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Letter from the Editor's Desk

I, Wish to extend my sincere thanks to readers, authors, reviewers and editorial board who ensured to bring out issues in time in the last year with all the challenges including covid surge, dengue outbreaks, floods affecting Chennai and southern districts etc.. This shows your commitment to the scientific world and I like to express my sincere gratitude to you all.

The public health conference which I described in the previous issue went on well at Madurai in the month of December 2023 with more than 1000 participants, brought out research talents in the district health officials and the practising medical doctors.

I am sure they will come out with excellent implementation based scientific articles in the coming days.

As usual our editorial board touched widespread topics including NCD and MCH in this issue and we hope to bring more diversified public health interventions in the coming years.

With raising noncommunicable disease in the community as an Epidemic, It is time to focus on life style modification at every level. We as public health professionals have role to advise and practice on LSM.

Wish you happy new year 2024.

***Dr. T.S.Selvavinayagam MD., DPH., DNB.,
Director of Public Health & Preventive Medicine***

CONTENTS

Original Article

01. Iodine Estimation in Salt Samples: A Secondary Data Analysis of Trends from 2017 to 2023 in Tamil Nadu

07

Shinu Priya R, Shanmugasundaram V, Selvavinayagam T S

02. Prevalence of Anemia in Adolescent Boys and Girls in Tamil Nadu - An Interim Analysis (June 2023 - October 2023)

11

Shinu Priya R, Shanmugasundaram V, Selvavinayagam T S

03. Revealing insights: A comprehensive secondary analysis of RBSK and MMU vehicle distance data across districts of Tamil Nadu from April to September 2023"

16

Shanmugasundaram V, Mohanasundaram S, Shinu Priya R, Selvavinayagam T S

04. Secondary data Analysis of Rabies deaths reported in Tamil Nadu for the last 5 years (2018-2022) from the Case Investigation forms (CIF).

21

Anandan Mohan, Sankarmani Ramasamy Mathivanan, Palani Sampath , Avudaiselvi Rathinasamy, Sudhakar Thangarasu, Selvavinayagam T S

05. Antimicrobial Resistant Pattern in District Public Health Laboratories in Tamilnadu – A Retrospective study

28

Avudai Selvi Rathinasamy, Amudha A, Sankarmani Ramasamy Mathivanan, Sudhakar Thangarasu, Srikumaran P, M.Anitha Jose, Suresh Jothi kumar S, Satheesh M, Palani Sampath, Vadivelan P, Somasundaram A, Selvavinayagam T S

06. Walk in Centre – One Stop TB Solution- A model- 'Game Changer' in Tuberculosis Control

34

Anandan Mohan, Sudhakar Thangarasu, Palani Sampath, Selvavinayagam T S, Asha Frederick

07. Assessment of Medical Certification of Cause of Death in two institutions (X & Y) of a district from Tamil Nadu, 2022

36

Abishek Stanislaus, Selvavinayagam T S

08. Prevalence of Hypertension and Diabetes among sanitary workers in Tiruvannamalai Municipality – A Cross-sectional study

41

Prathap Kumar P, Tamil Mani A, Revathy R, Krishnaraj K

09. Assessment of nutritional status and its determinants among children in the age group of 1-5 years in a tribal population of Coimbatore district-a cross-sectional study

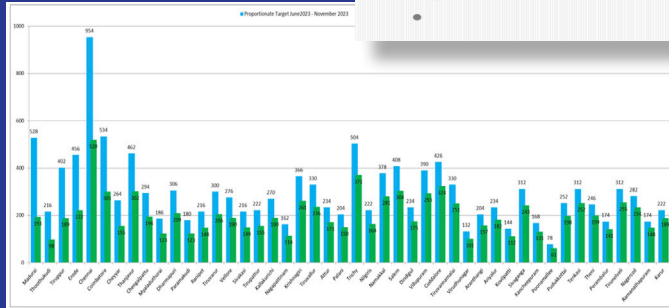
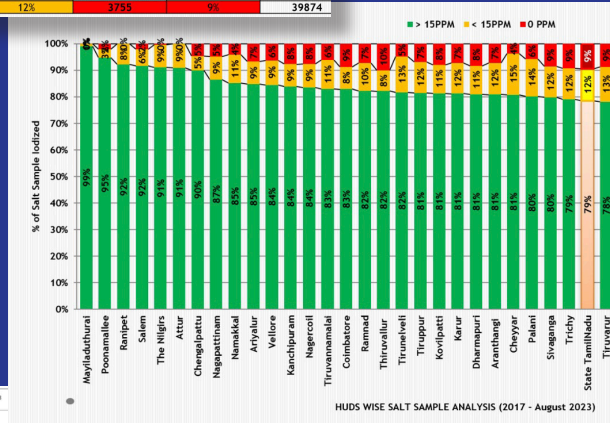
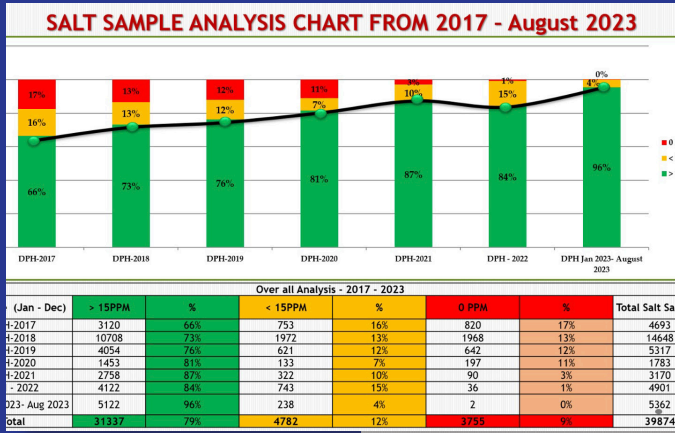
46

Pravin T, Govindarajan P K, John William Felix A, Krishnaraj K

10. Evaluation of Commercially Available Hb Meters (Poct Devices) Both Invasive and Non-Invasive Type With Haematology Analyzer

52

Sivadoss Raju, Baranidharan B, Shanthakumar M, Sudharshini Subramaniam, Somasundaram A, Senthil Kumar M, Rajeshkumar M, Kumaresan A, Sasikala P, Dinesh Kumar, Arthy Devi P, Srinithi A, Janani K, Pavithra, Kannan M, Shankar E M, Selvavinayagam T S



RESEARCH IS TO SEE WHAT EVERYBODY ELSE HAS SEEN, AND TO THINK WHAT NOBODY ELSE HAS

ORIGINAL ARTICLE - PUBLIC HEALTH

IODINE ESTIMATION IN SALT SAMPLES: A SECONDARY DATA ANALYSIS OF TRENDS FROM 2017 TO 2023 IN TAMIL NADU

*Shinu Priya R⁽¹⁾, Shanmugasundaram V⁽¹⁾, Selvavinayagam T S⁽¹⁾**(1) Directorate of Public Health and Preventive Medicine, Chennai.*Abstract

INTRODUCTION: Iodine deficiency is a global public health concern that can have severe consequences, including goiter and intellectual disabilities. Iodine fortification of salt is a widely adopted strategy to address this issue. This study analyzes trends in iodine estimation in salt samples in Tamil Nadu, India, from 2017 to 2023 to assess the effectiveness of iodization programs.

OBJECTIVES: The study aimed to quantitatively assess the iodine content in salt samples, determine changes in salt iodine content over seven years, and identify regional disparities in iodine levels within Tamil Nadu.

MATERIALS AND METHODS : It is a secondary data study. Salt samples were collected according to the National Iodine Deficiency Disorders Control Program (NIDDCP) guidelines. Samples were drawn from various sources, including rural and urban households and retailers, and analyzed using the iodometric titration method. Health inspectors collected salt samples, and iodine content was quantified in parts per million (ppm) using the iodometric titration method.

RESULTS : The study revealed a significant increase in adequately iodized salt from 66% to 96% over the study period. However, only 79% of salt samples contained iodine above 15 ppm, suggesting room for improvement. The study aligns with the National Family Health Survey (NFHS) data, which shows national and state-level improvements in salt iodization.

CONCLUSION : While progress in salt iodization is evident, regional and rural-urban disparities persist. Localized strategies in underperforming areas, sustained monitoring, targeted outreach, public awareness campaigns, and collaboration among stakeholders are recommended to ensure consistent iodine levels in salt and bridge disparities.

KEYWORDS : Iodine deficiency, salt iodization, NFHS, iodization programs.

INTRODUCTION

Iodine deficiency is a critical public health concern with far-reaching implications for human well-being. Globally two billion people are at risk of iodine deficiency disorders due to insufficient iodine intake.¹ Adequate iodine intake is essential for the proper functioning of the thyroid gland, which regulates various bodily functions, including metabolism. Iodine deficiency can lead to severe health issues, including goiter and intellectual disabilities, making it a significant global health challenge.²

To combat this issue, iodine fortification or enrichment of salt has been widely adopted as an effective and affordable strategy to ensure a stable and sufficient iodine intake at the population level. In this context, monitoring the iodine content of salt samples is of paramount importance to assess the progress and efficacy of iodine enrichment programs.³

This study focuses on the iodine estimation in salt samples and aims to provide an in-depth analysis of the trends observed in Tamil Nadu, India, from the year 2017 to 2023. Salt sample analysis is a crucial indicator of the success of iodine enrichment programs and can shed light on the extent to which the population's iodine needs are being met.

Tamil Nadu, a state in southern India, has been proactive in addressing iodine deficiency and has implemented various

initiatives to ensure the adequate iodization of salt. This research delves into the data collected through salt sample analysis in Tamil Nadu over the specified timeframe, with a primary focus on assessing the proportion of adequately iodized salt (defined as having an iodine content of >15 ppm) and non-iodized salt (0 ppm).

Understanding the trends in salt sample analysis will provide valuable insights into the progress of iodine enrichment efforts in Tamil Nadu. Moreover, it will help identify regions where additional interventions may be required to reach the target levels of salt iodization. This study contributes to the broader conversation surrounding public health and nutrition by offering a comprehensive analysis of the iodine estimation in salt samples in a specific geographical context.

OBJECTIVES

1. To quantitatively assess the iodine content in salt samples collected from various regions of Tamil Nadu during



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the period from 2017 to 2023

2. To determine whether significant changes or trends in salt iodine content have occurred over seven years, shedding light on the effectiveness of ongoing iodization programs and their impact on public health.

3. To identify and understand regional disparities in salt iodine levels within Tamil Nadu, pinpointing areas with inadequate iodine supplementation and those that demonstrate effective iodization practices, enabling targeted interventions as needed

METHODOLOGY

Methodology for Iodine Deficiency Disorder (IDD) Study – Secondary Data Analysis

This methodology outlines the procedures for conducting a secondary data analysis study aimed at evaluating iodine levels in salt samples, collected in accordance with the Government of India's National Iodine Deficiency Disorders Control Program (NIDDCP) guidelines of October 2006.

SAMPLE COLLECTION : Salt samples are systematically collected on a quarterly basis, with each Health Unit District (HUD) being tasked with obtaining a total of 200 salt samples annually. These samples are drawn from different categories, including 25 from rural households, 15 from urban households, 7 from rural retailers, and 3 from urban retailers. Proper labeling of each sample is imperative.

DATA COLLECTION TEAM : Health inspectors from the respective District Department of Health Services (DDHS) are the primary personnel responsible for the collection of salt samples. Technical Personal Assistants (PAs) to each DDHS assume a pivotal role in overseeing the entire process, monitoring compliance, and ensuring the timely dispatch of salt samples to the state IDD monitoring lab in accordance with the quarterly schedule.

ANALYSIS OF IODINE CONTENT : Iodine content in the salt samples is quantified in parts per million (ppm) utilizing the iodometric titration method. This process entails several steps. First, concentrated sulfuric acid (H₂SO₄) is introduced to the salt samples, liberating free iodine from the iodate. Excess potassium iodide (KI) is subsequently added to solubilize the free iodine, which is then titrated using sodium thiosulfate. The amount of thiosulfate consumed correlates with the liberated free iodine. Starch is introduced as an external indicator, reacting with free iodine to produce a distinctive blue color.

RESULT DISSEMINATION : The results, expressed in ppm, are communicated to the respective DDHS for further action. In instances where salt samples test below the critical

threshold of 15 ppm, instructions are issued to the DDHS to actively raise awareness in the districts regarding the crucial importance of adequate salt iodization.

DATA RETRIEVAL : As this study involves a secondary data analysis, the results of the iodine content analysis, which are sent to the DDHS, are also sent to the state Iodine Deficiency Disorders Control Programme (IDDCP) cell in Excel format which is in the Directorate of Public Health and Preventive Medicine (DPHPM). This data, retrieved from the Excel files at the IDDCP cell in DPHPM, serves as the basis for the secondary data analysis conducted in this study.

RESULTS

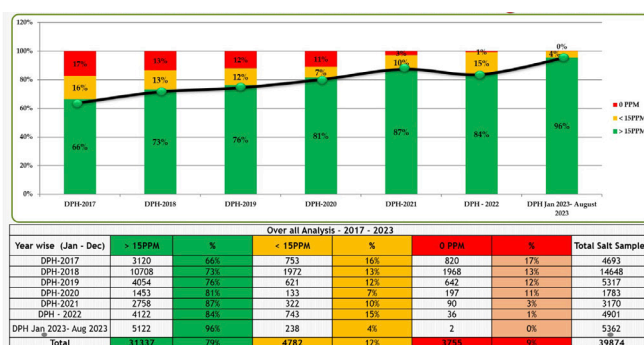


Figure 1 : Salt sample analysis chart from 2017 - August 2023

The Trend of salt sample analysis from 2017- August 2019 for the estimation of iodine in the salt using iodometric titration method shows that the proportion of adequate level iodized salt which is 15ppm has been increased from 66% to 96% and the percentage non iodized salt, which is 0ppm has been reduced from 17% to 0%.

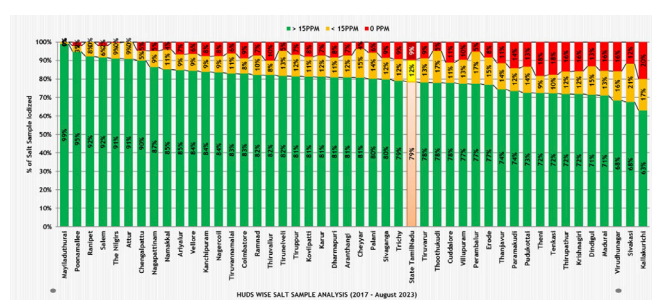


Figure 2 : HUD wise salt sample analysis (2017 - August 2023)

The Tamilnadu state average of the Salt sample analysis for the estimation of levels of iodine from 2017 - August 2023 shows, 91% Of salt samples tested are iodized. But only 79% of the Salt sample contains adequate level of iodine, which is >15ppm. About 18 out of 45 HUDs are below the state average level of salt iodization.

DISCUSSION

The study spans from 2017 to August 2023, demonstrates a significant and positive change in iodine levels within salt samples collected from various regions in Tamil Nadu.

The proportion of adequately iodized salt (with more than 15 ppm of iodine) increased impressively from 66% to 96%.

This increase underscores the effectiveness of iodization programs in improving salt iodine content, aligning well with the goal of reducing iodine deficiency disorders.

It's worth noting, though, that while 91% of salt samples were iodized, only 79% contained adequate iodine levels, suggesting a need for further improvement.

The NFHS 5 data⁴ for 2019-2021 and 2020-2021 provides a broader, national perspective on iodine sufficiency in India and Tamilnadu. The survey reports that in 2019-2021, 94.3% of salt samples in India were iodized.

Urban areas exhibited higher rates of iodization at 96.9%, while rural areas also demonstrated iodization at 93%. In NFHS 5 Tamil Nadu 2020-2021, the overall iodization rate remained high at 92%, with urban areas at 95% and rural areas at 89.3%.

The comparison of the current study with NFHS 5 data reveals several important insights. Firstly, the study's results demonstrate an upward trend in salt iodization within Tamil Nadu, signifying the effectiveness of iodization programs. This complements the national NFHS 5 data, which indicates a robust iodization trend across the entire country.

However, regional disparities are evident. The present study highlights the need for improving iodine content levels in Tamil Nadu, as only 79% of salt samples met the recommended iodine threshold. With the exception of Attur, Myladurai, Nilgiris, and Ranipet, all other 41 HUDs reported 0PPM in salt samples, indicating non-iodized salt. Even major salt-producing regions like Thoothukudi reported 0PPM in salt sample analysis.

Additionally, it's important to highlight that a significant portion of 0PPM salt samples is attributed to non-edible salt consumption, forming a substantial component of non-iodized salt in the region. This suggests that while iodization programs have raised the prevalence of iodized salt, ensuring the consistent iodine content remains a challenge.

NFHS 5 data further reveals variations between urban and rural areas, indicating the importance of bridging this gap. While urban areas demonstrate higher iodization rates, rural regions exhibit slightly lower rates.

This discrepancy underscores the need for continued efforts to ensure that rural populations have equal access to iodized salt to reduce regional disparities.

This the current study and the NFHS 5 data collectively reflect significant progress in iodized salt usage within India, with the study illustrating a positive trend in Tamil Nadu.

However, they also underscore the importance of maintaining consistent iodine levels in salt, particularly in rural areas, to ensure comprehensive iodine sufficiency across the nation. These findings collectively signify a positive direction toward reducing iodine deficiency disorders and advancing public health in India.⁴

CONCLUSION

While progress in salt iodization is evident, regional and rural-urban disparities persist. Localized strategies in underperforming areas, sustained monitoring, targeted outreach, public awareness campaigns, and collaboration among stakeholders are recommended to ensure consistent iodine levels in salt and bridge disparities.

RECOMMENDATIONS :

1. Given the regional disparities in iodine enrichment levels within Tamil Nadu, it is recommended to implement localized strategies in underperforming Health Unit Districts (HUDs).
2. Sustained monitoring of salt iodization efforts is essential to maintain consistent iodine content levels in salt samples
3. Collaborative efforts between public health authorities, salt producers, and research institutions should be fostered to address iodine enrichment challenges effectively. Additionally, further research should be conducted to explore the reasons behind the regional disparities and the best practices for improving salt iodization in underperforming areas.

LIMITATIONS :

The findings of the study are based on statistical analysis and do not account for qualitative aspects such as consumer preferences, cultural factors, and local practices that may influence salt usage.

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ORIGINAL ARTICLE - PUBLIC HEALTH

PREVALENCE OF ANEMIA IN ADOLESCENT BOYS AND GIRLS IN TAMIL NADU - AN INTERIM ANALYSIS (JUNE 2023 - OCTOBER 2023)

Shinu Priya R ⁽¹⁾, Shanmugasundaram V ⁽¹⁾, Selvavinayagam T S ⁽¹⁾

(1) Directorate of Public Health and Preventive Medicine, Chennai.

Abstract

INTRODUCTION : Anemia is a significant global public health concern, particularly in low- and middle-income countries, affecting adolescents' well-being and development. This study aims to assess the prevalence and severity of anemia among adolescents in Tamil Nadu, India, with a focus on identifying regional disparities and aligning the findings with existing national and state-level data.

OBJECTIVES : The study seeks to determine the prevalence and severity of anemia among adolescent boys and girls in Tamil Nadu, analyze the distribution of anemia across demographic and socio-economic variables, and make recommendations for targeted interventions.

MATERIALS AND METHODS : This secondary data study involves ongoing anemia detection camps conducted in Tamil Nadu from May 2023 to April 2024. Data was collected from 2127 Primary Health Centers (PHCs) and local schools and colleges. Blood samples were analyzed using cell counters to categorize anemia severity, and data was recorded in Excel spreadsheets for analysis.

RESULTS : The study reveals that 56% of adolescent girls and 41% of adolescent boys in Tamil Nadu have been identified with anemia, reflecting significant regional variations. Interim analysis shows that 10,290 girls and 2,316 boys have been identified with severe anemia, and efforts are underway to address their conditions. Comparisons with national and state-level data indicate alignment with existing prevalence rates.

CONCLUSION : The study underscores the persistent challenge of anemia among adolescents in Tamil Nadu. Targeted interventions, improved healthcare access, nutritional education, public awareness campaigns, and interdisciplinary collaboration are recommended to address this public health concern effectively. Collaborative efforts among healthcare professionals, educators, and policymakers are vital to enhance adolescent well-being.

KEYWORDS : Anemia, Adolescents, Prevalence, Severity, Tamil Nadu, India, Public Health, Targeted Interventions, Healthcare, Nutrition, Public Awareness

INTRODUCTION

Anemia is acknowledged as a global public health concern, especially in low- and middle-income countries.^{1,2} Anemia is defined based on low concentrations of hemoglobin or a decrease in the number of red blood cells.^{2,3} In clinical practice, it is categorized as mild, moderate or severe based on hemoglobin levels, with the cutoffs being based on age, sex and physiological state.

The word adolescence is derived from the Latin word, 'adolescere'; meaning "to grow, to mature".⁴ The WHO has defined adolescence as the age period between 10 to 19 years of age for both the sexes (married and unmarried). There are about 1.2 billion adolescents in the world, which is equal to 1/5th of the world's population and their numbers are increasing. Out of these, 5 million adolescents are living in developing countries. India's population has reached the 1 billion mark, out of which 21% are adolescents.⁵

WHO estimates that 40% of children 6–59 months of age, 37% of pregnant women, and 30% of women 15–49 years of age worldwide are anaemic. The WHO has defined adolescence as the age period between 10 to 19 years of age for both the sexes (married and unmarried). There are more

adolescents in the world than ever before, 1.2 billion, totalling one sixth of the global population. This number is expected to rise through 2050, particularly in low- and middle-income countries where close to 90% of 10- to 19-year-olds live.⁵

India has the largest adolescent population in the world, 253 million, and every fifth person is between 10 to 19 years. According to NFHS 5 data (2019-2021), the prevalence of anaemia among adolescent girls were 59% and adolescent boys was 31%. Similarly in Tamil Nadu the prevalence of anaemia among adolescent girls was 52.9% and boys was 24.6%.⁶

Anaemia in boys and girls limits their development, learning ability, reduces concentration in daily tasks, increases their vulnerability to infection, increases school dropout rates, reduces physical fitness and work productivity.⁷ Adolescent girls are at a high risk for anaemia and malnutrition.



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like Nilgiris, Tiruvallur, and Nagercoil exhibit relatively lower percentages.

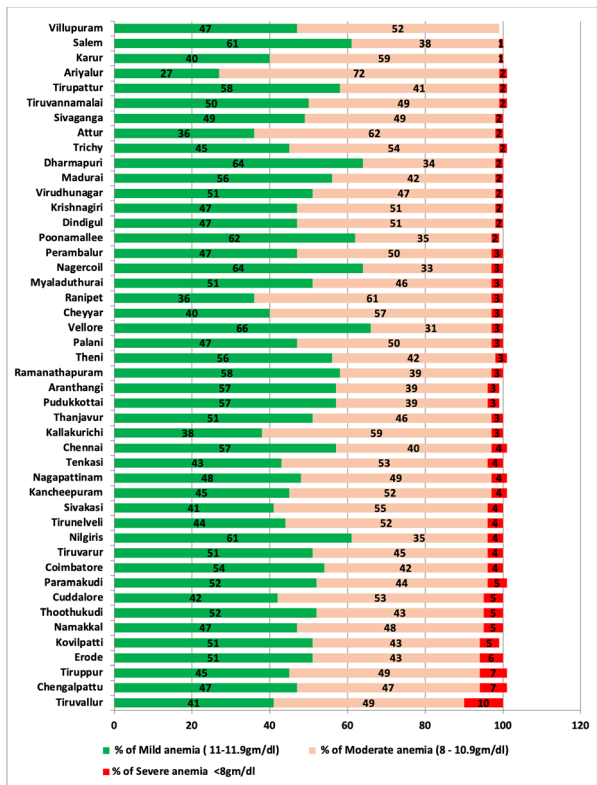


Figure 2 : Anemia Screening and Severity Distribution of adolescent female by HUD in Tamil Nadu (June - October 2023)

Examining the distribution of anemia severity, the percentage of mild anemia varies between districts, ranging from 27% to 64%, with Villupuram recording the highest percentage and Tiruvallur the lowest. Likewise, the percentages of moderate anemia span from 32% to 62%, with Villupuram again having the highest and Tiruvallur the lowest. On the other hand, the percentage of severe anemia falls within a range of 1% to 7%, encompassing the majority of districts. The percentage of identified anemia varies across districts is 41%, ranging from 7% to 63%. Districts like Thoothukudi and Poonamallee have relatively higher percentages of identified anemia. The percentage of mild anemia ranges from 34% to 79%, with Poonamallee having the highest percentage and Tiruppur the lowest. Moderate anemia percentages range from 14% to 54%, with Poonamallee having the highest and Tiruppur the lowest. The percentage of severe anemia varies from 0% to 4%, with most districts falling within the lower range.

The total count of girls with severe anemia across all districts is notably high, reaching 10,290. Chengalpattu and Chennai emerge as the districts with the highest numbers of girls identified with severe anemia, reporting 596 and 580 cases, respectively.

A total of 4,711 (46%) girls have transitioned from severe anemia to moderate anemia, which suggests that healthcare efforts have had a positive impact. Erode, with 331 cases, leads in the number of girls who have made this positive shift. The total number of boys identified with severe anemia across all districts is 2,316, which underscores the considerable health challenge posed by anemia among boys in the region. Specifically, 876 (38%) boys have successfully transitioned from a state of severe anemia to moderate anemia. Trichy has successfully converted 104 boys from a state of severe anemia to moderate anemia, followed by Ariyalur .

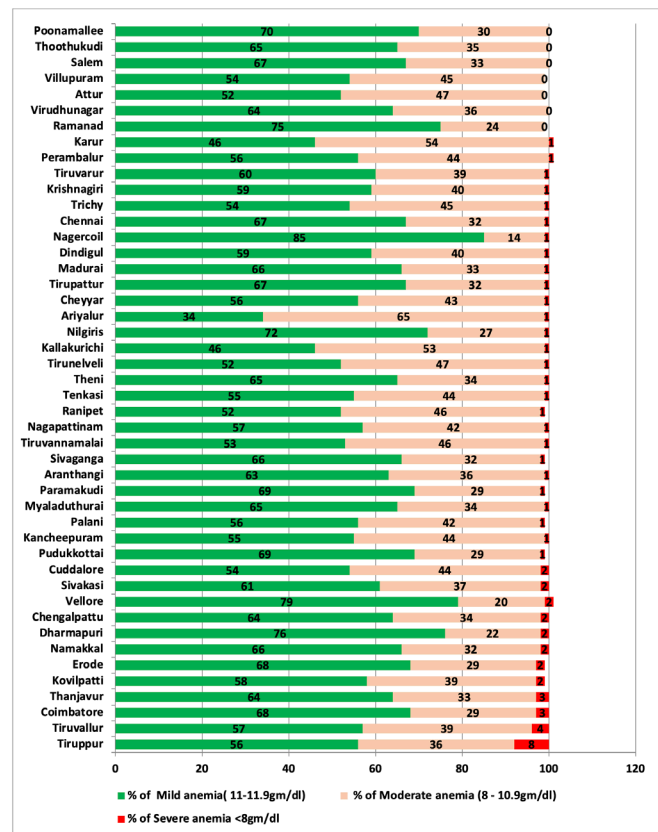


Figure 3 : Anemia Screening and Severity Distribution for adolescent male by HUD in Tamil Nadu (June - October 2023)

DISCUSSION

Comparing our study's findings with the NFHS 5 data and the specific data for Tamil Nadu reveals valuable insights into the prevalence of anemia among adolescents in the region.

Prevalence of Anemia	Present Study	NFHS 5 National Data	NFHS 5 Tamil Nadu-Specific Data
Female Adolescents	56%	59%	52.90%
Male Adolescents	41%	31%	24.60%

These comparisons underscore the persistent challenge of anemia among adolescents in Tamil Nadu, reflected in our study's findings that are in line with existing data trends. It highlights the continued need for research and interventions to effectively address this public health concern and improve the overall well-being of adolescents in the region.

RECOMMENDATIONS

1. Ensure improved access to healthcare facilities, especially in districts where a high proportion of adolescents are identified with severe anemia. This includes providing timely medical care, nutritional support, and regular follow-ups.
2. Implement nutrition education programs that aim to improve dietary habits and promote the intake of iron-rich foods among adolescents, which can contribute to a reduction in anemia prevalence.
3. Launch public awareness campaigns to educate parents, caregivers, and adolescents about the importance of regular health check-ups and early intervention in cases of anemia.
4. Interdisciplinary Collaboration: Promote collaboration between healthcare professionals, educators, and community organizations to address anemia comprehensively and holistically

LIMITATIONS

1. Our data is upto October, 2023, and may not reflect the most current situation. The situation can change over time, and it's important to consider this in policy and program planning.
2. Our study does not account for the underlying causes of anemia or socioeconomic factors that may contribute to the prevalence. A more in-depth analysis is required to understand the root causes better.
3. Our data is specific to Tamil Nadu, and the findings may not be generalizable to other regions or countries.

CONCLUSION

Our study sheds light on the challenges of addressing severe anemia among adolescents in various districts of Tamil Nadu. While we have made progress in identifying and following up on severe cases, it is clear that a more comprehensive approach is needed to combat anemia effectively. We recommend a focus on healthcare interventions, nutritional education, community awareness, and routine surveillance to reduce anemia's impact on adolescents. Collaboration among healthcare professionals, educators, and policymakers is essential to ensure the well-being of adolescents in the region.

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ORIGINAL ARTICLE - PUBLIC HEALTH

REVEALING INSIGHTS: A COMPREHENSIVE SECONDARY ANALYSIS OF RBSK AND MMU VEHICLE DISTANCE DATA ACROSS DISTRICTS OF TAMIL NADU FROM APRIL TO SEPTEMBER 2023"

Shanmugasundaram V⁽¹⁾, Mohanasundaram S⁽¹⁾, Shinu Priya R⁽¹⁾, Selvavinayagam T S⁽¹⁾

(1) Directorate of Public Health and Preventive Medicine

Abstract

INTRODUCTION : This study scrutinizes the operational dynamics of Rashtriya Bal Swasthya Karyakram (RBSK) and Mobile Medical Units (MMUs) in providing healthcare services to children and people in Indian districts. The aim is to enhance services, optimize resource allocation, and inform policy development. RBSK, launched in 2013, focuses on early detection and intervention for children's health, while MMUs extend healthcare services to underserved areas.

MATERIALS AND METHODS : Data from RBSK and MMU GPS dashboards, collected over a six-month period (April 2023 to September 2023), were analyzed. The study assessed vehicle distance coverage, identified factors influencing it, and compared RBSK and MMU performance.

RESULTS : RBSK demonstrated steady growth in distance coverage, increasing from 527,360.1 Km in April to 863,959.4 Km in September 2023. MMU coverage also expanded from 121,722.4 Km to 345,884.9 Km during the same period. Variations were observed across districts, with local conditions and patient demand influencing performance.

CONCLUSION : This study provides valuable insights into RBSK and MMU services' operational dynamics, highlighting positive developments and areas needing improvement. It recommends investigating inactivity and operational issues, understanding district-specific factors, addressing data anomalies, monitoring service performance, enhancing reporting mechanisms, and engaging stakeholders. The findings offer a basis for decision-making and resource allocation to enhance healthcare services in the studied districts.

KEYWORDS : RBSK, MMU, child healthcare, distance coverage, resource allocation

INTRODUCTION

Launched in 2013, the Rashtriya Bal Swasthya Karyakram (RBSK) is a pivotal child health program dedicated to addressing the healthcare needs of children aged 0-18 years. This initiative operates with the robust support of the National Health Mission (NHM) and the Tamil Nadu Health System Project (TNHSP). Alongside the RBSK program, Mobile Medical Units (MMUs) play a crucial role in extending healthcare services to remote and underserved areas, serving as a mobile lifeline that offers medical care and expertise.

Embracing modern technology, including Global Positioning System (GPS) tracking, both RBSK and MMUs effectively monitor the movements and reach of their mobile health teams. This utilization of GPS technology ensures efficient coverage and timely healthcare delivery. The GPS services are provided by Glovision, the designated GPS vendor.

Tamil Nadu serves as an exemplary model, with 805 active RBSK teams catering to the health needs of children in government and government-aided schools. These teams are distributed across 385 rural blocks, 8 corporations, and the Greater Chennai Corporation (GCC). Operating through a network of dedicated RBSK teams, with two teams assigned to each rural block and additional teams serving

in corporations and urban areas, underscores the scale and significance of RBSK operations. These teams are equipped with dedicated vehicles, highlighting the commitment to reaching children in diverse geographical locations.

The core mission of RBSK is to screen children at Anganwadi Centers, government, and government-aided schools to identify and address the "4 D's" - Defects at birth, Deficiencies, Diseases, and Developmental Delays. Early identification and intervention in these areas hold the potential to significantly impact the health and well-being of children, potentially altering the course of their lives for the better.

Mandated by the Ministry of Health and Family Welfare, the RBSK program has indeed made notable progress in improving child and adolescent healthcare in India. However, recognizing the need for continuous adaptation to meet evolving healthcare demands, understanding the travel behavior and service reach of RBSK and MMU vehicles is



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imperative for optimizing their impact and strengthening the program's effectiveness.

This study embarks on an in-depth secondary data analysis that scrutinizes the operational dynamics of RBSK and MMU vehicles over a five-month period, from April 2023 to August 2023, aiming to enhance services, optimize resource allocation, and inform policy development.

OBJECTIVES

1. Identifying patterns and trends in vehicle distance coverage.
2. Assessing the impact of various factors on distance coverage.
3. Evaluating the efficiency and utilization of RBSK and MMU resources.
4. Providing insights that can guide decision-making and resource allocation for healthcare services.
5. Suggesting potential improvements for the delivery of healthcare services in the studied districts

METHODOLOGY

DATA COLLECTION AND PRE-PROCESSING:

The data for this secondary study were sourced from the RBSK and MMU GPS dashboard, which is operational in all districts and provides distance reports.

The collected data were initially in Excel format and required pre-processing. Raw data was organized and structured for analysis.

Data pre-processing encompassed tasks such as data cleaning, sorting, and categorization of the distances travelled by RBSK and MMU vehicles.

DATA COLLECT:

Continuous variables were presented using descriptive statistics, allowing for a clear and concise representation of the data's characteristics.

To provide a comprehensive view of the study population, data distributions were effectively summarized and displayed in tables and other appropriate formats.

RESULTS

The table provides a comprehensive overview of the distance coverage by RBSK, highlighting the steady growth from 527,360 Km in April 2023 to 863,959 Km in September 2023. Notably, RBSK outperformed MMU in terms of distance covered throughout this period. This data showcases the continuous improvement in RBSK's performance, suggesting that it travelled greater distances compared to MMU.

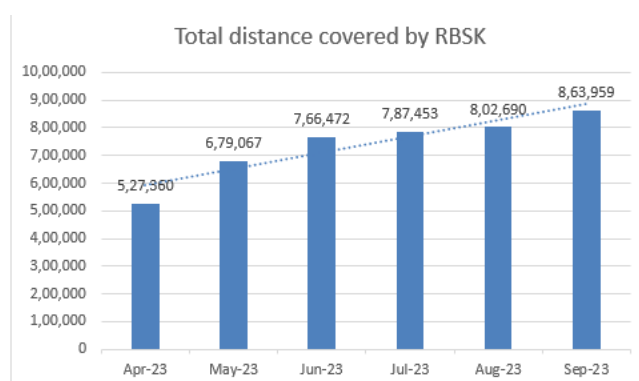


Figure 1 : Analysis of RBSK vehicle Distance Coverage from April to September 2023

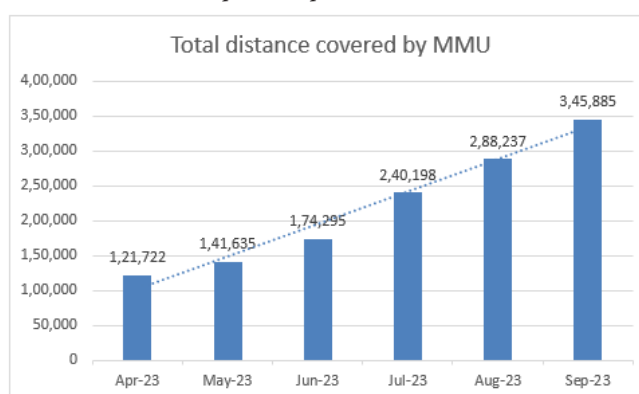


Figure 2 : Analysis of MMU vehicle Distance Coverage from April to September 2023

The figure provides a detailed breakdown of the distance coverage by MMU. The total distance covered by MMU started at 121,722 Km in April 2023 and steadily increased to 345,884 Km by September 2023. Similar to RBSK vehicle distance travelled, this data reveals a consistent growth trend in distance coverage over the six-month period.

The table presents a detailed analysis of RBSK distance coverage from April to September 2023, highlighting key trends and variations. Total distance covered across districts ranged significantly, with Trichy leading at 38,751 Km by September, signifying substantial growth. Districts displayed marked differences, with Trichy, Sivagangai, and Thiruvallur consistently covering longer distances, while Poonamallee and Pudukkottai reported relatively lower coverage. Notably, a common pattern emerges across all districts, showing increased distance coverage as the months progressed. This may be indicative of heightened activity or improved operational efficiency.

In April, there were 42 instances where no distance was covered by RBSK units. This number decreased to 33 in May but slightly decreased to 29 in June. However, from July onwards, there was a significant rise in instances of zero kilometers covered, reaching its peak at 45 in September. Investigating the reasons behind these occurrences can be essential for improving the efficiency and utilization of RBSK.

Thiruchirappalli	1,501	1,848	2,156	9,587	1,501	3,753
Thiruvallur	2,144	2,184	2,078	3,676	8,526	2,060
Thiruvannamalai	2,769	5,423	2,950	1,210	3,655	8,741
Thiruvaurur	1,788	3,114	3,773	7,164	1,533	3,463
Thoothukudi	993	848	1,835	3,040	7,891	1,171
Tirunelveli	3,241	4,453	4,725	6,021	1,119	6,874
Tirupattur	4,612	2,888	1,941	4,418	5,599	4,355
Tiruppur	5,488	3,124	3,308	2,191	4,188	5,681
Trichy	6,836	6,825	2,600	3,959	3,505	5,794
Vellore	2,300	3,275	4,104	1,765	3,631	4,225
Villupuram	2,959	5,359	3,474	2,191	3,563	9,537
Virudhunagar	865	1,255	1,067	3,959	959	2,353

The data underscores significant disparities in MMU distance coverage across districts, with certain areas, including Cuddalore, Thiruvannamalai, and Perambalur, consistently reporting longer distances covered, while others, like Poonamallee and Koilpatti, indicated substantially shorter distances.

Furthermore, when examining the monthly patterns, noticeable fluctuations become apparent. Some districts experienced peak performance during specific months, whereas others displayed more consistent patterns over time. These variations can be attributed to a range of factors, including local conditions, fluctuations in patient demand, or operational efficiencies.

Nonetheless, it is crucial to address the presence of extremely low values, such as 1.33 in Koilpatti and 1.35 in Poonamallee, as these values may signify data anomalies, potentially arising from data entry errors or days with minimal MMU activity.

Table 4 : MMU MONTHWISE 0KM COVERAGE

MMU	April	May	June	July	August	September
	30	30	28	44	44	44

During April, there were 30 instances when MMU services reported zero kilometers covered, indicating a lack of activity. This number remained constant at 30 in May and decreased slightly to 28 in June. However, a notable trend emerged from July onwards, with a substantial increase in the occurrences of zero kilometers covered, reaching its peak at 44 instances in both August and September.

REAL-TIME MONITORING FOR RBSK PROGRAM:

A special feature of RBSK GPS monitoring is real-time vehicle tracking through GPS. The RBSK Dashboard provides a comprehensive overview of critical operational

dynamics, facilitating real-time tracking and management of mobile health teams. Key components such as Total RBSK Teams, Active Teams, Moved Vehicles, Idle Vehicles, and GPS Inactive Vehicles are monitored to ensure seamless healthcare delivery. Additionally, planned visits to Anganwadi Centers and schools, as well as vehicle diversions, are also included. The system's adherence to the Annual Tour Plan (ATP) ensures efficient scheduling, contributing to the overall optimization of healthcare service delivery for children.



Figure 3 : Real-Time Monitoring Snapshot of RBSK Vehicle GPS dashboard (As of 20-9-2023, 10:34AM)

REAL-TIME MONITORING OF MMU AND FUTURE INTEGRATION OF FIXED TOUR PLAN (FTP):

This real-time monitoring of MMU vehicles enables the tracking of total devices, moving devices, idle devices, speeding devices, and offline devices, ensuring effective monitoring. In the future, the integration of a Fixed Tour Plan (FTP) will enhance monitoring by tracking adherence to the FTP and identifying any diversions, ensuring timely and targeted healthcare service delivery.

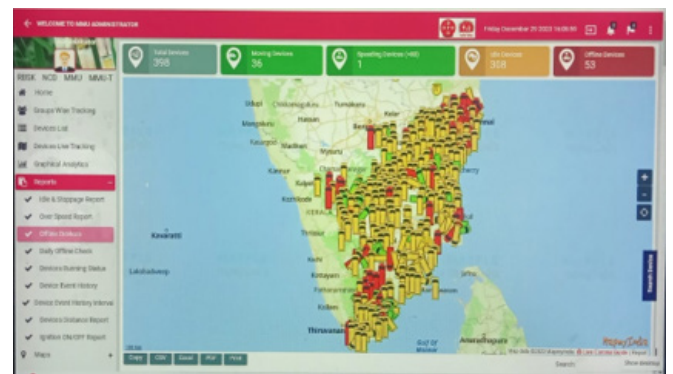


Figure 4 : Real-Time Monitoring of MMU Vehicles (Snapshot as of 20.9.2023, 16:05)

DISCUSSION

The study identified clear patterns and trends in vehicle distance coverage for both the Rashtriya Bal Swasthya Karyakram (RBSK) and Mobile Medical Units (MMU). These trends provide valuable insights into the evolution of healthcare service delivery over a six-month period. RBSK exhibited steady growth in distance coverage, increasing from 527,360 Km in April 2023 to 863,959 Km in September 2023. In contrast, MMU showed similar growth from 121,722 Km

to 345,884 Km over the same period, indicating an expansion of healthcare services in the studied districts.

The study highlights the impact of several factors on distance coverage for RBSK and MMU. Variations were observed across different districts, suggesting that local conditions and patient demand influence the performance of healthcare vehicles. Some districts consistently covered longer distances than others, potentially due to factors such as population density, geographical terrain, and the prevalence of healthcare facilities. Monthly patterns revealed fluctuations in performance, attributed to operational efficiencies and specific demand spikes.

The results indicate an overall increase in distance coverage for both RBSK and MMU. However, a concerning trend emerged, with an increased number of instances of zero kilometers covered by both services from July onwards. This suggests potential inefficiencies or resource underutilization that healthcare authorities should investigate and address to ensure efficient resource allocation and utilization. Understanding the reasons behind these instances of inactivity, such as vehicle breakdowns, staff availability, or logistical issues, is essential for improving service delivery.

The data generated by this study can guide decision-making and resource allocation for healthcare services. Decision-makers can use this information to identify districts or regions where healthcare services need improvement or expansion. The study also emphasizes the importance of addressing disparities in distance coverage among districts and identifying areas with potential data anomalies. It may be necessary to reallocate resources to areas with consistently low distance coverage or to investigate and rectify data entry errors that may skew the results.

FUTURE SCOPES

Extending GPS monitoring to "Makkalai Thedi Maruthuvam"(MTM) vehicles presents a promising future for the program, providing essential healthcare services to individuals over 45 with diabetes and high blood pressure. The initiative includes home medication delivery and vital services such as physiotherapy and palliative care administered by a dedicated team of professionals. This expansion enhances accessibility and ensures comprehensive healthcare support for those unable to visit hospitals.

ETHICAL CONSIDERATIONS:

Data Privacy: All data used in this study will be anonymized and aggregated to protect the privacy of individuals and comply with ethical data usage standards.

RECOMMENDATIONS

1. Investigate the rise in instances of zero kilometers covered from July to September for RBSK and MMU services to address potential inactivity and operational issues.

2. The fluctuations in distance coverage by districts can be attributed to local conditions and patient demand. It is recommended to conduct a detailed analysis of these factors in high-performing and low-performing districts to better understand the drivers of these variations.

3. The presence of extremely low values in some instances should be addressed. This could be due to data entry errors or days with minimal activity. Implement data quality checks and validation procedures to ensure the accuracy of the data.

4. Continuously monitor and compare the performance of RBSK and MMU units to identify factors contributing to RBSK's superior distance coverage.

5. Enhance reporting and tracking mechanisms for both services to identify and address issues in real-time for improved service delivery.

6. Engage stakeholders, including healthcare professionals, local authorities, and community members, in decision-making for insights into local dynamics affecting distance coverage.

LIMITATIONS

1. The study's findings may be specific to the region and time period under consideration (April 2023 to September 2023). Generalizing the results to different regions or time frames should be done cautiously

2. The study's data is limited to a specific time frame, which may not capture seasonal variations or long-term trends that could influence RBSK vehicle movement and service reach

3. The analysis does not consider external factors that could influence distance coverage, such as weather conditions, road infrastructure, patient demand, or changes in healthcare policies. These factors can significantly impact the results and should be considered when drawing conclusions.

4. The study relies solely on quantitative data from the GPS dashboard. It does not incorporate the perspectives and insights of RBSK program stakeholders, which could provide a more comprehensive understanding of the operational dynamics.

CONCLUSION

The study provides valuable insights into the trends and patterns of vehicle distance coverage for RBSK and MMU services, highlighting both positive developments and areas in need of improvement. These findings serve as a foundation

for decision-making and resource allocation to enhance healthcare services in the studied districts. Comparing these results with similar studies from other regions can offer a broader perspective on healthcare service delivery challenges and successes.

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ORIGINAL ARTICLE - PUBLIC HEALTH

SECONDARY DATA ANALYSIS OF RABIES DEATHS REPORTED IN TAMIL NADU FOR THE LAST 5 YEARS (2018-2022) FROM THE CASE INVESTIGATION FORMS (CIF).

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Abstract

BACKGROUND : Rabies is a neglected zoonotic disease that is highly prevalent in low and middle-income countries. It is caused by the bite of rabies-infected animals and is fatal if not treated timely with post-exposure prophylaxis. In spite of several initiatives by the government, India is still the leading country for rabies death globally. It is high time the gaps in the program are assessed and rectified.

METHODOLOGY : We conducted this retrospective descriptive study using the secondary data from the case investigation form (CIF) obtained following a rabies death and analyzed the factors. A total of 121 CIF from rabies death that occurred from 2018 to 2022 were collected and analysed.

RESULTS : Majority of victims were males between the age of 41 to 50 years and less than 1% of them were completely vaccinated. Pet dogs were the major source of infection and lower limb was predominantly involved in the animal bites. Government institutions were the preferred site for wound care and treatment while the private institution was preferred for the management of rabies-infected victims. The incubation period varied from less than a month to one year.

CONCLUSION : It was evident from the study that rabies death was due to lack of awareness about the treatment among the rabies victims leading to poor compliance. There is a need for frequent training in animal bite care and management and reporting among the healthcare workers to reduce the rabies death. It is high time initiatives are taken to achieve zero death due to rabies by 2030.

KEYWORDS : Rabies, Animal bite, Management, Immunoglobulin, vaccine.

INTRODUCTION

Rabies is a vaccine-preventable zoonotic disease caused by the rabies virus of the rhabdovirus family, genus *Lyssaviruses* which affects the central nervous system. It is prevalent in around 150 countries and territories.^{1,2} However, there is currently no treatment and is fatal once the symptoms appear with 100% mortality while the transmission of rabies can be prevented with proper wound care and post-exposure prophylaxis with vaccines with or without immunoglobulin.³ It is transmitted through bites or scratches of rabies-infected domestic or wild animals of which dogs contribute to 99% of rabies mortality. Rabies leads to tens of thousands of deaths every year with 95% of deaths occurring in Asia and Africa and 40% of the victims are school-going children.^{1,4} The exact number of deaths due to rabies is probably underestimated because of poor surveillance, reporting, and a lack of laboratory testing capacity.^{1,5}

To prevent the rabies death and to achieve the goal of zero death due to rabies, post-exposure prophylaxis (PEP) should be started and completed when there is an exposure to an animal that is either suspected or confirmed to be infected by rabies or when there is uncertainty regarding the circumstances that led to the exposure.^{6,7} The PEP includes a thorough wound wash with soap and water and appropriate

wound care, application of a virucidal agent to reduce the viral inoculum, a full course of post-exposure anti-rabies vaccination on day 0,3,7 and 28 to induce antibodies that reduce the risk of the virus entering the peripheral nerves, and a prompt diagnosis and treatment of the animal exposure.^{8,9} Category III, which is defined as single or multiple transdermal bites, scratches or licks on broken skin, and contamination of mucous membrane with animal saliva^{4,6,10} has to be managed with Rabies Immunoglobulins (RIG) which is either a Human RIG or Equine RIG in addition to the PEP.¹¹

Rabies has been eliminated in several high-income countries and controlled in some middle-income countries while rabies due to dog bite has been endemic in most of Asian and African countries. Some of the Asian countries like Thailand, Philippines and Sri Lanka have reduced the mortality and burden due to rabies while it remains high in India and its neighbouring countries like Bangladesh and Pakistan. The burden affects the poor and rural communities



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while children are most likely to be sufferers.⁵ Long before Aristotle recognised the illness in the Greco-Roman era, rabies had been recognised in India for many millennia. The ancient Vedic literature "Sushruta Samhita" offers grave depictions of rabies in both animals and humans.¹³ Rabies is endemic in India and is prevalent in all states and union territories of India except Andaman & Nicobar Islands, Lakshadweep Islands and Goa.⁶

With little intersectoral coordination, rabies is typically only controlled in a few urban areas. Through improved coordination and communication between the animal- and human-health sectors as well as other pertinent industries, India has now established a One Health network that will not only address rabies but also strengthen surveillance and health systems for numerous health risks at the human-animal-environment interface. With this context, in India, 'National Action Plan for Dog Mediated Rabies Elimination' (NAPRE) programme has been launched with the aim of reducing human deaths, caused due to dog-mediated rabies, to zero by 2030.⁷

In India, Tamil Nadu is the first state to launch a multisectoral, statewide rabies control strategy. To find patterns at the district level in the state, surveillance data on dog bites were triangulated with data on vaccination rates and dog populations. Different departments in Tamil Nadu that shared similar goals carried out rabies control initiatives.¹⁴ Other targeted treatments, including proper waste management, animal birth control, anti-rabies vaccination, awareness campaigns, and widespread availability of anti-rabies vaccine at all public health facilities, were also implemented in addition to animal census, and public health surveillance.¹⁰ There are a few retrospective studies to determine the factors leading to mortality due to rabies in animal bite cases globally and studies in Tamil Nadu are limited to selective districts or clusters. With this knowledge this study was conducted in the entire state of Tamil Nadu to assess the determinants for contracting rabies due to animal bites leading to mortality between the years 2018 to 2022.

MATERIALS AND METHODS

STUDY DESIGN AND POPULATION: This retrospective descriptive cross-sectional study was conducted in Tamil Nadu during the months of June to August 2023 to assess the determinants of mortality in rabies related deaths from the Case Investigation Form (CIF) collected following death of a rabies victim. This study included all cases of deaths due to rabies between 2018 to 2022. It was collected from the records of Zoonotic division of the Communicable Disease section of

The Directorate of Public Health and Preventive Medicine (DPH & PM) where the death due to rabies are recorded. The number and cases of deaths due to rabies obtained from Zoonotic division of the Communicable Disease section of DPH & PM were cross verified with the CIF collected from the district. The secondary data of the rabies victims regarding the determinants leading to death were obtained from the standard CIF used in Tamil Nadu for reporting after obtaining permission from the Director of Public Health and Preventive Medicine.

STUDY TOOL: CIF is a verbal autopsy tool which is a standard form used in Tamil Nadu to interview and collect details from the relatives or close acquaintances of the deceased to ascertain the cause of death in circumstances where the cause of death is lacking, or adequate information's are unavailable. It is semi structured questionnaire administered by a trained health care workers (Medical Officers) which consists of details regarding the victims (i) socio-demographic particulars, (ii) details regarding illness mentioning the date of onset of symptoms, place of care, and details on requirements of hospitalisation or not, (iii) clinical features and symptoms, (iv) history of exposure including date of attack, nature and extent of injury, site of injury, (v) source of infection and status of the source, (vi) treatment and post exposure prophylaxis, (vii) control measures by the health department and (viii) conclusion remarks.

DATA EXTRACTION: CIF of all the victims during the study period were collected, verified, and scanned. All the collected CIF forms were manually entered in the Microsoft Excel and cross verified by peers to exclude any errors while entering and coding. The data was analysed using OpenEpi a free web based statistical tool. The results are described in diagrammatic representation, tabular representation, and narrative summaries.

ETHICAL CONSIDERATION: Any mortality due to rabies is considered as a public health importance and appropriate response measures are to be initiated to prevent an outbreak. Permission to conduct this study was obtained from The Director of Public Health and Preventive Medicine, Tamil Nadu. To protect the confidentiality, the victims' and the informant's names were not mentioned in the data collected. In addition, the ethics committee were assured that the names of the victims and the informants would be kept secret.

RESULTS

A total of 37,71,496 cases of dog bites, and 121 rabies related deaths were registered in the Zoonotic division of the Communicable Disease section between the years 2018

to 2022 and CIF was available from all the 121 deaths due to rabies. The mean age of the victims was 49.9±19.1 years ranging from one to 83 years of age. Almost 25% (n=30)

Table 1 : Socio-demographic characteristics of the rabies victims

Factors	Frequency	Percent	95% CI
Sex			
Female	24	19.8	13.1 to 28.1
Male	97	80.2	91.9 to 86.9
Age			
< 10 years	12	9.9	5.2 to 16.7
11 - 20 years	10	8.3	4.0 to 14.7
21 - 30 years	16	13.2	7.8 to 20.6
31 - 40 years	17	14	8.4 to 21.5
41 - 50 years	30	24.8	17.4 to 33.5
51 - 60 years	21	17.4	11.1 to 25.3
61 - 70 years	11	9.1	4.63 to 15.7
> 70 years	4	3.3	0.9 to 8.25
Education			
Graduate	9	7.4	3.5 to 13.7
Higher Secondary school	5	4.1	1.4 to 9.4
High school	13	10.7	5.9 to 17.7
Middle school	30	24.8	17.4 to 33.5
Primary school	23	19	12.5 to 27.1
Illiterate	41	33.9	25.5 to 43.1
Occupation			
Professional	1	0.8	0.2 to 4.5
Student	21	17.4	11.1 to 25.3
Skilled	4	3.3	0.9 to 8.3
Semiskilled	32	26.4	18.8 to 35.2
Unskilled	63	52.1	42.8 to 61.2
Religion			
Hindu	110	90.9	84.3 to 95.4
Christian	8	6.6	2.9 to 12.6
Muslim	3	2.5	0.5 to 7.1
Local body			
Corporation	10	8.3	4.0 to 14.7
Municipality	13	10.7	5.9 to 17.7
Town Panchayat	13	10.7	5.9 to 17.7
Village Panchayat	85	70.2	61.3 to 78.2

Table 2 : History of exposure to the biting animal and the type of injury.

Factors	Frequency	Percent	95% CI
Biting Animal			
Dog	101	83.5	75.6 to 89.6
Cat	4	3.3	0.9 to 8.3
Not known	16	13.2	7.8 to 20.6
Immunisation status of the biting animal			
Fully	3	2.5	0.5 to 7.1
Partially	4	3.3	0.9 to 8.25
Not immunised	58	47.9	38.8 to 57.2
Not known	56	46.3	37.2 to 66.6
Status of biting animal			
Stray animal	41	33.9	25.6 to 43.1
Household pet	39	32.2	24.0 to 41.3
Neighbours pet	12	9.9	5.2 to 16.7
Not Known	29	24.0	
Suspicion of rabies among the biting animal			
Yes	26	21.5	14.5 to 29.9
No	15	12.4	7.1 to 19.6
Not known	80	66.1	56.95 to 74.5
Place of attack			
Home	48	39.7	30.9 to 49.0
Street	47	38.8	30.1 to 48.1
Forest	1	0.8	0.2 to 4.5
Others	7	5.8	2.3 to 11.6
Not Known	18	14.9	9.1 to 22.5
Nature of Exposure			
Bite	94	77.7	69.2 to 84.8
Lick	2	1.7	0.2 to 5.8
Scratch	13	10.7	5.9 to 17.7
Not Known	12	9.9	5.2 to 16.7
Extent of Injury			
Single	66	54.5	45.2 to 63.6
Multiple	25	20.7	13.8 to 28.9
Not Known	26	21.5	14.5 to 29.9
No injury	4	3.3	0.9 to 8.25
Site of Injury			
Lower limbs / toes	46	38.0	29.4 to 47.3
Upper limbs / fingers	37	30.6	22.5 to 39.6
Head/face / neck	17	14.0	8.4 to 21.5
Genitalia	1	0.8	0.2 to 4.5
Not Known	20	16.5	10.4 to 24.4
Category of bite			
II	15	12.4	7.1 to 19.6
III	89	73.6	64.8 to 81.2
Not known	17	14.0	8.4 to 21.5

Table 3 : Treatment and Post exposure prophylaxis.

Factors	Frequency	Percent	95% CI
Observation of the biting animal for 14 days			
Yes	18	14.9	9.1 to 22.5
No	52	43	34.0 to 52.3
Not known	51	42.1	33.2 to 51.5
Local wound treatment			
Yes	25	20.7	13.8 to 28.9
No	96	79.3	71.0 to 86.2
Inj. Tetanus toxoid administration			
Yes	34	28.1	20.3 to 37.0
Not given	39	32.3	24.0 to 41.3
Not known	48	39.6	30.9 to 49.0
Anti-Rabies vaccine administration			
Completed	1	0.8	0.2 to 4.5
Not completed	20	16.6	10.4 to 24.4
Not given	55	45.4	36.4 to 54.8
Not known	45	37.2	28.6 to 46.4
Equine rabies immunoglobulin administration			
Completed	4	3.3	0.9 to 8.25
Not given	54	44.6	35.6 to 54.0
Not known	63	52.1	42.8 to 61.2
Human rabies immunoglobulin administration			
Completed	2	1.7	0.2 to 5.8
Not given	59	48.7	39.6 to 58.0
Not known	60	49.6	40.4 to 58.8
Place of diagnosis of rabies			
Government Medical College Hospital	33	27.3	19.6 to 36.2
Government Hospital	22	18.2	11.8 to 26.2
Healers	1	0.8	0.2 to 4.5
Primary Health Centre	10	8.3	4.0 to 14.7
Private Clinic/ Hospital	55	45.5	36.4 to 54.8

Table 4 : History of exposure to the biting animal and the type of injury.

Factors	Frequency	Percent	95% CI
Difficulty in swallowing	81	66.9	57.8 to 75.2
Difficulty in breathing	62	51.2	41.2 to 59.6
Behavioural changes	56	46.3	37.17 to 55.6
Fever	49	40.5	31.7 to 49.8
Aerophobia	48	39.7	30.9 to 49.0
Hyperactivity	47	38.8	30.1 to 48.1
Encephalitis	23	19	12.5 to 27.1
Paralysis	10	8.3	4.0 to 14.7

The mean age of the of the victims were between the age group of 41 to 50 years. Among the death due to rabies 80.2% (n=97) of them were male and 20.7% (n=25) of them were between the age of 41 to 50 years. Majority, 70.2% (n=85) of the victims' residence were from village panchayat/ rural local bodies while only 8.5% (n=10) of the victims were from corporation/ urban local bodies. Almost one third, 35.5% (n=43) of them had middle school education, while 33.9% (n=41) had not attended schooling and 19% (n=23) had primary level of education. Regarding occupation, 52.1% (n=63) were unskilled workers and 26.4% (n=32) were semiskilled workers. First degree relatives were the most common source of information 75.2% (n=91) of the victims. Majority of individuals were attacked either at home 39.7% (n=48) or in the streets 38.8% (n=47). Dogs bites were the major cause of rabies death with 83.5% (n=101) and Category III bites were the most common category of injury with 73.6% (n=89). Regarding injury, 54.5% (n=66) of the victims sustained single injury and 38.8% (n=47) sustained superficial injury with bleeding while 21.5% (n=26) were not aware about the victim's injury. The most common site of injury was lower limbs or toes with 38% (n=46) followed by upper limbs or tips of fingers with 30.6% (n=37).

Following exposure to animal bite or lick, local wound care was sought by 20.7% (n=25) of the individuals while 13.2% (n=16) received care immediately and Tetanus Toxoid was administered for 28.1% (n=34) of the victims. PEP was not taken by 73.6% (n=89) of the victims while 17.4% (n=21) received Anti Rabies vaccination which was completed by just one victim. Equine Rabies Immunoglobulin (ERIG) was administered to 3.3% (n=4) and Human Rabies Immunoglobulin (HRIG) was administered to 1.7% (n=2) of cases.

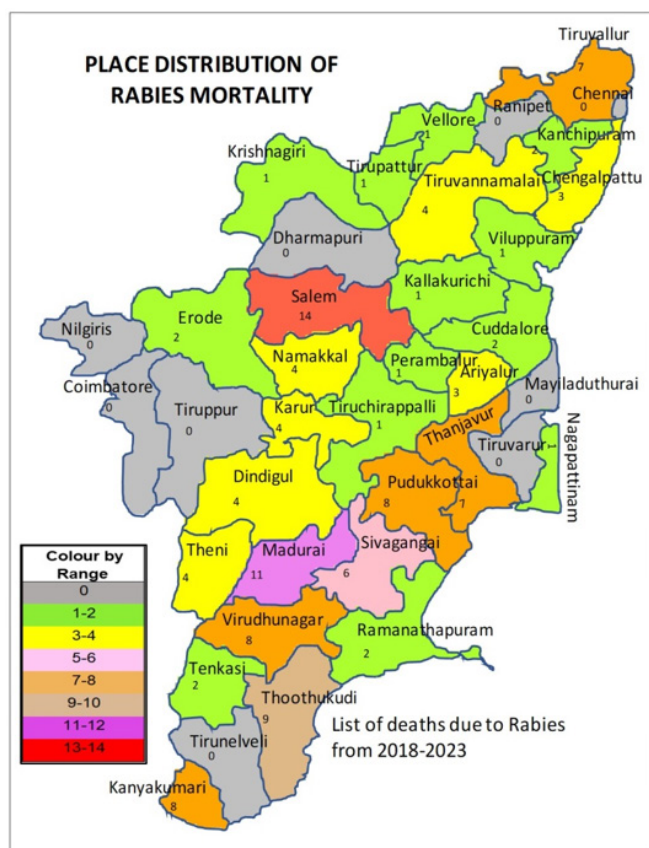


Figure 1 : Place Distribution of Rabies Mortality

Among the biting animals, dogs were the most common cause 83.5% (n=101), and 53.5% (n=54) of the dogs were not vaccinated and 40.6% (n=41) were not aware about the vaccination status. 42.1% (n=51) were exposure to household pets. Only 21.5% (n=26) of the animals were suspected to be a rabies infected animal and just 14.9% (n=18) of the animals were observed for 14 days to see if the biting animal was healthy and alive while 47.1% (n=57) of the animals were found to be dead later on. The median duration since animal bite to animal death was 5 days ranging from zero days to 21 days while 8.3% (n=10) animals were dead on the same day of bite and 6.6% (n=8) animals 3 days after bite. None of the dead animal's brain was sent to the laboratory testing for rabies virus.

The most common place for first aid and medical care

for rabies case was at private clinic or hospitals for 45.5% (n=55) of victims. The duration between animal bite and the death of victim was available only for 65.2% (n=79) of the victims and among them 54.4% (n=43) succumbed to rabies between 30 to 90 days. Duration between onset of symptoms and death varied between 24 hours to 16 days with 66.1% (n=80) of the death occurred within 72 hours. Among the 121 rabies deaths autopsy was performed for 7.4% (n=9) with brain biopsy performed for one individual for which results were not available. Data on vaccination of dogs especially pet dogs is not available in the Case Investigation form (CIF).

DISCUSSION

Since the population of Tamil Nadu is comparable with other states of India which is a part of Southeast Asian countries which shares similar culture, characteristics, economic development, and rabies burden like others the results of our studies can be related to the studies from these countries.^{1,15,16} On assessing the data of the past 5 years it is evident that rabies cases have been reported from all the districts of Tamil Nadu with highest incidence in Salem followed by Madurai and Thoothukudi.

Dog bite was the most common cause of rabies in our study which is similar to all the studies conducted on rabies in India and Tamil Nadu. These studies reported dogs as the main biting animal among all cases exposed to animal bite and also for rabies death.^{15,17,18,19} One study in New Delhi reported that dog bite was higher in urban slums of New Delhi compared to the rural slums in 2014 but was not statistically significant.²⁰ In almost all studies males were the victims of rabies which was similar to our findings. In studies, conducted in India and other countries most common age group of rabies victims varied. Children were most commonly affected in India^{3,14} and Philippines,¹⁹ while adults above 20 years were common in Pakistan.¹⁵ Majority of rabies victims in our study was between the age group of 41 to 50 years which could be because of loss of pay when seeking health care.

In our study home or residence was the most common site of animal bite and pet dogs were the major source of bite which is similar to the studies conducted in Pakistan, Philippines and Southeast Asian countries as pet dogs are relatively common^{2,15,19,21} in recent years and less compliance to treatment considering them to be less infective and not suspected to transmit the disease. Similarly lower limbs were the most common site of bite injury followed by upper limbs which is comparable to other studies from Asia and Africa^{2,15,19,21} as lower limbs are easily accessible by dogs due

their height.

When considering the exposure status, bite from animals was the most common presenting history and it was a single exposure with superficial injury leading to bleeding. Similar findings were also presented in other studies on rabies death.^{20,22} Category III animal bite was the most commonly observed finding in our study and other studies in conducted in India, Pakistan, Afghanistan, Philippines, China, and African countries.^{2,4,16} It indicates that there is an increased chance of rabies incidence due to increased possibility of transmission of virus because of the broken skin barrier.

Similar to our study, other studies also presented the fact that the biting animal was not suspected to transmit the disease as in most cases it was a pet and hence, they were not observed adequately for signs and symptoms of rabies in the animals.^{14,16} This could also bring light to the fact that the compliance was poor in wound care and reduced adherence to the treatment as most of the victims did not take PEP and even those who were initiated in PEP were not completely vaccinated.^{4,19,23} These findings necessitates more information, awareness and education towards wound handling and PEP is required for the population to bring down the mortality due to rabies.

Government hospitals were mostly preferred for first aid and medical care by majority of the victims when compared to primary health centres, medical college hospitals and private clinics/ hospitals. Other studies did not provide much light on the place of care following animal bite.¹⁸ This higher preference for government hospitals could be due to an assumption of availability of ARV and ERIG/ HRIG in those centres 24/7. The knowledge on the functioning, availability of ARV and ERIG/ HRIG in other government health facility is still poor among the population. Private hospitals or clinics were most preferred for initial treatment following signs and symptoms of rabies, but they were later referred to Government medical colleges for management due to availability of isolation wards in tertiary care centres. There was failure in ARV and ERIG/ HRIG in few patients in other studies and this finding could not be appreciated in our study as only one of the patient was fully immunised. Even after three dose some succumbed to death due to rabies, this could be the fact that the virus inoculation directly occurred in the peripheral nerve roots.^{11,24,25}

The incubation period observed in our study was identical to other studies and there was no long incubation period lasting more than a year in the victims.^{15,21,26,27} Majority of the victims in our study presented with difficulty in swallowing and hydrophobia followed by difficulty in

breathing. These findings were consistent with most other studies from Asia and Africa^{4,13,15} except for the study in Philippines where altered behaviour and irritability was the frequent observation.¹⁹ This difference could be due to the difference in observation from the first responders following the signs and symptoms or could be due to recall bias which needs further investigation. The duration between the onset of signs and symptoms to death was similar to our study when compared to other studies.

CONCLUSION

Majority of death due to rabies is contributed by dogs and pet dog bites were the major source of infection in rabies deaths compared to stray dog bites. Majority of the victims were males in middle age group who are the productive population. More than half of the rabies deaths occurred in those who did not take vaccines which shows poor adherence to treatment and most of those who took vaccines received it in government institutions which should be improved to reach a hundred percentage coverage. Even in those who took vaccines only few of the victims sought proper PEP for the dog bite and the PEP was not administered or not completed in majority of the victims. Unfortunately, a large proportion of them were not given ARV at first visit which could be due to lack of knowledge among the HCWs in the first place of contact between the animal bite victims and healthcare system. When analysed the Cat III bites, the data on Immunoglobulin administration was inadequate among the victims and only one tenth of them were administered Immunoglobulin which should be improved. The majority of the CIF were incomplete, and in many instances, even simple data is wrongly entered or missed.

RECOMMENDATIONS

It is evident from the aforementioned findings that in addition to stray animals, pet dogs play a major role in disease causation and must receive more attention, and effective monitoring of their immunisation is crucial. Some recommendation to improve male and middle age group vaccination to be given here or that point may be removed from the conclusion if it is not necessary. To improve the compliance in the victims the general population should be educated through information, education, communication (IEC) and behaviour change communication (BCC) using multimedia, visual, and auditory communication means. To identify the gaps in the treatment and care of animal bite victims, it is necessary to verify that HCWs have received training on how to complete a CIF for a rabies death and the

significance of all the facts provided.

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Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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ORIGINAL ARTICLE - PUBLIC HEALTH

ANTIMICROBIAL RESISTANT PATTERN IN DISTRICT PUBLIC HEALTH LABORATORIES IN TAMILNADU – A RETROSPECTIVE STUDY

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Abstract

BACKGROUND : The evidence of rising multidrug-resistant organisms requires implementation of effective stewardship programs to control Anti-Microbial Resistance (AMR). But this has to be informed by evidence-based knowledge of local antimicrobial resistance patterns. The aim of this study is to establish the prevalence of common pathogenic microbes including their antimicrobial susceptibility patterns and distribution in Tamilnadu. Globally the emergence of antibiotic resistance and limited availability of treatment options present an increasing challenge for the management of bacterial infections worldwide. Recently the incidence of bacterial infections has risen, and the lack of available treatment options against some Multi-drug-resistant (MDR) strains is alarming. Infections caused by MDR organisms are associated with high morbidity and mortality. Hence, careful adherence to infection control and infection treatment guidelines helps to improve patient outcome and reduce the antibiotic usage.

METHODOLOGY : It is a retrospective secondary data analysis. Data collected from October 2022 to March 2023 from the culture & sensitivity records of various clinical isolates at all District Public Health Laboratories in Tamilnadu performing culture and sensitivity and the data was received in excel sheet in a fixed format.

RESULTS : A total of 400 positive culture were included in this study, out of which E.coli (31%), Staphylococcus.sp (26%), Klebsiella.sp (22%), Pseudomonas.sp (10%), Proteus.sp (5%), Acinetobacter.sp (2%) were isolated. Maximum resistance was observed with commonly used first line antimicrobials such as co-trimoxazole, ampicillin, amoxycylav, fluoroquinolones, and third generation cephalosporins. Least resistant or highly sensitive were amikacin, meropenem, imipenem & cefaperazone sulbactam among the gram-negative bacteria. Macrolides, clindamycin, vancomycin & linezolid were the most sensitive antimicrobials against the gram-positive bacteria. Out of 102 Staphylococcus aureus, 53% were resistant to ceftiofime which implies there were Methicillin-resistant Staphylococcus aureus (MRSA)

CONCLUSION : The microbial culture and sensitivity for a clinical sample are essential before starting antimicrobial therapy. To prevent the rising trend of AMR, rational use of antibiotics, prescribing appropriate antibiotics after conducting culture and sensitivity, Preventive measures and health policies should be implemented to prevent the spread of infection caused by these pathogens.

KEYWORD : Antimicrobial resistance, Bacterial isolates, Antibiotic susceptibility

INTRODUCTION

Antibiotics plays major role in modern medicine. Antibiotic resistance is a worldwide public health problem and it is a threat to mankind.¹ The burden of infectious disease is highest in India and recent reports showed the inappropriate and irrational use of antimicrobial agents against the diseases led to increase in the development of antimicrobial resistance (AMR).² AMR is said to be the primary cause of death for both hospitalized and non-hospitalized patients in both developed and developing nations if proper control and prevention measures are not implemented. An average of 1 lakh deaths are attributed to AMR each year.³

The primary cause of infections in human is bacteria.⁶ As the infection due to Gram negative bacteria is more prevalent than Gram positive bacteria, infection control practices and new antimicrobial development have primarily targeted mainly for gram negative organisms.^{12,13,14,15} The treatment of

any bacterial infection requires the appropriate prescription and administration of antibiotics.^{4,5}

Antimicrobial agents are classified into different groups based on the mechanism of action, which are inhibition of bacterial cell wall synthesis, depolarisation of the cell membrane, inhibition of protein synthesis and inhibition nucleic acid synthesis. With this wide range of mechanism of action we would have controlled the microorganisms and protected the population from morbidity and mortality due to bacterial infection, but due to improper antibiotic usage lead to the drug resistance. The contributing factor for development

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of antimicrobial resistance is improper prescription of antimicrobial agents, such as the prescription of broad-spectrum antibiotics during the initial stage of infection and treating the patients with intrinsically resistant antibiotics.¹¹

The WHO-endorsed global action plan on antimicrobial resistance (AMR) states that it is critical to increase global knowledge of AMR through research and monitoring initiatives.^{7,8,9} AMR monitoring is essential and offers a number of advantages such as giving information on the rate of bacterial resistance, assisting in the selection of suitable antibiotics and thereby lowering the AMR rate¹⁰ a decline in the number of hospital admissions and medical expenses, and a drop in the death rate.

This study evaluated the antimicrobial susceptibility pattern of important pathogenic bacteria isolated from District Public Health Laboratories in Tamilnadu. Based on the results of various cultures of microbial specimens, the data can be used as a reference for pathogen identification and selection of empirical antibiotic therapy in our setup.

METHODOLOGY

This is a retrospective study, secondary data analysis. It was carried out at all District Public Health Laboratories, Tamilnadu performing culture and sensitivity. The study duration was six months (October 2022- March 2023). The data were collected retrospectively from records maintained at the laboratory. All infectious patients for whom the antimicrobial susceptibility tests have been performed and the reports found to be positive were included in the study. Any case having negative culture or incomplete data and mixed bacterial growth were excluded. A well-structured data collection form was used to collect the data. Antimicrobial susceptibility reports were analysed for the specimen used, the pathogen identified, sensitivity, and resistance pattern, Kirby-Bauer disc diffusion method was used to test the antimicrobial sensitivity of organisms. The data obtained were analysed using Microsoft excel.

RESULTS

A total of about 1089 clinical samples were cultured, out of which 400 (36.7%) samples showed significant bacterial growth and exhibited resistance to either single or multiple antibiotics. Remaining samples either had no bacterial growth or insignificant bacterial growth.

Out of the total 1089 samples, 678 were female and 411 were male patients, 237 & 163 shown significant growth. (Figure 1) Culture positive were predominant among 21-30 age group.

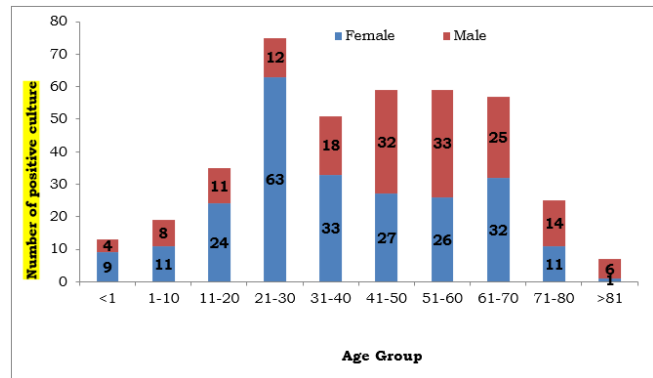


Figure 1: Age & Gender Distribution (n=400)

In this study, the results were discussed for this 400 isolates. The sample distribution of this study was 176 pus, 147 were urine, 44 were sputum, and 17 were blood. Rest other specimens like vaginal, throat, wound and eye swab, catheter tip, ET aspirate, pleural fluid & stool were less than 10. (Figure 2)

There are about 32 District Public Health Laboratories catering all the districts of Tamilnadu, of which data is obtained from those DPHLs performing culture and sensitivity profile. Table 1: shows the district wise distribution of bacterial isolates.

Table 1: District wise isolation of organism

Organism	Chennai	Coimbatore	Dindigul	Erode	Kannur	Kannur	Madurai	Nagapattinam	Pudukottai	Ramanipet	Salem	Sivaganga	Tenkasi	Thuraiyur	Thiruvananthapuram	Thiruvannamalai	Thiruvallur	Thoothukudi	Total
<i>E. coli</i>	1	7	24	11	13	1	1	2	1	19	1	5	20	8			3	8	122
<i>Staphylococcus. sp</i>		9	12	13	1	2	1	12	5	22	12	4					8	1	102
<i>Klebsiella. sp</i>	1	4	27	5	15			1	5	2	4	14	3				4	2	87
<i>Pseudomonas. sp</i>	1	7	1	3				2	6	3		9	3	1			3	3	39
<i>Proteus. sp</i>		4	5						4	1			3				1	2	20
<i>Acinetobacter. sp</i>	1		4	2	1				1										9
<i>Enterococcus. sp</i>				1					1	1			3				1	1	8
<i>Citrobacter. sp</i>				1					1		1							2	4
<i>Enterobacter. sp</i>												1	1				3		4
<i>Streptococcus. sp</i>					2								1						3
<i>Salmonella. sp</i>											1								1
<i>Shigella. sp</i>																		1	1
Total	3	16	76	32	47	2	5	2	49	13	33	59	22	1	22	18	18	18	400

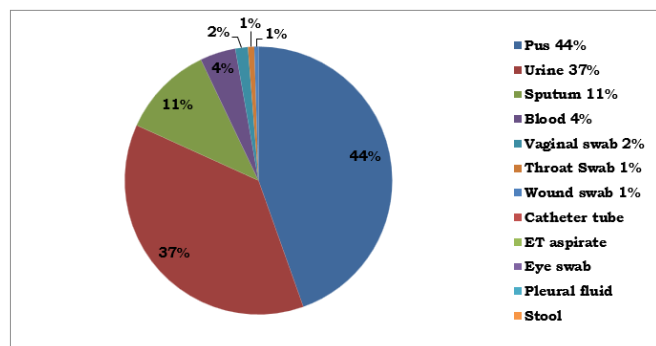


Figure 2: Distribution of Clinical sample

Bacteria isolated from various samples were E.coli, Staphylococcus aureus, Klebsiella, Pseudomonas, Proteus, Acinetobacter, Enterococcus, Citrobacter, Streptococcus, salmonella

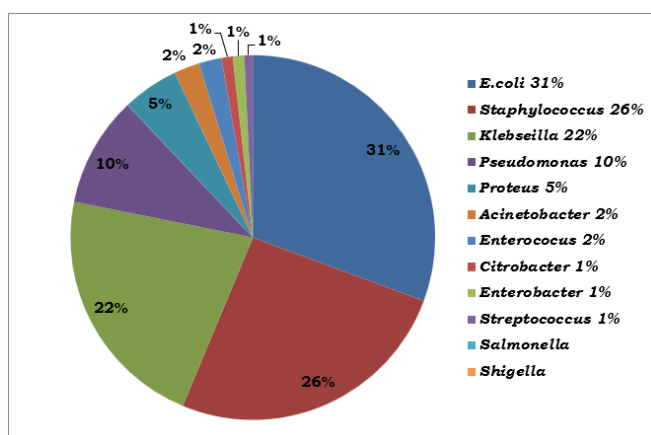


Figure 3: Distribution of Bacterial Isolates

E.coli was the most common organism isolated with a total of 122 (31%) Out of the 122, E. coli were isolated from 85 urine, 31 pus aspirate, 3 from blood. A total of 102 (26%) Staphylococcus aureus were isolated, 65 from pus swabs, 15 from urine, 7 from sputum. Klebsiella isolates were a total of 87 (22%). They were isolated from various samples such as pus/wound swabs (36), urine 25, sputum 24 and blood (2).

About 39 (10%) isolates of Pseudomonas were isolated from wound/pus swabs (20) and urine samples (8), sputum (7). Proteus, (5%) was isolated 13 each from Pus /wound swab and 6 from urine. 9 (2%) Acinetobacter isolates were from pus/wound swabs, sputum and blood. Citrobacter (4) and Enterobacter (4) were isolated from the urine sample, Sputum and pus. (Table 1)

Table 2: Distribution of clinical sample & bacteria isolated

Organism	Blood	Catheter Tip	ET aspirate	Ocular swab	Pleural fluid	Pus	Sputum	Stool	Throat Swab	Urine	Vaginal swab	Wound swab	No of Isolates
E.coli	3	1				31				85	2		122
Staphylococcus				1	1	65	7			15	4	2	102
Klebsiella	2					36	24			25			87
Pseudomonas			1			20	7		1				39
Proteus	1					13							20
Acinetobacter	2					3	3			1			9
Enterococci						4	1			3			8
Citrobacter						3				1			4
Enterobacter							2		1	1			4
Streptococcus						1			1	1			3
Salmonella										1			1
Shigella								1					1
Total	17	1	1	1	1	176	44	1	3	147	6	2	400

This analysis focused mainly on GLASS priority organisms (16) i.e.E.coli, S. aureus, Klebsiella and Acinetobacter. E.coli were tested on commonly used antibiotics, as shown in the stacked Bar graph in Figure 4. We noted that E.coli showed resistant to ampicillin, Cefazolin, Norfloxacin and

3rd generation cephalosporins. E.coli isolates shows resistant to Ceftriaxone (46%) & ceftazidime (56%), it implies that these E.coli can be ESBL producers. 6% and 9% isolates shows resistance to Imipenem and Meropenem which can be a Carbapenemase producers (Superbug). It is suggested that these antibiotics have almost exhausted their utility for this microbe.

Figure 5: details the antimicrobial susceptibility profiles of S. aureus, the listed antibiotic discs used in the laboratory. S. aureus highly underscores its resistance profiles to give a high light for Methicillin-Resistant Staphylococcus aureus (MRSA), Cefoxitin is surrogate marker for MRSA, in this study about 53% of the S. aureus shows resistant and interestingly all isolates shows sensitive to Vancomycin and 13% were resistant to Linezolid.

Klebsiella.sp were Intrinsic resistant to Ampicillin, resistant to Ceftriaxone (47%) & ceftazidime (45%), it can be ESBL producers. Only 17% were carbapenemase producers. (Figure 6), Acinetobacter.sp shows 33% resistant to Ceftazidime and Piperaciline tazobactam. 29% shows resistant to

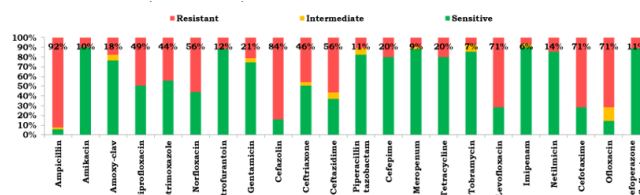


Figure 4: Antibiogram of E.coli: (n= 122)

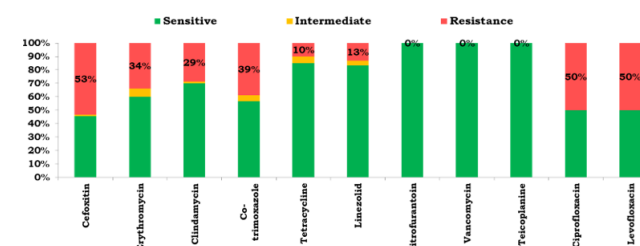


Figure 5: Antibiogram of Staphylococcus aureus. (n=102)

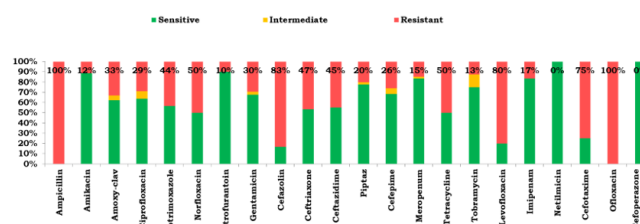


Figure 6: Antibiogram of Klebsiella pneumoniae: (n = 87)

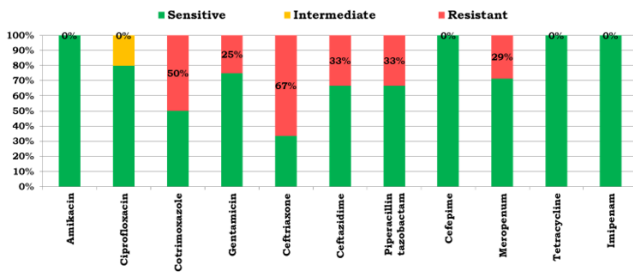


Figure 7: Antibiogram of *Acinetobacter.sp.* (n=9)

DISCUSSION

In the last few decades, antibiotic resistance has become a major problem in the health sector. It is a challenging issue to combat infectious diseases and complications with rising antibiotic resistance. It also results in a rise in morbidity and mortality, in addition to the increased out of pocket expenditure.

In our study, the number of samples that yielded significant bacterial growth is 36.7% which was lesser than other studies conducted in China¹⁷ and other studies conducted in India.^{18,19,20} This probably could be due to samples collected in the primary health centre, which is different from other studies conducted at tertiary care centres and also duration of the study is only 6months. But another study conducted at Gujarat showed 35% significant growth.²⁵

The number of clinical samples was higher among the age group 21-30, which is identical to the study in Uganda²¹ and in the systematic review involving multiple countries.²² Similarly the number of samples was more in female gender which is identical to most studies related to AMR.²³

Among the isolates in our study, the most common pathogen with resistance was observed in *E.coli* followed by *Staphylococcus.sp* and *Klebsiella.sp*. The observation of this study is similar to the findings from studies conducted in New Delhi²⁶ and other systematic reviews.²² There was a slight change in the top three organisms in the study conducted in Tamilnadu were *Klebsiella* was the common pathogen with resistance.²⁴

The maximum number of pathogen was isolated from pus sample followed by urine, sputum and blood and this finding was comparable to the studies conducted in Namakkam²⁴ and Pondicherry. In a tertiary care set up clinical sample such as tracheal aspirate, blood, ET tip would have been more number, but in our set up swab from wound, urine and sputum is higher.

Highest proportion of resistance in *E.coli* was found with Ampicillin followed by fluoroquinolones, and first and third-generation cephalosporins, It is similar to a study in

Europe²⁸ while maximum sensitivity was found with imipenem, tobramycin, meropenem and piperacillin-tazobactam. The finding from our study was comparable with other study conducted at Bangalore²⁷ except for the study conducted in Karnataka¹⁹ where the sensitivity pattern was different from our study with Tobramycin. This may be due to treating any infection with antibiotics, were patient fails to take the full course of antibiotics.

When observing the sensitivity pattern of *S.aureus*, 53% were Methicillin-resistant *S.aureus*. *S.aureus* has better sensitivity to other anti-microbials. The finding from our study is identical to the other studies conducted in Assam.²⁸ Sensitivity of ciprofloxacin is comparatively higher when compared with other antibiotics.

On observing the resistant pattern of *Klebsiella.sp*, the resistance is higher with ampicillin, 1st 2nd and 3rd generation Cephalosporins and Fluoroquinolones, in a study at Gujarat²⁵ the resistant pattern for cephalosporins was higher (71%) and sensitivity was observed with avibactam, Netilmicin, Amikacin and Nitrofurantoin in our study.

Acinetobacter.sp has good sensitivity for amikacin, Imipenem, tetracycline, 4th generation cephalosporins and fluoroquinolones when compared with other drugs. This finding was identical to the findings from other studies except for the sensitivity of Imipenem and amikacin. This difference in sensitivity pattern in our study is because the samples were collected from the primary health centre rather than tertiary care institutions where Health care-associated infections are high mainly due to Multi drug resistant organisms. The proportion of beta-lactamase producers was comparatively lesser probably due to the same reason.

CONCLUSION

In this study drug-resistant organisms were isolated from 400 samples which were mostly from pus samples. Gram-negative organisms like *E.coli*, *Klebsiella.sp*, and gram-positive *staphylococcus aureus* were isolated in higher numbers. All the pathogens were found to be resistant to more than 2-3 antibiotics. Even though the study is carried out at the primary health centre level the resistant pattern is quite alarming. This may be due to the overuse of antibiotics and extensive usage of antibiotics in veterinary medicine usage. In our study most of the isolates show resistance to ampicillin, which is the preliminary antibiotic prescribed at every Primary Health Centre in our community, hence it is the right time to check antibiogram at the community level and to implement escalation strategies and improve antibiotic prescription to treat infections and protect the community from unnecessary an-

tibiotic usage and combat antibiotic resistance.

To prevent the rising trend of AMR, rational use of antibiotics, prescribing appropriate antibiotics after conducting culture and sensitivity, Preventive measures, and health policies should be implemented to prevent the spread of infection caused by these pathogens.

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ORIGINAL ARTICLE - PUBLIC HEALTH

WALK IN CENTRE – ONE STOP TB SOLUTION- A MODEL- ‘GAME CHANGER’ IN TUBERCULOSIS CONTROL

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Abstract

INTRODUCTION : India accounts for one-third of the tuberculosis cases worldwide. States must step up their efforts if they have to meet the challenging target of eliminating tuberculosis by 2025. The prevalence of tuberculosis in Tamil Nadu was 210 per lakh population (1), according to the Tamil Nadu TB prevalence survey. A key factor in interrupting the chain of transmission is early detection and treatment. Despite the fact that National Tuberculosis Elimination Programme (NTEP) decentralised laboratory services, a lot of patients are still diagnosed only in the secondary and tertiary health facilities. This has made it necessary to improve the services provided by the primary health care facilities. Hence Tamil Nadu has adopted the walk-in tuberculosis centre paradigm in this setting where all the services are brought under one umbrella at Primary Health Centre level.

KEY WORDS : Walk in Centre- One Stop TB Solution, One Stop TB, Walk in Centre for TB, Game Changer in TB Control

INTRODUCTION

Tuberculosis (TB) is an infectious disease caused by Mycobacterium Tuberculosis and was the world's second leading cause of death in 2022 after Covid-19.¹ According to Global TB report 2023, 10.6 million people developed TB in 2022. The Global TB Report states that the prevalence of Tuberculosis In India was 196 per lakh people in 2022.² According to the Tamil Nadu TB prevalence survey 2019-2022, the prevalence of tuberculosis in Tamil Nadu was 210 per lakh population.¹ In 2022, Tamil Nadu had a case notification rate of 126 cases per lakh people.³ We have an ambitious goal of achieving the Sustainable Development Goal (SDG 3.3) related to TB by 2025, that is 90 percent reduction in TB deaths and 80 percent reduction in TB incidence rate by 2030 compared to the levels in 2015. To achieve this ambitious goal, early diagnosis and treatment plays an important role. Since 2001, Tamil Nadu's laboratory network has grown rapidly. There are currently 147 Trunaat sites, 127 Cartridge-based Nucleic Acid Amplification Test (CBNAAT) sites, and 1969 Designated Microscopic Centres (DMC).

Decentralization of laboratory services was deemed required for patients to receive testing at neighboring medical facilities. However, the actual situation showed that most of the testing takes place in the secondary and tertiary health facilities. The public's preference for visiting the secondary and tertiary health facilities and the causes of the increased

testing taking place are the dearth of qualified lab technicians at the peripheral health facilities, absence of functional fluorescence microscopes and lack of adequate training.

CURRENT SCENARIO

In 2022, a total of 4,49,33,062 adult patients were seen in the outpatient department of the 1969 Designated microscopy centres. Out of which 12,75,512 (2.8%) presumptive TB cases were identified and offered smear examination for the detection of TB.

The majority of the presumptive TB cases (10,20,832 presumptive TB cases - 80%) were tested in 805 health facilities (41%). The diagnosed patients were then offered molecular tests through the 147 TruNAAT and 127 CBNAAT facilities for knowing the Rifampicin resistance status. In the instances where the molecular testing labs coexisted with the DMCs, samples were immediately submitted by the patients themselves. In case the NAAT facilities are situated in a different facility, the samples of the patients are transported by courier or engaging a local human transporter. In some



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cases the TB staff themselves transport the samples. In some instances the patients are required to reach the NAAT facility for giving a second sample for Universal Drug Susceptibility Testing (UDST). Whilst testing in a facility with NAAT lab occurs earlier, it is considerably delayed in those facilities where in samples need to be transported because of non-availability of NAAT lab.

It is imperative that the services offered at the primary health care facilities to be strengthened. With this context, the idea of a Walk-in Centre-One Stop TB solution was introduced to bring all the services under the one umbrella starting from screening to monetary assistance and provision of nutritional supplement at primary health care level.

WALK IN CENTRE – ONE STOP TB SOLUTION

This approach states that a single primary health facility will be designated as a walk-in tuberculosis centre in each block. It will offer the following facilities.

- Diagnostic tests must be available (Microscopy/NAAT) in the facility. The results of the microscopy testing to be provided within 24 hours. In the event that the facility is unable to conduct the NAAT tests, the sample should be transported to the NAAT testing facility through Hub and Spoke and the results must be provided within 48 hours.

- And also the samples from other primary health centres of the block should be transported and processed in the One Stop TB centre

- Appropriate linkages for chest X-ray needs to be identified such as nearest community Health Centre, Government Taluk Hospital or Government Medical college Hospitals.

- Patients should be initiated on treatment within 24 hours of receiving their test results.

- The TB patients should be screened for other immunocompromised diseases such as Diabetes and HIV and vice versa

- The family members and close contact will be screened for TB

- TB Preventive therapy given to all close contacts of the patient

- Patients with tuberculosis must get monthly clinical follow-up as well as laboratory follow-up at the end of intensive phase and continuation phase.

- All the required entries such as registration, treatment details, direct beneficiary transfer etc to be done in Nikshay portal

- The medical officer has to ensure that every patient receives the Direct Benefit Transfer (Financial Incentive of

Rs.500 per month for each notified TB patients for duration for which the the patient is on Anti-TB treatment) provided through Nikshay Pojan Yojana.

- Nutritional support with high protein and vitamin rich diets can be given to patients who require additional nutritional support with the help of volunteers, NGOs, and under the corporate social responsibility funds from the industries.

- The Block Medical Officer is the nodal officer for the operationalization of the Walk in centre.

As on now 100 Walk in centres are inaugurated. It will be expanded to all 424 Community Health Centres. All centres will be monitored by the Deputy Director Medical Services (TB) and the Deputy Director of Health Services at district level.

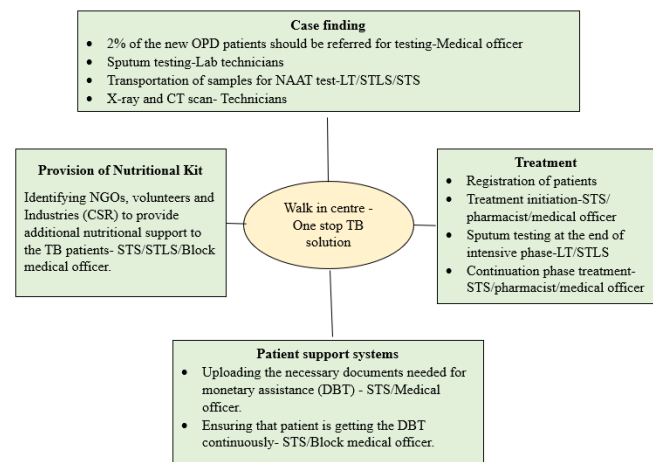


Figure 1 : Functions of Walk in TB centre and the responsibilities of each person

CONCLUSION

Accelerated efforts are needed to achieve the ambitious goal of ending TB by 2025. This Walk in TB centre will prove to be a one stop solution for TB patients where all the services will be offered under one roof. This model when appropriately implemented and followed will prove to be of great benefit to the patients.

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ORIGINAL ARTICLE - PUBLIC HEALTH

ASSESSMENT OF MEDICAL CERTIFICATION OF CAUSE OF DEATH
IN TWO INSTITUTIONS (X & Y) OF A DISTRICT
FROM TAMIL NADU, 2022*Abishek Stanislaus⁽¹⁾, Selvavinayagam T S⁽¹⁾**(1) Directorate of Public Health & Preventive Medicine, Chennai*Abstract

INTRODUCTION : Mortality statistics data is collected from Medical Certification of Cause of Death (MCCD) form 4 (Institutional Deaths)/4A(non-Institutional Deaths) and is a legal document which records the diseases, morbid conditions or injuries which either resulted in or contributed to death along with the timeline (3). The statistics available in the developing countries is of relatively poor quality (5-7). The errors such as missing or incorrect cause of death found in MCCD form in India is more than 90% (10). There are no studies found assessing the medical certification in Tamil Nadu. Hence it was decided to take up the MCCD data from two institutions (one government and one private) and assess the data to understand the completeness and errors noted in certification.

METHODOLOGY : It was a descriptive cross-sectional study in two Institutions (one government and one private) X & Y in a district from Tamil Nadu. One institution from government and private institution with highest number of deaths among all the institutions from the district was taken for the study and all deaths registered with MCCD was included for the study. The MCCD data from 1st June 2022 to 31st July 2022 was collected as soft copy from the two institutions. The data was analysed by State Nosologist for each record using the Bloomberg MCCD rapid assessment tool and entered and coded in a excel sheet. Demographic variables, completeness and error frequency of the records are calculated using proportions.

RESULTS : The total number of records taken for study was 1032. The total number of records from Institution X in 280 and Institution Y is 752. The time interval in any of the illness was recorded in 161 (57.5%) records in Institution X and 21(2.8%) records in Institution Y. The Records in which multiple causes were recorded in any line of Part 1 were 130 (46.4%) records in Institution X and 428(56.9%) records in Institution Y. The Records with error (Incorrect or clinically improbably chain of events leading to death in part 1) were 174 (62.1%) records in Institution X and 483(64.2%) records in Institution Y. Overall certification in records with at least any one of the error in writing MCCD is 251(89.6%) in Institution X and 746(99.2%) in Institution Y

CONCLUSION : It was noted that there is a lacunae in completion of time intervals in any of the illness especially in Institution Y(2.8%). The major errors in MCCD form like mentioning the wrong sequence of deaths (62.1% in Institution X & 64.2% in Institution Y), multiple cause of death recorded in a single line(46.4% in Institution X & 56.9% in Institution Y) is found in both institutions in a considerable level. The overall certification without errors is better in Institution X (89.6%) compared to Institution Y (99.2%) but still the overall certification is poor in both Institutions which must be addressed. The only way to overcome this gap is to adopt a multifaceted approach (training of doctors (interns, postgraduate and faculty) auditing of MCCD & awareness on MCCD importance) which may improve the quality of MCCD data.

KEYWORDS : MCCD, Completeness, Death Certification errors

INTRODUCTION

Mortality Statistics play a vital role in the world. Mortality statistics is used for monitoring and assessing the health indicators especially from Sustainable Development Goals (SDG) which in turn helps for the progression and development of the country. It also acts as the guide for resource allocation.¹ Mortality statistics data is collected from Medical Certification of Cause of Death (MCCD) forms. It is the only reliable cause specific source for mortality statistics in India. It is a standard format introduced by World Health Organization (WHO) in 1948 to bring uniformity in MCCD.²

MCCD form is issued in Form 4 for Institutional Deaths and form 4A for non-institutional deaths and is also a legal document provided by Registered Practitioners which

records the diseases, morbid conditions or injuries which either resulted in or contributed to death along with the timeline and comorbidities. MCCD document must be given mandatorily in the prescribed format properly and completely by the registered practitioner who has treated the deceased during their last illness as per Registration of Birth and Deaths Act (RBD) Act. MCCD has two parts capturing cause of death. Part 1 capturing the sequence of events leading



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to death which helps to know in which sequence more deaths happen and Part 2 capturing the comorbid conditions which guides us around the common risk factors for a particular cause of death.³

Globally less than 30% reliable death registration data alone is available.⁴ The statistics available in the developing countries is of relatively poor quality.⁵⁻⁷ India is a country with highest population, which has is a sample registration system to cover mortality statistics which does not covers entire population.⁸ The coverage of MCCD in India is 22.5%.⁹

The errors such as missing or incorrect cause of death found in Medical Certification of Cause of Death (MCCD) form in India is more than 90%.¹⁰ Tamil Nadu is one among the major states with highest mortality statistics coverage (43%).⁹

There are no studies found assessing the medical certification in Tamil Nadu. Hence it was decided to take up the MCCD data from two institutions (one government and one private) and assess the data to understand the completeness and errors noted in certification.

OBJECTIVE

To identify the completeness and frequency of errors from the MCCD certificates provided by the two institutions (one government and one private) X & Y using Bloomberg MCCD rapid assessment tool from 1st June 2022 to 31st July 2022 in a district of Tamil Nadu.

METHODOLOGY

STUDY DESIGN : The study design was a descriptive cross-sectional study of the MCCD records in Institutions X and Y in a district of Tamil Nadu State for the period 1st June 2022 -31st July 2022. One institution from government and private institution with highest number of deaths among all the institutions from the district was taken for the study. The study population taken for this study was any deceased registered in CRS in two institutions X & Y from the study area during the study period was taken. We included all the deceased with MCCD record from the two institutions registered in CRS were taken for the study. The sample taken was 1032. There are two type of errors in MCCD form. Major errors which constitute multiple causes recorded in any line of part 1, Incorrect or clinically improbably chain of events leading to death in part 1, Impossible underlying cause entered in the lowest used line of part 1. Minor errors constitute Abbreviations, time intervals of illness, legibility of certifier name.¹⁶

DATA COLLECTION: The MCCD data was collected as soft copy from the two institutions X and Y. The data was analysed by State Nosologist for each MCCD using the Bloomberg MCCD rapid assessment tool and entered and coded in a excel sheet.

DATA ANALYSIS: Data was entered in MS EXCEL by Nosologist and analyzed by calculating proportions regarding the Demographic variables (gender, age), completeness of variables (Age and gender of deceased, date of death, date of certification, name of certifier, cause of death, Time interval of any illness, circumstances missing for deaths due to external causes like accident or injury, additional details for neoplasm cases) and errors (multiple causes recorded in any line of part 1, abbreviations, illegible handwriting, Incorrect or clinically improbably chain of events leading to death in part 1, Impossible underlying cause entered in the lowest used line of part 1, certifier name not legible) frequency of the records in MCCD certificate.

HUMAN SUBJECT PROTECTION: Our study got approved by Institutional Ethics Committee of Tamil Nadu Journal of Public Health; we maintained privacy and confidentiality in such a way that no personal data was used or revealed during analysis or report preparation & presentation. The institution or the district name is not revealed for privacy and confidentiality purposes.

RESULTS

The total number of records taken for study was 1032. The total number of records from Institution X in 280 and Institution Y is 752. The composition of male and female in Institution X is 175 (68.6%) and 80 (31.4%) and in Institution Y the composition is 482(64.7%) and 263(35.3%). The records available by age group when compared it was noted that the age group 46 to 65 years was higher in both institutions X (92(35.4%)) and Y (300(40.9%)). It was followed by age group 16 to 45 years in institution X (83(31.9)) and age group in Above 65 in institution Y (185(25.2)). The records from age group less than 1 year in institutions X (16(6.2%)) and Y (72(9.8%)) (Table 1). T

Table 1: Frequency of demographic characters in MCCD records

	Variable	Institution X	Institution Y	Total
Gender	Male n(%)	175(68.6)	482(64.7)	657(65.7)
	Female n(%)	80(31.4)	263(35.3)	343(34.3)
Age group (Years)	less than 1	16(6.2)	72(9.8)	88(8.9)
	1 to 15	7(2.7)	14(1.9)	21(2.1)
	16 to 45	83(31.9)	163(22.2)	246(24.7)
	46 to 65	92(35.4)	300(40.9)	392(39.4)
	Above 65	62(23.8)	185(25.2)	247(24.8)

The records were assessed for completeness with the variables like age of deceased, gender of deceased, date of death, date of certification, name of certifier, cause of death & time interval of Cause of death in Part 1. The age of the deceased were recorded in 260(92.9%) records in Institution X and 734(97.6%) records in Institution Y. The gender of the deceased were recorded in 255 (91.1%) records in Institution X and 745(99.1%) records in Institution Y. Date of death of deceased was recorded in all records. The date of certification by certifier were recorded in 276 (98.6%) records in Institution X and 426(56.6%) records in Institution Y. The certifier name were recorded in 265 (94.6%) records in Institution X and 607(80.7%) records in Institution Y. The cause of death was recorded in all records in Institution X and not recorded in 1(0.1%) records in Institution Y. The time interval in any of the illness was recorded in 161 (57.5%) records in Institution X and 21(2.8%) records in Institution Y (Table 2). The Records in which circumstances were missing for deaths due to external causes like accidents or injury (155 deaths) were 4 (25%) records in Institution X and 9(6.5%) records in Institution Y. The Records in which additional details such as site, morphology and behaviour were missing for Neoplasm deaths (35 deaths) were 2 (7.7%) records in Institution X and 1(11.1%) records in Institution Y. The Records without missing any variables were 129 (46.1%) records in Institution X and 10(1.3%) records in Institution Y (Table 2).

Table 2: Completeness of the MCCD form

Variable	Institution X (n=280)	Institution Y (n=752)	Total (n=1032)
Age of deceased recorded n(%)	260(92.9)	734(97.6)	994(96.3)
Gender of deceased recorded n(%)	255(91.1)	745(99.1)	1000(96.9)
Date of Death of deceased recorded n(%)	280(100)	752(100)	1032(100)
Date of certification recorded n(%)	276(98.6)	426(56.6)	702(68.0)
Name of Certifier recorded n(%)	265(94.6)	607(80.7)	972(94.2)
Cause of death recorded in form n(%)	280(100)	751(99.9)	1031(99.9)
Time interval of any illness recorded in any of line n(%)	161(57.5)	21 (2.8)	182(17.6)
Circumstances missing for deaths due to external causes like accidents or injury records n* (%)	4(25)	9(6.5)	13(18.4)
Additional details such as site, morphology and behaviour missing for Neoplasm as cause of death n** (%)	2(7.7)	1(11.1)	3(8.6)
Overall certification without missing any variables	129(46.1)	10(1.3)	139(13.5)

*The number of records with deaths due to external causes like accidents or injury are 155 (Institution X = 16 & Institution Y =139)

**The number of records with deaths due to neoplasm are 35 (Institution X = 26 & Institution Y =9)

The records were assessed for the errors noted in MCCD form. The Records in which Multiple causes were recorded in any line of Part 1 were 130 (46.4%) records in Institution

X and 428(56.9%) records in Institution Y. The Records in which Abbreviations were recorded in entries in any of the lines were 40 (14.3%) records in Institution X and 246(32.7%) records in Institution Y. The Records in which illegible handwriting were 34 (12.1%) records in Institution X and 170(22.6%) records in Institution Y. The Records with error (Incorrect or clinically improbably chain of events leading to death in part 1) were 174 (62.1%) records in Institution X and 483(64.2%) records in Institution Y. The Records in which impossible underlying cause entered in the lowest used line of part 1 were 21 (7.5%) records in Institution X and 57(7.6%) records in Institution Y. The Records in which certifier name not legible were 2 (0.7%) records in Institution X and 110(14.6%) records in Institution Y. Overall certification in records with atleast any one of the error in writing MCCD is 251(89.6) in Institution X and 746(99.2) in Institution Y (Table 3).

Table 3: Frequency of errors in MCCD form

Variable	Institution X (n=280)	Institution Y (n=752)	Total (n=1032)
Multiple causes recorded in any line in Part 1 n(%)	130(46.4)	428(56.9)	558(54.1)
Abbreviation used in entries in any of the lines n(%)	40(14.3)	246(32.7)	286(27.7)
Illegible Handwriting recorded in form n(%)	34(12.1)	170(22.6)	204(19.8)
Incorrect or clinically improbably chain of events leading to death in part 1 n(%)	174(62.1)	483(64.2)	657(63.7)
Impossible underlying cause entered in the lowest used line of part 1 n(%)	21(7.5)	57(7.6)	78(7.6)
Certifier name not legible n(%)	2(0.7)	110(14.6)	112(10.9)
Overall certification with any one of the above mentioned errors	251(89.6)	746(99.2)	997(96.6)

DISCUSSION

All the records with MCCD were taken for the study from the both institutions X & Y from the study period. There was no much difference in age in comparison between both institutions. The completeness among the age and gender of the deceased is 96.3% & 96.9% respectively. It was noted that a study conducted at Gujarat revealed 0.5% error in age variable while gender was mentioned accurately in all certificates while another study observed errors 1.26% and 0.76% in this respective context in India.^{11,12} The date of death of deceased was mentioned in all records.

It was noted in three studies done in India that date of death was mentioned in 96.6%, 99.9% and 95.9% records.^{11,12,13} The name of the certifier was recorded in 94.2% in our study and the date of certification was only in 68%. In a study done in India the certifier name was recorded in 100% records.¹³ The time interval in any of the illness was noted in 17.6% records alone and the number of records captured time interval is very meagre in Institution Y (2.8%). In three studies (two from India, one from South Africa) the time interval in any of

the illness is not available for more than 98 % records.^{14,15,16} It was noted that in our study 18.4% records had circumstances missing for deaths due to external causes like accidents or injury. A study from India had nil data on the circumstances for deaths due to external causes.¹³ As per our study 54.1% had records in which multiple causes recorded in any line in Part 1. It was higher than other studies like Madhao G. Raje in which it was 8% in India and 4% in Tsung-Hsueh Lu et.al in Taiwan.^{17,18} The use of abbreviation was noted in 27.7 % records in our study while in other two studies in India, it was 38.8 %¹⁴, 40 %¹³ and 29.2% in India.¹⁶ 19.8% records had illegible handwriting in our study while in a study done in India, it was 10.07 %.¹⁴ The Records in which Incorrect or clinically improbable chain of events leading to death in part 1 was 63.7% which is one of the major errors and most common errors in MCCD and has to be looked upon. In three studies done in India, it was 64.74%¹⁴, 89.3% in Azim, et al¹⁶ and 55% in Amul B Patel study.¹⁹ 7.6% records were found in which impossible underlying cause entered in the lowest used line of part 1 in our study while in other studies it was 17.3% in Nojilana et al¹⁵ and 41.3% in Azim, et al.¹⁶ The overall MCCD certification with atleast one of the errors in MCCD is 96.6% in which institution Y has higher error percentage compared to Institution X. A study by Haque et al in Pakistan, it was observed that 1% certificates had no errors²⁰. In a study by Patel et al from India. it was noticed that all death certificate had errors.²¹

CONCLUSION

The study was conducted in two major institutions (one government and one private) in a district from Tamil Nadu to assess the MCCD forms provided by doctors. It was noted that there is a lacunae in completion of following variables date of certification, mentioning time intervals especially in Institution Y(2.8%) and mentioning additional details for deaths due to external causes (18.4%) & Neoplasm(8.6%). The major errors in MCCD form like mentioning the wrong sequence of deaths (62.1% in Institution X & 64.2% in Institution Y), multiple cause of death recorded in a single line is found in both institutions (46.4% in Institution X & 56.9% in Institution Y) in a considerable level. The overall certification without errors is better in Institution X (89.6%) compared to Institution Y (99.2%) but still the overall certification is poor in both Institutions which must be addressed.

The only way to overcome this gap is to adopt a multifaceted approach which may improve the quality of MCCD data. The death certification even after being included

in curriculum for undergraduate medical course, it is not put in practice. A hands-on training session especially for interns, postgraduate and faculty may be implemented with emphasis on the importance of mortality data and implications of poor MCCD data.²² Along with this intervention regular auditing of MCCD should be followed by discussion with the doctor who has certified death. The doctors must have the awareness that medical certificate completion is a physician primary responsibility and by doing so it may have a greater impact on health and should know about writing a proper MCCD form through the physician manual on Medical Certification of Cause of Death provided by Registrar General of India.

LIMITATIONS

The study was undertaken in two institutions from whole of the state and for the shorter period of two months. Hence the results may not replicate the same when taken for whole state.

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CONFLICT OF INTEREST

None

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PREVALENCE OF HYPERTENSION AND DIABETES AMONG SANITARY WORKERS IN TIRUVANNAMALAI MUNICIPALITY – A CROSS-SECTIONAL STUDY

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Abstract

ABSTRACT : Prevalence of Hypertension and Diabetes among sanitary workers in Tiruvannamalai Municipality – A Cross-sectional study

BACKGROUND : Sanitary Workers are an important but neglected occupational group. They engage in manual labour of door to door collection of wastes and exposed to stress at work interacting with public on a daily basis. In this background, study to estimate prevalence of hypertension and diabetes among sanitary workers becomes important.

AIM : The study aims to estimate the prevalence of Hypertension and Diabetes among sanitary workers in Tiruvannamalai Municipality.

METHODOLOGY : A cross-sectional study among 267 sanitary workers of Tiruvannamalai Municipality was done. All eligible sanitary workers after inclusion and inclusion criteria were included for the study and data collected using semi-structured questionnaire. Physical parameters, blood pressure, fasting and postprandial blood glucose were measured.

RESULTS : Among participants 19.9% had hypertension, 7.5% had diabetes mellitus and 7.5% had both hypertension and diabetes mellitus. More than 60% of them were newly detected.

CONCLUSION : Sanitary workers of Tiruvannamalai municipality differ in prevalence of hypertension and diabetes compared to general population. Screening and early detection of NCDs are important to prevent late detection and prevent complications.

KEYWORDS : Non-communicable diseases, Sanitary Workers, Tiruvannamalai Municipality

INTRODUCTION

World Health Organization reported in 2020, 70% of deaths globally are due to four major non communicable diseases – cardiovascular disease, diabetes, cancer and chronic respiratory disease.¹ Almost three quarters of all NCD deaths and 82% of premature deaths happen in low and middle income countries.² In India 63% of deaths are from non- communicable diseases.¹ Sustainable Development Goals 2030, aims to reduce premature mortality due to NCDs by one third. Age, sex, race, tobacco use, insufficient physical activity, harmful use of alcohol, unhealthy diet, raised blood pressure, overweight, obesity, raised cholesterol, cancer associated infections and environmental factors are risk factors for non- communicable diseases. Importantly, tobacco use, physical inactivity, harmful use of alcohol and unhealthy diet are the four major risk factors, which leads to overweight, obesity, raised blood pressure and raised cholesterol which independently and synergistically increase the risk of NCDs.

Different occupations have different levels of physical activity, stress, satisfaction, timings, smoking predilection and access to health care. People engaging in such occupations tend to differ in their risk for NCDs. White

collar jobs are more sedentary, requires more mental effort, involve more stress and less physical inactivity. While Blue collar jobs, involves more physical activity and people in such jobs tend to have more smoking and alcohol use.³⁻⁷

Sanitary work involves a range of activity including and not limited to cleaning and sweeping public spaces, cleaning of public and community toilets, clearing public drains and collection of domestic and commercial wastes. Sanitary work involves moderate to hard physical activity, irregular work timings and poor societal recognition.⁽⁸⁻¹⁰⁾ Sanitary workers tend to be from low social class and economically weaker sections of the community. People engaged in sanitary work also face stigmatisation and marginalisation in the community.¹¹ Perceived difficulty to access health care exists among sanitary workers.^{9,12,13}

Among NCDs, hypertension and diabetes mellitus are the most common, and share common risk factors



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including physical inactivity, overweight, obesity, unhealthy diet, tobacco use and alcohol use. In India, prevalence of high blood pressure is estimated to be 24% among adults.¹⁴

In a study among Sanitary workers of Thrissur Municipal Corporation 14.61% had diabetes and 13% had hypertension.¹⁵ In a similar study among workers in Shimla municipality 18.5% had high blood pressure.¹⁶ Among Aurangabad Municipal Corporation sweepers, prevalence of hypertension was 9.34% and diabetes was 4.9%.¹⁷ In a study among Ahmedabad municipal workers, 45.01% had hypertension.¹⁸ In a study among sanitary workers of Greater Chennai Corporation, prevalence of chronic non-communicable diseases was reported as 17.8%.¹⁹

In this background, need to study prevalence of hypertension and diabetes among sanitary workers of Thiruvannamalai Municipality was felt and undertaken.

METHODOLOGY

The study was undertaken as a cross-sectional study, among sanitary workers engaged in Thiruvannamalai municipality. The workers who were engaged in sanitation duties and have been continuously working for at least one year were included for the study. Sample size was calculated based on a study conducted among sanitary workers of Greater Chennai Corporation, prevalence of chronic non-communicable diseases was 17.8%.¹⁹ At confidence level of 95% and absolute precision of 5%, and a non-response rate of 20%, sample size was calculated as 270. After getting informed consent, sanitary workers were interviewed through a semi-structured questionnaire for socio-demographic factors. Out of total 330 sanitary workers, 23 have joined in past 6 months, 5 didn't consent, 7 were absent during the study, 16 individuals absented during blood sample collection and 12 individuals were not contactable during the study. Height was measured using stadiometer, weight using a bathroom weighing scale. Blood pressure was taken after ensuring participants hadn't consumed coffee/tea or smoked in last 30 minutes using digital sphygmomanometer. Blood pressure was measured twice during the interview at 10 minute interval and average of the readings was taken. Fasting and 2 hours post prandial venous blood sample was taken for blood sugar measurement. Systolic blood pressure more than or equal to 140 mm Hg and or diastolic blood pressure more than or equal to 90 mm Hg was taken as cutoff values for hypertension. Participants with history of hypertension and or being on treatment for hypertension were classified as known hypertensives. Fasting blood glucose more than on equal to 126 mg/dl and or post prandial blood glucose more than or equal to 200 mg/dl

was taken as cut off for diabetes. Participants with history of diabetes mellitus and or being on treatment for diabetes were classified as known diabetics. Data collected from 267 sanitary workers was entered and analysed using SPSS. All instruments used in the study were calibrated for accuracy. Study was conducted after obtaining ethical clearance from Institutional Ethical Committee. Participants were provided follow-up care for diabetes and hypertension at urban Primary Health Centre, Tiruvannamalai.

RESULTS

Socio-demographic characteristics of study participants are tabulated in tables 1-4. Among participants, males were 91 and females were 176. Participants in age group of 30 to 44 years were 47.6%, 39% in 45 to 50 years age, and 13.5% in 18 to 29 years age group. Mean age of the participants is 40.6 years and standard deviation 9.49 years.

Table 1 : Age characteristics of study participants

Characteristics	Males (N=91) n (%)	Females (N=176) n (%)
Age, 18 to 29 years	28 (30.8%)	8 (4.5%)
Age, 30 to 44 years	46 (50.5%)	81 (46%)
Age, 45 to 60 years	17 (18.7%)	87 (49.5%)

Table 2 : Residential status of study participants

Characteristics	Males (N=91) n (%)	Females (N=176) n (%)
Residence from urban	81 (89%)	152 (86.3%)
Residence from urban slum	4 (4.4%)	11 (6.3%)
Residence from rural	6 (6.6%)	13 (7.4%)

Table 3 : Marital status of study participants

Characteristics	Males (N=91) n (%)	Females (N=176) n (%)
Married	67 (73.6%)	107 (60.8%)
Single	24 (26.4%)	8 (4.5%)
Living without spouse (divorced, separated, widowed)	0 (0%)	61 (34.7%)

Table 4: Educational status of study participants

Characteristics	Males (N=91) n (%)	Females (N=176) n (%)
Not attended school	13 (14.3%)	64 (36.4%)
Primary school	22 (24.2%)	61 (34.6%)
Middle school	27 (29.7%)	33 (18.8%)
High school	24 (26.4%)	16 (9.1%)
Higher secondary school	5 (5.4%)	2 (1.1%)

Majority, 87.3% of participants were from urban area, 5.6% were from slum areas as per classification of municipal records and 7.1% were from rural areas. Majority of participants were married. Nearly one third of female participants reported as living separated including separated, divorced and widowed. Among males 26.4% were unmarried and among females less than 5% were unmarried. More among females (36.4%) had not attended schools as compared to males (14.3%). Among 45 to 60 years old, nearly 50% haven't attended school. Among 18 to 29 years old only 1 didn't attend school. Nearly 80% among not attended school were females.

Hypertension and Diabetes mellitus

Among study participants, individuals with only hypertension were 19.9%, only diabetes mellitus were 7.5% and with both hypertension and diabetes were 7.9%. Sex wise distribution of disease status is summarised in table 5.

Table 5: Sex distribution of hypertension and diabetes mellitus.

Disease status	Male (N=91) n (%)	Female (N=176) n (%)
Only Hypertension	20 (22%)	33 (18.8%)
Only Diabetes mellitus	5 (5.5%)	15 (8.5%)
Both hypertension and diabetes mellitus	6 (6.5%)	15 (8.5%)
Normal	60 (66%)	113 (64.2%)

Among individuals detected with Hypertension and diabetes, 33 (35.1%) have known their disease status and are on treatment. While, 61 (64.9%) are newly detected hypertension and diabetic individuals. Status of treatment and newly detected disease status of individuals is presented in table 6.

Table 6 : Old and newly detected hypertension and diabetes mellitus

	Hypertension (N=53) n (%)	Diabetes (N=20) n (%)	Both hypertension & diabetes (N=21) n (%)	Total (N=94) n (%)
On treatment	14 (26.4%)	10 (50%)	9 (42.9%)	33 (35.1%)
Newly detected	39 (73.6%)	10 (50%)	12 (57.1%)	61 (64.9%)

Socio-demographic factors association with hypertension and diabetes mellitus.

Age was dichotomised using mean age 41 years. Education was dichotomised as attended and not attended school.

Association between socio-demographic factors with disease status was analysed by chi-square method and odds ratio calculated. Results presented in table 7. Association of age more than or equal to 41 years and less than or equal to 41 years was found to be statistically significant with odds ratio 2.19 (1.26 – 3.84). Prevalence of hypertension among age \geq 41 years was 35% as compared to 19.7% among $<$ 41 years.

Table 7: Association between socio-demographic factors and hypertension

Characteristic	Category	Hypertension Yes n (%)	Hypertension No n (%)	Chi-square & p value	OR (95% CI)
Sex	Male	26 (28.6)	65 (71.4)	0.051 p = 0.82	1.07 (0.60-1.87)
	Female	48 (27.3)	128 (72.7)		
Age	\geq 41 yrs	49 (35)	91 (65)	7.79 p = 0.006*	2.19 (1.26-3.84)*
	$<$ 41 yrs	25 (19.7)	102 (80.3)		
Education	Yes	48 (25.3)	142 (74.7)	1.98 p = 0.176	0.66 (0.37-1.18)
	No	26 (33.8)	51 (66.2)		

* Statistically significant

Table 8 : Association between socio-demographic factors and hypertension

Characteristic	Category	Diabetes mellitus Yes n (%)	Diabetes mellitus No n (%)	Chi-square, p value	OR (95% CI)
Sex	Male	11 (12.1)	80 (87.9)	1.13, p = 0.29	0.67 (0.32-1.41)
	Female	30 (17)	146 (83)		
Age	\geq 41 yrs	35 (25)	105 (75)	21.06, p = 0.00 *	6.72 (2.72-16.61)*
	$<$ 40 yrs	6 (4.7)	121 (95.3)		
Education	Yes	13 (16.9)	64 (83.1)	0.19, p = 0.66	0.85 (0.41-1.75)
	No	28 (14.7)	162 (85.3)		

* Statistically significant

Chi-square test between socio-demographic factors and diabetes mellitus showed age more than 41 years and less than 41 years was statistically significant with odds ratio 6.72 (2.71-16.61).

DISCUSSION

Sanitary workers are important service providers, unseen and unheard in the socio-cultural milieu of the society. Health status of sanitary workers are relatively less studied compared to other working populations. In this study among sanitary workers of Tiruvannamalai municipality, 19.9% had hypertension, 7.5% had diabetes mellitus, and 7.9% had both hypertension and diabetes mellitus. Among participants, females (n=176, 65.9%) were nearly double the number of males (n=91, 34.1%). This was similar to the study among sanitary workers in Greater Chennai corporation in which females were 67.1% and males were 32.9%.¹⁹ In studies among sanitary workers in other states of India had more males compared to females (15,17,18). Though sanitary work involves more physical and manual labour, more

females are engaged in this job. Less preference among males could be due to less recognition in society and job timings of 6am to 11am in the morning and 2pm to 5 pm in the evening. Among participants in this study, 28.8% had not attended school, similar to the study among sanitary workers in Greater Chennai Corporation.¹⁹ Interestingly, among those completed middle school, more females are present as compared to more males among those attended school education after middle school. This indicates the need to promote girl child education in sections of the society.

Prevalence of hypertension was 27.7% among all participants, among males it was 28.6% and among females it was 26%. This proportion was more compared to study among sanitary workers by Mahajan et al. in Aurangabad Municipal Corporation, Chellama et al. Thrissur Corporation, Kerala, and Zapdey and Zopdey in Nagpur Municipal Corporation, while it is less compared to sanitary workers in Ahmedabad Municipal Corporation, reported by

Parikh et al.^{9,15,17,18} Among sewage workers of National capital region of Delhi, prevalence was more at 67.3%.⁽²⁰⁾ While Oommen et al. reported 21.4% of general population as being hypertensive.²¹ Prevalence of hypertension in the current study was also more compared to NCD risk factor survey in Tamil Nadu.²² Prevalence of diabetes among all sanitary workers in this study is 19.9%. This was more compared to 14.6% among sanitary workers in Thrissur corporation, 4.9% in sanitary workers in Auragabad municipality and 1.1% among street sweepers of Nagpur municipal corporation.^{9,17,15} Prevalence of diabetes was less compared to 25% among sewage workers in NCT Delhi.²⁰ In the present study, 12% among males and 17% among females had diabetes mellitus. Among general population in Tamil Nadu prevalence of diabetes mellitus was 15.9% which is less compared to sanitary workers.²¹

CONCLUSION

In our study prevalence of only hypertension is 19.9%, only diabetes is 7.5% and both hypertension and diabetes is 7.9%. All identified individuals with hypertension and diabetes were referred to Urban Primary Health Centre, Tiruvannamalai for further evaluation and follow-up. Differential rates of NCDs in different occupational groups is observed and need for further studies to understand NCDs and risk factors among occupational groups, especially among sanitary workers. More than 60% of hypertension and diabetics were newly detected. Regular screening is needed to detect these individuals early and prevent complications.

LIMITATION

Cross-sectional nature of the study, small sample size and single centre study are limitations of this study. A larger sample with participants from different municipalities is needed.

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ORIGINAL ARTICLE - PUBLIC HEALTH

ASSESSMENT OF NUTRITIONAL STATUS AND ITS DETERMINANTS AMONG CHILDREN IN THE AGE GROUP OF 1-5 YEARS IN A TRIBAL POPULATION OF COIMBATORE DISTRICT-A CROSS-SECTIONAL

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Abstract

BACKGROUND : Under-five children are more vulnerable to malnutrition especially in rural areas resulting in more morbidity and mortality among them. The present study is aimed to assess the prevalence of malnutrition among children of 1-5 years of age in tribal hamlets of Valparai block, Coimbatore district in Tamil Nadu.

METHODS : A community-based, cross-sectional study was conducted among 95 children in the age group of 1-5 years during December-January 2020. Anthropometric measurements were taken. The indicators of nutritional status of children like stunting, underweight, and wasting were expressed using WHO growth standards.

RESULTS : The overall prevalence of malnutrition in our study was 31.6%. Among the 30 (31.6%) malnourished children, 40% were underweight, and 6.67% were severely underweight. 40% were stunted, of which 13.3% were severely stunted. Wasting was present in 23.3% of malnourished children. Severe wasting was not seen. Socio-demographic factors including the type of house, maternal education, BMI of the mother, age of mother at childbirth and place of delivery had significant association with malnutrition among under-five tribal children.

CONCLUSION : Malnutrition poses a serious threat to under-five children. Though many known risk factors of malnutrition have been studied, understanding the local factors linked with malnutrition is so crucial while planning information, education, and communication programs in this area.

KEYWORDS : Under-five children, Stunting, Underweight, Wasting

INTRODUCTION

An adequate well-balanced diet is highly essential for child survival, health, and development. Well-nourished children remain healthy and productive while the malnourishment stunts intellect, reduces productivity, and perpetuates poverty. It increases their susceptibility to childhood infections, such as diarrhoea, pneumonia, and malaria and thereby the under-5 mortality rate.¹

Undernutrition includes stunting (chronic malnutrition), wasting (acute malnutrition), and deficiencies of micronutrients (essential vitamins and minerals). Alarming rise in mortality and morbidity due to undernutrition demands urgent implementation of health schemes thereby reducing their occurrence and consequences and this would include determining action on the social determinants of undernutrition.²

According to WHO, malnutrition is defined as a “pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients”.³

Globally, among under 5 children, 47 million are wasted, 14.3 million are severely wasted and 144 million are stunted. Around 45% of deaths among children under 5 years of age are linked to undernutrition.⁴

NFHS 4 data shows that the proportion of malnutrition among under 5 children increases rapidly with the age from childbirth to a peak at age of 20 months. Even children who are breast fed till 6 months of age showed 20-30% of malnutrition. It is be noted that by age of 18-23 months, when weaning food is added, 30 percent are severely stunted and one-fifth are severely underweight.

In Tamil Nadu, Children’s nutritional status Tamil Nadu has improved after NFHS-3 by all measures. Whatever the gains in all the nutrition indicators, child malnutrition continues to be a major problem in Tamil Nadu.⁵ There are small variations in the level of undernutrition by urban-rural residence or by the sex of the child. However, differences are more pronounced for other background characteristics. Malnutrition generally decreases with increasing maternal education, improved nutritional status of the mother, and a normal birth weight. Morbidity and mortality are also high



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among undernourished children.^{6,7}

The prevalence of malnutrition was found to be higher in rural areas (38%) than in urban areas (29%).^{8,9}

In South India, study data regarding the prevalence of malnutrition among under-five tribal-based children are limited compared with rural and urban areas. Hence this community-based study was conducted to assess the nutritional status and the association of selected known risk factors among children aged 1-5 years in the tribal hamlets of Valparai of Coimbatore.

INTRODUCTION

STUDY DESIGN : Descriptive cross-sectional study

STUDY AREA: Tribal area belonging to Valparai hills of Coimbatore District, Tamil Nadu

STUDY POPULATION : Children aged 1-5 years

SAMPLE SIZE DETERMINATION : With an estimated prevalence of 36% from earlier studies 5 and 20% allowable error, sample size was calculated as below,

$$n = (1.96^2) pq / d^2$$

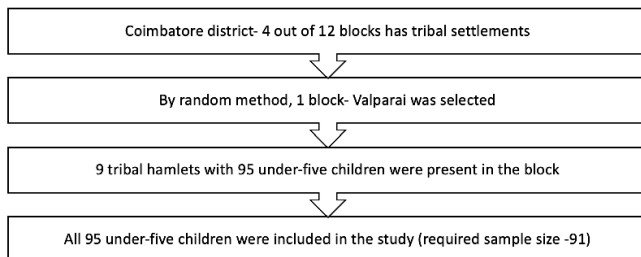
where, n=Number of samples required; p=Prevalence; q=100-p; d=allowable error.

Non response rate = 20%

Sample size = 91

STUDY PERIOD : DHome-visits were carried out from December 2019 to January 2020.

STUDY PROTOCOL :



DATA COLLECTION TOOLS : Pre-tested questionnaire and physical instruments included a standard weighing scale, metal measuring tape.

QUESTIONNAIRE

Data collection was done by interview method using a semi structured questionnaire which was pretested and modified after review in the Department. The questionnaire included socio demographic variables like age, gender, type of house, educational status of mother, BMI of mother and place of child birth. Height and weight of both the children and mother were measured using relevant instruments.

ANTHROPOMETRIC MEASUREMENTS

Height and weight of all the 95 children and their mothers who participated in the study were measured based on WHO recommended procedure.

ASSESSMENT OF NUTRITIONAL STATUS USING ANTHROPOMETRY METHOD

The standard deviation score (Z-score) for weight-for-age, height-for-age and weight for-height were calculated using WHO child growth standards (2009).

$$Z\text{-score (or SD-score)} = \frac{(\text{observed value}) - (\text{median reference value})}{\text{Standard deviation of reference population}}$$

This study adopted the cut-off points for WHO classification (Z-Scores) and broadly children are considered normal if the Z-Scores are above -2 and malnourished if Z-Scores below -2. Z scores less than -3SD are said to have severe malnourishment.

24-HOUR FOOD RECALL METHOD

The total consumption of Energy and Protein intake in terms of calories and grams was calculated using 24-hour food recall method and compared with the recommended daily allowance given by NIN.¹¹

STATISTICAL ANALYSIS

The data obtained from the study was entered in excel and analysed using “The Anthro Survey Analyser”, an online tool developed by the Department of Nutrition for Health and Development, WHO. Statistical analysis was done using SPSS 20.0 version.

RESULTS

A total of 95 children in the age group of 1-5 years were studied out of which, 50 were boys and 45 were girls.

The mean (SD) height and weight of the boys was 92.58cm (8.81) and 12.86 (2.22) respectively while the mean (SD) height and weight of girls was 91.31cm (9.14) and 12.69 (2.52) respectively.

The current study showed a general prevalence of malnutrition of 32.6 % while 68.4 % was anthropometrically normal.

Among the 30 malnourished children, 16 (53.3%) were stunted while 14 (46.7%) had both underweight and wasting.

Table 1: Age sex distribution of malnourished children:

Age group (Months)	Male		Female		Total	
	Total n (%)	Malnourished n (%)	Total n (%)	Malnourished n (%)	Total n (%)	Malnourished n (%)
13-24	10(20)	1(10)	6 (13.3)	1(16.7)	16 (16.8)	2(12.5)
25-36	10(20)	3(30)	11 (24.5)	7(63.6)	21 (22.1)	10(47.6)
37-48	18(36)	4(22.2)	11 (24.5)	2(18.2)	29 (30.5)	6(20.7)
49-60	12(24)	5(41.7)	17 (37.8)	7(41.2)	29 (30.5)	12(41.4)
Total	50	13(26)	45	17(37.8)	95	30(31.6)

There is no statistically significant gender difference in the prevalence of undernutrition among different age-groups (p= .184) (Table 1)

Table 2 : Energy and Protein consumption among children of 1-5 years:

RDA (percentage)	Energy		Protein	
	Normal n (%)	Malnourished n (%)	Normal n (%)	Malnourished n (%)
>90	5(7.7)	0	3(4.8)	0
71 – 90	38(58.5)	8(26.7)	11(16.9)	1(3.33)
50 – 70	22(33.8)	15(50)	41(63.1)	15(50)
<50	0	7(23.3)	10(15.4)	14(46.7)
Total	65	30	65	30

23.3% of malnourished children had energy consumption less than 50% RDA while 46.7% of malnourished children had less than 50 % of protein consumption as shown in table 2.

There was no malnutrition found among those children who had more than 90% of energy and protein intake. Majority of the malnourished children had only 50-70% of the RDA of energy and protein.

Table 3 : Nutrition intake associated with malnutrition among under-five children:

Factors	Category	Total n (%)	Malnourished		Unadjusted odds ratio	95% CI*	P value
			N	%			
Calorie consumption (% of RDA)	≥ 50	86 (90.5)	23	26.7	1	1.855-49.542	.002
	< 50	9 (9.5)	7	77.8	9.587		
Protein consumption (% of RDA)	≥ 50	71 (74.7)	16	22.5	1	1.799-12.876	.001
	< 50	24 (25.3)	14	58.3	4.813		

Table 3 shows significant association of malnutrition with the nutrition intake. Calorie intake less than 50% of RDA found to be a significant risk factor with a p-value of .002. Similarly, a protein intake of less than 50% of RDA shows nearly 5 times more risk of being malnourished. (p= .001)

Table 4: Factors associated with malnutrition among children of 1-5 years:

Factors	Category	Total n (%)	Malnourished		Unadjusted odds ratio	95% C.I.*	P value
			N	%			
Age of child	>2 year	79 (83.2)	28	35.4	1	0.055-1.228	.072
	< 2 year	16 (16.8)	2	12.5	2.60		
Sex	Male	50 (52.6)	13	26	1	0.242-1.386	.9218
	Female	45 (47.4)	17	37.8	0.579		
Type of house	Scam puosa	87 (91.6)	23	26.4	1	2.272-16.701	< .001
	Kutcha	8 (8.4)	7	87.5	19.478		
Mother's Educational status	Literate	65 (68.4)	11	16.9	1	3.164-22.724	< .001
	Illiterate	30 (31.6)	19	63.3	8.479		
Mother's BMI	Normal and above	70 (73.9)	16	23.9	1	1.633-11.296	.002
	Under weight	25 (26.32)	14	56	4.295		
Mothers age at child birth	≥ 20	46 (48.4)	9	12.9	1	1.296-7.785	.015
	< 20	49 (51.6)	21	19.6	3.083		
Place of birth	Hospital/ health centre	87 (91.6)	24	27.6	1	1.486-41.797	.006
	Home	8 (8.4)	6	75.0	7.871		

Table 4 shows various socio-demographic factors linked with malnutrition with the calculated unadjusted odds ratio. The risk factors including type of house, mother's education, BMI of the mother, birth factors including the age of mother at childbirth had significant association with malnutrition. Though female and higher age group children had more malnourishment, there is no significant difference among the study groups statistically (p > .05)

DISCUSSION

The study is aimed to assess the prevalence of malnutrition and their determinants among children in 1-5 years of age in the tribal hamlets of Valparai block. Of the 95 children studied, 30 were malnourished and 65 children were normal anthropometrically.

The risk factors known to be associated with malnutrition assessed in this study were age, sex, mother's education, mother's nutritional status, mother's age at pregnancy, place of delivery of the child, term of delivery of the child, birth order of the child, birth weight of the child, energy and protein consumption of the child.

DISCUSSION

The child was considered to be "Malnourished" if found underweight or wasted or stunted. The general prevalence of malnutrition in our study was 31.6%. Among the 30 malnourished children, 40% were underweight, and 6.67% were severely underweight. 40 % were stunted of which 13.3% were severely stunted. Wasting was present in 23.3%

of malnourished children. Severe wasting was not seen as calculated using WHO child growth standards.^{12,13} The lower levels of wasting, compared with stunting and underweight, indicate that chronic (long-term) malnutrition is more common than acute (severe but short-term) malnutrition in the study population.

As per NFHS-3 report, 54% of under 5 children were stunted, 55% underweight and 28% wasted among them.¹⁴ In the present study, the prevalence of all three indicators of malnutrition was less when compared with nationwide statistics.

Another study conducted by NIN, Hyderabad among tribal under-five children in 9 states of India in the year 2007-08 found that the overall prevalence of underweight was about 49%, of which 19% were severely underweight.¹⁵ 51% of children were stunted, and of them, about 24% were severely stunted. About 22% had wasting, among which 7% had severe wasting.

A study conducted among 1751 children in tribal areas of Maharashtra by Meshram et al showed a higher prevalence of stunting, underweight, wasting as 61%, 64% and 29%, than the present study.¹⁶

Rao et al conducted a study for National Institute of Research in Tribal Health (NIRTH), Jabalpur, India and concluded that 51.6% of preschool children were stunted, 61.6% were underweight, and 32.9% were wasted.¹⁷

Another study by Pradhan et al among 254 Bhil tribal children of Madhya Pradesh showed that there were 69.3% underweight, 63.4% stunting, and 58.7% wasting.¹⁸

Bisai et al conducted study among pre-school children of Lodha tribal community of West Bengal, and found out a prevalence of 33.9%, 26.1% and 19.4% underweight, stunting and wasting respectively. Among these, 9.1%, 9.7% and 3.6% children were having severe underweight, stunting and wasting. These findings show a slightly lower prevalence when compared to the present study.¹⁹

FACTORS ASSOCIATED WITH MALNUTRITION AMONG 1-5 YEARS CHILDREN:

AGE OF THE CHILD AND MALNUTRITION: The present study revealed no statistically significant association between different age groups of the under-five children and malnutrition. The findings differ from study conducted by Meshram et al¹⁵ who has reported that there is an increased risk of malnutrition in older children when compared with infants, whereas the results of Bisai et al is contradictory showing more risk of malnutrition in early childhood (1-3 years) when compared to older children (3-6 years).¹⁹

SEX OF THE CHILD AND MALNUTRITION : The present study had no significant difference in prevalence of malnutrition among male and female as per statistical analysis. Meshram et al has concluded that male under-five children are more prone for malnutrition when compared to female.¹⁵

MOTHER'S EDUCATION AND MALNUTRITION : The current study showed a significant risk of undernutrition among children of illiterate mother. According to NFHS-4 data, a strong inverse relationship exists between maternal education and child malnutrition.¹⁴ Similarly, Meshram et al had observed that an increased risk of malnutrition was seen among children of illiterate mothers.¹⁵ According to Islam S et al, as education level increases, risk of malnutrition decreases.²⁰ WHO report stated that children whose mothers have some primary education had 1.9 times more risk of being malnourished than that compared to children whose mothers had secondary or higher education.²¹

MOTHER'S NUTRITIONAL STATUS AND MALNUTRITION

The association of mother's nutritional status (BMI) with malnutrition is very much significant in the current study with an unadjusted odd's ratio of 4.295. NFHS-314 data and study done by Pushpa Lata Tigga and Jaydip Sen in a study done among 246 mothers in North Bengal, India indicated significant associations between mothers' and children's nutritional status.²²

TYPE OF THE HOUSE (PUCCA/SEMI-PUCCA/KUTCHA)

AND MALNUTRITION : The study subjects were residing in semi-pucca and kutcha houses and the risk of malnutrition was observed more with poor housing conditions. A community-based nutritional assessment study done by Yadav R J et al showed severe and moderate levels of malnutrition to be much higher among those with poor housing conditions even with the same level of dietary intake, whereas in spite of lower dietary intake, the level of malnutrition was significantly lower among those residing in a pucca house.²³

MOTHER'S AGE AT CHILD BIRTH AND MALNUTRITION :

Mother who were at the age of ≤ 20 at the time of their child birth had a significant association with malnutrition in the current study. Sonowal C J had reported that prevalence of malnourishment in children delivered by mothers before 20 years is high ($>12\%$) when compared to children delivered after 20 years ($<8\%$) in their study conducted in Maharashtra.²⁴

PLACE OF CHILD BIRTH AND MALNUTRITION : Home deliveries, when compared to institutional deliveries was reported as a serious association factor for malnutrition by Biswas S et al in a study done in West Bengal. Home delivery

children had 13 times more risk of being underweight, 5 times more risk of stunting and 6 times more risk wasting than their Institutional delivery counterparts. The present study also had similar association pertaining to place of birth.²⁵

PROTEIN ENERGY INTAKE AND MALNUTRITION :

Consumption of < 50% of the recommended amount of calories and protein were found to be another serious risk factor for malnutrition according to the present study. Mishra et al in their study of 520 under-five children of Varanasi showed that 90% of the malnourished children were consuming < 50% of the RDA of calories and the results were consistent with the current study.²⁶

CONCLUSION

The present study demonstrates that all the indicators of malnutrition-stunting, underweight and wasting remain to be a considerable burden among tribal under-five children. Various socio-demographic factors including type of house, maternal education, BMI of mother, age of mother at child birth and place of delivery had significant association with malnutrition among 1-5 years of tribal children.

LIMITATIONS

This is a cross sectional study and hence no causal relationship can be established.

RECOMMENDATION

Good maternal nutrition and improved education level of the mother plays a significant role in reducing malnutrition among under-five children. The health programs should be tailored keeping in mind the local socio-demographic factors influencing the nutrition status of the child.

FUNDING : No funding sources

CONFLICT OF INTEREST : None declared

ETHICAL APPROVAL : Ethical approval was obtained from the Institutional Ethics Committee of Rajah Muthiah Medical College and Hospital

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ORIGINAL ARTICLE - PUBLIC HEALTH

EVALUATION OF INVASIVE AND NON-INVASIVE
(POINT OF CARE TESTING DEVICES) FOR HAEMOGLOBIN IN
COMPARISON WITH HAEMATOLOGY ANALYZER

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Abstract

BACKGROUND : Anaemia is a major public health problem worldwide. Recent findings of NFHS-5 indicate an increasing trend in the overall prevalence of anaemia detected by Haemoglobin (Hb) meters at the community level. There is scepticism about the use of Point of Care Testing (POCT) devices to accurately measure the Hb level in community settings. The sensitivity and specificity of the Hb meters have to be evaluated properly before being used for the community level screening of anaemia.

OBJECTIVE : This study aims to evaluate the Sensitivity, Specificity and bias/Limits of Agreement (LOA) of the commercially available Hb meters / POCT devices, by comparing the results with Haematology Analyzer.

METHODS : A total of 416 blood samples were collected in a community setting at Kelampakkam Block, Chengelpet District and referred to State Public Health Laboratory (SPHL) for the analysis of haemoglobin. A total of 9 Hb meters were tested which included 3 non-invasive and 6 invasive devices. The Non-invasive devices were evaluated on the site of sample collection and the invasive devices were tested in SPHL and the results compared and analyzed with haematology analyser.

RESULTS : All the 9 Hb Meters failed to meet the Government of India's criteria for its sensitivity, specificity and bias/LOA, suggesting the use of Haematology Analyzer to accurately measure the Hb level.

CONCLUSION : Haematology analyser would be the method of choice for the accurate measurement of Hb in both institution and at community level screening of anaemia through an effective hub and spoke model of sample referral from community setting.

KEYWORDS : Anaemia, Haemoglobin, Hb meters

INTRODUCTION

Anaemia is a global public health problem that primarily affects young children, adolescent girls, menstruating women, pregnant and postpartum women. World Health Organisation (WHO) projects that 40% of children, 37% of pregnant women, and 30% of women are anaemic worldwide. Anaemia is characterised by reduced haemoglobin levels compared to normal.¹ A number of conditions can lead to anaemia, including poor diets, inadequate nutrient absorption, infections (such as malaria, parasitic infections, TB, HIV), inflammation, chronic illnesses, gynaecological and obstetric conditions, and hereditary red blood cell disorders. Iron deficiency is the most frequent nutritional cause of anaemia, whereas folate, vitamins B12, and A, and deficits in iron are other significant contributors.¹

The majority of anaemia cases occur in low and lower-middle-income nations, mostly impacting populations in rural areas and lower-class households.³ The Government of India's Ministry of Health and Family Welfare introduced

the Anaemia Mukh Bharat (AMB) policy in April 2018 in an effort to address the high prevalence of anaemia in the nation.⁴

AMB has set a goal to reduce the anaemia burden by 3% per year between 2018 and 2022. Standard medical testing facilities are frequently scarce and inaccessible to the majority of patients, despite the fact that anaemia is most common in underdeveloped countries.⁵ The National Family Health Survey (NFHS) has detected a substantial rise in anaemia from NFHS-4 to NFHS-5. The NFHS-6 has excluded the measurement of anaemia as the testing methods using the Hb meters are faulty.⁶ Appropriate anaemia care depends on an accurate and timely diagnosis of anaemia.



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WHO recommends the Haematology Analyzers to accurately measure the Hb value and diagnose anaemia.^{7,8,14,15} However, the haematology analyzers are expensive, sensitive and sophisticated equipment which cannot be taken to the field conditions and also requires a consistent supply of reagents.

In recent years, the point of care testing devices (POCT) has been used extensively for the detection of Hb value due to its portability, capillary blood, affordability, ease of use, and ability to provide immediate, digitally displayed results without the need for refrigeration or even electricity.⁹⁻¹¹

One of the interventions carried out by the AMB is the use of POCTs for haemoglobin estimation and anaemia treatment.⁴ These POCTs should be affordable, sensitive, specific, user-friendly, rapid and robust and deliverable.^{12,13}

Government of India recommends the commercially available Hb meters to have more than 80% sensitivity and specificity and a bias of ± 0.5 g/dL.

There are different types of digital Hb meters available for estimating haemoglobin levels, but POCTs with inadequate diagnostic precision or difficult procedures can result in inaccurate haemoglobin level estimation and ultimately in incorrect anaemia management, which can have an impact on the patient and the healthcare system.¹⁴

Thus, it is imperative to verify the sensitivity, specificity, and accuracy of the Hb meters. Our study focuses on the evaluation of non-invasive and invasive digital hemoglobinometer in a community level field setting with adolescents, adults, and pregnant women.

OBJECTIVES

To evaluate the performance of commercially available Hb Meters (POCT devices) both Invasive and Non-invasive Type for Hb estimation and also to find out the Sensitivity and Specificity of Hb Meters/POCT Devices at field conditions by comparing the results with Hematology Analyzers as Gold Standard.

METHODOLOGY

STUDY POPULATION : A community based cross sectional study was conducted at Govt.Primary Health Centre, Kelampakkam, Chengalpattu District in which adolescent boys, girls, men, women and antenatal mothers were included in the study. Individuals with severely ill conditions (MI, Stroke etc.,) were excluded from the study. Informed written consent was obtained from the individuals.

ETHICAL APPROVAL : The study protocol was approved by the Institutional Ethics Committee of the Directorate of Public Health and Preventive Medicine (DPH&PM), Teynampet, Chennai (IEC No.DPHPM/IEC/2023/166 dated 26.08.2023)

DESCRIPTION OF THE HB METER DEVICES : DPH&PM has requested the Tamil Nadu Medical Services Corporation Limited (TNMSC) to provide the commercially available Hb meters along with consumables for this community-based evaluation study. All the 14 prospective bidders were communicated in which 9 vendors have submitted their Hb meters along with consumables for this study. As per the Non-Disclosure Agreement (NDA), the brand name of the Hb meters are not disclosed in this publication. A total of 3 Non-invasive and 6 Invasive Hb meters were included in this study and the product details are summarized in Table.1.

Table 1 : Description of the Hb Meter Devices

S.No	Device Code	Hb Meter Type	Principle
1	Hb-1	Non-Invasive	Spectrophotometry
2	Hb-2	Non-Invasive	Spectrophotometry
3	Hb-3	Non-Invasive	Spectrophotometry
4	Hb-4	Invasive-Cuvette	Photometry
5	Hb-5	Invasive-Cuvette	Photometry
6	Hb-6	Invasive-Strip	Reflectance Photometry
7	Hb-7	Invasive-Strip	Reflectance Photometry
8	Hb-8	Invasive-Strip	Reflectance Photometry
9	Hb-9	Invasive-Strip	Reflectance Photometry

HEMATOLOGY ANALYZER : Sysmex XP 100, an automated blood cell counter was used for the accurate measurement of Hb with quality control validation using Sysmex Eightcheck™ – 3WP reference material. This value was communicated to the study participants as their Hb level.

DATA COLLECTION : Study subjects registered using a standard case sheet and necessary written consent was obtained followed by measurement of haemoglobin using 3 Non-Invasive Hb Meters. 5 ml of venous blood sample was collected in K2 EDTA Tubes from the study subjects and transported to State Public Health Laboratory (SPHL) for further analysis. EDTA samples were subjected to CBC using Sysmex X-100 Haematology Analyser to accurately measure the Hb value. Same EDTA samples were also subjected to measure Hb values using the 6 invasive Hb meters (4 strip based and 2 cuvette-based method). Hb Results were compared with the results of Haematology Analyser. Sensitivity, specificity, bias and limits of agreement were calculated by statistical methods.

RESULTS

A total of 9 Hb meters (POCT Devices) were subjected to

Hb evaluation in 416 subjects and the results were compared with the Haematology Analyzer. The prevalence of anaemia among the study participants was 44.4%. The criteria for performance evaluation were based on the Govt.of India recommendations on sensitivity, specificity, bias and limits of agreement. The results are summarized below in Table-2 & Fig-1.

Table 2 : Validity and Level of agreement of various Hb Meter Devices

Name of the Device	Principle of the Device	Sensitivity (>80%)	Specificity (>80%)	Bias (± 0.5 g/dL)	95% CI of LOA (± 1 g/dL)
Hb-1	Non-Invasive	66	67	-0.055	-2.532,2.422
Hb-2	Non-Invasive	50	57	-0.063	-5.192,5.067
Hb-3	Non-Invasive	47	73	-0.430	-4.601,3.740
Hb-4	Invasive-Cuvette	76	100	-0.398	-1.012, 0.276
Hb-5	Invasive-Cuvette	47	100	-1.052	-1.693, -0.411
Hb-6	Invasive-Strip	44	98	-1.170	-2.454,0.114
Hb-7	Invasive-Strip	96	58	0.804	-0.473,2.081
Hb-8	Invasive-Strip	95	36	0.581	-1.368,2.531
Hb-9	Invasive-Strip	96	21	2.975	-0.271,6.223

All the 9 commercially available Hb Meters evaluated for Hb measurement have failed to meet the Govt. of India requirements of achieving more than 80% sensitivity and specificity thus failing to accurately detect true anaemic and non-anaemic cases in the community.

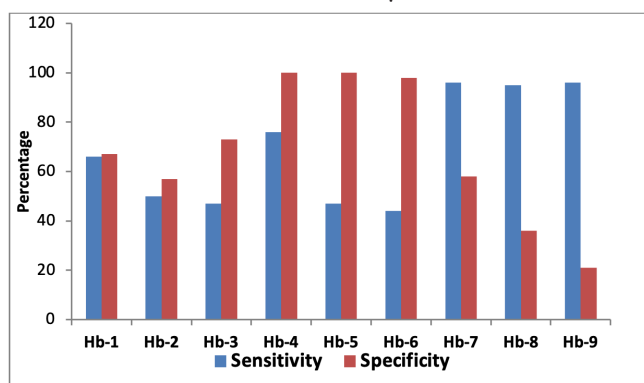


Figure 1 : Validity and Level of agreement of various Hb Meter Devices

DISCUSSION

Nine point-of-care devices—both invasive and non-invasive—have been examined in this study. The data from the present study shows that none of the Hb meter devices meets the Govt.of India’s qualifying criteria for POCT, which are >80% sensitivity, >80% specificity, and 0.5% bias. The NFHS-6 has excluded the measurement of anemia stating that the ways to measure anemia is faulty. The problem with the NFHS estimation was that it used capillary samples or blood drawn from a finger prick and then measured using the Hb meters whose results could vary by almost a gram/dL of blood. ^{6, 20} The present study at the community level also indicated the use of inappropriate Hb meters is the cause of the faulty measurements.

Challenges with Non-Invasive Hb meters include the

inability to measure Hb accurately in cases where nails are dirty, deformed, or painted. It was challenging to measure when elderly people's palms were creased and when children's fingers were too little to fit into the sensor. While using invasive hemoglobin meters, misleading results can arise from the presence of air bubbles in the microcuvette/strip or from inadequate blood flow that prevents the microcuvettes/strip from filling entirely.¹⁹ Although anaemia is still a concern in developing nations like India, the first line of defense against anaemia management is the use of accurate haemoglobin testing equipment. It is quite challenging to rule out the disease when there is an issue with the first step which is the measurement of blood Hb. The number of actual cases and the disease's prevalence cannot be determined until appropriate haemoglobin readings are obtained.

WHO recommends Hematology Analyzer/Cell Counters as the gold standard to accurately estimate the levels of haemoglobin in blood. In comparison to POCT devices, cell counters offer more precision and accuracy in testing. In order to ensure the accuracy of the data, cell counters frequently include integrated quality control and validation procedures.

We also recommend a solution to accurately screen anemia in the community setting using Haematolgy Analyzers by an effective Hub and Spoke model of sample referral as visualized in Fig.2.

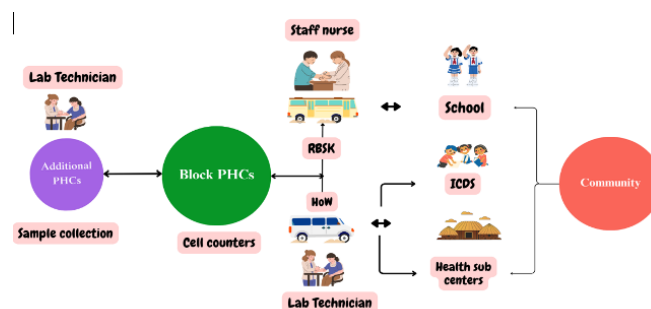


Figure 2 : Hub and Spoke model of sample referral

Haematology analyzers are available in 811 Primary Health Care Institutions in Tamil Nadu and there are qualified Laboratory Technicians in place to handle the analyzers. Integrated Essential Laboratory Services (IELS) being rolled out in Tamil Nadu provides the coverage of all the 2127 PHCs, so that EDTA Blood Samples can be collected from an Additional PHC(Spoke) and refer to the Block PHC(Hub) through an effective and efficient sample referral mechanism supported by LIMS.

Rashtriya Bal Swasthya Karyakram (RBSK) team¹⁵ and Mobile Medical Units (MMU)¹⁷ available in each Block

could be effectively used to cover the schools, ICDS centres and Health sub centres (HSCs) to screen the children and adults, collect blood at the community level and transport it to the Block PHC where Cell Counters are already available. Currently Adolescent Anaemia Program in Tamil Nadu has successfully adopted the same model using cell counters for the accurate measurement of Hb. Most importantly, the cost of the Cell Counter reagent fixed by TNMSC Ltd is Rs 9/ Test only which is valid up to 2027 which is comparatively at a low cost and also yielding 18 other blood parameters including cell counts and vital inflammatory status.¹⁸

CONCLUSION

There are several POCT devices commercially available for the estimation of Hb in blood, but the data on their validity in terms of sensitivity and specificity while testing in field conditions are limited. There is no comprehensive study undertaken on the commercially available Invasive and Non-Invasive Hb meters in the community settings to assess their usefulness for the accurate measurement of Hb. The current study suggests that the commercially available Hb Meters/ POCT devices used for Hb estimation are not reliable in terms of sensitivity and specificity as per the requirements of Govt. of India. The study also recommends the use of Hematology Analyzers for the accurate estimation of Hb by implementation of an effective Hub and Spoke sample referral which is being adopted now for the adolescent anemia screening program successfully implemented by the Directorate of Public Health and Preventive Medicine in Tamil Nadu.

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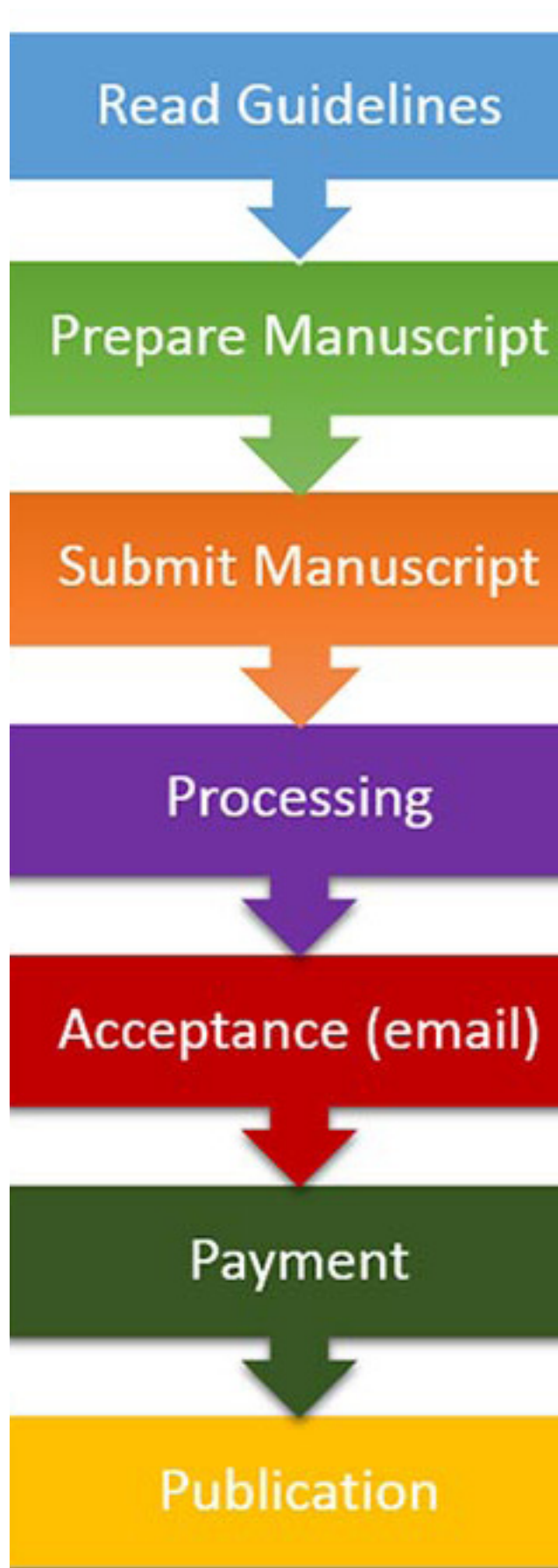
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