

Inferring Risks of Coronavirus Transmission from Community Household Data: Tranche 11 Update

Thomas House Heather Riley Lorenzo Pellis Koen B. Pouwels
Sebastian Bacon Arturas Eidukas Kaveh Jahanshahi
Rosalind M. Eggo A. Sarah Walker

New analysis

Previously, we considered the baseline probability of avoiding infection from outside the household,

$$q = e^{-\Lambda} , \quad (1)$$

where Λ is a quantity known as the *cumulative force of infection* in infectious disease epidemiology. Formally, if the force of infection λ is constant over a time period from time 0 to time τ , then

$$\Lambda = \int_{t=0}^{\tau} \lambda dt = \tau \lambda . \quad (2)$$

Substituting (2) into (1) and rearranging, we obtain

$$\lambda = \frac{-\log(q)}{\tau} . \quad (3)$$

By quoting this value, at low numerical values approximately equal to the daily probability of infection from outside the household, we can adjust for the duration of different time periods considered. These force of infection estimates are shown in the Middle plot of Figure 3 via rectangles of width equal to the time period and vertical extent equal to the 95% CI joined by dotted lines at the point estimates. It is also important to note that the model used in inference does not assume constant external force of infection as in (2), but this is just the simplest form in which to present the process as a rate rather than a probability.

Headline results

This document presents an updated analysis for the following time period:

- **Tranche 11:** 7 January 2022 to 6 February 2022; high prevalence; schools open; Omicron BA.1 lineage dominant and Omicron BA.2 lineage emerging; over 52 million first, 48 million second and 37 million third doses distributed by end of time period.

Properties of this Tranche are given in Table 1; the histogram and age density plots are in Figure 1; the pair and residual plots are in Figure 2; and the output from the fitted model is shown in Figure 3, Figure 4 and Table 2.

These results show a result for increased transmissibility of the OR+N PCR gene positivity pattern consistent with the BA.2 Omicron lineage, lower transmissibility in secondary-school aged children who recently experienced a particularly large (Delta) wave and are increasingly vaccinated, and larger transmissibility in primary-school aged children who are mainly unvaccinated. No strong effects in susceptibility are seen. Work in patient-facing roles has returned as associated with increased external infection, and children also remain at increased levels of external infection.

										Tranche 11	All
Number of participants										328959	451079
Number of households										174564	222746
Number of positive individuals										12811	64510
Households with 1+ positive										9779	45565
Children <12										21266	35503
Children 12–16										18322	24834
OR+N+S positives										638	27875
OR+N positives										11570	29974
Patient-facing participants										10501	17626

Table 1: Tranche 11 sample properties.

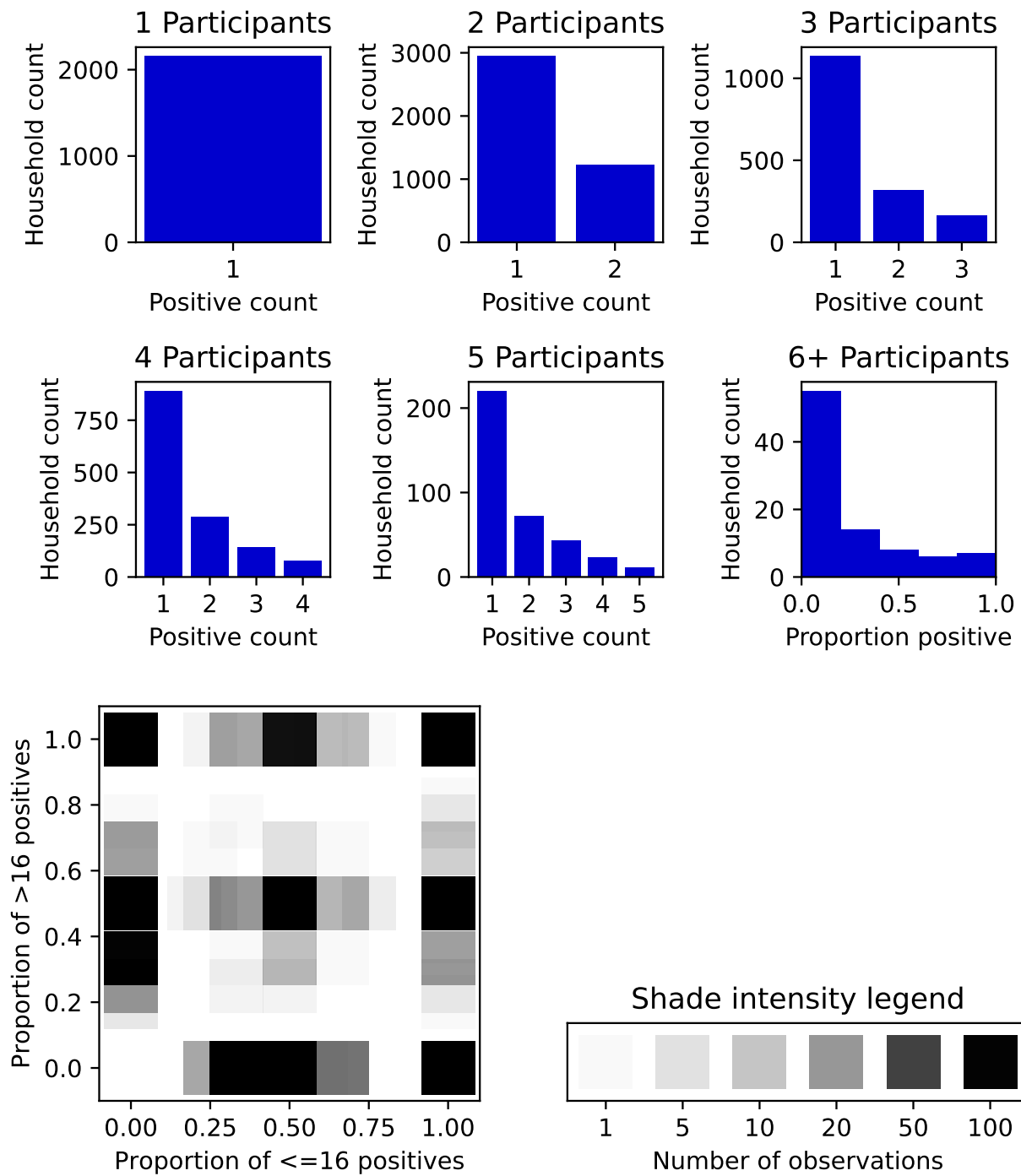


Figure 1: Top: histogram and Bottom: density plot for Tranche 11 data

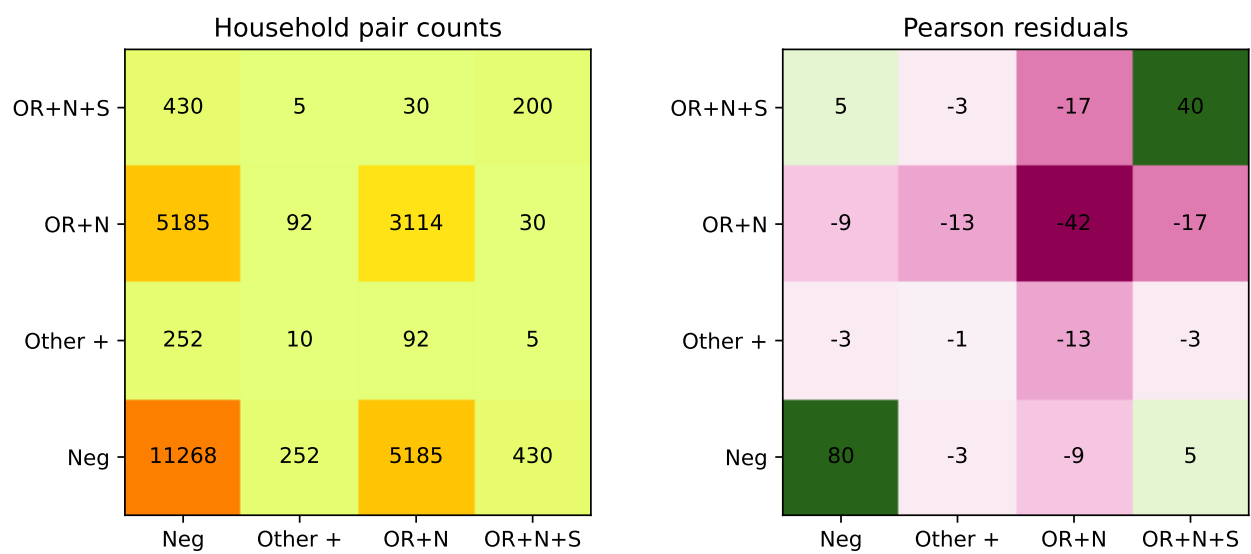


Figure 2: Left: pair count and Right: Pearson residual plots for Tranche 11 data

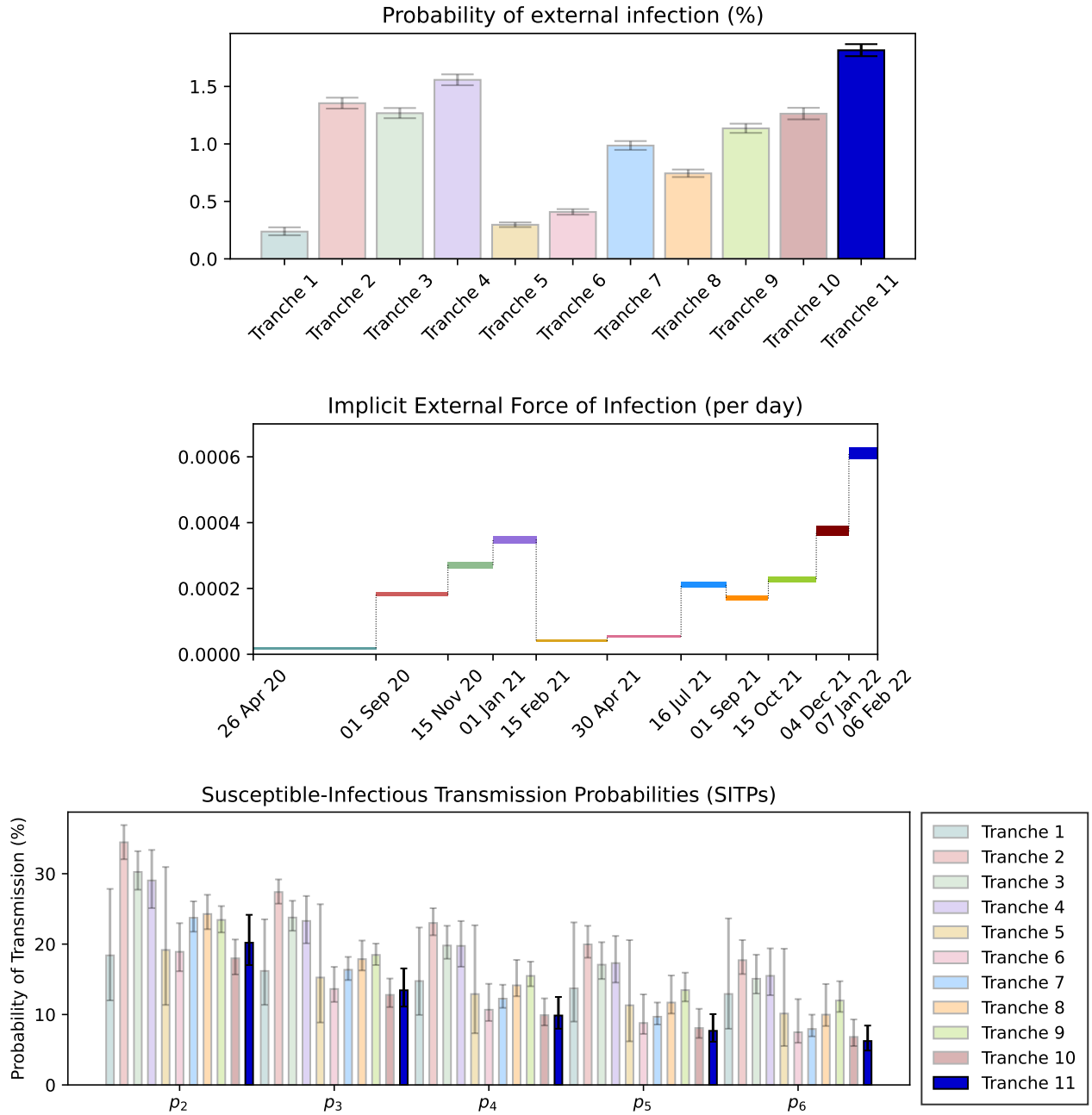


Figure 3: Visualisation of the fitted model. Top: Baseline probability of infection from outside. Middle: Force of infection implied by tranche duration and probabilities of infection from outside. Bottom: Per-pair baseline probabilities of secondary transmission within the household, not including tertiary transmission effects.

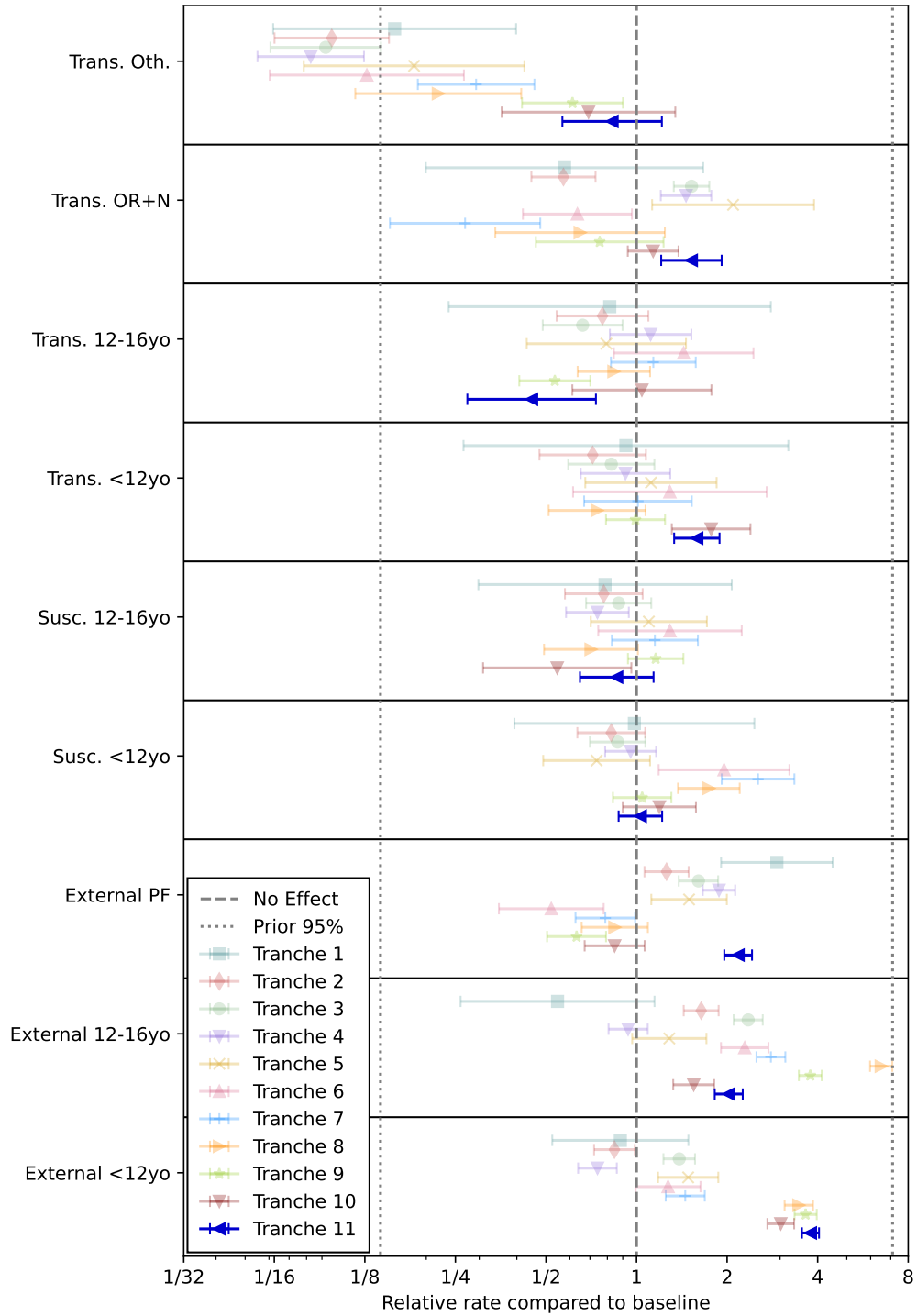


Figure 4: Visualisation of the fitted model. Relative effects on transmission, susceptibility and external exposure compared to baseline of an adult not working in a patient-facing role with OR+N+S maximal PCR gene positivity pattern if positive. ‘Trans.’ stands for relative transmissibility, ‘Susc.’ for relative susceptibility, and ‘External’ for relative external exposure.

										Tranche 11
$1 - q$										1.81 (1.76,1.87) %
p_2										20.2 (17.0,24.2) %
p_3										13.4 (11.1,16.5) %
p_4										9.86 (7.98,12.5) %
p_5										7.68 (6.14,10.1) %
p_6										6.24 (4.88,8.43) %
$\exp(\alpha_{2-11})$										3.79 (3.55,4.04)
$\exp(\alpha_{12-16})$										2.03 (1.82,2.25)
$\exp(\alpha_{PF})$										2.18 (1.96,2.42)
$\exp(\beta_{2-11})$										1.03 (0.872,1.22)
$\exp(\beta_{12-16})$										0.86 (0.649,1.14)
$\exp(\gamma_{2-11})$										1.59 (1.33,1.89)
$\exp(\gamma_{12-16})$										0.448 (0.274,0.733)
$\exp(\gamma_{OR+N})$										1.52 (1.21,1.92)
$\exp(\gamma_{CT-oth})$										0.83 (0.567,1.21)

Table 2: Tranche 11 parameter point estimates and CIs.