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ORIGINAL ARTICLE

Dietary supplement use in the spinal cord injury population

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Study design: Longitudinal, non-experimental.
Objectives: To determine the following: (1) prevalence of supplement use in a representative sample of the chronic spinal cord injury (SCI) population; (2) most frequently consumed supplements; and (3) characteristics of consistent supplement users.
Setting: Ontario, Canada.
Methods: A structured questionnaire was used to collect demographic information from 77 community-dwelling adults with chronic SCI (50.6% paraplegia, 81.8% male, 42.4 ± 11.9 years, body mass index (BMI) 25.4 ± 5.1 kg m^{-2}). A standardized form was used to record dietary intake, including supplements, in the previous 24 h, at three time points (baseline, 6 months and 18 months). Logistic regression and multivariate logistic regression were used to determine which characteristic(s) was (were) associated with consistent supplement use.
Results: Seventy-one percent of the sample reported using supplements at least once, with 50.6% being classified as consistent supplement users (at least twice across the three time points). The top three supplements consumed were multivitamins (25%), calcium (20%) and vitamin D (16%). Supplement use status was not associated with gender, level of injury, age, education, physical activity, BMI, smoking or alcohol intake.
Conclusions: Dietary supplement use was common in our sample of individuals with long-standing SCI, but no common characteristics distinguished users from non-users. We suggest that health practitioners be aware of the high dietary supplement use in this population so that they can probe for type, dose and frequency, as supplements may have an important influence on dietary assessment results.
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Keywords: supplements; lifestyle; health; spinal cord injury; SHAPE-SCI

Introduction

Spinal cord injury (SCI) affects more than 41 000 Canadians and approximately 1200 new injuries are incurred each year.[1] Given that 84% of injuries are sustained under the age of 34 years, individuals face many years of survival with potentially severe disability.[1] Individuals with SCI are susceptible to respiratory and cardiovascular diseases, the greatest chronic health threats to their survival,[2] and also from secondary impairments, such as urinary tract infections, pressure sores, musculoskeletal problems and depression.[3–6]

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Supplement use increases in individuals with at least one diagnosed chronic condition.[7] The 2003 Canadian Community Health Survey found that individuals with selected chronic conditions consumed significantly higher amounts of supplements than the estimates for both the general Canadian population (20%) as well as for people with no chronic conditions.[7] There is no current literature on supplement use in the SCI population. It is reasonable to believe that it may be high, due to decline in nutritional status and the high prevalence of chronic health conditions and secondary impairments that occur post injury.[8]

The majority of Canadians feel that supplements maintain or promote health or treat illness.[9] Seventy-one percent of Canadians have used a natural health product,[9] and between 12 and 27% use natural health products on a daily basis.[7,9,10] The top reported natural health products used by Canadians are vitamins and minerals at 57%.[9] About 20% of Canadians

report taking a single vitamin or mineral supplement and 40% of Canadians take a multivitamin supplement.[11] Consistent supplement users have similar characteristics. They tend to be female, live in Western Canada, have a higher level of education and household income, and are between the ages of 18 and 64 years.[7,9]

Information on supplement use in populations with chronic conditions (in this case the SCI population) would be valuable to clinicians because these individuals consume supplements more than the general population, and may be more likely to suffer from adverse effects.[12] Individuals with chronic conditions are often on a variety of prescription drugs. Supplements may interact with prescription and over-the-counter drugs, thereby reducing their effectiveness or causing unwanted side effects.[12] Knowing that dietary supplement use increases in individuals with at least one diagnosed chronic condition, it should thus encourage clinicians to probe SCI patients about supplement type, dose and frequency. In this way, clinicians will have a complete picture of what each patient is prescribed, as well as what supplements they choose to use.

Our objectives were to determine (1) the prevalence of supplement use in a representative sample of the adult chronic SCI population; (2) the most frequently consumed supplements; and (3) the characteristics of consistent supplement users.

Materials and methods

Participants

Participants were enrolled in the Study of Health and Activity in People with Spinal Cord Injury (SHAPE-SCI), a multicentre study of health and activity in over 695 community-dwelling adults living with SCI, for which complete study methods have been published.[13] The participants, men and women, were residents of Ontario, Canada, $\geqslant$18 years of age, $\geqslant$1-year post-traumatic SCI and used assistance (braces, cane, walker and wheelchair) for their primary mode of mobility. The data reported herein were drawn from a subset of Study of Health and Activity in People with Spinal Cord Injury participants living within a 200 km radius of McMaster University.

The study was approved by Research Ethics Boards at McMaster University and the University of Guelph. Each participant provided written, informed consent before participation. A nominal honorarium was given to sub-study participants.

Methods

Data were collected at baseline (T1), 6 months (T2) and 18 months (T3) by trained research assistants within the participants' homes. A structured questionnaire was used to collect demographic information, including sex, age, ethnicity, location and completeness of injury, and brief personal and family health histories. Participants were asked whether they smoked and/or consumed alcohol; if yes, amount and frequency were recorded. The research assistants then used a standardized 24-h recall form to record participants' dietary intake and supplement use in the previous 24 h. An intentionally open-ended questionnaire was used to capture all forms of dietary supplements. Participants were asked whether or not they consumed supplements; if yes, types were requested and recorded. These included vitamins, minerals and other substances consumed orally, the purpose of which must have been identified by the participant to supplement his/her diet. For a subset of the sample ($n=20$) at T2 and T3, if participants identified having consumed supplements in this time frame, they were further probed regarding: the type of supplement(s), brand name(s), amount(s), the reason for consuming the supplement(s) and the duration of supplement use.

Anthropometric data were also collected from participants. Participants were weighed to the nearest 0.1 kg wearing light clothing, without shoes using a portable, digital wheelchair scale (Health O Meter 2450KL, Brooklyn, NY, USA). Weight was calculated by subtracting the weight of the wheelchair from the weight of the participant sitting on the wheelchair. Length was measured while the participant was lying supine on a spine board (National Lifesaving Society item EQ-10, Edmonton, Alberta, Canada), with feet in dorsal flexion, trunk straight and head in Frankfurt plane. Length was determined with a non-elastic tape measure from the bottom of the right heel to the crown of the head for participants without contractures, and in segments from heel to knee, knee to hip and hip to crown for those with lower extremity contractures. Each measurement was taken twice; if measures differed by $>5\%$, a third measurement was taken and the two closest measures were averaged. Finally, leisure-time physical activity (LTPA) information was gathered over the telephone using the Physical Activity Recall Assessment for People with SCI.[14] Leisure-time physical activity was defined as the activity participants do voluntarily during their free time, expressed in min d^{-1}, averaged over 3 days.

Data analysis

Statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS version 15.0, Chicago, IL, USA). A *P*-value $\leqslant 0.05$ indicated statistical significance. A logistic regression model determined[15] whether there was a significant association between supplement level (users vs non-users) and age group (20–39, 40–59 vs 60–79 years of age), gender, level of injury (paraplegia vs tetraplegia), education (finished high school, at least some college or university vs at least some postgraduate), physical activity ($\geqslant 25$ min day^{-1} vs <25 min day^{-1}),[16] body mass index (BMI) ($\leqslant 22.0$ vs >22.0),[17] smoking (smoker ($\geqslant$1 cigarettes per day) vs non-smoker (0 cigarettes per day)) and alcohol consumption (consumer ($\geqslant$1 alcoholic beverage per week)) vs non-consumer (<1 alcoholic beverage per week)).

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

Results

Participant demographic and lifestyle characteristics are presented in Table 1. Some of these results have been

Table 1 Background characteristics of participants ($n=77$)

	Mean ± s.d.	*Range*
Age (years)	42.5 ± 11.9	21–79
BMI (kg m^{-2})	25.4 ± 5.1	15.1–40.9
Physical activity (minutes per day)	30.2 ± 45.2	0.0–260.0
	Frequency	*Percent*
Gender		
Male	63	81.8
Female	14	18.2
Level of injury		
Paraplegic	38	50.6
Tetraplegic	39	49.4
Education		
Finished high school	27	35.1
At least some college or university	39	50.6
At least some postgraduate	7	9.1
Smoking[a]		
Yes	26	33.8
No	51	66.2
Alcohol intake[b]		
Yes	46	59.7
No	31	40.3

[a]Smoking = Yes (smokes one or more cigarettes per day). Smoking = No (no cigarettes per day).
[b]Alcohol Consumer = Yes (drinks one or more alcoholic beverages per week); Alcohol Consumer = No (less than one alcoholic beverage per week)).

previously published.[18] The average age was 42.5 ± 11 years, average minutes of physical activity per day was 30.2 ± 45.2 and average BMI was 25.4 ± 5.1 kg m^{-2}. Fifty-one percent of total participants had paraplegia and 49.4% had tetraplegia ($P>0.05$). Most participants were male (81.8%), had at least some college or university education (50.6%), did not smoke (66.2%) and were consumers of alcohol (59.7%).

Seventy one percent of total participants reported using supplements at least once during the study period, with 50.6% of the sample classified as consistent supplement users (took supplements at least two of three time periods). Participants reported taking 57 different supplements and consumed anywhere from 0 to 10 supplements per day, with most (83–90%) reporting 0–3 supplements per day. The top three supplements taken by participants over the three time periods were multivitamins (25%), calcium (20%) and vitamin D (16%) (Figure 1). Other supplements commonly used included vitamin C, vitamin E, cranberry and omega-3 fatty acid. Participants' rationales for taking multivitamins were to supplement what they perceived as their poor diet; to provide energy; and to improve their general health. The reason for taking calcium was bone health and reasons for vitamin D were to make up for low exposure to sunlight, for bone health and for assisting calcium absorption. Preventing urinary tract infections was participants' primary reason for taking cranberry, and improving immune health and healing pressure sores in their legs were the primary reasons for taking vitamin C. Two participants reported that they did not know why they were taking supplements.

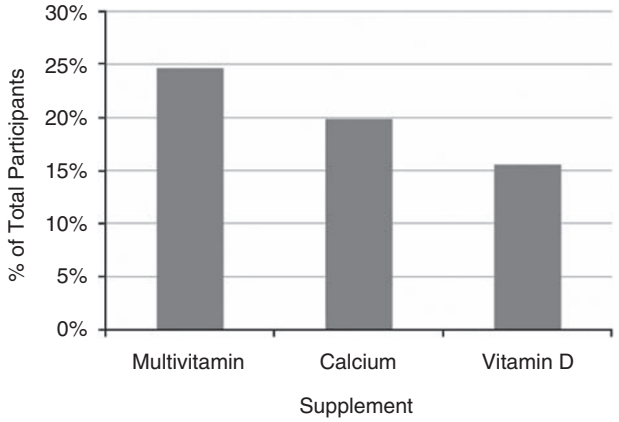

Figure 1 Top three supplements reported being taken by participants over the three time periods.

Table 2 shows supplement use across the three time periods for the whole group, and by gender and level of injury. Around 54, 54.3 and 63.5% of the study sample reported taking supplements at each of T1, T2 and T3, respectively. Supplement use in men increased slightly ($P>0.05$) from T1 (52.3%) to T2 (54.2%), however there was a large increase from T2 to T3 (64.9%). About 47, 52.8 and 70% of participants with paraplegia reported taking supplements at T1, T2 and T3, respectively. Supplement use in women and participants with tetraplegia stayed relatively constant over the three time periods.

Table 3 describes the characteristics of supplement users vs non-users. Gender, level of injury, age, education, physical activity, BMI, smoking and alcohol intake were not associated with supplement level (use vs non-use) ($P>0.05$).

Discussion

This is the first investigation of the frequency of supplement use, and characteristics of supplement users, in a representative sample of community-dwelling people with chronic SCI. The most important findings are that: (1) 71.4% of participants reported using supplements at least once during the study period, with 50.6% of the sample being classified as consistent supplement users; (2) the top three supplements consumed were multivitamins, calcium and vitamin D; and (3) gender, level of injury, age, education, physical activity, BMI, smoking and alcohol intake were not significantly associated with supplement level (use vs non-use).

We found that 71.4% of total participants reported using supplements at least once during the study period, remarkably consistent with 71% of Canadians.[9] Although the frequency of people taking supplements at least once appeared to be consistent in both populations, in comparison with the able-bodied population (27%),[9] the SCI population had a higher number of consistent users (50.6%). This difference was not surprising, given that individuals with long-standing SCI are susceptible to chronic diseases and secondary impairments, and that dietary supplement use increases in individuals with at least one diagnosed chronic condition.[7]

Table 2 Frequency of supplement usage across each time period

Characteristic	*Supplement user*[a] *(Frequency (%))*			*Supplement non-user (Frequency (%))*		
	Time period			*Time period*		
	1 (0 months)	*2 (6 months)*	*3 (18 months)*	*1 (0 months)*	*2 (6 months)*	*3 (18 months)*
Male	33 (52.3)	32 (54.2)	35 (64.9)	26 (41.9)	25 (42.4)	18 (33.3)
Female	8 (57.1)	6 (54.5)	5 (55.6)	6 (42.9)	4 (36.4)	3 (33.3)
Tetraplegic	23 (60.5)	19 (55.9)	19 (57.6)	13 (34.2)	13 (38.2)	12 (36.4)
Paraplegic	18 (47.4)	19 (52.8)	21 (70.0)	19 (50.0)	16 (44.4)	9 (30.0)
Total	41 (53.9)	38 (54.3)	40 (63.5)	32 (42.1)	29 (41.4)	21 (33.3)

[a]Defined as taking supplements at least two of three time periods.

Table 3 Characteristics of supplement users vs non-users

Characteristic	n	*Supplement user*[a] *(Frequency (%))*	*Supplement non-user (Frequency (%))*
Total Participants	77	39 (50.6)	38 (49.4)
Gender			
Male	63	32 (50.8)	31 (49.2)
Female	14	7 (50.0)	7 (50.0)
Level of injury			
Tetraplegic	39	19 (48.7)	20 (51.3)
Paraplegic	38	20 (52.6)	18 (47.4)
Age			
20–39	33	13 (39.4)	20 (60.6)
40–59	37	21 (56.8)	16 (43.2)
60–79	7	5 (71.4)	2 (28.6)
Education			
Finished high school	27	11 (40.7)	16 (59.3)
At least some college or university	39	22 (56.4)	17 (43.6)
At least some postgraduate	7	5 (71.4)	2 (28.6)
Other	3	1 (33.3)	2 (66.7)
Physical activity			
>25 min day^{-1}	28	15 (53.6)	13 (46.4)
<25 min day^{-1}	47	23 (48.9)	24 (51.1)
BMI			
$\leqslant 22.0$	18	9 (50.0)	9 (50.0)
>22.0	56	30 (53.6)	26 (46.4)
Smoking			
Yes	26	11 (42.3)	15 (57.7)
No	51	28 (54.9)	23 (45.1)
Alcohol intake			
Yes	46	23 (50.0)	23 (50.0)
No	31	16 (51.6)	15 (48.4)

Abbreviation: BMI, body mass index.
[a]Defined as taking supplements at least two of three time periods.

The top three supplements consumed by participants in our study were, in descending order of frequency, multivitamins, calcium and vitamin D. This was consistent with our expectations in this population as it is generally thought that vitamin deficiency is an important issue.[8] Traumatic SCI tends to occur in young, previously well-nourished individuals and decline in nutritional status are likely to occur post injury.[8] Multivitamins are often consumed to improve the overall health and can help reverse the decline in nutritional status. Increased bone fragility and fracture risk commonly follow SCI, eventually leading to osteoporosis.[6,19] Supplementing the diet with calcium and vitamin D may have a role in bone health, contributing to prevention or inhibiting further development of osteoporosis. Participants who were further probed regarding their reason for taking supplement(s) understood why they were consuming particular supplements, that is, multivitamins supplement a poor diet and calcium and vitamin D improve bone health. Participants also had a correct rationale for consuming cranberry (to prevent urinary tract infections), as well as vitamin C (to improve immune health).

Gender, level of injury, age, education, physical activity, BMI, smoking and alcohol intake were not significantly associated with supplement level (use vs non-use). These findings are inconsistent with those published in the able-bodied population. Health Canada's Baseline Natural Health Products Survey[9] and the Canadian Community Health Survey[7] both reported that consistent supplement users tend to be women, between the ages of 18 and 64 years, residents of Western Canada and to have higher levels of education and household income.[7,9] There are no comparable data in the in the SCI population. Our inability to detect consistent characteristics of supplement users is perhaps, in retrospect, not surprising given that the SCI population is more homogeneous than the able-bodied population. For example, our participants were predominantly male (80%), with lower levels of physical activity and higher BMIs. Worthy of note is the fact that SCI is often traumatic and frequently occurs under the age of 34 years. Individuals may therefore have increased difficulty completing/furthering their education and working outside the home, making comparisons based on socioeconomic status difficult.

Strengths and limitations

Our study addresses many gaps in the literature, and therefore extends the current knowledge of supplement use in the SCI population. First, our study was the first to investigate the frequency and type of supplement use longitudinally, in a larger sample size than that typically seen in the SCI literature. Second, our study mirrored the larger SCI population with respect to gender and level of

injury. According to the Canadian Paraplegic Association, individuals with SCI are 80% male and 50% paraplegic.[20] In our study 81.8% were male and 50.6% of individuals had paraplegia; our findings are therefore generalizable to the larger SCI population. Lastly, we included an intentionally non-specific questionnaire to capture all forms of dietary supplements to generate future hypotheses. Studies in other populations investigating the use of natural health products categorize dietary supplements as vitamins and minerals or list a few commonly consumed supplements.[9,11] In an effort to be more open-ended, we sought to capture a 'complete' picture of supplement consumption. In this way, we discovered that our participants used 57 different supplements; some even offered a rationale for supplement use. However, our open-ended questionnaire was not designed to identify brand name(s) or dose(s) of supplements consumed, nor did we conduct pill counts or assess serum levels to confirm the subject's self reported adherence, or determine possible seasonal variation in supplement use. Also, our sample size may not have been large or varied enough to accurately investigate the characteristics of consistent supplement users.

Conclusions and next steps

Supplement use was common in our sample of individuals with long-standing SCI, with multivitamins, calcium and vitamin D being the most frequently used supplements. Despite the high consumption of supplements there were no common characteristics distinguishing consistent supplement users from non-users. Our results can be used to generate hypotheses for future research. Investigations should include characteristics of supplement users in a larger and more varied sample size, with special attention paid to the type of supplement(s) consumed, brand name(s), amount(s), the reason for taking the supplement(s) and the duration of supplement use. Nonetheless, our results suggest that health practitioners need to be aware of the high prevalence of dietary supplement use in this population. Practitioners should probe for type, dose and frequency as supplements may have an important effect on dietary assessment results. Furthermore, supplements may interact with prescription and over-the-counter medications, common in this population, possibly reducing their effectiveness or causing undesirable side effects.

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