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 insufficient 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
**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

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%
### Who uses dietary supplements more often?

Some examples:

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Higher</td>
</tr>
<tr>
<td>Gender</td>
<td>women</td>
</tr>
<tr>
<td>Age</td>
<td>elderly</td>
</tr>
<tr>
<td>Young groups</td>
<td>children</td>
</tr>
<tr>
<td>Education</td>
<td>college</td>
</tr>
<tr>
<td>BMI</td>
<td>lower</td>
</tr>
<tr>
<td>Physical activity level</td>
<td>higher</td>
</tr>
<tr>
<td>Health (selfreported)</td>
<td>better</td>
</tr>
</tbody>
</table>
## Who uses dietary supplements more often?

Some examples – dietary habits:

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Higher</td>
</tr>
<tr>
<td>Nutrient intake</td>
<td>more proper</td>
</tr>
<tr>
<td>Diet</td>
<td>healthier</td>
</tr>
<tr>
<td>Wine consumption</td>
<td>higher</td>
</tr>
</tbody>
</table>

Dietary supplement users are more likely to conduct a healthier lifestyle.
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
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The main reasons for dietary supplements usage

to ensure adequate intake of vitamins and minerals:

1. hidden hunger
2. severe deficiencies

to maintain health:

1. reduce health risk factors
2. reduce the risk of chronic diseases (cancer, cardiovascular disease, osteoporosis etc.)
The main reasons for dietary supplements usage

to ensure adequate intake of vitamins and minerals:

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To maintain health:

1. 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.:

- **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%.
# Individuals who may benefit from dietary supplementation

<table>
<thead>
<tr>
<th>Group of people</th>
<th>Specific supplements that may help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>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</td>
</tr>
<tr>
<td>Pregnant teenagers</td>
<td>Fe and folic acid; other nutrients may be necessary if diet is very poor</td>
</tr>
<tr>
<td>Women</td>
<td>of childbearing age; pregnant or lactating</td>
</tr>
<tr>
<td>The elderly</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>recovering from serious illnesses 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;</td>
</tr>
</tbody>
</table>
Individuals who may benefit from vitamin D supplementation

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

Drake V.J., 2011
The main reasons for dietary supplements usage

to ensure adequate intake of vitamins and minerals:
• hidden hunger
• severe deficiencies

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
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** - 4,647 major incident CHD events occurred

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.

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

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

<table>
<thead>
<tr>
<th>PSA* at baseline</th>
<th>change of risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal</td>
<td>- 48**</td>
</tr>
<tr>
<td>&gt; normal</td>
<td>+ 54</td>
</tr>
</tbody>
</table>

* PSA – prostate specific antigen
** statistically significant

The antioxidant supplementation effects depend on the baseline health condition.
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
Relative risk for experimental group vs placebo group at the time the intervention stopped and after 6-year postintervention period

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Intervention phase</th>
<th>Post-intervention phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Lung cancer incidence</td>
<td>1.28</td>
<td>1.04-1.57</td>
</tr>
<tr>
<td>All cause mortality</td>
<td>1.17</td>
<td>1.03-1.33</td>
</tr>
<tr>
<td>Lung cancer mortality</td>
<td>1.46</td>
<td>1.07-2.00</td>
</tr>
<tr>
<td>Cardiovascular disease mortality</td>
<td>1.26</td>
<td>0.99-1.61</td>
</tr>
<tr>
<td>Other causes mortality</td>
<td>0.99</td>
<td>0.79-1.25</td>
</tr>
</tbody>
</table>

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

# ADVERSE EFFECTS OF DIETARY SUPPLEMENTS

In us food and drug administration 2002 health and diet survey

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

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

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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 supplements and fortified products taken at the same time contain the same nutrients,

3. many people eat fortified products unintentionally (do not read product labels).
Example on the basis of folate:

- absorption of natural folate (NA) ≈ 50% of synthetic folic acid (FA).
  
  \[1 \mu g \text{ FE} = 1 \mu g \text{ NF} = 1.7 \mu g \text{ FA}\]

- recommendation for women at reproductive age 400 \( \mu g \) NF

**dietary supplement:**

1 pastille of preparation with folic acid - \( \approx 400 \mu g \) = 680 FE \( \mu g \)

„natural” food product – spinach (boiled):

100 g – 129 \( \mu g \) NF = 129 \( \mu g \) FE

1 pastille = 544 g boiled spinach*

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*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

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Taking supplements and fortified products</th>
<th>Exceeding the UL dose with supplements and fortified products</th>
</tr>
</thead>
<tbody>
<tr>
<td>vit. B6</td>
<td>96</td>
<td>1</td>
</tr>
<tr>
<td>folic acid</td>
<td>93</td>
<td>5</td>
</tr>
<tr>
<td>Mg</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Fe</td>
<td>82</td>
<td>1</td>
</tr>
</tbody>
</table>

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

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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

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
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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-containing supplements, and herbs and botanicals preparations

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.
The best source of all nutrients 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