

# Use of dietary supplements

## Is there a risk of an excessive intake of vitamins and minerals?

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### Summary

Vitamins and minerals are consumed with conventional or enriched foods as well as with food supplements. A differentiated analysis of the vitamin and mineral intake from food supplements shows that – under consideration of the normal nutrition – excessive intake of these substances may only occur in rare and exceptional cases.

**Keywords:** food supplements, vitamins, minerals, tolerable maximum amounts, risk

The results summarized here are taken from several original publications [1–3]. In addition, some of the results were presented in two posters (P 1–2, P 9–7) during the 52nd Scientific Congress of the German Society for Nutrition from 11.–13.03.2015 in Halle-Wittenberg [4, 5].

### Introduction

Several surveys have found that about 18–50 % of adults in Germany use food supplements (FS) [6–10]. Aside from the potential benefits of micronutrient supplementation, possible risks to the consumer are discussed [11, 12]. The principle question is whether the use of food supplements leads to excessive vitamin or mineral intake and whether tolerable upper intake levels are then exceeded.

### Question

The results presented here are taken from a consumer survey which was conducted in collaboration with the

Association of Consumer Research (GfK), Nürnberg, and in which qualitative and quantitative data on the use of food supplements were collected. The objective was to calculate the actual individual intake of vitamins, minerals and other substances from food supplements and to evaluate the results.

### Methods

In the course of two survey waves (2012/2013), personal interviews were carried out using Computer Assisted Personal Interviews (CAPI, n = 4,963) or identical online questionnaires (n = 623); the latter included only persons who stated that they used food supplements. The evaluation only considered food supplements (FS), food for special medical purposes and other dietetic foods in concentrated form. Medicinal products containing micronutrients, other medicinal products (27.9 % of total) and products with missing or inadequate information (3.4 %) were excluded from further evaluation (♦ Figure 1). Personal as well as product-related data were recorded. These included the product

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### Abbreviations

CAPI:	Computer Assisted Personal Interview	PCN:	Pharmacy Central Number
EAN:	European Article Number	P5:	5th Percentile
FS:	food supplement	P50:	50th Percentile
MW:	mean	P95:	95th Percentile
NVS II:	National Consumption Study II	RE:	Retinol equivalent
		SD:	standard deviation
		UL:	Tolerable Upper Intake Level

name and manufacturer, the sales unit, the European Article Number (EAN) or Pharmacy Central Number (PCN), as well as the individual frequency of use, recorded as follows:

- Frequency of consumption: daily (\*1); several times weekly (\*3,5/7); several times monthly (\*3,5/30,4); very irregularly (\*12/365)
- Seasonal intake: throughout the year (\*1); only in summer (\*6/12); only in winter (\*6/12); only on special occasions (e.g. during a disease) (\*3/12)
- Duration of intake: for less than 3 months; for less than 6 months; for less than 1 year; for less than 5 years; for less than 10 years.

By multiplying the daily dose of the preparations with the frequency of use, the mean daily micronutrient intake from the specific FS could be calculated for each person.

In addition, in a theoretical model, the total supply of micronutrients from the FS and the normal food were calculated (NVS II). Three different groups could be distinguished:

**Exemplary calculation**

The daily dosage of vitamin D in a preparation is **10 µg**.  
This is used **several times a week** and **only in winter**:

**$10 \mu\text{g} \times 3.5/7 \times 6/12 = 2.5 \mu\text{g}$**   
(calculated mean vitamin D intake per day)

- intermediate supply (addition of 50th percentile of FS supply + 50th percentile of food supply [NVS III])
- intermediate to high supply (95th percentile FS supply + 50th percentile [NVS III])
- high supply (95th percentile FS supply + 95th percentiles [NVS III]).

The theoretical sum of 95th + 95th percentile was regarded as the worst case scenario. The resulting data were evaluated with respect to the Tolerable Upper Intake Level (UL) of each substance.

## Results

The detailed evaluation was based on anonymous data from 1 070 FS users (59 % women, 41 % men) aged 18 to 93 years ( $54.5 \pm 14.9$ ) (♦ Figure 1), who named a total of 1 614 products. About 70 % of the subjects used only a single preparation.

The most frequent micronutrients supplied by FS were magnesium (59.2 % of all FS users), vitamin C (52.6 %), vitamin E (45.3 %) and various B vitamins (37.0–44.8 %). Aside from the vitamins and minerals, more than 200 other substances were identified in these products. These were most frequently carotenoids, such as lutein and β-carotene, essential fatty acids – particularly eicosapentaenoic and docosahexaenoic acids – and glucosamine. Most of the other substances (about 96 %) were used by only very few people (< 4 % of all FS users).

There were only a few individual cases in which consumption of FS alone led to an exceeding of the UL (♦ Table 1). Magnesium was an exception here: More than 22 % of the FS consumers (n = 143) who used magnesium either reached or exceeded its UL (250 mg/day). In contrast to other vitamins and minerals, this UL is explicitly defined for supplements. In 68 % of these cases (n = 97), magnesium came from a single preparation.

With the theoretical model calculation (addition of FS and normal food intake) only few individuals surpassed the specific ULs for vitamin A, folic acid, calcium and zinc (♦ Figures 2a and b). The mean percentage of persons with supplementary micronutrient intake above the 95th

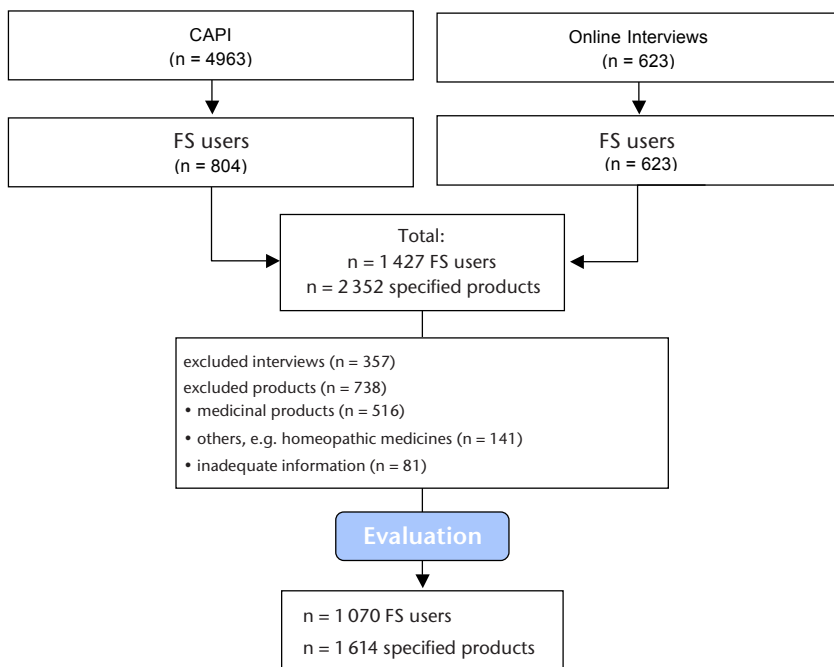


Fig. 1: Flow Chart

	Mean quantity supplied by FS (mean ± SD)	P5	P50	P95	maximum quantity supplied by FS	UL	Number of persons (n) with intake ≥ UL	% of persons who take the nutrient
Vitamin D [µg/day]	4,5 ± 7,9	0,04	3,8	10,0	130,0	100	1	0,3
Vitamin C [mg/day]	95,6 ± 159,1	0,91	60,0	288,0	2 551,0	2 000	1	0,2
Vitamin B <sub>6</sub> [mg/day]	2,6 ± 5,3	0,02	1,4	8,0	100,0	25	2	0,4
Folic acid [µg/day]	225,1 ± 198,9	1,65	200,0	600,0	1 000,0	1 000*	3	0,6
Magnesium [mg/day]	152,7 ± 138,6	1,0	112,5	400,0	700,0	250**	143	22,3
Zinc [mg/day]	4,1 ± 4,2	0,4	2,5	12,5	30,0	25	1	0,3

Tab. 1: Quantities supplied and supplement users exceeding ULs

\* = applies to synthetic folic acid

\*\* = only applies to supplement intake

percentile was less than 10 % - with the exception of vitamin A (14 %). In the case of vitamin A, the UL of 3 000 µg RE/day was already exceeded by normal food intake (95th percentile NVS II). Here it should be kept in mind that an unquantifiable fraction of retinol equivalents are not derived from retinol itself, but from other carotenoids showing vitamin A activity. For this reason, the retinol intake can be overestimated. If the calculation is solely based on the 95th percentile of retinol intake (2 800 µg/day men, 1 800 µg/day women) from the NVS II [8] and with a subsequent addition of

the respective intake percentiles, it resulted that the UL is exceeded only for men.

### Discussion

In general, use of FS was not associated with excessive intake of vitamins and minerals. With the exception of magnesium, UL was only exceeded in isolated cases from FS use alone. It has been repeatedly shown that FS users select better foods and achieve a better supply of nutrients than non-users - even aside from the intake by FS [9, 13]. Thus the theoretical total intake of

vitamins and minerals from FS, together with the intake from food, turned out to be only potentially critical when the FS users show a very high micronutrient intake by food already. This mainly applied to vitamin A, calcium and zinc. Folate in food is not a risk to health. Severe adverse effects are only known for synthetic folic acid at therapeutic doses ≥ 5 mg/day. For example, these include masking of hematological symptoms, epileptogenic or neurotoxic effects and inhibition of zinc absorption [14]. However, the number of cases above the UL (1 000 µg/day) in the present study (n =

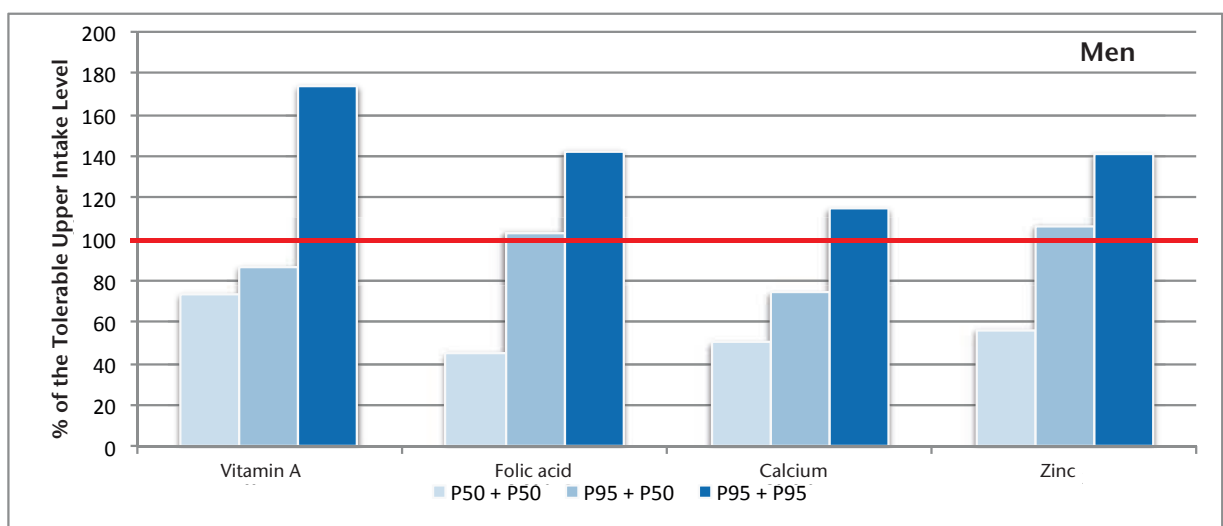


Fig. 2a: Percentages of the calculated vitamin and mineral intake\* relative to the UL in men (\*Theoretical model: Addition of the 50th/95th percentiles from FS and normal food [NVS II])

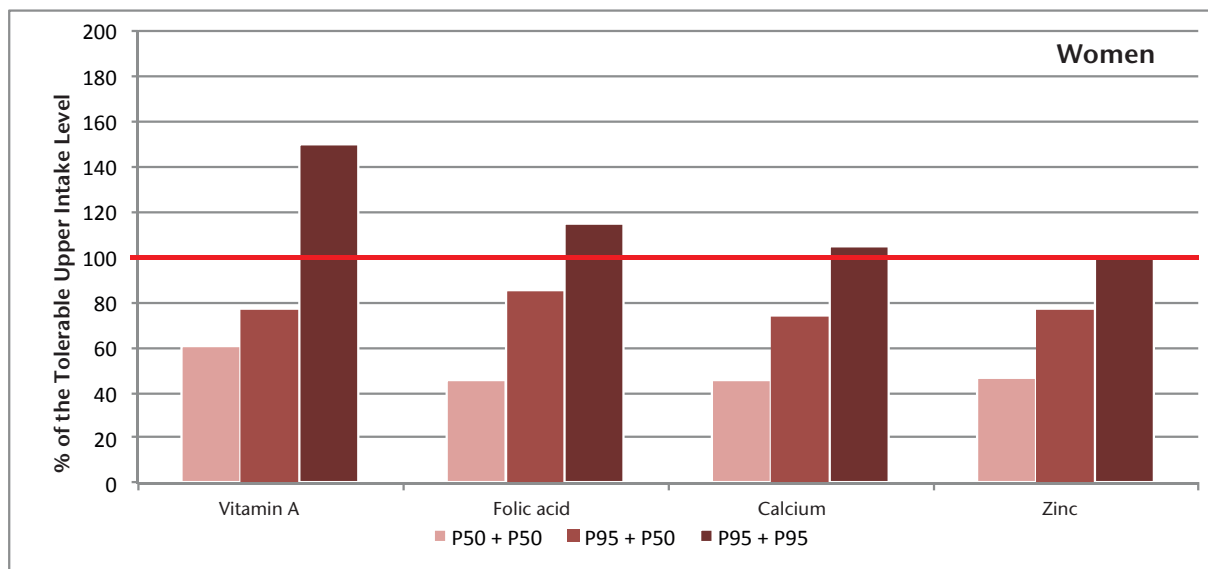


Fig. 2b: Percentages of the calculated vitamin and mineral intake relative\* to the UL in women  
 (\*Theoretical model: Addition of the 50th/95th percentiles from FS and normal food [NVS II])

3) was negligible. Moreover, current data on the effects of moderate folate supply – even below the UL – and enhanced carcinogenicity, particularly colorectal carcinomas [15–17] are inconsistent and therefore no final conclusion is yet possible.

## Limitations

For the model calculation of the total micronutrient intake data collected by the diet history method in the NVS II were used [8]. It must be stressed that these are secondary data which were not collected for the subjects examined in the present study. Aside from the NVS II data, there are no other representative data for micronutrient intake in Germany. Moreover, the population size in the NVS II was large enough to map the nutritional situation in Germany adequately.

In addition, our survey only quantified micronutrient intake by FS. Additional micronutrient supply by specific medicinal products was not considered, as it was assumed that these are generally taken on the advice of a doctor and are intended to be independent of food intake (e.g.

calcium and vitamin D in osteoporosis therapy). However, this is in contrast to most previous surveys in which both – FS and medicinal products containing micronutrients – were included in the evaluation [6, 8, 13].

### Conflict of interests

This project was partly founded by the German Federation for Food Law and Food Science [Bund für Lebensmittelrecht und Lebensmittelkunde e. V.; BLL].

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