THE OFFICIAL JOURNAL OF THE BRITISH DIETETIC ASSOCIATION

Journal of Human Nutrition and Dietetics

Journal of Human Nutrition and Dietetics

RESEARCH PAPER

Awareness of chronic disease diagnosis amongst family members is associated with healthy dietary knowledge but not behaviour amongst Inuit in Arctic Canada

M. Pakseresht,* E. Mead,* J. Gittelsohn,† C. Roache‡ & S. Sharma§

*Nutrition Research Institute, University of North Carolina at Chapel Hill, Kannapolis, NC, USA
†Center for Human Nutrition, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD, USA
‡Department of Health and Social Services, Government of Nunavut, Iqaluit, NU, Canada
§Department of Medicine, University of Alberta, Edmonton, AB, Canada

Keywords
Arctic, chronic disease, diet, dietary knowledge, Healthy Foods North, Inuit.

Correspondence
S. Sharma, University of Alberta, Department of Medicine, 1-126 Li Ka Shing Centre for Health Research Innovation, Edmonton, AB T6G 2EI, Canada.
Tel.: +1 780 248 1393
Fax: +1 780 248 1611
E-mail: sangitag@ualberta.ca

doi:10.1111/j.1365-277X.2010.01101.x

Abstract

Background: The extent to which awareness of chronic disease (CD) diagnosis affects one's healthy food knowledge, self-efficacy and intentions or healthy dietary and physical activity (PA) behaviours remains unexplored among Inuit in Canada.

Methods: A food frequency questionnaire and an adult impact questionnaire were used in a cross-sectional study to collect self-reported data on daily energy and nutrient intake, PA and the diagnosis of hypertension, diabetes, heart disease and cancer amongst adult Inuit and their family members. Associations between awareness of personal and family CD status and healthy food knowledge, self-efficacy and intentions, percentage of energy consumed from non-nutrient-dense foods and PA were assessed via ordinal logistic regression.

Results: Of the 266 participants, those who self-reported CD for both themselves and their relative(s) were more likely to have high healthy food knowledge [odds ratio (OR) = 2.45] than those who did not. Reporting hypertension and heart disease amongst only relatives increased the likelihood of high knowledge (OR = 5.20) and intentions (OR = 5.10) for healthy eating. Heart disease in both participants and their relatives was associated with high levels of PA (OR = 12.24). However, there were no associations when only participants (but not their relatives) reported having CD. A joint effect between a high level of education and awareness of CD was positively related to high food knowledge (OR = 38.93). An inverse association between awareness of CD and unhealthy eating was not observed.

Conclusions: Awareness of a relative having a CD was a more important factor in increasing knowledge and, to a lesser degree, self-efficacy or intentions to eat healthy than participants' awareness of personal CD. However, awareness was not associated with lower non-nutrient-dense food intake.

Introduction

The prevalence of chronic diseases and their risk factors have increased during the last three decades in both northern and southern Canadian populations (Trovato, 2000; Deering *et al.*, 2009). Cancer and heart disease are now the leading causes of death in Nunavut, whilst the prevalence of some cancers (e.g. liver, oesophageal) is significantly greater amongst Inuit than the national average for all Canadians (Lanier & Alberts, 1996; Inuit Tapiriit Kanatami, 2009). Obesity, smoking and physical inactivity are amongst the chronic disease risk factors that are increasingly prevalent amongst Inuit (Deering *et al.*, 2009).

As previously discussed in detail (Sharma, 2010a), the Inuit population in Nunavut has been undergoing a diet and lifestyle transition that has resulted in an increased

consumption of high fat/high sugar, non-nutrient-dense (NND) shop-bought foods (e.g. crisps and carbonated beverages). Physical inactivity has also become more common (Kuhnlein & Receveur, 1996; Bjerregaard *et al.*, 2004; Kuhnlein *et al.*, 2004). There is strong scientific evidence that a healthy diet and adequate physical activity (PA) play important roles in the prevention of chronic diseases and subsequent mortality (Whelton *et al.*, 2002; World Health Organization, 2005; World Cancer Research Fund/American Institute for Cancer Research, 2007; World Health Organization/World Economic Forum, 2008). Several intervention trials have reported the beneficial effects of lifestyle intervention programmes on reducing risk of chronic disease amongst high-risk populations (Muto & Yamauchi, 2001; Nilsson *et al.*, 2001; Whelton *et al.*, 2002; Duncan *et al.*, 2003; Irwin *et al.*, 2003; Mattila *et al.*, 2003).

Understanding determinants of behaviour is a key component for developing effective dietary and lifestyle interventions (Gittelsohn *et al.*, 1999, 2006; Lewis *et al.*, 2002; Baranowski, 2004). Many studies have assessed the predictive effect of a wide range of social and psychological factors on healthy food habits on various populations (Steptoe *et al.*, 2004; Shaikh *et al.*, 2008), including Inuit in Nunavut (Mead *et al.*, 2010). However, no research has explored whether an Inuit individual's awareness of a chronic disease diagnosis for either themselves or a first-degree relative influences the adoption of a healthy lifestyle.

The present study aimed to assess associations between self-reported diagnosis of a chronic disease (i.e. heart disease, high blood pressure, diabetes and/or cancer) in an individual participant or in an immediate biological family member and the participant's knowledge of healthy dietary practices, self-efficacy to engage in healthier dietary behaviours and intention to lead a healthy lifestyle. Additionally, the associations between chronic disease awareness and current lifestyle practices, including less NND foods (NNDF) consumption of and more PA, were assessed. The study also aimed to explore if there is a significant difference between the relative impact of a family member diagnosis versus personal diagnosis on an individual's food knowledge, self-efficacy, intentions, NNDF consumption and PA levels. In addition, it was a matter of interest to find if the magnitude of associations depends on the number of relatives with a chronic disease. For brevity, the term 'chronic disease(s)' (CD) is used throughout to represent the four diseases stated above.

Materials and methods

Study setting and sampling

The study setting and sampling methodology have been described elsewhere (Sharma, 2010a). Institutional Review Board approval was obtained from the Committee on Human Studies at the University of Hawaii and the Office of Human Research Ethics at the University of North Carolina at Chapel Hill, and the Nunavut Research Institute licensed the study.

Data collection

Data for the study were collected from two questionnaires: the adult impact questionnaire (AIQ) and a quantitative food frequency questionnaire (QFFQ). The validity and data collection methodology of the QFFQ and AIQ have been described elsewhere (Mead *et al.*, 2010; Sharma, 2010a). The AIQ measured participants' food-related knowledge, self-efficacy (i.e. confidence in one's own ability to successfully perform a behaviour) and intentions to perform healthy dietary behaviours using multiple-choice questions. The 'knowledge' section of the AIQ assessed the participant's level of knowledge about nutrition (e.g. the number of tablespoons of sugar in a carbonated drink), whilst the questions about self-efficacy assessed how easy or hard it would be for the participant to choose healthy foods and use healthy cooking methods. The 'intentions' section assessed how often participants planned to choose healthy foods and use healthy cooking methods during the next month (Appendices S1 and S2). Using a method from another study (Gittelsohn *et al.*, 2006), socioeconomic status was determined by questions regarding ownership of 20 assets or material goods (e.g. boat, car, digital camera) in working condition, which was then used to create the Material Style of Life (MSL) scale (Sharma, 2010a). Two open-ended questions asked about daily hours spent in moderate and/or vigorous PA and hours spent being sedentary during both weekends and weekdays. Moderate to vigorous PA was defined as activity that made the person breathe hard/sweat/feel hot, such as working out on the land, walking, sports or heavy cleaning. The locally developed and culturally appropriate QFFQ (Sharma *et al.*, 2010b) was administered to assess participants' consumption of 150 food items during the previous 30 days. Commercial foods shipped from southern Canadian regions that are high in sugar and fat but low in essential nutrients were selected from the QFFQ list of food items and called NND shop-bought foods. The percentage of daily energy intake from NNDF was computed based on the QFFQ and considered an index of unhealthy dietary behaviour (Sharma, 2010a). Finally, participants were asked to report if they or any of their first-degree relatives [biological mother, father, brother(s) and/or sister(s)] had ever been diagnosed by a doctor or nurse with coronary heart disease, hypertension, diabetes (type one or type two) or cancer.

Anthropometric indices were measured or self-reported (when the participant refused or was physically unable to be measured), and smoking status was assessed (Sharma, 2010a).

Statistical analysis

The present study explored self-reported diagnoses of four major CD (i.e. heart disease, hypertension, diabetes and cancer). Analyses were conducted using two different categorisation methods for level of awareness of CD diagnosis. The first method used binary categorisation to define positive exposure (participant or relative with diagnosis) versus null exposure (neither participant nor relative with diagnosis). The second method of categorisation used four levels of exposure, each compared with the reference group of neither participant nor relative with a CD. In this categorisation, level one (least exposed) was defined as only one relative with at least one CD; level two was defined as ≥2 relatives with at least one CD; level three was defined as only the participant reporting at least one CD; and level four (most exposed) was defined as the participant and ≥1 relative with at least one CD.

Level of education was categorised into low (no education, some elementary school, completed elementary school or some junior high school education), intermediate (completed junior high school, some high school or completed high school) and high (some trade school, college or university education completed). To calculate the MSL score (proxy for socioeconomic status), owning any number of each of the 20 items in working condition was scored with one, and the scores were added. Including all 20 items in the MSL scale yielded high internal reliability (range = 1–19, Cronbach's $\alpha = 0.83$) (Bland & Altman, 1997). The AIQ included eight questions to evaluate the level of nutritional knowledge (range = 0–8, Cronbach's $\alpha = 0.58$). The correct and incorrect answers to each question were, respectively, scored one and zero for the analysis. A new variable (knowledge) was produced, which included a sum of scores for the eight questions for each participant. For the eight questions about self-efficacy, the four answer choices were scored on a four-point Likert scale from one (least efficacious) to four (most efficacious) to show an increasing pattern of self-efficacy (range = 11–32, Cronbach's $\alpha = 0.63$). Similarly, the five answer choices for questions about intentions for healthy dietary behaviours were scored on a five-point Likert scale from one (least intention) to five (most intention) (range = 8–32, Cronbach's $\alpha = 0.55$). For both self-efficacy and intentions, new variables equal to the sum of scores of the relevant individual questions were created for analyses. Daily intake of NNDF (g) was computed for each NNDF item on the QFFQ as the daily frequency (monthly frequency divided by 30.4) multiplied by the usual portion size consumed (g) (Pakseresht & Sharma, 2010). The proportion of total energy intake from NNDF to total energy intake from all foods consumed was computed to estimate the percentage of energy from NNDF. Level of PA was determined as a proportional average number of hours spent per day engaged in moderate and/or vigorous PA during weekdays and weekends. Body mass index (BMI) was calculated as kg/m^2.

A chi-square test was used to explore differences in level of categorical variables between participants who reported having a CD and those who did not (based on the two methods of exposure categorisation). Continuous variables with a skewed distribution were logarithm transformed before performing Student's *t*-test. Because of non-normally distributed outcome variables, ordinal logistic regression (Williams, 2006) was used to determine the relationship between the different levels of participants' awareness of having a CD (as the exposure variable) and healthy food knowledge, self-efficacy, intentions, NNDF consumption and PA (as the outcome variables). Using the Brant test, it was found that the models did not violate the parallel regression assumption (Long & Freese, 2006). Hence, the odds ratio (OR) that describes the relationship between the high versus combined intermediate and low categories of the given response variable is the same as the OR that describes the relationship between combined high and intermediate categories versus the low category. The models were adjusted for the effect of potential confounders, which were chosen via a backward elimination method. Using a likelihood ratio test, the possibility of an effect modification was assessed for the variables of interest. The exposure variables were controlled for collinearity, which can potentially cause an under-estimation of the association with the outcome.

A likelihood ratio test was used to determine if there was a nonlinear relationship between the metric variables (age, BMI and MSL score) and each of the outcomes. None of the variables were linearly related to the outcomes; hence, the age variable was changed into three categories (19–30 years, 31–50 years and 51–89 years) based on the classification for the Dietary Reference Intakes (Institute of Medicine, 2005). BMI was categorised into overweight/obese (BMI ≥25 kg/m^2) and normal/underweight (BMI <25 kg/m^2) based on the WHO classification (WHO, 2010), whilst the MSL score was divided into tertiles (0–7, 8–12 and 13–19). The outcome variables of interest were categorised into tertiles. The cut-off points for low, intermediate and high categories were, respectively, 0–3, 4–5 and 6–8 for knowledge score; 0–24, 25–27 and 28–32 for self-efficacy score; 0–19, 20–22 and 23–35 for intentions score; 0–20, 21–33 and 34–100 for

percentage of energy intake from NNDF; and 0–1.3, 1.4–3.4 and ≥3.5 h per day for PA.

Data analyses were performed using STATA MP, version 10.1 (StataCorp LP, College Station, TX, USA). All statistical tests were two-sided, and differences with *P*-values <0.05 were considered statistically significant.

Results

The response rates 69–93% in the three communities. Fifty-one men and 215 women with a mean ranged from and standard deviation (SD) age of 41 (13) years participated. Of the participants, 25% reported no diagnosis of a CD for either themselves or their relatives, 17% reported that only one immediate relative was diagnosed with a CD, 30% reported that two or more immediate family members were diagnosed with a CD and 7% reported that only themselves and no immediate relatives were diagnosed with a CD. A history of CD for both the participant and at least one relative was recorded for 21% of participants (Table 1). Hypertension was the most frequently reported diagnosis for participants or their relatives (61%), followed by cancer (58%), heart disease (48%) and diabetes (23%). Almost all participants had a low or intermediate level of education (82%), and few had high levels of education (18%) (Table 2). Participants who reported that they and/or an immediate family member were diagnosed with a CD, on average, seven years older than those who did not ($P < 0.001$). Most participants were either overweight or obese (79%), and this condition was more prevalent amongst participants who reported a CD diagnosis for themselves or relatives. Seventy-four percent of participants reported that they currently smoke. All participants received almost 30% of their daily energy intake from NNDF. Participants who reported CD and those did not were not statistically significantly different ($P = 0.30$) in terms of mean (SD) hours engaged in moderate/vigorous PA [3.1 (2.5) h perday and 2.7 (2.2) h perday], respectively).

Participants' awareness of a CD diagnosis for themselves and/or relative(s) was positively associated with high healthy food knowledge after adjusting for confounding factors [OR = 2.38, 95% confidence interval (CI) = 1.34–4.23, $P = 0.003$] (Table 3, method 1). When the exposure variable was categorised in four groups (method 2), the results showed that awareness of only a relative having a CD, regardless of the number of diagnosed relatives, was linked with high healthy food knowledge (OR = 2.62, 95% CI = 1.21–5.64, $P = 0.01$ for level 1 and OR = 2.41, 95% CI = 1.24–4.68, $P = 0.01$ for level 2). A similar relationship between the exposure of interest and high healthy food knowledge was also observed for those participants who reported the diagnosis of a CD for themselves and their relative(s) (OR = 2.45, 95% CI = 1.17–5.14, $P = 0.02$ for level 4). However, participants' awareness of a CD diagnosis for only themselves was not likely to impact healthy food knowledge. The common finding between regression models using method 1 and models using diagnosis 2 of exposure categorisation was the lack of a significant association between all levels of awareness of CD and the other outcome variables of healthy food self-efficacy and level of PA. However, there were two exceptions: First, method 2 revealed that participants who reported a diagnosis of CD for two or more of their relatives had greater intention to eat healthy (OR = 2.44, 95% CI = 1.26–4.72, $P = 0.008$) than participants who did not report a diagnosis of CD. Second, those who reported a CD diagnosis for only one relative were more likely to eat a high quantity of NNDF (OR = 2.25, 95% CI = 1.08–4.67, $P = 0.03$) than participants who dit not.

In the analysis of the four CD subgroups (Table 4), participants' awareness of only one immediate relative beging diagnosed with hypertension increased the possi-

Table 1 Frequency and percentage of participants with different levels of awareness of chronic disease diagnosis and the frequency of reported chronic diseases

	n	%
Awareness of the diagnosis of ≥1 chronic disease*		
Reference: neither participant nor relatives were diagnosed	65	25
Level 1: only 1 relative was diagnosed	46	17
Level 2: >1 relative was diagnosed	80	30
Level 3: only participant was diagnosed	19	7
Level 4: participant and relative(s) were diagnosed	56	21
Frequency of reported chronic diseases amongst participants and their relatives		
Hypertension	123	61
Cancer (all types)	117	58
Heart disease	96	48
Diabetes (Types 1 and 2)	46	23
Total participants with reported chronic disease†	201	100

*Based on method 2 of categorisation of participants' awareness a CD diagnosis.
†Some participants reported more than one chronic disease.

Table 2 Demographic information, healthy food knowledge, self-efficacy and intention, and healthy lifestyle of adult Inuit by gender and awareness of chronic disease diagnosis

			Awareness of chronic disease diagnosis*		
		All participants (n = 266)	Yes (n = 201)	No (n = 65)	P-value
Age (years)	Mean (SD)	41 (13)	43 (13)	36 (12)	***<0.001***§
Education† n (%)	Low	114 (43)	84 (42)	30 (46)	*0.43*
	Intermediate	105 (39)	78 (39)	27 (42)	
	High	47 (18)	39 (19)	8 (12)	
MSL score‡ n (%)	Low	82 (31)	60 (30)	22 (34)	
	Intermediate	94 (36)	71 (36)	23 (35)	
	High	88 (33)	68 (34)	20 (31)	*0.82*
BMI (kg / m^2)	Mean (SD)	31 (7)	31 (7)	29 (6)	***0.03***§
BMI categories, n (%)	<25 kg / m^2	55 (21)	38 (19)	17 (26)	
	25.0–29.9 kg / m^2	70 (26)	52 (26)	18 (28)	*0.25*
	≥30 kg / m^2	141 (53)	111 (55)	30 (46)	
Smoking, n (%)	No	70 (26)	57 (29)	13 (20)	
	Yes	195 (74)	143 (72)	52 (80)	*0.16*
Knowledge score	Mean (SD)	4.3 (1.9)	4.4 (1.8)	3.7 (1.8)	***0.006***§
Self-efficacy score	Mean (SD)	26 (4)	26 (4)	26 (4)	*0.41*
Intention score	Mean (SD)	21 (4)	22 (4)	21 (4)	*0.18*
% of energy from NNDF	Mean (SD)	30 (14)	30 (14)	29 (13)	*0.64*
Moderate/vigorous physical activity (h perday)	Mean (SD)	3.0 (2.4)	3.1 (2.5)	2.7 (2.2)	*0.30*

*Diagnosis of chronic diseases amongst participants or at least one immediate relative (based on method 1 of exposure categorisation).
†Low: none, some elementary school, completed elementary school or some junior high school; Intermediate: completed junior high school, some high school or completed high school; High: some college, trade school or university or university completed.
‡Low: Material Style of Life scale (MSL) score ≤7; Intermediate: MSL score 8–12; High: MSL score >12.
§Statistically significant at p <0.05.
BMI, body mass index; NNDF, non-nutrient-dense foods.

Table 3 Adjusted† odds ratio (OR) and 95% confidence interval (CI) of awareness of having chronic disease(s) and indicators of healthy food knowledge, self-efficacy, intention and healthy lifestyle practices

Awareness of the diagnosis of ≥ chronic disease‡	n	Knowledge§ OR (95% CI)	Self-efficacy§ OR (95% CI)	Intention§ OR (95% CI)	% Energy from NNDF§ OR (95% CI)	Physical activity§ OR (95% CI)
Method 1 of categorisation						
Participant and/or relative(s)	201	2.38* (1.34–4.23)	0.94 (0.54–1.64)	1.43 (0.82–2.47)	1.26 (0.74–2.18)	1.54 (0.87–2.64)
Method 2 of categorisation						
Level 1: 1 relative	46	2.62** (1.21–5.64)	0.75 (0.36–1.57)	0.72 (0.35–1.51)	2.25** (1.08–4.67)	0.94 (0.45–1.97)
Level 2: >1 relative	80	2.41** (1.24–4.68)	1.07 (0.56–2.06)	2.44* (1.26–4.72)	1.03 (0.55–1.93)	1.92 (1.02–3.62)
Level 3: participant only	19	1.60 (0.55–4.69)	0.67 (0.26–1.71)	0.55 (0.19–1.55)	1.72 (0.63–4.70)	1.39 (0.52–3.73)
Level 4: participant and relative(s)	56	2.45** (1.17–5.14)	1.10 (0.52–2.31)	1.73 (0.84–3.57)	1.04 (0.50–2.14)	1.71 (0.85–3.44)

†Adjusted for gender, age, education, Material Style of Life score, body mass index and smoking status.
‡Coronary heart disease and/or hypertension and/or diabetes and/or cancer.
§High knowledge score was defined as 6–8; high self-efficacy score was defined as 28–32; high intention score was defined as 23–32; high percentage of energy from non-nutrient-dense foods (NNDF) was defined as more than 33%; high physical activity was defined as more than 3.5 h perday.
*P < 0.01; **P < 0.05.

bility of a high level of healthy food knowledge by more than twice (OR = 2.13, 95% CI = 1.10–4.13, P = 0.03). This positive association was even stronger if participants reported hypertension for more than one relative (OR = 5.20, 95% CI = 1.79–15.12, P = 0.002). Only those participants who reported hypertension for both themselves and their relative(s) were likely to have greater self-efficacy to eat a healthy diet (OR = 2.95, 95% CI = 1.10–7.91, P = 0.03). A positive association was observed between awareness of a diagnosis of heart disease for more than one relative and intention for healthy eating (OR = 5.10, 95% CI = 1.53–16.97, P= 0.008).

Table 4 Adjusted[†] odds ratio (OR) and 95% confidence interval (CI) of the awareness of a diagnosis of chronic disease(s) and indicators of healthy food knowledge, self-efficacy, intention and healthy lifestyle practices

Categories of awareness of a chronic disease diagnosis[‡]	Knowledge[§] OR (95% CI)	Self-efficacy[§] OR (95% CI)	Intention[§] OR (95% CI)	% Energy from NNDF[§] OR (95% CI)	Physical activity[§] OR (95% CI)
Hypertension					
Level 1: 1 relative	**2.13**** (**1.10–4.13**)	1.77 (0.93–3.38)	1.71 (0.90–3.22)	0.85 (0.47–1.56)	1.51 (0.82–2.79)
Level 2: >1 relative	**5.20*** (**1.79–15.12**)	1.01 (0.41–2.51)	1.79 (0.65–4.90)	0.49 (0.19–1.23)	1.69 (0.67–4.29)
Level 3: participant only	1.80 (0.81–3.98)	1.08 (0.52–2.28)	0.69 (0.32–1.50)	0.73 (0.34–1.59)	1.22 (0.59–2.53)
Level 4: participant and relative(s)	1.52 (0.64–3.61)	**2.95**** (**1.10–7.91**)	1.95 (0.78–4.87)	0.59 (0.24–1.45)	1.37 (0.56–3.32)
Heart disease					
Level 1: 1 relative	1.58 (0.90–2.80)	0.83 (0.47–1.46)	1.40 (0.80–2.45)	0.97 (0.56–1.68)	1.64 (0.93–2.88)
Level 2: >1 relative	2.32 (0.81–6.66)	2.06 (0.74–5.73)	**5.10*** (**1.53–16.97**)	1.18 (0.45–3.08)	1.17 (0.45–3.02)
Level 3: participant only	0.77 (0.14–4.28)	0.57 (0.14–2.25)	**0.11**** (**0.01–0.93**)	5.30 (0.90–31.20)	3.20 (0.66–15.60)
Level 4: participant and relative(s)	2.43 (0.67–8.85)	0.75 (0.20–2.83)	1.21 (0.34–4.29)	0.55 (0.14–2.17)	**12.24*** (**2.37–63.15**)
Diabetes					
Level 1: 1 relative	1.04 (0.49–2.25)	1.70 (0.80–3.62)	1.54 (0.71–3.32)	0.52 (0.25–1.07)	0.99 (0.48–2.02)
Level 2: >1 relative	1.76 (0.12–25.76)	0.68 (0.04–12.30)	All had high intention	0.80 (0.09–6.98)	0.60 (0.03–11.88)
Level 3: participant only	0.90 (0.24–3.38)	1.04 (0.31–3.47)	2.83 (0.67–11.97)	1.02 (0.28–3.74)	0.92 (0.24–3.45)
Level 4: participant and relative(s)	1.47 (0.19–11.14)	5.73 (0.51–64.86)	4.54 (0.43–47.55)	1.87 (0.20–18.01)	0.63 (0.12–3.31)
Cancer					
Level 1: 1 relative	1.52 (0.86–2.69)	0.81 (0.47–1.39)	1.56 (0.89–2.74)	1.43 (0.82–2.47)	1.29 (0.74–2.25)
Level 2: >1 relative	2.15 (0.94–4.94)	0.87 (0.37–2.02)	1.65 (0.72–3.78)	0.69 (0.29–1.61)	1.72 (0.80–3.73)
Level 3: participant only	2.39 (0.30–18.66)	1.88 (0.28–12.80)	5.27 (0.50–55.17)	0.17 (0.02–1.71)	1.85 (0.27–12.84)
Level 4: participant and relative(s)	1.14 (0.25–5.26)	0.27 (0.05–1.55)	2.02 (0.50–8.18)	2.86 (0.55–14.73)	1.54 (0.36–6.54)

[†]Adjusted for gender, age, education, Material Style of Life scale, body mass index and smoking status.

[‡]Coronary heart disease and/or hypertension and/or diabetes and/or cancer.

[§]High knowledge score was defined as 6–8; high self-efficacy score was defined as 28–32; high intention score was defined as 23–32; high percentage of energy from non-nutrient-dense foods (NNDF) was defined as more than 33%; high physical activity was defined as more than 3.5 h perday.

*Statistically significant at $P < 0.01$; **Statistically significant at $P < 0.05$.

However, participants with heart disease showed Fewer intention for healthy eating (OR = 0.11, 95% CI = 0.01–0.93, $P = 0.04$). Participants with heart disease who also had relative(s) with heart disease were very likely to spend >3.5 h perday in moderate/vigorous PA (OR = 12.24, 95% CI = 2.37–63.15, $P = 0.003$). No significant relationship was found between the outcomes when different levels of participants' awareness of a diagnosis of diabetes and cancer were included as exposure variables in the regression models.

Analyses for any interaction between awareness of the diagnosis of a CD (based on method 1 of exposure categorisation) and the level of education in association with the outcomes of interest showed a strong joint effect between these two exposure variables (Table 5). This effect was more evident amongst participants with a high level of education, which was associated with nearly 39 times greater likelihood of high healthy food knowledge (OR = 38.93, 95% CI = 12.84–118.07, $P < 0.001$) compared with participants without a personal of family history of CD and a low level of education. The likelihood of high healthy food knowledge was more than six times greater amongst participants with a high MSL score who were aware of having CD compared with the reference category (OR = 6.44, 95% CI = 2.26–18.36, $P < 0.001$).

The joint effect of the awareness of a CD diagnosis with the level of education MSL score failed overall to show a statistically significant change in ORs for self-efficacy, intention, energy consumed from NNDF and PA compared to the relevant reference categories (Table 4).

Discussion

The present study showed that, although awareness of the diagnosis of a CD was related to high healthy food knowledge, fewer significant associations were observed with higher intentions for healthy eating, greater confidence in one's ability to eat healthier, less NNDF consumption and more time spent in PA. However, these findings were not consistent across the four CDs studied.

The results obtained in the study are consistent with a study in Washington State with US adults, which revealed that self-reported history of CD was not associated with healthy eating practice (Trudeau *et al.*, 1998). Many factors may contribute to the lack of an impact of awareness of CD diagnosis on healthy eating. The results obtained

Table 5 The joint effect of the awareness of a chronic disease diagnosis (for the participant, relatives or both[†]) and education or Material Style of Life score (MSL) score on indicators of healthy food knowledge, self-efficacy, intention and healthy lifestyle practices

	Knowledge[‡] OR (95% CI)	Self-efficacy[‡] OR (95% CI)	Intention[‡] OR (95% CI)	% Energy from NNDF[‡] OR (95% CI)	Physical activity[‡] OR (95% CI)
Education[§]					
Chronic disease (No) and low level	1	1	1	1	1
Chronic disease (No) and medium level	4.35 (1.50–12.55)	**3.08***** (**1.06–8.92**)	1.96 (0.73–5.21)	2.39 (0.90–6.34)	1.19 (0.45–3.16)
Chronic disease (No) and high level	4.37 (0.98–19.56)	0.86 (0.19–3.94)	1.57 (0.35–7.10)	0.73 (0.15–3.50)	2.05 (0.48–8.74)
Chronic disease (Yes) and low level	**3.00***** (**1.24–7.27**)	1.19 (0.52–2.72)	1.70 (0.76–3.80)	1.55 (0.70–3.45)	**2.58***** (**1.12–5.96**)
Chronic disease (Yes) and medium level	5.19* (2.16–12.51)	1.73 (0.76–3.96)	**2.28***** (**1.02–5.06**)	1.87 (0.84–4.15)	1.56 (0.68–3.58)
Chronic disease (Yes) and high level	**38.93*** (**12.84–118.07**)	1.43 (0.57–3.59)	2.25 (0.89–5.67)	2.25 (0.90–5.64)	1.21 (0.47–3.11)
P-value for the interaction	0.04	0.33	0.81	0.24	0.17
MSL score[¶]					
Chronic disease (No) and low score	1	1	1	1	1
Chronic disease (No) and medium score	0.98 (0.29–3.35)	0.51 (0.15–1.70)	0.90 (0.30–2.74)	1.76 (0.59–5.29)	0.97 (0.33–2.90)
Chronic disease (No) and high score	**3.52***** (**1.06–11.70**)	1.93 (0.58–6.45)	0.80 (0.26–2.50)	1.32 (0.42–4.13)	1.90 (0.61–5.96)
Chronic disease (Yes) and low score	1.79 (0.65–4.89)	0.40 (0.15–1.10)	0.70 (0.28–1.78)	2.03 (0.80–5.14)	1.21 (0.49–2.96)
Chronic disease (Yes) and medium score	**4.12**** (**1.50–11.25**)	1.32 (0.52–3.43)	1.34 (0.53–3.38)	1.54 (0.62–3.87)	2.08 (0.84–5.14)
Chronic disease (Yes) and high score	**6.44*** (**2.26–18.36**)	1.44 (0.53–3.93)	2.25 (0.86–5.93)	1.56 (0.60–4.06)	**2.63***** (**1.03–6.72**)
P-value for the interaction	0.38	0.03	0.11	0.43	0.66

[†]Based on method 1 of exposure categorisation.

[‡]High knowledge score was defined as 6–8; high self-efficacy score was defined as 28–32; high intention score was defined as 23–32; high percentage of energy from non-nutrient-dense foods (NNDF) was defined as more than 33%; high physical activity was defined as more than 3.5 h per day.

[§]Adjusted for gender, age, MSL score, body mass index and smoking status.

[¶]Adjusted for gender, age, education, body mass index and smoking status. CI, confidence interval.

*Statistically significant at $P < 0.001$; **Statistically significant at $P < 0.01$; ***Statistically significant at $P < 0.05$.

in some studies suggest that up to 50% of patients with risk factors for cardiovascular disease (e.g. hypertension, diabetes) may not be advised appropriately about lifestyle modification (Centers for Disease Control and Prevention, 1999; Egede & Zheng, 2002). A study of inner-city American Indian adults with diabetes indicated that many participants recognised that a healthy diet could control their glucose levels, but few could apply this knowledge to their daily lives (Lautenschlager & Smith, 2006). The present Inuit study population did not exhibit significantly healthier behaviours when diagnosed with a CD, indicating that they may also face similar difficulties in changing behaviours. The present study population has a high consumption of unhealthy shop-bought foods (usually high-fat, high-sugar foods) (Hopping *et al.*, 2010; Sharma *et al.*, 2010b), indicating that these foods may be preferred for reasons of cost, taste and quality.

Variyam (1999) reported that individuals awareness of a relationship between diet and disease is influenced by their level of education, household income and ethnicity. The present study revealed a strong joint effect between awareness of diagnosis of a CD and level (particularly the high level) of education, suggesting that the awareness of a CD amongst educated people encourages them to obtain information about a healthy diet. This joint effect tended to be stronger with an increase in level of education. Awareness of a CD interacted with medium and high MSL scores to significantly increase the likelihood of greater healthy food knowledge. Hence, those individuals that reported a CD diagnosis for themselves and an immediate family member tended to have high levels of healthy food knowledge. Having a higher level of education and socioeconomic status would likely strengthen the possibility of obtaining healthy food knowledge probably as a result of greater access to media and other information sources.

The lack of an association between awareness of a CD diagnosis and other outcomes of interest in most of the simple regression and interaction models indicates that other environmental factors amongst Inuit adults should

be recognised and modified to increase self-efficacy and intentions for healthy eating and lifestyle behaviours (such as less NNDF consumption and more engagement in PA). Fanning *et al.* (2005) identified many factors that can influence an individual's decision to consume or not consume fast food. These factors include age, education level, gender, hours worked per week, the mealtime for which the decision is made, income, time spent watching television, owning or renting a home, geographical location, household size, time of year and possibly numerous interactions between these factors. Availability and quality of fruit and vegetables, as healthy alternatives for NNDF, should also be considered in Nunavut.

Participants' awareness of themselves alone being diagnosed with a CD (and not their family members) was not significantly associated with the outcomes of interest, except for a negative association with intention when participants reported heart disease. It would appear that a participant's awareness of his/her relatives' CD diagnosis is a greater motivation for Inuit to learn about and want to adopt a healthier diet compared with only the participant being diagnosed with a CD. This finding may indicate that family members may be able to more effectively communicate health information and serve as motivation to adopt a healthier lifestyle. Other studies have shown the success of peer educators (such as family members) in health promotion (Buller *et al.*, 1999; Pomerleau *et al.*, 2005; Gittelsohn *et al.*, 2010). However, in this setting, strong family communication did not always lead to a healthier diet, indicating the need for training as peer educators.

The ORs for high healthy food knowledge were almost the same for levels 1 and 2 of CD diagnosis awareness categorisation, indicating that the association does not depend on the number of relatives with CD. However, this factor may impact differently on intention for healthy eating and dietary behaviour.

In an adjusted regression model with the outcome of food knowledge, the individual ORs for CD diagnosis awareness (2.38) and high level of education (10.33, not shown) were smaller than the OR for their joint effect (38.93). The observed OR for the joint effect (38.93) was also considerably greater than expected under an additive model without interaction ($2.38 + 10.33 - 1 = 11.71$) and relatively greater than expected under a multiplicative model without interaction ($2.38 \times 10.33 = 24.59$). These results indicate synergy between the awareness of a CD diagnosis and a high level of education on healthy food knowledge and that people with a high level of education seek healthy food knowledge more when they are aware of having a CD. Performing a likelihood ratio test also confirmed that a regression model with an effect modification between awareness of CD and education fits significantly better than a model including education as confounder.

A high prevalence of being overweight/obesity (79%) and current smoking (74%), as well as a considerable proportion of energy consumed from NNDF (30%) in the present study indicate that Inuit populations are at high risk for CD. These findings are similar to a recent report from northern Canada (Deering *et al.*, 2009).

A cross-sectional study is an appropriate design for hypothesis generation, public health planning and when several outcomes need to be assessed (as in the present study). The present study had a relatively large total sample size of a homogeneous Inuit population and utilised well-developed, culturally appropriate assessment tools. Categorising the outcome variables into three groups and utilising ordinal logistic regression allowed for the evaluation of the associations more precisely and the prevention of missing associations.

The present study is not without limitations. Measurement bias may exist because CD diagnosis was self-reported, and food consumption and hours engaged in PA were obtained based on the participant's memory and, hence, were prone to recall bias. Second, almost four times more women than men enrolled in the study, and the relatively small sample size of male participants may partially explain the less significant association between gender group and the outcomes of interest. This gender difference is partially related to the structure of the sampling, in which the interviewers targeted the main person responsible for food shopping and cooking from each randomly selected household, which was usually a woman. This limits the generalisability of the results to the male population. Third, the large age difference between those who did and did not report a CD may have reduced the precision of observed ORs. Fourth, the response rate varied up to 31%, indicating that some nonresponse bias may be present in the results. Participants may have agreed to participate because they are health-conscious and practice healthier behaviours compared with nonparticipants. Finally, the results cannot be generalised to other Inuit communities in Nunavut, Canada.

Amongst the numerous factors affecting dietary choices, nutrition knowledge and beliefs about diet and health information are the most amenable to change (Institute of Medicine, 1991). Amongst Inuit populations living in three communities in the Canadian Arctic, those who reported a CD for their immediate relative(s) or for both themselves and their relative(s) had more knowledge about healthy food behaviours than those who did not report any of the four medical conditions discussed in the present study. It was also found that immediate relatives may play an important role in communicating information and motivating participants towards the adoption of

a healthier lifestyle. Accordingly, an intervention programme for decreasing CD risk factors could include trained educators from the community as an important bridge between health service providers and the target population. However, awareness of having a CD was not associated with self-efficacy, intention to eat healthier, or a healthier lifestyle, with a few exceptions. The present study is the first to report such data amongst Inuit adults in the Canadian Arctic. These data are useful for guiding and developing health promotion programmes aimed at influencing dietary and lifestyle behaviours and reducing CD risk factors.

Conflict of interests, sources of funding and authorship

The authors declare they have no conflicts of interest.

The project was supported by American Diabetes Association Clinical Research award 1-08-CR-57, the Government of Nunavut Department of Health Social Services, and Health Canada.

SS developed the conception and design of the study. EM conducted the data collection, and MP and JG contributed to data analysis. CR oversaw all data collection and field activities. All authors were responsible for data interpretation, and MP drafted the manuscript. All authors critically reviewed its content and have approved the final version submitted for publication.

References

Baranowski, T. (2004) Why combine diet and physical activity in the same international research society? *Int. J. Behav. Nutr. Phys. Act.* **3**, 2.

Bjerregaard, P., Young, T.K., Dewailly, E. & Ebbesson, S.O. (2004) Indigenous health in the Arctic: an overview of the circumpolar Inuit population. *Scand. J. Public Health* **32**, 390–395.

Bland, J.M. & Altman, D.G. (1997) Statistics notes: Cronbach's alpha. *Br. Med. J.* **314**, 572.

Buller, D.B., Morrill, C., Taren, D., Aickin, M., Sennott-Miller, L., Buller, M.K., Larkey, L., Alatorre, C. & Wentzel, T.M. (1999) Randomized trial testing the effect of peer education at increasing fruit and vegetable intake. *J. Natl Cancer Inst.* **91**, 1491–1500.

Centers for Disease Control and Prevention. (1999) Physician advice and individual behaviors about cardiovascular disease risk reduction: seven states and Puerto Rico, 1997. *Morb. Mortal. Wkly Rep.* **48**, 74–77.

Deering, K.N., Lix, L.M., Bruce, S. & Young, T.K. (2009) Chronic diseases and risk factors in Canada's northern populations: longitudinal and geographic comparisons. *Can. J. Public Health* **100**, 14–17.

Duncan, G.E., Perri, M., Theriaque, D., Hutson, A., Eckel, R. & Stacpoole, P. (2003) Exercise training, without weight loss, increases insulin sensitivity and postheparin plasma lipase activity in previously sedentary adults. *Diabetes Care* **26**, 557–562.

Egede, L.E. & Zheng, D. (2002) Modifiable cardiovascular risk factors in adults with diabetes: prevalence and missed opportunities for physician counseling. *Arch. Intern. Med.* **162**, 427–433.

Fanning, J., Marsh, T. & Stiegert, K. (2005) *Determinants of Fast Food Consumption. Food System Research Group, Working Paper Series*. Available at http://www.aae.wisc.edu/fsrg/publications/WP2005-02.pdf (accessed on 11 January 2010).

Gittelsohn, J., Evans, M., Story, M., Davis, S.M., Metcalfe, L., Helitzer, D.L. & Clay, T.E. (1999) Multisite formative assessment for the Pathways study to prevent obesity in American Indian schoolchildren. *Am. J. Clin. Nutr.* **69**(Suppl. 4), 767S–772S.

Gittelsohn, J., Aniliker, J.A., Sharma, S., Vastine, A.E., Caballero, B. & Ethelbah, B. (2006) Psychosocial determinants of food purchasing and preparation in American Indian households. *J. Nutr. Educ. Behav.* **38**, 163–168.

Gittelsohn, J., Roache, C., Kratzmann, M., Reid, R., Ogina, J. & Sharma, S. (2010) Participatory research for chronic disease prevention in Inuit communities. *Am. J. Health Behav.* **34**, 453–464.

Hopping, B.N., Mead, E., Erber, E., Sheehy, T., Roache, C. & Sharma, S. (2010) Dietary adequacy of Inuit in the Canadian Arctic. *J. Hum. Nutr. Diet.* **23**(Suppl. 1), 27–34.

Institute of Medicine, Committee on Dietary Guidelines Implementation & Food and Nutrition Board. (1991). In *Improving America's Diet and Health: From Recommendations to Actions*. pp. 33–38. Washington, DC: National Academy Press.

Institute of Medicine of the National Academies (IOM). (2005) *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Food and Nutrition Board*. Washington, DC: The National Academies Press.

Inuit Tapiriit Kanatami. (2009) *Inuit & Cancer: Fact Sheets*. Available at http://www.itk.ca/system/files/private/factsheet-seriesFINAL2.pdf (accessed on 2 April 2009).

Irwin, M.L., Yasui, Y., Ulrich, C., Bowen, D., Rudolph, R. & Schwartz, R. (2003) Effect of exercise on total and intra-abdominal body fat in postmenopausal women: a randomized controlled trial. *J. Am. Med. Assoc.* **289**, 323–330.

Kuhnlein, H.V. & Receveur, O. (1996) Dietary change and traditional food systems of indigenous peoples. *Annu. Rev. Nutr.* **16**, 417–442.

Kuhnlein, H.V., Receveur, O., Soueida, R. & Egeland, G.M. (2004) Arctic indigenous peoples experience the nutrition transition with changing dietary patterns and obesity. *J. Nutr.* **134**, 1447–1453.

Lanier, A.P. & Alberts, S.R. (1996) Cancers of the buccal cavity and pharynx in Circumpolar Inuit. *Acta Oncol.* **35**, 545–552.

Lautenschlager, L. & Smith, C. (2006) Low-income American Indians' perceptions of diabetes. *J. Nutr. Educ. Behav.* **38**, 307–315.

Lewis, B.A., Marcus, B.H., Pate, R.R. & Dunn, A.L. (2002) Psychosocial mediators of physical activity behavior among adults and children. *Am. J. Prev. Med.* **23**(Suppl. 2), 26–35.

Long, J.S. & Freese, J. (2006) *Regression Models for Categorical Dependent Variables Using Stata*, 2nd edn. pp. 452–454. College Station, TX: Stata Press.

Mattila, R., Malmivaara, A., Kastarinen, M., Kivelä, S.L. & Nissinen, A. (2003) Effectiveness of multidisciplinary lifestyle intervention for hypertension: a randomized controlled trial. *J. Hum. Hypertens.* **17**, 199–205.

Mead, E., Gittelsohn, J., Roache, C. & Sharma, S. (2010) Healthy food intentions and higher socioeconomic status are associated with healthier food choices in an Inuit population. *J. Hum. Nutr. Diet.* **23**(Suppl. 1), 83–91.

Muto, T. & Yamauchi, K. (2001) Evaluation of a multicomponent workplace health promotion program conducted in Japan for improving employees' cardiovascular disease risk factors. *Prev. Med.* **33**, 571–577.

Nilsson, P., Klasson, E.B. & Nyberg, P. (2001) Lifestyle intervention at the worksite: reduction of cardiovascular risk factors in a randomized study. *Scand. J. Work Environ. Health* **27**, 57–62.

Pakseresht, M. & Sharma, S. (2010) Validation of a quantitative food frequency questionnaire for Inuit population in Nunavut, Canada. *J. Hum. Nutr. Diet.* **23**(Suppl. 1), 67–74.

Pomerleau, J., Lock, K., Knai, C. & McKee, M. (2005) Interventions designed to increase adult fruit and vegetable intake can be effective: a systematic review of the literature. *J. Nutr.* **135**, 2486–2495.

Shaikh, A.R., Yaroch, A.L., Nebeling, L., Yeh, M.C. & Resnicow, K. (2008) Psychosocial predictors of fruit and vegetable consumption in adults a review of the literature. *Am. J. Prev. Med.* **34**, 535–543.

Sharma, S. (2010a) Assessing diet and lifestyle in the Canadian Arctic Inuit and Inuvialit to inform a nutritional and physical activity intervention programme. *J. Hum. Nutr. Diet.* **23**(Suppl. 1), 5–17.

Sharma, S., Cao, X., Roache, C., Buchan, A., Reid, R. & Gittelsohn, J. (2010b) Assessing dietary intake in a population undergoing a rapid transition in diet and lifestyle: the Arctic Inuit in Nunavut, Canada. *Br. J. Nutr.* **103**, 749–759.

Steptoe, A., Perkins-Porras, L., Rink, E., Hilton, S. & Cappuccio, F.P. (2004) Psychological and social predictors of changes in fruit and vegetable consumption over 12 months following behavioral and nutrition education counseling. *Health Psychol.* **23**, 574–581.

Trovato, F. (2000) Canadian Indian mortality during the 1980's. *Soc. Biol.* **47**, 135–145.

Trudeau, E., Kristal, A.R., Li, S. & Patterson, R.E. (1998) Demographic and psychosocial predictors of fruit and vegetable intakes differ: implications for dietary interventions. *J. Am. Diet. Assoc.* **98**, 1412–1417.

Variyam, J.N. (1999) Role of demographics, knowledge, and attitudes. In *America's Eating Habits: Changes and Consequences*. ed. E. Frazao, pp. 281–294. Agriculture Information Bulletin, US Department of Agriculture, Economic Research Service. no. 750, ch. 14.

Whelton, S.P., Chin, A., Xin, X. & He, J. (2002) Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Ann. Intern. Med.* **136**, 493–503.

Williams, R. (2006) Generalized ordered logit/partial proportional odds models for ordinal dependent variables. *Stata J.* **6**, 58–82.

World Cancer Research Fund/American Institute for Cancer Research. (2007) *Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective*. Washington, DC: AICR.

World Health Organization. (2005) *Preventing Chronic Diseases: A Vital Investment*. WHO global report. World Health Organization. Available at http://www.who.int/chp/chronic_disease_report/en/ (accessed on 25 September 2009).

World Health Organization. (2010) *BMI Classification*. Available at http://apps.who.int/bmi/index.jsp?introPage=intro_3.html (accessed on 11 January 2010).

World Health Organization/World Economic Forum. (2008) *Preventing Non-communicable Diseases in the Workplace Through Diet and Physical Activity*. WHO/World Economic Forum Report of a Joint Event. World Health Organization/World Economic Forum. Available at http://www.who.int/dietphysicalactivity/WHOWEF_report_JAN2008_FINAL.pdf (accessed on 29 September 2009).