The Majority of Older British Columbians Take Vitamin D-containing Supplements

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ABSTRACT

Objectives: Health Canada recommends vitamin D supplements (10 µg/d) for Canadians aged ≥50 years, but no data are available on adoption of this recommendation. Accordingly, this study was conducted to determine the current use of vitamin D supplements among British Columbian adults 50 years and over, and to explore relationships among vitamin D supplement use, socio-demographic variables, and knowledge, attitudes and beliefs about vitamin supplementation.

Methods: A population-representative stratified sample, recruited by random-digit dialling, completed a telephone-administered survey in late fall of 2008. Respondents provided details on supplements used in the past month (dosage, frequency, etc.) and demographic data, and responded to statements reflecting health beliefs about supplements, from which a Supplement Health Belief score was calculated. Eligible non-respondents indicated their age, sex, and whether they had used a supplement within the past month.

Results: Similar proportions of participants (n=969) and non-respondents (n=1,027) reported any supplement use in the past month. Among participants, 60% had used a vitamin D supplement (median intake among supplement users was 10 µg/d) and 3% exceeded the Tolerable Upper Intake Level of 50 µg/d. In multivariate analysis, vitamin D supplementation was significantly associated with female sex, not smoking, higher educational attainment, having a health care professional recommend supplement use, and a higher Supplement Health Belief score.

Conclusion: Although most older adults used a vitamin D supplement, further dissemination of this recommendation is needed.

Key words: Vitamin D; supplement; older people; health beliefs; British Columbia; survey

La traduction du résumé se trouve à la fin de l'article.

Can J Public Health 2010;101(3):246-50.

Current Dietary Reference Intakes specify an Adequate Intake for vitamin D of 10 µg/d (400 IU) for adults aged 51-70, and 15 µg/d (600 IU) for adults aged 71 and above.¹ The Canadian Cancer Society² and Osteoporosis Canada³ recommend even higher intakes for cancer and osteoporosis prevention, respectively. Because there are few natural dietary sources of vitamin D and fortified milk contains only 2.5 µg vitamin D per cup, it is very difficult to meet these recommendations through diet alone. For example, the eating pattern recommended for adults over the age of 50 in the 2007 Canada's Food Guide provides only approximately 6 µg of vitamin D.⁴ Accordingly, the Food Guide recommends that adults in this age group take a daily vitamin supplement providing 10 µg of vitamin D.⁵ In the time since this recommendation was released, no studies have been conducted to assess use of vitamin supplements, including vitamin D, by older Canadians. This information is needed to direct public health education campaigns and primary care practice. We therefore conducted a survey to determine the current use of vitamin D supplements among British Columbia (BC) adults 50 years of age and over, and to explore relationships among vitamin D supplement use, socio-demographic variables, and knowledge, attitudes and beliefs about vitamin supplementation.

METHODS

Setting and participants

In the fall of 2008, a population-representative sample of British Columbians aged 50 y and above was recruited by random-digit dialling⁶ to complete a telephone-administered survey. The sample

was stratified by age (50-60 y, 61-70 y, ≥71 y), sex (male, female), and geography (8 regions comprising the entire province). Asians, the major non-Caucasian ethnic group in BC, were oversampled to permit comparisons based on ethnicity. The target sample size was 1,000 respondents, which yields a margin of error of 3.1% at the 95% confidence level. Individuals who could not communicate in English were excluded. The study protocol was approved by the University's Behavioral Research Ethics Board, and participants provided verbal consent.

Procedure

In the telephone survey (which lasted approximately 20 minutes), respondents were asked to bring their supplement bottles to the telephone, and for each supplement, to provide the Drug Identification Number (DIN) or product name and brand, dosage, and frequency of intake over the past month. We asked questions on ethnicity, educational attainment, household income, employment status, smoking status, and whether the respondent had been diagnosed with osteoporosis. Respondents were also asked whether a health professional or friend/family member had recommended a

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Acknowledgements: The authors are indebted to Jung-Un Choi for her technical assistance and Roch Duhamel at Harris Decima for his technical support. This research was supported by a grant obtained through the Vitamin Class Action settlement.

Conflict of Interest: None to declare.

vitamin D supplement. Health beliefs about vitamin-mineral supplements were assessed using a 14-item scale developed for the study based on the Health Belief Model.⁷ Items reflected beliefs about the relevance of supplements, potential benefits to personal health, and perceived barriers to their use. For each item, respondents indicated the extent of their agreement on a 5-point Likert-type scale (where -2 = strongly disagree, 0 = neutral and +2 = strongly agree). Eligible non-respondents were asked to indicate their age, sex, and whether they had used a supplement within the past month. The survey procedure was pretested with older adults before data collection began.

Data handling and analysis

A vitamin-mineral supplement database was developed for the study using information from Health Canada's Drug Product Database (<http://www.hc-sc.gc.ca/dhp-mpps/prodpharma/databasdon/index-eng.php>), supplemented with manufacturers' information. For each individual, total vitamin D intake in International Units (IU) from all supplements was computed, and expressed as µg/d (40 IU = 1 µg). The source of supplemental vitamin D was classified as being provided by a multiple vitamin supplement; a supplement providing only vitamin D; a 'bone-health' supplement providing vitamin D and calcium, or vitamin D, calcium and magnesium; or a combination of two or more of the above sources. A Supplement Health Belief score was calculated by summing responses to the 14-item scale. The scale's internal consistency, assessed using Cronbach's alpha, was 0.763.

Age, sex, and use of any vitamin-mineral supplement over the past month were compared between respondents and eligible non-respondents by chi-square using unweighted data. For all other analyses, data were weighted by sex, age, and geographical region to reflect the BC population aged 50 and above. Those taking or not taking vitamin D supplements were compared by chi-square, and characteristics associated with supplement use in univariate analyses at $p < 0.10$ were included in a multivariate logistic regression. All analyses were conducted using programs available in SPSS version 17 (SPSS, Chicago, IL).

RESULTS

Of the 1,996 eligible individuals reached by telephone, 969 completed the telephone survey (respondents) and 1,027 provided data on their age, sex, and use of any vitamin supplements in the previous month (non-respondents). The respondent and non-respondent groups had similar proportions of men (38.0 vs. 37.3%; $p = 0.75$) and of those who used any supplement in the previous month (70.7 vs. 73.4%; $p = 0.18$). However, more non-respondents than respondents were 71 years or older (37.8 vs. 30.3%; $p < 0.01$).

Overall, 60% of respondents reported using a vitamin D supplement in the previous month and only 3% had a vitamin D intake above the Tolerable Upper Intake Level (UL) of 50 µg/d (Figure 1). Among supplement users, the median intake of vitamin D from supplements was 10 µg/d. The sources of supplemental vitamin D are shown in Table 1. Among those receiving vitamin D from only one source, the largest proportion took vitamin D as part of a single multivitamin, followed by those who took vitamin D alone or as part of a bone-health supplement. Over 25% obtained vitamin D from two or more supplement preparations, and in this group, most used a multivitamin as one of their supplements. Thus, in the

Figure 1. Distribution of BC adults over the age of 50 by supplemental vitamin D intake, 1999 (British Columbia Nutrition Survey) and 2008 (present study)

entire group of supplement users, over half (53.2%) obtained at least some of their supplemental vitamin D from a multivitamin. Those respondents who took multivitamins alone or bone-health supplements alone received less vitamin D than those who took a vitamin D supplement or combination of supplements.

In univariate analysis, vitamin D supplement users compared with non-users were more likely to be female, aged 61-70 y versus 50-60 y or 71+ y, have greater educational attainment, and have had a health professional or family/friend recommend vitamin D supplements (Table 2). Vitamin D users were more likely to have a higher Supplement Health Belief score than non-users. Vitamin D non-users were more likely to smoke than those who used a supplement. There were no differences based on ethnicity, employment, income, fracture, or osteoporosis in users versus non-users, although the difference in osteoporosis diagnosis approached significance.

In multivariate analysis, only female sex, not smoking, having a health care professional recommend supplement use, and the Supplement Health Belief score remained significant predictors of vitamin D supplement use (Table 3). Collectively, these variables explained 22% of the variability in vitamin D supplement use.

DISCUSSION

Here we show that 60% of older British Columbians are using a vitamin D supplement. The use of supplements containing vitamin D appears to have increased substantially since 1999 (Figure 1), when the British Columbia Nutrition Survey was conducted. At that time, use of a supplement containing vitamin D was reported by only 25% and 37% of men aged 51-70 y and ≥71 y, respectively. Corresponding values for women were 44% and 66%.⁸ The relatively high prevalence of vitamin D supplement use in our study supports preliminary findings from the Canadian Health Measures Survey (CHMS), which suggest that mean serum 25 hydroxy-vitamin D concentrations in adults aged 60-79 y were higher than means for younger adult age groups.⁹ This could be explained by a higher prevalence of supplement use among older Canadians.

The greatest proportion of people receiving supplemental vitamin D were taking it as part of a multivitamin supplement. Pre-

Table 1. Daily Intakes of Supplemental Vitamin D by Type of Supplement Used by Older BC Supplement Users*

Supplement Used	Percent Using	Median (IU/d)	Interquartile Range (IU/d)
Multiple vitamin/mineral	32.4	10.0	8.3, 11.4
Vitamin D alone	23.6	25.0	11.1, 25.0
"Bone health" supplement†	16.3	6.7	3.5, 10
Two or more of the above	27.7	27.8	19.8, 35.0

* Intakes differed by type of supplement used as assessed by Kruskal-Wallis ANOVA. $\chi^2=256$, $p<0.001$

† Supplement providing calcium and vitamin D, or calcium, magnesium and vitamin D

Table 2. Characteristics of Study Participants

Variable	Vitamin D Users (n=599) n* (%)	Vitamin D Non-users (n=370) n* (%)	Chi-Square	p value
Male	236 (40.5)	224 (57.9)	27.999	<0.001
Female	346 (59.5)	163 (42.1)		
Age (years)				
50-60	236 (40.5)	184 (47.5)	8.061	0.018
>60-70	177 (30.4)	87 (22.5)		
>70	169 (29.0)	116 (30.0)		
Ethnicity†				
European heritage	466 (80.1)	297 (76.7)	1.677	0.432
Asian	93 (16.0)	74 (19.1)		
Education				
High school or less	180 (30.9)	152 (39.3)	9.207	0.027
Technical school/College	167 (28.7)	91 (23.5)		
University graduate	223 (38.3)	132 (34.1)		
Employment				
Employed	166 (28.5)	124 (32.0)	1.559	0.459
Unemployed	406 (69.8)	258 (66.7)		
Income				
<\$40,000	142 (24.4)	108 (27.9)	1.497	0.683
\$40,000-\$80,000	177 (30.4)	112 (28.9)		
>\$80,000	105 (18.0)	67 (17.3)		
Refused	158 (27.1)	100 (25.8)		
Smoking				
Yes	49 (8.4)	66 (17.1)	16.657	<0.001
No	526 (90.2)	316 (81.7)		
Osteoporosis				
Yes	70 (12.0)	30 (7.8)	5.055	0.08
No	505 (86.6)	348 (90.2)		
Bone Fracture				
Yes	107 (18.4)	62 (16.0)	2.495	0.287
No	470 (80.8)	318 (82.2)		
Health Care Professional Recommends				
Yes	326 (56.0)	118 (30.5)	60.992	<0.001
No	256 (44.0)	269 (69.5)		
Friends/Family Recommends				
Yes	272 (46.7)	141 (36.4)	11.536	0.003
No	310 (53.2)	243 (62.8)		
Supplement Health Belief Statement ‡				
1 st Tertile (≤ 0)	122 (21.0)	199 (51.4)	111.9	<0.001
2 nd Tertile (1-7)	197 (33.8)	114 (29.5)		
3 rd Tertile (≥ 8)	263 (45.2)	74 (19.1)		

* Reported values reflect weighting for age, sex, region of the province and ethnicity. Due to adjustments and/or missing data, the number of participants do not necessarily sum to the total shown.

† 40 individuals who were not of European or Asian heritage were excluded from the analysis.

‡ Theoretical range from -28 to +28, where score of 0 is neutral.

sumably many of these individuals were not taking the supplement solely for its vitamin D content. However, at least 25% of those taking a vitamin D-containing supplement took it as a single supplement. With respect to dose, most vitamin D supplement users were receiving at least the 10 µg per day recommended by Health Canada. A notable exception was those who were taking a 'bone-health' supplement, who received only 6.3 µg/d. Many supplements included in this category were combinations of calcium and vitamin D, which typically contain 200-250 IU of vitamin D (5.0-6.2 µg) per capsule. Only 3% of the population surveyed exceeded the Tolerable Upper Intake Level (UL) of 50 µg/d, and of these, most were consuming only marginally above the UL.

Smokers and men were less likely to take a supplement containing vitamin D, which is consistent with some other studies examining vitamin supplement use.^{10,11} Income and employment were not significant predictors of vitamin D supplement use, which indi-

cates that "lack of money" was not a population-level barrier to vitamin D supplement use. This is perhaps not surprising as a year's supply of vitamin D supplements can cost less than \$10.00. Supplement use was also similar between those of European and Asian ethnicity, the two major groups in BC, suggesting that current recommendations are reaching these groups equally. An important finding was that having a health care provider recommend a vitamin D supplement was associated with a near doubling of supplement use. This is consistent with other research showing the importance of health care providers in influencing positive health behaviours.¹²

Surprisingly, having osteoporosis was not independently associated with vitamin D supplement use. This may be a consequence of the relatively small proportions of respondents reporting an osteoporosis diagnosis, to confounders in the multivariate model, and/or to inadequate post-diagnosis nutrition recommendations.

Table 3. Odds Ratio (and 95% CIs) for Vitamin D Intake by Characteristics of Elderly Population in British Columbia

Characteristics	OR (95% CI)	p-value
Female vs. Male	1.97 (1.43, 2.70)	<0.001
Age (years)		
60-70 versus 50-60	1.75 (1.20, 2.55)	0.003
>70 versus 50-60	1.15 (0.80, 1.65)	0.465
Health Care Professional		
recommended vitamin D	1.70 (1.23, 2.36)	0.001
Education		
University graduate versus high school or less	1.38 (0.96, 1.99)	0.185
Technical school/college versus high school or less	1.30 (0.88, 1.92)	0.197
Smoker	0.53 (0.33, 0.86)	0.009
Osteoporosis	1.37 (0.84, 2.24)	0.212
Supplement Health Belief score*		
1-7 vs. ≤0	2.27 (1.58, 3.26)	<0.001
≥8 vs. ≤0	4.35 (2.96, 6.38)	<0.001

Note: CI = confidence interval, OR = odds ratio, ($R^2 = 0.223$)

* Theoretical range from -28 to +28, where score of 0 is neutral.

In contrast, the strongest predictor of supplement use was higher Supplement Health Belief scores: those in the upper tertile were over four times more likely to use a vitamin D supplement than those in the lower tertile. High scores reflect beliefs that supplements are beneficial to personal health and do not present barriers to use. Such beliefs are consistent with current Health Canada recommendations that all older adults use a supplement providing vitamin D. Importantly, this recommendation represents a shift from previous nutritional guidance messages indicating that nutrient needs of non-pregnant adults could be met through a healthy diet. For example, educational support materials for the 1992 Canada's Food Guide stated that vitamin D supplements would only be appropriate for "people who are not exposed to the sun or who do not consume enough vitamin D-fortified fluid milk or margarine".¹³ The strong relationship between supplement health beliefs and supplement use shown here suggests that messages emphasizing the health consequences of vitamin D deficiency and the benefits of supplements may be of use in increasing uptake of supplement recommendations.

We cannot ascertain true response rate, since some randomly-dialed telephone numbers were not in service or could not be reached despite repeated attempts, and some individuals hung up before it could be determined whether the household contained an eligible individual. Nevertheless, the similarity of respondents and eligible non-respondents in terms of sex distribution and reported supplement use suggests respondents were similar to the BC population. Further evidence that our sample was representative of the BC population is provided by smoking prevalence: among our sample, 12% smoked, which is comparable to the 2006-07 smoking rate of 15% for BC adults aged 45 and above.¹⁴ The level of vitamin D supplement usage shown here may be specific to the fall season when the survey was conducted, as some promotional messages recommend taking vitamin D supplements when Daylight Savings Time is not in effect.¹⁵

It is difficult to extrapolate our findings to the rest of Canada as vitamin supplement use and other health indicators (e.g., not smoking, having normal body weight and desirable physical activity) tend to be more prevalent in BC,^{8,16} suggesting that if anything, vitamin D supplement use by older Canadians in other parts of Canada may be lower. Nevertheless, the apparent trend towards

increased use of supplements containing vitamin D may well be occurring in the rest of Canada. Further research is needed to explore regional differences in vitamin D supplement use.

In conclusion, the majority of older British Columbian adults used a vitamin D supplement, and most received the dose recommended by Health Canada. However, further strategies are needed to increase vitamin D supplement use in this group, especially among men and smokers. Recommendation by a health care professional and a high "Supplement Health Belief" score appear to be important modifiable predictors of vitamin D supplement use.

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Received: July 30, 2009

Accepted: January 21, 2010

RÉSUMÉ

Objectifs : Santé Canada recommande la prise de suppléments de vitamine D (10 µg/j) pour les Canadiens de 50 ans et plus, or il n'existe pas données ayant trait à l'adoption de cette recommandation. Cette étude a donc été effectuée afin de déterminer l'utilisation de suppléments de vitamine D des Britannico-colombiens de 50 ans et plus, et d'étudier les relations existant entre la prise de suppléments de vitamine D, les variables socio-démographiques ainsi que les connaissances, attitudes et croyances concernant la supplémentation en vitamines.

Méthodes : Un échantillon stratifié représentatif de la population et recruté au moyen d'appels téléphoniques aléatoires a répondu à une enquête par téléphone à la fin de l'automne 2008. Les répondants ont détaillé l'utilisation de suppléments dans le mois écoulé (dose, fréquence, etc.) en plus de fournir des données démographiques et de répondre à des énoncés reflétant leurs croyances en santé sur les suppléments, à partir desquels un indice de croyances en santé sur les suppléments a été calculé. Les répondants non admissibles ont indiqué leur âge, sexe, et s'ils avaient utilisé un supplément dans le mois écoulé.

Résultats : En proportion identique, les participants (n=969) et non-répondants (n=1 027) ont rapporté l'utilisation de divers suppléments dans le mois écoulé. Des participants, 60 % ont utilisé un supplément de vitamine D (l'apport médian parmi les utilisateurs de suppléments était

de 10 µg/j) et 3 % ont dépassé l'Apport maximal tolérable de 50 µg/j. L'analyse multivariée a montré que la supplémentation en vitamine D était significativement liée aux caractéristiques suivantes : sexe féminin, non fumeur, niveau d'instruction supérieur, avoir un professionnel de la santé ayant conseillé la prise d'un supplément et un indice de croyances en santé sur les suppléments plus élevé.

Conclusion : Même si la plupart des adultes plus âgés prennent des suppléments de vitamine D, il est nécessaire de diffuser plus largement cette recommandation.

Mots clés : vitamine D; suppléments; personnes âgées; croyances en santé; Colombie Britannique; enquête

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