**Supplementary information**

**Seabirds under environmental pressures: food supplementation has a larger impact than selenium on chicks exposed to mercury and a viral disease**

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**Bird classification based on clinical signs**

In the years 2016 and 2017, a total of three pictures for each bird were taken from the same spot and from the same distance, before, during, and after the treatment. These pictures were subsequently used to classify the sampled birds based on the severity of visible clinical signs. Pictures were analysed and blindly scored twice by the same person (1 week apart). Scores ranged from 0 (absolute absence of clinical signs) to 10 (bird fully covered by crusts), including half scores. An average score was, therefore, calculated and used to further divide chicks into three study groups to be used for statistical comparisons: healthy group (hereafter “no signs,” average score <1), chicks with few crusts on the neck and around the eyes (hereafter “mild,” average score ≥1 or <4) and very sick chicks showing more widespread and thicker crusts (hereafter “severe,” average score ≥4). This classification enabled us to detect birds that changed group over the progress of the disease (which matches a change in the visible clinical signs), thus to identify: (a) birds that never showed the appearance of clinical signs, hereafter “always healthy”; (b) birds that showed the appearance of clinical signs, hereafter “new sick”; (c) birds that had an improvement of visible clinical signs, hereafter “improved”; and (d) birds that did not change their status, hereafter “always sick”.

**Selenium pills supplementation**

Dietary selenium was purchased by Thorne US, and supplemented in its organic form (each pill containing 200 µg of L-Selenomethionine). Pills were provided nine times during the experimental period (24th of May 2017 - 8th of June 2017). Due to logistic reasons (i.e. impossibility to access to the study site during rough sea, or difficulties to stay more than 3-4 consecutive days on the island), Se pills were generally given for 2 consecutive days with a break of about 2-3 days between supplementations. All chicks received the pills on the same days. The beak of the chicks was kept open and after rapidly being dipped in fish oil, pills were dropped directly into the throat to facilitate swallowing. All birds were receptive to supplementation and none of the birds were forced to swallow the pills. Birds from the unsupplemented group were also handled to minimize any bias due to handling. Healthy and sick chicks received a similar amount of Se (linear model: F=2.85, p=0.10).

**Figure S1:** Hg concentrations (expressed as μg g−1 dry weight) in chicks sampled during the three years of study (panel a); in chicks divided by their health status (healthy vs sick, panel b); and in chicks divided based on the severity of clinical signs (nosign, mild, and severe, panel c).

Chart, box and whisker chart

Description automatically generated

**Figure S2:** Se concentrations (expressed as μg g−1 dry weight) in chicks sampled in 2016 and 2017 (panel a); in chicks divided by their health status (healthy vs sick, panel b); and in chicks divided based on the severity of clinical signs (nosign, mild, and severe, panel c).

Chart, box and whisker chart

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**Table S1:** Post-hoc comparisons among groups divided based on the health status and the treatment received. The estimate refers to a change from the first to the second sampling period within a specific group (indicated as 1-2). Post-hoc where only run when interactions of linear mixed models were significant. Significant p-values are shown in bold. Asterisks \* indicate a marginally significant p-value.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model on Hg** | **estimate** | **St. Error** | **t-value** | **p-value** |
| Control healthy 1-2 | -0.048 | 0.050 | -0.95 | 0.99 |
| Fish healthy 1-2 | -0.052 | 0.062 | -0.84 | 0.99 |
| Selenium healthy 1-2 | -0.012 | 0.045 | -0.26 | 0.99 |
| Control sick 1-2 | 0.105 | 0.053 | 1.98 | 0.70 |
| Fish sick 1-2 | -0.232 | 0.040 | -5.75 | <**0.001** |
| Selenium sick 1-2 | <0.001 | 0.047 | <0.01 | 0.99 |
|  |  |  |  |  |
| **Model on Se** | **estimate** | **St. Error** | **t-value** | **p-value** |
| Control healthy 1-2 | 0.673 | 0.380 | 1.77 | 0.83 |
| Fish healthy 1-2 | -3.791 | 0.467 | -8.12 | **<0.001** |
| Selenium healthy 1-2 | -4.251 | 0.340 | -12.5 | **<0.001** |
| Control sick 1-2 | -1.148 | 0.398 | -2.88 | 0.17 |
| Fish sick 1-2 | -4.037 | 0.303 | -13.3 | **<0.001** |
| Selenium sick 1-2 | -4.453 | 0.353 | -12.6 | **<0.001** |
|  |  |  |  |  |
| **Model on GSH** | **estimate** | **St. Error** | **t-value** | **p-value** |
| Healthy 1-2 | 0.290 | 0.040 | 7.47 | **<0.001** |
| Sick 1-2 | 0.150 | 0.040 | 4.34 | **<0.001** |
|  |  |  |  |  |
| **Model on GPX** | **estimate** | **St. Error** | **t-value** | **p-value** |
| Healthy 1-2 | 8.12\*10-5 | 3.06\*10-5 | 2.56 | 0.06\* |
| Sick 1-2 | -6.11\*10-6 | 2.82\*10-5 | -0.22 | 0.99 |

**Table S2:** Post-hoc comparisons among groups divided based on the progress of the disease. The estimate refers to a change from the first to the second sampling period within a specific group (indicated as 1-2). Post-hoc where only run when interactions of linear mixed models were significant. Significant p-values are shown in bold.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model on Hg** | **estimate** | **St. Error** | **t-value** | **p-value** |
| Always healthy 1-2 | -0.037 | 0.023 | -1.57 | 0.76 |
| Always sick 1-2 | -0.009 | 0.021 | -0.41 | 0.99 |
| New sick 1-2 | 0.005 | 0.022 | 0.22 | 1.00 |
| Improved 1-2 | 0.089 | 0.028 | 3.18 | **0.05** |
|  |  |  |  |  |
| **Model on Se** | **estimate** | **St. Error** | **t-value** | **p-value** |
| Always healthy 1-2 | 0.130 | 0.187 | 0.69 | 0.99 |
| Always sick 1-2 | -0.505 | 0.169 | -3.00 | 0.07 |
| New sick 1-2 | 0.516 | 0.174 | 2.97 | 0.08 |
| Improved 1-2 | -0.813 | 0.221 | -3.67 | **0.01** |