Methods

We applied age-structured contact matrices from the GlobalMix Mozambique rural and urban sites to a deterministic susceptible-infectious-recovered model with a vaccine conferring protection against infection. We compared GlobalMix contact patterns to those of synthetically projected contacts for Mozambique, which used POLYMOD contact patterns and Mozambique-specific demographic data ([Prem et al.](https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1005697)). We used the National Institute of Statistics 2021 rural and urban population distributions for Mozambique to weigh GlobalMix contacts by age group. Because synthetically derived contact patterns were not split by rural and urban settings, we used Mozambique’s entire population size by age group for weighting. We modeled vaccination as ‘leaky,’ providing partial protection for those vaccinated (50% vaccine coverage, 50% effectiveness), simulated duration of illness as 7 days, and fixed the basic reproduction number at 2.5. We present the attack rate for no vaccine (AR) and vaccine (ARv) scenarios and the overall vaccine effect calculated by the percent reduction of infections in the presence versus absence of vaccine. We used the ‘EpiModel’ package in R 4.3 to run all transmission models.

Results

Generally, overall vaccine effects using synthetically derived contact patterns were higher and attack rates were lower than those using empirically collected GlobalMix contacts across all but the youngest age group, 0-9 years (Table X). GlobalMix adult participants had more contact with children and adolescents than with their own age group, while synthetically derived contact patterns showed stronger assortative mixing by age. Compared to the GlobalMix rural and urban sites, synthetically derived contact patterns overestimated the number of contacts among those aged 0-9 years. This over-projection of contacts yielded higher attack rates (AR: 94.3%, ARv: 78.7%) and lower overall vaccine effects (16.6%) for this group compared to outcomes using empirically collected contact patterns (Rural AR: 91.4%, Rural ARv, 71.8%, Rural vaccine effects: 21.5%; Urban AR: 91.4%, Urban ARv: 72.0%, Urban vaccine effects: 21.2%). Additionally, synthetically derived contacts among those aged ≥60 years were underestimated compared to that of GlobalMix, producing notably lower attack rates among this age group (Synthetic AR: 13.4%, Synthetic ARv: 7.2%; Rural AR: 46.3%, Rural ARv: 26.6%; Urban AR: 40.9%, Urban ARv: 23.2%). Table X.

Table X. Simulated overall vaccine effects and attack rates from vaccine and no vaccine scenarios by age group across contact pattern assumptions

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Overall vaccine effect (Attack rate with without vaccine; Attack rate with vaccine) | | | | | | |
|  | 0-9 years | 10-19 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | ≥60 years |
| GlobalMix Rural | 21.5 (91.4; 71.8) | 12.2 (98.0; 86.0) | 29.3 (80.0; 56.6) | 31.2 (79.8; 54.9) | 40.9 (65.6; 38.7) | 39.3 (59.5; 36.1) | 42.5 (46.3; 26.6) |
| GlobalMix Urban | 21.2 (91.4; 72.0) | 12.8 (97.6; 85.1) | 27.6 (83.5; 60.4) | 29.6 (81.3; 57.2) | 42.4 (60.2; 64.7) | 40.4 (53.4; 31.8) | 43.4 (40.9; 23.2) |
| Prem, et al. | 16.6 (94.3; 78.7) | 22.5 (90.0; 69.8) | 34.3 (72.6; 47.7) | 35.9 (68.1; 43.6) | 51.4 (55.2; 26.8) | 46.1 (34.6; 18.6) | 46.4 (13.4; 7.2) |