Update on the Taiwan household model

20/07/2021

Household/non-household transmission model

- Agent-based model
  - Number of households: 100,000
  - Household size: 3

- Household transmission (within household i)

$$\lambda_{i,hh} = c_{hh} * t_{hh} * I_i$$

number of infectious cases (within a household)

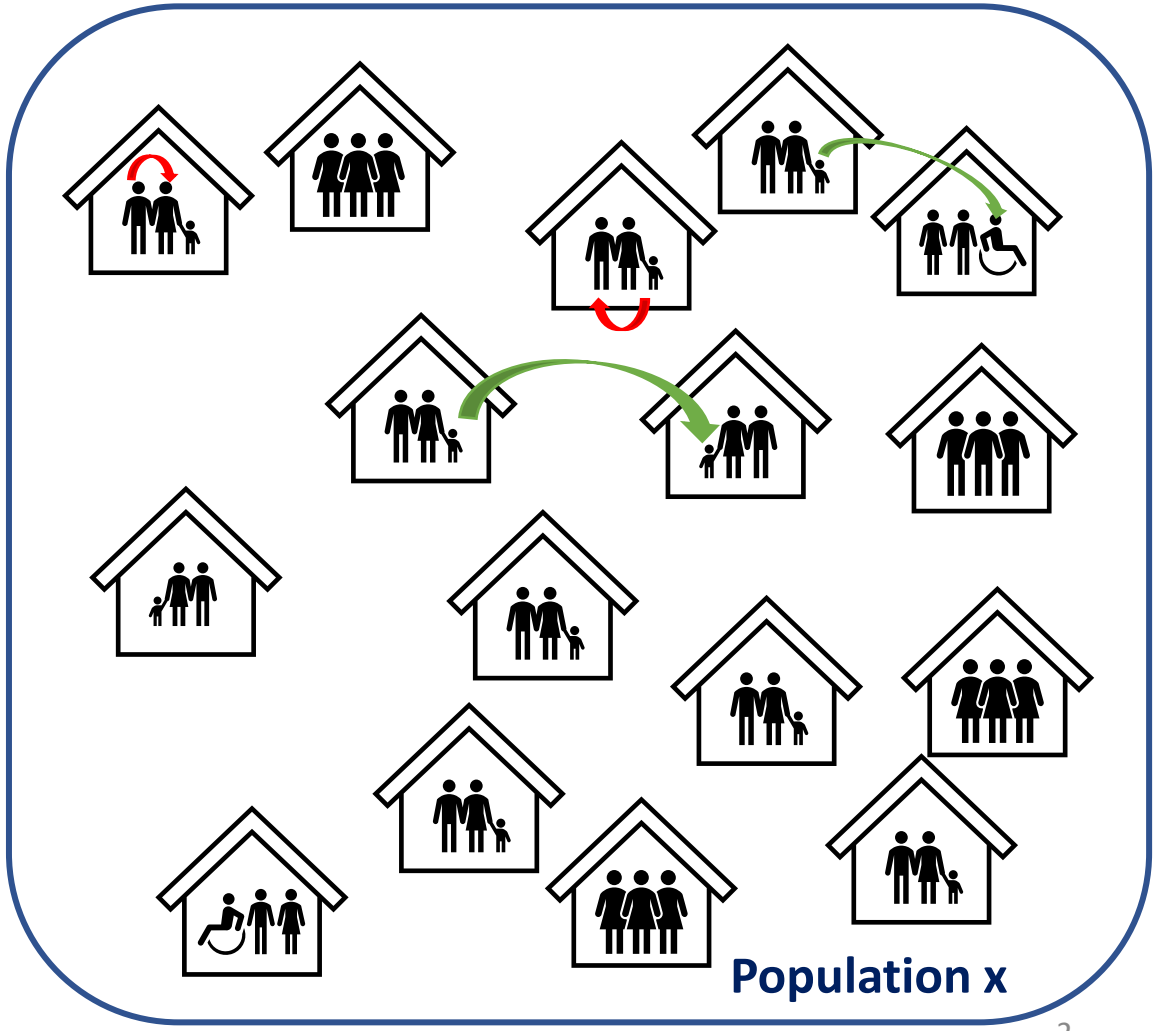
- Non-household transmission

$$\lambda_{nhh} = c_{nhh} * t_{nhh} * \sum I / \sum N$$

number of contact per day

transmission probability

total population



Household/non-household transmission model

- Model setting
  - Initial case in the population: 1
  - Duration of infectiousness: 5 days
  - Total population: 300,000 (number of households*household size)

- Model output
  - 3 stochastic runs (each costs about 4-5 minutes)
  - Reproduction numbers (Rt) for household and non-household cases
  - Number of new infections by household and non-household transmission

Changes in COVID-19 transmissibility

- **Before alert level 3**

(week 1-3)

- Wave 1 survey
  - Total contacts: 9.14
  - Household contacts: 2.26

- Transmission probability
  - Household: 0.21 (Thompson et al.)
  - Non-household: 0.26

- **After alert level 3**

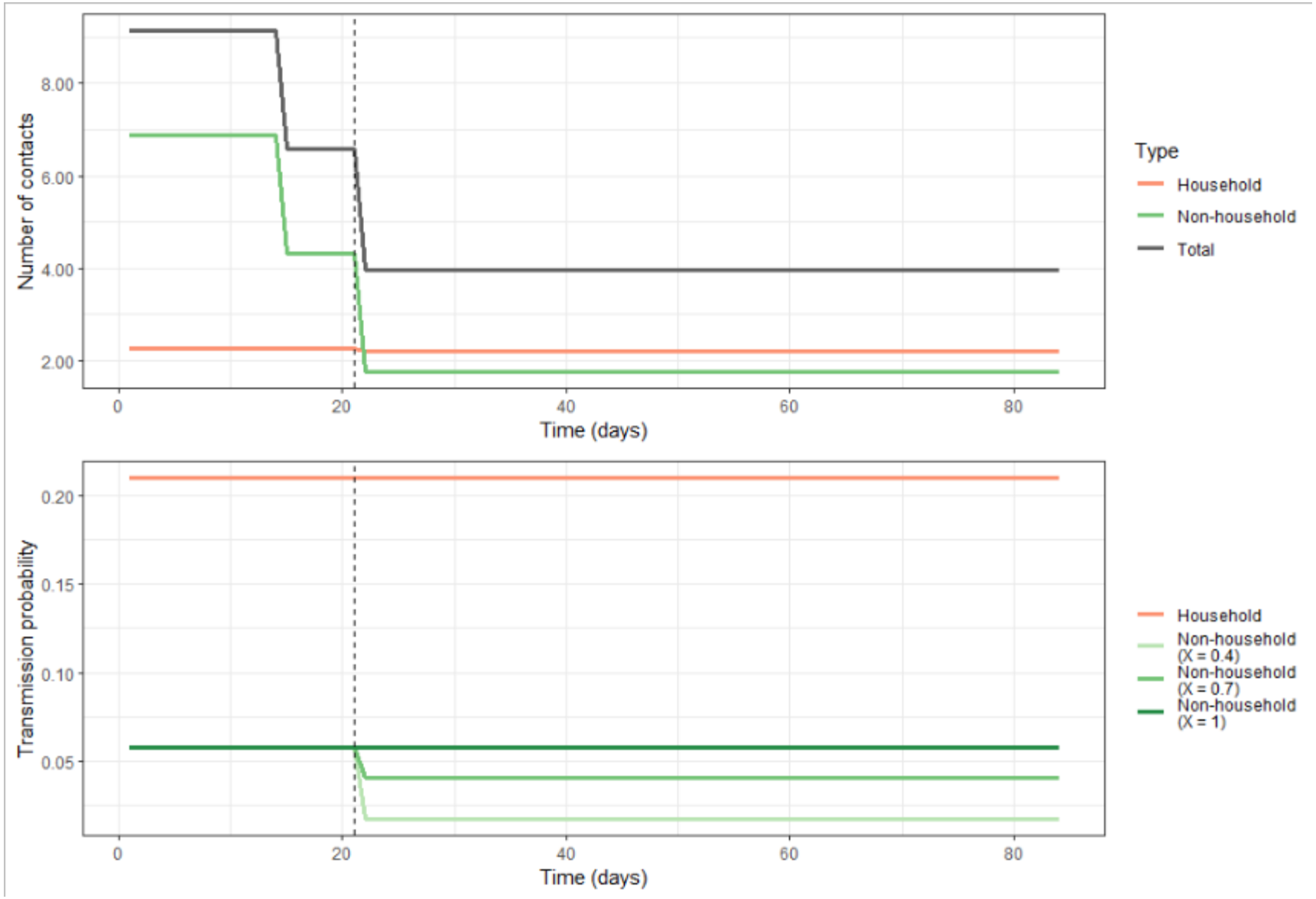
(week 4-12)

- Wave 3 survey
  - Total contacts: 3.97
  - Household contacts: 2.20

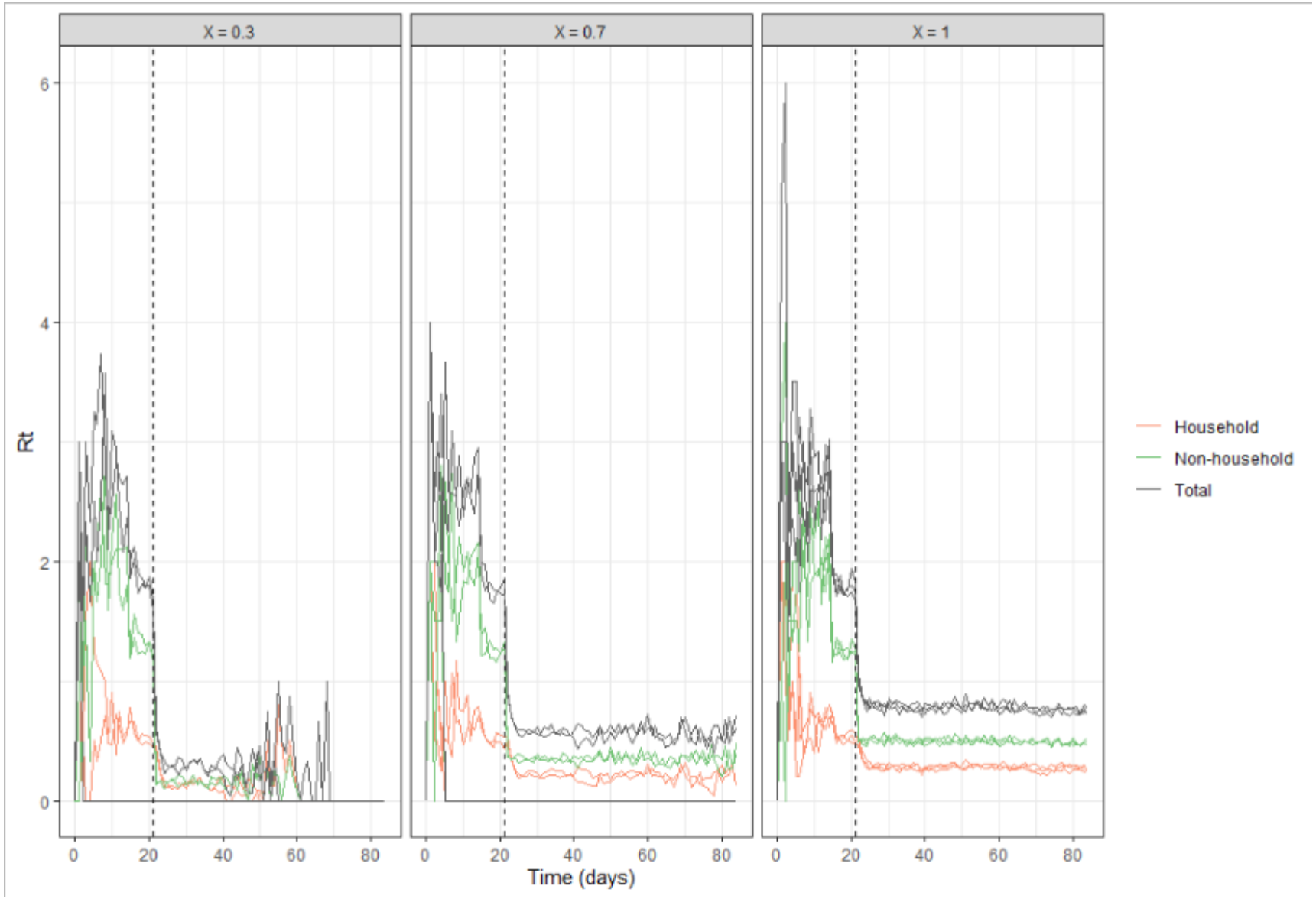
- Transmission probability
  - Household: 0.21
  - Non-household: 0.21*0.26*X
  - Multiplicative effect of measures
    - X = 1: no effect
    - X = 0.3: moderate effect
    - X = 0.7: strong effect

Fully susceptible scenario – **Input data**

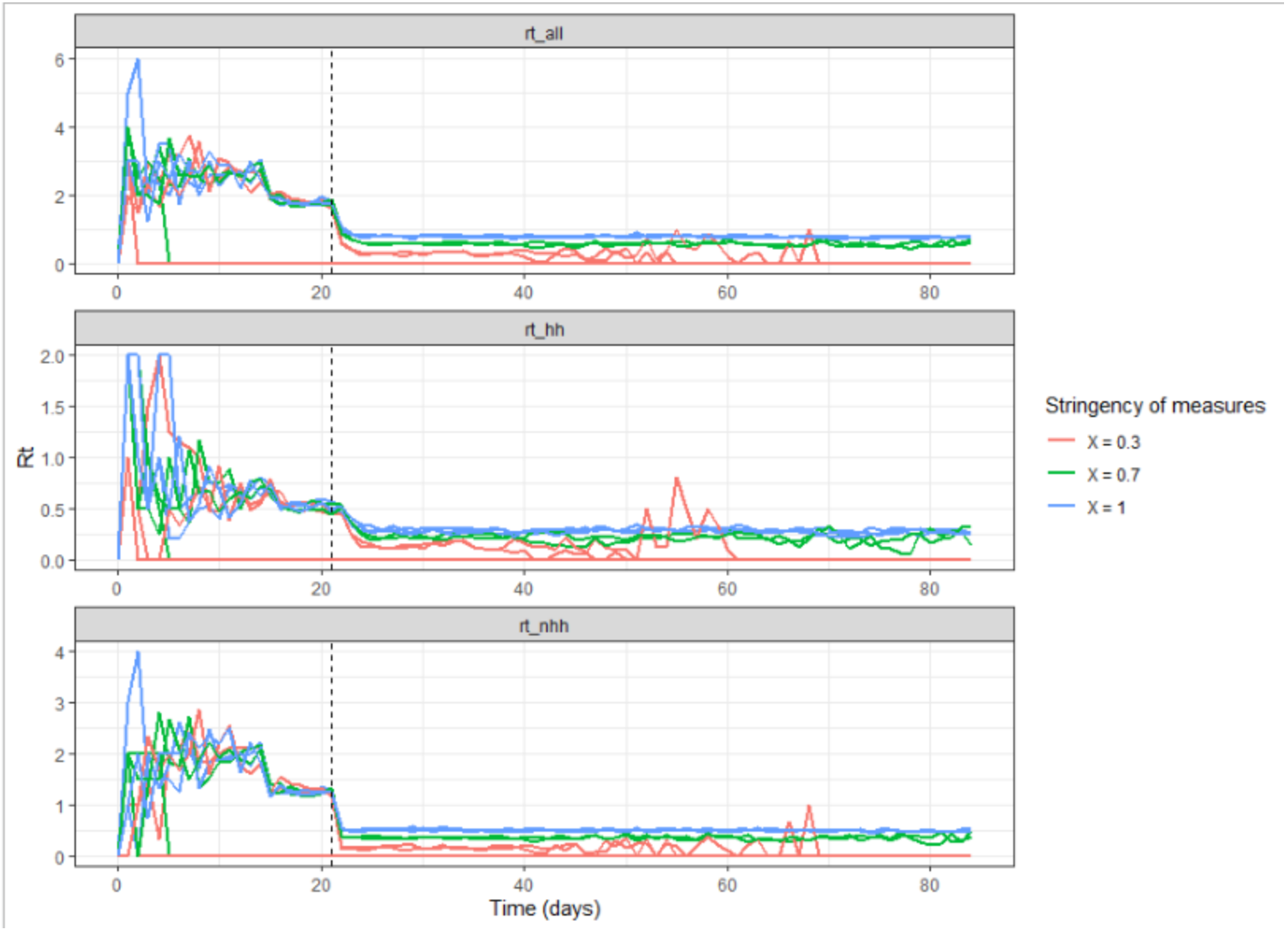
*non-contact rate declines a week before (15-21th day) the implementation of alert level 3 measures, to reflect the effect of alert level 2



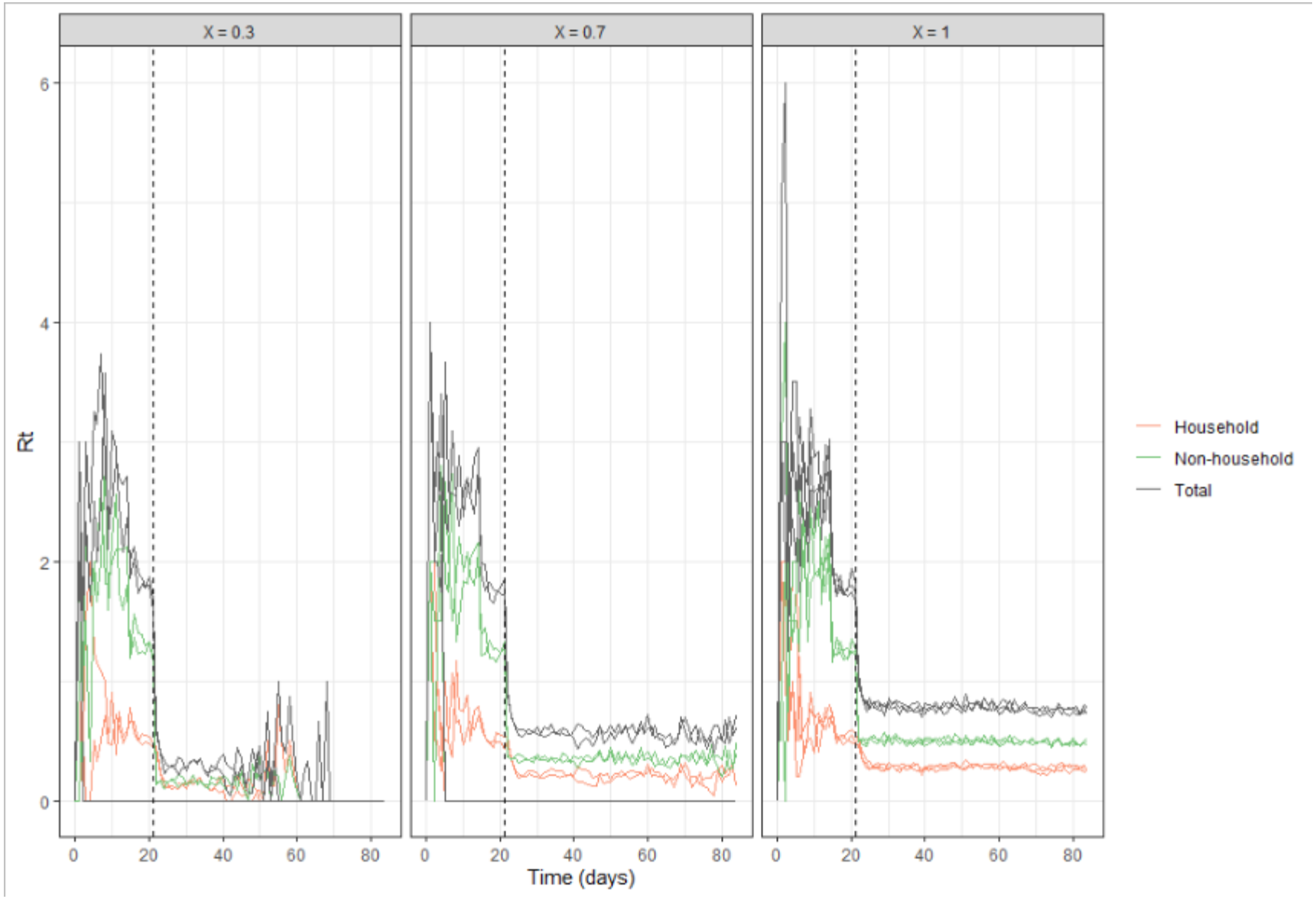
Fully susceptible scenario – **Rt estimates**



Fully susceptible scenario – **Rt estimates**



Fully susceptible scenario – **New infections**

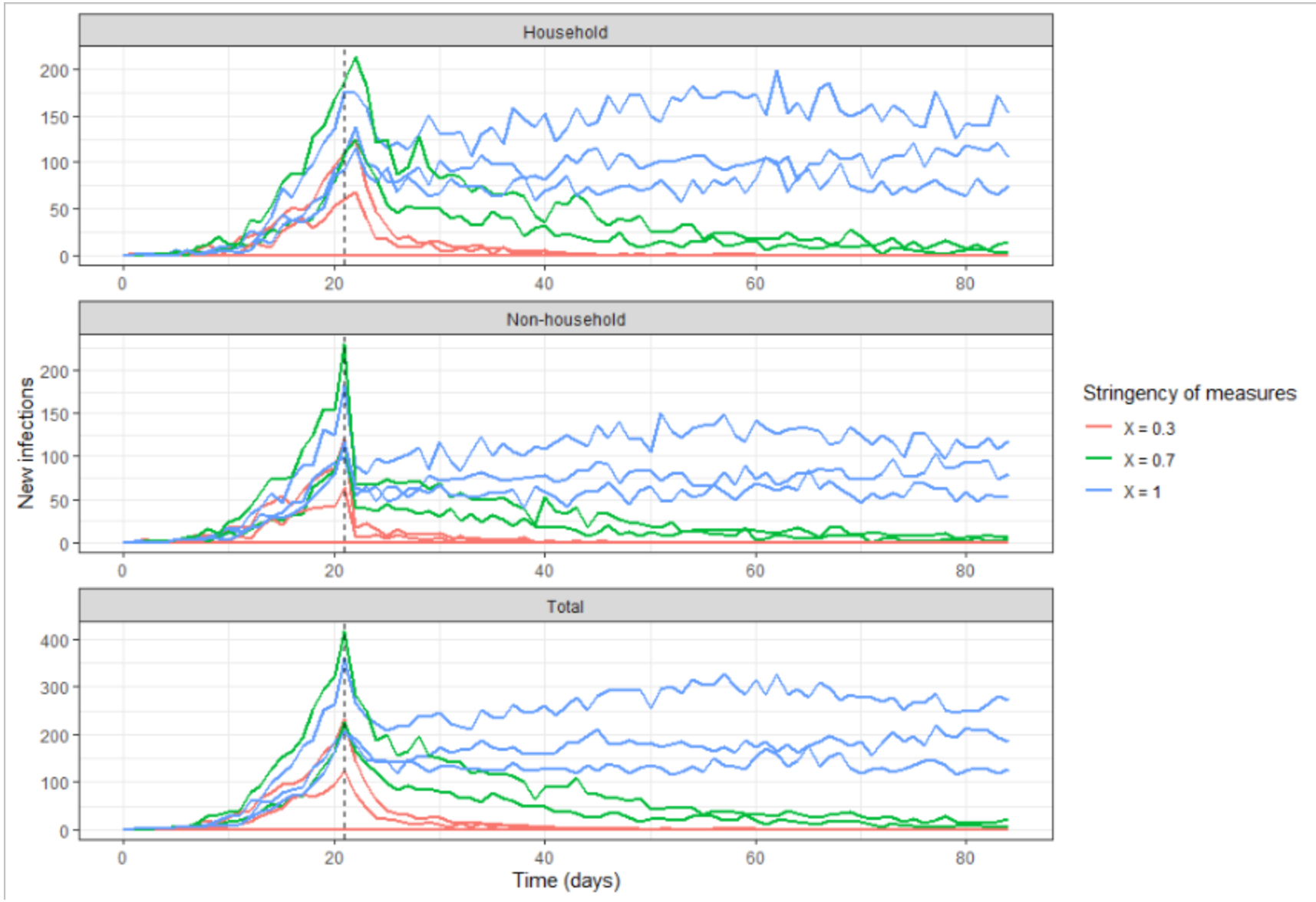


Fully susceptible scenario – **New infections**

Note:

Additional measures (X < 1) to reduce transmission probability is required to ‘eliminate’ transmission (清零?)

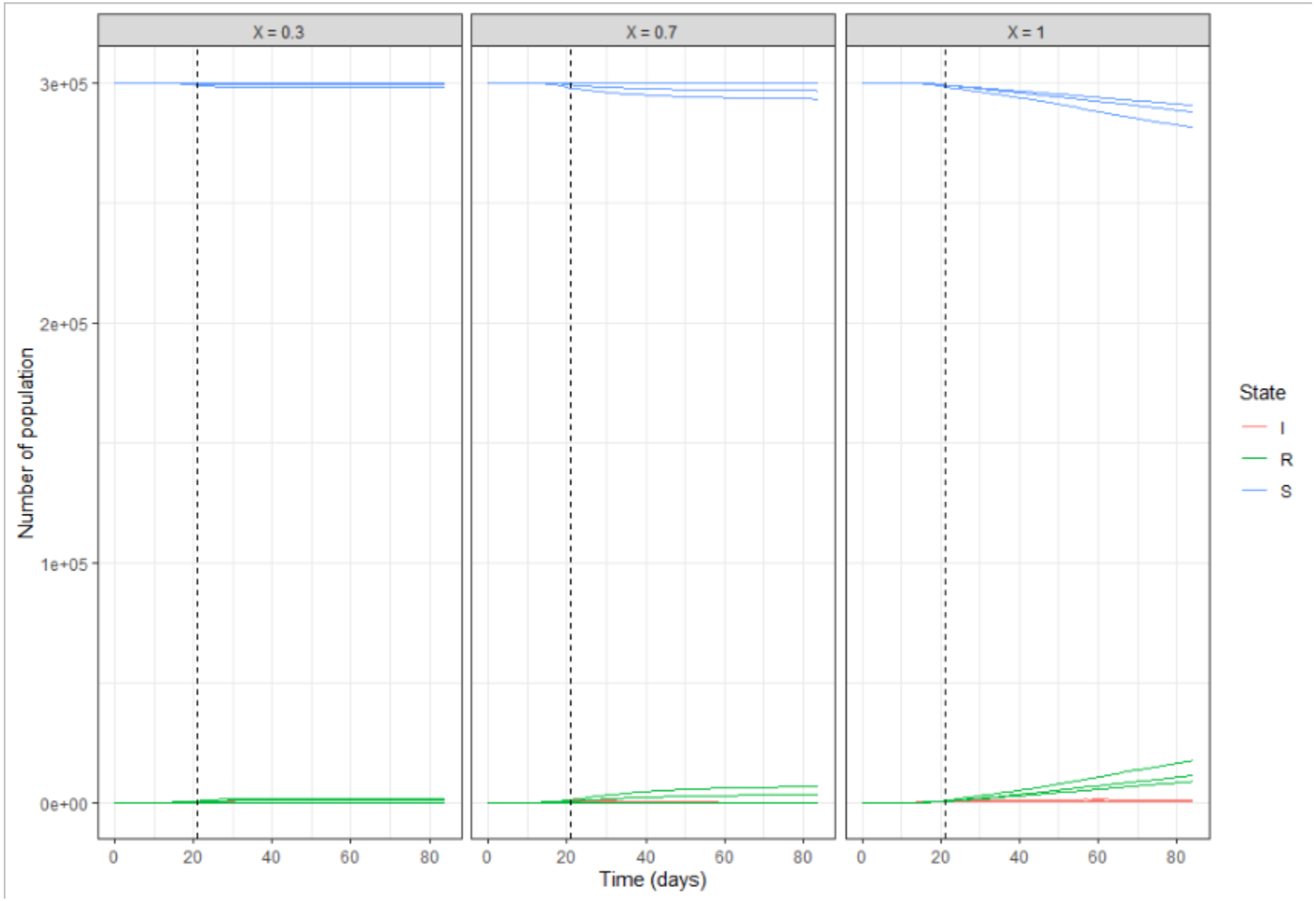
Different numbers of infections in the first three weeks reflects the stochastic characteristic of the model.



Fully susceptible scenario – **State overview**

Note:

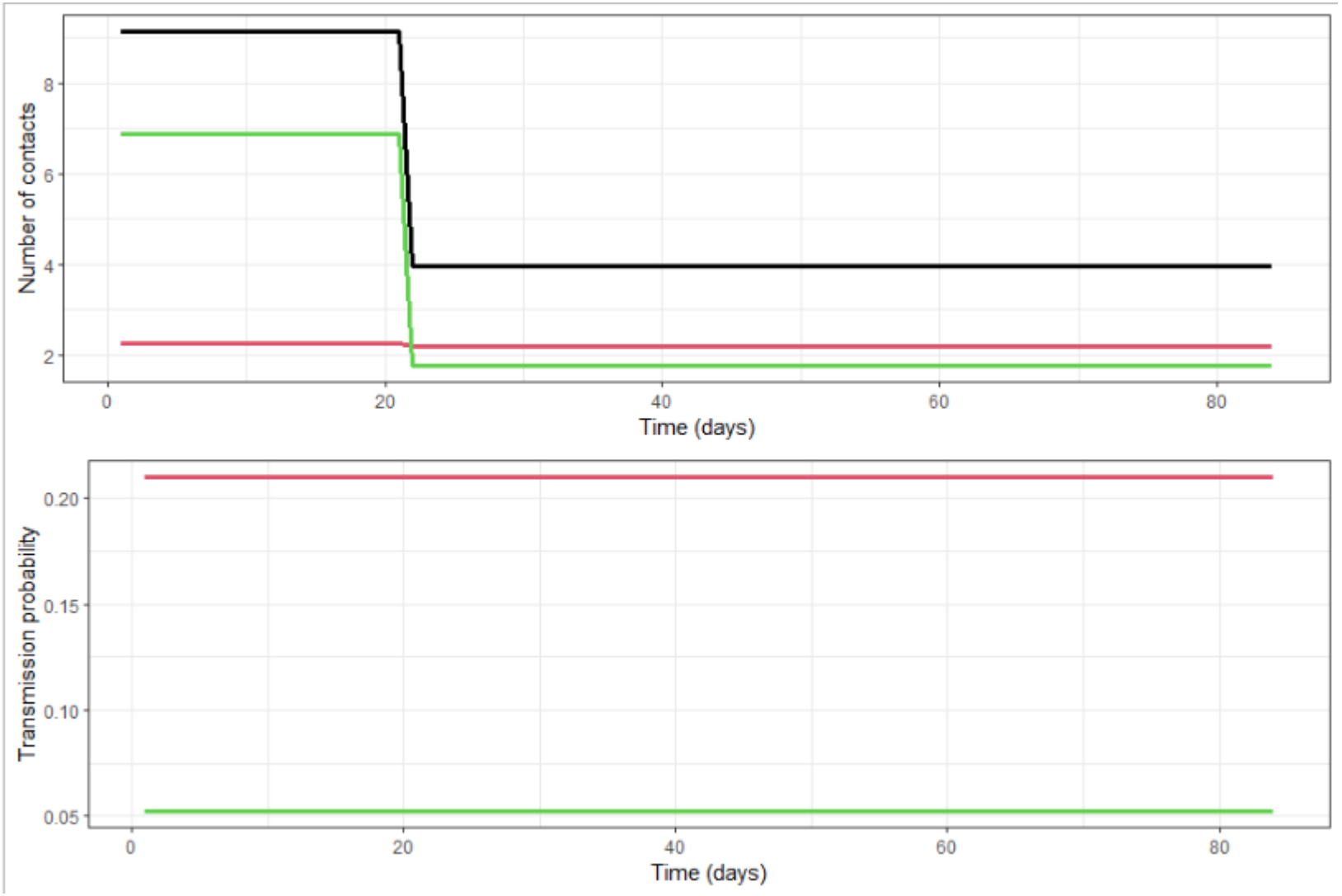
The majority of population remains susceptible after 12 weeks since the introduction of the initial case.



Partially vaccinated scenario – **Input data**

*same as the previous scenario

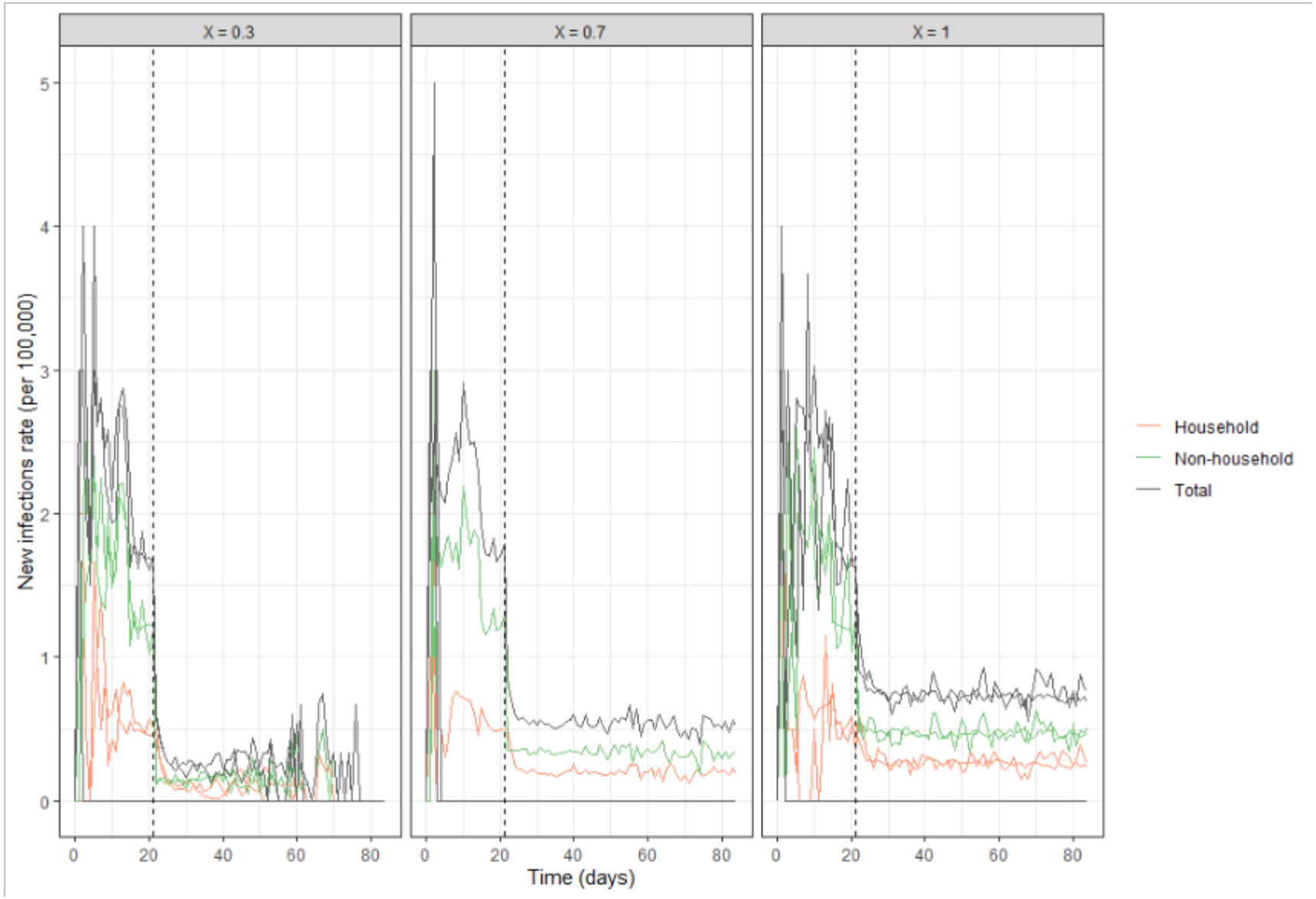
**assume 10% of population are vaccinated (one in each household)



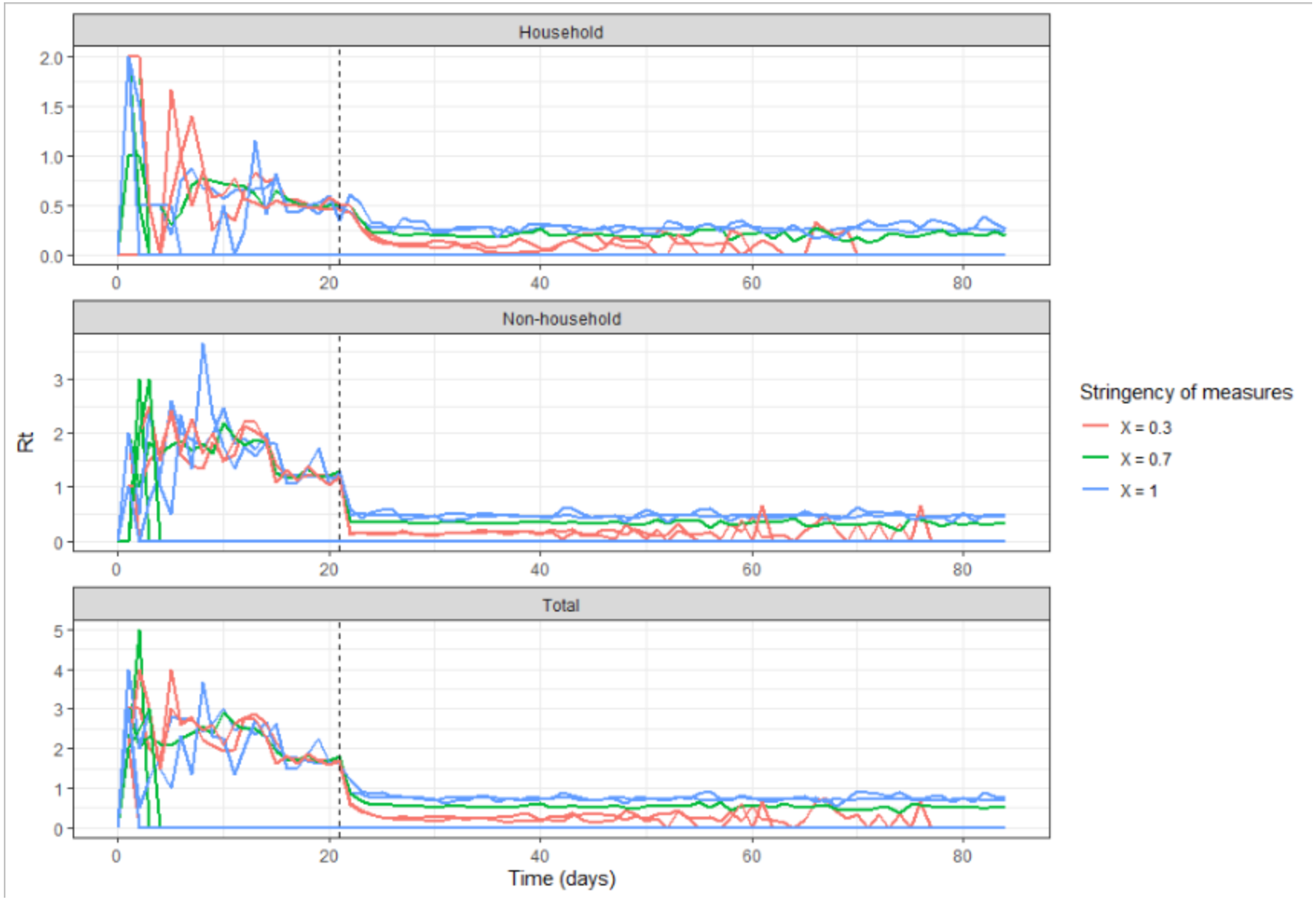
Partially vaccinated scenario – **Rt estimates**

Note:

Force of transmission is less likely to build up in the scenario with 10% vaccine coverage.



Partially vaccinated scenario – **Rt estimates**

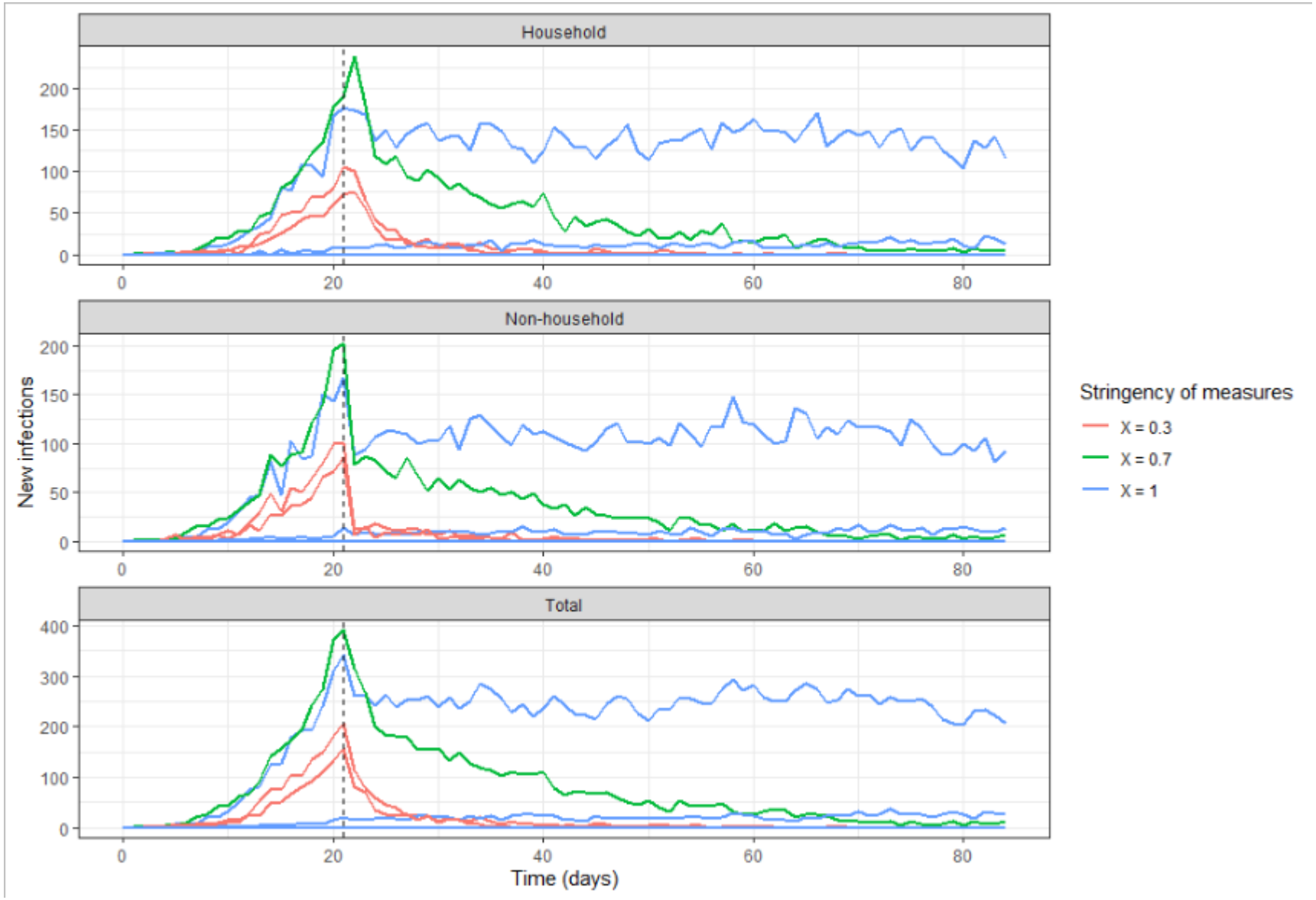


Partially vaccinated scenario – **New infections**

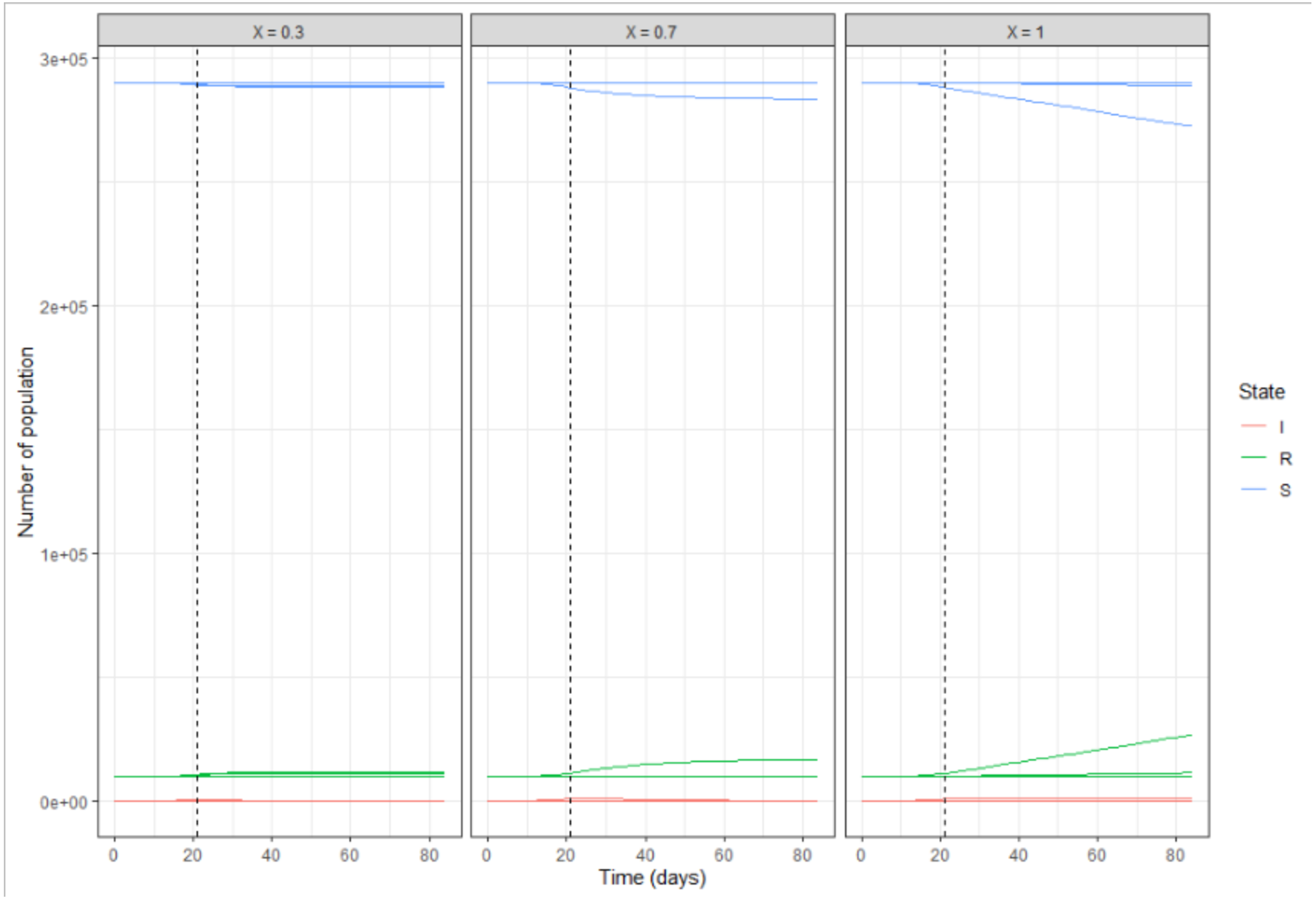
Note:

Stochastic effects are strong after including vaccination.

In general, fewer infections would occur and accumulate in the partially vaccinated population.



Partially vaccinated scenario – **State overview**



Comparison between fully susceptible and partially vaccinated scenarios

Note:

After including vaccination, the initial case is less likely to lead to an outbreak.

More runs are needed to better understand the stochastic pattern.