Department of Human Nutrition,
Warsaw University of Life Sciences-SGGW

Food supplements and effect on human health

Pietruszka Barbara

DEFINITION

- **foodstuffs** with the purpose of supplement the **normal diet** and provide nutrients *(vitamins, minerals, fiber, fatty acids, amino acids)*, that may be consumed in in sufficient quantities,
- **concentrated** sources of vitamins, minerals or other substances with a nutritional or **physiological** effect,
- ingredient **alone** or in **combination** with others,
- in **dose form**, designed to be taken in measured small unit quantities.





1 dose = 1 pill, 1 capsule, 1 pastille, 1 sachet, several drops etc

EU Directive 2002/46/EC

DEFINITION

Form of dietary supplements – capsules, drops, powder etc. **like as medicines**

Place of marketing – markets, grocery stores, **chemist's**

Contrast to pharmaceuticals

there is no need to demonstrate their efficacy in clinical trials

Dietary supplements – prevalence of use:

- **European countries** - on the basis of the European Prospective Investigation into Cancer and Nutrition Calibration Study (10 countries; n=36,034, age 35-74 years; 1995-2000)

north-south gradient in use

- 2% men, 6.7% women – Greece – the lowest level
- 51% men, 65.8% women - Denmark – the highest level

Skeie et al. Eur J Clin Nutr. 2009,63 Suppl 4:S226-38.

Dietary supplements – prevalence of use:

- **In the USA** – on the basis of the National Health and Nutrition Examination Survey (NHANES) 1999–2000 (n=4,862, age ≥ 20 years)
  - **52% adults (47% men, 57% women) – in the past month**
  - **35% regular users of multivitamin/multimineral products**

NHANES I (1971-1975) - 23%
NHANES II (1976-1980) - 35%
NHANES III (1988-1994) – 40%

Rock Am J Clin Nutr 2007, 85(1):277S-279S

Who uses dietary supplements more often?

Some examples:

	Prevalence	
	Higher	Lower
Gender	women	men
Age	elderly	younger
Young groups	children	teenager
Education	college	lower levels
BMI	lower	higher
Physical activity level	higher	lower
Health (selfreported)	better	worse

Who uses dietary supplements more often?

Some examples – dietary habits:

	Prevalence	
	Higher	Lower
Nutrient intake	more proper	less proper
Diet	healthier	less healthy
Wine consumption	higher	lower

Dietary supplement users are more likely to conduct a healthier life style

What is the risk connected with vitamin/mineral supplement usage?

1. the composition of supplements – the kind of ingredients, doses, the reason of supplement usage
2. the quality of preparation
3. consumers' behaviour
4. mixed

What is the risk connected with vitamin/mineral supplement usage?

1. the composition of supplements – the kind of ingredients, doses, the reason of supplement usage
2. the quality of preparation
3. consumers' behaviour
4. mixed

The main reasons for dietary supplements usage

1

to ensure adequate intake of vitamins and minerals:

- hidden hunger
- severe deficiencies

2

to maintain health:

- reduce health risk factors → reduce the risk of chronic diseases *(cancer, cardiovascular disease, osteoporosis etc.)*

The main reasons for dietary supplements usage

1

to ensure adequate intake of vitamins and minerals:

- hidden hunger
- severe deficiencies

2

to maintain health:

- reduce health risk factors ⟶ reduce the risk of chronic diseases *(cancer, cardiovascular disease, osteoporosis etc.)*

In the developing world (Africa, south-eastern Asia) vitamin and mineral supplementation is effective in reducing nutrients deficiency e.g.:

1

- **vitamin A – in regions** (Bangladesh, Guinea-Bissau, Indonesia, India) **where at least 22% of pregnant women have vitamin A deficiency, giving neonates vitamin A supplements will have a protective effect against infant death (lower infant mortality),**

- **iron and folic acid supplements in pregnancy improve child survival in Indonesia – risk of death of children < 5 y of age was reduced significantly by 34%.**

Sanghvi TG, Harvey PWJ, Wainwright E: Maternal iron–folic acid supplementation programs: Evidence of impact and implementation. Food and Nutrition Bulletin, vol. 31, no. 2 (supplement) © 2010; Badham J: World Food Crisis: A Wake-Up Call to Save a Generation of Children. Participants Statement: Castel Gondolfo, Italy, 25 January, 20091. The Journal of Nutrition 2010, Supplement: The Impact of Climate Change, the Economic Crisis, and the Increase in Food Prices on Malnutrition, 130-131S. Dibley et al. Am J Clin Nutr 2012, 95; 220-30

Individuals who may benefit from dietary supplementation

	Group of people	Specific supplements that may help
Children	Newborns; infants; on strict vegetarian diets; with poor eating habits or overweight; on an energy-restricted diet	depends on condition: vit. K, D, B12, multivitamin, Fe, Zn
Pregnant teenagers		Fe and folic acid; other nutrients may be necessary if diet is very poor
Women	of childbearing age; pregnant or lactating	Multivitamin-mineral suppl.; Fe, Zn, Cu, Ca, vit.B_6, C, D, folic acid,
The elderly		Multivitamin-mineral suppl.; Zn, vit. B_{12}, D,
Others	recovering from serious illneses or surgery; with devastating diseases; with a removed section of the intestinal tract; with malabsorption; addicted to drugs or alcohol; vegans; on energy restricted diets -prolonged weight reduction; with lactose intolerance;	depends on condition: Multivitamin-mineral suppl., vit. B_{12}, B_2, D, Ca, Fe, Zn

Thompson and Manroe, Nutrition and applied approch, 2009

1

Individuals who may benefit from vitamin D supplementation

Group of people
Infants, children adolescents
Women of childbearing age
Pregnant and lactating women
People with dark-colored skin
Those who cover all exposed skin or use sunscreen whenever outside
Older adults
People with malabsorption syndrom
Vegans and those who limit intake of animal products

Drake V.J., 2011

The main reasons for dietary supplements usage

1

to ensure adequate intake of vitamins and minerals:

- hidden hunger
- severe deficiencies

2

to maintain health:

- reduce health risk factors ➡ reduce the risk of chronic diseases *(cancer, cardiovascular disease, osteoporosis etc.)*

Results of epidemiological studies have shown effects that are:

- **Beneficial**
- **Inconclusive**
- **Harmful**

BENEFICIAL

ANTIOXIDANT VITAMINS AND CORONARY HEART DISEASE RISK: a pooled analysis of 9 cohorts

- **Objective:** the relation between the intake (diet and supplements) of antioxidant vitamins (vitamin C, carotenoids, vitamin E) and CHD risk.
- **population under study -** 293 172 subjects (age > 35 y) who were free of CHD at baseline
- 10-y follow-up - 4647 major incident CHD events occurred

Knekt et al. Am J Clin Nutr 2004;80:1508–20.

BENEFICIAL

A pooled analysis of 9 cohorts

ANTIOXIDANT VITAMINS AND CORONARY HEART DISEASE RISK

Results:

- Subjects with higher **supplemental vitamin C** intake (>700 mg/d) had a **25% lower risk of CHD incidence** compared with subjects who did not take supplemental vitamin C

- Supplemental vitamin E and β-carotene intake was not significantly related to reduced CHD risk.

Conclusion:

Because the effects of high antioxidant vitamin intake are not fully understood, the study does not provide adequate support for recommending high doses of vitamin C supplements.

Knekt et al. Am J Clin Nutr 2004;80:1508–20.

INCONCLUSIVE

Antioxidant vitamin and mineral supplementation and prostate cancer prevention in SU.VI.MAX trial (1994-2002)

- 5,141 men at the age of 45-60 years
- men randomized to take either a placebo or a supplementation with nutritional doses of vitamin C (120 mg), vitamin E (30 mg), β-carotene (6 mg), selenium (100 µg) and zinc (20 mg)
- follow-up - 8 years
- 103 cases of prostate cancer

Meyer et al. Int J Cancer 2005, 116, 182

INCONCLUSIVE

Antioxidant vitamin and mineral supplementation and prostate cancer prevention in SU.VI.MAX trial (1994-2002)

PSA* at baseline	change of risk (%)
normal	- 48**
> normal	+ 54

* PSA – prostate specific antigen

** statistically significant

- the antioxidant supplementation effects depend on the baseline health condition

Meyer et al. Int J Cancer 2005, 116, 182

HARMFUL

Beta-Carotene and Retinol Efficacy Trial (CARET, US) 1985-1996

The study participants (18 314) - two cohorts

- **asbestos-exposed -** with substantial occupational exposures:
  - β-carotene (30 mg/d) + retinol (7 500 µg/d)
  - placebo
- **smokers -** extensive **cigarette smoking histories**,
  - β-carotene (30 mg/d)
  - retinol (7 500 µg/d, 8 times the RDA)
  - β-carotene + retinol

HARMFUL

Beta-Carotene and Retinol Efficacy Trial (CARET, US) 1985-1996

Relative risk for experimental group vs placebo group at the time the intervention stopped and after 6-year postintervention period

Endpoint	Intervention phase		Post-intervention phase	
	RR	95% CI	RR	95% CI
Lung cancer incidence	1.28	1.04-1.57	1.12	0.97-1.31
All cause mortality	1.17	1.03-1.33	1.08	0.99-1.17
Lung cancer mortality	1.46	1.07-2.00	1.20	1.01-1.43
Cardiovascular disease mortality	1.26	0.99-1.61	1.02	0.88-1.19
Other causes mortality	0.99	0.79-1.25	1.07	0.95-1.21

January 1996 - CARET was stopped ahead of schedule

31 December 2001 – estimation a post-intervention risks

Other risks connected with the use of dietary supplements:

- interactions (people taking dietary supplements as add-on to the medicine therapy):
    - nutrients-medicines (Mg ↔ aspirin)
    - medicines-nutrients (Fe ↔ tetracycline)
    - nutrients- nutrient (Zn ↔ Fe)
- influence on diagnostic tests (Fe ↔ occult blood in feces)
- adverse effects

Yetley A: Multivitamin and multimineral dietary supplements: definitions, characterization, bioavailability, and drug interactions *Am J Clin Nutr 2007;85(suppl):269S–76S.*

ADVERSE EFFECTS OF DIETARY SUPPLEMENTS

In us food and drug administration 2002 health and diet survey

Use of	All users (n=2,101)(%)	Users with advers events (n=87) (%)
Multivitamins alone	15.9	10.1
Multivitamins /minerals plus single vitamin/mineral	32.0	31.1
Multivitamins plus herbs/botanical	5.2	4.7
Multivitamins plus single vitamin/mineral plus herb/botanical	31.8	41.9
Single vitamins or mineral	9.8	2.9
Single vitamins or mineral plus herb/botanical	2.9	1.1

Timbo et al. J Am Diet Assoc. 2006;106(12):1966-74.

What is the risk connected with vitamin/mineral supplement usage?

1. the composition of supplements – the kind of ingredients, doses, the reason of supplement usage
2. the quality of preparation
3. consumers' behaviour
4. mixed

The risk connected with a quality of dietary supplements

Contamination - a divergence from the information provided on the label of products.

REASONS - ranging from **accidental** to **intentional**:

- contaminants presence in the **raw material**,
- the **manufacturing** process (cross-contamination from shared equipment or improper cleaning),
- **transportation**, including packaging and storage,
- **different concentration in the supplement than those on the label**,
- deliberate contamination which may be used to increase the effectiveness of the supplement product, and hence of sales.

Cole, M.R., Fetrow, C.W., 2003. Adulteration of dietary supplements. Am. J. Health-Syst. Pharm. 60, 1576–1580.

What is the risk connected with vitamin/mineral supplement usage?

1. the composition of supplements – the kind of ingredients, doses, the reason of supplement usage
2. the quality of preparation
3. consumers' behaviour
4. mixed

The risk connected with consumers behaviour

Paracelsus - dose makes the poison,

true for all substances including vitamins and minerals

1. the risk increases when supplements and fortified products are taken at the same time,
2. dietary supplemets and fortified products taken at the same time contain the same nutrients,
3. many people eat fortified products unintentionally (do not read product labels).

Consumer behaviour - the risk of overdose of some nutrients

Dietary supplements - concentrated source

Example on the basis of folate:

- *absorption of natural folate (NA) ≈ 50% of syntetic folic acid (FA).*

1 μg FE = 1 μg NF = 1.7 μgFA

- *recommendation for women at reproductive age 400 μg NF*

dietary supplement:

1 pastille of preparation with folic acid - ≈ 400 μg –= 680 FE μg

„natural" food product – spinach (boiled):

100 g – 129 μg NF = 129 μg FE

1 pastille = 544 g boiled spinach*

*on the basis of Polish tables of the food and nutrition value (Kunachowicz et al. 2005)

Consumer behaviour - the risk of overdose of some nutrients

Warsaw - the assessment of supplements and fortified foods intake during the previous year among 128 children aged 7-12 years[1]

Ingredient	number of children	
	taking supplements and fortified products	exceeding the UL dose with supplements and fortified products
vit. B6	96	1
folic acid	93	5
Mg	20	1
Fe	82	1

[1] Kozyrska et al.: Profile of dietary intake of vitamin and mineral supplements and fortified food products among children aged 7-12 years Probl Hig Epidemiol 2010, 91(4): 549-555

Poland - the study among parents of 743 children attending primary schools: supplements and fortified products were used simultaneously by **34%** of children.

Bylinowska et al.: Factors influenced vitamin or mineral supplements use in a chosen group of children aged 6-12. Roczn Panstw Zakl Hig 2012 Vol. 63 No. 1 pp. 59-66

What is the risk connected with vitamin/mineral supplement usage?

1. the composition of supplements – the kind of ingredients, doses, the reason of supplement usage
2. the quality of preparation
3. consumers' behaviour
4. mixed

CASE STUDY - Uncontrolled usage of supplements associated with health risk

- An individual man in the USA Army - death because of cardiac arrest after completing his daily physical training

- **Probable reason of death** - taking a large variety of supplements and drugs – for physical performance enhancement:

  - vitamin & minerals,
  - hormones & proteins
  - herbs & botanicals
  - prescription & over-the-counter drugs

- **Contaminations** - As and Pb – detected in hormone-containg supplements, and herbs and bothanicals preparations

Van der Voet et al. Biol. Trace Elem. Res. 2008, 125, 1-12.

CONCLUSIONS:

As evidence of a protective effect of dietary vitamin/mineral supplements is not clear:

- Some researchers warn against the long-term intake of high-doses of some vitamins and minerals, because it could be associated with adverse effects

- Some authors consider that there is a need of new randomized trials because of several unsolved issues including:

  - selection of the effective dose,
  - varying baseline levels of subjects before randomization,
  - compliance with the intervention,
  - contamination of the placebo group (i.e., intake of supplements by subjects allocated to the placebo group)
  - unknown effective lag time between start of the intervention and disease onset,
  - unknown effect of high doses of nutrients after termination of supplementation

CONCLUSIONS:

The best source of all nutirents are natural food products:

- **if you have a balanced diet you can get all the nutrients your body needs**

- **however –** in a situation:
  - of deficiencies
  - in specific cases where it is impossible to implement the required amount of nutrients from natural food products

it is recommended to supplement:

- firstly by use of fortified products
- use dietary supplements only when necessary, after consultation with dietetician or doctor

THANK YOU FOR YOUR ATTENTION