

## Herbal self-medication use in patients with diabetes mellitus type 2

Ivana DAMNJANOVIĆ<sup>1\*</sup>, Dusanka KITIC<sup>1</sup>, Nikola STEFANOVIĆ<sup>1</sup>, Snezana ZLATKOVIĆ-GUBERINIC<sup>2</sup>  
Aleksandra CATIC-DJORDJEVIĆ<sup>1</sup>, Radmila VELICKOVIĆ-RADOVANOVIĆ<sup>1</sup>

<sup>1</sup>Department of Pharmacy, Faculty of Medicine, University of Nis, Nis, Serbia

<sup>2</sup>Health Care Institution Pharmacy Remedia Nis, Nis, Serbia

Received: 14.10.2014 • Accepted/Published Online: 23.12.2014 • Printed: 30.07.2015

**Background/aim:** A considerable number of patients suffering from diabetes mellitus (DM) turn to self-medication using medicinal plants, preparations, and medicine. The aim of this study was to investigate self-medication using medicinal plants and the potential influence of health care professionals' advice or media information regarding the use of herbal dietary supplements with hypoglycemic effect in a population of patients with type 2 DM.

**Materials and methods:** This research, in the form of an analytic cross-sectional study, was conducted in 6 pharmacies in the territory of Nis, Serbia, during October 2013. The criterion set for the study was to include patients diagnosed with type 2 diabetes who used pharmacotherapy in addition to herbal supplements.

**Results:** Surveyed women showed a statistically significant difference in the frequency of using herbal supplements compared to men ( $P < 0.001$ ). More frequent symptoms of hypoglycemia were reported in the group of diabetic respondents who used herbal dietary supplements ( $P < 0.05$ ). The media was most responsible for influencing decisions about self-medication that included the use of herbal dietary supplements.

**Conclusion:** The role of health professionals is indispensable and very important, especially when the media is a potential cause of seeking self-medication.

**Key words:** Herbal self-medication, diabetes, hypoglycemia, professionals' advice

### 1. Introduction

Diabetes mellitus (DM) is one of the leading public health problems of the modern era. According to the World Health Organization, 347 million people worldwide are suffering from DM, with the prediction that it will be the seventh leading cause of death in 2030 (1). Basically, DM is marked by the disturbed homeostasis of carbohydrates and lipids resulting in a high concentration of glucose in the blood. This serious metabolic disease has a significant effect on health, quality of life, and life expectancy of diabetic patients (2).

Treating DM requires the use of different drugs depending on the level and stage of the disease. During almost life-long therapy that includes oral hypoglycemic agents and/or insulin, many patients turn to alternative forms of treatment, relying on medicinal plants. Recently there has been a positive tendency concerning the use of the herbal medicine in treating chronic diseases, while this therapeutic approach has been the only choice in the underdeveloped countries of the world (3).

A considerable number of patients that are suffering from diabetes turn to self-medication using medicinal plants, preparations, and medicine, in the opinion that the use of herbal supplements combined with antidiabetic drugs is absolutely safe and justified. However, a large number of literature data indicate that natural does not always mean safe (4).

Simultaneous use of oral antidiabetic agents or insulin and medicinal plants with hypoglycemic action emphasizes the development of interactions that can result in a positive effect or in the manifestation of adverse effects of applied drugs and supplements, where the most common pharmacodynamic interaction that can occur is hypoglycemia.

The aim of this study was to investigate self-medication using medicinal plants and the potential influence of health care professionals' advice or media information regarding the use of herbal dietary supplements with hypoglycemic effect in a population of patients with type 2 DM.

\* Correspondence: [ivanad.ph@gmail.com](mailto:ivanad.ph@gmail.com)

## 2. Materials and methods

This research, in the form of an analytical cross-sectional study, was conducted in 6 Remedia Pharmacy Health Facilities in the territory of Nis, Serbia, during October 2013. The criterion set for the study was to include patients diagnosed with type 2 diabetes who used pharmacotherapy in addition to herbal supplements.

The research was performed by surveying a total of 519 respondents. The survey was divided into two parts. In the first part, the questions were related to the personal data of patients (age, duration of disease, and pharmacological groups of drugs the patients used in the treatment of DM type 2). The second part of the survey was related to the frequency of diabetic supplements used and the influence of health care professionals' advice (doctors, pharmacists) and the media (television, radio, Internet) on the choice of herbal supplements. We also investigated the frequency of symptoms of hypoglycemia (malaise, dizziness, headache, tinnitus, sweating). Dietetic supplements were based on extracts of *Ginseng radix-Panax ginseng* (ginseng), *Allii sativi bulbos-Allium sativum* L. (garlic), *Aloe vera leaf-Aloe barbadensis* (aloe), *Cinnamomi cortex-Cinnamomum ceylanicum* (cinnamon), *Hyperici herba-Hypericum perforatum* (St. John's wort), *Aronia fructus-Aronia melanocarpa* (Siberian aronia), and *Myrtilli fructus-Vaccinium myrtillus* L. (blueberry).

The data were statistically analyzed and processed by using descriptive statistics as well as appropriate tests of statistical significance (chi-square test of independence with correction of continuity according to Yeats), illustrated with tables and graphs. The database was

created in an Excel statistical program, and for statistical processing, SPSS 19.0 was applied. All statistical tests would be accepted if the null hypothesis was equal to or less than 5%.

## 3. Results

The research included 276 (53.18%) women and 243 (46.82%) men divided into 4 age categories. Demographic characteristics of the surveyed patients are shown in the Table.

The highest percentage of respondents (52.60%) had been diagnosed with DM 6–9 years before, while 16.38% and 31.02% of the respondents had suffered from DM for less than 5 years and for more than 10 years, respectively. A total of 330 respondents (63.58%) used only oral hypoglycemic agents in the treatment of type 2 DM, while 36.42% of the respondents used a combined therapy with oral hypoglycemic and insulin.

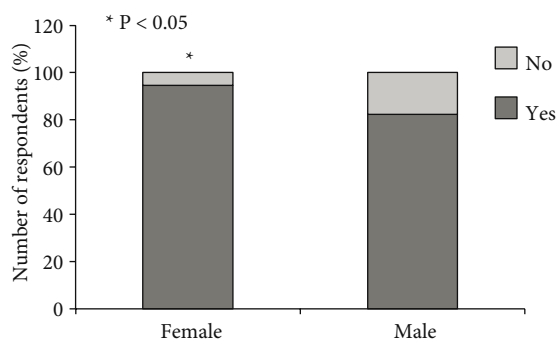
The frequency of the use of herbal dietary supplements in relation to the sex of respondents is shown in Figure 1.

Out of the total of 519 respondents, 94.57% of women and 82.30% of men used herbal dietary supplements along with the prescribed therapy in the treatment of type 2 DM, and 50.29% of the surveyed female respondents showed a higher frequency of use of herbal supplements in relation to males. Herbal dietary supplements were most frequently used by diabetic women aged 45–54. In the group of surveyed male respondents, an increased use of herbal supplements by men over the age of 64 was observed.

In the group of surveyed women there was a statistically significant difference ( $P < 0.001$ ) in the use of herbal

**Table.** Demographic characteristics of the surveyed patients.

Age (years)	Female		Male	
	Number	%	Number	%
1 (<45)	49	9.44	33	6.36
2 (45–54)	87	16.76	63	12.14
3 (55–64)	63	12.14	60	11.56
4 (>64)	77	14.84	87	16.76
Duration of disease (years)				
≤5	41	7.90	44	8.48
6–9	161	31.02	112	21.58
≥10	74	14.26	87	16.76
Type of antidiabetic therapy				
Oral antidiabetics	179	34.49	151	29.09
Insulin + oral antidiabetics	97	18.69	92	17.73

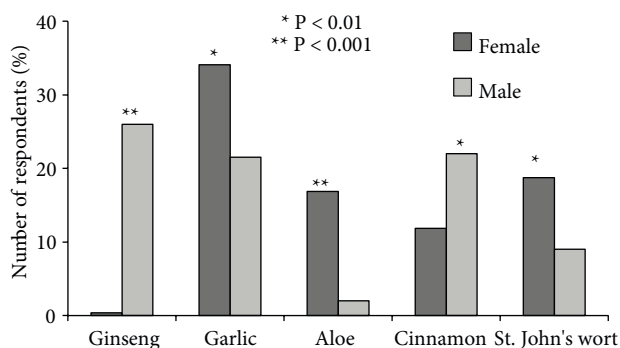


**Figure 1.** The frequency of the use of herbal dietary supplements in relation to sex differences.

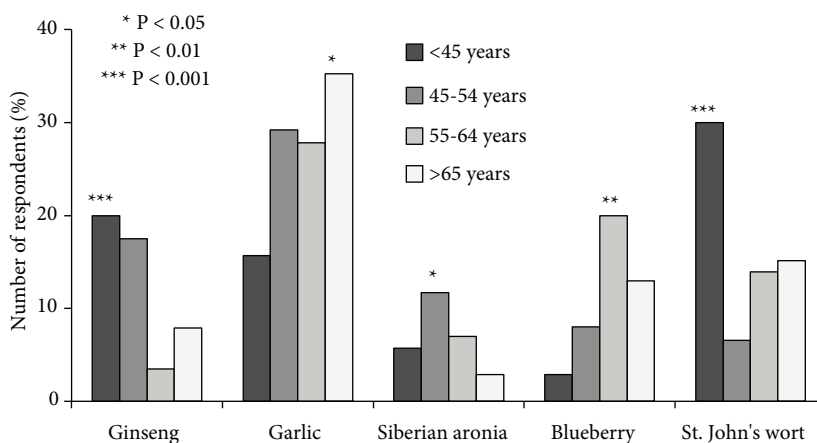
supplements (94.57%) compared to male respondents (82.30%).

The choice of statistically significant different dietary supplements in relation to sex is shown in Figure 2.

There was a statistically significant difference between the sexes in the use of herbal dietary supplements. The surveyed male respondents most often used products



**Figure 2.** Presentation of respondents according to sex in relation to the use of herbal dietary supplements.



**Figure 3.** The choice of herbal dietary supplements according to the age categories of respondents.

based on ginseng ( $P < 0.001$ ) and cinnamon ( $P = 0.005$ ), and women mostly used products based on garlic and St. John's wort ( $P = 0.005$ ). There was no significant statistical difference according to the sex of respondents who used products based on Siberian aronia, aloe, and blueberry.

The choice of statistically significant herbal dietary supplement by the age categories of respondents is shown in Figure 3.

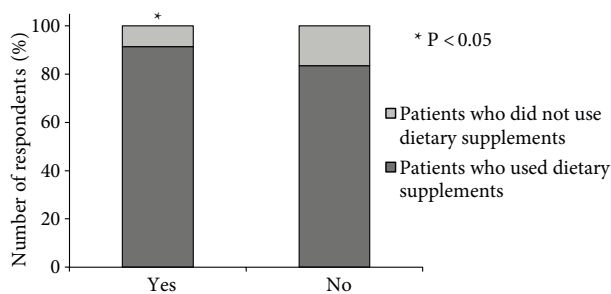
There was a statistically significant difference between the age groups of respondents. The use of herbal supplements based on ginseng was more prevalent in men under the age of 45 (13.58%,  $P < 0.001$ ). Garlic preparations were used more often by women over the age of 64 (11.23%,  $P = 0.033$ ), while supplements based on St. John's wort were mainly used by respondents under the age of 45, mostly women (7.6%,  $P < 0.001$ ).

Frequency of symptoms of hypoglycemia in diabetic patients surveyed who used herbal dietary supplements is shown in Figure 4.

There was a statistically significant difference in the frequency of symptoms of hypoglycemia (malaise, dizziness, headache, tinnitus, sweating) in diabetic patients surveyed who used herbal dietary supplements ( $P = 0.012$ ). In the group of diabetic respondents who used herbal dietary supplements 91.4% of respondents reported that they had some of the symptoms of hypoglycemia. In 48.81% of respondents the symptoms of hypoglycemia appeared from time to time, in 20.39% of the respondents they appeared frequently, and 30.8% said they had never had these symptoms of hypoglycemia.

Figure 5 shows the frequency of statistically significant symptoms of hypoglycemia, dizziness, and malaise in the surveyed diabetic men and women.

Using the chi-square test of independence demonstrated a statistically significant difference between



**Figure 4.** Frequency of symptoms of hypoglycemia in diabetic patients surveyed who used herbal dietary supplements.

age groups when it came to dizziness and malaise in the group of diabetic women surveyed, while significance was not observed for other hypoglycemic symptoms (headache, sweating, tinnitus). There was a statistically significant difference in the occurrence of tinnitus and sweating in relation to other symptoms of hypoglycemia for the diabetic men, while significance was not observed in other hypoglycemic symptoms (headache, dizziness, and malaise). It was found that there was a statistically significant difference in the incidence of hypoglycemia symptoms depending on the sex and age of the subject. Dizziness was reported significantly more frequently in the group of women younger than 45 years old ( $P < 0.05$ ), whereas fatigue was observed more frequently among

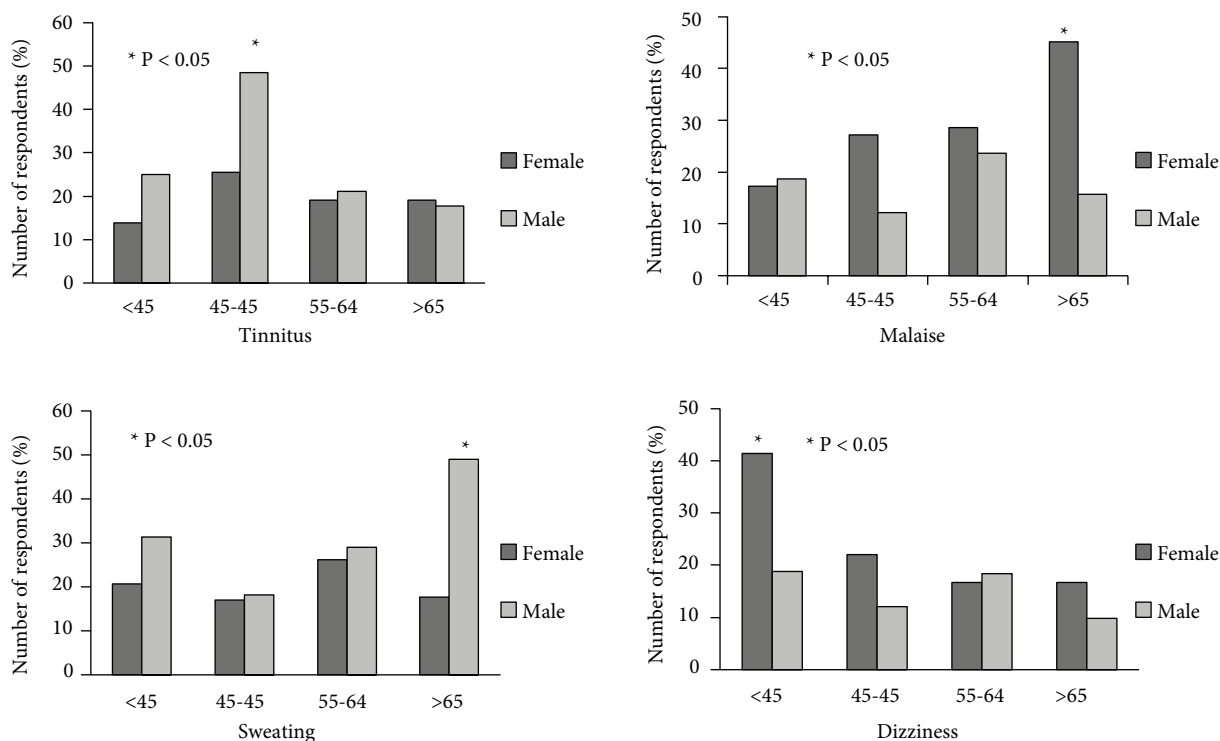
women in the oldest age group ( $P < 0.05$ ). Unlike women, men with diabetes reported a more frequent occurrence of sweating and tinnitus compared to the other symptoms of hypoglycemia. Sweating was much more common in the group of men between 45 and 54 years of age ( $P < 0.05$ ), while tinnitus was more often reported in the older age group ( $P < 0.05$ ).

The influence of doctors, pharmacists, friends, and media information concerning advice on the use of herbal dietary supplements according to age categories is shown in Figure 6.

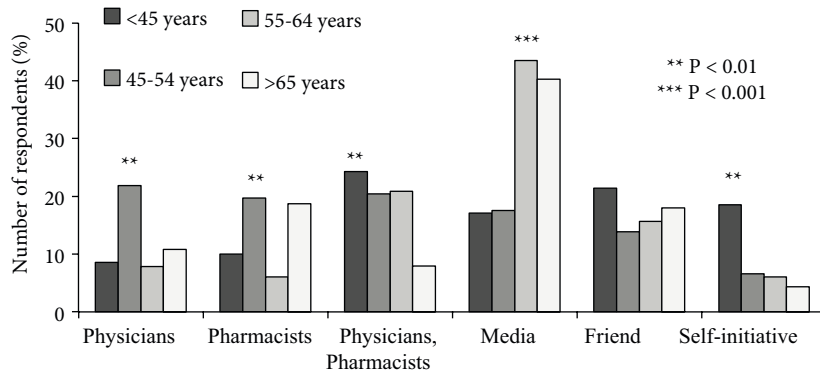
There was a statistically significant difference between the age groups of respondents in relation to the influence of health service professionals and media on making decisions about the use of herbal dietary supplements. Self-initiative in the use of herbal dietary supplements was most marked in the group of respondents under the age of 45 ( $P = 0.002$ ). Most frequently, respondents aged 45–54 ( $P = 0.005$ ) followed the recommendation and advice of their doctors or pharmacists, while the respondents over the age of 55 ( $P < 0.001$ ) were most influenced by media (TV, radio, Internet) in making decisions about applying self-medication using herbal dietary supplements.

#### 4. Discussion

In our research, the group of surveyed women showed a statistically significant difference ( $P < 0.001$ ) in the



**Figure 5.** The frequency of symptoms of hypoglycemia, dizziness, and malaise in the surveyed diabetic men and women.



**Figure 6.** The influence of physicians, pharmacists, friends, and media information on the use of herbal dietary supplements.

frequency of using herbal supplements compared to the group of men, which was consistent with the study conducted by Martin et al. (5).

Self-medication involves treating common health problems using drugs specifically designed and labeled for use without medical supervision (6). Use of herbal medicines and self-medication by using herbal dietary supplements in the diabetic population are common, and the purpose is to alleviate the symptoms of this disease. Herbal dietary supplements with hypoglycemic action usually contain one or more plant components. The composition of these products is determined by the availability of the plant's active principles, which most often are the active components of garlic, cinnamon, ginseng, aloe, and blueberry (7,8).

Self-medication control and its degree of advancement in recent years are very interesting issues, because this form of treatment can be the cause of the lack of recognition and the masking of symptoms of the basic disease, as well as the cause of the development of bacterial resistance and the occurrence of iatrogenic diseases (9).

Over the past few decades, herbal medicines have attracted much attention as potential therapeutic agents in the prevention and treatment of diabetic complications due to their multiple targets and fewer toxic side effects (10). The extracts or constituents of some plants with hypoglycemic action may act at different levels, such as inhibiting glucose absorption from the intestines, increasing insulin secretion from the pancreas, enhancing glucose uptake by adipose and muscle tissues, or inhibiting glucose production from hepatocytes (11). Ranging from preclinical to clinical studies, there is evidence that herbal dietary supplements may be beneficial in the treatment or prevention of type 2 diabetes (12,13). Mahluji et al. showed that the use of herbal dietary supplements with hypoglycemic effects is useful for patients with type 2 diabetes due to fasting blood sugar and HbA1c reduction (14), and Mozaffari-Khosravi

et al. showed an improvement of insulin resistance by ginger powder supplementation (15).

In this survey, conducted among patients suffering from type 2 DM, out of the total of 519 respondents, 94.57% of women and 82.30% of men used herbal dietary supplements along with prescribed therapy for the treatment of diabetes. Similar results were obtained from India, where it was recorded that 71% of diabetics used herbal medicines along with the conventional therapy (16). In a study conducted in Ethiopia, almost half of respondents suffering from diabetes used herbal dietary supplements (17), while the frequency of use of herbal preparations was significantly lower in diabetic patients in America and Iraq, at 14% and 17%, respectively (18,19).

Women surveyed showed a higher frequency (50.29%) of herbal supplement use compared to men. Similar results were obtained in the studies conducted by Balamurugan and Ganesh and by Alavi et al. (16,20). Diabetic women aged 45–54 most often used herbal supplements. In the group of male respondents surveyed an increased use of herbal supplements was observed in men over the age of 65, which is consistent with the results of Egede (21).

Self-medication patterns differ between populations and are influenced by many factors such as age, sex, level of financial income, self-medication orientation, level of medical education and knowledge, and perception of the disease. With aging, the amount of chronic health conditions increases, as well as the number of drugs used in therapy. Because of all this, we face an increased demand for health services, including alternative forms of treatment (22).

In addition to the justified benefits provided by self-medication, it is necessary to recognize the occurrence of potential interactions between dietary supplements and herbal therapy prescribed by a doctor (23). The level of the occurrence of these interactions is significantly affected by the number of drugs a patient is taking and the general

health state of the patient, while an inappropriate choice of herbal preparations can result in deterioration of the primary disease (24).

In this research, the use of herbal supplements based on ginseng was more prevalent in men under the age of 45 ( $P < 0.001$ ). The therapeutic potential of products based on ginseng varied according to the geographic location, dosage, processing, and type of diabetes. *Panax ginseng* had the highest therapeutic potential compared to *Panax japonicus* and *Panax quinquefolius*. Out of the total of 705 components isolated from ginseng, it is considered that ginsenosides are responsible for pharmacological effects (25). Intense stimulation of insulin secretion (26), blocking the intestinal absorption of glucose, and inhibition of hepatic glucose-6-phosphatase are potential hypoglycemic mechanisms of the active principles of ginseng (27,28). The application of products based on ginseng is considered relatively safe. Side effects can be manifested in the form of insomnia, headaches, vaginal bleeding, and diarrhea. Caution is required when used simultaneously with anticoagulants and antidiabetics, due to the emphasized pharmacological effects of the drugs applied simultaneously (24).

Preparations based on garlic were most frequently used by women over the age of 65 ( $P = 0.033$ ), and similar data were observed in a study that included a population of diabetics in Iraq (15). Allicin, a sulfur compound isolated from garlic, is responsible for the hypoglycemic effect of this plant (28). It is believed that allicin increases hepatic metabolism by stimulating the release of insulin from the beta cells of the pancreas (29). Investigations conducted so far have shown a relatively safe profile of preparations based on garlic. Side effects can be manifested at the level of the gastrointestinal tract in the form of nausea and diarrhea. The active ingredients of garlic are CYP 2C9 inhibitors, so special attention is required when it is coadministered along with sulfonyl urea derivatives, as they are metabolized by the same isoenzyme (30). Hypoglycemia may occur as a consequence of this pharmacokinetic interaction. Mittal et al. confirmed this interaction with an animal model (31).

Supplements based on St. John's wort were usually chosen by respondents under the age of 45, predominantly women ( $P < 0.001$ ). The active ingredients of St. John's wort may lead to pharmacokinetic and pharmacodynamic interactions. Hyperforin is the ingredient responsible for a large number of interactions due to the induction of cytochrome CYP450 metabolic enzymes, most frequently isoenzymes 3A4, 2C9, and 2C19, as well as for the induction of membrane expression of P-glycoprotein, responsible for the transport of drugs through the intestinal epithelium (32). It is assumed that the hypoglycemic effect of hyperforin, the active principle isolated from St. John's wort, is a result of the protective effect of the active substance in relation to cytokines, which can

damage functional pancreatic cells (33). In their study, Xu et al. showed significantly altered pharmacokinetics of gliclazide during a simultaneous application with St. John's wort (34).

Diabetic male respondents (22%) more frequently used dietary supplements based on cinnamon while Fabian et al. showed that women with diabetes mostly opted for cinnamon preparations (35). In vitro and in vivo studies have confirmed the positive effect of the aqueous extract of cinnamon in the treatment of DM (36). The mechanism of action is based on the increased glucose uptake and activation of the insulin receptors. Side effects of cinnamon are rare and are manifested in the form of allergies or contact dermatitis. Hypoglycemic episodes can be expected in cases of parallel application with insulin preparations or insulin secretagogues (37).

The efficacy of herbal medicines with hypoglycemic effects is explained by increased insulin secretion, potentiating glucose uptake by adipocytes of muscle tissue, or the inhibition of intestinal absorption of glucose (38,39).

In the group of diabetic respondents who used herbal dietary supplements, 91.4% of respondents reported that they had some of the symptoms of hypoglycemia. In 48.81% the symptoms of hypoglycemia appeared from time to time, in 20.39% they appeared frequently, and 30.8% said they had never had these symptoms of hypoglycemia. It was found that there was a statistically significant difference in the incidence of hypoglycemia symptoms depending on the age and sex of the subject. Dizziness was reported significantly more frequently in the group of women younger than 45 years ( $P < 0.05$ ), whereas malaise was observed more frequently among women in the oldest age group ( $P < 0.05$ ). Unlike women, men with diabetes reported more frequent occurrences of sweating and tinnitus compared to other symptoms of hypoglycemia. Sweating was much more common in the group of men 45–54 years of age ( $P < 0.05$ ), while tinnitus was more often reported in the older age group ( $P < 0.05$ ). There are no similar studies with which we can compare our results. Therefore, it is necessary to be cautious in the use of herbal medicines with hypoglycemic effects along with conventional oral therapy in order to avoid possible interactions and potentiation of hypoglycemic effects.

There was a statistically significant difference between the age groups of respondents concerning the choice of herbal dietary supplements with hypoglycemic effects. In the group of patients under the age of 45, 24.29% ( $P = 0.005$ ) of diabetic patients opted for the use of herbal supplements recommended by doctors and pharmacists, while in the same age group, 18.57% ( $P = 0.002$ ) of respondents opted for self-initiated use of herbal preparations. The media was most responsible for influencing decisions about self-medication that included use of herbal dietary

supplements in 28.74% of women and 33.5% of men over the age of 55 ( $P < 0.001$ ). In a survey conducted by Al-Asadi and Salih, self-initiated application of herbal preparations was reported by 10.5% of respondents, while the media was responsible for frequent self-medicating with herbs in 7.2% of the surveyed diabetics (19). In India, the effect of exposure to the media in the diabetic population was dramatically lower (only 5.5%), while more than half of respondents opted for the use of herbal medicines on the advice of pharmacists (16).

Media exposure and advertising of herbal remedies presenting 100% efficiency without emphasizing the possible side effects and drug interactions can be a confusing factor that can have a very significant influence on the population, especially elderly patients, who can get a feeling of being involved and of participating in the care of their own health (40). Marketing activities of pharmaceutical companies encourage the use of their products, ignoring the fact that prospective customers may have little knowledge about the products and their side effects (41).

## References

- Alwan A, editor. Global Status Report on Noncommunicable Diseases 2010. Geneva, Switzerland: World Health Organization; 2011.
- Sancheti S, Sancheti S, Seo SY. *Chaenomeles sinensis*: a potent  $\alpha$ - and  $\beta$ -glucosidase inhibitor. *Am J Pharmacol Toxicol* 2009; 4: 8–11.
- Lal VK, Gupta PP, Tripathi P, Pandey A. Interaction of aqueous extract of *Trigonella foenum-graecum* seeds with glibenclamide in streptozotocin induced diabetic rats. *Am J Pharm Toxicol* 2011; 6: 102–106.
- Rai A, Eapen C, Prasanth VG. Interaction of herbs and glibenclamide: a review. *ISRN Pharmacol* 2012; 2012: 1–3.
- Martins AP, Miranda Ada C, Mendes Z, Soares MA, Ferreira P, Nogueira A. Self-medication in a Portuguese urban population: a prevalence study. *Pharmacoepidemiol Drug Saf* 2002; 11: 409–414.
- Walker RJ, Gebregziabher M, Martin-Harris B, Egede LE. Quantifying direct effects of social determinants of health on glycemic control in adults with type 2 diabetes. *Diabetes Technol Ther* 2015; 17: 80–87.
- Birdee G, Yeh G. Complementary and alternative medicine therapies for diabetes: a clinical review. *Clinical Diabetes* 2010; 28: 147–155.
- Shojaii A, Goushegir A, Dabaghian FH, Abdollahi M, Fallah Huseini H. Herbs and herbal preparations for glycemic control in diabetes mellitus (a systematic review). *J Med Plants Res* 2011; 5: 3846–3855.
- Corrêa da Silva MG, Soares MC, Muccillo-Baisch AL. Self-medication in university students from the city of Rio Grande, Brazil. *BMC Public Health* 2012; 12: 339.
- Watal G, Dhar P, Srivastava SK, Sharma B. Herbal medicine as an alternative medicine for treating diabetes: the global burden. *Evid Based Complement Alternat Med* 2014; 2014: 596071.
- Rotman-Pikielny P, Ness-Abramof R, Charach G, Roitman A, Zissin R, Levy Y. Efficacy and safety of the dietary supplement DBCare® in patients with type 2 diabetes mellitus and inadequate glycemic control. *J Am Coll Nutr* 2014; 33: 55–62.
- Lee T, Dugoua JJ. Nutritional supplements and their effect on glucose control. *Curr Diab Rep* 2011; 11: 142–148.
- Mahluji S, Attari VE, Mobasser M, Payahoo L, Ostadrahimi A, Golzari SE. Effects of ginger (*Zingiber officinale*) on plasma glucose level, HbA1c and insulin sensitivity in type 2 diabetic patients. *Int J Food Sci Nutr* 2013; 64: 682–686.
- Mozaffari-Khosravi H, Talaei B, Jalali BA, Najarzadeh A, Mozayan MR. The effect of ginger powder supplementation on insulin resistance and glycemic indices in patients with type 2 diabetes: a randomized, double-blind, placebo-controlled trial. *Complement Ther Med* 2014; 22: 9–16.
- Singh R, Kaur N, Kishore L, Gupta GK. Management of diabetic complications: a chemical constituents based approach. *J Ethnopharmacol* 2013; 150: 51–70.
- Balamurugan E, Ganesh K. Prevalence and pattern of self medication use in coastal regions of South India. *BJMP* 2011; 4: 428.



17. Ayele K, Tesfa B, Abebe L, Tilahun T, Girma E. Self care behavior among patients with diabetes in Harari, Eastern Ethiopia: the health belief model perspective. *PLoS One* 2012; 7: e35515.
18. Kaufman DW, Kelly JP, Rosenberg L, Anderson TE, Mitchell AA. Recent patterns of medication use in the ambulatory adult population of the United States: the Slone survey. *JAMA* 2002; 287: 337–344.
19. Al-Asadi J, Salih N. Herbal remedies use among diabetic patients in Nassyria, Iraq. *Middle East Journal of Family Medicine* 2012; 10: 40–46.
20. Alavi NM, Alami L, Taefi S, Gharabagh GS. Factor analysis of self-treatment in diabetes mellitus: a cross-sectional study. *BMC Public Health* 2011; 11: 761.
21. Egede LE, Ye X, Zheng D, Silverstein MD. The prevalence and pattern of complementary and alternative medicine use in individuals with diabetes. *Diabetes Care* 2002; 25: 324–329.
22. Goh LY, Vitry IA, Semple SJ, Esterman A, Luszcz MA. Self-medication with over-the-counter drugs and complementary medications in South Australia's elderly population. *BMC Complement Altern Med* 2009; 9: 42.
23. Pereira CM, Alves VF, Gasparetto PF, Carneiro DS, Ferreira Valoz FE. Self-medication in health students from two Brazilian universities. *RSBO* 2012; 9: 361–367.
24. Hui H, Tang G, Go VL. Hypoglycemic herbs and their action mechanisms. *Chin Med* 2009; 4: 11.
25. Baby J, Jini D. Insight into the hypoglycemic effect of traditional Indian herbs used in treatment of diabetes. *Res J Med Plant* 2011; 5: 352–376.
26. Kim K, Kim HY. Korean red ginseng stimulates insulin release from isolated rat pancreatic islets. *J Ethnopharmacol* 2008; 120: 190–195.
27. Kim HY, Kang KS, Yamabe N, Nagai R, Yokozawa T. Protective effect of heat-processed American ginseng against diabetic renal damage in rats. *J Agric Food Chem* 2007; 55: 8491–8497.
28. Phil RA, Khan RA, Ashraf I. Effects of garlic on blood glucose levels and HbA1c in patients with type 2 diabetes mellitus. *J Med Plant Res* 2011; 5: 2922–2928.
29. Ashraf R, Khan RA, Ashraf I. Garlic (*Allium sativum*) supplementation with standard antidiabetic agent provides better diabetic control in type 2 diabetes patients. *Pak J Pharm Sci* 2011; 24: 565–570.
30. Ackermann RT, Mulrow CD, Ramirez G, Gardner CD, Morbidoni L, Lawrence VA. Garlic shows promise for improving some cardiovascular risk factors. *Arch Intern Med* 2001; 161: 813–824.
31. Mittal P, Juyal V. Drug-dietary interaction potential of garlic on glimepiride treated type 2 diabetic Wistar rats. *Journal of Diabetology* 2012; 3: 2.
32. Russo E, Scicchitano F, Whalley BJ, Mazzitello C, Ciriaco M, Esposito S, Patanè M, Upton R, Pugliese M, Chimirri S et al. *Hypericum perforatum*: pharmacokinetic, mechanism of action, tolerability, and clinical drug-drug interactions. *Phytother Res* 2014; 28: 643–655.
33. Husain GM, Singh PN, Vikas K. Anti-diabetic activity of Indian *Hypericum perforatum* L. on alloxan-induced diabetic rats. *Pharmacologyonline* 2008; 3: 889–894.
34. Xu H, Williams KM, Liauw WS, Murray M, Day RO, McLachlan AJ. Effects of St John's wort and CYP2C9 genotype on the pharmacokinetics and pharmacodynamics of gliclazide. *Br J Pharmacol* 2008; 153: 1579–1586.
35. Fabian E, Töschler S, Elmadfa I, Pieber TR. Use of complementary and alternative medicine supplements in patients with diabetes mellitus. *Ann Nutr Metab* 2011; 58: 101–108.
36. Mang B, Wolters M, Schmitt B, Kelb K, Lichtinghagen R, Stichtenoth DO, Hahn A. Effects of a cinnamon extract on plasma glucose, HbA, and serum lipids in diabetes mellitus type 2. *Eur J Clin Invest* 2006; 36: 340–344.
37. Campbell PA. Diabetes and dietary supplements. *Clinical Diabetes* 2010; 28: 35–39.
38. Fasinu PS, Bouic PJ, Rosenkranz B. An overview of the evidence and mechanisms of herb–drug interactions. *Front Pharmacol* 2012; 3: 69.
39. Stull AJ, Cash KC, Johnson WD, Champagne CM, Cefalu WT. Bioactives in blueberries improve insulin sensitivity in obese, insulin-resistant men and women. *J Nutr* 2010; 140: 1764–1768.
40. Fakeye TO, Adisa R, Showande SJ. Attitude and opinion of Nigerian community pharmacists to self medication practices. *African Journal of Pharmacy and Pharmacology* 2012; 6: 1147–1152.
41. Silva IM, Catrib AM, de Matos VC, Gondim AP. Self-medication in adolescence: a challenge to health education. *Cien Saude Colet* 2011; 16: 1651–1660.