Prenatal Omega-3 Polyunsaturated Fatty Acids and Allergic Risk

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Hypothesis

High levels of prenatal n-3 PUFA will have an immunological effect on the offspring by decreasing allergic risk later in life

Introduction

The prevalence of allergic diseases has increased immensely over the past 2-3 decades, leading to significant decrease in the quality of life in patients who suffer from such disease states. The proposal of certain dietary changes during gestation to enhance the immune system in utero has been brought to light, specifically in the form of omega-3 polyunsaturated fatty acid (n-3 PUFA). This meta-analysis poses to provide a conclusion to if high levels of prenatal n-3 PUFA will have an immunological effect on the fetus thus decreasing their allergic risk later in life

N-3 vs N-6

The theory behind looking at n-3 PUFA specifically during gestation is due to the concept that diet is a driving force behind this allergic trend. The ratio of polyunsaturated fatty acids omega-6 (n-6) and omega-3 (n-3) in modern diets is imbalanced favoring n-6. Vegetable oils (sunflower, corn, soybean), which are used vastly in processed and fast foods are sources of n-6 PUFA. N-3 PUFA is mostly found in fish (salmon, mackerel, tuna) and seeds. On a molecular level these two compete for which specific molecules are incorporated into the cell membrane. In those with a n-6 PUFA predominance, Arachodnic acid is more favorably incorporated into the cells, which is a highly inflammatory substrate. Whereas, a diet that is high in n-3 PUFA will have a predominance of D.ocosahexenoic acid (DHA) and Eicosapentenoic aicd (EPA) which works to counteract the inflammatory response of Arachdonic acid as well as decrease cytokine and immunoglobulin E (IgE) production which are main contributors to the allergic cascade.

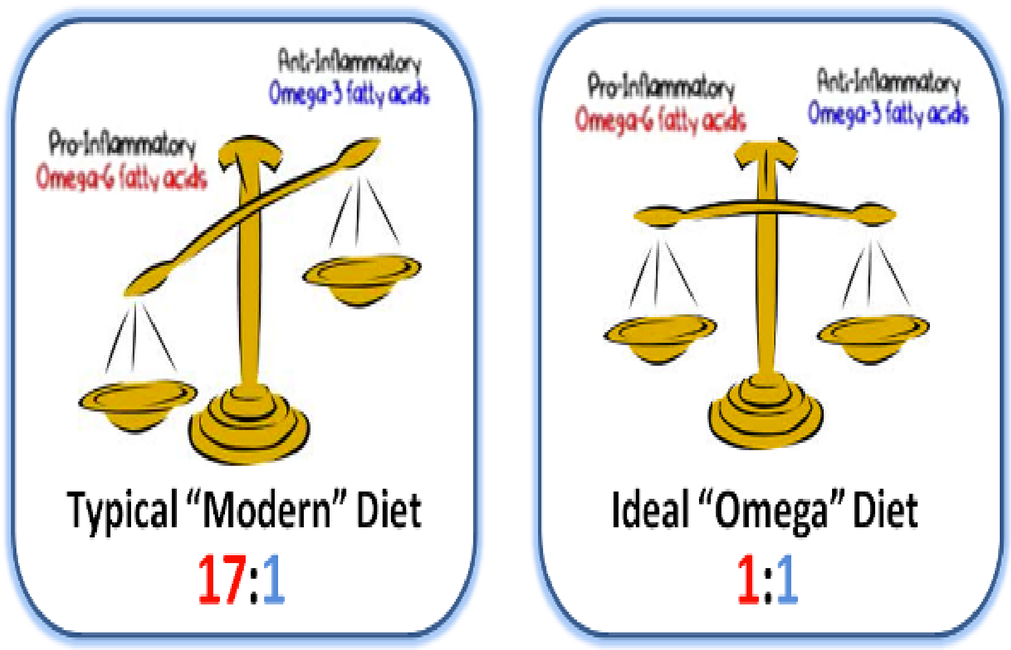

Figure 1: Depicts the modern diet and how a pro-inflammatory state is favored over an anti-inflammatory diet

Exclusion & Inclusion Criteria

The inclusion criteria was such that only double-blind randomized controlled clinical trial (RCT) were used. The intervention had to be supplementation with DHA/EPA and the clinical outcome had to involve skin prick test (SPT) analysis and clinical diagnosis of eczema to determine atopy. Exclusion criteria were studies that involved continuing supplementing post partum

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Skin Prick Test

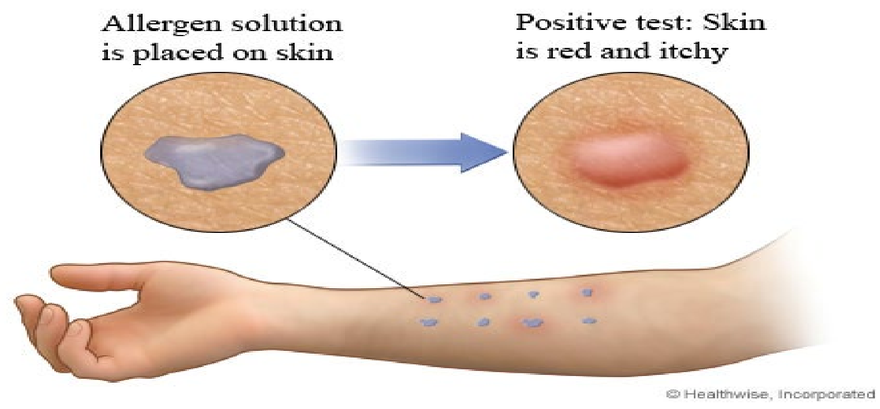

Figure 2: Shows a simple procedure and positive result of skin prick testing that was used to determine allergic risk in the studies used in this meta-analysis

Study	Egg sensitization			Dust mite sensitization			Eczema		
	N-3 PUFA %	Control %	P-value	N-3 PUFA %	Control %	P-value	N-3 PUFA %	Control %	P-value
Dunstan, 2003	10	17	0.05	5	8	0.75	30	45	0.16
Furuhjelm, 2009	13	30	0.04	1	1	0.99	9	24	0.04
Palmer, 2012	9	15	0.02	1	1	0.99	7	12	0.04
Noakes, 2012	4	3	0.47	-	-	-	7	12	0.04
Best, 2018	3	2	0.85	12	21	0.04	9	11	0.07
Biagaard, 2016	6	38	0.07	-	-	-	10	8	0.23

Figure 3 : Data from 6 RCT, in regards to SPT results from egg and dust mites and clinical diagnosis of eczema by a medical professional

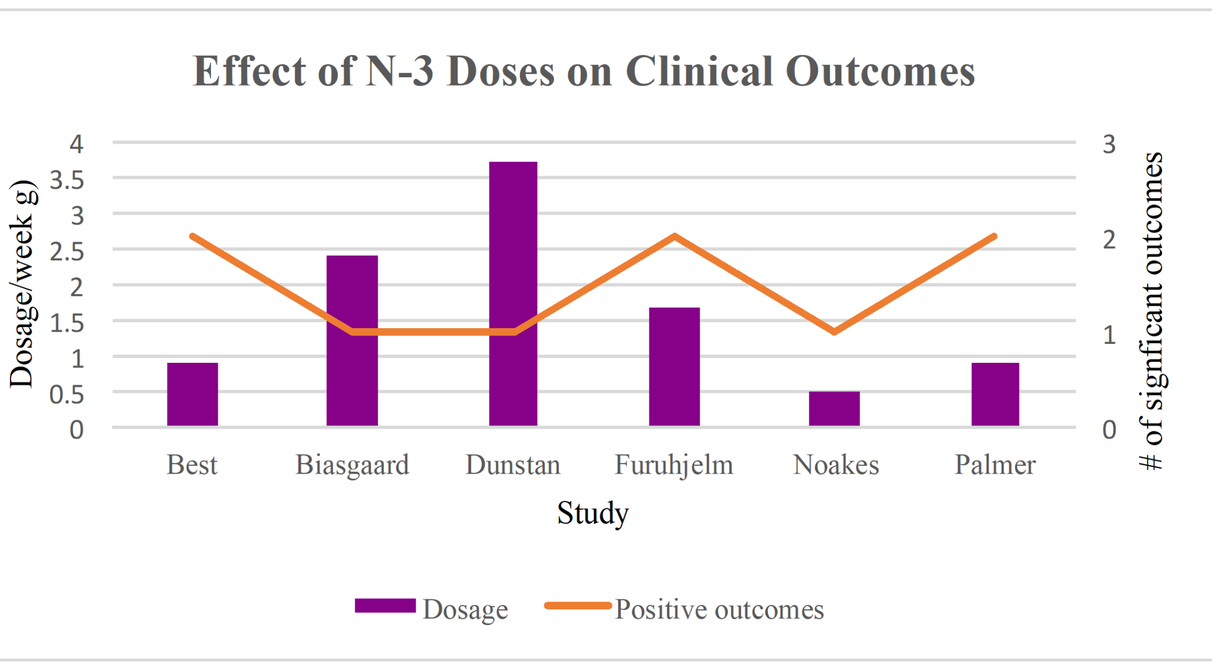

Figure 4: Dosages per study correlating with number of statistically significant results observed per study

Conclusion

- There is conflicting evidence supporting high levels of fish oil in pregnancy and the allergic risk of the offspring
- Dosages of 900 mg of n-3 PUFA correspond to the most positive results in regards to SPT and eczema rates over higher doses
- There has been no negative results reported for prenatal n-3 supplementation and can pose as an additional benefit to the fetus

Future Research

- More RCT studies involving long-term follow up is needed to determine benefit.
- Studies observing similar characteristics (SPT, eczema diagnosis) are needed with differing doses to determine the most efficient dose needed to provide benefit
- Determining at what point during gestation is most critical to begin supplementation

Adverse Outcomes

Of all the studies there were no adverse outcomes in regards to age at delivery, birth weight, mode of delivery and Apgar scores

References: Best, K., PhD, Sullivan, T. (2017). Prenatal Fish Oil Supplementation and Allergy: 6-Year Follow-up of a Randomized Controlled Trial. *Pediatrics, 140*(Supplement 3). doi:10.1542/peds.2017-2475t **Bisgaard, H., MD, Stokholm, J., MD. (2016).** Fish Oil–Derived Fatty Acids in Pregnancy and Wheeze and Asthma in Offspring. *The New England Journal. of Medicine*. doi:10.1056/NEJMoa1503734 **Dustin, J. A., Mori, T. A., & Barden, A. (2003).** Maternal fish oil supplementation in pregnancy reduces interleukin-13 levels in cord blood of infants at high risk of atopy. *Wiley Online Library,33*(4), 1178-1184. Retrieved November, 2018 **Furuhjelm, C., & Warstedt, K. (2009)**. Allergic disease in infants up to 2 yr of age in relation to plasma omega-3 fatty acids and maternal fish oil supplementation in pregnancy and lactation. *Wiley,98*(9). Retrieved November, 22018. **Noakes, P. S., Vlachava, M. (2012).** Increased intake of oily fish in pregnancy: Effects on neonatal immune responses and on clinical outcomes in infants at 6 mo. *The American Journal of Clinical Nutrition,95*(2), 395-404. doi:10.3945/ajcn.111.022954 **Palmer, D. J., Gold, M, S(2012)**. Effect of n-3 long chain polyunsaturated fatty acid supplementation in pregnancy on infants allergies in first year of life: Randomized controlled trial. *Bmj,344*(Jan30 2). doi:10.1136/bmj.e184