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BRIEF COMMUNICATION

Vitamin and mineral supplement use in medically complex, community-living, older adults

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Abstract: Individuals who take medications may benefit from using vitamin and/or mineral supplements (VMS) yet excess supplementation can lead to overuse (daily intake exceeding the tolerable upper intake level (UL)). This study assessed VMS use of medically complex, community-living, older adults. A chart review of 229 patients ≥50 years with new medication assessments between 2014 and 2017 indicated that 76.9% of patients used ≥1 VMS daily. The UL for one or more nutrients was exceeded by 39.8% of supplement users.

Key words: older adult, supplement, vitamin, mineral, dietary supplement, Upper-Level.

Résumé : Les personnes qui prennent des médicaments peuvent tirer profit de l'utilisation de suppléments de vitamines ou de minéraux (« VMS »), mais une surapprovisionnement peut entraîner une surconsommation (apport journalier dépassant le niveau tolérable d'apport maximal (« UL »). Cette étude évalue l'utilisation de VMS chez des personnes âgées recevant une médication complexe et vivant dans la communauté. Un examen des dossiers de 229 patients âgés de 50 ans et plus et dont la médication a été réévaluée entre 2014 et 2017 révèle que 76,9 % d'entre eux utilisent au moins 1 VMS par jour. L'UL concernant au moins 1 nutriment est dépassé chez 39,8% des consommateurs de suppléments. [Traduit par la Rédaction]

Mots-clés : personne âgée, supplément, vitamine, minéraux, supplément alimentaire, niveau supérieur.

Introduction

Consumers in Canada and the United States have seen an increase in the variety of dietary supplements and have increased their use of supplements (Health Canada 2011; Qato et al. 2016). Individuals who take multiple medications and/or are at risk of undernutrition may benefit from using vitamin and/or mineral supplements (VMS), yet excessive nutrient supplementation can cause intake beyond the Tolerable Upper Intake Level (UL), increasing risk for adverse effects (Goorang et al. 2015*a*, 2015*b*; Vatanparast et al. 2009, 2010; Viveky et al. 2012). The UL is a reference amount whereby no adverse effects should be observed. The risk of adverse effects increases as intake surpasses the UL (Otten et al. 2006). Assessing VMS use should be part of nutrition (Ford and Whiting 2018) and medication assessments (Jorgenson et al. 2016).

A review on supplement use in Canada and the United States found that data were lacking on the frequency and quantity of supplement use (Ford and Whiting 2018). Even less is known about supplement use in compromised people who may be at higher risk for inappropriate supplement use. A chart review showed an average age of 64.8 years and an average medication use of 13.8 drugs (including supplements and nonprescription products); however, the review reported little information on VMS (Jorgenson et al. 2016).

The purpose of this study was to assess the personal VMS use of community-living older adults with complex medication use to investigate use, non-use, and characteristics of supplement users. The objectives were to identify use and possible overuse of VMS.

Materials and methods

Participants were included if they were ≥50 years of age and taking ≥1 medication or dietary supplement. VMS were defined as any oral vitamin/mineral-containing supplement. Patients brought all medications, over-the-counter products (OTCs), and supplement bottles to their first appointment. Pill count was defined as the total number of different products (i.e., prescription medications, dietary supplements, and OTCs). Patients were deemed to "overuse" a supplement if their intake was ≥UL. Dietary intake was not assessed, thus we categorized patients who consumed supplemental nutrients at the UL as overusers because intake from food would push total intake >UL, where applicable.

A chart review of patients (age ≥ 50 years) who attended the Medication Assessment Centre (MAC) at the University of Saskatchewan between January 2014 and January 19th, 2017, was completed. The MAC accepts patients of all ages through self-referral or referral by a health-care professional and offers in-depth medication assessments at no cost to the patient. Patient data included sex, age, health conditions, product name, reported dosage and frequency of prescription medications, dietary supplements, and OTC products. Extracted data were reviewed on 3 separate occasions by the researcher to ensure extraction accuracy and to increase intra-rater reliability. Standard formulations from the national brands Centrum (Pfizer Canada, Mississauga,

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Table 1. Summary of demographics and product usage (N = 229).

	Minimum	Maximum	Mean (SD)	Median (IQR)
Age, y	50.0	93.0	68.9 (11.1)	69.0 (17.0)
Reported health conditions	1.0	16.0	4.8 (2.2)	5.0 (3.0)
Prescription drugs + OTCs	0.0	18.0	6.5 (3.5)	6.0 (5.0)
VMS	0.0	19.0	2.4 (2.5)	2.0 (3.0)
NVMS	0.0	23.0	0.9 (2.0)	0.0 (1.0)
Total product count	1.0	45.0	9.8 (5.2)	9.0 (6.0)

Note: IQR, interquartile range; NVMS, non-vitamin/mineral supplement; OTC, over-the-counter product; VMS, vitamin/mineral supplement.

Ont., Canada) and Jamieson (Toronto, Ont., Canada) were used when specific brand names were not available. The total intake of each nutrient was summed and compared with the respective UL (Otten et al. 2006; Ross et al. 2011).

This study was approved by the University of Saskatchewan Biomedical Research Ethics Board (Bio 16-169). Descriptive statistical analysis was performed using IBM SPSS Statistics software (version 24; IBM Corp., Armonk, N.Y., USA). The χ^2 test was used to test for association between variables.

Results

Of the 286 charts reviewed, 80.1% (n = 229) charts met the inclusion criteria. The average age of subjects was 68.9 years and females represented 57.2% of the sample. Prescription and OTC medication use ranged up to 18 per person, with an average intake of 6.5 per person. VMS use ranged from no use (0) to 19 products, with a mean intake of 2.4 per person. The use of non-vitamin/mineral supplement (NVMS) products (ex. melatonin) was less, with a mean usage of 0.9 per person, but the range was wider, with 1 subject reporting use of 23 NVMS. Prescription medications, OTCs, VMS, and NVMS were summed to give a total product count, which ranged from 1–45, with an average intake of 9.8 per person.

A total of 76.9% (n = 176) of patients reported using ≥1 VMS (Table 1). Vitamin D was most frequently consumed (78.4%) by supplement users, followed by 54.0% reporting use of a combination multi-vitamin/mineral (MVM) product and 29.0% reporting vitamin C use. VMS use was not statistically significant for age by decades (p = 0.234) and sex (p = 0.829) with 77.5% (n = 76/98) of males and 76.3% of females (n = 100/131) reporting use. Differences in VMS use and the number of self-reported health conditions were not statistically significant (p = 0.058). The percentage of supplement users increased for patients who reported 7 or more health conditions (87.2%), when compared with those who reported 6 or less health conditions (74.2%). Reported use of VMS was not statistically significant for prescription and OTC medication use (p = 0.17), but the percentage of patients using VMS was greater in those who took 8 or more prescription and OTC medications (81.9%) compared with those who took 7 or less (73.9%).

Daily use of adequate supplemental vitamin D (≥400 IU) was reported by 64.6% (n = 148) of subjects, with fewer (56.8%) subjects between the ages of 50 and 69 years using an adequate dose compared with persons over 70 years of age (72.9%). Daily use of adequate supplemental vitamin D (≥400 IU) was associated with age (p = 0.01) when comparing patients aged 50–69 years with those 70+ years of age. Use by females (67.9%) was greater than for males (60.2%) but noted differences in use between sex was not statistically significant (p = 0.226). For VMS users, 39.8% met or exceeded the UL for at least 1 nutrient from supplements alone. As some patients consumed more than 1 nutrient at or above the UL (Table 2), the total number of occurrences of excessive nutrient intake with supplements (n = 117) was more than the number of people who consumed nutrients at or above the UL (n = 70). The average VMS intake of reported supplement users who consumed nutrients at or above the UL is compared with the UL for each nutrient in Table 2. Nutrients with intakes ≥UL were niacin, magnesium, iron, vitamin, zinc, vitamin B_6, folate, vitamin C, calcium, and manganese. Close to half (n = 76) of the 176 supplement users (43.2%) reported taking one or more nutrients from multiple sources, averaging 3.1 nutrients (median 2.0). Of these 76 subjects, 53.9% took nutrient(s) in amounts ≥UL. Nutrient intake from multiple supplemental sources was significantly associated (p < 0.001) with intake of supplemental nutrients in amounts ≥UL. Most (86.8%) reported taking supplemental vitamin D from multiple sources.

Table 2. Prevalence of intakes at or over the UL of supplemental nutrients by reported supplement users (N = 176).

Nutrient	≥UL,* n (%)	UL,† mg/d	Average intake at or over UL, mg/d (median)	Intake from multiple sources, n (% of overusers)
Niacin‡	26 (14.7)	35	155 (100)	14 (18.4)
Magnesium‡	22 (12.5)	350	586 (500)	23 (30.3)
Iron	14 (7.9)	45	135 (103)	9 (11.8)
Vitamin D	13 (7.4)	4000 IU/d	5223 IU/d (4400)	66 (86.8)
Zinc	12 (6.8)	40	60 (54.5)	13 (17.1)
Vitamin B_6	11 (6.2)	100	139 (100)	14 (18.4)
Folate‡	9 (5.1)	1	2.5 (1.9)	10 (13.2)
Vitamin C	7 (3.9)	2000	3070 (3000)	27 (35.5)
Calcium	2 (1.1)	2000	2100 (2100)	31 (40.8)
Manganese	1 (0.6)	11	30 (30)	3 (3.9)

Note: UL, upper intake level.
*Considered overuse.
†Otten et al. 2006; Ross et al. 2011.
‡UL only applies to synthetic form.

Discussion

This study is the first to investigate quantity and frequency of supplement use in medically complex, community-dwelling, older adults. We found no significant difference in VMS use by age or sex. A Canadian study of supplement use in community-dwelling individuals found that VMS use was closely related to age and was significantly higher in females than males (Vatanparast et al. 2010). In our study population, men and women shared the commonality of having complex medication concerns (Jorgenson et al. 2016).

Vitamin D was the most used supplement in this study, followed by an MVM product and vitamin C. Nationally representative Canadian data revealed vitamin D as the most common supplement used in women >50 years, but for men of the same age, it was vitamin C (Shakur et al. 2012).

Health Canada recommends that all adults over the age of 50 years take a daily 400 IU supplement of vitamin D to ensure adequacy (Health Canada 2012). Osteoporosis Canada recommends 800–2000 IU/day of supplemental vitamin D for older adults (Hanley et al. 2010). We found it concerning that 64.6% of patients follow this recommendation as this patient population is considered to be medically complex and the Endocrine Society recommends persons with a clinical condition take additional vitamin D (Holick et al. 2011).

Overall, 70 participants (30.6% of participants or 39.8% of supplement users) reported an intake ≥UL for at least 1 nutrient.

Canadian adults did not exceed the UL from food alone for any nutrient but when supplements were considered; over 10% of some age and sex groups exceeded the UL for several nutrients (Shakur et al. 2012). Reporting uptake of nutrients from more than 1 supplement was significantly associated with supplemental nutrient intake ≥UL ($p < 0.001$). Consuming supplemental nutrients from more than 1 source raises concerns as it is more likely to exceed the UL, as found in the current study and elsewhere (Viveky et al. 2012). Data from 3469 American adults aged ≥60 years showed that 69% reported taking more than 1 dietary supplement daily (Gahche et al. 2017), which is more than the 43.2% found in this study. To mitigate the risks of supplement consumption in conjunction with medication use, dietary intake should be taken into consideration when completing medication assessments for complex patients.

This study found that 14.7% of supplement users reported intake of supplemental niacin that exceeded the UL, with average intake 155 mg/day, compared with the UL of 35 mg/day. A study by Shakur et al. (2012) found that 50% of adult supplement users (aged >50 years) had a niacin intake above the UL. The UL for niacin only applies to synthetic forms and is based on flushing (Otten et al. 2006). Patients in this study may have been at greater risk for adverse effects from intakes > UL, secondary to their medical complexity (Otten et al. 2006).

Only pharmacological agents contribute to the UL for magnesium of 350 mg/day, which was set based on diarrhea, but only in the absence of food (Otten, et al. 2006). In the current study, 23 patients consumed magnesium supplements ≥UL but timing of food intake was not available. Excess magnesium can cause metabolic alkalosis, hypokalemia, or a paralytic ileus (Otten et al. 2006). Older adults are more likely to experience decreased magnesium absorption and increased urinary magnesium excretion; however, individuals with impaired renal function are at a greater risk of experiencing magnesium toxicity from pharmacological sources (Otten et al. 2006).

Iron supplements were the next most common product to be taken in doses ≥UL. The UL for iron is based on gastrointestinal distress, but some conditions such as hemochromatosis, chronic alcoholism, or other liver disorders may not be protected by this UL (Otten et al. 2006).

Supplemental vitamin D intake was ≥UL in 13 patients. The UL for vitamin D is based on risk of hypercalcemia, an indicator of vitamin D intoxication (Ross et al. 2011). Calcium supplement use was common (21% of supplement users), but was only potentially excessive in 2 female patients in the study; however, dietary intakes can contribute to intake. Of female supplement users over 50 years of age in Canada, 15% exceeded the UL for calcium from a combined intake of diet and supplements (Shakur et al. 2012). The UL for calcium is based on several adverse effects, with kidney stone formation being the key marker for older adults (Ross et al. 2011). People with multiple morbidities should be aware that renal failure or the use of thiazide diuretics put them at an increased risk of experiencing adverse effects from calcium (Otten et al. 2006).

Other nutrients that were overused include zinc (5.2%), folate (5.2%), vitamin B_6 (4.8%), and vitamin C (3%). The UL for folate applied to synthetic forms obtained from supplements, fortified foods, or a combination (Otten et al. 2006), suggesting that overuse by 5.2% of the supplement users is an underestimation because dietary intake data was lacking. Excessive folate intake can mask a vitamin B_{12} deficiency, which if left untreated can cause neurological damage (Otten et al. 2006). Recent literature suggests that this UL is less meaningful because of the use of serum biomarkers but noted that certain populations including vegetarians and chronic proton-pump inhibitor users remain at increased risk of vitamin B_{12} deficiency (Field and Stover 2018). Chronic intake of excess zinc can cause gastrointestinal distress, headaches, and impaired immune function (Otten et al. 2006).

Concomitant use of medications and VMS was common, with many users consuming supplements in excess of the UL. The development of practice support tools would aid in identifying the riskiest and most common medication–supplement combinations and potentially unsafe overuse of VMS. This study highlights the need for improved interdisciplinary collaboration between dietitians and pharmacists since VMS use was so common in these medically complex patients.

Limitations

The inherit limitations of a retrospective chart review include relying on self-reported data including adherence. Many supplements were recorded in the chart without a brand name, thus necessitating use of standard formulations to analyze data. Generalizability of this study is limited to medically complex, community-living, older adults and it is possible that self-referrals may bias the sample, although the authors do not feel this is the case as the majority of patients were referred from health-care providers. Dietary data were not available; thus the study investigated nutrient intake from supplements.

Conclusion

This study reports high rates of VMS usage in older, community dwelling, medically complex patients, indicating the importance of an interdisciplinary team approach to complex medication assessments. While some use of VMS may be justified (i.e., vitamin D), intakes of nutrients ≥UL revealed that risk of excessive intake was possible. Specialized knowledge in dietary intake and the role of supplements in achieving recommended intakes should be integrated into patient care.

Conflict of interest statement

The authors have no conflicts of interest to report.

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