# Appendix 1

# Detailed description of the models

## Anti-parasite immunity

**Models**

To explore the association between age, exposure (aEIR) and parasite density upon infection, we fit the following models.

AP1:

AP2:

AP3:

AP4:

Where *i* is an index for individuals, *j* for households and *k* for specific visits. Thus, represents the age of child i from household j during visit k, and represents the average annual EIR recorded for household *j*. ui and γj denote the individual and household random effects, respectively, assumed to be normally distributed with mean 0. Tensor interactions were used for interaction models (AP4).

## **Appendix 1-Table 1. Anti-parasite immunity Model fit**

|  |  |  |  |
| --- | --- | --- | --- |
| Model | DF | % Deviance Explained | AIC |
| AP1 | 418.7 | 33.2 | 14052 |
| AP2 | 414.2 | 33.1 | 14048 |
| AP3 | 408 | 33 | 14046 |
| AP4 | 404 | 33 | 14032 |

## Anti-disease immunity

**Models**

To explore the association between age, exposure (aEIR), parasite density and objective temperature, we fit the following models

AD1:

AD2:

AD3:

AD4:

Where *i* is an index for individuals, *j* for households and *k* for specific visits. Thus, represents the age of child i from household j during visit k, and represents the average annual EIR recorded for household *j*. ui and γj denote the individual and household random effects, respectively, assumed to be normally distributed with mean 0. Tensor interactions were used for interaction models (AD4).

## **Appendix 1-Table 2. Anti-disease immunity Model fit**

|  |  |  |  |
| --- | --- | --- | --- |
| Model | DF | % Deviance Explained | AIC |
| AD1 | 315 | 37.7 | 14946 |
| AD2 | 285 | 39.0 | 14774 |
| AD3 | 314 | 38.3 | 14894 |
| AD4 | 296 | 39.4 | 14758 |

**Fever threshold**

In order to estimate the fever threshold, defined as the minimum parasite density associated with fever (temperature greater than 38oC) we first used the best fitting model (AD3) to predict the expected temperature across levels of parasite density, age and exposure (aEIR) (as shown in Figure 6). For each level of age and aEIR, we then extracted the minimum parasite density that predicted a temperature > 38oC. This was possible since the association between parasite density and temperature is positive (Figure 6- figure supplement 1 ).

## Overall immunity against symptomatic malaria

**Models**

To explore the association between age, exposure (aEIR), and the odds of symptomatic malaria upon infection, we fit the following models.

SM1:

SM2:

SM3:

SM4:

Where *i* is an index for individuals, *j* for households and *k* for specific visits. Thus, represents the age of child i from household j during visit k, and represents the average annual EIR recorded for household *j*. ui and γj denote the individual and household random effects, respectively, assumed to be normally distributed with mean 0. Tensor interactions were used for interaction models (SM4).

|  |  |  |  |
| --- | --- | --- | --- |
| Model | DF | % Deviance Explained | AIC |
| SM1 | 399.8 | 28 | 5382 |
| SM2 | 385.3 | 28 | 5373 |
| SM3 | 385.5 | 27.8 | 5380 |
| SM4 | 362.6 | 27.3 | 5369 |

## **Appendix 1-Table 3. Overall immunity against symptomatic malaria Model fit**