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Assessment of supplement use (including vitamin D) in Inuvialuit adults in the Northwest Territories, Canada

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Abstract

Background: Inuvialuit of Arctic Canada are at high risk for inadequate vitamin D status as a result of rapid dietary transitions and a lack of solar ultraviolet B exposure. This may have implications for the development of adverse skeletal diseases, cardiovascular diseases and cancers. Data are limited regarding supplement use in Arctic Aboriginal populations. The present study aimed to describe the type and extent of supplement use, emphasising vitamin D, and to identify differences between supplement users and non-users.

Methods: Supplement information was collected from a population-specific quantitative food frequency questionnaire in three communities in the Northwest Territories, Canada, as part of a cross-sectional study. Data were analysed for frequency of supplementation and types of supplements. Users and non-users were compared in terms of age, sex, body mass index, education, marital status, income support, employment and chronic disease diagnosis using nonparametric tests and the chi-squared test.

Results: Response rates ranged from 65% to 85%. Included in the analysis were 192 Inuvialuit (45 males, 147 females) with a mean (SD) age of 43.6 (13.9) years. Twenty-three percent reported using a supplement, with multivitamins being the most common. Three percent indicated taking a vitamin D-containing supplement. No significant differences between supplement users and non-users were found.

Conclusions: Despite limited sun exposure for many months of the year, a small proportion of Inuvialuit adults were using supplements, and specifically vitamin D-containing supplements. Future population-based intervention strategies should promote consumption of vitamin D rich foods and encourage the use of vitamin D supplements if diet alone is unable to meet recommendations.

Introduction

In recent years, vitamin D has emerged as a key nutrient in the development and treatment of nonskeletal diseases, including diabetes, cancer and cardiovascular disease (Plum & DeLuca, 2010). In high latitude nations such as Canada, a high proportion of the population have inadequate vitamin D status throughout the winter and spring (Greene-Finestone *et al.*, 2011). Arctic Aboriginal populations (Inuit, Inuvialuit, First Nations and Métis) (Indian & Northern Affairs Canada, 2000) are at an even higher risk for vitamin D deficiency than the general Canadian population because of recent dietary transitions (Kuhnlein *et al.*, 2004; Sharma, 2010), limited solar ultraviolet B exposure (Webb *et al.*, 1988; Huotari & Herzig, 2008; Sharma *et al.*, 2011), darker skin pigmentation (Holick, 2004; Greene-Finestone *et al.*, 2011) and a high prevalence of obesity (Leslie *et al.*, 2007; Sharma *et al.*, 2011).

Inuvialuit peoples are indigenous to the Northwest Territories (NT) of Canada at latitude 69°N. Recently, Inuvialuit have been undergoing a dietary transition characterised by an increased intake of processed foods high in refined carbohydrates, fats and salt, and a lower intake of nutrient dense traditional foods (Kuhnlein & Receveur, 2007; Sharma *et al.*, 2009; Erber *et al.*, 2010a; Sharma, 2010). Consequently, chronic diseases associated with diet change are increasing in this population (Sharma, 2010).

It has been estimated that nutrient dense traditional foods comprise 28% of daily energy intake of Inuvialuit (Kuhnlein *et al.*, 2004). A significantly higher mean intake of vitamin D has been shown on days with traditional versus nontraditional food consumption (approximately 25 and 9 μg day^{-1}, respectively) (Kuhnlein *et al.*, 2004; Kuhnlein & Receveur, 2007). The mean intake of vitamin D from food among Inuvialuit adults has shown to be below the Dietary Reference Intake of 15 μg day^{-1}, ranging from 3.0 to 7.7 μg day^{-1} (Erber *et al.*, 2010b) and 1.9–6.4 μg day^{-1} (Sharma *et al.*, 2009). With a limited ability to synthesise vitamin D year round and an inadequate intake from food, supplementation may be needed (Huotari & Herzig, 2008; Sharma *et al.*, 2011).

General supplementation (Hoggatt *et al.*, 2002; Troppmann *et al.*, 2002; Foote *et al.*, 2003; Fennell, 2004; Berti *et al.*, 2008; Robson *et al.*, 2008; Guo *et al.*, 2009; Poliquin *et al.*, 2009; Greene-Finestone *et al.*, 2011; Whiting *et al.*, 2011) and characteristics of supplement users (Hoggatt *et al.*, 2002; Troppmann *et al.*, 2002; Foote *et al.*, 2003; Fennell, 2004; Robson *et al.*, 2008; Guo *et al.*, 2009; Vatanparast *et al.*, 2010) have been investigated within Canada and the USA in various adult populations. However, these findings have limited applicability to the Inuvialuit population, which is undergoing rapid dietary and lifestyle changes, in the context of a unique geography and culture.

The present study aimed to describe the type and extent of vitamin and mineral supplement use, with an emphasis on vitamin D, among Inuvialuit adults from three communities in the NT, Canada. Furthermore, our objective was to characterise supplement users and identify whether age, sex, body mass index (BMI), education, marital status, income support, employment and chronic disease diagnosis differ among supplement users and nonusers.

Materials and methods

The sample was derived from participants of the Healthy Foods North nutrition and lifestyle intervention programme, as described previously (Sharma, 2010). Briefly, three Inuvialuit communities located in the NT were assessed in a cross-sectional study as part of a baseline data collection for Healthy Foods North from July 2007 to 2008. Community populations ranged from 400 to 3500 people, with approximately 40–90% self-identifying as Inuvialuit.

Participants were aged ≥ 19 years and excluded pregnant and breastfeeding women. Communities were small and houses were in close proximity to each other. Potential households were first randomly selected from each corner of the community and the community centre using up-to-date government housing maps. Household proximity to food stores was then taken into account so that households both near and far from food stores were included in the study. Every other household was then selected and the main food shopper and preparer in the household was targeted for data collection. Interviews were conducted mainly in English, with local translators being available. All participants provided their written informed consent.

Supplement information was collected as part of a population-specific quantitative food frequency questionnaire, which was developed (Sharma *et al.*, 2009) and validated (Pakseresht & Sharma, 2010) for use within the Inuvialuit population using a pre-established method (Sharma, 2011). Supplement users were defined as those answering 'yes' to supplement use within the past 30 days. Supplement type was described. Height and weight were measured in duplicate by trained staff. BMI (kg m^{-2}) was calculated and participants were classified in accordance with World Health Organization BMI categories (World Health Organization, 2000). An interviewer-administered Adult Impact Questionnaire was used to collect data on education level, marriage status, income support, employment and chronic disease diagnosis. Response rates for questionnaires ranged from 65% to 85% and varied by community.

Ethical approval was obtained from the Office of Human Research Ethics at the University of North Carolina at Chapel Hill. A research licence was granted by the Aurora Research Institute (Inuvik, NT, Canada).

The Mann–Whitney test was used to compare characteristics of supplement users and non-users. The chi-squared test was used to compare BMI categories, sex, education level, marital status, income support, employment status and chronic disease diagnosis among users and non-users. $P < 0.05$ was considered statistically significant. All statistical analysis was performed using SPSS, version 18 (SPSS Inc., Chicago, IL, USA).

Results

A total of 45 Inuvialuit males and 147 females participated in the present study. The mean (SD) age of the study population was 43.6 (13.9) years. Most participants were overweight (65%) and obese (45%) (Table 1). Twenty-three percent of participants reported using one or more

Table 1 Characteristics of Inuvialuit adults (n = 192) in Northwest Territories, Canada

Characteristic	Mean ± SD	Median (range)
Age (years)	43.6 ± 13.9	43.0 (19.0–84.0)
BMI (kg m^{-2})	30.1 ± 8.6	28.1 (17.4–59.8)
		n (%)
Sex		
Female		147 (76.6)
Male		45 (23.4)
BMI		
Underweight (<18.5 kg m^{-2})		3 (1.6)
Normal weight (18.5–24.9 kg m^{-2})		64 (33.3)
Overweight (≥25.0 kg m^{-2})		39 (20.3)
Obese (≥30.0 kg m^{-2})		86 (44.8)
Education*		
<Junior high		63 (32.8)
≤High school		79 (41.1)
Post-secondary		49 (25.5)
Prefer not to answer		1 (0.5)
Marital status†		
Yes		104 (54.2)
No		81 (42.2)
Prefer not to answer		7 (3.6)
% of household on income support‡		
0		130 (68.0)
1–50		40 (20.9)
>50		21 (11.0)
% of household working‡		
0		52 (27.2)
1–50		98 (51.3)
>50		41 (21.5)
Chronic disease§		
Yes		63 (32.8)
No		129 (67.2)

*<Junior high = none, some elementary school, elementary school completed, some junior high school; ≤High School = junior high school completed, some high school, high school completed; Post secondary = some college or trade school, college or trade school completed, some university, university completed.
†Yes = married, common law; No = never married; separated; divorced; widowed.
‡Information missing for one participant; n = 191.
§Yes = doctor/nurse diagnosed chronic disease, has at least one of following: heart attack/disease, hypertension, cancer, diabetes.

nutrient supplements in the past 30 days. Three percent of all participants indicated taking a vitamin D-containing supplement and 20% reported using supplements other than vitamin D (Fig. 1). Eleven different types of supplements were reported, with multivitamins being the most common supplement (39%), followed by vitamin C and iron (24% and 8%, respectively) (Fig. 2). Vitamin D-containing supplements accounted for 10% of supplements used. There were no significant differences between the characteristics of users and non-users (Table 2).

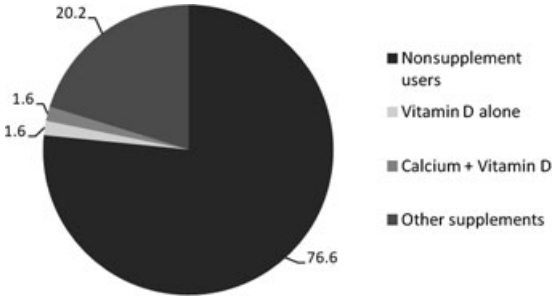

Figure 1 General supplementation and vitamin D use of adult Inuvialuit in the Northwest Territories, Canada.

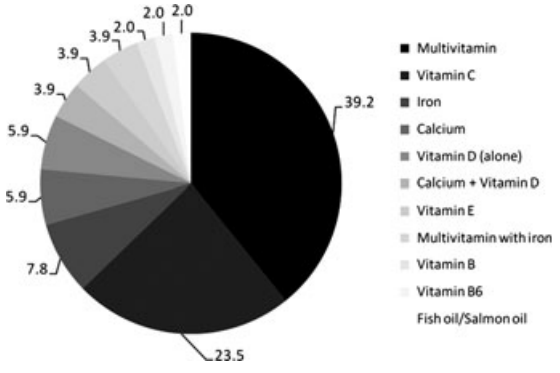

Figure 2 Supplement types used by Inuvialuit adults in the Northwest Territories, Canada.

Discussion

The present study describes supplement use in Inuvialuit of Arctic Canada, with a specific emphasis on vitamin D. The majority of Inuvialuit were not taking supplements and even fewer were taking supplemental vitamin D. Moreover, there were no significant differences in age, sex, BMI, education, marital status, income support, employment and chronic disease diagnosis between supplement users and non-users.

Forty percent of Canadians (excluding the NT and Nunavut) in the Canadian Community Health Survey cycle 2.2 took supplements compared to 23% of Inuvialuit adults in the present study (Guo *et al.*, 2009). The lower supplement use in Arctic Canada may be attributed to the accessibility and cost of supplements, cultural acceptability of supplement use, lower socio-economic status compared to the rest of Canada, and limited nutrition education and media influence encouraging the use of nutrient-specific supplements.

In the present study, there was no information collected on the vitamin D content of multivitamin supplements. However, Health Canada's Licensed Natural Health Products Database showed that 264 products in

Table 2 Characteristics of adult Inuvialuit supplement users and nonsupplement users in the Northwest Territories, Canada

Characteristic	Supplement users (n = 45)		Nonsupplement users (n = 147)		P-value
	Mean ± SD	Median (range)	Mean ± SD	Median (range)	
Age (years)	41.3 ± 14.4	41(21–84)	44.3 ± 13.7	43 (19–83)	0.14
BMI (kg m^{-2})	30.3 ± 8.9	28.6 (19.6–59.8)	30.1 ± 8.5	27.8 (17.4–57.1)	0.96
	n (%)		n (%)		
Sex					
Male	7 (15.6)		38 (25.9)		0.15
Female	38 (84.4)		109 (74.1)		
BMI					
Underweight (<18.5 kg m^{-2})	0 (0.0)		3 (2.0)		0.80
Normal weight (18.5–24.9 kg m^{-2})	15 (33.3)		49 (33.3)		
Overweight ($\geq$ 25.0 kg m^{-2})	10 (22.2)		29 (19.7)		
Obese ($\geq$ 30.0 kg m^{-2})	20 (44.4)		66 (44.9)		
Education*					
<Junior high	12 (26.7)		51 (34.7)		0.28
≤High school	24 (53.3)		55 (37.4)		
Post-secondary	9(20.0)		40 (27.2)		
Prefer not to answer	0 (0.0)		1 (0.7)		
Marital status†					
Yes	22 (48.9)		82 (55.8)		0.53
No	22 (48.9)		59 (40.1)		
Prefer not to answer	1 (2.2)		6 (4.1)		
% of household on income support‡					
0	33 (75.0)		97 (66.0)		0.28
1–50	9 (20.5)		31 (21.1)		
>50	2 (4.5)		19 (12.9)		
% of household working‡					
0	11 (25.0)		41 (27.9)		0.93
1–50	23 (52.3)		75 (51.0)		
>50	10 (22.7)		31 (21.1)		
Chronic disease§					
Yes	18 (40.0)		45 (30.6)		0.24
No	27 (60.0)		102 (69.4)		

Differences between age and BMI tested using Mann–Whitney test. Sex, BMI category, education, marital status, income, employment and chronic disease differences tested using chi-squared test.

*<Junior high = none, some elementary school, elementary school completed, some junior high school; ≤High School = junior high school completed, some high school, high school completed; Post-secondary = some college or trade school, college or trade school completed, some university, university completed.

†Yes = married, common law; No = never married, separated, divorced, widowed.

‡Information missing for one participant; n = 191.

§Yes = doctor/nurse diagnosed chronic disease, has at least one of following: heart attack/disease, hypertension, cancer, diabetes.

Canada are listed as multivitamins, of which 245 contained (on average) 10 μg of vitamin D, whereas sole vitamin D supplements contain either 10 or 25 μg (Health Canada, 2011). Thus, all people taking any type of supplement were categorised as 'users'. This method is not unique to the present study and has been used by other groups (Guo *et al.*, 2009; Vatanparast *et al.*, 2010).

Three percent of participants reported taking a vitamin D-containing supplement. This is in contrast to data from the Canadian Health Measures Survey (2007–2009), which reported that 31% of Canadians used at least one vitamin D-containing supplement in the past month (Whiting *et al.*, 2011). The survey represented approximately 96% of the Canadian population and included a data collection site in Yellowknife, NT. However, there was no comparison between vitamin D supplement users in the different regions or by Aboriginal status.

The present study shows that a small number of this sample of Inuvialuit took supplements and very few were taking vitamin D specifically. Overall, there is limited research on the use of vitamin D supplements in Canada and, more specifically, among adult Arctic Aboriginal populations, who may be at higher risk for vitamin D

inadequacy. Information from the present study can be used to promote evidence-based, population-specific public health interventions among Arctic Aboriginal populations encouraging the consumption of traditional dietary sources of vitamin D, such as fatty fish, and nontraditional sources, such as fortified orange juice. Additionally, there may be a need for vitamin D supplements if diet alone is unable to meet nutrient recommendations.

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Conflict of interests, source of funding and authorship

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SKK was responsible for data analysis and interpretation, as well as manuscript write-up. NM and JLB were responsible for data analysis and interpretation, as well as manuscript editing. TMH was responsible for data analysis and manuscript editing. AC was responsible for the study conception and manuscript editing. SS was responsible for study conception and design, as well as manuscript editing. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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