

# Vitamin D

*"I need more... Vitamin D, in my diet"*

Infos assembled by Jimmy

All the references are displayed at the end of the document

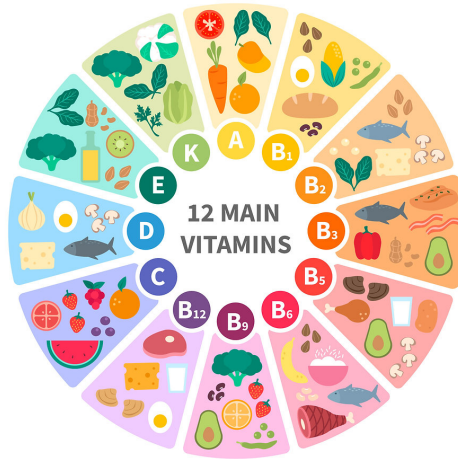


# Contents

<b>1</b>	<b>What are vitamins, in general ?</b>	<b>3</b>
<b>2</b>	<b>What is Vitamin D ?</b>	<b>3</b>
2.1	Types of Vitamin D . . . . .	3
2.2	Synthesis by sunlight . . . . .	3
2.3	Need for Magnesium . . . . .	4
2.4	Synergy with Vitamin K2 . . . . .	4
2.5	Recommanded Vitamin D daily intake . . . . .	4
<b>3</b>	<b>Vitamin D benefits</b>	<b>5</b>
3.1	Calcium and Phosphorus regulation . . . . .	5
3.1.1	Calcium . . . . .	5
3.1.2	Phosphorus . . . . .	5
3.2	Slowing down cell aging . . . . .	6
<b>4</b>	<b>Vitamin D deficiency</b>	<b>6</b>
<b>5</b>	<b>Where to find Vitamin D ?</b>	<b>7</b>
5.1	Sources of Vitamin D . . . . .	7
5.2	Vitamin D supplementation . . . . .	8
5.2.1	Gummies and tablets . . . . .	8
5.2.2	Capsules and oral sprays . . . . .	8
<b>6</b>	<b>Conclusion</b>	<b>8</b>

# 1 What are vitamins, in general ?

Simply put, vitamins are vital substances for the well-being of a person. They are active in growth, skeletal development, use of micro-nutrients (like Calcium, Zinc, Magnesium, Phosphorus etc.), sight (e.g. Vitamin A), blood clotting, nervous system and immune system, DNA production, etc. [5].



However, the body CANNOT synthesize (aka produce) vitamins by itself, EXCEPT Vitamin D which is the main focus of this document, and vitamin K. An appropriate intake of vitamins can prevent cancer, cardiovascular diseases and many age-related diseases. Overconsumption of vitamins can be toxic for the body and vitamin deficiency can lead to clinical or pathological disorders.

Vitamins DO NOT give energy as they contain 0 calorie, but having an adequate intake of all the needed vitamins is good to perform your daily activities and to keep your body healthy and functional.

## 2 What is Vitamin D ?

### 2.1 Types of Vitamin D

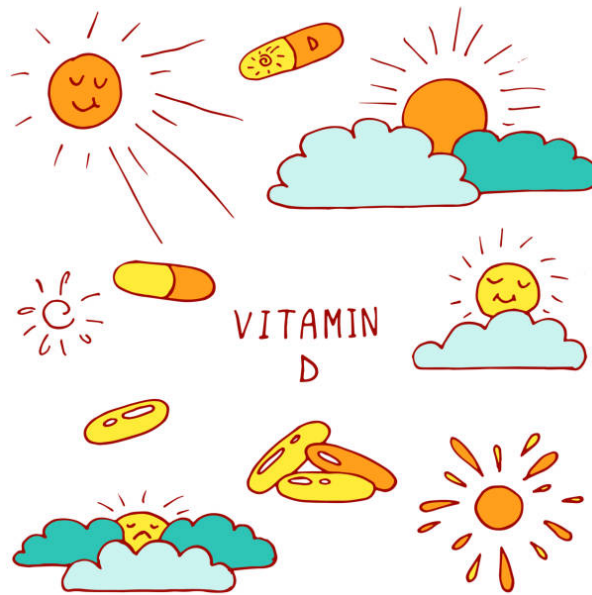
There are two types of Vitamin D (but they are very very similar nutritionally, so we group them as just "Vitamin D") : Vitamin D2 and Vitamin D3.

- Vitamin D2 (ergocalciferol) is found in plants and shrooms (pretty vegan friendly)
- Vitamin D3 (cholecalciferol) is mostly found in oily fish, egg yolk and fortified dairy products (a lot less vegan friendly)

Vitamin D is a liposoluble vitamin (in reality it is a hormone, but in practice a common mortal like me does not need to make that difference anyway), which means it dissolves in fat [5]. Because Vitamin D is stored in fat (in the liver and the body's fatty tissue), there is a higher risk of toxicity if the intake is too high. The amount of fat with which Vitamin D is ingested does not seem to significantly modify the bioavailability (aka absorption) of Vitamin D3 [9].

### 2.2 Synthesis by sunlight

If the body is exposed to the sunlight, it can synthesize this vitamin (more precisely Vitamin D3) in the skin by UV rays. 15 to 20 minutes in the sun (safely) is enough to get approximately 80% [2] your daily intake of Vitamin D, as sunlight is the major source of this vitamin. The remaining 20% is found in your diet.



People with darker skin can have a harder time synthesizing Vitamin D. Sunscreen, pollution, age and seasons can also impair its synthesis [25]. The body stops producing Vitamin D from sunlight when the needs are met, so over-exposition to sunlight for Vitamin D is useless [33] (or even dangerous, c.f. skin cancer [15]). Indeed, in longer exposure to sunlight, compounds called "lumesterol" are formed and they do not show Vitamin D activity [2].

### 2.3 Need for Magnesium

Vitamin D CANNOT be metabolized ("transformed via chemical reactions and used") by the body without the necessary Magnesium level. It means that, without enough Magnesium, Vitamin D is stored but not used. 50% of Americans are Magnesium deficient.

The recommended Magnesium intake is 420 micrograms for men and 320 micrograms for women. Foods high in magnesium include almonds, bananas, beans, broccoli, brown rice, cashews, egg yolk, fish oil, flaxseed, green vegetables, milk, mushrooms, other nuts, oatmeal, pumpkin seeds, sesame seeds, soybeans, sunflower seeds, sweet corn, tofu, and whole grains [7].

Vitamin D itself contributes to the good absorption of Magnesium [6], so these two compounds kinda have a love-love relationship.

### 2.4 Synergy with Vitamin K2

Vitamin K2 can pull Calcium from the blood so it can be used to build or strengthen the bones and teeth [21]. Vitamin K2 can also reduce calcification (Calcium accumulation) of soft tissues like kidneys or blood vessels, which keeps the heart healthy.

Studies have found that combining vitamins K2 and D3 in the treatment of osteoporosis may have additive or synergistic effects. The combination of vitamin K and D can significantly increase the total bone mass density, with a better effect with Vitamin K2 [23]. Adequate intake or supplementation with Vitamin D and Vitamin K combined are reported to be key protective agents in the prevention of osteoporosis [1]. Another study shows that the combination of vitamin D3 and K2 significantly increased osteoblast cell formation (i.e. cells that synthesize bone) [27].

Vitamin K2 is pretty hard to come by. It is found in natto, some cheese, chicken, salmon, etc.

### 2.5 Recommended Vitamin D daily intake

The recommended intake of Vitamin D is 600 IU (International Unit) per day for children and adults, and 800 IU for elders [12] [31]. IU is a unit used to measure vitamin activity and **differs for each**

substance.

For Vitamin D, 40 IU = 1 microgram. Thus 600 IU = 15 micrograms and 800 IU = 20 micrograms.

## 3 Vitamin D benefits

Vitamin D plays a crucial role in the quality of bone tissues, muscular tissues and immune system, as almost every organ and cell in the body has a Vitamin D receptor [18].

### 3.1 Calcium and Phosphorus regulation

Vitamin D helps in absorbing Calcium (which, in itself, is not that easy to get) [5] [17] and Phosphorus in the blood.

#### 3.1.1 Calcium

A good Calcium regulation leads to :

- Optimal tissue mineralization : bones, teeth and cartilage (ears, nose)
- Good muscular contraction
- Good nervous transmission
- Good coagulation (liquid blood changes into semisolid blood clots, which helps preventing blood loss from damaged blood vessels) [8]
- Good immune health and hormone regulation [20]
- Cell differentiation (an unspecialized cell that takes on individual characteristics to become a specialized cell [10])

Too much Vitamin D tends to increase Calcium levels too much in the blood, which is NOT good for cardiovascular and renal health. Plus, you can experience headaches, nausea, vomiting or excessive fatigue [20].

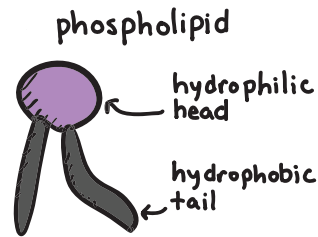
#### 3.1.2 Phosphorus

Phosphorus is a very prominent component in the body and is fairly easy to find in food.

It helps with apoptosis (the natural and planned death of the cells) and it is a component of **ATP** (stands for "Adenosine TriPhosphate", that comes often in nutrition), which acts as the body primary source of energy.

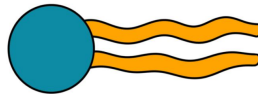
Phosphorus is also found in DNA (which stores genetic information) and RNA (a messenger that helps to synthesize proteins). Thus, without Phosphorus, the body would NOT be able to properly create genes, proteins and new cells.

Furthermore, Phosphorus is part of compounds called "phospholipids" (Phosphorus + saturated fat + unsaturated fat, c.f. my document on olive oil for more infos on fats) that make up your cell membranes [14].

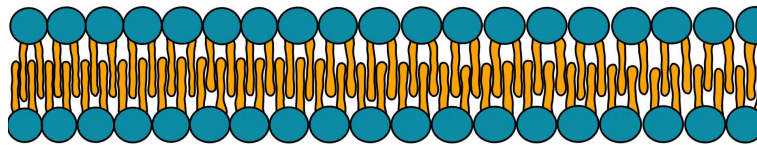


### Types of Lipids: Phospholipids

Phospholipids make up the cell membrane.  
Each phospholipid consists of a phosphate head linked to 2 fatty acid chains.



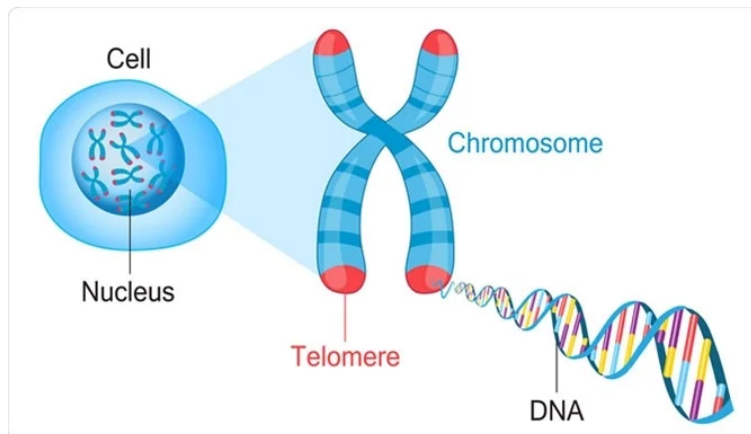
The head is hydrophilic and interacts with water. The tails are hydrophobic and hate water.  
Phospholipids create two layers to make the cell's double membrane.



## 3.2 Slowing down cell aging

A very recent study (June 2025) [38] suggests that Vitamin D supplements may lead to a strategy to counter biological aging.

Telomeres are regions of DNA [35] and shorten every time a cell divides. This shortening has been linked to aging and to age-related diseases like vascular dementia, type II diabetes, and cancer.



The study showed that the telomeres exposed to Vitamin D are longer than those which were not, and that is equivalent to 3 years of aging [29].

## 4 Vitamin D deficiency

Vitamin D deficiency is very common worldwide (1 billion children and adults at risk [19]). In Europe, 40% of the population has a Vitamin D deficiency [2]. During winter, in France, 75% of the population lacks Vitamin D [3].

For example, Vitamin D deficiency can lead to :

- Muscular issues (weakness, aches) [5] [17] [19]

- Rickets (soft and weak bones in children)
- Osteomalacia (decalcification of the bones, which can lead to bone deformation and a higher risk of fracture) [28],
- Osteoporosis (your bones become weak and brittle) [5]
- Multiple sclerosis (breakdown of the protective covering of nerves called "myelin") [11]
- Increased symptoms of depression and anxiety [2]
- Increased risk of cardiovascular diseases [19] [34]
- Increased risk of autoimmune diseases [19]
- Type I and Type II diabetes [17] [19] [39]
- Anemia (abnormal low level of hemoglobin, a substance which helps red blood vessels to carry oxygen to all organs)[5]
- Alzheimer's disease [19]
- Breast, colon, pancreas and prostate cancer [19] [22]

Furthermore, pregnant and lactating women need more Vitamin D than usual, as biochemical disturbances and bone issues can have occur in the infant [17]. In a study on 1048 pregnant women [26], 80% of them presented a Vitamin D deficiency. Another study from Karolina Lagowska [24] reported that low Vitamin D concentrations co-occur with disturbed menstrual cycles : women who did not meet the recommended level of Vitamin D had almost five times the odds of having menstrual cycle disorders as women who were above the recommended Vitamin D level.

## 5 Where to find Vitamin D ?

### 5.1 Sources of Vitamin D



The main source of Vitamin D is the sunlight. Note that diet alone CANNOT make up the needed daily intake of Vitamin D [25]. Here are good sources of Vitamin D [4] [32]:

- Egg yolks
- Oily fish (poissons gras, e.g. salmon, tuna, anchovy, etc.)
- Shrooms (e.g. girolles, cèpes, etc.)
- Black chocolate
- Butter
- Vitamin D fortified products (e.g milk or cereals)

- Vitamin D supplementation

It is possible to get the daily intake of Vitamin D while following a vegan diet, as Vitamin D3 is produced by sun exposition and Vitamin D2 is mostly found in plants, c.f. Section 2.

Fun fact : Vitamin D food fortification is the lowest in France [30].

## 5.2 Vitamin D supplementation

For some populations, Vitamin D supplementation is necessary to ensure an adequate status. To prevent any risks of overdose, medicinal products should be used in preference to food supplements, as they guarantee readable information on doses, precautions for use and risk of adverse effects. Supplementary intake should only be on dietary or medical advice [4].

### 5.2.1 Gummies and tablets

There is a study comparing the bioavailability (absorption) of Vitamin D3 between gummies (manufactured by VitaFusion Church & Dwight, Princeton, NJ) and tablets (manufactured by Nature Made, Mission Hills, CA). It found that, for Vitamin D, gummies were more bioavailable than tablets [37].

The coating seems to play a role in the results : gummies were coated with syrup/sucrose/gelatin/pectin and tablets with cellulose gel/maltodextrin/gelatin/cornstarch. These different coatings lead to a "different dissolution" and a different absorption. Plus, the mean of ingestion is slightly different. Indeed, to quote the study : "one also must consider the digestive processes that begin in the mouth. Gummies are chewed and would begin their dissolution in the mouth when combined with saliva. This process of dissolution would continue in the stomach, with further dissolution in the small intestine".

Gummies have a shorter shelf life and very often contain a non negligible amount of sugar and natural/artificial flavors to make the taste better, but they are more easy to "eat" than tablets (which can leave a bad aftertaste in the mouth) or capsules (tasteless but some people have trouble swallowing them, like me) [16].

Tablets have a longer shelf life and allow for an exact dosage of active ingredients, but can be absorbed slower depending on its coating and composition [13] and can be harder to swallow.

### 5.2.2 Capsules and oral sprays

Vitamin D3 capsules are odorless and allow the integration of synergistic ingredients and actives in the formula and in a precise and serious dosage [13]. However, they have a lower shelf life and can contain less active ingredients : for instance, you may need more capsules to be equivalent to one tablet.

Vitamin D3 oral sprays are also a form of supplementation that bypasses the gastrointestinal absorption route [36]. The study [36] showed that oral spray Vitamin D3 is an equally effective alternative to capsule supplementation in healthy adults.

## 6 Conclusion

As Vitamin D is used almost everywhere in our body, it is important to have an adequate intake of this vitamin. Taking advantage of our ability to synthesize it easily, going out in the sunlight every day is an excellent way to meet our daily Vitamin D needs. Moreover, it is also very important to have an adequate intake of Magnesium to properly metabolize Vitamin D in the body.

However, Vitamin D is one of the most common deficiency, thus Vitamin D rich food and complementation may help to solve this issue, while being careful as to not consume it in excess to avoid unwanted health issues.



## References

- [1] Jan O. Aaseth et al. “The Importance of Vitamin K and the Combination of Vitamins K and D for Calcium Metabolism and Bone Health: A Review”. In: *Nutrients* 16.15 (Jan. 2024), p. 2420. ISSN: 2072-6643. DOI: 10.3390/nu16152420.
- [2] Şerife Akpınar and Makbule Gezmen Karadağ. “Is Vitamin D Important in Anxiety or Depression? What Is the Truth?” In: *Current Nutrition Reports* 11.4 (2022), pp. 675–681. ISSN: 2161-3311. DOI: 10.1007/s13668-022-00441-0.
- [3] Anamacap. *Vitamine D2*. URL: <https://www.anamacap.fr/telechargement/alimentation/vitamineD2.pdf>.
- [4] ANSES. *ANSES VITAMIN D*. URL: <https://www.anses.fr/fr/content/vitamine-d-pourquoi-et-comment-assurer-un-apport-suffisant>.
- [5] ANSES. *What are vitamins ?* URL: <https://www.anses.fr/en/content/what-are-vitamins>.
- [6] Apyforme. *Vitamine D et Magnesium*. URL: <https://apyforme.com/blog/articles-sante/vitamine-d-et-magnesium>.
- [7] American Osteopathic Association. *Researchers find low magnesium levels make Vitamin D ineffective*. URL: <https://osteopathic.org/2018/02/26/researchers-find-low-magnesium-levels-make-vitamin-d-ineffective/>.
- [8] *Blood coagulation*. URL: [https://ec.europa.eu/health/scientific\\_committees/opinions\\_layman/en/non-human-primates/glossary/abc/blood-clot.htm](https://ec.europa.eu/health/scientific_committees/opinions_layman/en/non-human-primates/glossary/abc/blood-clot.htm).
- [9] P. Borel, D. Caillaud, and N. J. Cano. “Vitamin D Bioavailability: State of the Art”. In: *Critical Reviews in Food Science and Nutrition* 55.9 (2015), pp. 1193–1205. ISSN: 1549-7852. DOI: 10.1080/10408398.2012.688897.
- [10] *Cell Differentiation*. URL: <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/cell-differentiation>.
- [11] Mayo Clinic. *Multiple Sclerosis*. URL: <https://www.mayoclinic.org/diseases-conditions/multiple-sclerosis/symptoms-causes/syc-20350269>.
- [12] Mayo Clinic. *Vitamin D*. URL: <https://www.mayoclinic.org/drugs-supplements-vitamin-d/art-20363792>.
- [13] Green Ethnies. *Quelles formes choisir*. URL: <https://green-ethnies.ch/en/blogs/blog/quelles-formes-choisir>.
- [14] Talon Fitness. *Phosphorus - The True Nutrients*. Youtube. 2024. URL: <https://www.youtube.com/watch?v=9cW6F0hvvs0>.
- [15] Skin Cancer Foundation. *Sun protection and Vitamin D*. URL: <https://www.skincancer.org/fr/blog/sun-protection-and-vitamin-d>.
- [16] Goodrx. *Are gummy vitamins better than pills ?* URL: <https://www.goodrx.com/well-being/supplements-herbs/are-gummy-vitamins-better-than-pills>.
- [17] William B Grant and Michael F Holick. “Benefits and Requirements of Vitamin D for Optimal Health: A Review”. In: ().
- [18] Michael F Holick. “Evidence-Based D-bate on Health Benefits of Vitamin D Revisited”. In: *Dermato-Endocrinology* 4.2 (Apr. 2012), pp. 183–190. ISSN: 1938-1980. DOI: 10.4161/derm.20015.
- [19] Michael F. Holick. “Health Benefits of Vitamin D and Sunlight: A D-bate”. In: *Nature Reviews Endocrinology* 7.2 (Feb. 2011), pp. 73–75.
- [20] INSERM. URL: <https://www.inserm.fr/c-est-quoi/jveux-du-soleil-cest-quoi-la-vitamine-d>.
- [21] Joinmidi. *Benefits of D3 and K2*. URL: <https://www.joinmidi.com/post/benefits-of-d3-and-k2>.
- [22] Aruna V. Krishnan, Srilatha Swami, and David Feldman. “The Potential Therapeutic Benefits of Vitamin D in the Treatment of Estrogen Receptor Positive Breast Cancer”. In: *Steroids* 77.11 (Sept. 2012), pp. 1107–1112. ISSN: 0039-128X. DOI: 10.1016/j.steroids.2012.06.005.

- [23] Xiaotong Kuang et al. “The Combination Effect of Vitamin K and Vitamin D on Human Bone Quality: A Meta-Analysis of Randomized Controlled Trials”. In: *Food & Function* 11.4 (Apr. 2020), pp. 3280–3297. ISSN: 2042-650X. DOI: 10.1039/c9fo03063h.
- [24] Karolina Lagowska. “The Relationship between Vitamin D Status and the Menstrual Cycle in Young Women: A Preliminary Study”. In: *Nutrients* 10.11 (Nov. 2018), p. 1729. ISSN: 2072-6643. DOI: 10.3390/nu10111729.
- [25] Laboratoire Lescuyer. *Vitamine D*. URL: <https://www.laboratoire-lescuyer.com/blog/vitamine-d-de-nombreux-roles-a-jouer-pour-notre-sante>.
- [26] Cheng-Chiang Liu and Jian-Pei Huang. “Potential Benefits of Vitamin D Supplementation on Pregnancy”. In: *Journal of the Formosan Medical Association* 122.7 (July 2023), pp. 557–563. ISSN: 0929-6646. DOI: 10.1016/j.jfma.2023.02.004.
- [27] Sindy Cornelia Nelwan et al. “The Benefits of the Combination of Vitamin D3, K2 Supplements, and UV-B Exposure for Increasing Bone Density: A Simple Solution for Bone Health”. In: *Journal of International Dental and Medical Research* 14.4 (2021), pp. 1453–1458. ISSN: 1309-100X.
- [28] Santé sur le net. *Osteomalacie*. URL: <https://www.sante-sur-le-net.com/maladies/rhumatologie/osteomalacie>.
- [29] NHI. *Vitamin D supplements may slow cellular aging*. URL: <https://www.nhlbi.nih.gov/news/2025/vitamin-d-supplements-may-slow-cellular-aging>.
- [30] Lars Ovesen, Rikke Andersen, and Jette Jakobsen. “Geographical Differences in Vitamin D Status, with Particular Reference to European Countries”. In: *The Proceedings of the Nutrition Society* 62.4 (Nov. 2003), pp. 813–821. ISSN: 0029-6651. DOI: 10.1079/PNS2003297.
- [31] Medline Plus. *Vitamin D*. URL: <https://medlineplus.gov/ency/article/002405.htm>.
- [32] Pharmacie du Polygone. *Vitamines D2 et D3 : Comment faire la difference ?* URL: <https://www.pharmaciepolygone.com/fr/page/vitamines-d2-et-d3-comment-faire-la-difference>.
- [33] Vegan pratique. *La vitamine D*. URL: <https://vegan-pratique.fr/conseils-nutrition-vegetalienne/la-vitamine-d/>.
- [34] Fatemeh Tavakoli, Kokab Namakin, and Mahmood Zardast. “Vitamin D Supplementation and High-Density Lipoprotein Cholesterol: A Study in Healthy School Children”. In: *Iranian Journal of Pediatrics* 26.4 (July 2016), e3311. ISSN: 2008-2142. DOI: 10.5812/ijp.3311.
- [35] *Telomere*. URL: <https://www.genome.gov/genetics-glossary/Telomere>.
- [36] Joshua J. Todd et al. “Vitamin D3 Supplementation in Healthy Adults: A Comparison between Capsule and Oral Spray Solution as a Method of Delivery in a Wintertime, Randomised, Open-Label, Cross-over Study”. In: *British Journal of Nutrition* 116.8 (Oct. 2016), pp. 1402–1408. ISSN: 0007-1145, 1475-2662. DOI: 10.1017/S0007114516003470.
- [37] Carol L. Wagner et al. “Bioequivalence Studies of Vitamin D Gummies and Tablets in Healthy Adults: Results of a Cross-Over Study”. In: *Nutrients* 11.5 (May 2019), p. 1023. ISSN: 2072-6643. DOI: 10.3390/nu11051023.
- [38] Haidong Zhu et al. “Vitamin D3 and Marine  $\omega$ -3 Fatty Acids Supplementation and Leukocyte Telomere Length: 4-Year Findings from the VITamin D and Omega-3 TriaL (VITAL) Randomized Controlled Trial”. In: *The American Journal of Clinical Nutrition* 122.1 (July 2025), pp. 39–47. ISSN: 0002-9165. DOI: 10.1016/j.ajcnut.2025.05.003.
- [39] A. Zittermann. “The Estimated Benefits of Vitamin D for Germany”. In: *Molecular Nutrition & Food Research* 54.8 (2010), pp. 1164–1171. ISSN: 1613-4133. DOI: 10.1002/mnfr.200900494.