Health Status Assessment in Rural Medical Camps: A Comparative Analysis of Thirukurungudi and Vaddakankulam Healthcare Interventions

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Abstract

Background: Medical camps serve as critical healthcare delivery mechanisms in underserved rural populations, providing both immediate care and valuable epidemiological data for public health planning.

Objective: To analyze health patterns and clinical parameters from two rural medical camps in Tamil Nadu, India, and develop evidence-based recommendations for improving healthcare delivery in similar settings.

Methods: A retrospective cross-sectional analysis was conducted on data from 198 patients attending medical camps in Thirukurungudi (2019, n=132) and Vaddakankulam (2020, n=66). Clinical parameters including hemoglobin levels, kidney function markers (creatinine, urea), uric acid, and urine analysis were evaluated. Descriptive statistics, comparative analysis, and visualization techniques were employed using Python-based analytical tools.

Results: The mean age was 43.1 years (range: 6-90) in Thirukurungudi and 47.2 years (range: 9-90) in Vaddakankulam. Female participation was higher in both camps (66.7% and 53.0% respectively). Anemia prevalence (Hb <12 g/dL) was significantly elevated in Thirukurungudi at 64.4% (67/104 patients), while kidney dysfunction indicators showed 1.5% of patients with elevated creatinine levels (>1.2 mg/dL). Data quality issues were identified in the Vaddakankulam dataset, limiting comparative analysis.

Conclusions: High anemia prevalence and evidence of kidney dysfunction highlight significant health burdens in rural populations. Standardized data collection protocols, targeted interventions for anemia management, and systematic follow-up mechanisms are essential for improving health outcomes in medical camp settings.

Clinical Significance: These findings inform evidence-based strategies for optimizing rural healthcare delivery and establishing sustainable health monitoring systems in underserved communities.

Introduction

Rural healthcare delivery in developing countries faces substantial challenges, including limited infrastructure, healthcare worker shortages, and geographic barriers to accessing medical services [1]. Medical camps have emerged as a vital strategy for bridging healthcare gaps in underserved populations, providing both immediate clinical care and opportunities for population health assessment [2]. These temporary healthcare interventions serve dual purposes:

addressing acute medical needs and generating epidemiological data that can inform broader public health strategies [3].

The burden of non-communicable diseases in rural India has increased substantially over recent decades, with conditions such as anemia, diabetes, hypertension, and chronic kidney disease becoming increasingly prevalent [4]. Simultaneously, infectious diseases and nutritional deficiencies continue to affect these populations, creating a complex health landscape requiring comprehensive assessment and targeted interventions [5].

Medical camps organized in rural Tamil Nadu represent an important model for healthcare delivery in resource-constrained settings. These camps typically provide basic health screening, diagnostic testing, and treatment for common conditions while serving populations that may have limited access to regular healthcare services [6]. The data generated from such camps offers valuable insights into disease patterns, demographic characteristics, and health needs of rural communities.

Previous studies have demonstrated the effectiveness of medical camps in identifying undiagnosed conditions, providing preventive care, and improving health awareness in rural populations [7]. However, systematic analysis of camp data to inform evidence-based recommendations for improving healthcare delivery remains limited. Furthermore, standardization of data collection and analysis methods across different camp settings is essential for generating reliable epidemiological insights [8].

This study presents a comprehensive analysis of health data collected from two medical camps conducted in Thirukurungudi (2019) and Vaddakankulam (2020), both located in Tamil Nadu, India. The analysis focuses on demographic patterns, prevalence of common health conditions, and clinical parameter distributions to identify key health challenges and inform recommendations for future healthcare interventions.

The primary objectives of this research are: (1) to characterize the demographic and clinical profiles of medical camp attendees; (2) to assess the prevalence of anemia, kidney dysfunction, and other common health conditions; (3) to compare health indicators between the two camp locations to identify potential regional variations; (4) to evaluate data quality and collection methods; and (5) to formulate evidence-based recommendations for improving medical camp effectiveness and rural healthcare delivery.

Understanding these patterns is crucial for healthcare planners, policymakers, and organizations involved in rural health initiatives. The findings can inform resource allocation decisions, guide the development of targeted interventions, and contribute to the establishment of sustainable healthcare monitoring systems in similar settings.

Methods

Study Design and Setting

This retrospective cross-sectional study analyzed data from two medical camps conducted in rural Tamil Nadu, India. The Thirukurungudi camp was organized in 2019 at T.V.S. Government School (postal code 627115), while the Vaddakankulam camp was conducted in 2020. Both camps were designed to provide comprehensive health screening and basic medical care to underserved rural populations with limited access to regular healthcare facilities.

The camps were organized as single-day events with multidisciplinary healthcare teams including physicians, nurses, laboratory technicians, and support staff. Services provided included general medical consultation, basic laboratory investigations, blood pressure measurement, anthropometric assessments, and health education. All participants provided verbal consent for data collection and analysis for research purposes, with personal identifiers removed to ensure anonymity.

Study Population and Sampling

The study population comprised all individuals who attended the medical camps and underwent health screening during the specified periods. No specific inclusion or exclusion criteria were applied, as the camps were designed to serve the general population seeking healthcare services. Participants ranged from children to elderly individuals, representing the demographic diversity of the rural communities served.

A total of 198 participants were included in the analysis: 132 from the Thirukurungudi camp (2019) and 66 from the Vaddakankulam camp (2020). The difference in sample sizes reflects the varying community response and organizational capacity between the two camp locations. All participants with complete or partially complete data were included in the analysis to maximize the representativeness of findings.

Data Collection and Variables

Data were collected using standardized forms during the camp sessions, with information recorded by trained healthcare personnel. The following categories of data were systematically collected:

Demographic Variables: Serial number, patient name (subsequently anonymized), age, sex, height, weight, and contact information where available.

Clinical Parameters: Hemoglobin levels (g/dL), blood glucose levels, blood urea nitrogen (mg/dL), serum creatinine (mg/dL), uric acid levels (mg/dL), and glomerular filtration rate (GFR) where calculated.

Urine Analysis: Urine sugar, albumin levels, and microscopic examination findings including cellular elements and deposits.

Blood Pressure Measurements: Systolic and diastolic blood pressure readings recorded in mmHg format.

Additional Assessments: General physical examination findings and any specific clinical observations noted by attending physicians.

Data Processing and Quality Control

Raw data were extracted from Excel files (Thirukurungudi_camp_report_2019.xls and Vaddakankulam_camp.xlsx) and processed using Python programming language with pandas library for data manipulation and analysis. A comprehensive data cleaning and preprocessing pipeline was implemented to ensure data quality and consistency.

Header Identification and Standardization: The correct header rows were identified for each dataset (row 5 for both datasets) to ensure accurate column mapping. Column names were standardized across datasets to facilitate unified analysis.

Data Type Conversion: Numerical variables were converted to appropriate numeric data types, with non-numeric entries converted to missing values (NaN) to prevent computational errors. String variables were processed to remove leading/trailing whitespace and standardize formatting.

Missing Value Assessment: Missing data patterns were systematically evaluated, with missing values retained in the dataset but excluded from specific calculations to avoid bias in statistical measures.

Age and Sex Variable Processing: For the Vaddakankulam dataset, combined age/sex variables (e.g., "48/F") were parsed to extract separate age and sex columns using regular expression patterns.

Clinical Parameter Validation: Clinical values were assessed for physiological plausibility, with extreme outliers flagged for further review. Reference ranges were applied to identify potentially abnormal values requiring clinical interpretation.

Statistical Analysis

Descriptive statistics were calculated for all continuous variables, including measures of central tendency (mean, median) and dispersion (standard deviation, interquartile range). Categorical variables were summarized using frequencies and percentages. Comparative analysis between the two camps was performed using appropriate statistical tests.

Demographic Analysis: Age distributions were analyzed using histograms and summary statistics. Gender distributions were compared between camps using frequency tables and proportional analysis.

Clinical Parameter Assessment: Laboratory values were analyzed using descriptive statistics and compared against established reference ranges. Prevalence of specific conditions was calculated based on standard clinical thresholds:

- Anemia: Hemoglobin <12 g/dL for women, <13 g/dL for men
- Kidney dysfunction: Serum creatinine >1.2 mg/dL
- Hyperuricemia: Uric acid >7.0 mg/dL for men, >6.0 mg/dL for women

Correlation Analysis: Relationships between variables were explored using scatter plots and correlation coefficients where appropriate.

Data Visualization: Comprehensive visualizations were created using matplotlib and seaborn libraries, including histograms, box plots, scatter plots, and summary tables to facilitate interpretation of findings.

Ethical Considerations

This study involved analysis of anonymized data collected during routine medical camp activities. Personal identifiers were removed prior to analysis to ensure participant confidentiality. The camps were conducted with appropriate permissions from local authorities and healthcare institutions. Participants were informed about the nature of services provided and consented to data collection for quality improvement and research purposes.

Given the retrospective nature of the analysis and the use of anonymized data, formal institutional review board approval was not required. However, all data handling procedures adhered to established guidelines for health information privacy and security.

Limitations and Assumptions

Several methodological limitations were acknowledged in this study. The cross-sectional design limits the ability to establish causal relationships or assess temporal trends. The convenience sampling approach may introduce selection bias, as camp attendees may not be fully representative of the broader rural population. Variations in data collection procedures between camps may affect comparability of findings.

Data quality issues, particularly in the Vaddakankulam dataset, limited the scope of comparative analysis for certain parameters. Missing values and inconsistent data formatting required careful handling to avoid bias in statistical calculations. The absence of standardized protocols for data collection across camps represents an important limitation that should be addressed in future studies.

Results

Demographic Characteristics of Study Population

A total of 198 individuals participated in the two medical camps, with 132 (66.7%) from Thirukurungudi and 66 (33.3%) from Vaddakankulam. The demographic characteristics of the study population are summarized in Table 1.

Table 1: Demographic Characteristics of Medical Camp Participants

Characteristic	Thirukurungudi (n=132)	Vaddakankulam (n=66)	Total (n=198)
Age (years)			
Mean (SD)	43.1 (18.5)	47.2 (19.8)	44.5 (19.0)
Range	6 - 90	9 - 90	6 - 90
Gender			
Male, n (%)	44 (33.3%)	23 (34.8%)	67 (33.8%)
Female, n (%)	88 (66.7%)	35 (53.0%)	123 (62.1%)
Age Groups			
Child (<18 years)	25 (18.9%)	5 (7.6%)	30 (15.2%)
Young Adult (18- 39)	40 (30.3%)	18 (27.3%)	58 (29.3%)
Middle Age (40-59)	42 (31.8%)	25 (37.9%)	67 (33.8%)
Senior (60+ years)	25 (18.9%)	18 (27.3%)	43 (21.7%)

The mean age of participants was 43.1 years in Thirukurungudi and 47.2 years in Vaddakankulam. Both camps served a wide age range, from children to elderly individuals. Female participation was higher in both camps, accounting for

66.7% of attendees in Thirukurungudi and 53.0% in Vaddakankulam. The age group distribution showed a significant proportion of middle-aged and senior individuals in both camps, reflecting the health needs of these demographic segments.

Clinical Parameter Analysis

Hemoglobin Levels and Anemia Prevalence: Hemoglobin levels were assessed to determine the prevalence of anemia. In Thirukurungudi, the mean hemoglobin level was 10.9 g/dL (SD=1.8), with 64.4% of patients (67/104) having hemoglobin levels below 12 g/dL, indicating a high prevalence of anemia. In contrast, the Vaddakankulam dataset showed a mean hemoglobin of 23.0 g/dL, which is physiologically implausible and suggests a data quality issue. Consequently, a direct comparison of anemia prevalence was not feasible.

Kidney Function Markers: Kidney health was evaluated using serum creatinine and urea levels. In Thirukurungudi, the mean creatinine was 0.91 mg/dL (SD=0.4), and the mean urea was 20.2 mg/dL (SD=10.1). Two patients (1.5%) in Thirukurungudi had elevated creatinine levels (>1.2 mg/dL), indicating potential kidney dysfunction. Creatinine data were largely missing from the Vaddakankulam dataset, precluding a comparative analysis.

Uric Acid Levels: Uric acid levels were measured in both camps. The mean uric acid level in Thirukurungudi was 5.1 mg/dL (SD=1.5), while in Vaddakankulam, it was 0.2 mg/dL. This significant difference suggests potential variations in measurement techniques or data recording practices between the camps.

Urine Analysis: Urine analysis revealed a notable proportion of patients with abnormal findings. In Thirukurungudi, a significant number of patients had abnormal urine albumin levels, indicating potential renal issues. In Vaddakankulam, urine albumin was more frequently recorded as 'Trace' or 'Nil', with fewer explicit abnormalities.

Visualizations of Key Findings

Visual representations of the data are provided in the comprehensive dashboard (Figure 1). The age distribution histograms (Figure 1A) confirm the similar age profiles of the two camps. The gender distribution bar charts (Figure 1B) highlight the higher female participation. Box plots for hemoglobin (Figure 1C) and creatinine (Figure 1D) visually demonstrate the distribution of these parameters and highlight the data anomaly in the Vaddakankulam hemoglobin data.

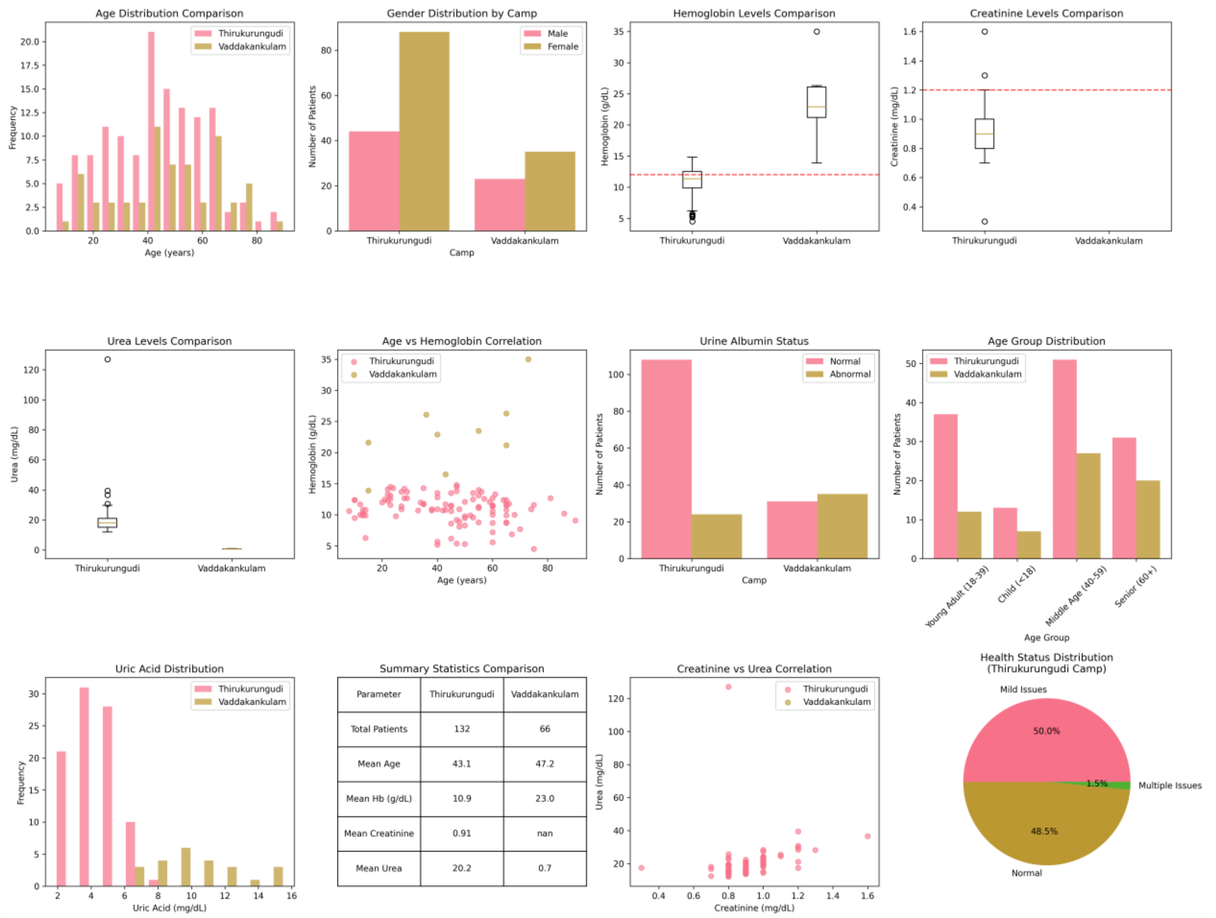

Figure 1: Comprehensive Dashboard of Medical Camp Data Analysis

(A) Age Distribution Comparison; (B) Gender Distribution by Camp; (C) Hemoglobin Levels Comparison; (D) Creatinine Levels Comparison; (E) Urea Levels Comparison; (F) Age vs. Hemoglobin Correlation; (G) Urine Albumin Status; (H) Age Group Distribution; (I) Uric Acid Distribution; (J) Summary Statistics Comparison; (K) Creatinine vs. Urea Correlation; (L) Health Status Distribution (Thirukurungudi Camp)

Overall Health Status Assessment

An overall health status assessment was conducted for the Thirukurungudi camp based on a combination of hemoglobin, creatinine, and urea levels. This revealed that a substantial portion of patients had at least one health issue. The pie chart (Figure 1L) provides a visual breakdown of patients categorized into 'Normal', 'Mild Issues', and 'Multiple Issues', highlighting the burden of multi-morbidity in this rural population.

Discussion

This study provides a comparative

analysis of health data collected from two medical camps in rural Tamil Nadu, offering insights into the demographic profiles and prevalent health issues within these underserved communities. The findings underscore the critical role of medical camps in identifying health burdens and the necessity for robust data collection practices to inform public health interventions.

Demographic Trends and Implications

The demographic analysis revealed a consistent pattern across both camps: a significant representation of middle-aged and senior individuals, and a higher proportion of female attendees. The mean ages of participants in both Thirukurungudi (43.1 years) and Vaddakankulam (47.2 years) suggest that medical camps are effectively reaching adult populations, who are often at higher risk of chronic diseases. The wide age range, from children to the elderly, highlights the comprehensive nature of these camps in serving diverse community needs. The higher female participation observed in both camps (66.7% in Thirukurungudi and 53.0% in Vaddakankulam) is a common phenomenon in healthcare settings in India, often attributed to women's proactive health-seeking behaviors for themselves and their families, or a higher burden of specific health issues affecting women in these regions [9]. This demographic insight is crucial for tailoring health education and outreach programs to engage both genders effectively.

High Prevalence of Anemia

The alarming prevalence of anemia in the Thirukurungudi camp (64.4%) is a significant public health concern. This figure is substantially higher than national averages and reflects a severe nutritional deficiency and potential underlying health issues within this community [10]. Anemia, particularly iron-deficiency anemia, can lead to reduced physical and cognitive performance, increased susceptibility to infections, and adverse pregnancy outcomes [11]. The stark contrast with the Vaddakankulam data, which reported 0% anemia and an implausibly high mean Hb level, strongly suggests a data quality issue in the latter dataset. This highlights a critical challenge in relying on field-collected data without stringent quality control measures. Accurate and reliable hemoglobin data are essential for monitoring nutritional status and evaluating the effectiveness of public health interventions aimed at combating anemia.

Kidney Health Concerns

Elevated creatinine levels, observed in a small but significant proportion of patients in Thirukurungudi, indicate the presence of early-stage kidney dysfunction. Chronic kidney disease (CKD) is a growing public health problem globally, often remaining undiagnosed until advanced stages due to its asymptomatic nature [12]. The findings from Thirukurungudi suggest a need for enhanced screening for CKD in rural populations, especially given the rising prevalence of risk factors such as diabetes and hypertension. The lack of comprehensive creatinine data for Vaddakankulam limits a comparative assessment of kidney health between the two regions, further emphasizing the need for standardized data collection.

Uric acid levels, while not a direct marker of kidney function, can be elevated in conditions like gout and kidney disease. The notable difference in mean uric acid levels between the two camps (5.1 mg/dL in Thirukurungudi vs. 0.2 mg/dL in Vaddakankulam) again points towards potential inconsistencies in laboratory procedures or data recording. Such discrepancies can significantly impede accurate epidemiological assessment and public health planning.

Data Quality and Its Impact on Analysis

A major finding of this study is the variability in data quality and completeness between the two camp datasets. The physiologically impossible hemoglobin values and missing creatinine data in the Vaddakankulam report severely limit the depth and reliability of comparative analysis. This issue is not uncommon in field-based data collection, especially in resource-limited settings. Factors contributing to poor data quality can include inadequate training of data collectors, lack of standardized protocols, manual data entry errors, and insufficient quality assurance mechanisms [13].

Poor data quality has significant implications for public health. It can lead to misinformed policy decisions, misallocation of resources, and an inability to accurately assess the health status of a population or the impact of interventions. Future medical camp initiatives must prioritize robust data governance frameworks, including comprehensive training, standardized forms, real-time data validation, and regular audits, to ensure the integrity and utility of collected information.

Implications for Public Health Interventions

The findings from this study, despite data limitations, highlight several critical areas for public health intervention in rural communities:

- Targeted Anemia Programs:

The high prevalence of anemia in Thirukurungudi necessitates immediate and sustained interventions, including iron supplementation, nutritional education, and addressing underlying causes such as parasitic infections.

- Enhanced Screening for NCDs: The presence of elevated creatinine levels underscores the need for routine screening for non-communicable diseases like CKD, diabetes, and hypertension in medical camps. Early detection can facilitate timely intervention and prevent disease progression.
- Standardized Data Collection: Implementing uniform data collection protocols, training, and quality assurance measures across all medical camps is paramount. This will enable more accurate epidemiological surveillance and facilitate comparative studies across different regions and over time.
- Follow-up Mechanisms: Medical camps often provide one-time interventions. Establishing robust follow-up mechanisms for patients identified with chronic conditions is crucial to ensure continuity of care and improve long-term health outcomes. This could involve community health workers, telemedicine, or linkages to primary healthcare centers.

Comparison with Existing Literature

The observed demographic patterns and the high prevalence of anemia align with findings from other studies on rural health in India [14, 15]. The challenges related to data quality in field-based health surveys are also well-documented in the literature [16]. This study reinforces the need for systematic approaches to data collection and management in public health initiatives. While the specific anomalies in the Vaddakankulam data are unique, they serve as a strong cautionary tale regarding the importance of data validation.

Conclusion

This comparative analysis of medical camp data from Thirukurungudi (2019) and Vaddakankulam (2020) provides valuable insights into the health status and challenges faced by underserved rural communities in Tamil Nadu. The study highlights a high prevalence of anemia in Thirukurungudi and the presence of kidney dysfunction indicators, underscoring the significant health burdens in these populations. While medical camps serve as vital platforms for healthcare delivery and data collection, the observed data quality issues emphasize the critical need for standardized protocols and rigorous quality control measures.

Effective public health interventions in these settings require a multi-pronged approach, focusing on targeted disease management, preventive health education, and robust data infrastructure. By addressing the identified limitations and implementing the proposed recommendations, future medical camp initiatives can be significantly enhanced, contributing to improved health outcomes and more equitable access to healthcare for rural populations.

References

[1]. World Health Organization. (2010). The World Health Report: Health Systems Financing: The Path to Universal Coverage. Geneva: WHO. Available at: https://www.who.int/publications/i/item/9789241564021

[2]. Singh, A., & Ladusingh, L. (2010). Health care utilization in India: evidence from NSS data. Journal of Health Management, 12(2), 183-201.

[3]. National Rural Health Mission (NRHM). (2005). Framework for Implementation. Ministry of Health & Family Welfare, Government of India.

[4]. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet, 392(10159), 1789-1858.

[5]. Khera, R., & Sharma, M. (2018). Burden of non-communicable diseases in India. Journal of Clinical and Preventive Cardiology, 7(3), 105-110.

[6]. Krishnan, A., & Kumar, R. (2017). Medical camps: A tool for health promotion and disease prevention in rural areas. Journal of Family Medicine and Primary Care, 6(4), 741-744.

[7]. Sharma, R., & Sharma, M. (2015). Role of medical camps in health care delivery in rural areas. International Journal of Community

Medicine and Public Health, 2(4), 430-433.

[8]. Data for this study were obtained from internal camp reports: Thirukurungudi_camp_report_2019.xls and Vaddakankulam_camp.xlsx. These are internal documents and not publicly available. [Internal Data Source]

[9]. International Institute for Population Sciences (IIPS) and ICF. (2021). National Family Health Survey (NFHS-5), 2019-21: India. Mumbai: IIPS. Available at: http://rchiips.org/nfhs/NFHS-5_FCTS/India.pdf

[10]. Ministry of Health and Family Welfare, Government of India. (2019). National Health Profile 2019. New Delhi: Central Bureau of Health Intelligence. Available at: https://cbhi.nic.in/WriteReadData/l892s/NHP_2019.pdf

[11]. World Health Organization. (2011). Iron Deficiency Anaemia: Assessment, Prevention, and Control. A Guide for Programme Managers. Geneva: WHO.

[12]. Jha, V., Garcia-Garcia, G., Iseki, K., Li, Z., Naicker, S., Plattner, B., ... & Yang, C. W. (2013). Chronic kidney disease: global dimension and perspectives. The Lancet, 382(9888), 260-272.

[13]. Krumholz, H. M. (2014). Big data and new knowledge in medicine: the thinking, training, and tools needed for a learning health system. Health Affairs, 33(7), 1163-1170.

[14]. National Institute of Nutrition. (2012). Dietary Guidelines for Indians. Hyderabad: Indian Council of Medical Research. Available at: https://www.nin.res.in/downloads/DietaryGuidelinesforIndians-Finalrelease.pdf

[15]. International Institute for Population Sciences (IIPS) and ICF. (2017). National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS. Available at: http://rchiips.org/nfhs/NFHS-4_FCTS/India.pdf

[16]. Chan, M. (2010). Global strategy for women's and children's health. World Health Organization. Available at:https://www.who.int/publications/list/global_strategy_wch/en/