time with a dietitian was 65 minutes for basic care and 151 minutes for the practice guidelines group. Results showed a greater reduction in fasting plasma glucose in the practice guidelines group. The authors used a cost-effectiveness ratio (calculated as the per-patient costs relative to the amount of change in glycemic control at 6 months) for each of the interventions. Using this analysis, the net cost-effectiveness ratio was $5.32 for the basic care group and $4.20 for the practice guidelines group, suggesting that the beneficial outcomes of a more intensive intervention can be delivered at a reasonable cost.

- Wolf et al (2004, 2007) conducted a 1-year randomized controlled trial in 147 obese adults with type 2 diabetes to compare usual medical care to usual care plus a lifestyle case management approach with a dietitian that included individual and group education, support and referrals. Results showed that case management participants had greater weight loss (difference = 3.0 kg), reduced A1C level, decreased medication use, decreased hospital admissions and improved health-related quality of life compared to usual care participants. Incorporating the cost of the intervention (net cost $328/person/year), mean health plan costs were $3,586 (34%) lower in the case management group, suggesting that a dietitian-led lifestyle intervention program is cost-effective.
A.3 CARDIOVASCULAR DISEASE

Cardiovascular disease (CVD) is the leading cause of death in Canada. In 2004, 2.8 million Canadians were hospitalized for CVD (Heart and Stroke Foundation, 2008) and the treatment costs for CVD are estimated at $18 billion every year in physician services, hospital costs, lost wages and decreased productivity (PHAC 2002). Hypertension, a major risk factor for cardiovascular disease, occurs in 4.1 million Canadians (15%), which represents a marked increase from the 2.1 million (9%) of Canadians diagnosed in the 1990s (HCC, 2007a).

Reducing risk factors for CVD can lower the demand for health care and save money. It has been estimated that if all Canadians lowered their daily salt consumption by less than 1 teaspoon (1840 mg sodium/day), this could result in a 30% decrease in cases of high blood pressure in Canada. Direct cost savings from a reduced need for physician visits, laboratory tests and medication are estimated at $430 million/year (Joffres et al, 2007). Dietitians support and advocate for healthy eating strategies to promote healthy blood pressure for Canadians (Dietitians of Canada, 2008b).

Cardiovascular disease – primary and secondary prevention

Canadian clinical practice guidelines establish a clear benefit of dietary intervention for the prevention of cardiovascular disease (CVD) in individuals without existing CVD (primary prevention) and in individuals with risk factors for CVD (secondary prevention), including hypertension (McPherson et al, 2006; Khan et al, 2008).

A systematic review examining the effectiveness of nutrition interventions for the treatment of chronic diseases, identifies a convergence of data supporting a benefit of reducing blood cholesterol levels and cardiac events by lowering saturated fat intake, increasing omega-3 fatty acid intake and following diet patterns such as the Mediterranean diet (Ciliska et al, 2006). In addition, the author cites a Cochrane review which supports that multiple risk factor interventions (using combinations of diet, exercise, weight loss, and smoking cessation) have demonstrated reductions in cardiovascular risk factors (e.g. blood pressure, blood cholesterol) (Ebrahim et al, 2006). In particular, effective strategies for achieving nutrition and lifestyle goals and subsequent risk factor reduction include personal or family counselling and behavioural modification techniques (e.g. goal-setting, self-monitoring) (Ebrahim et al, 2006; Gaede et al, 2003).

A recent Cochrane review examines the effectiveness of dietary advice alone to achieve changes in dietary intake and improve cardiovascular health in healthy adults (Brunner et al, 2007). The interventions involved individual or small group counseling for at least 3 months and up to 4 years in healthy adults or adults at high risk of cardiovascular disease. Low-intensity interventions (15 trials) consisted of between one and three scheduled contacts and high-intensity interventions (23 trials) ranged from four brief interventions to 50 hours of individual counselling over four years. Many of the interventions (including most of the high intensity interventions) were conducted by dietitians.
Of the 38 trials (over 17,000 participants) that met the inclusion criteria comparing dietary advice with no advice, overall results showed that dietary advice reduced serum total and LDL cholesterol by 0.16 mmol/L and 0.18 mmol/L after 3 to 24 months. Furthermore, dietary advice decreased blood pressure by 2.07 / 1.15 mmHg. High intensity interventions (consisting of ≥4 scheduled personal contacts) tended to show larger effects than low intensity interventions; however there was considerable variability within the high intensity subgroup. Of the interventions conducted in the workplace setting (4 trials), all were low intensity interventions that only evaluated behaviour change (e.g. number of daily fruit and vegetable servings), making it difficult to draw meaningful conclusions. The authors of the review conclude that dietary advice appears to be effective in achieving modest changes in diet and cardiovascular risk factors over about 10 months; however there is a lack of data on the longer term effects (Brunner et al, 2007).

Cost-effectiveness

One systematic review examining the cost-effectiveness of nutrition services identified 6 randomized controlled trials conducted in adults with hypercholesterolemia (Delahanty et al, 2001; Naglak et al, 1998; Hebert et al, 1999; and Schectman et al, 1996), hypertension (Johannesson et al, 1992) and coronary artery disease (Masley et al, 2001) (Pavlovich et al, 2004). The interventions generally consisted of a comparison of a more intense diet intervention with counselling by a dietitian versus usual health care. Overall, the results presented weak evidence that nutrition therapy was cost-effective for reducing low-density lipoprotein levels and dietary cholesterol intake, but not for blood pressure lowering. It was not possible to determine overall cost savings because of the wide range of cost estimates provided, which were generally shown from the providers’ rather than the users’ perspective.

More recently, a review examining the effectiveness of nutrition therapy provided by dietitians for the treatment of lipid disorders identified eight studies, four of which were identified as high quality studies (McCoin et al, 2008). For the four high quality studies (Dalgard et al, 2001; Sikand et al, 2000; Hebert et al, 1999; Dalgonville et al, 1994), overall results showed that dietitian-delivered nutrition therapy (consisting of two to six planned visits) for individuals with hypercholesterolemia produced beneficial effects on dietary intake and reductions of 6 to 11% in total plasma cholesterol and 7 to10% in LDL cholesterol. Changes in triglyceride and HDL cholesterol were inconsistent. Four studies (including one high quality study) provided information on the costs or cost-effectiveness of the intervention (Table 2). Only provider costs are provided. The results show that positive health effects of the dietitian intervention can be delivered at a reasonable cost and are cost-effective when compared against medication costs.
Table 2: Cost-effectiveness of nutrition therapy for the treatment of dyslipidemia

<table>
<thead>
<tr>
<th>Reference</th>
<th>Sample size/ study design</th>
<th>Intervention</th>
<th>Health Outcomes</th>
<th>Cost Evaluation</th>
</tr>
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<tbody>
<tr>
<td>Delahanty et al, 2001</td>
<td>90 (45 nutrition therapy vs 45 usual care); randomized clinical trial</td>
<td>Usual care by physician or 2 to 3 nutrition therapy visits in 2-3 months plus additional 2-3 visits over next 3 months if needed</td>
<td>At 6 months (compared to usual care): decrease total cholesterol (5%), LDL (4%), weight (2%); no difference in HDL or triglycerides</td>
<td>Costs of nutrition therapy: $217 per patient for 6% decrease in cholesterol; cost-effectiveness ratio: $36 per 1% decrease in cholesterol and LDL</td>
</tr>
<tr>
<td>McGehee et al, 1995</td>
<td>474 (complete data for 285); chart review of various sites (before-after study)</td>
<td>2 or more nutrition therapy visits; length of intervention varied due to various settings</td>
<td>Length unknown (compared to baseline): decrease in total cholesterol (9%); cholesterol reduction correlated to time spent with dietitian</td>
<td>Mean cost for intervention $163 (for four visits); estimated annual treatment costs using drug therapy $1450</td>
</tr>
<tr>
<td>Sikand et al, 1998</td>
<td>95 (complete data for 75); chart review (before/after study)</td>
<td>2 to 4 nutrition therapy visits (30-60 minutes/encounter) over 6-8 weeks</td>
<td>At 6-8 weeks (compared to baseline): decrease total cholesterol (13%), LDL (14%), HDL (4%), triglycerides (11%).</td>
<td>51% (34 of 67) did not require lipid lowering medication for an estimated cost savings of $60,561/year.</td>
</tr>
<tr>
<td>Sikand et al, 2000</td>
<td>73 men (complete data available for 43); chart review (before-after study)</td>
<td>2 to 4 nutrition therapy visits (30-70 minutes/encounter) over 8 weeks</td>
<td>At week 6 or 7 (compared to baseline): decrease total cholesterol (11%), LDL (9%), triglycerides (22%) and BMI (2%); increase HDL cholesterol (4%)</td>
<td>50% (15 of 30) did not require lipid-lowering medication representing a cost savings of $27,449/year or $638/patient. Cost saving of $3.03 in statin therapy/dollar spent on nutrition therapy.</td>
</tr>
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</table>
A.4 KIDNEY DISEASE

The prevalence of chronic kidney disease (CKD) has been estimated at 11% in the U.S. adult population and another 11% are at increased risk for developing CKD including individuals with diabetes, hypertension or a family history of hypertension, diabetes or CKD (National Kidney Foundation, 2002); prevalence rates are expected to be similar in Canada.

Almost half of individuals with CKD are unaware they have it and without aggressive treatment, CKD progresses through stages 1 to 5 to end stage renal disease requiring dialysis or transplant. CKD is a costly disease with treatment costs roughly doubling as individuals progress from one stage of CKD to the next (Sullivan, 2007). Of the health-related costs attributed to CKD (projected to be $39 billion in the U.S. in 2010 (Trivedi et al, 2002)), about 25% of costs are due to disability and absenteeism in the workplace for employees with CKD (Sullivan, 2007). Interventions to prevent or slow the progression of CKD are expected to result in cost-savings. A mathematical model to assess the economic impact of decreasing kidney disease decline by 10% over 10 years calculates that medical care spending will be reduced by $18.5 billion (Trivedi et al, 2002).

Chronic kidney disease treatment

A clinical practice guideline for nutrition and chronic kidney disease (CKD) recommends that education and dietary counselling by a dietitian be provided to individuals with CKD in order to assess and monitor nutritional status and to achieve adequate nutrient intake to prevent or treat malnutrition (National Kidney Foundation, 2000). This recommendation is based on reports of the high prevalence of malnutrition observed in individuals with CKD and evidence that malnutrition is associated with high rates of morbidity and mortality in this population. In addition to preventing malnutrition, individuals with CKD require individualized diet therapy to slow disease progression and prevent disease complications. Diet therapy may involve restricting intake of protein, phosphorus, potassium, sodium and fluid and increasing intake of water-soluble vitamins and minerals such as iron.

One randomized controlled trial was identified examining the effectiveness of diet counselling by a dietitian in individuals with end stage renal disease to control accumulating blood levels of toxins to prevent complications. In this study, 63 individuals with end stage renal disease received extra counselling by a dietitian (additional 20-30 minutes/month) regarding a phosphorus restricted diet or usual care (Ford et al, 2004). After 6 months, individuals in the extra diet counselling group showed improved laboratory measures (reduced serum phosphate and calcium phosphate product by 23%), indicating the importance of additional dietary education to improve phosphate control.

The efficacy of a low protein diet for delaying the progression of CKD was examined in a systematic review that identified 8 randomized controlled trials in adults without diabetes (n = 1524 individuals) (Fouque et al, 2006). Meta-analysis showed a 31% reduced risk of renal deaths on the low protein diet (≤0.6 g/kg/day) compared to a higher or unrestricted protein intake (103 versus 148 deaths). Subgroup analysis also showed a beneficial effect of a low protein diet in delaying the start of dialysis (odds ratio, 0.56). The authors conclude that a low protein intake in individuals with CKD reduces the risk of renal deaths and slows the progression of kidney failure and is thus warranted in individuals with CKD.

No studies regarding the cost-effectiveness of registered dietitian interventions in individuals with CKD were identified.
B. DIETITIAN INTERVENTIONS IN THE WORKPLACE

Worksite health promotion programs

Poor health has been associated with reduced employee performance, safety and morale. The costs of workers in poor health and those with risk factors for chronic disease include high medical, disability and workers’ compensation expenses, increased absenteeism and employee turnover and decreased work productivity (referred to as presenteeism) (Goetzel et al, 2004). In contrast, the workplace offers an opportunity for educational, behavioural, environmental and economic strategies to improve nutrition and physical activity, such as health risk assessment, behavioural counselling, cafeteria menu planning and financial incentive programs. Worksite health promotion programs often focus on providing health promotion services, but may also include disease management. A recent narrative review examining promising practices for worksite health promotion programs indicates that effective programs include the following: addresses multiple risk factors, provides tailored behaviour change messages, supports self-care and management and provides easy access to programs with effective follow-up (Goetzel et al, 2008).

Several literature reviews were identified examining the impact of worksite health promotion interventions on health outcomes or employer costs associated with absenteeism, disability or work productivity. Many of these were multicomponent health promotion programs, but included a dietitian in at least one aspect of the intervention, such as conducting a workshop on healthy eating:

- A 2001 literature review examining employee health promotion programs identified 14 studies, some of which included interventions by dietitians (Aldana et al, 2001). All studies showed reductions in employee absenteeism, but only three studies reported return on investment ratios from $2.5 to $10.10 saved for every dollar invested.

- More recently, in a meta-analysis of 56 financial impact worksite health promotion studies, it was shown that participants in worksite programs have 25-30% lower medical and absenteeism costs compared with nonparticipants over an average study period of 3.6 years (Chapman, 2005). A mix of cross-sectional and prospective research was used and the analysis did not adjust for study design, which may account for higher estimates of cost savings.

- A recent systematic review evaluating the effectiveness of worksite interventions for weight control identified 11 intervention studies (1994-2006) (Benedict et al, 2008). Most of the studies were multicomponent interventions with a focus on education and individual or group counselling to change diet and increase physical activity that ranged from 2 to 18 months. Although 7 of the studies were randomized controlled trials, no studies randomized by worksite and most were methodologically weak due to inconsistent reporting on employee participation and program attrition. None of the studies provided data on costs. Overall, the interventions reported
significant weight loss, with differences between the control and intervention group ranging from -0.2 kg to -6.4 kg. Other outcomes included changes in serum lipids (n=7 trials) and blood pressure (n=6 trials), with overall results showing modest improvements in these measures. Program effectiveness appeared to be related to the intensity of the intervention, with programs that incorporated face-to-face contact with participants at least once/month showing greater effectiveness than lower intensity interventions. Although the review found fair evidence from controlled trials that worksite-based programs can produce short-term weight losses, most of the studies did not evaluate weight loss after 6 months or report weight maintenance.

Although dietitians are involved in a number of corporate wellness programs, there is a shortage of data showing outcomes from interventions. The main reason identified is the time and expense involved in conducting a controlled trial and companies would rather spend money on providing wellness services (Peregrin, 2005). Thus the following narrative reviews provide illustrative examples of outcomes associated with dietitian health promotion interventions in the workplace, but do not use a control group or provide data related to costs, improvement in job satisfaction, productivity, absenteeism, or company image.

- A narrative review provides several examples of organizations in which nutrition interventions provided by dietitians for employees with chronic disease conditions, have produced positive health outcomes that have generated reductions in employer health care spending (Larson, 2001). For example, The Lewin Group reported that nutrition therapy reduced health care spending (8-9% decrease in claims for hospitalizations and 17 - 23% decrease in claims for physician visits) when provided to individuals with diabetes, cardiovascular disease and renal disease (Sheils et al, 1999). In another example, Pfizer Corporation initiated a program to provide individual nutrition counselling to individuals with dyslipidemia along with an exercise and physical activity intervention. Results showed significant reductions in blood lipids at one year (11.6% decrease in blood cholesterol) (Pfizer, 1998). Based on cardiovascular medical claims, the organization calculated that if this type of intervention was offered to all of the at-risk population at Pfizer, the cost savings would be $728,000/year.

- A narrative review of a team-based weight loss program offered by a dietitian in several different organizations (>6000 employees), reports that 88% of participants complete the program and lose an average of 3.5 kg over the 8 week core segment (Peregrin, 2005). Furthermore, reductions in blood cholesterol, high blood pressure and medication reductions for treatment of diabetes, hypertension and dyslipidemia have accompanied the weight loss. Long-term unpublished data shows that participants maintain or continue to lose weight; however there is a lack of interest by companies to conduct a controlled trial on the effects of the intervention or to statistically analyze the data.
Worksite chronic disease management

Published data identified four primary studies examining outcomes of dietitian interventions in the workplace targeting individuals with risk factors for chronic disease or a chronic disease condition (Table 3). Three of the four studies were randomized interventions, however low participation rate (or lack of data on this) combined with a high drop-out rate for most studies, limit the strength of the findings. All of the interventions showed improved health outcomes over a range of 3 to 18 months; however only one intervention which was the highest quality study enrolling a large number of participants provided data on costs (Byers et al, 1995):

- In an evaluation of a nutrition education intervention to reduce cholesterol following cholesterol screening in the workplace, 40 worksites (n=844 men and women) were randomized to receive the usual intervention (5 minutes of counselling) or an intensive intervention of 2 hours of behaviourally based education on dietary changes to lower serum cholesterol (Byers et al, 1995). The intervention was provided in small groups over several sessions in a month by a health professional, usually a dietitian. After 1 year, of the 59% of participants who returned for screening, the intervention group showed a 3.5% decrease in total cholesterol compared to the usual treatment group. Although the cost savings of this type of program were not calculated, the program was described as cost-effective as the total costs for the screening and intervention were about $50/person.
### Table 3: Outcomes of Dietitian Interventions in the Workplace Setting

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Byers et al, 1995 (U.S.)</td>
<td>40 worksites; 844 men &amp; women (498 completed); randomized by worksite (20 worksites usual care; 20 worksites intervention)</td>
<td>Following cholesterol screening, usual intervention (5 minutes of counselling) or intensive intervention (2 hours total of several sessions in 1 month of behaviourally based dietary education)</td>
<td>At 1 year (59% follow-up) (compared to usual care): decrease total cholesterol (3.5%)</td>
<td>Provider costs of nutrition therapy: $50/person</td>
</tr>
<tr>
<td>Pritchard et al, 2002 (Australia)</td>
<td>66 overweight men recruited from a national business corporation following screening (58 completed); randomized to diet, exercise or control for one year</td>
<td>Diet counselling (low-energy diet); physical activity (30 minutes, 3 times/week) or no intervention; monthly monitoring for 1 year</td>
<td>At 1 year, (compared to control): decrease weight (diet = 8%, exercise = 4%); no significant change in blood lipids or blood pressure. Compared to baseline all interventions showed improvements in blood lipids (total cholesterol - 4%) and blood pressure (diastolic BP -5%) with weight loss (-5%).</td>
<td>Not evaluated – described as “low cost”</td>
</tr>
<tr>
<td>Nilsson et al, 2001 (Sweden)</td>
<td>Main public sector employer identified 128 men and women with increased CVD risk from health screening questionnaire (89 completed at 18 months); randomized 65 to intervention, 63 to control</td>
<td>Lifestyle intervention (16 group sessions over 1 year including diet sessions by dietitian plus individual counselling by a nurse) or usual care (written and oral advice)</td>
<td>At 18 months (69% follow-up; n=89) (compared to control): decrease BMI, diastolic blood pressure and increase HDL cholesterol; In previous 4 months, decrease number of sick days</td>
<td>Not measured – a total of 680 hours over 18 months spent delivering the intervention; health economic benefits attributed to decrease in mean number of sick days in the intervention group but not in the control group.</td>
</tr>
<tr>
<td>White et al, 2007 (U.S.)</td>
<td>50 university staff with ≥ 1 CVD risk factor (25 completed); pre/post intervention</td>
<td>3 month pilot wellness program offering 19 workshops organized by a dietitian related to diet and exercise</td>
<td>At 3 months (compared to baseline) decrease total cholesterol (11%), LDL (13%), triglycerides (18%) and weight (2%)</td>
<td>Not measured; noted that if improvements in CVD risk can be maintained, a substantial cost-savings can be realized by employers supporting this type of program.</td>
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</table>
CONCLUSIONS

The rising prevalence of chronic diseases in Canada (including obesity, diabetes and cardiovascular disease) have been estimated to cost the Canadian economy $80 billion per year. Nutrition interventions that include nutrition counselling by a registered dietitian targeting at-risk groups, have been demonstrated to improve health outcomes and can be delivered at a low cost or be cost-effective.

The strongest evidence of the cost-effectiveness of nutrition interventions for disease prevention comes from large clinical trials in diabetes where it has been demonstrated that an intensive and structured lifestyle intervention delivered by dietitians that supports healthy eating, exercise and achieves a weight loss of about 5% (approximately 4 kg) delivered over three to six years can reduce the risk of developing type 2 diabetes by almost 60% in individuals at risk for diabetes (CDA, 2008). Canadian data have demonstrated that this type of intervention is also cost-effective leading to greater health benefits than medication at reasonable costs (Caro et al, 2004).

The literature search demonstrated that nutrition therapy provided by dietitians improves modifiable health risks, which decreases chronic disease progression and disease complications that increase health care costs. Nutrition therapy provided by dietitians (including nutrition assessment, diet modification and counselling to achieve nutrition goals and health outcomes) has resulted in the following positive health outcomes:

• decreased body weight, blood lipid levels and blood pressure for overweight/obese individuals
• reduced glycated hemoglobin (AIC) levels for the management of diabetes
• reduced total cholesterol and LDL levels and subsequent cardiac events in individuals with dyslipidemia at increased cardiovascular risk
• reduced blood pressure in individuals with hypertension
• prevention and treatment of malnutrition in individuals with chronic kidney disease, contributing to slowed disease progression

Despite the positive health outcomes associated with nutrition therapy provided by dietitians, there is limited evidence examining the cost-effectiveness of these interventions, as the long-term economic benefits of reduced risk factors and decreasing disease complications was not collected in many studies. Limited evidence suggests that dietitian interventions can improve health outcomes and be delivered at a reasonable cost.
In the workplace, studies have demonstrated that worksite health promotion programs can decrease medical and absenteeism costs, which have been shown to be higher in individuals with chronic conditions than their peers without chronic conditions. Many health promotion programs are multi-component interventions that include individual or group education on dietary behaviour change as one component of the program. Dietitians are involved in a number of worksite health promotion programs and studies in the workplace, particularly in individuals at increased risk for cardiovascular disease, have demonstrated benefits on body weight, blood lipid levels and blood pressure. It has been identified as a challenge to collect data on costs (i.e. absenteeism and productivity) of dietitian interventions in the workplace, as employers prefer to invest money in the intervention than the costs of a controlled trial. Despite this challenge, limited evidence suggests that dietitian interventions in the workplace setting can improve health outcomes and be delivered at a reasonable cost.

The following research gaps were identified:

- High quality research is needed to more comprehensively evaluate the costs of nutrition therapy against the long-term economic benefits of reduced risk factors and preventing co-morbidity; studies should include costs to users, payers and providers.

- More studies are required targeting all types of individuals typically considered candidates for nutrition therapy including in the early stages of chronic conditions where nutrition interventions may prevent future costly complications.

- Research is required examining the optimal theoretical counselling framework (including duration and frequency of visits) for nutrition therapy to produce the maximum improvement in decreasing risk factors and sustaining optimal benefits.
REFERENCES


