Community Needs Assessment of Ten Rural Villages in Karnataka and Tamil Nadu, India

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Abstract

Background: India's health disparities are clearly visible in the southern state of Karnataka. A community needs assessment, one of the first done in this area in over a decade, was conducted to identify unsatisfied needs. The Northwell Center for Global Health worked alongside a local boarding school, Shanti Bhavan, to conduct a needs assessment using the Center for Disease Control and Prevention's Community Assessment for Public Health Emergency Response tool.

Methods: A community based cross-sectional survey design was implemented in ten rural villages in Karnataka throughout February 2019. The target population for this study included people that earned less than US$2 / day. The survey instrument consisted of a questionnaire and tracking form.

Results: 197 of 359 households participated in the survey which encompassed a total of 1023 individuals. Proper housing structure was the most common need (27.7 %) followed by access to transportation (16.1 %) and access to healthcare (15.2 %). Agitated behavior, sad mood, and frequent worries were the most experienced behavioral health concerns with 47.7%, 41.6% and 41.1 % prevalence respectively. Chronic diseases (i.e. high blood pressure, diabetes, asthma) were prevalent in 35 of the households (9.7%). The major disease concern in relation to mosquito borne illness was Dengue (36.0 %). Access to healthcare was an issue in 44 of the 197 households (22.3%) with financial reasons being the most common barrier.

Conclusions: Notably, there were no expressed needs for basic necessities such as food, water and medication. This may be due to the help of state programs or a limitation of the survey format. Respondents were most concerned with Dengue but are also at risk for other vector diseases such as Malaria and Chikungunya, highlighting the need to increase awareness and safety measures. Additionally, mental health problems represented a significant burden of disease.

Background

As the second-most populous country in the world, India makes a substantial contribution to the global burden of disease, accounting for 18% of the world's deaths [1]. Chronic disease is predicted to account for 53% of all deaths, while communicable diseases, maternal health, and nutritional deficits constitute 36% [2]. Within India, there are wide variations in these indicators across gender, caste, education, and geography.

These disparities are exemplified within the southern state of Karnataka. Despite being home to Bangalore, the fifth most populated city in India, the majority (61.33%) of the population resides in rural areas [3]. The birth rate in Karnataka as of 2016 was 18.5 births per 1,000 population in rural communities versus 16.2 per 1,000 population in urban areas. The death rate in rural communities was 7.9 deaths per 1,000 population compared to 4.9 deaths per 1,000 population in urban areas. Infant mortality also differs at 27 deaths per 1,000 live births in rural areas and 19 deaths per 1,000 live births in urban areas [4]. Life expectancy for females is 71.1 years and 67.1 for males [5].

The public health system in India aims to provide universal access to free healthcare. In 2005, the National Rural Health Mission (NRHM) was launched to strengthen the primary health care system. Investments in the NRHM have improved access and coverage in public health facilities. However, diagnostic services are still mostly unavailable and usually need to be paid for out of pocket [2]. This hinders evidence-based care and the delivery of essential and universal healthcare. Karnataka's government also utilizes the *panchayat raj* system. A *panchayat* is a group of elderly leaders elected by community members. The system is an installation of local self-government at the village, block, and district levels. Despite national health initiatives and local self-governance, public health measures have not been implemented in many villages, which has perpetuated disparities in health care [6]. It is within this context that a community needs assessment was conducted for a group of villages in Karnataka and the neighboring state of Tamil Nadu.

A community needs assessment is a systematic approach to determine the unsatisfied healthcare needs of a population with the goal of making changes and improvements to meet these unfulfilled needs. The methodology incorporates qualitative and epidemiological approaches to identify what changes can be afforded [7]. The Community Assessment of Public Health Emergency Response (CASPER) is a tool created by the Centers for Disease Control and Prevention (CDC) to allow public health practitioners and emergency management officials to rapidly determine the health status and basic needs of affected communities. Although it was developed for use in a disaster response scenario, CASPER can be utilized whenever the public health needs of a community are

not well known. The tool is not intended to provide direct services to the affected community, but instead makes use of household-based information to provide a quick, reliable, and accurate assessment of a community's needs [8]. Due to its efficiency, the CASPER tool was used for this study.

The Northwell Global Health team worked alongside the local boarding school, Shanti Bhavan, which is located southeast of Bangalore city on the border of Karnataka and Tamil Nadu. Shanti Bhavan is a non-profit organization that seeks to educate students and lift them out of generational poverty. The children recruited by the school are from families that earn less than US$2 a day and belong to the former Dalit caste, formerly known as "untouchables" [9]. Former caste positions in India have a clear relationship with current economic status and wellbeing, where the former lower castes are the least paid, making socioeconomic mobility extremely difficult [10]. Shanti Bhavan invited Northwell Health with the intention of starting a long-term health partnership and the two groups decided that a needs assessment was an efficient way to identify the specific health needs of surrounding community members. As a result, the CASPER tool was used to conduct a health needs assessment in ten rural villages that surround Shanti Bhavan, from which the school recruits employees and students.

Methods

Study design

A community-based, cross-sectional design was implemented by utilizing the CDC CASPER tool to conduct a Rapid Needs Assessment in the villages surrounding Shanti Bhavan outside of Bangalore, India in February 2019. This assessment focused on household, social, behavioral, and health needs, along with accessibility needs for basic resources such as water, food supply, and medications (see Additional File 1). The project qualified for review by expedited procedures under 45 CFR 46.110(d) by Hofstra University's Institutional Review Board (Approval Ref#: 20190905-HPHS-BHU-1). The required ethical approvals were also received from the panchayats of each of the villages. Oral consent was received from participants and panchayat members due to low literacy levels in the villages surveyed. Participant consent was tracked using the survey tracking form and documentation of the panchayat members consulted for ethical approval can be found in Additional File 2.

Study site

The study was conducted by Northwell Health in collaboration with Shanti Bhavan Children's Project and Baldev Medical and Community center, located in Tamil Nadu, India. The study sites included ten villages in the states of Karnataka, India and Tamil Nadu, India, which are listed in Table 1. These villages were selected based on their proximity to Shanti Bhavan. Each village was considered a cluster in the systematic randomized cluster sampling as suggested by the CASPER toolkit.

Table 1
Villages Surveyed

Villages in Tamil Nadu	Villages in Karnataka
Alur	Bachahalli
Baliganpalli	Devarapalli
Lakshmipuram	Siddhanahalli
Odapalli	Sonnur
Rajkrishnapuram	Thatanahalli

Study population

The target population for this study included residents of low-income neighborhoods that earned less than $2 US/day. The villages included in the study were geographically segregated by class, with lower-classes living on the opposite sides of the village from upper-classes. Houses were identified for inclusion in the study by their geographical location within the communities and their living conditions. A community liaison helped the survey team to identify eligible houses within the villages. Overall, 359 houses were randomized, of which 197 completed the survey.

Inclusion criteria for the study population:

- Families that belong to the section of the village below poverty income status
- A person above the age of consent (15 years of age) is available to be interviewed
- Self-reported sound state of mind of the interviewee

Exclusion criteria:

- Families that belong to the middle or upper classes
- Families of landlords or the *panchayat* committee members
- Individuals below 15 years of age

Instrument

The CDC CASPER tool was used for the Rapids Needs Assessment in this cross-sectional study. This is a validated tool consisting of a specific set of questions that are designed to provide rapid, inexpensive, and reliable data on the needs of the community based on household public health information [11]. The tool was originally created in English but was translated to the local language of the village (Kannada, Telugu, or Tamil) on-site with the assistance of the translators and a community liaison. The objective of using this tool was to determine critical health needs by characterizing the population residing in the targeted area. The CASPER toolkit suggests dividing the sampling frame into clusters and recommends the 30x7 sampling design to gain approximately 210 interviews in the sampling frame [12]. We modified the sampling frame to include ten clusters to engage the ten villages that were included in the study.

The survey instrument consisted of two components – a questionnaire and a tracking form.

The Survey Questionnaire consisted of a set of 46 questions, including demographic questions, multiple-choice questions, Likert-type scales, matrix questions, and a few open-ended questions [13]. As per the CDC guidelines, each question had the options of "Don't Know" and "Refused" [8]. The initial questions of the survey focused on the demographics of the family by identifying the type of housing structure, the number of family members in the household, and their age groups. The remainder of the questions focused on the social, medical, and behavioral needs of the household (see Additional File 1).

The tracking form was used to monitor the outcome of every interview attempt, and it was the basis for calculating the response rates (completion, contact, and cooperation) [11]. This form was coded for all the houses, irrespective of their response type. The tracking form was essential in assessing the housing structures and responses from the households, along with assessing some challenges met during the interview phase (see Additional File 3).

Procedures

Systematic random cluster sampling was used as the randomization process for this study. Each village surveyed was considered as an individual cluster. These clusters were then further systematically divided based on the income status of the households into lower-income groups and middle- and upper-income groups. Only the lower-income groups were qualified to participate in the study. Depending on the size of each village, every other house or every third house was selected for the study. Only houses selected by the randomization process were surveyed. If no one in the household was home, the house would be revisited up to three times before being marked as incomplete.

The survey team included eight members, consisting of physicians from Northwell Health, Public Health students from Hofstra University, interpreters, and community liaisons that were divided into four pairs. Three teams conducted the surveys while one team monitored the randomization process. Each survey took approximately 25 minutes to complete, including the translation process. The house conditions and the quality of the survey were measured using the tracking form by the team overseeing the randomization process. Each team was accompanied by a translator to assist with the translation of the survey questions from English to languages spoken in the communities (Kannada, Telugu, or Tamil). Prior to the start of data collection, the translators were trained to administer the survey in an efficient and unbiased manner. A trained nurse at Baldev Community Medical Center played the role of community liaison and worked as a mediator between the survey team and the village community. She communicated with the village *Panchayats* or leaders to seek the necessary permissions to conduct the interviews within these villages.

Data management and storage

All of the surveys were conducted using a printed paper copy of the CASPER tool, along with the tracking form. These surveys were collected and stored by the team managing the randomization process in a secure location. At the end of the surveying process, the responses were entered in the database of Epi Info 7, as suggested by the CDC CASPER toolkit [11]. The descriptive analysis of the survey was carried out using Epi Info 7, and the original survey forms were aggregated and stored in a secure location in Northwell Health.

Results

This study was a pilot study conducted to identify the primary needs of an unidentified population in Karnataka and Tamil Nadu. 359 households were approached to undertake the survey, of which 197 households consented to participate. Of the 162 households that did not participate, 13 households refused to participate while 149 households did not have anyone present to answer at the time. The average response rate for these villages was 57%. Table 2 discusses the individual response rates from each village. The total population residing in the 197 houses surveyed was 1023 individuals. Descriptive analysis of the survey data was performed using Epi Info 7 software.

Table 2
– Response Rates for the Survey Responses

Village Name	Households Approached	Surveys Completed	Response Rate
Baliganapalli	34	20	59%
Thattanahalli	44	20	45%
Oppachalli	34	20	59%
Siddhanahalli	41	27	66%
Alur	30	15	50%
Odapalli	36	16	44%
Rajakrishnapura	59	30	51%
Devarapalli	40	24	60%
Sonnur	24	14	58%
Lakshmipura	17	11	65%
Total:	359	197	55%

Demographic evaluation

Table 3a discusses the demographic make-up of the ten villages. The houses selected belonged to the lower-income class of the villages. There was an almost equal proportion of male (50.14%) and female participants (47.8%). Almost two-thirds of the population was between the ages of 18 and 64, followed by 23.65% of the population falling between the ages of 2 and 17. There was a low prevalence of both geriatric and infant populations in these villages, which was believed to be attributable to the poor quality of life and lack of healthcare resources, as stated by the local population. The most prevalent language spoken was Telugu (65.0%), with Kannada, the regional language of Karnataka, as the second most spoken language (30.5%). A total of 19 deaths were recorded in the 197 houses in the previous year. Of these 19 deaths, 13 individuals were over the age of 65.

Table 3
a − Demographic Variables of the Households

Demographic variable	Total population (N)	n	% (n/N)
Gender -	N = 1023		
Male		513	50.1
Female		489	47.8
Age groups -	N = 1023		
Less than 2 years of age		29	2.8
2 to 17 years of age		242	23.7
18 to 64 years of age		665	65.0
Above 65 years of age		68	6.6
Household Languages -	N = 197		
Telugu		128	65.0
Kannada		60	30.5
Tamil		9	4.6
Births and Deaths	N = 1023		
Birth Rate in the last year		29	2.83
Death Rate in the last year		19	1.86

Housing structures and need

Table 3b demonstrates the housing demographic information from the ten clusters. The most common housing structures identified within this population were single-family houses (78.7%). This means most of the households lived as nuclear families as opposed to following a joint family housing system. These houses were evaluated as either intact (none or minimal damage), damaged, or destroyed housing structures using the CASPER Tracking form. As per this evaluation, 43 (21.8%) houses were damaged, and 9 (4.6%) houses were reported destroyed. Of the 197 households, 117 stated that the most common source of drinking water was tap water. A majority of the households had access to functioning toilets (69.5%). Almost all houses had access to a telephone (91.9 %), which proved to be the basic mode of communication. There were no determined needs for basic necessities such as food, water, and medication. An open-ended question asked the households to mention their greatest need at the time of the survey. Of the 197 households, 112 households provided a response, and a need for a proper housing structure was the most common (27.7%), followed by transportation (16.1%), and healthcare (15.2%).

Table 3
b – Housing Structures and Needs

Housing structures and needs	n	Total Population (N)	% (n/N)
Most common structure - Single family	155	197	78.7
Most common source of drinking water - Tap	117	197	59.4
Access to functioning toilet	137	197	69.5
Access to telephone	181	197	91.9
Access to internet	69	197	35.0
Need for food	11	197	5.6
Need for water	9	197	4.6
Need for medications	14	197	7.1
Most common need mentioned by the household – house	31	112	15.7
Number of damaged houses	43	197	21.8
Number of destroyed houses	9	197	4.6

Behavioral health concerns

Behavioral health was assessed by the survey through a series of multiple-choice questions. The results are located in Table 3c. Agitated behavior, sad mood, and frequent worries were the most experienced behavioral health concerns with 47.7%, 41.6%, and 41.1% prevalence, respectively. 23 of the 197 households mentioned instances of witnessing violent behaviors or threats. These were mainly observed in cases of disputes among the neighbors. Table 3c illustrates all of the possible recorded behavioral health concerns.

Table 3
c – Behavioral Health Concerns

Behavioral health concerns	Total population (N)	n (%)	% (n/N)
Difficulty concentrating	197	26	13.2
Trouble sleeping	197	26	13.2
Nightmares	197	44	22.3
Loss of appetite	197	22	11.2
Sad mood	197	82	41.6
Difficulty enjoying things	197	42	21.3
Unusually happy mood	197	16	8.1
Frequent worries	197	81	41.1
Thoughts about suicide	197	35	17.7
Agitated behavior	197	94	47.7
Witnessed violent behaviors / threats	197	23	11.7
Experienced violent behaviors / threats	197	17	8.6
Had traumatic experiences	197	19	9.6

Other health concerns

Lastly, other health concerns are documented in Table 3d. Chronic diseases were prevalent in 35 of the households, with hypertension and diabetes being the most commonly identified in this population. Although mental health is believed to be stigmatized in rural parts of India, a few households reported previous mental health issues (n = 7). When asked about concern for mosquito-borne diseases, 84 households reported being somewhat concerned. The major disease concern in relation to mosquito-borne illness was Dengue (36 %). Lack of access to healthcare was an issue detected in 44 of the 197 households, with a lack of money or high cost being the most common reasons.

Table 3
d − Other Health Concerns

Other health concerns	n (%)
Disease (N = 197)	
Chronic illness	35 (17.7%)
Diabetes prevalence	13 (6.6%)
Hypertension	22 (11.1%)
Previous mental health issues	7 (3.5%)
Injuries	28 (14.2%)
Population concerned with mosquito-borne diseases	
Somewhat concerned	84 (42.6%)
Most common disease concern - Dengue	71 (36%)
Access to healthcare (N = 197)	
Difficulty in accessing healthcare	44 (22.3%)
Lack of Money / cost	32 (16.2%)
Lack of transportation	14 (7.1%)

Discussion

The results offer a cross-sectional perspective regarding the health and needs of ten villages surrounding the Shanti Bhavan boarding school. The number one identified need was a proper housing structure, with 26.7% of respondents claiming that this was their greatest need. According to the observations made on the tracking forms, 43 houses were damaged, and nine houses were destroyed, resulting in a total of 14.5% of houses being classified as damaged or destroyed.

Contrary to expectations, there were no determined needs for basic necessities such as food, water, and medication. 117 of the 197 households (59.4%) used government-provided tap water as their source of drinking water. This may be due to the success of the Karnataka Rural Water Supply and Sanitation project (KRWSS). This project was approved in 2001 and continued through 2014. The goal of the KRWSS project was to improve access to sustainable drinking water in rural areas using the panchayat system [14]. A similar program exists in Tamil Nadu. The Tamil Nadu Water Supply and Drainage Board has rural water supply schemes which are committed to supplying piped water to all rural households by 2024 [15]. In terms of food supply, the Government of India uses a public distribution system (PDS) where it provides certain minimum quantities of food grains to the Government of Karnataka in order to protect low-income groups [16]. The PDS supplies rice, wheat, sugar, and kerosene to the Government of Karnataka who then makes use of ration cards that determine how much citizens are entitled to receive [17]. Shanti Bhavan also aids particularly vulnerable families by providing ragi balls, which are a type of non-perishable food rich in protein.

The threat of mosquito-borne diseases concerned 84 of the 197 households (42.6%). A Likert-style question was used to assess the threat of mosquito-borne disease as seen in question 16 in the Survey Questionnaire (Additional File 1). A response of "very concerned" or "somewhat concerned" indicated that the threat of mosquito-borne disease did concern the house. The National Vector

Borne Disease Control Program is an integral part of India's National Rural Health mission. It is responsible for controlling the prevalence of vector-borne diseases such as malaria, dengue, Japanese encephalitis (JE), and chikungunya [18]. According to the needs assessment, 71 of the 84 households (84.5%) that were concerned about mosquito-borne diseases were most concerned by Dengue. Conversely, only 40 households were concerned about malaria (47.6%) and 14 were concerned about chikungunya (16.7%). However, there were 9655 cases of Malaria, 6105 cases of Dengue, 1471 cases of chikungunya, and 746 cases of Japanese encephalitis in the state of Karnataka between April 2016 and March 2017 [19]. It is important to raise awareness of the risks of other mosquito-borne diseases and actions communities can take to stay safe because Dengue is not the only mosquito-borne illness the people in Karnataka are at risk of contracting. Cases of both malaria and dengue spike in the monsoon season (May-October), while chikungunya and JE spike in December [19]. If villagers can be made aware of when the diseases are most prevalent, they can take better actions to both avoid and treat these diseases.

Behavioral health was also a point of importance in the survey. Mental health needs, which tend to be largely unmet in poorer communities, represented a significant burden of disease. Over 40% of the population experienced agitated behavior, sad moods, or frequent worries. Despite the significant amount of people with behavioral health concerns, only 22 households (11.2%) received services from a counselor, religious leader, therapist, or social worker to address their concerns. 143 of the 197 households (72.6%) had access to a form of counseling but believed they had no need for this service. A possible explanation for this observed gap between the availability and utilization of these resources could be the stigmatization of mental health issues within these populations. This bolsters the need for increasing awareness regarding mental health services along with normalizing the use of these resources to alleviate the burden of disease.

Another interesting finding was that despite the lack of medical providers serving these rural villages, only 22.3% of survey respondents identified a lack of access to medical care as a major obstacle. In India, 40% of all health workers work in rural areas, however, over 70% of the population lives in rural areas [20]. As a result of this disparity in workforce density between rural and urban areas, it was expected that the rural communities surveyed would consider access to medical care a much more significant need. A possible explanation could be that rural households in India extensively rely on informal medical providers, who lack medical qualifications [21].

Limitations

Geographical limitations

The clusters were selected based on the proximity of the villages to the Shanti Bhavan School. Villages were approached on the basis of geographic accessibility as opposed to the true geo-demographic composition of the villages. This may have led to selection bias within the target population. Also, the climate and heat during the surveying process resulted in reduced efficiency of the surveying team.

Language barrier

The two states approached for the survey procedures had several local languages spoken. The most common languages spoken were Telugu, Kannada, and Tamil. A very small proportion of the population understood and spoke English. This created a need for the use of translators to administer the surveys. Shanti Bhavan employees volunteered and were used as translators to help administer the survey. Although the employees were trained to administer the survey objectively, they were not trained translators, which could have resulted in a loss of information.

Literacy barrier

The surveys were conducted in the states of Karnataka and Tamil Nadu where low literacy rates were observed. The low literacy rate was also responsible for the lack of knowledge and awareness of healthcare issues and available resources.

Sampling strategies

Depending on the village, only every other house or every third house was eligible to be surveyed. As a result, houses with potential interview candidates were skipped because they did not fall within the sampling frame. Conversely, some houses that were included in the study were unoccupied and, therefore, did not yield responses. This led to a loss of potential information that could have bolstered, but also biased, the results.

Crowding effects

Since many of the surveys were conducted outside, there were times where other villagers would walk by and observe the interview. At times, crowds of people would form, including other family members, immediate neighbors, or other villagers. This may have affected some survey responses, especially for more sensitive questions such as ones regarding mental health. Thus, a response bias may have occurred during the survey procedures, which can be overcome in future assessments by conducting one on one interviews in private spaces.

Conclusion

The application of the CDC CASPER tool in this community represented one of the first systematic cross-sectional needs assessment surveys done in this area in over a decade. While limited, the survey data provides interesting insight into the changing needs of poor rural communities in Karnataka and Tamil Nadu, India. The data collected here will inform future research into the behavioral and general health needs of these communities. It will also be used to inform the design of interventions created by the Shanti Bhavan and Northwell collaboration to address some of the gaps identified.

List Of Abbreviations

NRHM: National Rural Health Mission

CASPER: Community Assessment of Public Health Emergency Response

CDC: Centers for Disease Control and Prevention

KRWSS: Karnataka Rural Water Supply and Sanitation

PDS: public distribution system

JE: Japanese Encephalitis

Declarations

Ethics Approval and Consent to Participate

The project qualified for review by expedited procedures under 45 CFR 46.110(d) by Hofstra University's Institutional Review Board (Approval Ref#: 20190905-HPHS-BHU-1). The required ethical approvals were also received from the panchayats of each of the villages. Oral consent was received from participants and panchayat members due to low literacy levels in the villages surveyed. Participant consent was tracked using the survey tracking form of the CASPER tool and documentation of the panchayat members consulted for ethical approval can be found in Additional File 2. All methods were performed in accordance with the guidelines and regulations set forth by the Institutional Review Board and local village leaders.

Consent for Publication

Not applicable.

Availability of Data and Materials

The dataset supporting the conclusions of this article is included within the article (and its additional files).

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

TB, KT, and ECP made substantial contributions to the conception and implementation of the project. TB, KT, and ECP gathered data and conducted interviews in India. TB and KT analyzed the collected data. TB, KT, and JH interpreted the data and were major contributors in drafting the manuscript. All authors read and approved the final manuscript.

References

1. Balarajan Y, Selvaraj S, Subramanian S. Health care and equity in India. The Lancet. 2011;377:505–15.

2. Kumar V, Kumar Y, Gupta M, Stobbelaar F, Agrawal S, Venkatraman A. Evaluation of the Free Diagnostics Scheme in Andhra Pradesh [Internet]. World Health Organization; 2018. Available from: https://apps.who.int/iris/bitstream/handle/10665/277473/andhrapradeshevaluation_freediagnosticsscheme.pdf

3. Economic Survey [Internet]. Government of Karnataka; 2018. Available from: https://karunadu.karnataka.gov.in/hfw/decell/SBHI%20Doc/Economic%20Survey%20up%20to%20Nov%202018%20English.pdf

4. Office of the Registrar General, India. Sample Registration System Bulletin May 2019 [Internet]. Census India Off. Regist. Gen. Census Comm. India. 2017 [cited 2019 Dec 8]. Available from: https://www.censusindia.gov.in/vital_statistics/SRS_Bulletins/SRS_Bulletin-Rate-2017-_May_2019.pdf

5. Indian Council of Medical Research, Public Health Foundation of India, University of Washington, Institute for Health Metrics and Evaluation. India: health of the nation's states: the India state-level disease burden initiative: disease burden trends in the states of India, 1990 to 2016. 2017.

6. Seshadri SR, Parab S, Kotte S, Latha N, Subbiah K. Decentralization and decision space in the health sector: a case study from Karnataka, India. Health Policy Plan. 2016;31:171–81.

7. Wright J, Williams R, Wilkinson JR. Health needs assessment: Development and importance of health needs assessment. BMJ. 1998;316:1310–3.

8. Overview of CASPER [Internet]. Cent. Dis. Control Prev. 2016 [cited 2019 Dec 8]. Available from: https://www.cdc.gov/nceh/casper/overview.htm

9. Frequently Asked Questions [Internet]. Shanti Bhavan Child. [cited 2019 Dec 8]. Available from: https://www.shantibhavanchildren.org/about/faq/

10. Gang IN, Sen K, Yun M-S. Is caste destiny? Occupational diversification among Dalits in rural India. Eur J Dev Res. 2017;29:476–92.

11. Schnall AH, Nakata N, Bayleyegn T. Community Assessment for Public Health Emergency Response (CASPER) Toolkit: Third edition [Internet]. Centers for Disease Control and Prevention; 2019. Available from: https://www.cdc.gov/nceh/casper/docs/CASPER-toolkit-3_508.pdf

12. Schnall A, Nakata N, Talbert T, Bayleyegn T, Martinez D, Wolkin A. Community Assessment for Public Health Emergency Response (CASPER): An Innovative Emergency Management Tool in the United States. Am J Public Health. 2017;107:S186–92.

13. Fowler FJ. Survey research methods. Fifth edition. Los Angeles: SAGE; 2014.

14. Karnataka RWSS II Additional Financing [Internet]. World Bank. [cited 2019 Dec 8]. Available from: https://projects.worldbank.org/en/projects-operations/project-detail/P050653

15. Rural Water Supply Schemes [Internet]. TamilNadu Water Supply Drain. Board. [cited 2020 Oct 25]. Available from: https://www.twadboard.tn.gov.in/content/rural-water-supply-schemes

16. Government of Karnataka. Organization Functions [Internet]. Food Civ. Supplies Consum. Aff. Dep. [cited 2019 Dec 8]. Available from: https://ahara.kar.nic.in/functions.html

17. Public Distribution System , functioning, limitations, revamping [Internet]. Civ. Serv. India. [cited 2019 Dec 8]. Available from: https://www.civilserviceindia.com/subject/General-Studies/notes/public-distribution-system-functioning-limitations-revamping.html

18. Summary About the Programme (NVBDCP) [Internet]. Natl. Health Mission Gov. Meghalaya. 2017 [cited 2019 Dec 8]. Available from: http://nhmmeghalaya.nic.in/programmes/nvbdcp/summary.html

19. Arali PK, Shanbhag DN. Assessment of national vector borne disease control programme in state of Karnataka. Int J Community Med Public Health. 2019;6:525.

20. Anand S, Fan V. The Health Workforce in India [Internet]. World Health Organization; 2016. Report No.: 16. Available from: https://www.who.int/hrh/resources/16058health_workforce_India.pdf

21. Gautham M, Shyamprasad KM, Singh R, Zachariah A, Singh R, Bloom G. Informal rural healthcare providers in North and South India. Health Policy Plan. 2014;29:i20–9.

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