

## The use of *Ginkgo biloba* in healthy elderly

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**Abstract** To promote health-conscious behavior in the aging society and gain insight into the sources of knowledge on which preventive strategies are based, analyzing the behavior of elderly people who are recognized as highly health conscious may be useful. We focused on the use of *Ginkgo biloba*, which is commonly considered to be effective in preventing cognitive decline and dementia, among elderly adults. A total of 1,672 questionnaires were distributed among geriatric participants (60–94 years) who attended university lectures at 22 universities throughout Germany. Response rate was 36.1 %. We collected data on demographic characteristics, preventive strategies (use of *Ginkgo* and other supplements), health-conscious behavior, sources of knowledge concerning health behavior, and factors associated with the participants' concept of aging. The prevalence of *Ginkgo* use was 15.3 %. *Ginkgo* was assumed to be effective for cognitive enhancement and the treatment of cognitive decline by two thirds of the surveyed participants and one third believed *Ginkgo* to be effective for preventing dementia. *Ginkgo* use was significantly higher among participants using natural remedies and herbal and food supplements. The use of *Ginkgo* was recommended by physicians (57.3 %), chemists (16 %), and healthcare magazines (10.7 %).

Food supplements were taken by 65.8 % of the sample: this percentage was significantly higher among subjects who exhibited health-conscious behavior. “Knowledge” about strategies to enhance cognition or prevent cognitive decline among the elderly do not appear to be evidence based. Thus, there is a need to establish reliable and independent sources of scientific information for healthcare professionals and the general public.

**Keywords** *Ginkgo biloba* · Cognitive enhancement · Elderly · Cognitive decline · Dementia

### Introduction

The advancing age of the population worldwide has necessitated the increase in research on disorders primarily affecting older people, such as dementia and cognitive decline. Using observational data, some authors have suggested that up to 50 % of dementia might be preventable (Brayne 2007), and it has been shown that people with higher levels of education are at lower risk of dementia (Stern et al. 1994). The reasons for this difference remain unclear. Additionally, the concept of “successful aging” has become increasingly important in an aging society (Baltes 1997; Jeste et al. 2010; Rowe and Kahn 1987). Cognition plays a crucial role in the definition of this concept, as the maintenance of cognition allows elderly people to remain actively involved in society.

Understanding self-contained strategies to prevent cognitive impairment and dementia and to engage in

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successful aging has become increasingly important in societies of advancing age of the population. A high level of education is not only associated with a lower risk of dementia but also with higher rates of health conscious behavior (Stern et al. 1994; Pearson et al. 2009; Hui and Rubenstein 2006; van der Bij et al. 2002; Rhodes et al. 1999). Health-conscious behavior is determined by behavioral factors and factors related to knowledge and awareness. Indeed, to engage in high levels of health-conscious behavior, people must know and be well aware of factors that could either promote or impair health. Furthermore, they must be convinced that they are responsible for their own health and can influence their health using certain strategies. Beyond that, they must be willing to influence their own health positively in the areas of nutrition, lifestyle, physical exercise (sports), etc. (Dlugosch and Krieger 1995).

However, the basis from which such knowledge is obtained by elderly people and how they choose which behaviors will, in their opinion, actually lead to successful aging remains unclear. Integral parts of the concept of successful aging are the use of food supplements, natural remedies, and other over the counter (OTC) drugs. *Ginkgo biloba* supplements have a leading position in this market and are commonly considered to be effective in preventing cognitive decline; thus, they represent a strategy that is not evidence-based to prevent cognitive impairment and dementia (Blumenthal 1997). *G. biloba* is one of the oldest living tree species in the world and is an integral part of the Asian culture and traditional medicine. *G. biloba* extracts contain high concentrations of flavonoids and terpenoids which have, among other (possible) advantages, antioxidative effects (Oyama et al. 1996). Further assumed mechanisms of action are only partially evidence-based thus far and include the following: neuroprotection via anti-apoptotic effects, inhibition of  $\beta$ -amyloid-aggregation, and changes in gene expression (Ahlemeyer and Krieglstein 2003; Bastianetto et al. 2000; DeFeudis and Drieu 2000; Fowler et al. 2000; MacLennan et al. 2002; Rimbach et al. 2003).

*G. biloba* supplements are currently one of the most popular herbal drugs in the world (Blumenthal 1997). In Germany, pharmaceuticals containing *G. biloba* essence are approved for the therapy of peripheral arterial disease, tinnitus, vertigo, and “dementia related syndrome”. More than 20 different pharmaceutical companies provide *G. biloba*, the most common OTC drug, in Germany. The effectiveness of these supplements, however, remains unclear.

Numerous randomized placebo-controlled trials and meta-analyses have investigated the (pro-) cognitive effects of *G. biloba*. The large majority of studies suggest that *G. biloba* does not have procognitive effects in younger or older subjects or in those with or without cognitive impairment or dementia. While there is no evidence that reliably shows that *G. biloba* has a positive impact on cognition, this supplement also has minimal relevant side effects and can be used with little concern. Several studies have shown the lack of positive effects on particular cognitive domains, such as vigilance, attentiveness, reaction time, memory or mood, regardless of whether *G. biloba* extracts are used once or over a period of several months (Birks et al. 2002; Birks and Grimley Evans 2007, 2009; Franke and Lieb 2010; Franke et al. 2009; Solomon et al. 2002). The recent GuidAge trial highlighted that even the long-term use of *G. biloba* is not efficacious (Schneider 2012; Vellas et al. 2012).

Despite the missing clinical evidence, *G. biloba* supplements are one of the best-selling herbal products on the market (Morris and Avorn 2003). Epidemiological studies show prevalence rates for *G. biloba* usage ranging from 2 to 13 % in the USA, and no epidemiological studies exist outside the USA (Abebe et al. 2011; Barnes et al. 2008; Kelly et al. 2005; Adusumilli et al. 2004; Watts et al. 2001; Kaufman et al. 2002).

The study presented here examines the prevalence of *G. biloba* use and sources of information about further potentially effective preventative strategies in highly educated elderly people. Therefore, we focused on strategies that are commonly considered to be effective in preventing cognitive decline and dementia, thus enabling successful aging and factors associated with these strategies.

## Methods

**Participants** This study presents data from a survey performed between July and December 2011 of 1,672 university students over the age of 60 in Germany at 22 public universities offering specialized university lectures for elderly people.

**Procedure** Staff from all German universities offering specialized studies/lectures for elderly people were asked if they were interested in participating; subsequently, they were sent questionnaires. The students were

informed of the study by the heads of the department and were asked to participate. The students gave written informed consent prior to participation. Questionnaires were distributed by staff and participants were asked to return them by post in prepaid envelopes. The study was approved by the local Ethics Committee.

**Assessments** An extensive self-report paper-and-pencil questionnaire was developed to capture data about health behavior and the use of *G. biloba* (frequency, period, dose, etc.). Demographic data, health insurance status, educational background, etc. were assessed to characterize *G. biloba* users. Answers were given by free recall (free space for writing in the questionnaire), dichotomous (yes/no) questions, or via Likert scales. Standardized questionnaires were used for further characterization: Anxiety about Aging Scale (AAS, 20 questions about anxiety and attitudes about aging in general using six-step Likert scale, 6=very correct, 1=very false; high values=high level of anxiety about aging) for evaluation of anxiety of aging processes (Lasher and Faulkender 1993; Watkins et al. 1998); the 12-item version of the General Health Questionnaire (GHQ-12, 12 questions about various psychiatric symptoms using four-step Likert scale, 1=not at all, 4=considerably worse than normal; high values=subjectively felt high level of impairment caused by psychiatric symptoms) for screening for acute psychiatric disorders (Goldberg and Blackwell 1970); the Symptom Check List (SCL-90-R, 90 items about physical and mental symptoms using five-step Likert scale, 1=not at all, 5=very strong/pronounced; sum score=GSI; high values=numerous physical and mental symptoms) as a self-assessment instrument for physical and mental symptoms (Franke 2002); the Subjective Memory Complaints Questionnaire (SMCQ, 14 dichotomous (yes/no) questions about subjective memory complaints; high values=subjectively pronounced memory complaints) for assessment of subjective memory deficits (Youn et al. 2009); the Health locus of control scale (Fragebogen zur Erhebung von Kontrollüberzeugungen zu Krankheit und Gesundheit, KKG, 21 questions about beliefs of health control using six-step Likert scale, 6=very correct, 1=very false; high values=high level of conviction to control one's own health; Lohaus and Schmitt 1998; Schuler 2006); a questionnaire to assess health-conscious behavior (Fragebogen zur Erfassung des Gesundheitsverhaltens, FEG, 13 questions about frequency of health-conscious behavior using five-step

Likert scale, 5=very often, 1=never; high values=pronounced health-conscious behavior; Dlugosch and Krieger 1995).

**Statistical analysis** Statistical analyses were carried out using SPSS for Windows, Version 17.0. For descriptive statistics, minima/maxima, means, and standard deviation (MI±SD) were used. User data were weighted on independent variables (e.g., age, gender, etc.) using  $\chi^2$  test and the Clopper–Pearson confidence intervals (CI) for categorical variables or the Wilcoxon–Mann–Whitney test in cases of continuous variables. Significance was defined as  $p \leq 0.05$ . Odds ratios (OR) were calculated based on logistic regression analysis. Statistical analysis was supported by the Institute of Medical Biostatistics, Epidemiology and Informatics.

## Results

### Sample characteristics

All public universities offering specialized university lectures for elderly people throughout Germany ( $n=64$ ) were contacted and informed about the investigation, and 22 universities (34.4 %) cooperated.

Of the 1,672 questionnaires distributed, 603 were returned (response rate, 36.1 %). All participants under the age of 60 were excluded ( $n=73$ ). The answers of 530 participants were considered for analysis. Of the participants, 37.5 % ( $n=199$ ) were male, 61.7 % ( $n=327$ ) were female, and 0.7 % ( $n=4$ ) were left unspecified. The age of the participants (male and female) ranged from 60 to 94 years ( $69.74 \pm 5.68$  years), with men being slightly older (male, 60–90 years;  $70.26 \pm 5.48$ ) than women (female, 60–94 years;  $69.44 \pm 5.81$ ). The vast majority of participants (88.3 %;  $n=468$ ) were retired. The majority of participants (63.8 %,  $n=338$ ) had a university degree, 19.4 % ( $n=103$ ) had completed professional training, 9.1 % ( $n=48$ ) had a general qualification for university entrance, 5.1 % ( $n=27$ ) had a certificate of finished Secondary Education, and 2.5 % ( $n=13$ ) had a Master's degree. More than half of all subjects were married (59.1 %;  $n=313$ ), 17.5 % ( $n=93$ ) widowed, and 14.0 % ( $n=74$ ) divorced. Most subjects participated in statutory health (73.4 %;  $n=389$ ), while only 24.9 % ( $n=132$ ) had private healthcare insurance.

## Knowledge and assumptions about *G. biloba*

The vast majority of participants (90.4 %,  $n=473$ ) reported that they knew about *G. biloba*. A significantly larger proportion of female participants than male participants had heard about *G. biloba* (female:  $n=305$ , 94.7 %; male:  $n=165$ , 83.8 %;  $p<0.001$ ). Most participants (66.7 %) thought that *G. biloba* could be used for cognitive enhancement. In particular, 61.5 % assumed that *G. biloba* would be useful for memory enhancement. Approximately two thirds (64.1 %) of the sample assumed that *G. biloba* is effective for treating cognitive decline, while 31.8 % “knew” that *G. biloba* is effective in prevention of dementia.

## Prevalence of *G. biloba* use

A total of 15.3 % (95 % CI, 11.8–18.0;  $n=78$ ) of participants reported the use of *G. biloba* supplements, with slightly more women (15.4 %;  $n=50$ ) than men (14.7 %;  $n=27$ ;  $p=0.819$ ) doing so. There were no significant differences between subjects who did and did not use *G. biloba* with respect to education, current professional situation, family status, or health insurance (see Table 1). However, there was a significant difference between users and non-users with respect to age, with higher prevalence rates of *G. biloba* use noted among older participants (user of *G. biloba*,  $71.51\pm6.65$  years old; non-user,  $68.00\pm5.41$  years old;  $p=0.006$ ). The average intake reported was  $139.4\pm82.7$  mg per day; male participants used a slightly higher dosage ( $148.8\pm113.3$  mg) than female participants ( $134.4\pm61.6$  mg;  $p=0.563$ ). Substances were mainly used to improve cognitive performance (80.5 %;  $n=60$ ) or to prevent dementia (47.6 %;  $n=30$ ). Sex differences could not be detected for “improve cognitive performance” (male: 92.6 %,  $n=25$ ; female: 73.5 %,  $n=36$ ;  $p=0.097$ ) and for “prevent dementia” (male: 61.9 %,  $n=13$ ; female: 40.5 %,  $n=17$ ;  $p=0.194$ ). In addition, the pharmaceuticals were also used to treat tinnitus (36.4 %), to enhance the immune system (32.7 %), and to improve peripheral arterial disease (30.9 %). No significant differences concerning gender could be found regarding the use of *G. biloba* for somatic diseases. Most people had heard about the substances from physicians and pharmacists (73.3 %). For over half of all users (53.8 %), the drug had been recommended by a physician (see Fig. 1). Pharmaceutical companies associated with *G.*

*biloba* products could be spontaneously named by 76.6 % of all participants by free recall. The following pharmaceutical companies were named by the users and had produced the used *G. biloba* drug: Dr. W. Schwabe GmbH & Co. KG (Tebonin®; 32.8 %), Hexal AG (Gingium®; 29.7 %), ratiopharm GmbH (Ginkobil®; 14.1 %). Most of the substances had been purchased in pharmacies (58.0 %). When asked whether the effects of *G. biloba* are scientifically proven, the majority of participants were convinced that the effect of *G. biloba* supplements had been scientifically proven (six-step Likert scale: 1=“very correct”, 6=“very false”; all participants, 2.35); furthermore, a higher number of users of *G. biloba* were convinced that the effect of *G. biloba* has been scientifically proven than non-users (six-step Likert scale: 1=“very correct”, 6=“very false”; users, 3.27; non-users, 2.58;  $p<0.001$ ).

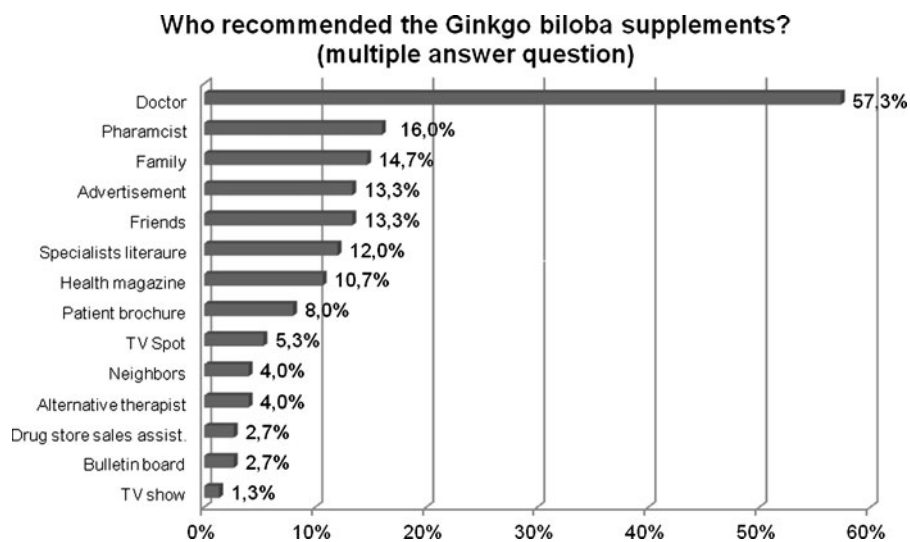
## Characteristics of *G. biloba* supplement users

Bivariate analysis showed that participants taking *G. biloba* had higher values for health-conscious behavior (analysis according FEG manual: five-step Likert scale, 5=very often, 1=never; *G. biloba* users, 3.52; non-users, 3.29;  $p<0.001$ ), used natural remedies more often (use of natural remedies among *G. biloba* users:  $n=65=83.3$  %, use of natural remedies among non-users of *G. biloba*:  $n=274=63.3$  %,  $p=0.001$ ) and were more likely to use vitamins (use of vitamins among user of *G. biloba*:  $n=42=53.8$  %; use of vitamins among non-users of *G. biloba*:  $n=155=34.2$  %,  $p=0.001$ ). Moreover, *G. biloba* users were more concerned about aging when compared to non-users (analysis according to AAS manual: six-step Likert scale, 6=very correct, 1=very false; *G. biloba* users, 57.86; non-users, 55.52;  $p=0.036$ ) and self-reported a larger number of SMCQ (analysis according SMCQ manual: dichotomous questions (yes/no); *G. biloba* users,  $3.71\pm2.86$ ; non-users,  $2.86\pm2.30$ ,  $p=0.022$ ) compared to non-users of *G. biloba*. Multivariate analysis by logistic regression showed that age (OR, 1.06; CI, 1.01–1.11), the use of vitamins and herbal supplements (OR, 2.16; CI, 1.06–4.40), and the use of natural remedies (OR, 1.42; CI, 1.08–1.85) were positively related to *G. biloba* use. In the case of slight disorders (e.g., symptoms of a cold, etc.), *G. biloba* users more frequently used naturopathic treatments than non-users ( $p<0.001$ ; OR, 1.42; CI, 1.08–1.85).

*G. biloba* users generally evaluated their own memory to be significantly worse than non-users

**Table 1** Socio-economic characteristics of the sample according to *G. biloba* use

Characteristics	Users ( <i>n</i> =78) (%)	Non-users ( <i>n</i> =452) (%)	<i>p</i> values
Mean age in years ( $\pm$ standard deviation)	71.51 ( $\pm$ 6.65)	68.00 ( $\pm$ 5.41)	0.006
Gender			
Female	63.6	64.9	0.819
Male	36.4	35.1	
Education			
University degree	55.1	65.7	0.389
Professional training completed	23.1	18.5	
Secondary school certificate (Realschule)	2.6	3.2	
Qualification for university entrance	14.1	8.1	
Secondary school certificate (Hauptschule)	1.3	2.3	
Master certificate	3.8	2.1	
Current professional situation			
Retired	89.6	88.9	0.165
Partial retirement	1.3	4.6	
Housewife/man	2.6	3.5	
Employed	2.6	2.1	
Part time employed	3.9	0.7	
N/C	0.0	0.2	
Family status			
Married	56.4	58.9	0.380
Widowed	21.8	16.6	
Divorced	10.3	15.2	
Single	10.3	9.0	
N/C	1.3	0.2	
Health insurance			
Private healthcare	28.2	24.7	0.380
Others	71.8	75.3	

**Fig. 1** Sources of information on *G. biloba*

(according to SMCQ:  $p=0.022$ ). Furthermore, compared to non-users, a significantly higher number of *G. biloba* users evaluated their capacity of memory subjectively to be so poor that—according to the questionnaire’s specifications—physicians would have to consider the diagnosis of dementia (*G. biloba* users,  $n=21=28.8\%$ ; non-users,  $n=57=13.4\%$ ;  $p=0.001$ ).

We detected no differences between *G. biloba* users and non-users regarding self-efficacy beliefs for illness and health (analysis according KKG manual: six-step Likert scale, 6=very correct, 1=very false). Indeed, none of the three subscales showed any significant differences (internal health locus of control: user of *G. biloba*, 43.34; non-users, 45.48 ( $p=0.507$ ); external-p (powerful others) user of *G. biloba*: 67.32; non-users, 65.00 ( $p=0.666$ ); external-c (chance) user of *G. biloba*: 80.41; non-users, 77.17 ( $p=0.196$ )). Furthermore, the SCL-90-R detected no significant differences between users of *G. biloba* and non-users (analysis according to SCL-90 manual: T-value GSI: users of *G. biloba*:  $44.65\pm 9.62$ ; non-users,  $44.60\pm 10.25$  ( $p=0.282$ )). However, significant differences were detected using the GHQ-12 (analysis according GHQ-12 manual: *G. biloba* users,  $1.28\pm 2.46$ ; non-users,  $0.31\pm 2.74$  ( $p=0.012$ )), implying that *G. biloba* users evaluated their general health to be worse than non-users. The significance of influencing factors for the use of *G. biloba* is shown in Fig. 2.

#### Prevalence of vitamins/dietary supplement use

The prevalence of vitamin and dietary supplement use was 65.8 %. Bivariate analysis showed that supplement

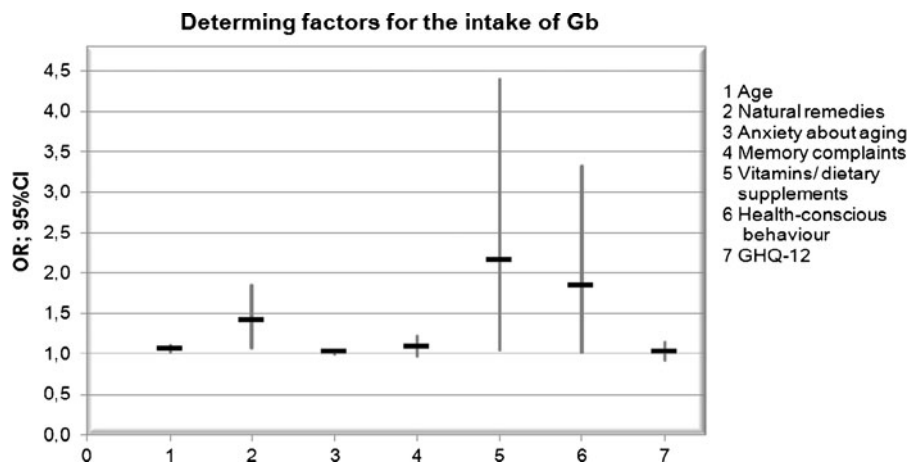
usage was significantly higher among subjects who were female (male:  $n=117$ , 58.8 %; female:  $n=229$ , 70.0 %;  $p=0.01$ ), exhibited health-conscious behavior ( $p<0.001$ ), self-reported memory complaints most often ( $p=0.003$ ), and used natural remedies ( $p=0.003$ ). A multivariate analysis by logistic regression revealed that subjects with higher values for health-conscious behavior (FEG) (OR, 3.73; CI, 2.32–6.02) and subjects with higher values regarding subjective memory complaints (SMCQ; OR, 1.12; CI, 1.02–1.23) used vitamins/dietary supplements more often.

#### Sources of information

The use of *G. biloba* was most often recommended by health professionals such as physicians (57.3 %,  $n=43$ ) or chemists (16.0 %,  $n=12$ ; see Fig. 1). Moreover, 28.0 % of all users reported that friends and family recommended the supplement. Only 15 % of all users had not discussed the use of *G. biloba* with their (family) physician and none of the users reported that their doctor had advised against taking the supplement. No significant distinctions were observed between the responses of male and female subjects.

#### Discussion

In this study, we found that the prevalence of *G. biloba* use in a population of 1,672 highly educated people was 15.3 %. Although there was a significant difference between users and non-users with respect to age, there were no differences between the groups with



**Fig. 2** Factors determining the use of *G. biloba*

respect to education, current professional situation, family status, or health insurance.

Compared to our study, three US household studies revealed a prevalence of *G. biloba* use of 2 % (Barnes et al. 2008), 1.9–2.2 % among males and 1.2–4 % among female participants (Kelly et al. 2005) and <1–4 % among male and 1–5 % among female participants (Kaufman et al. 2002). A study performed by our research group of regular German students (mean, 24.4 years) revealed a lifetime prevalence for the use of *G. biloba* of 4.5 %, which is consistent with previous results. In addition, people aged over 65 years more often used *G. biloba* than younger ones which fits with our results (Kelly et al. 2005). Similar findings were noted for female participants aged  $\geq 65$  years in the study by Kaufmann et al. (2002). These data, taken together, suggest higher prevalence rates for the use of *G. biloba* among people as they get older, highlighting our results showing that *G. biloba* users were significantly older than non-users.

Regarding the types of substances used to increase cognition, the most recent study about cognitive enhancement among 2,600 students using a specialized technique shows a 1-year prevalence of 20 % for the nonmedical use of prescription and illicit drugs for cognitive enhancement (Dietz et al. 2013). Furthermore, an online poll conducted by the journal “Nature” demonstrated a lifetime prevalence of 20 % for the use of stimulants, modafinil, or beta blockers for cognitive enhancement purposes (Maher 2008). Compared to *G. biloba*, these so-called “smart pills” seem to play a more important role among regular students and employed persons than *G. biloba* (Franke and Lieb 2010; Smith and Farah 2011; de Jongh et al. 2008). However, substance use to increase cognition among regular students is captured by the “Cognitive Enhancement” paradigm, which suggests that to increase academic performance and enhance their position, students are often prepared to take high risks (Franke et al. 2012).

Regarding educational status, the majority of participants in our study had a university degree (63.8 %,  $n=338$ ), which highlights the high educational status of the surveyed population. Although we did not aim to include participants with considerably different education statuses, we can demonstrate a relatively high prevalence of *G. biloba* use among this group of highly educated participants. In this respect, the study of Adusumil and colleagues compared participants’ educational status and revealed higher prevalence of

*G. biloba* use among participants with higher educational status (Adusumilli et al. 2004) which underlines our findings.

With respect to recommendations regarding the use of *G. biloba*, more than 50 % of participants in our study were advised to use *G. biloba* by a physician, which is one of the most important findings of this study and certainly explains, at least in part, the high prevalence of *G. biloba* use. This observation confirms results of a previous US study which revealed that 38 % of surveyed US geriatricians recommend the use of *G. biloba* to their patients (Watts et al. 2001). One can only speculate as to why physicians recommend *G. biloba*—especially given that the use of *G. biloba* does not conform to treatment guidelines, which have shown the lack of efficacy of *G. biloba* and advise against the recommendation of *G. biloba* to patients (Maier 2010; Vollmar et al. 2008).

One of the most important reasons for primary care physicians to recommend such drugs to patients (and for subjects asking for preventive strategies against cognitive decline) may be the patients’ expectation of a solution and their desire for a prescription (Bradley 1992; Lewis and Tully 2011). This may increase pressure among physicians to prescribe “lifestyle” or “herbal” medicine such as *G. biloba* (Walley 2002). In addition, physicians may feel the need to prescribe a drug with (nearly) no side effects, which may at least offer a “placebo” effect to healthy subjects.

A further explanation for the high prevalence of *G. biloba* use is the users’ assumed “knowledge” about *G. biloba* and its scientifically proven procognitive effectiveness. In this respect, a physicians’ recommendation is quite important. Further sources of knowledge available to users include the internet, healthcare magazines, and patient brochures containing information about *G. biloba* and other herbal products from unknown sources. The pharmaceutical industry may have a significant influence over the distribution of this information to patients and healthy subjects searching for preventive strategies against cognitive decline (e.g., via the internet, etc.; Morris and Avorn 2003). Therefore, it seems particularly difficult to inform oneself objectively about *G. biloba* and further herbal products which are marketed for cognitive well-being and the prevention of cognitive decline (Morris and Avorn 2003).

However, in regard to scientific literature, older clinical and experimental laboratory studies, which often used poor methodological approaches, seem to support

the procognitive clinical effectiveness of *G. biloba* (Weinmann et al. 2010; Kanowski et al. 1996; Le Bars et al. 1997). Such studies are often sponsored by pharmaceutical companies that produce *G. biloba* products (e.g., Dr. Willmar Schwabe AG). Independent studies using elaborated methods (i.e., randomized controlled double-blind clinical trials) and meta-analyses (e.g., the Cochrane collaboration) clearly demonstrate the lack of procognitive effects of *G. biloba* (Birks et al. 2002; Birks and Grimley Evans 2007, 2009; Solomon et al. 2002).

Based on a previous study, we were able to demonstrate that *G. biloba* users also use other natural remedies, food supplements, and beverages that seem to be known to be salutary among the general public (Morris and Avorn 2003), suggesting that the act of using substances without scientific evidence is not limited to *G. biloba*. This behavior fits well with the high values for health-conscious behavior, as we were able to demonstrate. Furthermore, *G. biloba* users are very critical of their own cognitive and memory skills, thus highlighting their awareness concerning the loss of their cognitive skills. It may be that their perception of their cognitive capabilities makes them more likely to use non-evidence-based methods to conserve their remaining cognitive capacity. One important reason for this awareness and the assumed consequence of using *G. biloba* and other herbal products may be the high degree of popularity of the supplement, as 90.4 % of our sample knew about *G. biloba*.

Additionally, cognition, which is the basis for further psychosocial functioning, is an integral part of the multidimensional definition of “successful aging” (Jeste et al. 2010; Baltes 1997; Rowe and Kahn 1987). However, cognitive decline is part of the normal aging process which the studied population attempts to avoid. Indeed, they are prepared to use non-evidence-based, herbal “lifestyle” drugs to avoid cognitive decline regardless of the effectiveness of the substances used. *G. biloba* and other used herbal substances have nearly no side effects that could decrease the user’s quality of life. Therefore, these substances can only ameliorate the aging process from a well-being perspective and do not impair their users.

This study has several limitations. (1) First, the data are not representative of the healthy elderly population, as the entire focus of the study was understanding a particular subset of elderly adults, i.e., those who are healthy, elderly, and highly educated. Furthermore,

our participants were actively using cognition within the scope of their studies and had a higher degree of introspection as a result of being afraid of losing cognitive function. These factors might have led them to be more sensitive to cognitive decline. (2) In addition, only 34 % of the German universities offering specialized study programs for elderly people participated; thus, the response rate was only 36 %. Therefore, the national representativeness of this study was jeopardized. However, the study included participants from all corners of Germany, which increased the power of the data. To our knowledge, these are the only available data concerning preventive strategies with respect to cognitive decline among healthy, elderly, and highly educated people in Germany. (3) An important limitation lies in the fact that *G. biloba* had been investigated as a representative of other herbal supplements. Although it is plausible that the findings presented here apply to other supplements as well, this remains speculative and should be explored in future studies.

In this respect, our study should be regarded as preliminary and should be followed by other more representative surveys. Further studies should investigate the knowledge, assumed knowledge, and the prevalence of evidence-based and non-evidence-based strategies for maintaining health among healthy elderly people.

Finally, we can conclude that this study primarily reveals the extent to which healthcare professionals recommend the use of *G. biloba* and the extent to which users assume *G. biloba* to be an effective and scientifically proven strategy for enhancing cognition and treating cognitive decline. This conclusion is consistent with the high prevalence of *G. biloba* use, although there is poor scientific evidence supporting its effectiveness. Access to objective and reliable information proved to be limited in the surveyed population. With regard to the growing use of herbal and dietary supplements such as *G. biloba*, reliable and not misleading information should be provided to the physicians who recommend and prescribe these products and to consumers themselves.

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