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Analysis of Oral Dietary Supplement Use in Rural Older Adults

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Abstract

Aims and objectives—The purpose of this analysis is to describe and explore characteristics associated with oral dietary supplement use and identify potential interactions with prescription medications in a sample of rural community-dwelling older adults.

Background: Older adults use polypharmacy to help manage chronic diseases. Due to health care access disparities rural older adults may consider dietary supplement use as an alternative approach to maintain health and manage disease. Oral dietary supplement use is expected to increase among aging adults; placing them at risk for potential interactions and adverse events.

Design—A secondary analysis was conducted on oral dietary supplement, medication, and health characteristic data collected on N=138 participants. The original study was adherent to STROBE guidelines.

Results—Researchers found that 83% of the rural older adults used oral dietary supplements in addition to their prescribed medications. Participants took additional single-dose vitamins along with their multivitamin; 57% took Vitamin D, 52% took calcium, 15% took Vitamin C, and 13% took additional Potassium and Vitamin E. Participants also used oral dietary supplements with medications that had a potential for interaction.

Conclusions—Compared with national samples of older adults, a high percentage of rural older adults used oral dietary supplements in addition to their prescribed medications. In the rural setting, older adults are at risk for potential drug-oral dietary supplement interactions.

Relevance to Clinical Practice—Nurses can conduct vigilant medication reconciliation that includes documenting characteristics of oral dietary supplement use. Nurses can assist with providing appropriate dietary supplements education that promotes patient knowledge and prevent inappropriate use; particularly when caring for older adults from rural settings.

Introduction

According to the Council for Responsible Nutrition, more than 170 million Americans take oral dietary supplements (ODSs); that number is expected to increase in the geriatric population (Gahche, Bailey, Potischman, & Dwyer, 2017). An ODS is a product that contains one or more dietary ingredients taken by mouth with the intent to supplement an individual's regular diet. Examples of ODSs include vitamins, minerals, and herbal preparations (National Institutes of Health Office of Dietary Supplements, 2011). Almost 70% of those 60 years and older use at least one dietary supplement along with routine medications, the most common being multivitamins and mineral supplements (39%), vitamin D (26%), omega-3 fatty acids (22%), B vitamins and B-complex (16%) (Gahche et al., 2017; Nahin et al., 2009). Unlike those living in urban settings, older adults living in rural areas encounter more chronic disease and health care access disparities that may promote divergent characteristics of ODS use; placing them at increased risk for negative outcomes associated with drug-ODS interactions (Bolin et al., 2015).

Background

According to the National Academy of Sciences, older adults may be encouraged to take calcium, vitamin D, and B-vitamins for several functions such as improved bone health, cell metabolism and nervous system function (Bruyère et al., 2014; US Department of Health and Human Services, 2015). Older adults are more likely to suffer from chronic diseases that increase nutrient needs and may have difficulty consuming adequate amounts of nutrients in food (McCormick, 2012). Older individuals may experience dysphagia and altered taste perception. The subsequent decreased food intake and gut absorption specifically place older adults at risk for vitamin deficiencies such as vitamin D and B12 (Boucher, 2012; McCormick, 2012). ODSs are available over-the-counter (OTC) and may help meet nutrient recommendations; however, use may not routinely be documented or monitored by health care providers (Owens, Toone, & Steed-Ivie, 2014).

Risks with Supplement Use

The use of ODSs is associated with risks, but many consumers believe that supplements are federally regulated, tested and pose no risk (Marinac et al., 2007). Older individuals are not routinely included in research testing ODS products. For example, researchers have not yet identified the optimal amount of vitamin D supplementation that minimizes cardiovascular or renal system effects in older adults (Hin et al., 2017). In clinical practice, supplement dose and toxicities are not routinely monitored in the geriatric population (Bailey, Gahche, Miller, Thomas, & Dwyer, 2013; Geller et al., 2015; Gurley, 2010). Also, health and nutrient assessments in older adults may not include calculations of total nutrients, including regular diet, fluids, and the use of supplements. Independent older consumers may not comprehend that the intake of vitamins and nutrients above the recommended upper limit may cause adverse events, such as cardiac or gastrointestinal problems (Geller et al., 2015; McCormick, 2012; Sebastian, Cleveland, Goldman, & Moshfegh, 2007). Most ODSs have chemical similarities to pharmaceutical drug preparations; however, the adverse events that may occur

from ODSs are only tracked postmarket and are dependent on consumer or health provider reports.

Patients seldom reveal the use of herbal dietary supplements to health care professionals; in conjunction, a lack of patient and provider knowledge about ODSs may impede communication and monitoring (de Souza Silva, José Edson et al., 2014). According to a study by Tarn and colleagues, only 24% of adults and providers engaged in ODS discussions; therefore, most individuals make decisions about the use of ODS independently (Tarn et al., 2015; Tarn et al., 2013). Older adults often use ODSs in conjunction with prescription medications, which poses a risk for interactions (Gahche et al., 2017; Nahin et al., 2009). Potential interactions may occur between ODS and medication classes such as anticoagulants, antiplatelet drugs, antidiabetics, and cholesterol-lowering agents (Peng, Glassman, Trilli, Hayes-Hunter, & Good, 2004; Qato, Wilder, Schumm, Gillet, & Alexander, 2016; Sood et al., 2008).

ODS Use in Rural Older Adults

Few studies have explored the characteristics of ODS use in rural older adults. The percentage of older adults in rural settings is slightly higher than in urban areas (Bolin et al., 2015). Compared with urban areas, several aspects of rural living may influence the use and risks associated with ODS use. Individuals living in rural areas face a shortage in health care providers, limited access to pharmacies, and lack geriatric specialists, which impacts health care access. As a result, older adults in rural areas may use complementary approaches with no clinical indication to maintain health and manage multiple chronic diseases. In 2000, Vitolins and colleagues explored ODS in rural community-dwelling older adults and found little association with the use of ODS and dietary deficiency with calcium, iron, zinc, folate, and vitamins A, C, E, and B6 from dietary recall. While exploring the dimensions of complementary therapy, Arcury et al. (2009) found that rural older adults regularly use botanical/herbal therapies at higher levels than conventional therapies. Three years later Arcury et al. (2012) found that 26% of 200 rural community-dwelling older adults experienced at least one adverse symptom, using an herb or supplement for treatment. Blalock and colleagues (2009) focused on botanical/herbal supplement use and potential interactions in rural community-dwelling middle-aged and older adults. Participants mostly used garlic, glucosamine, and omega 3 fish oil, and nearly 22% were using a combination of products associated with a potential interaction such as bleeding (Blalock et al., 2009).

In rural communities, the high use of ODS alongside prescription medications may be particularly problematic for older adults given disparities of higher disease burden and lower health care access for this group. There is a need for current research on older rural adults and their ODS use to better understand the potential for drug-ODS interactions and overall usage patterns. The purpose of this study is to describe ODS use, explore characteristics associated with ODS use, and identify potential interactions with prescription medications in a sample of rural community-dwelling older adults.

Methods

Design

This is a secondary analysis of a previously published cross-sectional study of rural community-dwelling older adults that explored the use of prescribed and OTC potentially inappropriate medications, and self-reported adverse drug events (Shade et al., 2017). In this analysis, we focused on ODS and medication use. We examined demographic, independent health variables, self-reported health status characteristics and the association with ODS use. The Institutional Review Board at the University of Nebraska Medical Center (732–14-EP) served as the ethical committee that reviewed and approved the study. The study conformed to recognized standards and adhered to the STROBE guidelines checklist as seen in Supplementary File 1.

Sample and Setting

Participants (N=138) were recruited from a clinic in the Midwest that serves four rural counties, according to Rural-Urban Commuting Area codes 7 through 10 in Nebraska (Cromartie & Bucholtz, 2008). Adult men and women that were 65 years of age or older, lived independently and used at least three prescribed medications to manage multiple chronic conditions were recruited for the study. Additional details regarding study design were previously published (Shade et al., 2017).

Data Collection on ODS

One-week after enrollment, participants were asked to bring all bottles of medications and ODS taken in the last month. One-hour in-person semi-structured interviews with medication review were performed in the clinic. Data collected from vitamins, minerals, and herbal preparation bottles, were combined to document individual ODS use. Participants were asked what herbal medicines do they take (e.g., herbal teas and herbal pills, amino acids, and nutritional supplements purchased over-the-counter or in a health food store) and what vitamins and minerals do they take. All data were recorded on an investigator-developed medication log (Sarzynski, Luz, Rios-Bedoya, & Zhou, 2014).

Measures

In addition to medication and ODS use, other data analyzed from the original study included participant demographics, individual health variables, and self-reported physical and mental health. Demographic data included age, gender, education, marital status, and income. Health variables included body mass index (BMI) and the number and type of medical diagnoses retrieved from the medical record. The Charlson Comorbidity Index was used to calculate comorbidity severity based on medical diagnoses recorded on the patient medical record (Charlson, Szatrowski, Peterson, & Gold, 1994).

Self-reported physical and mental health status was measured using the 12-Item Medical Outcomes Survey (MOS) Short Form (SF-12). The SF-12 is comprised of both physical component scores (PCS) and mental component scores (MCS) with a combined score ranging from 0 to 100. Higher scores indicate better self-reported health. The PCS of 43.4 and MCS of 55.2 have been reported as average scores among individuals 65 years of age

and older (Ware Jr, Kosinski, & Keller, 1996), and the Cronbach's alpha was 0.82 for this study.

Data Analysis

Each ODS was categorized and analyzed as a dichotomous variable, with ODS use = one and no ODS use = zero. Frequencies were calculated to describe the characteristics and distribution of demographic, health, self-reported health and ODS use data. To explore statistical relationships, a Pearson Chi square test was performed on dichotomous variables and nonparametric correlations to account for the data that was not normally distributed. Using a predetermined two-tailed alpha of 0.05, Spearman correlations were performed to examine relationships between ODS use and self-reported health status, and health variables (BMI and comorbidity severity). Statistical analysis was performed in version 25 of SPSS statistical software.

Results

Table 1 provides a representation of demographic and health variables of the sample. The mean age of the participants was 78 (SD 7.4) years, they were diagnosed with multiple chronic conditions, and the SF-12 scores were low, 38.7 (SD 9.9) for self-reported physical and 53.2 (SD 8.6) mental health. The average number of medications and supplements used was 11.6 (SD 4.8).

Of the participants in this sample, 83% used at least one ODS in conjunction with their prescribed medications. As Table 2 demonstrates, participants used more than one ODS; in fact, 29% used five or more. The most common ODS used by participants were vitamin D, multivitamins, and calcium. Other common supplements included omega 3 fish oil and glucosamine. Less than 1% of participants used supplements such as vitamin A, melatonin, black cohosh, garcinia, or garlic. Participants reported supplements were used to maintain health, manage joint or arthritis pain, prevent urinary tract infections and maintain the gastrointestinal flora. It was common for participants to take additional single ingredient vitamins along with multivitamins. Of those who took multivitamins; 57% took additional vitamin D, 52% took additional calcium, 15% took additional vitamin C, and 13% took additional potassium, and 13% of participants took additional vitamin E.

A significant association was found between gender and multivitamin use $\chi^2 (2, N=138) = 12.535, p < 0.001$. There was a strong difference in multivitamin use based on female gender, and there was a small negative association between the use of omega fish oil supplements and lower comorbidity severity score ($\rho = -.178, p = .038$). No statistically significant relationships were found between the ODS used and other demographic, health variables, or self-reported health characteristics. Table 3 lists potential interactions between ODS and medications and the frequency of combined use. More than half of participants took vitamin D along with cholesterol lowering agents. In addition, of participants using omega 3 fish oil, 65% also took 81mg of aspirin, and 12% used vitamin E.

Discussion

This study provides an assessment of overall ODS use in a sample of rural community-dwelling older adults with an average age of 78 years. The findings add to the knowledge in a population often neglected in research. This study documented a high percentage of this rural sample using ODS along with prescribed maintenance medications and taking additional single-doses of vitamins. Although older individuals supplemented with vitamins and minerals, such as calcium and vitamin D, there were instances of use that could potentially interact with daily medications, causing negative outcomes. This could be problematic for older rural adults with limited health care access.

Compared with published evidence on nationally representative samples of older adults, this sample of rural older adults used a higher percentage of ODSs along with their prescribed medications. The types of ODSs used by the older adults in this sample were consistent with national trends of those in older age groups (Gahche et al., 2017). As the rates of ODS use among older adults continues to rise nationally, this trend may be consistent and even higher in rural areas.

In contrast to the study by Blalock et al. (2009), this sample did not use high amounts of herbal/botanical ODS. Rural older adults did not report frequent use of herbals such as garlic; additionally, there was low use of popular herbals such as melatonin, turmeric, or other herbals such as kava kava with a potential for harm. These results may differ due to the mean age of middle age and older adults included in their study sample, whereas our study focused on primarily older adults.

The characteristics of ODS use could be related to barriers of living in rural areas. According to a previous study by Marshall, Stumbo, Warren, & Xie (2001), rural, community-dwelling older adults have inadequate intakes of several nutrients. The intake of these vitamins and nutrients should be encouraged mostly through diet, but the consumption of nutrient-rich foods may be challenging for those living in rural settings. Compared to 12.3% of U.S. households, 15% of rural households are unable to rely on having access to affordable and healthy food at all times at least sometime during the year (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2016). The higher prevalence of ODS use may be due to barriers such as limited access to healthy fresh food and Registered Dietitians.

It was not surprising to find that higher multivitamin use was associated with female gender, as this is consistent with studies that have reported ODS use among women (Gahche et al., 2017). According to Bailey et al. (2013), users of ODSs were more likely to report very good or excellent health. The results from this analysis did not reflect an association between self-reported good physical and mental health and ODS use. Overall, the older adults in this analysis reported low physical and mental health, yet the use of ODSs was high. The lack of association may be explained by the perceptions of ODSs and the belief that they help manage health or symptoms (Arcury et al., 2009; Arcury et al., 2012; Owens et al., 2014). An interesting finding was the relationship between omega 3 fish oil use and lower comorbidity severity. Comorbidity was calculated based on the diagnoses of multiple conditions and, in this analysis, it represented a characteristic of health in contrast to self-

reported health. The findings seemed to highlight a small relationship between health and the use of omega 3 fatty acids. Although studies have shown different benefits in support for the role of omega 3 fish oil for managing hypercholesterolemia, older adults may be using it for the prevention of other diseases (Din, Newby, & Flapan, 2004; Rizos, Ntzani, Bika, Kostapanos, & Elisaf, 2012). Older adults in this sample may be using omega 3 fatty acids because of the reported benefits and potential of preventing and reducing comorbidities in older adults, such as cognitive decline and cardiac events (Molfino, Gioia, Fanelli, & Muscaritoli, 2014).

Participants took additional single-doses of vitamins along with multivitamins. Several vitamins may cause negative outcomes when taken more than of the tolerable upper intake levels. In this sample, older adults reported high use of vitamin D and used additional single-doses with multivitamins. The importance of calcium and vitamin D in fracture prevention is well known. Researchers also have studied the role of calcium and vitamin D in fall prevention in older adults; however, the use of vitamin D alone does not influence the prevention of falls (Boucher, 2012). Independent rural older adults may not be aware of this and take additional doses in efforts to improve bone and muscle health to prevent fractures, falls or other age-related conditions, such as cognitive decline (Annweiler et al., 2015). Toxicity is possible with over supplementation. Toxic levels of vitamin D may manifest as anorexia, heart arrhythmias, and raise blood levels of calcium. Excessive calcium may lead to constipation and kidney stones, which can be an added problem for older adults (Ross et al., 2011).

Compared to the study of rural adults conducted by Blalock (2009) there was a higher use of medications and ODS with potential for interaction. Vitamin E has been reported to interact with anticoagulants and lipid-lowering agents and excessive amounts of vitamin E may impact blood clotting and lead to bruising, especially when combined with omega 3 fish oil (Institute of Medicine, 2005; Trumbo, Schlicker, Yates, & Poos, 2002; Wachira, Larson, & Harris, 2014). Several common medication classes used by older adults in this analysis and with chronic conditions have the potential to interact with omega 3 fish oils and glucosamine chondroitin, especially anticoagulant or antiplatelet medications (Knudsen & Sokol, 2008). The older adults living in rural areas may be at risk for adverse outcomes associated with potential drug-ODS interactions.

Limitations

The results may not be generalizable to all rural older adults. This analysis was of a convenience sample of primarily Caucasian older adults in the rural Midwest. Older adults living in rural areas of other geographic regions of the US may have different patterns of ODS use. Secondary analysis of data may have limited the ability to examine additional characteristics associated with ODS use. While patients were encouraged to bring all of their ODSs, it is possible they did not bring all their ODSs to the appointment. The study may present participation bias leaning toward a healthier sample; as those who are more frail or ill may not participate in research. ODS-taking patterns such as dosing schedule were not addressed in the present study. We also did not assess the dietary intake of participants, doing so in future studies could suggest additional criteria of ODS appropriateness.

Conclusion

Rural older adults in this sample were using oral dietary supplements at higher rates compared to published evidence of national samples. There is a risk of potential interactions with prescription medications. As the use of supplements is projected to increase among older adults, strategies are needed to monitor their use while ensuring proper nutrition and the prevention of adverse events. Nurses play a key role in surveilling use of ODS and collaborating with the rural older adult and nutrition professionals to ensure safe supplementation.

Relevance to Clinical Practice

There are several considerations for nursing practice. Older adults may view ODSs as safe because they are available OTC and without a prescription (Marinac et al., 2007). The lack of health care providers in rural areas combined with the hesitancy to disclose ODS use to providers may be putting patients at an increased risk for problems. Older adults may need additional encouragement to tell their providers about ODS use so potential interactions can be assessed. Technological strategies may involve providers such as Registered Dietitians at a distance to assess geriatric nutritional status and encourage meal planning. Clinical nurses in health clinics can assist with nutritional assessments. Medication reviews and reconciliation should be in-depth with an inquiry about ODS patterns and length of use. Healthcare providers can incorporate assessment from patient interviews and the dietitian's assessment of total dietary intake into care plans. Clinicians can conduct additional inquiry about rationale of specific ODS use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What Does this Paper Contribute to the Wider Global Clinical Community?

- A higher percentage of older adults living in rural settings use oral dietary supplements as compared to national samples of older adults.
- Older adults use multiple single vitamins in combination with multivitamins.
- Older adults take oral dietary supplements that may interact with scheduled prescribed or over-the-counter medications.

Table 1.

Sample Demographic and Health Characteristics

Demographic Characteristics	N	%
Gender		
Male	77	56
Female	61	44
Caucasian	137	99
Mean (SD)		
Age	78 (7.4)	
Education (N=138)		
8 th Grade	10	7
9 th through 12 th Grade	85	62
College	33	24
Postcollege/Other	9	7
Marital Status		
Married	100	73
Single	2	1
Widowed	33	24
Divorced	1	1
Cohabitation	2	1
Income (11 declined to answer)		
Under 10K through 49k	85	67
50k through over 100k	42	33
Health Variables		
BMI		
Normal Weight (18.5-<25.0)	23	17
Overweight (25-<30.0)	51	37
Obese (>30)	64	46
	Mean (Range)	SD
Number of chronic diseases	5.6 (1 to 11)	1.9
Charlson Comorbidity Index	4.6 (2 to 9)	1.5

Table 2.

List of Oral Dietary Supplement Used by Participants (N=138) *

Oral Dietary Supplement (ODS)	N (%)
Vitamin D	64 (46)
Multivitamin	54 (40)
Calcium	51 (37)
Omega Fish Oils	26 (19)
Vitamin C	20 (14)
Potassium	17 (12)
Glucosamine Chondroitin	15 (11)
Probiotic/Gastrointestinal Supplement	13 (10)
Eye Health Supplement	13 (10)
Folic Acid	12 (9)
Vitamin E	11 (8)
Vitamin B12	9 (6)
Magnesium	7 (5)
Ferrous Sulfate	7 (5)
CoQ 10	6 (4)
Zinc	5 (3)
Vitamin B Complex	5 (3)
Fiber supplement	5 (3)
Chromium	4 (2)
Cranberry extract	4 (2)
Vitamin B6	4 (2)
Joint Supplement Combination	4 (2)
Cinnamon	3 (1)
Melatonin	3 (1)
Saw Palmetto	3 (1)
Rose Hips	3 (1)
Methylsulfonylmethane	3 (1)
Garlic	3 (1)
Pomegranate extract	2 (1)
Vitamin A	2 (1)
Turmeric	2 (1)
Niacin	2 (1)
Lutein	2 (1)
Alpha Lipolic Acid	2 (1)
Supplements Per Participant	N (%)
1 Supplement	23 (20)
2 Supplements	23 (20)
3 Supplements	25 (22)

Oral Dietary Supplement (ODS)	N (%)
4 Supplements	11 (9)
5 or More Supplements	33 (29)

* participants used multiple oral dietary supplements

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Table 3.

ODS Use and Potential for Interactions.

ODS	Combined with Prescribed Medication (%)	
Vitamin D (N=64)	Cholesterol lowering agents	36 (56)
Omega 3 Fish Oil (N=26)	Aspirin	17 (65)
	Cholesterol lowering agents	14 (53)
	Prescribed Anticoagulant	6 (23)
	Antidiabetic Agents	5 (19)
	NSAIDs	3 (12)
	Vitamin E	3 (12)
Glucosamine Chondroitin (N=15)	Antidiabetic Agents	3 (20)
	Prescribed Anticoagulant	2 (20)