

Title: Timely Access to Healthcare in India: Travel-time Analysis for 52478 Primary and Community Healthcare Centres

Authors: Siddhesh Zadey BSMS MSc-GH^{1,2}, Lokesh Krishna MBBS¹

Affiliations:

1 Association for Socially Applicable Research (ASAR), Pune, Maharashtra, India

2 Department of Surgery, Duke University School of Medicine, Durham, North Carolina, United States

Conflicts of Interest: None (for both)

Background:

Long times taken to reach health facilities are a major barrier to healthcare access and contribute to increased mortality risk in several low- and middle-income countries (LMICs) including India. Previous studies have found significant associations between distance to healthcare centres and increased mortality risk in India. However, travel-times, which better characterize the geographical access to these facilities is unavailable for India. Here, we provide novel high-resolution maps of travel-times to primary and community healthcare centres (PHCs and CHCs) using motorized and walking modes of travel.

Methods:

Data on PHC and CHC geolocations was obtained from the Pradhan Mantri Gram Sadak Yojana (PMGSY) database in October 2021. We obtained motorized and walking friction surface rasters (1 km²) from the Malaria Atlas Project and the administrative boundary data from the Community Created Maps and GADM v3.6. Travel-time taken to reach the nearest PHC or CHC from every 1km² grid on the friction surfaces was calculated using an implementation of the Dijkstra algorithm. We report the median (and accompanying interquartile range, IQR, 25th and 75th percentiles) times (in minutes) taken to reach the nearest PHC/CHC at national and state levels.

Findings:

We included 52478 primary and secondary-level healthcare facilities (46002 PHCs and 6476 CHCs). Nationally, the median [IQR] travel-time using motorized transport at optimal driving speed was 14.34 [5.96, 30.97] mins. while that for walking was 63.23 [36.83, 108.01]. The motorized travel-time was lowest for Puducherry (median [IQR] = 2.27 [1.38, 3.78]) and highest for Ladakh (median [IQR] = 1713.40 [1713.40, 1713.40]). Walking travel-time was lowest for Puducherry (median [IQR] = 21.80 [11.06, 33.19]) and highest for Ladakh (median [IQR] = 2363.14 [2363.14, 2363.14]).

Interpretation:

To our knowledge, this is the first attempt to comprehensively map travel-times to PHCs and CHCs in India. Our findings point to overall adequate access but significant

disparities across states. These findings can inform subnational healthcare access policies and future research on effective population health coverage.

Source of Funding:
None



**Timely Access to Healthcare in India: Travel Time Analysis for
52,478 Primary and Community Healthcare Centers**
Siddhesh Zadey BSMS MSc-GH^{1,2}, Lokesh Krishna MBBS¹

¹ Association for Socially Applicable Research (ASAR), Pune, Maharashtra, India
² Department of Surgery, Duke University School of Medicine, Durham, North Carolina, United States

BACKGROUND

- Timely access is a major barrier to healthcare and contributes to increased mortality risk in several low- and middle-income countries (LMICs) including India.
- Previous studies have found significant associations between distance to healthcare centres and increased mortality risk in India.
- Travel times, which better characterize the geographical access to these facilities are unavailable for India.

METHODS

- Data on PHC and CHC geolocations was obtained from the Pradhan Mantri Gram Sadak Yojana (PMGSY) database in October 2021.
- Motorized and walking friction surface rasters (1 km²) was obtained from the Malaria Atlas Project and the administrative boundary data from the Community Created Maps and GADM v3.6.
- Travel time to reach the nearest PHC or CHC from every 1km² grid on the friction surfaces was calculated using an implementation of the Dijkstra algorithm.
- The median (and accompanying interquartile range, IQR, 25th and 75th percentiles) times (in minutes) taken to reach the nearest PHC/CHC at national and state level when utilising motorized transport and when walking was mapped.

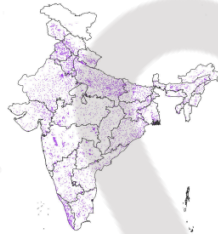


Fig 1. Map displaying community health centers in India (Source: Pradhan Mantri Gram Sadak Yojana, October 2021)

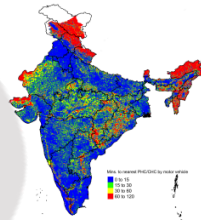


Fig 3. Map displaying travel time to nearest PHC/CHC using motorized transport at optimal driving speed

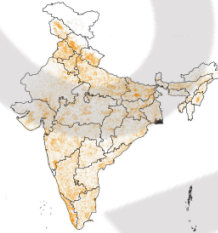


Fig 2. Map displaying primary health centers in India (Source: Pradhan Mantri Gram Sadak Yojana, October 2021)

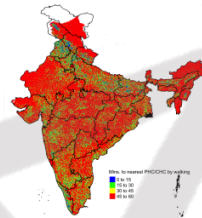


Fig 4. Map displaying travel time to nearest PHC/CHC when walking

FINDINGS

- The dataset consists of 52,478 primary and secondary-level healthcare facilities (46,002 PHCs and 6,476 CHCs)
- Nationally, the median [IQR] travel time using motorized transport at optimal driving speed was 14.34 [5.96, 30.97] mins and 63.23 [36.83, 108.01] for walking
- The motorized travel time was lowest for Puducherry (median [IQR] = 2.27 [1.38, 3.78]) and highest for Ladakh (median [IQR] = 1713.40 [1713.40, 1713.40]). Walking travel time was lowest for Puducherry (median [IQR] = 21.80 [11.06, 33.19]) and highest for Ladakh (median [IQR] = 2363.14 [2363.14, 2363.14]).

CONCLUSION

To our knowledge, this is the first attempt to comprehensively map travel times to PHCs and CHCs in India. Our findings point to overall adequate access but significant disparities across states. These findings can inform subnational healthcare access policies and future research on effective population health coverage.

REFERENCES

1. Weiss, D.J., Nelson, A., Vargas-Ruiz, C.A. et al. Global maps of travel time to healthcare facilities. *Nat Med* 26, 1835-1838 (2020). <https://doi.org/10.1038/s41591-020-1059-1>