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ORIGINAL PAPER

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A REVIEW OF CURRENT POLISH RECOMMENDATIONS ON DIETARY SUPPLEMENTATION AS A PREVENTIVE STRATEGY AGAINST NUTRITIONAL DEFICIENCIES ACROSS THE LIFESPAN OF HEALTHY INDIVIDUALS

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ABSTRACT

Although dietary supplements are generally recommended only when nutritional needs cannot be met through diet alone, their use remains widespread in Poland. This review explores the current Polish recommendations on dietary supplementation, evaluating their relevance across different stages of life in healthy individuals. The analysis is grounded in scientific research, nutritional dietary standards, and expert opinions from leading professional bodies, including the Committee on Human Nutrition Science of the Polish Academy of Sciences, the National Consultant in Pediatrics, the Main Board of the Polish Pediatrics Society, the Polish Society of Gynecologists and Obstetricians (PSGO), and the Polish Menopause and Andropause Society. The collected evidence suggests that supplementation should be employed only when clearly warranted. Decisions regarding the use of supplements should be made in consultation with qualified healthcare professionals – physicians, pharmacists, or registered dieticians – especially in cases involving concurrent medication use. Current literature provides limited and inconclusive evidence regarding the efficacy of diet supplements in the prevention of non-communicable diseases.

Keywords: dietary supplementation, public health recommendations, nutritional deficiencies, age, physiological state

INTRODUCTION

Although it is widely acknowledged that diet supplementation should be considered only when maintaining an adequate nutritional intake through regular diet is challenging, the popularity of supplements in Poland continues to grow. According to the PMR Market Experts report *Rynek suplementów diety w Polsce 2023* ["Diet supplement market in Poland 2023"], the value of the Polish supplement market increased by nearly 12% in 2022 compared to the previous year, reaching almost 7 billion PLN. This rapid expansion reflects a broader trend of overconsumption, which has become a focal point in many recent publications on the topic.

A study commissioned by the supplement manufacturer OSAVI revealed that over 67% of Poles report using dietary supplements, with 75% of those individuals declaring regular use. Notably, 45.2% admit to using supplements without consulting a healthcare professional. The most commonly used products include vitamin and mineral supplements in tablet or

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capsule form (approximately 81% of respondents), followed by supplements aimed at improving the appearance of skin, hair and nails (33.2%), and those targeting joint health (31.4%) (Raport OSAVI 2022a; 2022b). It is important to recognize, however, that supplementation is not limited to dietary supplements alone – it may also involve the use of medical devices or over-the-counter (OTC) medications.

Given the scale of supplement use and its public health implications, it is both timely and necessary to review the current Polish recommendations on dietary supplementation. This review draws upon recent research findings, national dietary standards, and expert opinions from key professional bodies, including the Committee on Human Nutrition Science of the Polish Academy of Sciences, the National Consultant in Pediatrics, the Main Board of the Polish Pediatrics Society, the Polish Society of Gynecologists and Obstetricians (PSGO), and the Polish Menopause and Andropause Society.

These expert recommendations focus on selected nutrients, particularly those for which deficiencies have been identified within the population. Nonetheless, individualized supplementation – based on clinical assessment and tailored to specific age-related risk factors – is not excluded.

Human postnatal development can be broadly divided into the following stages: neonatal, infancy, post-infancy, childhood, adolescence, adulthood, menopause/andropause, and old age. Each stage is marked by distinct rates of growth and physiological change, necessitating, among other factors, adjustments to the nutritional regimen to align with the body's evolving needs and capabilities. However, even with a well-balanced diet, it may not always be possible to fully meet the body's requirements for certain essential nutrients. Furthermore, the roles of specific dietary components can vary significantly across different life stages.

SUPPLEMENTATION IN NEONATAL AND INFANTS

The neonatal period, lasting approximately 28 days in full-term infants, is marked by rapid physiological adaptation to extrauterine life. During this time, the infant's body undergoes significant morphological and functional maturation, which continues intensively throughout infancy – the first 12 months of life. In these early stages, targeted nutritional supplementation – particularly with vitamins D and K – is recommended in Poland to support healthy development.

Vitamin D supplementation

In Poland, vitamin D supplementation for all infants – regardless of whether they are breastfed or formula-fed – involves the daily administration of cholecalciferol at a dose of 400 international units (IU) (10 μg). Between 6 and 12 months of age, the recommended intake increases to 400–600 IU (10–15 μg), depending on the dietary intake of vitamin D from complementary foods (Kuciński et al., 2023; Płudowski et al., 2023). The upper end of this range (600 IU) applies to infants who consume little fortified formula or cereal and are not yet eating sufficient quantities of vitamin D-rich foods such as fish and eggs.

According to the group of experts, these recommended dosages are safe and do not carry a risk of toxicity. Supplementation is considered essential because infants are generally not exposed to sunlight – owing to their immature, highly sensitive skin – and because human milk is inherently low in vitamin D, particularly during the winter months (við Streym et al., 2016).

Vitamin D concentrations in human milk vary significantly by season and milk fraction. For instance, wintertime foremilk contains 0.16–0.64 IU/100 ml, and hindmilk 0.16–1.44 IU/100 ml, compared to summer levels of 0.32–2.08 and 0.48–4.8 IU/100 ml, respectively (við Streym et al., 2016). By contrast, fortified formula consistently provides higher levels: 40–56 IU/100 ml in standard formulas and 56–76 IU/100 ml in follow-on formulas. Specialized formulas, including elimination diets and cereal-based alternatives, typically contain 40–80 IU/100 ml (við Streym et al., 2016). A market analysis by Wierzejska (2015) found that infant formulas available in Poland contained 36–48 IU/100 ml, while follow-on formulas contained 36–60 IU/100 ml.

Vitamin K supplementation

To prevent vitamin K deficiency bleeding (VKDB), the National Consultant in Pediatrics, along with the group of experts and the Main Board of the Polish Pediatric Society, recommends administering a single intramuscular dose of 1 mg of vitamin K within the first 6 hours after birth for healthy, full-term neonates. If the administration is not feasible, a 2 mg oral

dose should be given at the first feeding, followed by a weekly oral dose of 1 mg until the infant reaches 3 months of age in exclusively breastfed infants (Borszewska-Kornacka et al., 2016; Jackowska and Peregud-Pogorzelski, 2016).

This preventive strategy addresses the low vitamin K content of breast milk and the limited intestinal synthesis in neonates due to their immature gut microbiota. While breast milk promotes the colonization of beneficial bacteria such as *Lactobacillus* and *Bifidobacterium* (*B. breve*, *B. lactis*, *B. longum)* these microbes do not synthesize vitamin K. Consequently, vitamin K levels remain insufficient to prevent VKDB until complementary foods are introduced between 4 and 6 months of age. The gradual diversification of the microbiome, influenced by dietary components such as fructo-oligosaccharides, eventually supports endogenous vitamin K synthesis. Over time, microbial diversity increases, with species from the *Enterobacteriaceae* family contributing to vitamin K production (Cohen et al., 2021; Ellis et al., 2022).

The American Academy of Pediatrics (AAP) updated its guidelines in 2022, reaffirming the need for vitamin K prophylaxis (Hand et al., 2022). VKDB presents in three forms:

- **early VKDB** (within 24 hours), typically occurring in infants whose mothers took medications interfering with vitamin K metabolism
- **classic VKDB** (days 2–7), occurring spontaneously
- **late VKDB** (weeks 1–24), almost exclusively occurring in breastfed infants who did not receive prophylactic vitamin K.

According to the 2022 AAP guidelines, all infants weighing over 1500 g should receive a 1 mg intramuscular dose of vitamin K within 6 hours of birth. Earlier studies (e.g., Cornelissen et al., 1997) showed that lower or orally administered doses were ineffective in preventing late VKDB. Despite strong evidence supporting intramuscular administration, recent studies indicate a growing trend of parental refusal, raising significant concerns (Loyal et al., 2018; 2019).

DHA supplementation

Recommendations for docosahexaenoic acid (DHA) supplementation in infants, as outlined by the group of experts (Czerwionka-Szaflarska et al., 2023), align with the Polish Nutritional Standards (Jarosz et al., 2020). For infants up to 6 months of age, exclusive breastfeeding is recommended, and n-3 and n-6 fatty acids should be supplied solely through breast milk.

From 6 months onwards, breastfed infants should receive at least 100 mg DHA per day, primarily through dietary sources such as small portions of fish served once or twice weekly. For formula-fed infants, additional DHA supplementation may be considered when the combined intake from diet and formula is below the recommended threshold of 100 mg/day.

SUPPLEMENTATION IN POST-INFANCY

The post-infancy stage (13th–36 months) is a period of rapid physical, mental and motor development (Weker et al., 2022). With appropriate feeding and a balanced diet, infants should not experience nutritional deficiencies. Accordingly, the group of experts recommends vitamin D supplementation as the only mandatory supplement during this period. It is difficult to meet vitamin D needs through diet alone, yet this vitamin is crucial for processes such as bone ossification and the proper development of spinal curvature and body verticalization (Kaczmarski, 2013). Children aged 1–3 years should receive 600 IU (15 µg) of vitamin D daily throughout the year, as sun exposure is not recommended for this age group (Kuciński et al., 2023; Płudowski et al., 2023).

Guidelines for the intake of long-chain polyunsaturated fatty acids (n-3 LC-PUFAs) during the post-infancy period are outlined in the Polish Nutritional Standards (Jarosz et al., 2020) and according to the Polish Academy of Sciences' Committee on Human Nutrition Science (Weker et al., 2022). For children aged 7–24 months, 100 mg of DHA per day is recommended. For children aged 2 years and over, the combined intake of eicosapentaenoic acid (EPA) and DHA should be 250 mg/day, which corresponds to 1–2 servings of fish and seafood per week, including at least one portion of fatty fish. To ensure food safety, recommended fish species include farmed Norwegian salmon, sprat, sardines, Atlantic mackerel, farmed trout and herring (maximum of one serving of herring per week) (Jarosz et al., 2020).

However, the group of experts suggests DHA and omega-3 supplementation only when a child's diet

lacks sufficient n-3 LC-PUFA, as determined through an assessment of dietary intake and safety (Czerwionka-Szaflarska et al., 2023). This recommendation aligns with the 2010 opinion of the group of experts (Czajkowski et al., 2010). The need for DHA supplementation is particularly important because a child's brain reaches approximately 85% of its adult size by the age of one. The brain undergoes the most rapid development during the first 2–3 years of life, with a marked increase in neural connections. DHA makes up about 97% of all the omega-3 fatty acids present in the brain, where, as a component of membrane phospholipids, it plays a vital structural role in neuronal membranes. DHA also accounts for 93% of the omega-3 fatty acids in the retina, where it helps prevent structural defects in rods, thereby protecting against vision disorders.

SUPPLEMENTATION IN CHILDHOOD

The preschool (ages 4–6 years) and early schooling (ages 7–10 years) years are the stages during which the group of experts recommends daily vitamin D supplementation of 600–1000 IU (15–25 µg) throughout the year (Kuciński et al., 2023; Płudowski et al., 2023). This recommendation is based on the difficulty of obtaining sufficient vitamin D from diet alone and the limited, often inconsistent, sun exposure among children.

According to various sources, sun exposure during the period from early May to late September may be sufficient to meet vitamin D needs. Płudowski et al. (2023) suggest 15–30 minutes of sun exposure to uncovered forearms and legs without sunscreen, while Kuciński et al. (2023) recommend 30–45 minutes, and Jarosz et al. (2020) specify 15–20 minutes with at least 18% of body surface exposed without sunscreen, between 10 a.m. and 3 p.m. These exposures may be enough to meet vitamin D requirements. However, while cholecalciferol supplementation is not necessary in such cases, it remains safe and recommended.

If these guidelines are not met in healthy children aged 4–10 years, cholecalciferol supplementation at a dose of 600–1000 IU/day (15–25 µg/day) is advised year-round, taking into account body weight and dietary intake. While the recommended exposure time and body surface area are generally adequate for vitamin D synthesis, these guidelines do not fully align with photoprotection recommendations. The World Health Organization (2002) advises limiting sun exposure during peak UV radiation hours (11 a.m. to 3 p.m.) and using sunscreen with radiation-absorbing filters year-round (Kuros et al., 2019).

Exposure to intense UV radiation is linked to several skin concerns, including sunburn, erythema multiforme, and both benign and malignant skin cancers (Chang et al., 2022). Therefore, year-round vitamin D supplementation remains a prudent and safer alternative for children, even if sun exposure is limited or insufficient.

THE ROLE OF VITAMIN D IN GROWTH AND DEVELOPMENT

Vitamin D is essential for children aged 4–10 years due to its role in calcium and phosphate metabolism and the fact children typically grow at an average rate of about 5–7 cm/year. While spinal curvature is already established, bones continue to strengthen, including the ossification of the wrists and the broadening of the pectoral cage. Around age six, children begin losing milk teeth and replacing them with permanent teeth, a process that includes tooth calcification and continues through the early school years, with the eruption of four new teeth annually.

According to the Polish Nutritional Standards (Jarosz et al., 2020), children aged 4–10 years require a daily dose of 600 IU (15 µg) of vitamin D. Consuming 1–2 portions of fish per week can provide sufficient vitamin D and DHA, eliminating the need for additional supplementation or special sun exposure (see Table 1).

This is also the view of the group of experts (Czerwionka-Szaflarska et al., 2023), who additionally address the food safety concerns associated with the fish species recommended for children's consumption. However, a study by Zadka et al. (2019) revealed that 37.2% of children living in Central Poland, ate fish only once a week, and as many as 15% consumed fish just 1–3 times a month. The fish served to children were most often fried (67%), with the most commonly consumed species being cod (41%), smoked mackerel (25%), and pangasius (20%), which may not always align with health guidelines.

Table 1. Vitamin D and DHA content in fish species recommended for children, and in eggs (Kunachowicz et al., 2021)

Species	Vitamin D µg/100 g	DHA mg/100 g
Herring, raw*	19.0	620
Mackerel, raw**	5.0	2290
Rainbow trout, raw***	13.6	1760
Salmon, raw***	13.0	2150
Sardines, raw	11.0	100
Egg	1.7	80

*Weekly consumption of herring should not exceed one portion.
**Atlantic mackerel is recommended.
***Farmed species.

These findings underscore the importance of ongoing vitamin D supplementation, especially when children's diets fall short of recommended fish intake.

PARENTAL KNOWLEDGE AND SUPPLEMENTATION PRACTICES

Despite the expert consensus that most nutrients can be met through a balanced diet – with vitamin D being the notable exception – many parents still opt to supplement their children's diets. According to Mazurek et al. (2022), 71.4% of parents reported giving their children supplements, with 57% administering them daily. The most common supplements were multivitamins and multimineral preparations (39.2%), often taken to address perceived nutritional gaps (77%) or to improve immunity (63%). However, many parents remain unaware of proper supplementation practices. Specifically, 53% were unfamiliar with specific recommendations for their children's supplementation, and 45% lacked adequate knowledge about the role and safety of individual supplements.

The lack of sufficient and relevant knowledge, coupled with reliance on unverified sources of information (as reported by many parents) may result in the purchase of supplements that fail to meet their children's nutritional needs and may not be safe. Although Polish law requires dietary supplements to adhere to the qualitative and quantitative standards declared by the manufacturer on the packaging, these regulations are frequently violated (Bąk-Sypień et al., 2019; Raport NIK, 2016; 2021; Stępień et al., 2019).

SUPPLEMENTATION IN ADOLESCENCE

Adolescence is a period of significant, physical, mental, and hormonal changes. During this time, teenagers experience rapid growth, development and the onset of puberty. The group of experts recommend a daily dose of 1000–2000 IU (25–50 µg) of vitamin D for adolescents aged 11 to 18 years (Kuciński et al., 2023; Płudowski et al., 2023). From early May to the end of September, a 15–30 minute exposure to sunlight between 10 a.m. and 3 p.m. (with uncovered forearms and legs) can be sufficient to meet vitamin D needs. However, given the variability of sun exposure, year-round supplementation is advised and considered safe.

Puberty, which typically starts earlier in girls than boys (about two years earlier), is accompanied by a "growth spurt". During this phase, girls experience an annual growth of approximately 9 cm, while boys grow about 12 cm per year. It was once believed that bone mineral density issues primarily affected the elderly, but research has shown that irregular bone mineralization can occur during periods of rapid growth, such as adolescence (Kolmaga et al., 2011). For this reason, among others, year-round vitamin D supplementation is equally justified during adolescence.

Although no other specific supplements are recommended for adolescents, their unique nutritional needs are acknowledged in the 2019 Healthy Nutrition and Lifestyle Pyramid for Children and Youth. One concern, especially among girls, is anemia, which often results from iron and folic acid deficiencies. A study by Skolmowska and Głąbska (2021) found that 16.5% of girls aged 15 to 20 were anemic, and 74.9% consumed less iron than recommended.

Deficiencies can be exacerbated by alternative diets, which are increasingly adopted by young people, such as meat-free, vegetarian or vegan diets, where the bioavailability of iron is limited, increasing the risk of anemia. This concern is reflected in a recommendation from the PSGO, advising non-pregnant women of reproductive age (15–49) to undergo blood testing at least once a year (Sieroszewski et al., 2023). If any

deficiencies are detected, the recommendation is to consider appropriate supplementation under the supervision and guidance of a physician.

SUPPLEMENTATION IN ADULTHOOD

Adulthood is the longest stage of life, beginning at age 19 and continuing throughout the lifespan. The recommended daily dose of vitamin D for adults is 1000–2000 IU (25–50 μg), according to the group of experts. 14–30 minutes of daily sun exposure with uncovered forearms and legs between 10 a.m. and 3 p.m. from early May to the end of September may be sufficient, but additional vitamin D supplementation at the recommended dose is still advised and considered safe (Kuciński et al., 2023; Płudowski et al., 2023). For women of reproductive age, the PSGO recommends a daily intake of 0.4 mg of folic acid, in addition to a folate-rich diet (Zimmer et al., 2020). It is important to note that adulthood encompasses several distinct life stages, such as pregnancy and breastfeeding, for which tailored supplementation recommendations exist. In contrast, while there are no specific supplementation guidelines for menopause and andropause, these stages may still warrant supplementation because of the physiological changes they involve.

SUPPLEMENTATION IN PREGNANCY

During pregnancy, it is generally assumed that a healthy woman with a normal weight can meet most of her vitamin and mineral needs through a well-balanced diet. However, certain vitamins and minerals are recommended as supplements, with the type, dose and duration to be determined by the physician. In 2020, the Polish Society of Gynecologists and Obstetricians (PSGO) issued recommendations for supplementation during pregnancy (Zimmer et al., 2020). Experts emphasized the importance of proper nutrition, noting that if the diet is insufficiently balanced, supplementation is justified. The recommended supplements and their doses include folic acid, vitamin D, iodine, DHA and iron; the latter is not recommended unless medical tests indicate a deficiency. These recommendations are based on the fact that deficiencies in these nutrients may lead to pregnancy complications and impaired fetal development. Routine multi-vitamin supplementation is not advised, nor is supplementation with other nutrients in healthy women.

Folic acid

During the first trimester (up to week 12), the PSGO recommends a daily dose of 0.4–0.8 mg of folic acid, increasing to 0.6–0.8 mg/day after week 12 until the end of pregnancy for women without additional risk factors. Folic acid is crucial for preventing neural tube defects, which, in 95% of cases, occur as the first incidence in the family and cannot be predicted. As neural tube defects can develop very early in pregnancy, even before a woman is aware of her pregnancy (as early as weeks 3–4), the PSGO recommends women of childbearing age begin supplementation with 0.4 mg of folic acid daily at least 3 months before conception (Zimmer et al., 2020; Stoś et al., 2019).

Vitamin D

The PSGO recommends that healthy women with normal body weight supplement 1500–2000 IU (37.5––50 μg) of vitamin D daily. For pregnant and lactating women, Polish guidelines recommend a daily dose of 2000 IU (50 μg) (Płudowski et al., 2023), a recommendation supported by Stoś et al. (2019), who emphasize that lower doses are ineffective in maintaining adequate vitamin D levels throughout pregnancy. Although Kuciński et al. (2023) do not provide specific recommendations for these groups, Stoś et al. (2019) caution against the joint supplementation of vitamins D and K. They argue that vitamin K is generally abundant in the diet and synthesized by gut microbiota, making deficiencies rare in adults. While some studies have suggested benefits of combined vitamin D and K supplementation for osteoporosis prevention – particularly due to their shared role in bone metabolism – the findings remain inconsistent. Kucharz et al. (2018) attribute this inconsistency to the narrow focus of many studies, which often consider only clinical outcomes, like the incidence of low-energy fractures, rather than broader indicators of bone health. Nonetheless, existing evidence suggests that combined supplementation could be an effective strategy for preventing osteoporosis. Kucharz et al. (2018) also note with concern that this approach has not yet been formally adopted in Europe, the United States, or Poland.

Iodine

Iodine requirements increase during pregnancy, not only due to the growing fetus, but also because maternal thyroid hormone production rises, and iodine excretion in urine increases. The PSGO recommends a daily iodine supplement of 150–200 µg for healthy pregnant women (not affected by thyroid diseases) with the Polish Nutritional Standards recommending 220 µg/day (Jarosz et al., 2020). To avoid excessive iodine intake, the Dietary Supplements Advisory Team has limited the daily supplementation dose for pregnant women to 200 µg/day.

DHA

The PSGO advises all pregnant women to supplement with at least 200 mg of DHA daily. For those with low fish consumption, higher doses are recommended. Studies have shown that many pregnant women in Poland have DHA-deficient diets, so those consuming insufficient fatty fish (less than two portions a week, or 200–300 g) should consider taking 600 mg/day of DHA starting from the first month of pregnancy (Wierzejska et al., 2018).

Iron

Given the adverse effects of both iron deficiency and excess during pregnancy, the PSGO recommends checking blood morphology and ferritin levels at the first gynecological visit and periodically throughout pregnancy (weeks 15–20, 27–32, 33–37, and 38–39). Iron supplementation is prescribed by the gynecologist if hemoglobin (Hb) levels drop below 11 g/dl before week 16, accompanied by low ferritin. Detailed guidelines for diagnosing and treating iron deficiency are outlined in the PSGO Recommendations of 2023 (Sieroszewski et al., 2023).

Calcium

No official recommendations for calcium supplementation during pregnancy have been issued in Poland. However, the WHO has recommended that pregnant women with low calcium intake be supplemented with 1.5–2.0 g/day to reduce the risk of preeclampsia (WHO, 2018). In 2020, the WHO reiterated this recommendation for pre-pregnancy women as a preventive measure. However, studies on the benefits of calcium supplementation before and during pregnancy remain inconclusive, indicating that further research is needed.

SUPPLEMENTATION IN LACTATION

Just like during pregnancy, a well-balanced, varied diet in lactation typically provides enough vitamins and minerals to meet a woman's needs. However, vitamin D is an exception, as it is difficult to obtain adequate amounts through diet alone while breastfeeding. Therefore, the PSGO recommends supplementation (Zimmer et al., 2020). Given the increased nutritional demands of lactation, supplementation is often considered both beneficial and necessary, particularly when dietary intake is insufficient. Commonly recommended supplements include vitamin D, iodine, DHA, folic acid, and, in some cases, calcium.

Vitamin D

The PSGO recommends supplementation with 1500–2000 IU (37.5–50 µg) of vitamin D daily in healthy women with normal body weight – an identical recommendation to that made for pregnancy (Zimmer et al., 2020).

Iodine

Iodine requirements increase during lactation, as maternal intake directly determines the iodine content of breast milk The recommended daily intake for lactating women is 200 µg. A similar recommendation is provided by the Institute of Food and Nutrition (Stoś et al., 2019).

DHA

DHA is another essential nutrient during lactation. Expert recommendations on the supplementation of DHA and other omega-3 fatty acids for pregnant and lactating women – along with infants, children and adolescents (Czerwionka-Szaflarska et al., 2023) – emphasize that breastfeeding women should receive a daily supplementation of at least 200 mg of DHA. Additionally, the recommended intake is 250 mg/day EPA + DHA, with 100-200 mg specifically from DHA (Jarosz et al., 2020). Conversely, the National Food and Nutrition Institute (Stoś et al., 2019) highlights that a mother's DHA intake significantly influences the DHA content in breast milk. As such, they recommend

that women who consume fewer than two portions of fatty fish per week (less than 200–300 g) take a DHA supplement of 600 mg DHA/day.

Folic acid

The PSGO recommends continued folic acid supplementation during lactation at a dose of 0.6–0.8 mg/day in women without additional risk factors (Zimmer et al., 2020).

Calcium

There are no universal recommendations for routine calcium supplementation during lactation in Poland. However, the Polish nutrition standards advise an increased daily calcium intake of 1100–1300 mg for adolescent mothers (<19 years), and 800–1000 mg/day for women aged 19–50 – values consistent with the general population (Jarosz et al., 2020). In contrast, Stoś et al. (2019) recommend that lactating women, particularly those with calcium-deficient diets, be supplemented with 1000–1200 mg of calcium per day. This recommendation seems justified, considering the importance of calcium homeostasis in a lactating woman's body.

During lactation – particularly in the first four months – calcium demand increases by an average of 50% (Thiele et al., 2017). This rise is primarily due to calcium loss through breast milk, which typically ranges from 200–400 mg/day and may increase to as much as 700–1000 mg per day during the second and third months of breastfeeding. To maintain calcium homeostasis in the women's body and support healthy bone metabolism, vitamin D supplementation is recommended. The presence of vitamin D in breast milk contributes to its so-called anti-rickets activity. A deficiency of vitamin D in lactating women is associated with significantly lower calcium concentrations in breast milk (Thiele et al., 2017).

It is important to note that additional calcium required for breast milk production is not supplied through increased intestinal absorption via calcitriol. Instead, in cases of dietary deficiency, it is mobilized from maternal stores through bone resorption, a process driven by increased synthesis of the PTH-like peptide and low estradiol concentration.

Finally, the Polish Academy of Sciences' Committee on Food Science, referencing guidelines from the Scientific Committee on Food (SCF) and the European Food Safety Authority (EFSA), regards a calcium intake of up to 2500 mg per day from food, water, and supplements as safe (Wawrzyniak et al., 2021).

Summary of supplementation in lactation

Although a well-designed, nutrient-rich diet is generally sufficient to meet most micronutrient needs during lactation – with vitamin D as the primary exception – expert guidelines increasingly support selective supplementation. This recommendation reflects the elevated nutritional demands of breastfeeding, particularly in light of evidence that a 500 kcal increase in energy intake (Jarosz et al., 2020) does not necessarily ensure adequate intake of key vitamins and minerals essential for maternal health and optimal infant development.

SUPPLEMENTATION IN MENOPAUSE

Menopause is a natural biological process, but its effects can significantly impact a woman's health and well-being. Numerous studies have shown that dietary habits play a key role in the severity of menopause-related symptoms (Erdélyi et al., 2023; Soleymani et al., 2019). For this reason, improving dietary quality is often considered an effective strategy to manage symptoms and may reduce the need for supplementation, with the exception of vitamin D, for which a daily dose of 1000–2000 IU (25–50 μg) is recommended.

To date, the only formal recommendations for "supplementation" during menopause in Poland are those concerning hormone replacement therapy (HRT) and the use of progesterone, issued by the Polish Menopause and Andropause Society (Bińkowska et al., 2014) and the Polish Society of Gynecologists and Obstetricians (Bomba-Opoń et al., 2015), respectively. These recommendations refer to pharmacological treatments rather than dietary supplements and are based on extensive clinical evidence. The benefits and risks of HRT have been widely studied and reviewed both by these expert bodies and other researchers (Skrzypulec-Plinta et al., 2019).

It is worth noting that the Polish Menopause and Andropause Society emphasizes a higher risk of breast cancer associated with the use of progestogens compared to estrogens. However, they also point out that

the risk is comparable to that of gaining 5 kg after menopause or regularly consuming strong alcohol. Importantly, all HRT medications are prescription only.

By contrast, a wide range of recommendations for dietary supplements during menopause can be found on internet platforms. These often include herbal sedatives and natural sources of phytoestrogen, which are available over the counter and, in some cases, used as alternatives to conventional HRT. However, it is essential to recognize that their biological activity – primarily through binding to estrogen receptors – is significantly weaker than that of 17β-estradiol used in medical HRT.

Additionally, many multivitamin and mineral supplements marketed for menopausal women are not clinically justified if the diet is well-balanced and aligned with nutritional recommendations for this stage of life. In this context, awareness of menopause-related health issues among Polish women remains low. According to the 2023 report *Menopauza bez tabu* ("Menopause Without a Taboo"), based on a representative survey of peri- and postmenopausal women:

- 93% could not define what menopause is
- 71% rated their knowledge as insufficient
- 50% described their experience of menopause as negative or neutral.

When asked how they manage menopausal symptoms:

- 36% reported using herbal products (infusions, tinctures, pills)
- 35% used vitamins (most commonly C and D) and minerals
- 34% turned to homeopathic remedies
- 15% used phytoestrogens
- 17% said they had no specific strategy to manage menopausal symptoms.

Awareness of HRT was limited – only half of the respondents had heard of it. Of those, 44% of premenopausal and 47% of menopausal women, stated they did not plan to use hormonal therapy (Menopauza bez tabu, 2023).

SUPPLEMENTATION IN ANDROPAUSE

Andropause, like menopause, is a natural consequence of aging. However, in men, the focus is more often placed on medical treatment than on dietary supplementation. Most commonly, treatment involves restoring hormonal balance in testosterone-deficient individuals through testosterone hormone replacement therapy (THRT). This is frequently combined with human chorionic gonadotropin (hCG) therapy (Wenker et al., 2015).

The European Menopause and Andropause Society (EMAS) currently recommends that THRT be reserved for men who have been confirmed to have low testosterone levels and only after potential concerns regarding the safety of long-term testosterone therapy have been addressed (Kanakis et al., 2023). EMAS emphasizes the importance of lifestyle interventions, especially for overweight or obese individuals. Diet modification and regular physical activity are advised as first-line strategies to reduce body weight and naturally increase testosterone levels.

In Poland, there are no formal national guidelines for testosterone supplementation. Decisions regarding THRT are typically made on an individual basis, depending on the patient's measured testosterone levels and clinical symptoms (Gomuła and Rabijewski, 2010). The therapy may be initiated by various specialists, including endocrinologists, gynecologists, urologists, psychiatrists, sexologists, or andrologists.

As in the case of menopause, various dietary supplements marketed online target men undergoing andropause. These often include multivitamins, minerals, and so-called "testosterone boosters" containing ingredients such as steroidal saponins, which are believed to stimulate testosterone production. Some over-the-counter prescriptions may also contain dehydroepiandrosterone (DHEA). However, the use of such supplements without medical supervision is not recommended. Even non-prescription (over-the-counter) products can cause adverse effects, sometimes even when used exactly as directed in the information leaflet.

An exception is vitamin D, which is widely recommended. According to expert consensus (Kuciński et al., 2023; Płudowski et al., 2023), men should supplement with 1000–2000 IU/day (25–50 μg) of vitamin D, alternatively, obtain it through sun exposure from early May to the end of September. In that period, 15–30 minutes of daily exposure between 10 a.m. and 3 p.m., with uncovered forearms and legs,

is considered sufficient. Nonetheless, additional supplementation with vitamin D during those months is also considered safe and recommended by the expert group.

SUPPLEMENTATION IN OLD AGE

According to the World Health Organization (WHO), old age begins at 60 years, while the United Nations (UN) defines it as beginning at 65 years – a definition also adopted by Kuciński et al. (2023). These authors recommend that seniors aged 65–75 years supplement vitamin D at a daily dose of 1000–2000 IU (25–50 µg) year-round, due to reduced skin synthesis of cholecalciferol. For those older than 75 years, who often experience impaired vitamin D absorption and altered vitamin D metabolism (Donati et al., 2023), a higher daily dose of 2000–4000 IU (50–100 µg) is advised.

As an alternative to cholecalciferol supplementation, Płudowski et al. (2023) recommend calcifediol (a solution for oral application) at a dose of 10 µg daily throughout the year, with effectiveness monitored by measuring blood serum 25(OH)D levels after 6–8 days. When documented vitamin D deficiency is present, the doses of cholecalciferol or calcifediol should be individually adjusted based on blood 25(OH)D concentrations, age, dietary vitamin D intake, underlying health conditions and treatments, and – in the case of cholecalciferol – body weight.

In Poland, vitamin D remains the only dietary supplement formally recommended for the elderly, reflecting the physiological changes associated with aging. These changes vary between individuals, organs, and systems, occurring at different times and intensities.

While the rate of food passage through the small intestine generally remains unchanged with age, nutrient absorption can be affected. Decreases are often observed in the absorption of carbohydrates, proteins, fats, vitamins B_{12}, D_3, folates and calcium (Morley, 2007), whereas absorption of cholesterol and vitamins A and C may increase. Absorption of thiamine, riboflavin, vitamin K, zinc, and magnesium typically remains stable (Feldman et al., 2020).

However, numerous other factors can contribute to nutritional deficiencies in the elderly, including, diminished appetite due to reduced taste and smell sensitivity, chewing difficulties due to tooth loss, swallowing disorders due to weakened esophagus muscles and lower saliva production, and gastrointestinal diseases that impair digestion and absorption. Additional risks may arise from behavioral factors (e.g., skipping meals, reduced intake of vegetables, fruits, dairy products, meats, and fluids) and socioeconomic conditions (Gajda et al., 2023).

These risk factors may necessitate supplementation with specific vitamins (B_2, B_6, B_{12}, folic acid, E, C) and/or minerals (calcium, zinc, iron), as well as omega-3 fatty acids. However, the type, dose and duration of supplementation should be individually tailored by a physician. Medical supervision is critical because the PolSenior study (Błędowski et al., 2021) that 90% of individuals aged 65 and older use medication daily, with over half taking at least five medications, significantly increasing the risk of adverse drug-supplement interactions.

Despite this, supplementation is often initiated without medical consultation. In a study by Kostecka (2015), over half (55.5%) of elderly participants reported supplementing their diets, with 34% using supplements regularly (at least 4–5 times a week) and 30% using two or more supplements simultaneously, often without physician guidance. There is a lack of current research quantifying supplement use among Polish seniors, although occasional media reports suggest that supplement consumption is rising, sometimes involving the intake of multiple products daily.

This overuse may be driven by aggressive marketing strategies targeting seniors, portraying supplements as simple solutions for memory enhancement, cognitive support, circulatory health, joint care, and overall vitality. Particularly appealing to older consumers are "natural" supplements and herbal products, whose perceived safety and efficacy are often overstated (Stępień et al., 2019).

However, as systematic reviews by Khan et al. (2019) and Zhang et al. (2020) demonstrate, there is no unequivocal that dietary supplements effectively prevent non-communicable diseases. In contrast, there is robust evidence supporting the role of proper nutrition and healthy lifestyle choices in reducing the risk of major conditions such as cardiovascular diseases, obesity, diabetes and certain cancers (notably breast, prostate, and colon cancers).

CONCLUSIONS

In summary, according to the opinions, recommendations and guidelines provided by expert groups, the use of dietary supplements should be restricted to situations where their necessity is clearly justified. The decision to initiate supplementation should be made in consultation with a physician, pharmacist or dietician, particularly when concurrent medication use is involved.

DECLARATIONS

Data statement
All data supporting this study has been included in this manuscript.

Ethical Approval
Not applicable.

Competing Interests
The authors declare that they have no conflicts of interest.

OPEN ACCESS

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