BMJ Open

Strategies and challenges in Kerala's response to the initial phase of COVID-19 pandemic: a qualitative descriptive study

Kannamkottapilly Chandrasekharan Prajitha,[1] Arya Rahul,[1] Sujatha Chintha,[1] Gopakumar Soumya,[1] Meenu Maheswari Suresh,[1] Anjana Nalina Kumari Kesavan Nair,[1] Mathew Joseph Valamparampil,[2] Aravind Reghukumar,[3] Sriram Venkitaraman [ID] ,[4] Thekkumkara Surendran Nair Anish [ID] [1]

For numbered affiliations see end of article.

Correspondence to
Dr Thekkumkara Surendran Nair Anish; doctrinets@gmail.com

ABSTRACT

Objective To understand the structures and strategies that helped Kerala in fighting the COVID-19 pandemic, the challenges faced by the state and how it was tackled.

Design Qualitative descriptive study using focus group discussions and in-depth interviews.

Setting State of Kerala, India.

Participants 29 participants: four focus group discussions and eight in-depth interviews. Participants were chosen purposively based on their involvement in decision-making and implementation of COVID-19 control activities, from the department of health and family welfare, police, revenue, local self-government and community-based organisations. Districts, panchayats (local bodies) and primary health centres (PHCs) were selected based on epidemiological features of the area like the intensity of disease transmission and preventive/containment activities carried out in that particular area to capture the wide range of activities undertaken in the state.

Results The study identified five major themes that can inform best practices viz social capital, robust public health system, participation and volunteerism, health system preparedness, and challenges. This study was a real-time exploration of the intricacies of COVID-19 management in a low/middle-income country and the model can serve as an example for other states and nations to emulate or adjust accordingly.

Conclusion The study shows the impact of synergy of these themes towards more effective solutions; however, further research is much needed in examining the relationship between these factors and their relevance in policy decisions.

Strengths and limitations of this study

► The study has examined the response of the state of Kerala towards the COVID-19 pandemic comprehensively by involving representatives not only from different levels of the healthcare system but also from various other sectors including police and local self-government department.

► The possibility of a positive bias in highlighting the efficiency of the system cannot be excluded as the majority of the respondents were within the government system.

► The COVID-19 pandemic and associated social distancing have forced remote data collection techniques using the online platform which might have affected the data quality.

► At the same time, the remote data collection has increased the participation, who might not have otherwise consented to the study.

INTRODUCTION

When COVID-19 grew into a pandemic of extraordinary magnitude, several countries started following different strategies to contain and mitigate the spread. The unprecedented nature of the virus has contracted the economy of the world and there is a divergence in opinion on strategies adopted by different nations in handling the pandemic.[1] Kerala, the southernmost state of India, reported its first confirmed case of COVID-19 on 30 January 2020.[2] Amid the persistent vulnerabilities of high population density $(860/km^2)$,[3] the high proportion of old age populations (12.6% of the total population)[4] and a large number of expatriates,[5] the state showed slow progression of cases, reporting zero new cases by the beginning of May 2020.[6] While the case fatality rate reached around 7% globally and 4% nationally in the month of May, Kerala could maintain a low fatality of less than 1%.[7 8] The state's efficient handling of the initial phase of the pandemic received global appreciation.[9 10]

As the COVID-19 pandemic is raging across the world, the responses and collective actions galvanising solidarity across nations

are making the pandemic a social phenomenon. Qualitative methods help in understanding the social responses and the gaps between the assumptions and realities as well as why certain interventions work and others fail.[11] It can play a pivotal role in understanding the sociopolitical and management approach to control epidemics like COVID-19, especially to narrate and put forward effective solutions and strategies that could be used by other communities.[12] This demands a study on the intricacies of COVID-19 control to fill the lacunae put forth by various literature. The study aimed to understand the structures and strategies that helped Kerala in fighting the COVID-19 19 pandemic. The study also explored the challenges faced by the state and how they were tackled.

METHODOLOGY

This qualitative research was undertaken in Kerala spanning from May to August 2020. To understand the way in which the state and district level decision makers zeroed down to several combinations of measures and how people could cope-up with the decisions of the government, the paradigm used for the study was advocacy and participatory. We used a descriptive approach for the study and conducted in-depth interviews and focus group discussions. Participants were chosen purposively based on their involvement in decision-making and implementation of COVID-19 control activities. For a comprehensive understanding of the phenomenon, the researchers attempted a triangulation of data sources and the participants were chosen from the department of health and family welfare, the police, revenue, local self-government (LSGD) and community-based organisations. Districts, panchayats (local bodies) and primary health centres (PHCs) were selected based on epidemiological characteristics of the area like the intensity of disease transmission and preventive/containment activities carried out in that particular area to capture the wide range of activities undertaken in the state. Four focus group discussions and eight in-depth interviews were conducted (table 1).

The investigators who were well trained in qualitative research contacted each participant over the phone and the study objective was informed and willingness enquired. The researchers had no personal relationship with the participants. The only presupposition in the study was the social capital and a good public health system would have helped the state in handling the initial phase of the COVID-19 pandemic. Once verbal consent was obtained, the date, time and place were fixed according to the convenience of the interviewee. In the case of interviews using online platforms, informed consent was emailed and interviews were conducted at a time convenient for the interviewee. Every participant was informed about the freedom to refuse the invitation or to withdraw from the study at any point of time. Among the focus group discussions conducted, one was conducted at a PHC maintaining social distancing and taking adequate precautions, the other three were

Table 1 List of focus group discussions and in-depth interviews

Focus group discussion	FGD1	State COVID-19 expert committee members (SCE1–SCE7)
	FGD2	District programme managers and district officials (DPM1–DPM4, DO1–DO3)
	FGD3	Police officers of rank SI and CI (PF1–PF6)
	FGD4	Health staffs—3, junior health inspectors (JHI1–JHI3), junior public health nurses (JPHN1–JPHN4)
In-depth interview	IDI1	State medical board member
	IDI2	State police official
	IDI3	Health inspector 1
	IDI4	Health inspector 2
	IDI5	Local self-government people's representative (municipality)
	IDI6	Local self-government people's representative (village panchayat)
	IDI7	State-level public health expert
	IDI88	State PEID cell coordinator

PEID, Prevention of Epidemic and Infectious Disease.

conducted over an online platform. The time duration for focus group discussions was 1–1.5 hours. An in-depth interview with a member of the state medical board was conducted at the author's institute, and IDI3 with health inspector-1 was conducted at the PHC. The remaining in-depth interviews were conducted via an online platform. IDIs lasted for 45 min to 1 hour. The interviews were done with a topic guide (table 2) and were participant-led. Discussions and interviews were conducted maintaining confidentiality after obtaining informed consent and were audio-recorded. At the end of each interview, the researchers summarised the information to the participants, to determine the accuracy. The recordings were transcribed and translated to English. Thematic analysis using a hybrid coding process was the approach followed. Data were coded using Nvivo and were rigorously reviewed and categorised. The emerging patterns, themes and relationships were identified. Consensus on emerging themes was reached through regular discussion among the researchers. Direct quotes were used wherever possible. Findings were shared with all the participants through email, allowing them to critically analyse and review their comments. The study has been reported in accordance with the Standards for Reporting Qualitative Research guidelines.[13]

Patient and public involvement

As our study was an attempt to understand the sociopolitical and management approaches adopted by the state of Kerala during the COVID-19 pandemic, patients and the public were not involved in the design, conduct, and reporting of the study.

Table 2 Interview schedule

Topic	Main question	Follow-up question	Probe question
Achievements	What have we achieved?	How could we achieve this?	How will it be over time?
Strategies	What were the factors/strategies that helped us in achieving it?	How will you evaluate Kerala's strategies? (SWOT analysis)	What were the merits and demerits of the strategies adopted?
Roles and responsibilities	What was your (organisation's) role in control activities?	How did your activities help the government?	
Challenges	What were the main challenges in implementing the government decision?	1. How could you overcome the challenges? 2. What was the guidance given by the government?	Who supported you in facing these challenges?
Suggestions	Can you suggest any modifications for the specific strategies adopted by the state?	Why do you think such a modification needed?	

RESULTS

Data analysis led to the emergence of 50 codes and five themes (table 3).

Social capital

Historical aspects and socio-political movements

The unique public health history of Kerala was commented on by majority of the participants.

By the beginning of the nineteenth century the princely state of Kerala initiated vaccination and within 25 years community-based vaccination programs evolved. Kerala was ahead in education and health compared to other states of India, contributed by the missionaries and the socio-political movements even before independence. The investments in public health and social determinants of health continued during the post-independence era. (State-level public health expert, IDI7)

The state has a legacy of linking health to non-health sectors. The socialist movements and land reforms were instrumental in nourishing equity by mitigating the difference in economics, education and social advantage between different communities.

Social determinants of health and health indicators

Kerala model of health care focussed mainly on social welfare elements like education, agriculture, water, and sanitation, which could bring substantial improvements in the health status of the population. This prompts the state to act at the level of social determinants in every emerging health issue. (SEC1, FGD1)

In the context of COVID-19, the high literacy rate of Kerala has helped in better penetration of knowledge and awareness among people, thereby creating more alert and response in the civil society. This has attributed to the involvement of people especially youth in campaigns and community organisations.

It was not necessary to inform people, they were aware of COVID 19 and the importance of hand hygiene and sanitation practices. Even many expatriates reported and quarantined themselves. Monitoring alone was needed in those places. (Health inspector 1, IDI3)

The level of literacy and healthcare-seeking behaviour enabled people to understand the mode of spread of infection and improved the willingness to follow the protocols and guidelines.

With the health system well in place, the delay in symptom onset to admission was around 2.5 days. (State medical board member, IDI1)

Robust public health system

Efficiency and distribution

The most important strength of Kerala's health system is the wide distribution of health facilities, most importantly the PHCs that facilitate the grassroot-level healthcare of the community. Every panchayat (LSGD for every 20 000–40 000 population) in Kerala has a PHC and an AYUSH (indigenous system of medicine) hospital and

Table 3 Emergent themes and categories

Themes	Categories
Social capital	1. Historical aspects and socio-political movements. 2. Social determinants of health and health indicators.
Robust public health system	1. Efficiency and distribution. 2. Disease surveillance system.
Participation and volunteerism	1. Leadership. 2. Intersectoral coordination. 3. People's participation.
Health system preparedness	1. Previous experiences. 2. Evidence-based action. 3. Upscaling of facilities and services.
Challenges	1. Victim of initial success. 2. Limited resources.

evenly distributed compared with other parts of the country. Every PHC has 5–6 peripheral outreach centres known as subcentres manned with a junior health inspector and a junior public health nurse (JPHN). Along with the government facilities, there is a wide network of private hospitals in Kerala that cater to a major proportion of the state's healthcare needs.

The well-qualified and trained healthcare staff with good unity of command resulting from the experience in managing several communicable diseases over the years is the backbone of Kerala's healthcare system. The efficiency was not confined to identification, reporting and clinical management of cases, but also to the strong mechanism of supervising, monitoring and grievance redressal.

> … So, once we have any program or guidelines in place, there is a system to receive it … and that is very important. In the absence of an efficient system, preparing guidelines is a futile exercise. I repeatedly use the word system … because in such responses system does matter, at the micro and macro level. (State PEID cell coordinator, IDI8)

Disease surveillance system

Integrated Disease Surveillance Project initiated in 2005 with daily and weekly reporting of communicable diseases through paramedical field staffs, clinical surveillance throughout hospitals and laboratory surveillance represent a robust surveillance network at the grassroots level.

> Even though the disease was new, COVID only needed to be included in the established surveillance mechanisms of the state. In the same way as identifying a diarrhoea cluster through syndromic surveillance, we needed to identify ILI clusters here. (JPHN2, FGD4)

The existing strong surveillance mechanism for infectious diseases incorporating private institutions through Integrated Disease Surveillance Programme, Prevention of Epidemic and Infectious Disease (PEID) cells for medical college institutions and Joint Effort for Elimination of Tuberculosis for surveillance of respiratory symptoms has helped in building up mechanisms for tackling any emerging outbreak.

Anganwadi workers (outreach workers of Integrated Child Development Service Scheme) and a well-motivated group of Accredited Social Health Activists recruited through National Health Mission forms a network to capture potential health issues that can emerge in the community. During the pandemic, COVID-19 control became a part of their routine activities.

Participation and volunteerism
Leadership

Effective leadership made the system well accommodative and open for community participation.

> … I would like to call it an enlightened leadership … accepting scientific advice and trying to understand

things as much as possible, has played a big role. (SCE 1, FGD1)

The knee-jerk administrative response and the checks and balances were evident from the very beginning of the pandemic. The daily press conference by the chief minister of the state and open discussions with the media made the leadership more democratic. Each district was assigned to a state minister and review meetings were held as and when needed. The vertical and horizontal integration made the administrative system of the state more transparent and acceptable to the people. At the subdistrict level, a medical officer was posted as the nodal officer to coordinate the activities related to COVID-19 and to ensure proper communication.

Intersectoral coordination

> It would be too reductive to even think that, it's the health system which alone has done all these activities. It's the combined effort of all sectors, along with people who can understand and comply with the instructions of the state, which made this fight more fruitful. (DPM1, FGD2)

The role of various departments notably, LSGDs, public distribution system, police, disaster management, education, information technology, media and fire force were evident from the beginning. They played a pivotal role in addressing the medical and non-medical needs of the people, and in control measures including ensuring quarantine and maintaining social distancing. LSGD integrated different departments at the field level and provided financial assistance for COVID-19 control activities. The proactive action of LSGD in social mobilisation along with non-government organisations and self-help groups like Kudumbashree (Kudumbashree is the neighbourhood group of women, part of the poverty eradication mission of the government of Kerala and is widely distributed across Kerala) was evident during the pandemic. They were instrumental in ensuring an uninterrupted supply of food to quarantined people, migrant labourers and the destitute by initiating a 'community kitchen' immediately following the lockdown along with public distribution system. Disaster management authority along with LSGD identified unoccupied buildings and converted it to quarantine and treatment facilities.

The fire force department helped in procuring and delivering drugs and other medical needs, using the district and gram panchayat funds. The police force played an important role in enforcing the preventive measures at the community level including the use of face masks and preventing social gatherings. They ensured food and shelter to the vulnerable including migrants and the destitute.

> … I would like to describe our police department in two phases, one before COVID and the other after COVID. Even though police are more community-oriented in Kerala through 'Janamaithri' (people friendly) police stations and students' police cadets,

the police department was more focused on enforcing law and order … But now, social welfare is our additional focus … (PF1, FGD3)

To a greater extend various campaigns were effective because of widespread awareness generation by social media. Media scrutinised different administrative data, integrating and debating expert opinion, and acted as a corrective force to the government.

… We witnessed epidemiology, public health, mathematical models being discussed in and out of medical circles in all media platforms. Medical personnel acquired an epidemiological perspective, so did common people. (DO 2, FGD2)

The information technology department simplified the surveillance and data management by developing platforms for contact tracing and surveillance, mobile application (named GoK Direct) to ensure the real-time transfer of information related to COVID-19, providing trained human resources and integrating data from various departments.

People's participation

Community participation saw many appreciable facets in Kerala from participating in government sensitisation campaigns to innovative community-level approaches and control measures. Through several groups like 'Jagratha Samithi' (means alertness committee and are ward level committees formed by volunteers), people came forward by themselves and took the responsibility. Social surveillance measures from the public acted as a third eye and helped the health workers in ensuring quarantine. The response from the community was quick and effective, and special strategies to ensure food delivery and medical provisions were possible largely due to the people's participation.

We started a help desk for Non-Resident Indians to meet their medical needs, which later expanded to non-medical needs too, a project with zero budget and finally distributed around 48 lakh materials by volunteers … It's like sleeping cells we just need to activate it … it's not easy to find such systems in other parts of India. (SCE 3, FGD1)

Health system preparedness
Previous experiences

… Both the Nipah outbreak and two flood experiences in successive years, 2018, 2019 and the successful prevention of outbreaks of infectious disease following the disasters, taught the health fraternity that more than the individual doctor/nurse skill, the system is more important and should be in place … (DPM 1, FGD2

By late January, even when the first case of COVID-19 was identified in the country from a Wuhan returnee under quarantine in Kerala, the state had established

Corona Control Cell, and protocols were set in place. This pre-emptive response was possible from the previous experiences of managing an outbreak.

The experience with Nipah brought several guidelines in place for infection control including the establishment of an outbreak monitoring unit and regular training to all health workers through link nurses. It familiarised the health workers with triage, red channel, and personal protective equipment.

Evidence-based action

Even before the first case of COVID-19 was reported in the country, the health system of Kerala was preparing with abundant measures. Evidence-based guidelines and evolving protocols to accommodate the emerging evidence made the process more scientific.

Kerala was a step ahead in including people coming from Middle East countries in the surveillance network, even before WHO included those countries. We couldn't allow even 1% error considering the high population density in the state. (SCE 5, FGD1)

Contact tracing of each positive patient with route maps and their risk stratification by the surveillance team at the district level helped in widening the surveillance network. Call centres were enabled to provide round-the-clock support. Guidelines for quarantine, testing and treatment were established. If the institutional medical board had difficulty in decision-making, they can refer to the district or state medical board. District Programme Management and Support Units acted as dedicated real-time management structures for coordinating admission, referrals and inpatient facilities across government and private sectors.

In our state, protocols are flexible, the institutional medical board is endowed with the power of decision making in COVID management. They should document it. There is currently no COVID 19 expert in the world. (State medical board member, IDI1)

The state announced several campaigns like 'break the chain campaign' and 'SMS campaign-Soap-mask-social distancing' for better penetration of preventive strategies to the grassroot level. Reverse quarantine was an important strategy post lockdown to protect the vulnerable from infection. Considering the evolution of disease spread along with the socio-cultural aspects, region-specific strategies for the containment zones were devised.

Upscaling of facilities and services

The rate-limiting element in terms of resources was the availability of personal protective equipment and prompt measures were undertaken to attain self-sufficiency. The increased demand for masks and sanitisers was well handled by initiating locally sustainable production, including N-95 masks.

Health system preparedness was ensured at all three levels of healthcare. At primary and secondary levels, protocols were set for respiratory triage, and all staff

were provided training on infection prevention and control. A good example of institutional preparedness demonstrated by the state was the setting up of tiers of COVID-19 management centres including the COVID-19 hospitals, COVID-19 Second Line Treatment Centres, COVID-19 First-Line Treatment Centres (CFLTCs, dedicated centres to isolate and manage asymptomatic and mild cases) and COVID-19 care centres (centres for institutional quarantine). The disaster management authority with the help of LSGDs identified infrastructure in the form of buildings like schools, colleges, auditoriums and so on to establish these facilities. Increased demand for human resources was met by hastening the appointment of doctors through Kerala public service commission, appointing the freshly passed out batch of medical graduates in CFLTCs, and making a contract-based appointment through National Health Mission. Facilities for intensive care in the tertiary care centres were revamped. Daily district-wise forecasting of cases was done to plan for resource management. The private health institutions were well informed and their cooperation was ensured. Telemedicine facilities were established to reduce patient contact (for COVID-19 and non-COVID-19 services) with the hospitals. Walk-In Kiosk for sample collection and mobile testing units were established.

Challenges
Victim of initial success

… It's called prevention paradox when people start seeing a very low number of cases around, they might think all measures were unnecessary … (SCE 2, FGD1)

The low number of cases and deaths in the initial phase has given a false sense of security and complacency among people. People failed to recognise the seriousness of the situation when all services were provided free of cost.

… People started believing that they won't get infected and when asymptomatic individuals became positive for the disease, they even denied their infections. … The involvement of religious leaders and peoples' representatives have helped in tranquilizing people and obliteraterating their misconceptions … (PF5, FGD3)

… At the end of it, how much ever we enforce and give Information Education Communication, it is people who need to self-restraint … so we need to shift the focus from enforcing for a short duration to a behavioural change ingrained in the society … (State police official, IDI2)

Limited resources

As the healthcare mechanisms focused on COVID-19, the non-COVID-19 care was affected and the restriction of movement and lack of conveyance reduced the access to even available facilities. This was tackled to a great extent by telemedicine facilities, home delivery of drugs for chronic ailments and designating COVID-19 hospitals enabling non-COVID-19 care to run smoothly in other hospitals.

The challenge of human resource scarcity cropped up when few of the existing workforce was diagnosed with the disease and many were quarantined.

… When one among us became COVID positive for the first time, around 19 officers were primary contacts and all had to go for quarantine, later we started following the duty shift practices as per the advice of public health experts, and when the second case was detected among officers, there were only 4 primary contacts … (PF2, FGD3)

There was discordance in communication at the state level and between the state and districts. With the evolving evidence, the guidelines were frequently modified without addressing the capacity and resources at lower levels. The lack of proactive actions and failure to understand the urgency of the situation by some sectors overburdened the existing system.

DISCUSSION

Kerala's experience with COVID-19 19 puts forth lessons to transcribe and assimilate, not only for the state and the nation but also on a global perspective. The trajectory of Kerala's development is distinguished by the primacy of the social sector and the Kerala model of healthcare is often described as 'good health based on social justice and equity'.[14 15] The state has held up this basic principle in every health scenario and the 'humane' nature of Kerala's COVID-19 control has received wide global appreciation.[16]

Kerala has marched far ahead of other states of India in health indicators decades back with its organised healthcare.[15 17] During this pandemic, with the effective containment strategies, Kerala had become the front runner in India's initial fight against COVID-19.[18 19] The state has witnessed several viral outbreaks in the past, and the experiences thus gained paved the way to the expeditious response from the state in exercising strategies focusing on the prevention of the spread of infection rather than on curative care. When the impact of the pandemic especially the lockdown devastated the social sphere of already famished societies of other states, Kerala was well prepared to extend special care and uninterrupted food supply to all including migrant labourers and destitute.[14 20 21]

In a pandemic situation, every government department and the non-government institute has a responsibility to the society and is pivotal for the well-balanced functioning of the system.[22] In a state where more than 60% of the population depends on the private healthcare system, an epidemic response from surveillance to management mandates private sector involvement.[23] The early initiative of the government to establish public–private partnerships ensured adequate manpower and material resources in the COVID-19 response. However,

beyond the system, the backbone of Kerala's COVID-19 control strategy was community participation and the social capital was well harnessed by the state at the time of crisis. In a state like Kerala with a high proportion of religious diversity, the religious/community leaders played an inevitable role in alleviating anxiety and ensuring safety measures. The use of local governance structures and community health networks in implementing dynamic policy made Kerala distinct from other states in the country, another example being Odisha.[24 25] The long experience with disaster in the state of Odisha had led to the repurposing of crisis prevention measures engaging a vast network of local institutions during the pandemic.[26] Unlike Odisha, Kerala is not historically known for frequent natural calamities; however, in the recent past, the state has been facing several disasters in quick succession.[27] The well-organised local self-governance of the state was further fine-tuned towards emergency preparedness and outbreak response and had facilitated a quick response during the pandemic.[28 29] The time and effort of the community became the major resource of the state, unlike other successful global models. While Germany had a well-prepared health infrastructure in advance which could cater the intensive care even during the peak of the outbreak, many other European counterparts had to adapt to other spaces in the hospital to accommodate the critically ill. As in Kerala, community care facilities were organised by repurposing large spaces like conference halls, schools and so on in countries like Hong Kong, Singapore, South Korea and the UK.[30]

The state had its own challenges, foremost being the high number of expatriates and high population density.[31 32] The heavy burden of non-communicable diseases and the old age population in the state was a threat owing to the risk of severe illness and mortality.[21 33 34] This was tackled to a large extend by the coordinated activities of various departments by providing essential services via social welfare programmes, ensuring effective surveillance and stringent measures for reverse quarantine. This mechanism where each sector knows their capabilities and the ability to channelise those resources to function together helped in overcoming many challenges.

Limitation

Officials working in the immigration department and the state coordinate national operations were not included in the study. Further, the possibility of a positive bias in highlighting the efficiency of the system cannot be excluded as the majority of the respondents were within the government system. Every possible effort was made to avoid this bias through probing questions ensuring documentation of all dimensions.

CONCLUSION

With the easing of restrictions and resuming of routine life, every nation is at a threat of rise in COVID-19 cases. It is of high priority to revisit the successful strategies from different nations to appraise the lessons learnt and to identify the challenges to help future planning. The present study is a much-needed treatise to provide a balanced perspective on the intricacies of epidemic management in a low/middle-income country. Kerala puts forth a model of evidence-based actions through a robust public health system with good community participation and intersectoral collaboration build on existing social capital. As the future of COVID-19 remains unknown, it is never late for any evidence-based innovative strategies and interventions to be cautiously implemented.

Author affiliations
[1]Community Medicine, Government Medical College Thiruvananthapuram, Thiruvananthapuram, Kerala, India
[2]District Medical Office(Health), Department of Health Services, Kasargode, Kerala, India
[3]Infectious Disease, Government Medical College Thiruvananthapuram, Thiruvananthapuram, Kerala, India
[4]Department of Health and Family Welfare, Government of Kerala, Thiruvananthapuram, Kerala, India

ORCID iDs
Sriram Venkitaraman http://orcid.org/0000-0003-3764-5809
Thekkumkara Surendran Nair Anish http://orcid.org/0000-0002-6957-5895

REFERENCES

1 COVID-19 Response Approved by Most in 14 Nations with Advanced Economies [Internet]. Pew Res. Cent. Glob. Attitudes Proj, 2020. Nw 1615 L. ST, suite 800Washington, inquiries D 20036USA202-419-4300 | M-857-8562 | F-419-4372 | M. Available: https://www.pewresearch.org/global/2020/08/27/most-approve-of-national-response-to-covid-19-in-14-advanced-economies/ [Accessed 2 Sep 2020].

2 GoK Dashboard | official Kerala COVID-19 statistics. Available: https://dashboard.kerala.gov.in/ [Accessed 7 Nov 2020].

3 Officer of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, 2020. Available: www.censusindia.gov.in

4 Bangalore I, Delhi IEG, TISS Mumbai U. *Building a knowledge base on population aging in India: the status of elderly in Kerala, 2011.* New Delhi: UNFPA, 2013.

5 Economic review 2016. external sector: Non-Resident Keralites, 2020. Available: http://spb.kerala.gov.in/EconomicReview2016/web/chapter06_03.php

6 COVID 19 Kerala – dhs. Available: /public-health-2019-n-corona-virus/ [Accessed 23 Apr 2020].

7 Directorate General of health services. Available: https://dghs.gov.in/ [Accessed 25 Apr 2021].

8 About Worldometer COVID-19 data - Worldometer. Available: https://www.worldometers.info/coronavirus/about/#about [Accessed 25 Apr 2021].

9 Kerala's COVID-19 response puts "so-called first world" to shame: British economist. The Week. Available: https://www.theweek.in/news/india/2020/04/13/kerala-covid-19-response-puts-so-called-first-world-to-shame-british-economist.html [Accessed 14 Jul 2020].

10 Afsal K, Sulaiman KM, Muhammad T. Trace, quarantine, test, isolate and treat: a Kerala model of Covid-19 response. *medRxiv* 2020.

11 Covid-19 - a social phenomenon requiring diverse expertise, 2020. Inst. dev. stud. Available: https://www.ids.ac.uk/opinions/covid-19-a-social-phenomenon-requiring-diverse-expertise/ [Accessed 2 Sep 2020].

12 Teti M, Schatz E, Liebenberg L. Methods in the time of COVID-19: the vital role of qualitative inquiries. *Int J Qual Methods* 2020;19:160940692092096.

13 O'Brien BC, Harris IB, Beckman TJ, *et al*. Standards for reporting qualitative research: a synthesis of recommendations. *Acad Med* 2014;89:1245–51.

14 Alaoui A PM. How countries of South mitigate COVID-19: models of Morocco and Kerala, India, 2020

15 Kutty VR. Historical analysis of the development of health care facilities in Kerala state, India. *Health Policy Plan* 2000;15:103–9.

16 Masih N. Aggressive testing, contact tracing, cooked meals: how the Indian state of Kerala flattened its coronavirus curve. The Washington post. Available: https://www.washingtonpost.com/world/aggressive-testing-contact-tracing-cooked-meals-how-the-indian-state-of-kerala-flattened-its-coronavirus-curve/2020/04/10/3352e470-783e-11ea-a311-adb1344719a9_story.html [Accessed 12 Oct 2020].

17 ghd-042_kerala_as_a_positive_outlier_2018_09_05.pdf. Available: https://www.globalhealthdelivery.org/files/ghd/files/ghd-042_kerala_as_a_positive_outlier_2018_09_05.pdf [Accessed 14 Oct 2020].

18 Responding to COVID-19 - Learnings from Kerala. Available: https://www.who.int/india/news/feature-stories/detail/responding-to-covid-19-learnings-from-kerala [Accessed 7 Nov 2020].

19 Udhaya Kumar S, Thirumal Kumar D, Siva R, *et al*. Kerala, India's Front Runner in Novel Coronavirus Disease (COVID-19). *Front Med* 2020;7 https://www.frontiersin.org/articles/10.3389/fmed.2020.00355/full

20 (PDF) COVID-19: Challenges and its consequences for rural health care in India [Internet]. ResearchGate. Available: https://www.researchgate.net/publication/341172883_COVID-19_Challenges_and_its_consequences_for_rural_health_care_in_India [Accessed 16 Oct 2020].

21 Menon JC, Rakesh PS, John D, *et al*. What was right about Kerala's response to the COVID-19 pandemic? *BMJ Glob Health* 2020;5:e003212.

22 World Health Organization. Roles and responsibilities in preparedness and response, 2009. Pike USNL of M 8600 R, MD B, USA 20894. Available: https://www.ncbi.nlm.nih.gov/books/NBK143067/ [Accessed 7 Nov 2020].

23 Centre for Comparative Studies. Public and private healthcare institutions: preference and expenditure pattern, 6 Jun 2017

24 Basu D, Salvatore M, Ray D, *et al*. A comprehensive public health evaluation of Lockdown as a Non-pharmaceutical intervention on COVID-19 spread in India: national trends masking state level variations. *medRxiv* 2020 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7310653/

25 WHO. From governance to community resilience: Odisha's response to COVID-19. Available: https://www.who.int/india/news/feature-stories/detail/from-governance-to-community-resilience-odisha-s-response-to-covid-19 [Accessed 7 Nov 2020].

26 Sahoo N, Kar MR. Evaluating Odisha's COVID-19 response: from quiet confidence to a slippery road. *J Soc Econ Dev* 2020.

27 Hunt KMR, Menon A. The 2018 Kerala floods: a climate change perspective. *Clim Dyn* 2020;54:2433–46.

28 Dutta A, Fischer HW. The local governance of COVID-19: disease prevention and social security in rural India. *World Dev* 2021;138:105234.

29 Climate change and public health in India: the 2018 Kerala floods, 2021. Available: https://onlinelibrary.wiley.com/doi/10.1002/wmh3.429

30 Han E, Tan MMJ, Turk E, *et al*. Lessons learnt from easing COVID-19 restrictions: an analysis of countries and regions in Asia Pacific and Europe. *The Lancet* 2020;396:1525–34.

31 Board Splanning. Economic review 2016. Available: http://spb.kerala.gov.in/EconomicReview2016/web/chapter06_03.php [Accessed 7 Nov 2020].

32 Census 2011. Districts of Kerala. Available: https://www.census2011.co.in/census/state/districtlist/kerala.html [Accessed 7 Nov 2020].

33 Sarma PS, Sadanandan R, Thulaseedharan JV, *et al*. Prevalence of risk factors for non- communicable diseases in Kerala, India: results of a cross-sectional study. *BMJ Open*;10.

34 Thankappan K. Combating corona virus disease 2019 and comorbidities: the Kerala experience for the first 100 days. *Int J Noncommun Dis* 2020;5:36.