

Nutritional Lipids  
Whitepaper | July 2021

# How Nutritional lipids support health across the life span



# Contents

- 04 An introduction to omega-3 and omega-6 LCPUFAs
- 08 Supporting cardiovascular health
- 10 Addressing brain health
- 12 Maintaining good vision
- 12 Beyond well-known benefits
- 14 Why is lipid status low worldwide?
- 15 Bringing effective solutions to the market
- 16 Partner with dsm-firmenich

# Executive summary

The omega-3 long chain polyunsaturated fatty acids (LCPUFAs) docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), and omega-6 LCPUFA arachidonic acid (ARA) are an important part of the human diet and are well-known to play a key role in human growth and development, as well as overall health and wellbeing throughout life. There are around 40,000 scientific papers, including over 4,000 human trials, dedicated to the study of omega-3 LCPUFAs, meaning they are amongst the most researched nutrients in the world.<sup>1</sup>

DHA and ARA promote optimal growth and development during the first 1,000 days – between the onset of a woman's pregnancy and her child's second birthday – laying the foundation for a healthy childhood, adolescence and adulthood.<sup>2</sup> EPA and DHA are proven to provide us with specific health benefits as we age, with current scientific studies emphasizing their supportive role in heart, brain and eye health, as well as their positive effects on inflammatory pathways and immune health.<sup>3-7</sup> And, as new research emerges in different areas of human health, scientists and nutritionists continue to gain a deeper understanding of the effects of nutritional lipids on the body beyond their recognized health benefits.

Despite the important and proven functions of omega-3 LCPUFAs and high consumer awareness of these nutrients, less than 20% of the global population consumes recommended levels.<sup>8</sup> This has a significant impact on public health and global healthcare systems, because lower levels of EPA and DHA may be linked to negative health outcomes, including higher risk of non-communicable diseases (NCDs).<sup>9</sup>

This whitepaper draws on the latest clinical and market data to demonstrate the importance of nutritional lipids across the life span, and discusses how changing the conversation around omega-3 LCPUFAs may help to create accessible purpose-led products that meet the latest consumer preferences. It also explores how manufacturers can tap into the lesser-known health benefits offered by omega-3 LCPUFAs, including their positive impact on immunity, sports performance, mood and sleep, to reach a new generation of consumer seeking holistic health and wellness solutions. While the paper will discuss the inclusion of omega-3 and omega-6 LCPUFAs in nutritional solutions, it does not provide scientific or medical recommendations for their use, nor does it advise using nutritional solutions to treat the medical conditions outlined.



# An introduction to omega-3 and omega-6 LCPUFAs

The omega-3 and omega-6 LCPUFA families are important dietary fats that provide humans with several health benefits.

The human body can derive these LCPUFAs to a limited degree by synthesizing them through the essential fatty acids  $\alpha$ -linoleic acid (ALA; 18:3 n-3) and linoleic acid (LA; 18:2 n-6).<sup>10,11</sup> However, the conversion of  $\alpha$ -linoleic acid into omega-3 and linoleic acid into omega-6 is too low to meet normal metabolic demands and nutritional requirements. Appropriate omega-3 and omega-6 LCPUFAs levels must therefore be achieved through the diet in order to ensure optimal nutritional status and support human health.

## Omega-3 fatty acids

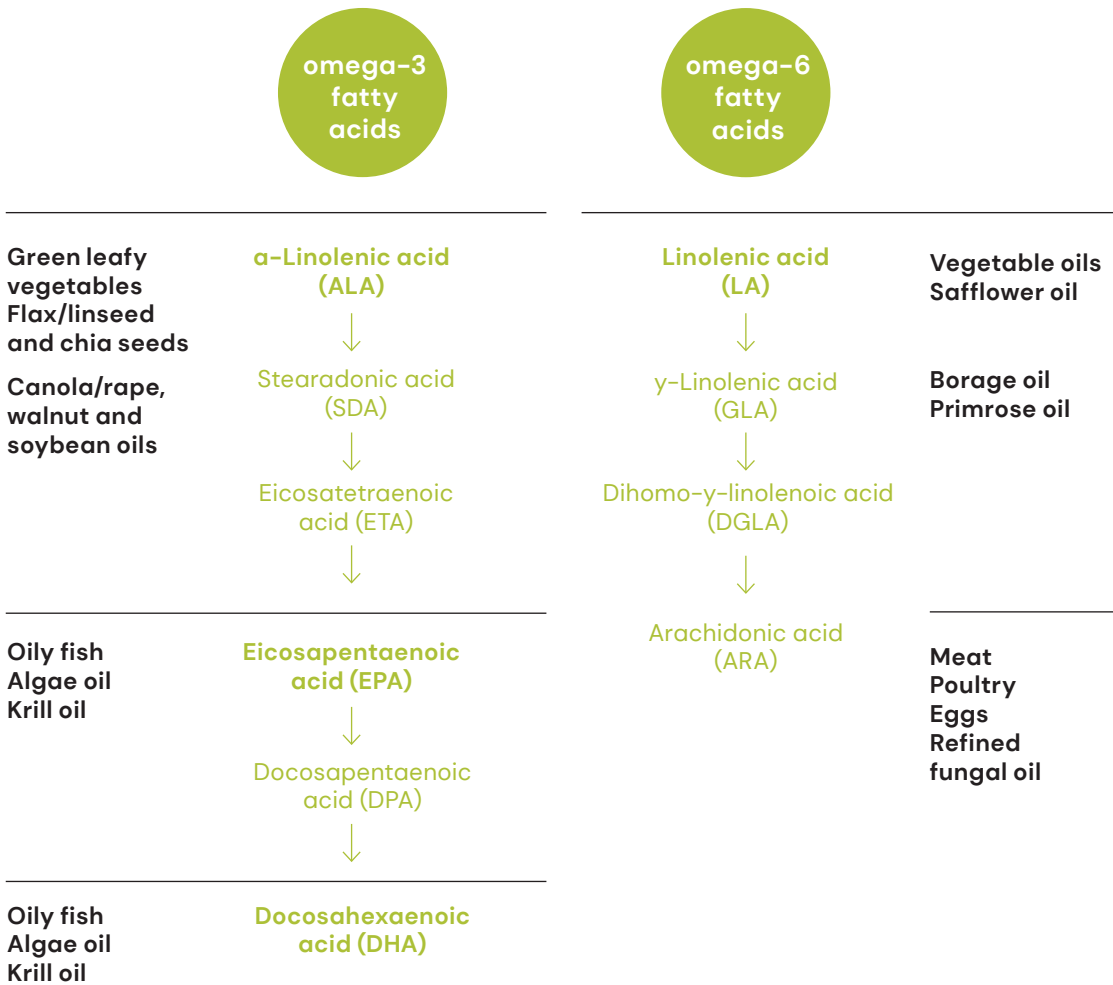
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## Omega-6 fatty acids

Considered an important source of energy, most omega-6 fatty acids are consumed in the diet from vegetable oils, and to a much lesser extent, fatty seeds and nuts, in the form of essential fatty acid LA. Omega-6 ARA is an important component of biological cell membranes – notably those that are part of the nervous system, skeletal muscles and immune system – promoting normal cell signaling.<sup>13</sup> Especially critical for development and growth during infancy, ARA must be obtained through breast milk – the gold standard for infant nutrition – or infant formulas and follow-on formulas during this life stage. ARA is also well-known to have some pro-inflammatory and immune-supportive roles throughout life, playing a role in wound healing when cell damage or injury occurs.<sup>14</sup> Although ARA is the most readily used omega-6 LCPUFA in the body, gamma linolenic acid (GLA), which is synthesized from LA and commonly found in breast milk, also benefits human health by modulating the body's anti-inflammatory response.<sup>15</sup>



**Figure 1: The omega-3 and omega-6 LCPUFA families and pathways**



## Getting the balance right

The balance of omega-3 and omega-6 LCPUFAs in an individual's diet is important, because an imbalance may contribute to several NCDs. A healthy ratio of omega-6:omega-3 is estimated to be 4:1 or less,<sup>16</sup> however research indicates that Western populations are consuming far higher ratios of omega-6 than necessary, as a result of modern eating habits and low fish consumption.<sup>17</sup> This means that some ratios are 20:1 or higher.

Emerging evidence also suggests that genetics may have a part to play. New research reveals that genetic polymorphisms can affect how an individual converts omega-3 and omega-6 precursors into their corresponding LCPUFAs<sup>18,19</sup> For instance, DHA and ARA synthesis is lower in individuals that have a single nucleotide polymorphism (SNP) in the FAD (fatty acid desaturase) genes. So, while low levels of omega-3 LCPUFAs in the bloodstream are often associated with an increased risk of chronic disease, including heart disease, cancer, autoimmune disease, depression and diabetes, these data imply that a number of chronic diseases may have a genetic component.<sup>20</sup> Because of these

factors, increased consumption of omega-3 LCPUFAs is widely promoted by the World Health Organization (WHO) and European Food Safety Authority (EFSA).<sup>21,22</sup> Current guidelines recommend:

- Individuals eat at least two servings of fatty fish, such as salmon, tuna or herring, per week
- Healthy adults consume a minimum of 250–500 mg combined EPA and DHA per day
- Higher amounts are recommended for pregnant and breastfeeding women.<sup>23,24</sup>

## New research

A large cohort analysis explored the association between fish and omega-3 intake and cause-specific mortality. Prospectively following the omega-3 dietary intakes of more than 420,000 individuals over 16 years, it concluded that higher fish consumption, and therefore omega-3s levels, were linked to lower total mortality and mortality from major causes; supporting current guidelines for fish consumption and omega-3 intake.<sup>25</sup>

**Table 1: Health benefits of nutritional lipids throughout life**

Life stage	Key target	Health benefits
Birth / infants	Brain, vision and immune system development	<p>Nutrition during the first 1,000 days is critical to ensure human development and lay the foundation for a healthy future. Omega-3 and omega-6 LCPUFAs – namely DHA and ARA – are reported to play essential roles during this period by having a positive long-term effect on neurocognitive development, psychomotor development, visual function, blood flow, blood vessel function and the development and function of the immune system.<sup>26–30</sup></p> <p>Found naturally in breast milk, which is considered the gold standard for infant nutrition, DHA and ARA are passed from mother to infant through the placenta during pregnancy and then during breastfeeding and through complementary foods after birth. It is recommended that an infant is exclusively breastfed for the first six months of life, but where a mother cannot breastfeed, or chooses not to, experts advise that DHA and ARA are included in infant formulas and follow-on formula.<sup>31</sup></p>
Childhood / adolescence	Brain health, including learning and behavior	<p>Childhood continues to be a significant period of growth and maturation, particularly for the brain. DHA is a major lipid in the brain, recognized as critical for normal brain function. Some evidence suggests that in toddlers and children of school age, DHA supplementation improves cognition, including learning, attention and behavior.<sup>32,33</sup> Further reports indicate the positive benefits of omega-3 nutrition on sleep during childhood, reduced allergy risk and respiratory tract infections, and likelihood to develop attention deficit hyperactivity disorder (ADHD).<sup>34–38</sup></p>
Adulthood	Maintenance of heart health, mental wellbeing and muscle mass	<p>Key benefits of omega-3 intake during adulthood include reduced risk of developing a NCD later in life, especially those linked to heart health.<sup>39</sup> Maintaining brain health and a positive mood are top concerns for this demographic and nutritional lipids have been reported to support brain function and a positive mood balance.<sup>40,41</sup> As active aging becomes a priority for most consumers globally, the benefits of omega-3 on muscle health, recovery and performance during exercise is also becoming significant.<sup>42,43</sup></p>
Senior adults	Cognitive function, maintenance of muscle mass and heart health	<p>Aging increases an individual's vulnerability towards a number of conditions that can affect normal heart and brain function, as well as optimal vision and mobility. Insufficient omega-3 intake has been linked to a variety of age-associated diseases including cardiovascular disease (CVD), Alzheimer's disease and sarcopenia.<sup>44–46</sup> EPA and DHA nutritional solutions that target healthy aging may therefore support an individual's health and quality of life as they age.</p>





# Supporting cardiovascular health

EPA and DHA omega-3s are strongly associated with heart health benefits throughout life.

However, despite a vast number of scientific papers being devoted to this area of research, mixed results reported by some recent large clinical trials, and the subsequent media coverage regarding their effectiveness, means the benefits of omega-3s for heart health have been a topic of debate among the medical and nutrition community.<sup>47-49</sup> This whitepaper highlights the growing bank of evidence exploring the benefits of nutritional lipids for cardiovascular health:

- 1 In a recently published study, researchers analyzed the effects of prenatal DHA supplementation on the blood pressure of 171 children.<sup>50</sup> Elevated blood pressure is a common consequence of weight gain and obesity that can lead to hypertension and CVD in adulthood if left unmanaged.<sup>51</sup> This study found a strong link between prenatal supplementation of algal DHA and lowered blood pressure in children who are overweight or obese, highlighting the significance of omega-3 nutrition from infancy onward.
- 2 A study observing 500,000 individuals with no CVD at baseline linked regular fish oil intake to lower risk of CVD and premature death.<sup>52</sup> Conducted over nine years, the large population-based prospective cohort study concluded that omega-3 fish oil supplements were associated with a 13% lower risk of death, 16% reduced risk of dying from CVD and 7% lower risk of CVD, such as stroke or heart attack. This indicates that omega-3s may be useful in helping to reduce the risk of CVD.
- 3 The VITAL trial assessed the benefits of 1 g/d omega-3 for heart health in healthy older adults.<sup>53</sup> Although omega-3 supplementation was not effective for the primary outcome (composite CVD events), a significant reduction in composite CVD events was observed for individuals consuming less than the median fish intake. Profound reductions in CVD events were also observed in African American individuals and decreased vascular death and heart attacks were observed in diabetic patients with no evidence of CVD.
- 4 A meta-analysis investigating the effect of omega-3 fatty acids on coronary heart disease, looked at primary, mixed and secondary prevention study outcomes and concluded that EPA and DHA may be linked to reduced risk of coronary heart disease, with a greater benefit observed in higher risk populations, i.e. individuals with elevated triglyceride levels and elevated LDL cholesterol.<sup>54</sup>
- 5 Another meta-analysis evaluating primary and secondary prevention trials showed that omega-3 supplementation is associated with a modest reduction in cardiac death.<sup>55</sup> Whereas a final report determined that marine omega-3 supplementation lowered the risk of myocardial infarction, coronary heart disease and CVD death.<sup>56</sup> It also found that risk reductions appeared to linearly relate to the dose of marine omega-3 applied, demonstrating that greater cardiovascular benefits may be achieved at higher doses of omega-3 supplementation.



The exact mechanisms by which EPA and DHA omega-3 LCPUFAs exert their protective effects on cardiovascular health remain an area of active research. A body of evidence indicates that omega-3s reduce many risk factors associated with CVD, including blood pressure, vascular function, endothelial dysfunction, inflammation, platelet reactivity and thrombosis, as well as heart rate and heart rate variability.<sup>57-64</sup> They have also been shown to reduce oxidative stress; a crucial hallmark of CVD.<sup>65,66</sup> Furthermore, their effects in combination with other heart-related medications, such as statins, have been investigated, with studies showing important and positive outcomes. Statins are widely prescribed to help lower levels of low-density lipoprotein (LDL) cholesterol in the blood and reduce the risk of CVD. Despite having distinct modes of action, and overlapping effects on heart health, a recent review concluded that concomitant therapy with statin medication and omega-3 LCPUFAs is complementary.<sup>67</sup>

Despite the strong link shown between omega-3 LCPUFAs and heart health, most individuals worldwide have an omega-3 index between 4% and 6%, indicating a low status of omega-3s.<sup>69</sup> An omega-3 index of 8% or higher is considered healthy and levels lower than 4% are deemed a risk zone and have been associated with increased threat of CVD.<sup>70</sup>

The EFSA opinion is that EPA and DHA contribute to “the maintenance of normal cardiac function”. Further considerations by EFSA and the US Food and Drug Administration (FDA) on the role of omega-3 LCPUFAs in relation to cardiovascular health led to the following authorized heart health claims:<sup>68</sup>

1. EPA and DHA contribute to the normal function of the heart, based on a daily intake of 250 mg combined total
2. EPA and DHA contribute to the maintenance of normal blood pressure, based on a daily intake of 3 g
3. EPA and DHA contribute to the maintenance of normal blood triglyceride levels, based on a daily intake of 2 g combined total
4. FDA qualified health claim on EPA and DHA for coronary heart disease risk
5. FDA qualified health claims on EPA and DHA for hypertension risk



# Addressing brain health

DHA and ARA are highly concentrated in the brain, where they act as major and essential structural components of cell membranes and affect a number of neurological pathways and processes. These nutrients support almost every area of brain function and development. Studies show that consuming key nutrients as we age helps to maintain brain health on two levels; it addresses cardiovascular risk factors that are linked to cognitive impairment and it helps to maintain overall brain function. The following research highlights how nutritional lipids support brain health throughout life:

## Brain development and maturation

DHA and ARA are especially important during vulnerable periods, such as pregnancy, breastfeeding and infancy, as they support optimal mental development during this time and brain function later in life. Supplementation during the first 1,000 days has been shown to have lasting effects on brain structure, function and neurochemical concentrations associated with attention and brain cell signaling, even at nine-years of age.<sup>71</sup> Moreover, the DHA ARA balance (1:1 or 1:2) may be an important factor in the impact of DHA and ARA on cognitive and behavioral development in infancy and early childhood.<sup>72</sup> There is also evidence to suggest that omega-3 LCPUFAs improve behavior and learning in childhood.<sup>73,74</sup>

## Cognitive health

Maintaining proper brain health is becoming an increasingly significant matter for senior adults. Due to the aging population, cognitive decline is now a major public health concern and one of the modern world's greatest health challenges. There are already 50 million individuals living with dementia worldwide, a major cause of disability and dependency among senior adults.<sup>75</sup> Alzheimer's disease is the most common cause of dementia, contributing to 60-70% of cases.<sup>76</sup> There are increasing data indicating that EPA and DHA may support memory in healthy adults.<sup>77</sup> Research also indicates that high dose DHA supplementation in APOE4 carriers – the most prevalent risk factor for Alzheimer's disease – may reduce the risk of older individuals developing the condition.<sup>78</sup> However, research is currently limited and inconsistent, with outcomes dependent on the specific dose and time of intervention (early intervention versus intervention in the later stages of neurocognitive decline), as well as other factors.

In a prospective study using the data of 865 adult participants (aged 57 years) from the Boston Puerto Rican Health Study (BPRHS), higher dietary intake of omega-3 and erythrocyte concentration were associated with better executive function, i.e. the cognitive skills individuals use to control and coordinate other cognitive abilities and behaviors.<sup>79</sup> The fact that EPA and DHA supplementation has the potential to enhance blood flow to the brain is also thought to be partly responsible for benefiting cognition.<sup>80</sup>



## Emotional health

More than ever, consumers are prioritizing their mental wellbeing. Growing evidence hints that omega-3 nutrition may help to support a healthy mind, specifically mood.<sup>81-84</sup> In fact, depression appears to be less common in nations where people eat large amounts of fish.<sup>85</sup> Multiple studies have demonstrated that omega-3 LCPUFA supplementation rich in EPA can benefit the mood of adults and relieve depression symptoms, including those associated with perinatal depression.<sup>86-88</sup> In women suffering from depression during pregnancy or recently after giving birth, lower levels of EPA and DHA have been observed. Here, omega-3 deficiency may be associated with chronic low-grade inflammation and pathophysiological mechanisms of depression.<sup>89</sup> Further to this, some studies also propose that omega-3 LCPUFAs may help alleviate or lower the risk of developing certain mood disorders, like bipolar disorder, schizophrenia and obsessive-compulsive disorder.<sup>90-92</sup>

These results are consistent with the findings of meta-analyses exploring this field of research. One report determined that omega-3 supplementation had a beneficial effect in patients with major depressive disorder; especially higher doses of EPA in participants taking antidepressants.<sup>93</sup> A second analysis concluded that omega-3s with EPA  $\geq 60\%$  at a dosage of  $\leq 1$  g/d would have beneficial effects on depression.<sup>94</sup> A final systematic review and meta-analysis concluded that current evidence supports the adjunctive use of omega-3 with antidepressants to reduce depressive symptoms.<sup>95</sup> With this evidence in mind, experts agree on using omega-3s in the treatment of mild depressive disorder for pregnant women, children and the elderly, and risk reduction in high-risk populations.<sup>96</sup>



# Maintaining good vision

Eye health continues to be a difficult challenge for healthcare services worldwide. Every life stage has a different set of risk factors that can impact eye health, and the ongoing threat of blue light from sunlight and the screens of digital devices can affect people of all ages. Age is a significant risk factor for visual health, and visual impairment is most prevalent in the senior generation. For the adult age group, it is therefore critical to futureproof against potential visual impairment.

One meta-analysis comparing omega-3 fatty acids to a placebo fatty acid in the management of dry eyes found that omega-3s could offer an effective therapy for the management of dry eye disease. Looking at seven independent studies, with a total of 790 participants, the results suggested that omega-3s could be introduced to individuals' diets to lower the risk of both AMD and dry eye syndrome.<sup>97</sup> This is supported by a second meta-analysis, which concluded that omega-3 supplementation significantly improves dry eye symptoms in patients with dry eye disease.<sup>98</sup> In this specific report, a number of clinical trials also showed that omega-3s may support healthy tear production, contributing to overall eye comfort. Glaucoma – the second major cause of blindness worldwide – is another emerging area that has shown benefits with omega-3 supplementation.<sup>99</sup> It is thought to lower the risk of developing glaucoma by elevating intraocular pressure (IOP), a major modifiable risk factor for the condition.<sup>100</sup>

# Beyond wellknown benefits

As consumers look to adopt a more holistic approach to their health and wellbeing, it is important to understand the lesser-known benefits of omega-3s to appeal to a new generation of consumers. Scientific data indicates important and emerging health areas for omega-3s including benefits for full-term pregnancy, immunity, sports performance and sleep.

## Lower risk of premature birth

Omega-3 LCPUFAs can reduce the risk of pre-term birth. One paper suggested that lower plasma concentrations of EPA and DHA during pregnancy is a strong risk factor for early preterm birth.<sup>101</sup> A Cochrane review – including more than 70 randomized controlled trials – agreed, concluding that omega-3 supplementation during pregnancy (500 – 1000 mg/d DHA + EPA, with at least 500 mg/d DHA) is an effective strategy for reducing the incidence of preterm birth.<sup>102</sup> The scientific evidence is so strong that experts determined no further studies are required to establish a relationship between omega-3 and preterm birth.

## Supporting the body's natural defenses

An effective, fully functioning immune system is essential in helping the body to protect against infection and disease. Both omega-3 and omega-6-derived metabolites have important immune-regulatory functions.<sup>103</sup> Of the LCPUFAs, however, EPA and DHA exert the most positive influence over the immune system throughout life. As well as playing a critical role in the development of the immune system in infancy, omega-3s help optimize the immune system by enhancing the function of immune cells.<sup>104</sup> This enhanced function translates to a reduced risk of infection, as evidenced by several randomized trials. These trials have shown that omega-3 supplementation may be beneficial in decreasing the incidence and duration of infections in children.<sup>105–107</sup>



In adults, the anti-inflammatory properties of omega-3s contribute to normal immune function.<sup>108</sup> Inflammation is an important component of the immune response, but continued inflammation can have a negative impact on the body and result in tissue damage. EPA and DHA help to resolve inflammation as part of the immune response by being converted into specialized pro-resolving mediators known as resolvins, protectins and maresins. Together with other molecules, they coordinate the resolution of inflammation and support healing.<sup>109,110</sup> Linked to omega-3 anti-inflammatory properties are allergies. Allergic disease is one of the most common chronic health conditions in the world, usually occurring because of an overactive immune system. EPA and DHA supplementation throughout life may help to reduce the risk of allergy, like asthma.<sup>111,112</sup> Maternal nutrition strategies including omega-3 LCPUFAs may also lower risk of allergies in infants, with one study reporting that postnatal fish oil consumption is linked to decreased food sensitization and food allergies in infants.<sup>113</sup>

## Sports performance

Omega-3s have many benefits for the categories of sports performance, muscle recovery and cardiorespiratory fitness. Research shows that EPA and DHA supplementation (>860 mg/d for more than eight weeks) contributes to muscle strength and function, while at the same time reducing muscle damage and pain.<sup>114–118</sup> Further reports have demonstrated that omega-3s improve cardiorespiratory fitness, i.e. the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity, and reduce exercise-induced inflammation; aiding a great workout session and muscle recovery afterwards.<sup>119–122</sup> An association has been observed between omega-3 serum concentrations and resting heart rate and heart rate recovery.<sup>123</sup> A randomized controlled trial showed that DHA-rich fish oil modulated oxygen consumption during

intense exercise.<sup>124</sup> Other studies have found improvements in stroke volume, cardiac output and heart rate recovery following omega-3 supplementation.<sup>125,126</sup> This evidence is in line with a consensus statement from the International Olympic Committee, which says that 2 g/d omega-3 supplementation may assist with training capacity, recovery, muscle soreness and injury management.<sup>127</sup>

## Sleep quality and duration

Good sleep is one of the foundations of optimal health. Omega-3s, especially DHA, help to improve length and quality of sleep in adults, children and adolescents.<sup>128–130</sup> In children aged between 7–9 years of age, 600 mg/d DHA supplementation increased sleep duration by one hour.<sup>131</sup> Another study found that teenagers with the highest levels of DHA in their plasma slept 32 minutes longer on the weekends when supplemented with DHA for just one week.<sup>132</sup> Low levels of DHA are also associated with lower levels of the hormone melatonin, which helps individuals fall asleep.<sup>133</sup>

## Key health concerns worldwide

dsm-firmenich's 2019 survey found that eye health is one of the top priorities for consumers today. But while 66% of consumers said they are worried about their vision, only 58% take action. Protection against disease is also important for a high proportion of consumers (65%), as are other emerging health areas such as mental and emotional health (60%). These findings highlight the importance of consumer data and reveal new opportunities to develop innovative and accessible nutrition solutions that target specific health benefits.

# Why is lipid status low worldwide?

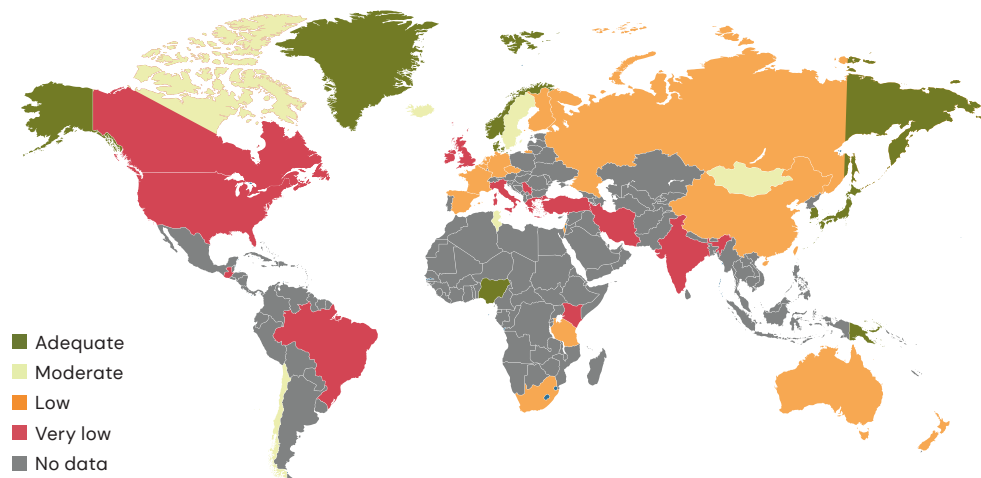
Despite extensive scientific evidence on the link between LCPUFAs and human health, and expert advice on nutritional lipid consumption levels, most adults worldwide do not meet the recommended intake of 250–500 mg of EPA and DHA omega-3 LCPUFAs per day.<sup>134</sup> A reason for this is that one-third of the world's population does not have access to, or cannot afford, a nutritious and healthy diet. Known as 'hidden hunger', these individuals lack adequate quantities of important micronutrients and nutritional lipids in their foods, which can have a devastating and long-term impact on individuals and communities globally. Another reason is that even when omega-3-rich foods such as fatty fish are available, eating these foods regularly may not be compatible with modern eating habits.

A DSM-Firmenich Insights survey, including more than 17,000 consumers across 23 countries worldwide, found that only 34% of individuals eat the recommended 2–3 portions of fish a week.<sup>135</sup> This is in line with a study that observed 'very low' EPA and DHA blood levels in many individuals worldwide.<sup>136</sup> As indicated, low EPA and DHA intake and

status and high omega-6: omega-3 ratios can have serious negative consequences on human health, creating pressure on healthcare systems that are tasked with managing and treating these conditions.

The first systematic review to examine blood levels of omega-3 LCPUFAs – specifically EPA and DHA – on a global scale analyzed 298 studies to develop a global map showing the levels of the two fatty acids in the blood stream of healthy adults (figure 2).<sup>137</sup> The report concluded that consumption of EPA and DHA may be too low to have a preventative or positive action on cardiovascular and cognitive health in a number of regions worldwide. Regions that had the lowest EPA and DHA blood levels (<4%), and therefore most at risk of developing a chronic disease, included North America, Central and South America, Europe, the Middle East, Southeast Asia, and Africa.

Figure 2: The global status of EPA and DHA<sup>138</sup>



298

studies analyzed to examine blood levels of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in healthy adults globally

83%

of the global population live in countries where the average intake of EPA and DHA is below the minimum WHO guidelines

# Bringing effective solutions to the market

Right from the start of life, early life nutrition solutions help to shape longer and healthier futures by ensuring mothers and their children receive the necessary nutrients at appropriate levels. Fortified food and beverage products are also an important tool, especially in vulnerable populations suffering from 'hidden hunger', as they help to close nutritional gaps and support individuals in meeting their nutrition requirements. Whereas dietary supplements, in combination with a healthy diet, are an efficient, convenient and cost-effective way to help consumers reach adequate nutritional lipid levels at all life stages.<sup>139</sup> But despite 71% of consumers reporting that they are familiar with omega-3 supplements, only 33% of those interviewed in dsm-firmenich's survey said they currently take them.

To address changing consumption routines of consumers globally and break down barriers to consumption, while at the same time meeting evolving nutritional, convenience and taste needs, continued innovation in product format and application is essential. Consumer research and insights are important as they enable manufacturers to address current consumer health concerns and meet shifting preferences. Awareness and understanding of emerging trends – such as the shift towards vegetarian or vegan diets in certain demographics, or growing environmental concerns and demand for sustainable products – is also critical to developing innovative nutritional lipid solutions that will promote the health and wellbeing of global populations.

dsm-firmenich helps dietary supplement manufacturers overcome common compliance and consumption issues, including:

- To help reduce capsule size, dsm-firmenich provides highly concentrated or potent solutions as part of its offering
- Reduce fishy smell or aftertaste via stability expertise and by using highquality oils
- dsm-firmenich enables the use of attractive claims on labels making the health benefits more tangible for the consumer
- dsm-firmenich's nutrition science and advocacy and help raise awareness of deficiency levels of omega-3s and support clear messaging about the health benefit solutions that EPA and DHA can provide across every life stage
- dsm-firmenich offers plant-based omega-3 ingredients and solutions to meet the vegetarian and vegan consumer trends
- Sustainability concerns are minimized due to dsm-firmenich's sustainable manufacturing processes and 'Friends of the Sea' certifications meaning dsm-firmenich's nutritional lipids from fish origin are sourced from sustainable fisheries.

# partner with dsm-firmenich: your end-to-end innovation partner

It takes more than ingredients to unlock insight-led innovations in the nutritional lipids market; it takes a partner that supports you at every stage of your product development process – from concept to consumer. As a purpose-led company, dsm-firmenich is passionate about supporting the health and wellness of consumers worldwide.

At dsm-firmenich we know that purpose can be the difference between simply driving consumer interest and elevating your product as unique on supermarket shelves. That's why we take an insight-led and human-centric approach to innovation; to ensure consumer trends, needs and preferences are addressed in a way that will ultimately enhance their health and enable them to live better for longer.

When you partner with dsm-firmenich, you get access to our broad portfolio of science-backed products, customized solutions and expert services at every stage of the development process, so you can create purpose-driven nutritional lipid products that attract a new generation of consumers.

## High-quality products

dsm-firmenich provides a complete portfolio of science-based and high-quality nutritional ingredients, including EPA and DHA omega-3 fatty acids from marine and algae sources.

dsm-firmenich's ingredients can be used in a range of dietary supplement formulations and food and beverage products.

## Your end-to-end partner

Products – Customized solutions – Expert services

## Customized solutions

dsm-firmenich's are designed to help bring your products to market faster, more efficiently, and with enduring success. From offering global blending capabilities that allow for the creation of fully customizable nutrient blends in one single, homogeneous premix, to providing tailored market-ready solutions that dramatically simplify a customer's supply chain, dsm-firmenich helps you turn people-inspired insights into products that consumers will love.

## Expert services

It takes more than ingredients to bring a product to market. dsm-firmenich is committed to adding value at every stage of development – from concept to consumption – through a broad range of expert services available across its global network. These services, which bring scientific and technical, innovation, market insight, and regulatory expertise to customers, support the development of nutritional solutions that successfully address the needs and format preferences of individuals worldwide.



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