Effect of 1 year krill oil supplementation on cognitive achievement in typically developing Dutch adolescents: Preliminary results

ISM van der Wurff, C von Schacky, T Bergeland, R Leontjevas, MP Zeegers, PA Kirschner, RHM de Groot
Research Question

What is the influence of 1 year of krill oil supplementation in 13-15 year old adolescents attending lower general secondary education on:

- Cognitive functioning and academic achievement?
- Mood and self-esteem?
- Sleep quality and quantity and visual processing?
Study design

Omega-3 Index <5%

Inclusion

Krill:
- 520mg EPA p/day
- 280mg DHA p/day

or

Placebo:
- 0 mg EPA p/day
- 0 mg DHA p/day

Baseline

3 months

6 months

12 months

Dose adjustment

Mental health

Cognition

2 + 2 = 5
## Cognitive tests

<table>
<thead>
<tr>
<th>Cognitive test</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter digit substitution task</td>
<td>Speed of information processing</td>
</tr>
<tr>
<td>D2 test of attention</td>
<td>• Speed of information processing&lt;br&gt;• Impulsivity&lt;br&gt;• Inattention</td>
</tr>
<tr>
<td>Stroop test</td>
<td>Inhibition</td>
</tr>
<tr>
<td>Concept shifting test</td>
<td>Shifting</td>
</tr>
<tr>
<td>Digit span forward</td>
<td>Short term memory</td>
</tr>
<tr>
<td>Digit span backward</td>
<td>Working memory</td>
</tr>
</tbody>
</table>
Unique characteristics

- Adolescents
- Lower general secondary education (TL/MAVO)
- Selection <5% Omega-3 Index
- Personalised dose-adjustment after 3 months
- Supplement consumed at dinner time
Flow chart

286

- Dose adjustment (n 10)
- Inability to take supplements (n 6)
- Motivation (n 5)
- Other (n 2)
- Remembering (n 7)

Omega-3 status > 5% (n 15)
No blood sample (n 4)
Inability to take supplements (n 16)
Other (n 3)
Motivation (3)
Remembering (1)

t = 0

126

- Dose adjustment (n 10)
- Inability to take supplements (n 6)
- Motivation (n 5)
- Other (n 2)
- Remembering (n 7)

Forgetting/motivation (n 34)

Inability to take supplement (n 6)
Other (n 3)

t = 3

126

- Forgetting/motivation (n 22)
- Inability to take supplements (n 1)
- Other (n 10)

Still participate NPT (n 84)
Declined further testing (n 54)

t = 6

126

- Forgetting/motivation (n 22)
- Inability to take supplements (n 1)
- Other (n 10)

t = 9

Krill (n 53)
Placebo (n 73)
### Baseline characteristics

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD or N [%]</th>
<th>min</th>
<th>max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>14.10 ± 0.49</td>
<td>13.09</td>
<td>15.44</td>
</tr>
<tr>
<td><strong>Male/Female</strong></td>
<td>127/139 [47.7/52.3%]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Smoking no/yes¹</strong></td>
<td>239/26 [90.2/9.8%]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>19.93 ± 3.00</td>
<td>13.7</td>
<td>31.5</td>
</tr>
<tr>
<td><strong>Diagnosis yes/no²</strong></td>
<td>69/196 [26/73.7%]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alcohol per week³</strong></td>
<td>0.46 ± 1.77</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>

¹ Smoking ‘yes’ was defined as anybody who indicated to smoke more than 0 cigarettes per week.
² Diagnosis was indicated by students themselves and included (but not limited to) dyslexia, dyscalculia, depression, autism and ADHD.
³ Alcohol consumption was asked as how many times per week and units per consumption moment, alcohol per week is defined as these factors multiplied.
Baseline results

A higher Omega-3 Index was associated with better information processing speed.

A higher Omega-3 Index was associated with less inattention/impulsivity (i.e. paid more attention)

van der Wurff et al. (2016)
## Change in fatty acids (ITT)

<table>
<thead>
<tr>
<th>fatty acid (%wt/wt of total FA)</th>
<th>condition</th>
<th>baseline</th>
<th>3 months</th>
<th>6 months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 20:4n-6</td>
<td>Placebo</td>
<td>11.19 ± 1.36</td>
<td>11.00 ± 1.19</td>
<td>11.04 ± 1.51</td>
<td>11.13 ± 1.28</td>
</tr>
<tr>
<td></td>
<td>Krill</td>
<td>11.15 ± 1.16</td>
<td>10.27 ± 1.12*</td>
<td>10.30 ± 1.39 *</td>
<td>10.70 ± 1.48*</td>
</tr>
<tr>
<td>EPA 20:5n-3</td>
<td>Placebo</td>
<td>0.39 ± 0.15</td>
<td>0.43 ± 0.15</td>
<td>0.41 ± 0.14</td>
<td>0.41 ± 0.14</td>
</tr>
<tr>
<td></td>
<td>Krill</td>
<td>0.39 ± 0.16</td>
<td>0.95 ± 0.59*</td>
<td>0.99 ± 0.71*</td>
<td>0.75 ± 0.58*</td>
</tr>
<tr>
<td>ObA 22:5n-6</td>
<td>Placebo</td>
<td>0.42 ± 0.11</td>
<td>0.41 ± 0.17</td>
<td>0.42 ± 0.09</td>
<td>0.38 ± 0.12</td>
</tr>
<tr>
<td></td>
<td>Krill</td>
<td>0.44 ± 0.10</td>
<td>0.32 ± 0.12*</td>
<td>0.32 ± 0.11*</td>
<td>0.33 ± 0.13*</td>
</tr>
<tr>
<td>DPA 22:5n-3</td>
<td>Placebo</td>
<td>1.22 ± 0.20</td>
<td>1.29 ± 0.22</td>
<td>1.30 ± 0.20</td>
<td>1.30 ± 0.19</td>
</tr>
<tr>
<td></td>
<td>Krill</td>
<td>1.23 ± 0.17</td>
<td>1.59 ± 0.34*</td>
<td>1.56 ± 0.35*</td>
<td>1.47 ± 0.31 *</td>
</tr>
<tr>
<td>DHA 22:6n-3</td>
<td>Placebo</td>
<td>2.63 ± 0.48</td>
<td>2.63 ± 0.55</td>
<td>2.70 ± 0.54</td>
<td>2.74 ± 0.55</td>
</tr>
<tr>
<td></td>
<td>Krill</td>
<td>2.53 ± 0.52</td>
<td>3.30 ± 0.76*</td>
<td>3.48 ± 0.95*</td>
<td>3.24 ± 0.84*</td>
</tr>
</tbody>
</table>

* Krill oil and placebo condition are significantly different p<0.05
Change in Omega-3 Index over time

* Krill oil and placebo condition are significantly different p<0.05
## In comparison

<table>
<thead>
<tr>
<th>Target group</th>
<th>Omega-3 index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unselected Japanese men (n 262)</td>
<td>9.58</td>
</tr>
<tr>
<td>Unselected Germans (n 5000)</td>
<td>7.15 ± 2.19</td>
</tr>
<tr>
<td>Unselected Europeans (n 10000)</td>
<td>6.96 ± 2.15</td>
</tr>
<tr>
<td>Framingham-Offspring (n 3196)</td>
<td>4.90 ± 2.10</td>
</tr>
<tr>
<td>American adolescents with major depression (n 150)</td>
<td>3.46</td>
</tr>
<tr>
<td>Americans with major depression (n 118)</td>
<td>2.90 ± 1.50</td>
</tr>
</tbody>
</table>

Analyses

• Multilevel analyses – with person as unit
• Intention to treat and blood Omega-3 Index
• Correction for covariates
  – Drinking (units per week)
  – Smoking (yes/no)
  – Age at specific test moment
  – BMI (self-reported at baseline)
  – Sex
  – Cohort number
  – Level of parental education
Results speed of information processing

ITT analyses:
\[ \beta = -1.28 \]
\[ p = 0.114 \]
95% CI: -2.84 to 0.28

Omega-3 Index:
\[ \beta = 0.02 \]
\[ p = 0.911 \]
95% CI: -0.33 to 0.37
Results: D2 (1)

ITT analyses:
β = -11.91
p = 0.151
95% CI: -27.84 to 4.04

Omega-3 Index:
β = -1.70
p = 0.258
95% CI: -4.66 to 1.22

ITT analyses:
β = -4.25
p = 0.278
95% CI: -11.79 to 3.29

Omega-3 Index:
β = -1.70
p = 0.100
95% CI: -2.37 to 0.20
Results: D2 (2)

ITT analyses:
\[ \beta = -1.86 \]
\[ p = 0.129 \]
95% CI: -4.21 to 0.49

Omega-3 Index:
\[ \beta = -0.07 \]
\[ p = 0.804 \]
95% CI: -0.63 to 0.48

ITT analyses:
\[ \beta = -0.34 \]
\[ p = 0.077 \]
95% CI: -0.70 to 0.03

Omega-3 Index:
\[ \beta = -0.01 \]
\[ p = 0.929 \]
95% CI: -0.12 to 0.11
Results: Shifting

ITT analyses:
β = -0.59
p = 0.443
95% CI: -2.06 to 0.88

Omega-3 Index:
β = -0.05
p = 0.853
95% CI: -0.53 to 0.44
Results: Interference

ITT analyses:
\[ \beta = -0.100 \]
\[ p = 0.888 \]
95% CI: -1.26 to 1.46

Omega-3 Index:
\[ \beta = -0.28 \]
\[ p = 0.290 \]
95% CI: -0.78 to 0.23

Graph showing interference score over time with two groups: Placebo and Krill.
Results: Digit Span

ITT analyses:
\[ \beta = 0.03 \]
\[ p = 0.793 \]
95% CI: -0.20 to 0.26

Omega-3 Index:
\[ \beta = 0.01 \]
\[ p = 0.684 \]
95% CI: -0.05 to 0.08

ITT analyses:
\[ \beta = -0.03 \]
\[ p = 0.759 \]
95% CI: -0.25 to 0.18

Omega-3 Index:
\[ \beta = 0.00 \]
\[ p = 0.932 \]
95% CI: -0.07 to 0.07
Discussion (1)

- No significant effects of supplementation on cognitive test performance.
- Even analyses according to omega-3 fatty acid status did not show effects.
- 1 year of krill oil, still low Omega-3 Index
  - Did not take capsules – compliance
  - Factors associated with metabolism
  - Krill oil
Discussion (2)

- Further analyses are in progress and other outcome measures (mental well-being, sleep, academic achievement, mental processing).
- Important to take blood values!
Funding

• Study was funded by:
  – Grant of Dutch Scientific Organisation
  – Aker Biomarine
  – Omegametrix
Publications


Thank you for your attention