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Knowledge and Attitudes of Health Professionals toward Dietary Supplements and Herbal Foods

Sağlık Profesyonellerinin Besin Destekleri ve Bitkisel Besinlere Yönelik Tutum ve Bilgi Düzeyleri

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ABSTRACT

Dietary supplements are vitamins, minerals, amino acids, fatty acids, fiber, various plants, and extracts. They enhance nutritional status and immune function, and have a significant impact on disease prevention and health. However, it is important to note that dietary supplements should be used to supplement a diet, not replace it, and only when the diet fails to meet nutritional needs or when individuals suffer from undernourishment. Determining the appropriate dosage of dietary supplements is crucial for ensuring their safety. Overconsumption of dietary supplements may result in toxic side effects. In addition, dietary supplements and herbal foods should be carefully used due to possible drug-nutrient/herbal interactions. Questioning and monitoring patients' use of all dietary supplements, herbal foods, and medications by health professionals is important for the prevention of toxicity or other adverse effects. The attitudes and knowledge levels of health professionals regarding dietary supplements and herbal foods affect their counseling of patients, including questioning and monitoring the use of supplements. Therefore, this study aims to review the literature about the knowledge and attitudes of health professionals toward dietary supplements and herbal foods.

Keywords: Health professionals, dietary supplements, herbal, food

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ÖZ

Besin destekleri; vitaminler, mineraller, amino asitler, yağ asitleri, posa, çeşitli bitkiler ve bitki özlerinden oluşmaktadır. Beslenme durumunu ve bağışıklık fonksiyonunu iyileştirmekte, hastalıkları önleme ve sağlık üzerinde önemli bir etkiye sahiptir. Ancak, besin destekleri yalnızca diyetin beslenme gereksinimlerini karşılamak için yetersiz olduğu veya bireylerin yetersiz beslendiği durumlarda diyete ek olarak (bir gıda alternatifi olarak değil) önerilir. Besin desteklerinin dozu, güvenilirliklerini belirlemek için oldukça önemlidir. Besin desteklerinin büyük miktarlarda tüketilmesi toksik etkilere neden olabilir. Ayrıca besin destekleri ve bitkisel besinler olası besin-ilaç etkileşimleri nedeniyle dikkatli kullanılmalıdır. Hastaların tüm besin destekleri, bitkisel besin ve ilaç kullanımlarının sağlık profesyonelleri tarafından sorgulanması ve izlenmesi, toksisite veya diğer yan etkilerin önlenmesi açısından önemlidir. Sağlık profesyonellerinin besin destekleri ve bitkisel besinlere ilişkin tutumları ve bilgi düzeyleri, besin desteği kullanımını sorgulama ve izleme de dahil olmak üzere hastalara verdikleri danışmanlık hizmetlerini etkilemektedir. Bu nedenle bu çalışma, sağlık profesyonellerinin besin destekleri ve bitkisel besinlere yönelik tutum ve bilgi düzeyleri ile ilgili çalışmaları derlemeyi amaçlamaktadır.

Anahtar Kelimeler: Sağlık profesyonelleri, besin destekleri, bitkisel, besin

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Introduction

Dietary supplements (DS) include vitamins, minerals, amino acids, fatty acids, fiber, various plants, and extracts. They improve nutritional status as well as immune function (Bailey et al., 2019). Furthermore, they have important effects on preventing diseases and improving health. For instance, folic acid supplements prevent neural tube defects during fetal development, omega-3 fatty acids may inhibit mental illness, and probiotics have an impact on gastrointestinal wellness (Umhau et al., 2012). Dietary supplements could be in several forms, including tablets, capsules, liquids, and powders. It is often recommended for nutrient deficiencies (Pitkälä et al., 2016).

According to a review of guidelines, DS should only be suggested when the diet is inadequate to meet nutritional requirements or people are undernourished. It is recommended as an additive to a diet, not as a food alternative (Cawood et al., 2020). Although it is often overlooked, DS has a pharmacological action. Use of DS can potentially interact with medications and may lead to negative consequences. For example, Ginseng may cause bleeding when used simultaneously with anticoagulants. In addition, the potentially adverse effects of DS use should be considered. Although adverse effects are rare, DS may cause allergic reactions and gastrointestinal symptoms. Hence, DS should be used with caution, especially by individuals, such as the elderly, who take several medications for their diseases. Since the use of DS by individuals is often based on the recommendations of health professionals, they should be aware of the patient's other drug or DS/herbal foods (HF) consumption due to possible interactions. (Pitkälä et al., 2016).

The attitude and knowledge of health professionals have a great impact on recommending DS/HF to individuals, as well as on monitoring of their DS/HF use. Studies demonstrated that the knowledge of health professionals about DS was not sufficient (Waddington et al., 2015; Bukic et al., 2018; Altamimi et al., 2021). A study reported that it is useful to give additional training to health professionals about DS (Rittenhouse et al., 2020). For public health, it is important to prevent information conflict and the unnecessary use of DS/HF. Therefore, this study aims to review the literature about the knowledge and attitudes of health professionals toward DS and HF.

Dietary Supplements and Herbal Foods

DS is defined as products that support healthy diet. Vitamins, minerals, probiotics, fish oils, herbs and botanicals, enzymes, amino acids, and protein powders are examples of DS products. Nowadays, DS/HF use is a very popular topic. The use of DS has increased over the past 20 years (Dwyer et al., 2018). A study reported that more than half of the adults had used DS in the last 30 days. The most commonly used DS were vitamin C, vitamin E, calcium, and vitamin D (Chen et al., 2019). A study in Turkey demonstrated that almost a fifth of the students used DS in the last 12 months (Tarı Selçuk & Çevik, 2020). It was observed that DS use is positively correlated with age, income, and education. In addition, DS use was more common among females than males (Dickinson & MacKay, 2014).

DS are not intended to treat any medical condition or disease. However, a lack of vitamins and minerals causes deficiencies, resulting in diseases such as scurvy, beriberi, pellagra, and rickets. Adequate intake of vitamins and minerals is crucial to supporting ideal health (Hilleman et al., 2020). In a study, 20.4% of admitted patients, 39.1% of ambulatory patients, and 30.7% of healthy participants were using DS. The main reason for using DS was the health maintenance (Chiba et al., 2014).

Although they are estimated to be completely natural, there have been serious safety concerns with DS/HF. Dietary supplements have been anticipated to be associated with more than 20,000 emergency department visits and 2000

hospitalizations per year (Hilleman et al., 2020). The dose of DS is important to determine its safety. Consumption of vitamin/mineral supplements in huge amounts may cause toxic effects. High doses of some nutrients may cause more damage than others (Dwyer et al., 2018). While toxicity concerning water-soluble vitamins is rare, toxicity at higher doses of pyridoxine associated with DS is reported (de Kruijk & Notermans, 2005). Toxicity associated with fat-soluble vitamins is more common. For instance, intake higher than the upper limit of vitamin E may result in bleeding, diarrhea, gastroenteritis, small bowel obstruction, pancreatitis, and cholestasis (Owen & Dewald, 2022).

Another potential danger of using DS or HF is the possibility of drug-nutrient or herb-food interactions. Due to the possibility of drug-nutrient or herbal interactions, health professionals must be aware of their patients' other medication, DS, or HF use (Pitkälä et al., 2016). In a study, 17.7% of admitted patients and 36.8% of ambulatory patients used DS concurrently with their medications. Moreover, 70% of both admitted patients and ambulatory patients did not report DS use to their physicians. Among all participants, 3.3% became conscious of adverse effects related to DS (Chiba et al., 2014). The knowledge level of health professionals regarding DS/HF has a crucial role in recommending them to their patients and preventing drug-DS/HF interactions (Pitkälä et al., 2016). A study showed that health professionals had adequate knowledge of most major drug-DS/HF interactions. However, they had a lack of knowledge regarding most moderate interactions (Stanojević-Ristić et al., 2022). Additionally, when health professionals do not trust their knowledge regarding drug-DS/HF interactions, they may hesitate to recommend these products to their patients. In a study, dietitians stated that they were hesitant about using DS in practice, mainly because of potential drug-nutrient/herbal interactions (Marx et al., 2016).

Use and Recommendation of DS/HF by Health Professionals

Health professionals' use of DS/HF for self-care was thoroughly researched. According to a study, 51% of the physicians and 59% of the nurses were using DS regularly, mainly health and well-being (Dickinson et al., 2009). In a study on medical doctors, 14% of them took vitamin D supplementation regularly all year and 24% only in the fall and winter (Zgliczyński et al., 2021). In a study on dietitians, 51% of them used DS (Steyn et al., 2005). Research on DS use for protection against COVID-19 demonstrated that 94.5% of the dietitians used DS and 46.1% HF during the pandemic. The most used DS was fish oil (81.9 %), and HF was cinnamon (63.5 %) (Kamarli Altun et al., 2021). According to another study, the use of DS was significantly higher among nurses (67%) than dietitians (42%) (Lederman et al., 2009b) .

The recommendations of health professionals for DS/HF influence their patients' use of DS/HF. In a study of 438 people, it was determined that the main reason for using DS was advice from health professionals (49.4%) (Alsaleem et al., 2021). Among 104 gynecologic oncologists, 93% stated that they suggested integrative therapy to breast cancer patients. Furthermore, DS and HF were among the most frequently recommended integrative medicine treatments (Klein et al., 2017). While dietitians were more likely to recommend DS than nurses, more nurses believed that HF was effective than dietitians in a study (Lederman et al., 2009b). According to another study, 79% of physicians and 82% of nurses said that they had recommended DS before (Dickinson et al., 2009).

One of the most commonly researched DS/HF that health professionals recommend to their patients is vitamin D supplementation. A study evaluating the recommendations of general practitioners for vitamin D supplementation showed that 54.6% of them regularly suggest it to their patients. The main reasons for recommendations were vitamin D deficiency (92.1%), prevention of osteoporotic fractures (77.8%), and suggestions by various scientific societies (38.1%) (Buckinx et

al., 2016). However, most medical doctors (61%) did not suggest regular vitamin D supplementation to their patients in another study (Zgliczyński et al., 2021).

Knowledge and Attitudes of Health Professionals toward DS/HF

The attitudes and knowledge level of health professionals also affect the recommendation of DS/HF to their patients. Table 1 summarizes the studies about knowledge and attitudes of health professionals toward DS/HF in this section. The percentage of correct answers regarding knowledge of DS/HF was moderate (66%) among health professionals (Kemper et al., 2006). In a study on dietitians, the mean knowledge score of DS ranged from 56.5% to 62.5%. And the oldest group (participants who were above 40 years old) had the highest score. Moreover, 38% of them recommended DS 3 times a week (Steyn et al., 2005). The mean score of knowledge about DS was 12.98 ± 6.16 out of 30 points in another study. The knowledge level of dietitians regarding DS was higher than nurses'. In addition, both had more knowledge of DS than HF (Lederman et al., 2009a). Similarly, another study revealed that dietitians were mostly interested in DS (65%) (Marx et al., 2016). In a study on the knowledge of health professionals regarding iodine supplementation, 71% of them were aware of the National Health and Medical Research Council's recommendation for iodine supplementation. However, only 38% were aware of the recommended dose, and 44% were aware of the duration (Guess et al., 2017).

Table 1. Studies about Knowledge and Attitudes of Health Professionals toward DS/HF

Source	n	Study Population	Measures	Outcomes
Altamimi et al., (2021)	194	-Pharmacists	-Knowledge -Attitudes -Practices	-Participants had average knowledge about DS (3.68 ± 1.1 out of 5). -The correct answers of participants were between 3.6% and 75.3%. -73.2% of the participants provide advice about DS. -52% of the participants believed that DS was appropriate.
Marx et al., (2016)	231	-Dietitians	-Attitudes regarding DS -Perception -Confidence and knowledge regarding DS	-Dietitians were mostly interested in DS (65%). -Dietitians are hesitant about using DS in practice. -67% of the participants hesitated using DS in clinical practice because of the potential food-drug interactions. -Most of the participants (79%) has a attention in training on DS.
Steyn et al., (2005)	520	-Nurses -Dietetic Interns -Registered Dietitians	-Practices regarding use of DS -Knowledge about DS	-The mean knowledge score of DS was between 56.5% and 62.5%. -Participants who were above 40 years old had the maximum knowledge level. -38% of the dietitians recommended DS at least 3 times a week.
Kemper et al., (2006)	1268	-Physicians -Nurses -Pharmacists -Dietitians -Traniees in those areas	-Knowledge scores -Confidence scales scores -Communications practices scale	-The percentage of correct answers regarding knowledge of DS/HF was moderate. -Scores were lowest for trainees and nurses compared with physicians, pharmacists, and dietitians.
Lederman et al., (2009a)	1200	-Dietitians -Nurses	-Perceived knowledge -Knowledge -Training interests regarding both DS and HF	-The mean score of knowledge about DS was 12.98 ± 6.16 out of 30 points. -The knowledge level of dietitians regarding DS was higher than nurses'. -Both had more knowledge of DS than HF.
Guess et al., (2017)	396	-Obstetricians -Gynaecologists -General practitioners -Midwives -Dietitians -Lactation consultants	-Knowledge -Practice about iodine	-71% of them were aware of the recommendation for iodine supplementation. -Only 38% were aware of the dose of recommendation. -44% were aware of the duration.

Table 1. (cont.) Studies about Knowledge and Attitudes of Health Professionals toward DS/HF

Source	n	Study Population	Measures	Outcomes
Harnett et al., (2018)	63	-Pharmacists	-Perception -Opinion -Knowledge	-72% of pharmacists thought they should recommend appropriate DS or HF to cancer patients. -60% of pharmacists lacked confidence in their knowledge. -Confidence in pharmacists' knowledge was moderately associated with their knowledge level. -The majority (94%) emphasized the importance of education in DS/HF.
Marupuru et al., (2019)	639	-Pharmacists	-Use of DS -Recommendation DS to patients, family, or friends -Perception regarding CAM	-59% of the pharmacists considered that DS was safe. -32% of the pharmacists considered that DS was effective. -The most recommended DS/HF were fiber/psyllium (94%) and calcium (90%).
Wilson & Whitehead, (2019)	1360	-Dietitians -Pediatricians -General practitioners	-Knowledge and attitudes regarding probiotics	-Most of the participants (86.3%) believed that probiotics have an important effect in clinical medicine. -The majority (72.1%) were inclined to recommend them. -Only 55.7% of the dietitians were aware of the correct description of a probiotic. -Recommending a probiotic was positively correlated with a higher education level ($p<0.005$).
Valdovinos-García et al., (2019)	997	-Gastroenterologists -Nutritionists -Chemists -Microbiologists	-Probiotic prescribing -Frequency of recommendation -Justification for prescription -Recommended strains -Perception of safety of probiotics -Personal use of these agents	-71% of the participants knew the definition of probiotics. -64.9% stated that they always recommended them. -31.7% reported that rarely recommended them. -The vast majority declared probiotics as effective and safe.
Fijan et al., (2019)	1066	-Medical doctor -Dentist -Registered nurse -Midwife -Psychologist -Pharmacist -Allied health professional	-Knowledge of probiotics -Use of probiotics -Beliefs about probiotics -Advising the probiotics	-Majority reported their knowledge of probiotics as mediate (36.4%) or good (36.2%). -81.3% of medical doctors or dentists, 86% of pharmacists, and 75.8% of registered nurses or midwives knew the correct definition of probiotics.
Wheeler et al., (2016)	191	-Pharmacists	-Attitudes toward probiotics -Knowledge of probiotics -Use of probiotics in clinical practice	-62.0% of the participants used probiotics for at least 1 intensive care unit (ICU) patient in the previous year. -80.1% agreed that they did not volunteer to recommend probiotics for inhibition of ventilator-associated pneumonia in ICU patients.
Cordina et al., (2011)	177	-Surgeons -Gastroenterologists	-Frequency of probiotic prescribing -Preferences for probiotics -Probiotic use in clinical practice	-53.4% of surgeons and 80.8% of gastroenterologists suggested probiotics to their patients. -Probiotics were prescribed mostly for irritable bowel syndrome (70.7% of prescribers) and pouchitis (67.5% of prescribers).
Bjerså et al., (2012)	737	-Physicians -Nurses -Physiotherapists	-Recommendation -Knowledge about CAM -Personal usage of CAM therapies	-95.7% of the participants valued their knowledge about complementary and alternative medicine (CAM) including DS and HF as minor or non-existent. -80.9% of the participants agreed on the importance of knowledge. -72.8% were keen on CAM research results. -55.8% of them were eager to learn about such a method.

Table 1. Studies about Knowledge and Attitudes of Health Professionals toward DS/HF (cont.)

Source	n	Study Population	Measures	Outcomes
Hussain et al., (2012)	418	-Pharmacy students	-Frequency at which various categories of CAM were encountered by the students -Attitudes of students toward CAM and barriers to CAM use -Source of information about CAM	-Pharmacy students had positive attitudes toward CAM methods. -The majority agreed on the importance of training in CAM.
Jong et al., (2015)	335	-Nurses	-Use of CAM -CAM practice -Perception and knowledge of CAM	-DS was one of the most used CAM methods (51.3%). -The main reason for the prevention of CAM practices was considered a lack of knowledge and scientific evidence.

Abbreviations: DS: Dietary Supplements, HF: Herbal Foods, CAM: Complementary and Alternative Medicine

A systematic review reported that pharmacists had both positive and negative attitudes equally toward DS. Also, they did not believe that their knowledge of DS was sufficient. They did not regularly monitor or question their patients' use of DS. Furthermore, pharmacists believed that additional training on DS would help (Kwan et al., 2006). In another study attended by 194 pharmacists, participants had moderate knowledge about DS (3.68 ± 1.1 out of 5). Pharmacists stated that they gave DS to any patient who requires it. The study also revealed that knowledge and practices were strongly related to each other (Altamimi et al., 2021). In another study, while 72% of pharmacists thought they should recommend appropriate DS or HF to cancer patients, 60% of pharmacists lacked confidence in their knowledge. Confidence in pharmacists' knowledge was moderately associated with their knowledge level. The majority (94%) emphasized the importance of education in DS/HF (Harnett et al., 2018). In another study, 59% of the pharmacists considered that DS was safe and 32% considered that DS was effective. The most recommended DS/HF by pharmacists were fiber/psyllium (94%) and calcium (90%) (Marupuru et al., 2019).

The knowledge and attitude of health professionals toward probiotics are also well documented. A study involving dietitians, pediatricians, and general practitioners was conducted in 2019. Most of the participants (86.3%) believed that probiotics have an important effect in clinical medicine. The majority (72.1%) were inclined to recommend them. However, only 55.7% of the dietitians were aware of the correct description of a probiotic. Recommending a probiotic was positively correlated with a higher education level ($p<0.005$). In addition, most health professionals stated that they require more training on this topic (Wilson & Whitehead, 2019). In a study involving 997 participants, 71% knew the definition of probiotics. While 64.9% stated that always recommended them, 31.7% reported that rarely recommended them. The vast majority declared probiotics as effective and safe (Valdovinos-García et al., 2019). A study revealed that 81.3% of medical doctors or dentists, 86% of pharmacists, and 75.8% of registered nurses or midwives knew the correct definition of probiotics (Fijan et al., 2019). Furthermore, a study on 191 pharmacists indicated that 62.0% used probiotics for at least 1 intensive care unit (ICU) patient in the previous year. However, most of them (80.1%) agreed that they did not volunteer to recommend probiotics for inhibition of ventilator-associated pneumonia in ICU patients. Pharmacists who were indecisive about the safety of probiotics in this patient group were more likely to agree with this opinion than those who believed that they had adequate knowledge about the safety of probiotics (Wheeler et al., 2016). Another study described that 53.4% of surgeons and 80.8% of gastroenterologists suggested probiotics to their patients. It was prescribed mostly for irritable bowel syndrome (70.7% of prescribers) and pouchitis (67.5% of prescribers) (Cordina et al., 2011).

DS/HF use is one of the more popular complementary and alternative medicine (CAM) methods. Among 737 health professionals, 95.7% valued their knowledge about CAM including DS and HF as minor or non-existent. However, 80.9% of the participants agreed on the importance of knowledge. In addition, 72.8% were keen on CAM research results, and 55.8% of them were eager to learn about such a method (Bjerså et al., 2012). Another study on pharmacy students found that they had positive attitudes toward CAM methods. The majority agreed on the importance of training in CAM (Hussain et al., 2012). In a study on nurses, DS was one of the most commonly used CAM methods (51.3%). The main reason for the prevention of CAM practices was considered a lack of knowledge and scientific evidence (Jong et al., 2015).

Training of Health Professionals About DS/HF

Studies showed that health professionals lack confidence in their knowledge about DS/HF. In addition, they stated that additional training on DS/HF would be helpful (Kwan et al., 2006; Hussain et al., 2012; Wilson & Whitehead, 2019; Rittenhouse et al., 2020). A study that administered physicians, pharmacists, advanced practice nurses, and dietitians 10-week internet-based training about DS/HF reported that all participants had significant improvements in knowledge, confidence, and communication practices in DS/HF (Kemper et al., 2002). A study was conducted to evaluate online education's effect on dietitians' knowledge and attitude regarding DS/HF in 2014. The percentage of correct answers increased from 78.0% ± 10.0% to 87.4% ± 6.0% after the intervention ($p<0.001$) (da Silva et al., 2014). In another study, 1249 health professionals attended an online education on DS/HF. During the online education, 81% of the participants stated that they had used DS or HF in the previous week. Using rates were highest among nurses (88%) and nurse practitioners (84 %), and the lowest among pharmacists (66%) and trainees (72%). The most used supplements were multivitamins (60%), calcium (40%), vitamin B (31%), vitamin C (30%), and fish oil (24%). High knowledge of DS was associated with higher use of DS/HF (Gardiner et al., 2006). Another study reported that DS use by health professionals decreased after training ($p<0.001$) (Kemper et al., 2007).

Conclusion and Recommendations

Although DS/HF have many effects on improving health and the immune system, there have been serious safety concerns regarding them. The consumption of high doses of DS/HF and/or drug-nutrient/herbal interactions may cause toxicity. Therefore, patients' use of dietary supplements, herbal foods, and medications should be questioned and monitored carefully by health professionals. The knowledge level of health professionals influences their recommendation of these products to their patients. The less knowledge health professionals have about DS/HF, the more anxious they are and the more hesitant they are to make recommendations. In addition, most health professionals stated that they did not have confidence in their knowledge about DS/HF and were eager to have training on this issue. Hence, it is important that health professionals have adequate knowledge about DS/HF and monitor the DS/HF use of their patients due to possible drug-nutrient interactions. Giving additional training to health professionals on DS/HF may help to increase their knowledge level.

Conflict of Interest

There is no conflict of interest.

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References

Alsaleem, S. A., Asiri, M. M., Alsaleem, M. A., AlShahrani, A. N., Alamer, K. A., & Mahfouz, A. A. (2021). Dietary supplement use among primary health care attendants in Abha city, southwestern Saudi Arabia. *Nutrients*, *13*(9), 2968. https://doi.org/10.3390/nu13092968

Altamimi, M., Hamdan, M., Badrasawi, M., & Allahham, S. (2021). Knowledge, attitudes and practices related to dietary supplements among a group of Palestinian pharmacists. *Sultan Qaboos University Medical Journal*, *21*(4), 613-620. https://doi.org/10.18295/squmj.4.2021.029

Bailey, R. L., Dodd, K. W., Gahche, J. J., Dwyer, J. T., Cowan, A. E., Jun, S., Eicher-Miller, H. A., Guenther, P. M., Bhadra, A.,Thomas, P. R., Potischman, N., Carroll, R. J., & Tooze, J. A. (2019). Best practices for dietary supplement assessment and estimation of total usual nutrient intakes in population-level research and monitoring. *The Journal of Nutrition*, *149*(2), 181-197. https://doi.org/10.1093/jn/nxy264

Bjerså, K., Stener Victorin, E., & Fagevik Olsén, M. (2012). Knowledge about complementary, alternative and integrative medicine (CAM) among registered health care providers in Swedish surgical care: A national survey among university hospitals. *BMC Complementary and Alternative Medicine*, *12*, 42. https://doi.org/10.1186/1472-6882-12-42

Buckinx, F., Reginster, J. Y., Cavalier, E., Petermans, J., Ricour, C., Dardenne, C., & Bruyère, O. (2016). Determinants of vitamin D supplementation prescription in nursing homes: A survey among general practitioners. *Osteoporosis International*, *27*(3), 881-886. https://doi.org/10.1007/s00198-015-3469-3

Bukic, J., Rusic, D., Bozic, J., Zekan, L., Leskur, D., Seselja Perisin, A., & Modun, D. (2018). Differences among health care students' attitudes, knowledge and use of dietary supplements: A cross-sectional study. *Complementary Therapies in Medicine*, *41*, 35-40. https://doi.org/10.1016/j.ctim.2018.09.005

Cawood, A. L., Walters, E. R., Smith, T. R., Sipaul, R. H., & Stratton, R. J. (2020). A review of nutrition support guidelines for individuals with or recovering from COVID-19 in the community. *Nutrients*, *12*(11), 3230.https://doi.org/10.3390/nu12113230

Chen, F., Du, M., Blumberg, J. B., Ho Chui, K. K., Ruan, M., Rogers, G., Shan, Z., Zeng, L., & Zhang, F. F. (2019). Association among dietary supplement use, nutrient intake, and mortality among U.S. Adults: A cohort study. *Annals of Internal Medicine*, *170*(9), 604-613. https://doi.org/10.7326/m18-2478

Chiba, T., Sato, Y., Nakanishi, T., Yokotani, K., Suzuki, S., & Umegaki, K. (2014). Inappropriate usage of dietary supplements in patients by miscommunication with physicians in Japan. *Nutrients*, *6*(12), 5392-5404. https://doi.org/10.3390/nu6125392

Cordina, C., Shaikh, I., Shrestha, S., & Camilleri-Brennan, J. (2011). Probiotics in the management of gastrointestinal disease: Analysis of the attitudes and prescribing practices of gastroenterologists and surgeons. *Journal of Digestive Diseases*, *12*(6), 489-496. https://doi.org/10.1111/j.1751-2980.2011.00534.x

da Silva, L., Brody, R., Byham-Gray, L., & Parrott, J. S. (2014). Online education improves Canadian dietitians' attitudes and knowledge regarding recommending and ordering multivitamin/mineral supplements. *Canadian Journal of Dietetic Practice and Research*, *75*(3), 111-117. https://doi.org/10.3148/cjdpr-2014-001

de Kruijk, J. R., & Notermans, N. C. (2005). Sensory disturbances caused by multivitamin preparations. *Nederlands Tijdschrift voor Geneeskunde*, *149*(46), 2541-2544.

Dickinson, A., Boyon, N., & Shao, A. (2009). Physicians and nurses use and recommend dietary supplements: Report of a survey. *Nutrition Journal*, *8*, 29. https://doi.org/10.1186/1475-2891-8-29

Dickinson, A., & MacKay, D. (2014). Health habits and other characteristics of dietary supplement users: A review. *Nutrition Journal*, *13*, 14. https://doi.org/10.1186/1475-2891-13-14

Dwyer, J. T., Coates, P. M., & Smith, M. J. (2018). Dietary supplements: Regulatory challenges and research resources. *Nutrients*, *10*(1), 41. https://doi.org/10.3390/nu10010041

Fijan, S., Frauwallner, A., Varga, L., Langerholc, T., Rogelj, I., Lorber, M., Lewis, P., & Povalej Bržan, P. (2019). Health professionals' knowledge of probiotics: An international survey. *International Journal of Environmental Research and Public Health*, *16*(17), 3128. https://doi.org/10.3390/ijerph16173128

Gardiner, P., Woods, C., & Kemper, K. J. (2006). Dietary supplement use among health care professionals enrolled in an online curriculum on herbs and dietary supplements. *BMC Complementary and Alternative Medicine*, *6*, 21. https://doi.org/10.1186/1472-6882-6-21

Guess, K., Malek, L., Anderson, A., Makrides, M., & Zhou, S. J. (2017). Knowledge and practices regarding iodine supplementation: A national survey of healthcare providers. *Women and Birth*, *30*(1), e56-e60. https://doi.org/10.1016/j.wombi.2016.08.007

Harnett, J., Le, T. Q., Smith, L., & Krass, I. (2018). Perceptions, opinions and knowledge of pharmacists towards the use of complementary medicines by people living with cancer. *International Journal of Clinical Pharmacy*, *40*(5), 1272-1280. https://doi.org/10.1007/s11096-018-0645-5

Hilleman, D. E., Wiggins, B. S., & Bottorff, M. B. (2020). Critical differences between dietary supplement and prescription omega-3 fatty acids: A narrative review. *Advances in Therapy*, *37*(2), 656-670. https://doi.org/10.1007/s12325-019-01211-1

Hussain, S., Malik, F., Hameed, A., Ahmed, S., Riaz, H., Abbasi, N., & Malik, M. (2012). Pakistani pharmacy students' perception about complementary and alternative medicine. *American Journal of Pharmaceutical Education*, *76*(2), 21. https://doi.org/10.5688/ajpe76221

Jong, M., Lundqvist, V., & Jong, M. C. (2015). A cross-sectional study on swedish licensed nurses' use, practice, perception and knowledge about complementary and alternative medicine. *Scandinavian Journal of Caring Sciences*, *29*(4), 642-650. https://doi.org/10.1111/scs.12192

Kamarli Altun, H., Karacil Ermumcu, M. S., & Seremet Kurklu, N. (2021). Evaluation of dietary supplement, functional food and herbal medicine use by dietitians during the COVID-19 pandemic. *Public Health Nutrition*, *24*(5), 861-869. https://doi.org/10.1017/s1368980020005297

Kemper, K. J., Amata-Kynvi, A., Sanghavi, D., Whelan, J. S., Dvorkin, L., Woolf, A., Samuels, R. C., & Hibberd, P. (2002). Randomized trial of an internet curriculum on herbs and other dietary supplements for health care professionals. *Academic Medicine*, *77*(9), 882-889. https://doi.org/10.1097/00001888-200209000-00014

Kemper, K. J., Gardiner, P., Gobble, J., & Woods, C. (2006). Expertise about herbs and dietary supplements among diverse health professionals. *BMC Complementary and Alternative Medicine*, *6*, 15. https://doi.org/10.1186/1472-6882-6-15

Kemper, K. J., Gardiner, P., & Woods, C. (2007). Changes in use of herbs and dietary supplements (HDS) among clinicians enrolled in an online curriculum. *BMC Complementary and Alternative Medicine*, *7*, 21. https://doi.org/10.1186/1472-6882-7-21

Klein, E., Beckmann, M. W., Bader, W., Brucker, C., Dobos, G., Fischer, D., Hanf, V., Hasenburg, A., Jud, S. M., Kalder, M., Kiechle, M., Kümmel, S., Müller, A., Müller, M. T., Paepke, D., Rotmann, A. R., Schütz, F., Scharl, A., Voiss, P., Wallwiener, M., Witt, C., & Hack, C. C. (2017). Gynecologic oncologists' attitudes and practices relating to integrative medicine: Results of a nationwide ago survey. *Archives of Gynecology and Obstetrics*, *296*(2), 295-301. https://doi.org/10.1007/s00404-017-4420-y

Kwan, D., Hirschkorn, K., & Boon, H. (2006). U.S. and Canadian pharmacists' attitudes, knowledge, and professional practice behaviors toward dietary supplements: A systematic review. *BMC Complementary and Alternative Medicine*, *6*, 31. https://doi.org/10.1186/1472-6882-6-31

Lederman, V. G., Huffman, F. G., & Enrione, E. B. (2009a). Knowledge of Florida nurses and dietitians regarding dietary supplements. *Complementary Therapies in Clinical Practice*, *15*(1), 38-43. https://doi.org/10.1016/j.ctcp.2008.10.006

Lederman, V. G., Huffman, F. G., & Enrione, E. B. (2009b). Practices, attitudes, and beliefs regarding dietary supplements among Florida's dietitians and nurses. *Journal of Dietary Supplements*, *6*(2), 124-142. https://doi.org/10.1080/19390210902861833

Marupuru, S., Axon, D. R., & Slack, M. K. (2019). How do pharmacists use and recommend vitamins, minerals, herbals and other dietary supplements? *BMC Complementary and Alternative Medicine*, *19*(1), 229. https://doi.org/10.1186/s12906-019-2637-y

Marx, W., Kiss, N., McKavanagh, D., & Isenring, E. (2016). Attitudes, beliefs and behaviours of Australia dietitians regarding dietary supplements: A cross-sectional survey. *Complementary Therapies in Clinical Practice*, *25*, 87-91. https://doi.org/10.1016/j.ctcp.2016.09.002

Owen, K. N., & Dewald, O. (2022). Vitamin E toxicity. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK564373/

Pitkälä, K. H., Suominen, M. H., Bell, J. S., & Strandberg, T. E. (2016). Herbal medications and other dietary supplements. A clinical review for physicians caring for older people. *Annals of Medicine*, *48*(8), 586-602. https://doi.org/10.1080/07853890.2016.1197414

Rittenhouse, M., Scott, J., & Deuster, P. (2020). Dietary supplements: Knowledge and adverse event reporting practices of Department of Defense health care providers. *Military Medicine*, *185*(11-12), 2076-2081. https://doi.org/10.1093/milmed/usaa157

Stanojević-Ristić, Z., Mrkić, I., Ćorac, A., Dejanović, M., Mitić, R., Vitković, L., Rašić, J., Valjarević, D., & Valjarević, A. (2022). Healthcare professionals' knowledge and behaviors regarding drug-dietary supplement and drug-herbal product interactions. *International Journal of Environmental Research and Public Health*, *19*(7), 4290. https://doi.org/10.3390/ijerph19074290

Steyn, N. P., Labadarios, D., Nel, J. H., & Heidi-Lee, R. (2005). Development and validation of a questionnaire to test knowledge and practices of dietitians regarding dietary supplements. *Nutrition*, *21*(1), 51-58. https://doi.org/10.1016/j.nut.2004.09.008

Tarı Selçuk, K., & Çevik, C. (2020). Use of dietary supplements among nursing students in turkey in the last 12 months and its relation with orthorexia nervosa. *Perspectives in Psychiatric Care*, *56*(4), 885-893. https://doi.org/10.1111/ppc.12507

Umhau, J. C., Garg, K., & Woodward, A. M. (2012). Dietary supplements and their future in health care: Commentary on draft guidelines proposed by the food and drug administration. *Antioxidants & Redox Signaling*, *16*(5), 461-462. https://doi.org/10.1089/ars.2011.4402

Valdovinos-García, L. R., Abreu, A. T., & Valdovinos-Díaz, M. A. (2019). Probiotic use in clinical practice: Results of a national survey of gastroenterologists and nutritionists. *Revista de Gastroenterología de México*, *84*(3), 303-309. https://doi.org/10.1016/j.rgmx.2018.05.004.

Waddington, F., Naunton, M., Kyle, G., Thomas, J., Cooper, G., & Waddington, A. (2015). A systematic review of community pharmacist therapeutic knowledge of dietary supplements. *International Journal of Clinical Pharmacy*, *37*(3), 439-446. https://doi.org/10.1007/s11096-015-0092-5

Wheeler, K. E., Cook, D. J., Mehta, S., Calce, A., Guenette, M., Perreault, M. M., Thiboutot, Z., Duffett, M., & Burry, L. (2016). Use

of probiotics to prevent ventilator-associated pneumonia: A survey of pharmacists' attitudes. *Journal of Critical Care*, *31*(1), 221-226. https://doi.org/10.1016/j.jcrc.2015.10.016

Wilson, Z., & Whitehead, K. (2019). A cross sectional survey to assess healthcare professionals' attitudes to and understanding of probiotics. *Clinical Nutrition ESPEN*, *34*, 104-109. https://doi.org/10.1016/j.clnesp.2019.08.004

Zgliczyński, W. S., Rostkowska, O. M., & Sarecka-Hujar, B. (2021). Vitamin D knowledge, attitudes and practices of Polish medical doctors. *Nutrients*, *13*(7), 2443. https://doi.org/10.3390/nu13072443