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New National Education Policy 2024 and Healthcare Skill Development

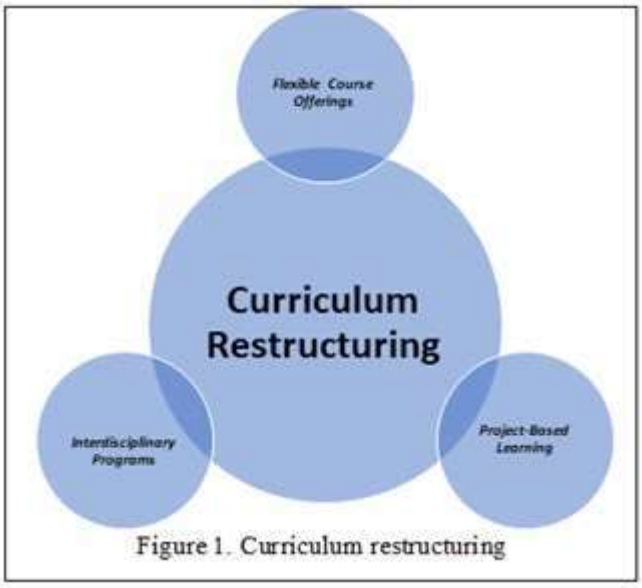

Figure 1. Curriculum restructuring

Figure 2. Collaborative teaching and learning

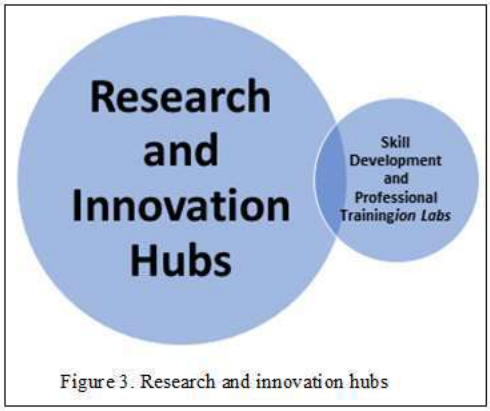

Figure 3. Research and innovation hubs

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EDITORIAL

New National Education Policy 2024 and Healthcare Skill Development

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Embracing Opportunities

India's education system has significantly transformed by introducing the new National Education Policy (NEP) 2024. The policy, approved by the Union Cabinet of India, aims to empower students with high-quality education and job-centric skills. The NEP 2024 is on the evolution of the national education policy introduced in 2020 by Prime Minister Modi. This policy aims to propel India towards becoming a thriving knowledge-based society and a global leader in knowledge. Among its key objectives are enhancing the quality of education, promoting holistic learning, ensuring equitable access, and fostering innovation and research. By prioritising continuous improvement and a focus on holistic development, NEP is well-positioned to create a brighter future for India and its people.

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The following are the aspects of higher education, with special emphasis on professional education as related to healthcare education.

The NEP articulates a broad view of education encompassing the holistic development of youth, with special emphasis on kindling the creative potential of each individual in all its richness and complexity. It aims to develop 21st-century skills in students while also giving them enough flexibility in making choices.

Increasing population is a boon for Globalization. Over the next decade, India will have the world's highest population of young people, with more than 50% below the age of 35 aspiring for high-quality education. This demographic dividend must be taken advantage of by Globalization, and the demands of a knowledge economy and knowledge society call for emphasis on the need for the acquisition of new skills by learners on a regular basis for them

to ‘learn how to learn’ and become lifelong learners, a critical consideration that needs to be addressed appropriately.

The vision of India’s new educational system has been crafted to ensure that it touches every citizen's life and is consistent with their needs and necessities, besides creating a just and equitable society. The new education policy provides an integrated yet flexible approach to education. Further, it has kept the interconnectedness of the various phases of education in mind and how the same will enable continuity, coherence, and processes to ultimately realize an end-to-end educational roadmap for the country.

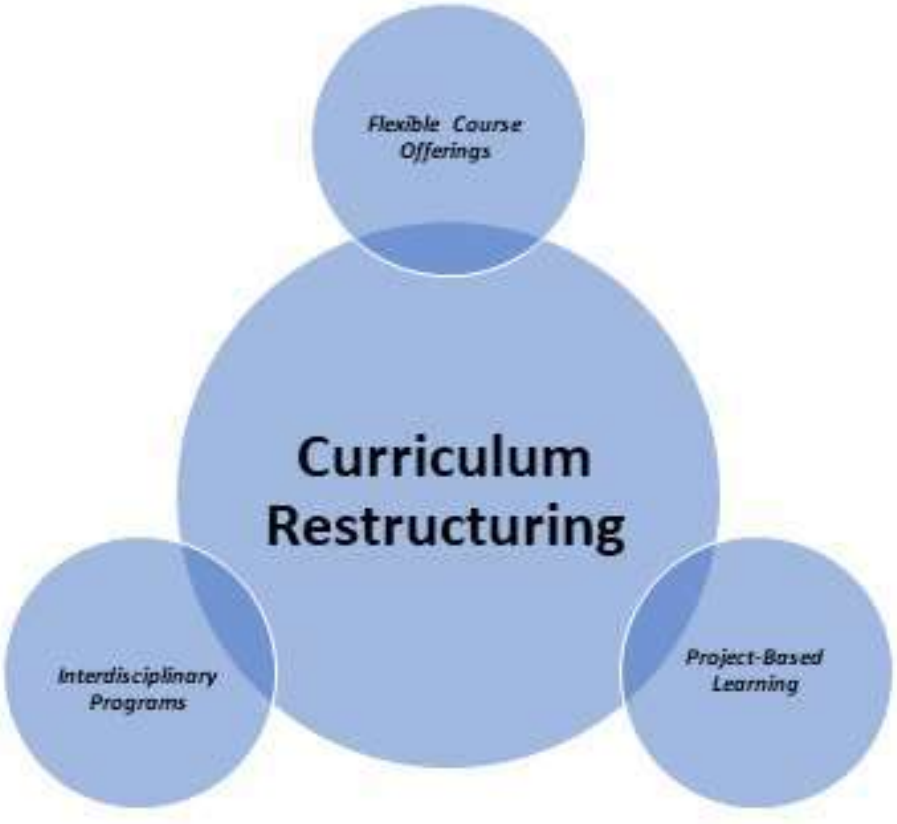

Figure 1. Curriculum restructuring

With respect to the health care manpower, there has been a considerable increase in the number of medical colleges, MBBS and PG seats in the last 10 years. As of July 2024, the following figures have been provided to the Lok Sabha by the Hon’ble Union MoS for Health Ms Anupriya Patel:

- 1,12,112 MBBS seats—in 731 Medical Colleges
- 72,267 PG seats
- 322 Government colleges with 48,012 seats &
- 290 Private Institutes with 43,915 seats.
- An increase from 51,348 MBBS seats and 31,185 PG seats

In the context of increasing the intake of students, the NHP recommendation is to upgrade the 600 or so district hospitals in the country to teaching hospitals at the earliest by investing in infrastructures for

targeted specialties and stationing adequately qualified teaching faculty.

Some of the specific recommendations from the policy are as follows:

- The first relates to ensuring the superior quality of an MBBS degree. The expectation that society has from a medical doctor is extremely high, more than any other profession. It is, therefore, imperative that all MBBS graduates possess (i) medical skills; (ii) diagnostic skills; (iii) surgical skills; and (iv) emergency skills. This should be ensured in the revamped education of medical students. Further, curriculum, pedagogy, assessment, and opportunity for gaining work experience during studies should all be improved (Figure 1). The compulsory rotation internship needs to be reintroduced and made more robust and effective.
- A second important recommendation relates to pluralistic healthcare education and delivery. The suggestion here is to design the first year or two of the MBBS course as a common period for all science graduates, after which they can take up MBBS, BDS, Nursing, or other specializations. Core courses will follow common foundational courses based on medical pluralism focused on specific systems and electives that encourage bridging across systems. Another important aspect relates to the flexibility for the graduates from other medical disciplines such as nursing, dentistry, etc. being allowed lateral entry in to the MBBS course (Figure 2).

Given the pluralistic healthcare legacy of the country, the different health systems such as Ayurveda, Yoga, Naturopathy, Unani, Siddha and Homeopathy (AYUSH) will be mainstreamed.

Figure 2. Collaborative teaching and learning

- A third important recommendation of the policy relates to nursing education and the career progression of nurses. Quality (especially the curriculum) of nursing education will be improved and strengthened. Institutions providing nursing education will be accredited every five years. A national accreditation body for nursing education and other sub-streams needs to be created for the purpose. Nurse Practitioners courses will be introduced and recognized throughout India so that nurses can compensate in part for the non-availability of doctors.

☐ Professional education might represent a smaller segment of the overall educational system in India but has a huge impact, as follows:
- Its influence on the economy and society is substantial.
- The specialized skills and expertise it provides have far-reaching effects on innovation, economic development, and social progress.
- The contexts in which professions are practiced are being redefined constantly by the changes in our understanding of society, the environment, human rights and ethics. At the same time, professions are also becoming highly differentiated and are constantly evolving as developments in science and technology gather pace. Professional undergraduate education must rise to this challenge.
- It means blending practical, job-oriented training with traditional academic learning.
- Adding relevant professional skills and industry knowledge into academic courses.
- Providing hands-on experiences
- Collaborating with businesses to offer insights
- Career planning, including resume writing and interview coaching.
- Communication and teamwork
- Regularly updating programs based on industry trends
- Overall, this reintegration helps students acquire both theoretical knowledge and practical skills for successful careers.

☐ All higher educational institutions, including those offering professional education, will be empowered to widen the scope of their course offerings so that each of them becomes a large multidisciplinary institution offering a wide selection of courses. This is best achieved by making institutions offering professional education a part of the larger ecosystem of higher education instead of remaining isolated entities.

☐ **Advantages of a multidisciplinary-based approach**
- The power of a multidisciplinary-based approach to realize an appropriate outcome is well illustrated by the example of the remarkably speedy development of effective vaccines to combat the COVID-19 pandemic. In February 2020, the World Health Organization said that it did not expect a vaccine against SARS-

CoV-2 in less than 18 months. And just 13 months later, over 2 crore people were vaccinated in India alone. The successful development of these vaccines has been, thanks to the tireless efforts from experts across numerous disciplines—from ***bioinformatics*** for identifying the genetic sequences of this deadly virus to ***computational biology*** for identifying potentially efficacious vaccines, to ***chemical engineering*** to develop vaccines at sufficient scale for clinical trials, to actually ***conducting*** these vaccines.

- However, these experts have been able to work largely within their well-defined silos before "handing off" to experts from other disciplines at well-understood points in the overall vaccine development process. This is the hallmark of a "multi-disciplinary"-based approach.
- Innovation, in surveys of health care is generally ignored. India imported Rs. 41,000 crores worth of medical instruments (65%), medical devices (25%), implants (4%), consumables and disposables (6%) for the health care sector in 2020. Due to their high cost, their accessibility and affordability are, unfortunately, limited to 20% of our population, according to a study by the Public Health Foundation of India (PHFI) and Confederation of Indian Industry (CII).
- India has made a modest start in this direction by R&D and production in medical devices such as blood bags, heart valves, implantable lenses, etc. (Figure 3). What is less known is that technology and modern science have cast a spell on Ayurveda as well. The cumbersome and ancient methods of producing drugs in Ayurveda have been streamlined by large producers—whose number in rising—employing advances in process control and quality assurance.
- Equally importantly, a new branch of science—Ayurvedic Biology—is making progress in research at the molecular level based on cues from Ayurveda. This is a path that will take us to major discoveries and likely benefits to the practice of medicine.

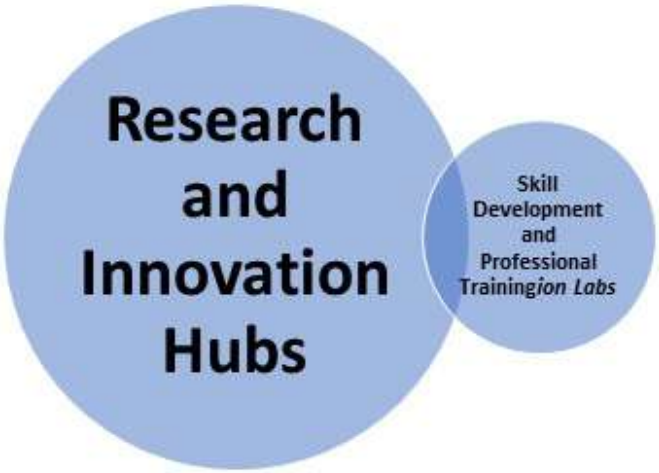

Figure 3. Research and innovation hubs

Innovation in health Care: By aligning with the principles of NEP 2024, healthcare education can become more dynamic, inclusive, and relevant, ultimately leading to a more skilled and adaptable healthcare workforce.

The Skill Development Programs will receive a boost as NEP advocates for skill development as a key component of the education system, promoting both technical and soft skills. This would support the development of specialized training programs in healthcare that align with industry needs and technological advancements. Integration of vocational training into mainstream education systems can lead to the inclusion of healthcare vocational training programs within schools and colleges, allowing students to gain practical skills alongside their academic education. The NEP supports collaboration between educational institutions and industry, which can lead to the development of industry-relevant training programs and internships. The development of curricula that are relevant to current and future needs would update the inclusion of the latest medical practices, technologies, and patient care strategies. NEP also aligns with the national skill development missions, which would lead to a well-prepared and skilled healthcare workforce.

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ORIGINAL ARTICLE

Knowledge and Attitude of Rheumatic Heart Disease among Nursing Mothers in Nigeria

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Abstract

Introduction: Rheumatic heart disease (RHD) is a chronic condition caused by an attack of acute rheumatic fever. It has the potential to worsen, from clinically silent damage to very complicated damage to the heart valve. According to the WHO, in 2020, it was estimated to affect over 288,348 lives annually, with the bulk of cases being found in developing countries. As mothers play a major role in the care and nurture of their children, this study is aimed at assessing their level of knowledge and their attitude towards rheumatic heart disease. Method: The study was cross-sectional in nature and was conducted at the maternal and child units of a primary health care center. The questionnaires were independently filled out by the respondents, and the data was carefully coded into the SPSS version 25 software. **Results:** In this study, a total of 150 nursing mothers were reached. In terms of age distribution, the age group 26–30 years old (38%) made up most of the population, and 92% of the total population were married. In terms of education, 50.7% had completed their secondary school education. Overall, the assessment of the level of knowledge of the participants was 86%, 9.3%, and 4.7%, categorized as poor, fair, and good, respectively. **Conclusion:** More educational intervention needs to be carried out, especially among mothers attending primary health care centers in the nation, in order to increase their knowledge and improve their attitude towards the disease, which we found to be low.

Keywords: Rheumatic Heart Disease, Nursing Mothers, Knowledge, Attitude, Nigeria

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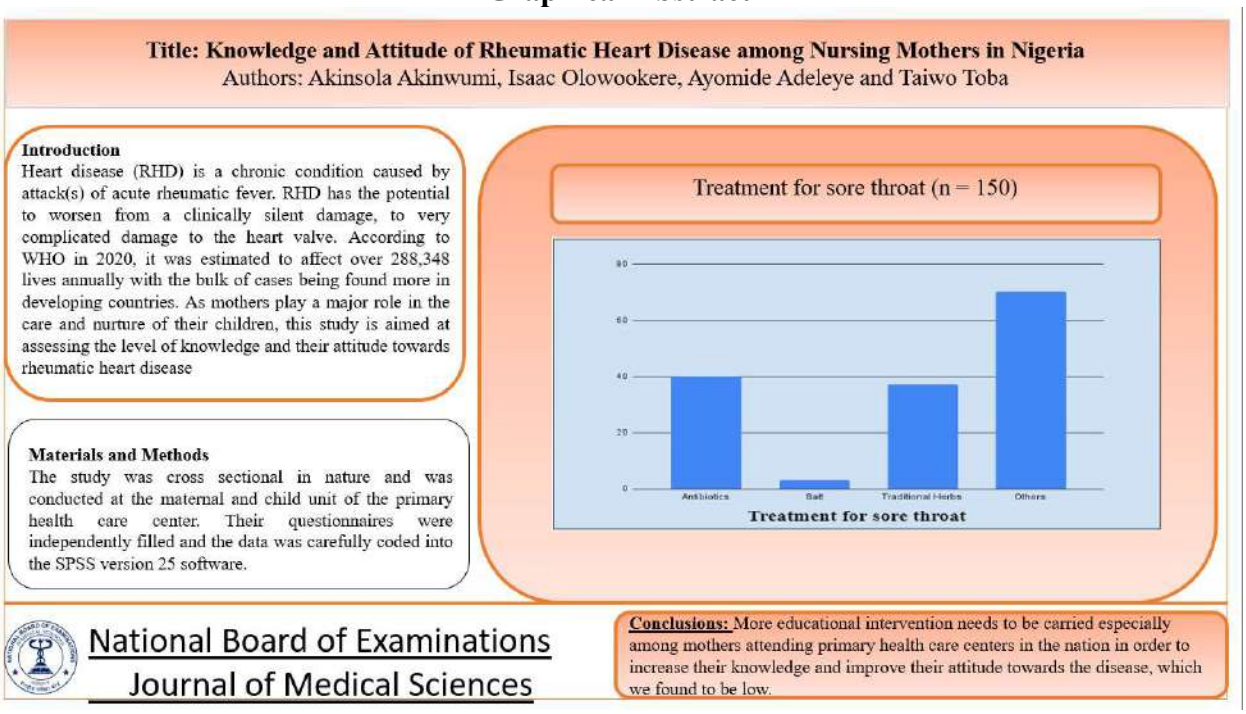
Graphical Abstract



Introduction

Rheumatic heart disease (RHD) is a chronic condition caused by one or more attacks of acute rheumatic fever [1]. RHD has the potential to worsen from clinically silent damage to very complicated damage to the heart valve, with the mitral valve being the most commonly damaged valve, followed by the aortic and tricuspid valves accordingly. Without proper care and attention, heart failure may occur. Rheumatic fever (RF), the cause of RHD, develops due to an abnormal autoimmune response to group A streptococcus (GAS) bacterial infection that causes sore throat [3,4]. Acute rheumatic fever is mostly common among children 5–15 years of age; however, on rare occasions, it also affects adults 30 years of age and older [4]. Rheumatic heart disease, according to the WHO in 2020, is estimated to affect over 288,348 lives annually. It has also been estimated that there are 282,000 new cases of RHD each year, with the bulk of these cases being found in developing countries. A study by Carapetis et al. [5] revealed that as much as 80% of the total cases of RHD were from developing countries. At present, there is no cure for rheumatic heart disease, and the cause of its precursor disease, group A streptococci, is easily transmitted like other infections of the respiratory tract [6], especially in crowded spaces. If this infection is poorly treated or not treated at all, between two and three weeks, it can lead to the development of rheumatic fever, the precursor disease to RHD [7].

However, there are various strategies used to prevent and manage the development of RF. These strategies include primordial prevention, which involves the provision of better housing structures and management to prevent overcrowding [8].

Primary prevention, on the other hand, deals with the rapid identification and treatment of group A streptococcus infections. Intramuscular benzathine penicillin G is widely used in primary prevention [9]. Secondary prevention, also known as long-term management, involves the recurrent administration of antimicrobials to prevent the recurrence of acute rheumatic fever [8]. This administration occurs at an interval of three to four weeks. Various studies have been developed to access the knowledge of RHD and RF. One of these was carried out by Nkoke et al. in Cameroon, which showed that over 70% of its participants did not know the cause of sore throats or what its complications could lead to. In the same population, over 80% did not know what RHD was [10]. In Saudi Arabia, a study was also carried out among parents to assess their knowledge of RHD and RF. This study showed that only about 40% of parents had good knowledge about RHD [10]. As mothers play a major role in the care and nurture of their children, this study is aimed at assessing the level of knowledge and their attitude towards rheumatic heart disease among nursing mothers attending the primary health center in Osun State, Nigeria.

To the best of our knowledge, no study of such has been carried out, and the paper aims at filling this gap.

Methodology

Study design and setting

The study was cross-sectional in nature and was conducted at the maternal and child sections of the primary health care center in Ilesha, Osun State, Nigeria. This primary health care center serves as a first point of contact for medical services, especially for pregnant women and nursing mothers within the region, due to its central location.

Participants and data collection

The study was made up of nursing mothers who attended the primary health care center and brought their children for various reasons (immunization, medical checkup, consultation, etc.) and who agreed to participate in the study. Verbal consent was obtained after the objectives and benefits of the study were briefly explained. The participants independently filled out their questionnaire while under observation by the investigator. The investigator provided guidance to those who did not understand the question nor needed help.

The questions were divided into two parts. Part A assessed the socio-demographic information of the nursing mothers, which included their age, level of education, and occupation. Part B was used to evaluate the nursing mother's level of knowledge and attitude toward rheumatic heart disease. Most of the questions were on a three-point categorical scale: yes, no, and don't know.

Sample size

The study was made up of 150 nursing mothers attending the primary health center in Ilesha, Osun State.

Data analysis

The collected data was carefully coded into the SPSS version 25 software. Descriptive and Chi-square analyses were then performed and interpreted accordingly.

In the study, each participant could earn a total of four (4) points based on their knowledge of rheumatic heart disease. Individuals with three to four points were considered to have good knowledge of the disease; those with two were considered to have fair knowledge; and those with one or fewer points were considered to have poor knowledge. For the participants attitude a total of three (3) points were obtainable. The points were grouped as three (3), two (2) and between zero (0) and one (1), corresponding to good, fair and poor attitude respectively.

Results

In this study, a total of 150 nursing mothers were reached. Table 1 shows the sociodemographic characteristics of the group. In terms of age distribution, the age group 26–30 years (38%) made up most of the population; others included 21–25 years (32%), 31–35 years (18.7%), 36–40 years (10%), and 41–45 years (1.3%). 92% of the population were married. In terms of education, 50.7% had completed their secondary school education, 32.7% had completed a diploma, 14.7% had completed university, and only 2% of the population had their education stopped after primary school. It was also discovered that 72.7% worked in the informal sector of the country, 16% in the formal sector, and 11.3% were unemployed. It was also noted that at the time of this study, 44% of the nursing mothers had just one child, the one being nursed.

The assessment of knowledge of rheumatic heart disease is shown in Figure 1 below.

Table 1. Socio-demographic variables of the participants (n = 150)

Variable	Category	Frequency	Percentage(%)
Age	21 -25	48	32.0
	26 -30	57	38.0
	31 - 35	28	18.7
	36 - 40	15	10.0
	41 -45	2	1.3
Marital Status	Single	12	8.0
	Married	138	92.0
Education	Primary	3	2.0
	Secondary	76	50.7
	Diploma	49	32.6
	University	22	14.7
Occupation	Government Sector	24	16.0
	Informal Sector	109	72.7
	Unemployed	17	11.3

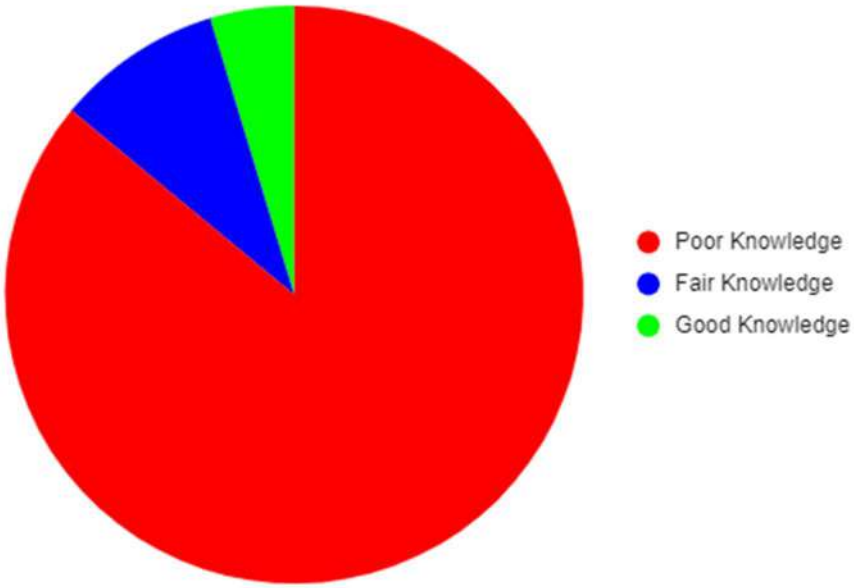


Figure 1. Overall assessment of the participant's level of knowledge

In this study, 100% of the participants did not know what caused rheumatic heart disease. When asked if it was important to treat streptococcal sore throats, 87.3% of the participants said no, while 12.7% recognized treatment as important and chose yes. It was also noted that 72.7% did not know of any complications that could occur from the poor treatment of streptococcal sore throat. Furthermore, 54% of the participants were unaware of any form of relationship present between streptococcal sore throat and heart disease; 34.7% believed there was no relationship, while 11.3% of the participants in fact believed there was a relationship.

Overall, the assessment of the level of knowledge of the participants was 86%, 9.3%, and 4.7%, categorized as poor, fair, and good, respectively.

Figure 2 below gives a graphical representation of the respondents' attitude towards rheumatic heart disease. We observed that 26.7% preferred using antibiotics for the treatment of streptococcal sore throat, 2% made use of salt, 24.7% used traditional herbs, and 46.7% made use of other treatment options. Furthermore, it was found that 40%

Of the participants who chose their treatment option based on a prescription from friends, 21.3% got theirs either from doctors or health personnel, while 38.7% self-medicated. When their opinions were sought on the importance of treating streptococcal sore throat with antibiotics, 46.7% of the participants noted that it was; however, 32% disclosed that it was not; however, 21.3% were neutral on this. Based on this, attitude levels were divided into good, fair, and poor, with 16%, 9.3%, and 74.7%, respectively (Fig. 2).

A chi-square analysis test was also carried out in order to better understand the relationship between the various levels of knowledge and the participants sociodemographic characteristics. We found a positive association between age and

knowledge, as participants between the ages of 41 and 45 were significantly associated with a good level of knowledge ($c^2 = 41.47$; $p < 0.001$). In contrast, no significant association was found among other sociodemographic characteristics (education level, marital status, and occupation) and the levels of knowledge ($p > 0.05$).

In regard to the sociodemographic characteristics of participants and their attitude, we observed significant relationships between participants' level of education, occupation, and attitude. Participants who had obtained a university degree were significantly correlated with a fair attitude towards rheumatic heart disease ($C^2 = 15.37$; $p < 0.001$).

In addition to this, we observed that those who were employed had significantly poor attitudes towards the disease ($C^2 = 9.18$; $p = 0.002$). However, there was no significant relationship between attitude level and other sociodemographic variables such as education level, age, and marital status.

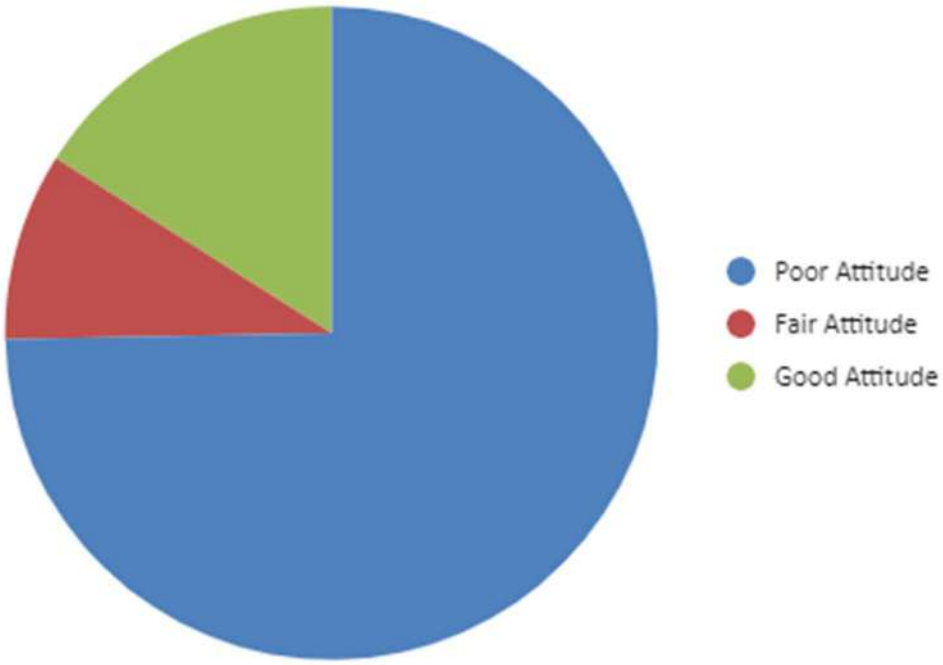


Figure 2. Overall assessment of the participant's attitude level

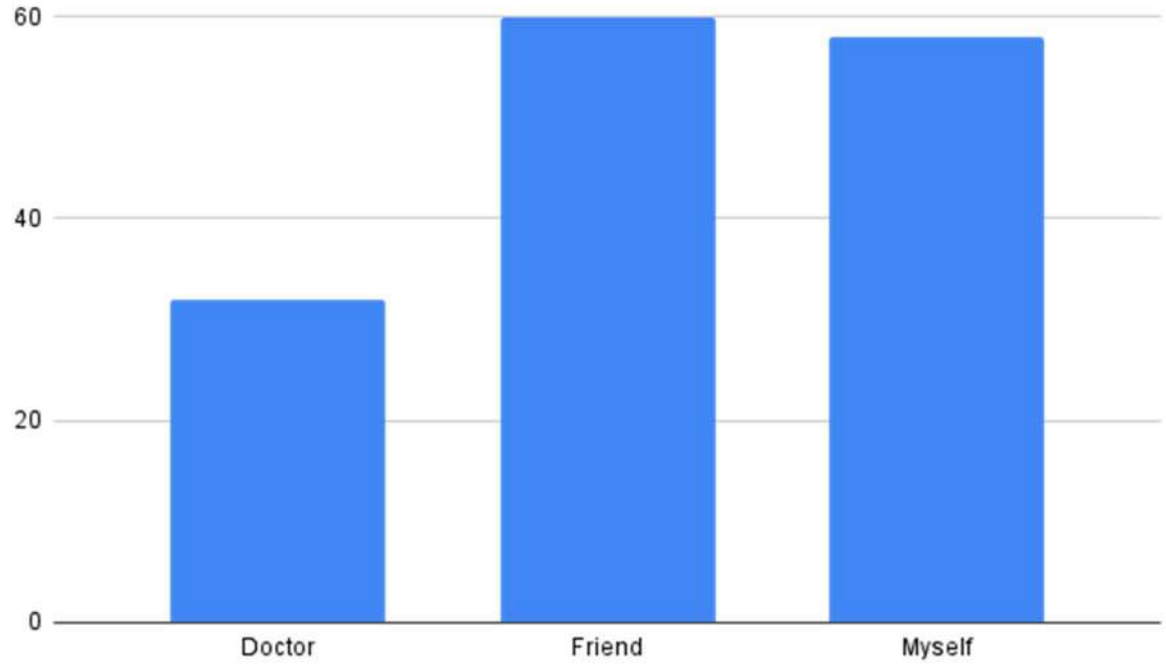


Figure 3. Who prescribed the drug used? (n = 150)

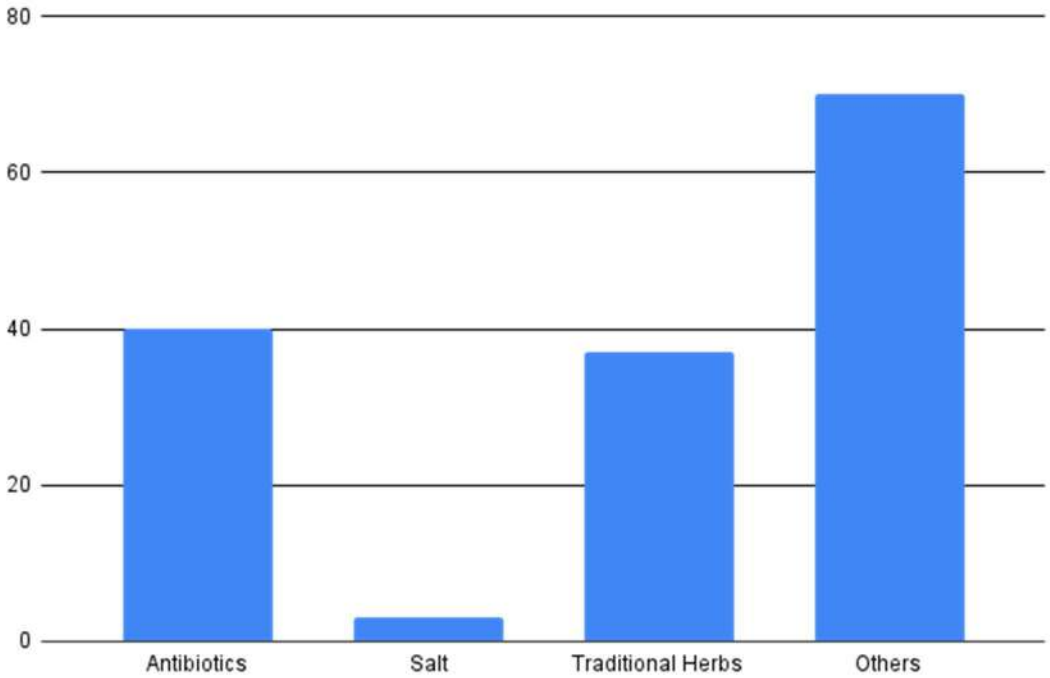


Figure 4. Treatment for sore throat (n = 150).

Discussion

Rheumatic heart disease (RHD) is one that can easily be prevented by primary intervention, which involves the use of antibiotics to treat cases of sore throats caused by A streptococcus infection occurs before complications like rheumatic fever, a precursor of rheumatic heart disease, develop. For this to be successful, the public needs to be aware of and have adequate knowledge of rheumatic heart disease. Rheumatic heart disease and fever are more common among children aged 5–15 [4]. It is expected that this age group is still under the care of their parents, especially their mothers; thus, this study was done to assess the knowledge and awareness of rheumatic heart disease among nursing mothers.

The overall knowledge of rheumatic heart disease among nursing mothers in this study was very low, as 86% of the participants had poor knowledge about the disease and only 4.7% possessed good knowledge, while the rest of the participants possessed fair knowledge about the disease. Although our findings are a bit higher, they are similar to the study carried out amongst parents by Almadhi et al., [8], where 80% of the participants had poor knowledge about rheumatic heart disease and 3.6% of the parents had good knowledge. In the study, the poor level of knowledge was attributed to a lack of awareness of the disease and emphasized the importance of raising awareness within the region.

Contradictory to our finding was that by ElTellawy et al. [1], who noted that as much as 40% of its participants possessed good knowledge of rheumatic heart disease. This difference could be due to the increased incidence of cases of rheumatic heart disease in that region, as reported by the authors, who also emphasized the need to create more awareness to combat the rise.

In this study, older participants (≥ 41 years) were found to be significantly associated with good knowledge of the disease. This finding is in tandem with that of other studies, which found that adults ≥ 35 years of age had good knowledge of the disease; however, unlike these studies, ours did not identify any significant association between the participants' level of education, occupation, and knowledge of the disease [8,11].

Two contributing factors to the level of knowledge among the mothers were their knowledge of the cause of rheumatic heart disease and the association between streptococcal sore throat and heart disease. It was observed that none of the participants knew the cause of rheumatic heart disease, and 11.3% believed there was an association between streptococcal sore throat and heart disease. Our findings, however, are in contrast to those conducted in Sokoto, which found about half of its participants unaware of acute rheumatic fever, and over 70% of them knew that there was an association between streptococcal sore throat and heart disease [12]. This disparity could be due to years of practice and attendance at health training, as the study participants were health workers at the primary health center in that city [12].

In our study, participants' attitude level towards rheumatic heart disease was quite low, as more than two-thirds (74.7%) of the participants had a poor attitude. This finding is in contrast to that by Almedhesh [13], who observed an overall positive attitude

level towards the disease among 80% of their participants. A contributing point to participants' attitudes was the importance of treating streptococcal sore throats with antibiotics, to which almost half (46.7%) of the participants in our study affirmed that it was important. This was also similar but slightly higher compared to the assessment by Almedhesh [13] in Saudi Arabia, where 45.2% of the participants agreed to the importance of treatment with antibiotics. Another similarity between our study and that by Almedhesh was in the relationship between sociodemographic characteristics and attitude level. In our study, we found a fair attitude level to be significantly present among participants who had obtained a university degree, while Almedhesh noted that a negative attitude was associated with mothers who had low education. In addition, they also found a negative attitude to be associated with being a new mother and being of a younger age, while ours found it to be associated with participants who were employed. It should be noted, however, that Almedhesh's study made use of binary logistic regression, while our study made use of chi-square in investigating the relationship between sociodemographic characteristics and the attitude level of participants.

Conclusion

Rheumatic heart disease can be prevented easily by the identification and treatment of group A streptococcus infection, which could be presented in the form of sore throats. Since this disease is more common among children 5–15 years of age, expected to be under the care, more educational intervention needs to be carried out, especially among mothers attending primary health care centers in the nation, in order to increase their knowledge and improve their attitude towards the disease, which we found to be low.

Conflict of interest

The authors declare they do not have a conflict of interest.

Funding

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ORIGINAL ARTICLE

Correlation of Vitamin D Levels with Severity of Asthma in Children Between 6 to 12 Years

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Abstract

Background: Millions of children worldwide suffer from chronic asthma, a serious respiratory disease that has a major influence on everyday living and health outcomes. There are significant public health concerns regarding the estimated 10-15% frequency of asthma in children in India. Vitamin D, which is recognized for its immunomodulatory qualities, according to recent studies reduces the severity. In this study, children aged 6 to 12 years old's vitamin D levels and the severity of their asthma were examined. **Materials and Methods:** At a tertiary care teaching hospital, 100 children between the ages of 6 and 12 who were presenting with acute exacerbations of bronchial asthma were the subjects of a prospective cohort study from August 2021 to August 2022. ELISA was used to evaluate serum 25-hydroxyvitamin D levels, and the GINA recommendations were used to determine the severity of asthma. Based on their levels of vitamin D, the kids were divided into three groups: sufficient (>30 ng/mL), insufficient (20–30 ng/mL), and deficient (<20 ng/mL). Children who were deficient in vitamin D were given supplements and monitored for three months. With SPSS 27, statistical analysis was carried out. **Findings:** The results of the study showed a strong correlation between increased asthma severity and inadequate asthma control and reduced vitamin D levels. Children with the most acute and uncontrollably asthmatic episodes were those with low vitamin D levels (<20 ng/mL). Significant improvements in asthma control, decreased activity limits, and decreased need for rescue medication were noted after three months of vitamin D administration. **Conclusion:** This study shows a clear link between children's asthma control issues and higher asthma severity when there is a vitamin D Deficiency. Supplementing with vitamin D significantly improved asthma outcomes, indicating a possible therapeutic role for this nutrient. Future studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and further elucidate the underlying mechanisms.

Keywords: Asthma, vitamin D, children, asthma severity, immunomodulation

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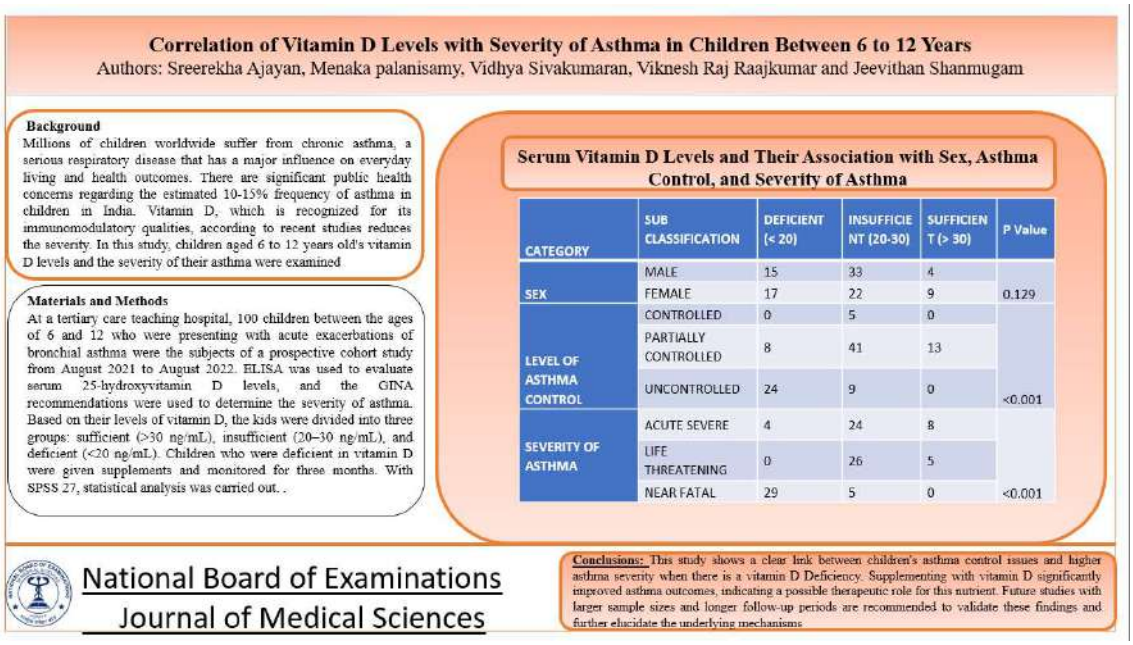
Graphical Abstract



Introduction

Chronic asthma is a respiratory disease that causes wheezing, coughing, and shortness of breath among other symptoms. It is characterized by hyperresponsiveness of the airway, inflammation and bronchoconstriction. It has a major effect on everyday activities, academic achievement, and general quality of life among children. About 7.5% of children worldwide suffer from asthma, which translates to millions of affected people and a significant financial burden on families and healthcare systems. The estimated frequency in India is between 10-15%, which raises serious public health concerns [1].

Asthma pathophysiology is a result of intricate interactions between environmental and genetic factors. Hyperresponsiveness, airway remodeling, and chronic inflammation are all influenced by these variables. Allergens, respiratory illnesses, exertion, and chilly air are common triggers. Because asthma is a chronic condition, frequent hospital visits, missed school days, and a reduced quality of life are common [2].

Although vitamin D has long been known for its benefits to bone health, its immunomodulatory properties have drawn more attention. It has a role in controlling both adaptive and innate immune responses. T-lymphocytes and dendritic cells are among the immune cells that have vitamin D receptors, suggesting that the nutrient may have a role in regulating inflammation and immunological function [3,4]. Recent data points to a link between vitamin D deficiency and an increase in the frequency and severity of asthma flare-ups. Research has demonstrated that vitamin D can boost the synthesis of anti-inflammatory cytokines, lessen airway inflammation, and strengthen immune system performance in general [5,6].

Given the significant incidence of vitamin D insufficiency worldwide, especially in children, the possible function of vitamin D in managing asthma is especially pertinent. Vitamin D insufficiency is a common condition in

India due to variables like skin pigmentation, eating habits, and insufficient sun exposure. Given its possible effects on asthma outcomes and respiratory health, this deficit is cause for concern [7].

The purpose of this study is to investigate the relationship between vitamin D levels and asthma severity in children aged 6 to 12 years, taking into account the significant burden of asthma in children as well as the high incidence of vitamin D deficiency. We can more accurately evaluate the possible advantages of vitamin D supplementation as a therapeutic approach for enhancing asthma management and lowering exacerbations by comprehending this association.

Materials and Methods

The purpose of this prospective cohort study is to investigate the association between children's asthma control, severity and vitamin D levels. Children between the ages of 6 and 12 who arrived at a tertiary care teaching hospital with an acute exacerbation of bronchial asthma made up the study population. An estimated sample size of 100 was obtained by applying a suitable statistical method with a 5% level of significance to establish the sample size. August 2021–August 2022 was the study's one-year period of conduct.

Children under the age of six or older than twelve, individuals who had recently had vitamin D treatment, kids whose conditions affected their vitamin D levels in the previous six months, who declined to give consent, and who were unwilling to follow up were all excluded. The parents of the participants (LARs, Legally Acceptable Representatives) gave their informed consent after being fully informed about the procedures and techniques of the study. Participants in the study gave their consent. The hospital's institutional ethical committee also provided ethical clearance.

Following the children's informed consent (assent) when they presented with an acute asthmatic exacerbation, pertinent data from each case chosen for the study was entered into a pre-structured Performa. Thorough clinical tests were carried out, and over the course of four weeks, the degree of asthma control was evaluated and classified in accordance with GINA recommendations. Using a Performa in Tamil, a thorough history was taken as part of the data collection process. Important details included the child's age at the onset of bronchial asthma, the time since the last attack, acute severe exacerbation, status asthmaticus, hospitalization history, history of other atopic diseases, drug history, socioeconomic history, and family history. Vital indicators like heart rate, resopiratory rate, and saturation were monitored throughout medical exams, and a thorough chest examination was performed as well. ELISA was used to measure serum 25-hydroxyvitamin D as part of the investigation. In accordance with the Vitamin D Standardization Program, blood samples were taken under aseptic precautions upon presentation in order to estimate serum 25-hydroxyvitamin D levels. These samples were then analyzed using a fully automated luminescent immunoassay. Next, using statistical techniques, vitamin D levels and asthma severity were connected. In order to examine the impact of vitamin D supplementation on asthma control and severity, children with vitamin D insufficiency were given vitamin D supplements and followed up for three months.

Based on the results of the initial measurement of vitamin D levels, the asthmatic group was split into three categories: inadequate (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL). Following a three-month period of vitamin D supplementation, the treatment's impact on asthma-related symptoms and control was assessed.

SPSS 27 was used to analyze the data once it was imported into Microsoft Excel. The fundamental clinical and sociodemographic data were tallied and presented as Mean ± SD or Frequency/ Percentage. To determine whether there was any correlation between the three categories of vitamin D levels and contributing factors, the chi square test was used. $P < 0.05$ was regarded as significant.

Results

The information offered gives a thorough picture of the patient circumstances, treatment options, and symptoms associated with asthma in a sample group. The study participants' average age was 8.36 ± 1.39 years. Over 80% of the study participants were between the ages of 7 and 10. Nine percent more were eleven years old. Boys made up 52% of the study participants, while girls made up the remaining 48%. With 51% of patients reporting less than two episodes per week, the majority of patients experienced symptoms during the day less frequently. The frequency of nocturnal awakenings was slightly lower, as only 52% of patients reported having them. Of the patients, 42% experienced limitations in their activities, and a significant majority (91%) needed rescue therapy. There were differences in the patients' levels of asthma control: only 5% had their asthma under control, 62% had it moderately controlled, and 33% had it uncontrolled. 59% of those with a hospitalization history had fewer than five admissions prior. 33% of patients were lethargic, and 62% of patients were hyperalert, according to the sensorium status. 75 percent of the patients had fast breathing. According to oxygen saturation levels, 57% of people were less than 92% saturated. In 57% of the cases, the perfusion was sufficient. The percentage of children with severe asthma was high: 36% had acute asthma, 31% had asthma that was life-threatening, and 33% had asthma that was almost fatal. 54% of hospital visits lasted fewer than five days, which is a very balanced percentage. A combination of bronchodilators, steroids, adrenaline, and magnesium sulphate were used as therapy options; 39% of patients received the most thorough care. Serum vitamin D levels showed that a significant percentage of patients (55%) had insufficient levels, with only 13% having appropriate levels. Oxygen delivery modalities varied, with 48% adopting HFNC (Table 1).

Table 1. Clinical Characteristics of the study population

Parameter	**Subclassification**	**No of Patients**	**Percentage**
Day time symptoms	> 2 times per week	49	49%
	< 2 times per week	51	51%
Nocturnal awakening	Yes	48	48%
	No	52	52%
Limitation of activity	Yes	42	42%

	No	58	58%
Rescue therapy	Required	91	91%
	Not required	9	9%
Level of asthma control	Controlled	5	5%
	Partially controlled	62	62%
	Uncontrolled	33	33%
Number of previous hospitalisation	Less than 5	59	59%
	More than 5	41	41%
Sensorium	Alert	5	5%
	Hyperalert	62	62%
	Lethargic	33	33%
Fast breathing	Present	75	75%
	Absent	25	25%
Oxygen saturation	Less than 92	57	57%
	More than 92	43	43%
Perfusion	Adequate	57	57%
	Not adequate	43	43%
Severity of asthma	Moderate	0	0%
	Acute severe	36	36%
	Life threatening	31	31%
	Near fatal	33	33%
Duration of hospital stay	Less than 5 days	54	54%
	More than 5 days	46	46%
Treatment modalities	Bronchodilator + steroid	0	0%
	Bronchodilator + steroid + s.c. Adrenaline	33	33%
	Bronchodilator + steroid + s.c. Adrenaline + mgso4	39	39%
	Aminophylline infusion	28	28%
Mode of oxygen delivery	O2 mask	13	13%
	Hfnc	48	48%
	Ventilator/cpap	41	41%
Serum vitamin d levels	Deficient (< 20)	32	32%
	Insufficient (20-30)	55	55%
	Sufficient (> 30)	13	13%

Age and vitamin D levels do not significantly correlate in the research sample. The distribution of serum vitamin D levels by category, such as sex, degree of asthma control, and asthma severity, is shown in Table 2. The distribution of vitamin D levels between males and females revealed no discernible difference ($P = 0.129$). There was a substantial correlation ($P < 0.001$) between vitamin D levels (20–30 ng/mL) and asthma control, with most controlled cases falling into this category. Likewise, a noteworthy association was discovered ($P < 0.001$) between the intensity of asthma and Vitamin D levels, emphasizing that the majority of instances that were close to death had low Vitamin D levels (< 20 ng/mL). These results imply that more severe and poorly controlled asthma episodes may be linked to decreased vitamin D levels.

Table 2. Serum Vitamin D Levels and Their Association with Sex, Asthma Control, and Severity of Asthma

CATEGORY	SUB CLASSIFICATION	DEFICIENT (< 20)	INSUFFICIENT (20-30)	SUFFICIENT (> 30)	P Value
Sex	Male	15	33	4	0.129
	Female	17	22	9	
Level of asthma control	Controlled	0	5	0	<0.001
	Partially controlled	8	41	13	
	Uncontrolled	24	9	0	
Severity of asthma	Acute severe	4	24	8	<0.001
	Life threatening	0	26	5	
	Near fatal	29	5	0	

Frequency and Percentage are the same.

88% of the children who were hospitalized to the hospital received vitamin D supplements, whereas 12% did not because their vitamin D levels were enough. Following a three-month course of therapy, additional measurements of the symptoms were taken and compared to the initial ones. The number of nighttime awakenings dropped from 48% to 39%, yet P = 0.129 indicates that this drop was not statistically significant. Significant improvements were noted in the number of children reporting restrictions of activity (P < 0.001), which decreased from 42% to 4%. Additionally, from 91% to 54% children, there was a significant (P < 0.001) drop in the need for rescue therapy. After therapy, there was a significant improvement in asthma control, as evidenced by the rise in controlled cases from 5 to 36 and the absence of uncontrolled (P < 0.001). (Table 3)

Table 3. Impact of Treatment on Asthma-Related Symptoms and Control

CONDITION	STATUS	BEFORE TRT	AFTER TRT	P VALUE
Nocturnal awakening	Present	48	39	0.129
	Absent	52	61	
Limitation of activity	Yes	42	4	<0.001
	No	58	96	
Rescue therapy	Required	91	54	<0.001
	Not required	9	46	

Level of asthma control	Controlled	5	36	<0.001
	Partially controlled	62	64	
	Uncontrolled	33	0	

Frequency and Percentage are the same.

Discussion

The goal of this cross-sectional study was to determine how vitamin D affects asthma. Our study's results are consistent with other research, showing a strong link between elevated asthma severity and inadequate asthma control and reduced vitamin D levels (6–11). According to our findings, a significant fraction of kids with severe asthma had low vitamin D levels. In particular, it was discovered that 32% of study participants lacked sufficient amounts of vitamin D. Furthermore, these individuals exhibited the greatest frequencies of severe and unmanaged asthma. After taking vitamin D supplements for three months, 88% of the hospitalized children's asthma symptoms and control significantly improved (Table 3).

Similar correlations between the severity of asthma and vitamin D insufficiency have been shown in several investigations. Children with severe asthma had considerably lower serum vitamin D levels than children with mild asthma, according to a research by Searing et al. [8]. Furthermore, Brehm et al. showed that reduced vitamin D levels were linked to a higher chance of hospitalizations and severe asthma exacerbations in children [9]. Our results are further supported by a Turkish study that found a strong inversely proportional association between elevated asthma severity and low vitamin D levels [10].

In contrast, other research has shown contradictory findings. For example, a Spanish study indicated that there was no statistically significant correlation between children's vitamin D levels and the severity of their asthma, indicating that additional factors might also contribute to the pathophysiology of asthma [11].

The function of vitamin D in immune modulation and inflammation is one of the pathophysiological processes underpinning the correlation between the severity of asthma and vitamin D deficiency. Antimicrobial peptides are better expressed when vitamin D is present, and it also affects how immune cells—such as macrophages, dendritic cells, and T lymphocytes—activate. It increases the production of anti-inflammatory cytokines like IL-10 and decreases the production of pro-inflammatory cytokines like IL-6, IL-9, and IL-17 [12,13]. This immunomodulatory impact aids in preserving the balance of the airways while lowering inflammation and hyperresponsiveness.

By increasing the expression of genes related to preserving epithelial integrity and lowering airway remodelling, vitamin D also improves lung function. Research has demonstrated that vitamin D can enhance lung function metrics like FEV1 and FVC, which are essential for managing asthma [14]. These scientific discoveries clarify why, as our study showed, vitamin D administration can

result in notable improvements in asthma control and symptom reduction.

Conclusion

This study shows a strong relationship between 6 to 12 years children's vitamin D levels and the severity and control of their asthma. The results imply that vitamin D administration may enhance symptom control and decrease the frequency of exacerbations, therefore improving asthma outcomes. It is advised that future studies be conducted with bigger sample sizes and longer follow-up times in order to confirm these results and thoroughly examine the underlying mechanisms.

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

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ORIGINAL ARTICLE

Study on the public awareness of stroke risk factors, symptoms, treatment and rehabilitation: A community based cross sectional survey from a tertiary referral centre in South India

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Abstract

Background: The incidence of Non communicable diseases (NCDs) including stroke is increasing in India over the past few years. Thrombolysis therapy has revolutionized management of acute ischemic stroke. In spite of such recent advances in stroke therapy, the public remains uninformed about stroke symptoms and management. **Objective:** To assess the public awareness of stroke risk factors, symptoms, treatment and rehabilitation measures. **Methods:** The study was a community-based cross-sectional study, designed as an online survey. The tool used for the survey was a semi-structured online questionnaire. **Results:** Regarding the risk factors of stroke, of the participants, 41 (14.8%) were aware of valvular heart diseases, 18 (6.5%) of lack of exercise, 238 (85.9%) of dyslipedemia, 236 (85.2%) of hypertension, 222 (80.1%) of smoking, and 154 (55.6%) of diabetes. Regarding symptoms of stroke, of the participants, 209 (75.5%) were aware of loss of balance, 240 (86.6%) of speech abnormalities, 261 (94.2%) of facial weakness, and 234 (84.5%) of weakness. **Conclusion:** Efforts should be made to educate the public regarding uncommon symptoms of stroke, thrombolysis treatment and rehabilitation measures, so that people make beneficial health care decisions in stroke management.

Keywords: Stroke; Window period; Thrombolysis

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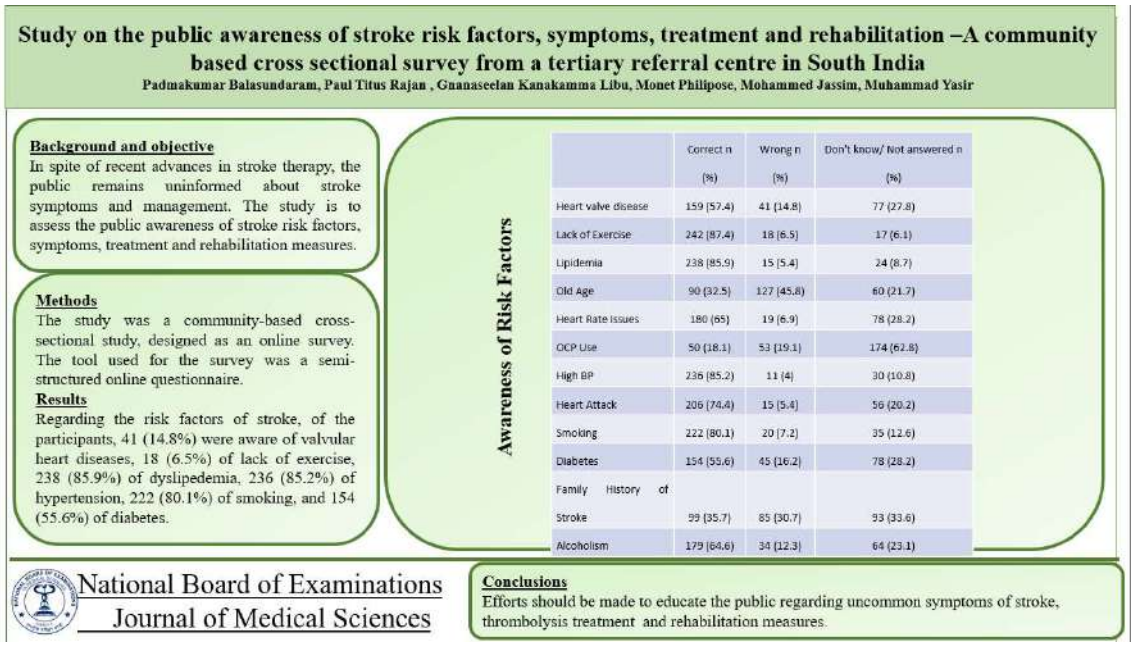
Graphical Abstract



Introduction

Global Burden of Disease (GBD) 2019 stroke burden estimates showed that stroke remains the second leading cause of death and the third leading cause of death and disability combined (as expressed by disability-adjusted life-years lost—DALYs) in the world [1]. The burden of stroke will grow mostly in developing countries rather than in developed countries [2]. The incidence of Non communicable diseases (NCDs) is increasing in India over the past few years and stroke is India's fourth leading cause of death and fifth leading cause of disability [3].

In recent studies from India, it has been estimated that less than 20% of stroke patients reach a thrombolysis ready centre within the window period and only up to 3.5% of all stroke patients receive thrombolysis [4,5].

Studies from India reported poor awareness of stroke among the population, where the respondents could not even identify the organ affected in stroke [6]. Lack of knowledge of warning signs of stroke and inadequate emergency response often lead to delays in delivery medical/emergency care within the golden hour [7]. Distance from hospital, contact with a local doctor and low threat perception of symptoms of stroke were independent factors associated with delay in arrival [8].

Methodology

The study was a community-based cross-sectional study, designed as an online survey and the study setting was entire State of Kerala.

Inclusion criteria were people aged more than 18 years who could access the online questionnaire through smart phone or computer and were willing to participate in the study. People who were not willing to participate in the study were excluded from the study.

The study duration was 3 months. The tool used for the survey was a semi-structured online questionnaire that included consent and questions regarding risk factors, symptoms and treatment of

stroke. The questionnaire questions were direct, simple and precise.

KoBo Toolbox, a free, open-source tool for mobile data collection, were used in the survey. Those who gave consent could finish the online survey and submit to the principal investigator's account on a real-time basis. The gathered data was exported from the database to IBM SPSSv. 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) and was analyzed.

Results

277 persons took part in the survey and 140 (50.5%) were males and 137 were (49.5%) females. 139 (50.9%) persons belongs to 18-45 age group, 109 (39.9%), 46-65, and 25 (9.2%) above 66 years. Regarding the educational status among the 271 respondents 25 (9.2%) had school education, 147 (54.2%) college education and 99 (36.5%) were professionally qualified. Among the respondents 53 (19.5%) were students, 8 (2.9%) were manual labourers, 127 (46.7%) were office workers, 46 (16.9%) were retired from service, 38 (14%) had no job and 5 (1.8%) persons did not respond to the question.

Regarding awareness about transient ischemic attack, 231 (83.4%) answered that such patients require prolonged treatment and 2 (0.7%) answered that no need of it and for 44 (15.9%) persons, they do not know the answer. 153 (55.2%) answered that transient ischemic attack is a predictor of future stroke and 18 (6.5%) answered that it is not a predictor and 106 (38.3%) answered that they do not know the answer.

Questions were asked regarding steps to be taken if we suspect stroke. Of the participants, 264 (95.3%) responded that we should carefully observe the symptoms, 3 (1.1%) answered that there is no need, and 10 (3.6%) responded that they do not know the answer. Regarding first aid, 226 (81.6%) of the participants responded that first aid should be given to patients who have developed stroke, 9 (3.2%) responded that there is no need for it, and 42 (15.2%) responded that they do not know the answer. Of the participants, 83 (30%) responded that food and drinks can be given to a patient who has developed a stroke, 64 (23.1%) responded that food should not be given, and 130 (46.9%) responded that they do not know the answer. Of the participants, 270 (97.5%) answered that immediately we should call an ambulance, 2 (0.7%) answered that there was no need for it, and 5 (1.8%) responded that they did not know the answer. Of the participants, 256 (92.4%) responded that immediate care is necessary for a patient who has developed a stroke, and 21 (7.6%) responded that they do not know it [4,5].

Regarding awareness about the complications of stroke, 173 (62.5%) responded that venous thrombosis of the legs can occur, 100 (36.1%) answered that they did not know it, and 4 (1.4%) did not know the answer. Of the participants, 188 (67.9%) answered that they knew about muscle contracture following stroke, 83 (30%) answered that they did not know it, and 6 (2.2%) answered that they did not know the answer. Of the participants, 158 (57%) responded that they knew about the aspiration of food contents producing pneumonia as a complication of stroke, 117 (42.2%) responded that they did not know about it, and 2 (0.7%) responded that they did not know the answer. Of the participants, 160 (57.8%) responded that depression can occur as a complication of stroke, 114 (41.2%) do not know about it, and 3 (1.1%) do not know the answer.

Table 1. Awareness of Risk Factors

	Correct *n* (%)	**Wrong *n* (%)**	**Don't know/ Not answered *n* (%)**
Heart valve disease	159 (57.4)	41 (14.8)	77 (27.8)
Lack of Exercise	242 (87.4)	18 (6.5)	17 (6.1)
Lipidemia	238 (85.9)	15 (5.4)	24 (8.7)
Old Age	90 (32.5)	127 (45.8)	60 (21.7)
Heart Rate Issues	180 (65)	19 (6.9)	78 (28.2)
OCP Use	50 (18.1)	53 (19.1)	174 (62.8)
High BP	236 (85.2)	11 (4)	30 (10.8)
Heart Attack	206 (74.4)	15 (5.4)	56 (20.2)
Smoking	222 (80.1)	20 (7.2)	35 (12.6)
Diabetes	154 (55.6)	45 (16.2)	78 (28.2)
Family History of Stroke	99 (35.7)	85 (30.7)	93 (33.6)
Alcoholism	179 (64.6)	34 (12.3)	64 (23.1)

Table 2. Awareness of Stroke Symptoms

	Correct *n* (%)	**Wrong *n* (%)**	**Don't know/ Not answered *n* (%)**
Loss of Balance	209 (75.5)	16 (5.8)	52 (18.8)
Symptoms of Vision	148 (53.4)	39 (14.1)	90 (32.5)
Speech Disturbance	240 (86.6)	8 (2.9)	29 (10.5)
Facial Palsy	261 (94.2)	1 (0.4)	15 (5.4)
Weakness of Limbs	234 (84.5)	7 (2.5)	36 (13)
Time	172 (62.1)	105 (37.9)	

Table 3. Awareness about Hospital Selection, Thrombolysis and Ideal Time for Thrombolysis

	Correct *n* (%)	**Wrong *n* (%)**	**Don't know/ Not answered *n* (%)**
Hospital Selection	159 (57.4)	117 (42.2)	1 (0.4)
Awareness of Thrombolysis	159 (57.4)	117 (42.2)	1 (0.4)
Time Interval for Thrombolysis from Stroke Onset	263 (94.9)	7 (2.5)	7 (2.5)

Table 4. Awareness about Rehabilitation and home care

	Correct *n* (%)	**Wrong *n* (%)**	**Don't know/ Not answered *n* (%)**
Need for Rehabilitation	183 (66.1)	93 (33.6)	1 (0.4)
Speech Therapy	249 (89.9)	25 (9)	3 (1.1)
Long Term treatment	184 (66.4)	90 (32.5)	3 (1.1)
Rehabilitation Useful	167 (60.3)	108 (39)	2 (0.7)
Palliative Care	228 (82.3)	46 (16.6)	3 (1.1)
	Correct n (%)	Wrong n (%)	Don't know/ Not answered n (%)
Sitting Feeding	217 (78.3)	56 (20.2)	4 (1.4)
Ryles Tube Feeding	246 (88.8)	28 (10.1)	3 (1.1)
Prevention of Bedsore	247 (89.2)	27 (9.7)	3 (1.1)
Urine Catheter	244 (88.1)	28 (10.1)	5 (1.8)
Catheter Change	238 (85.9)	32 (11.6)	7 (2.5)

Discussion

Awareness about risk factors of stroke were found to be satisfactory among the participants of the study. More than fifty percent of the participants were aware that valvular heart disease (57%), lack of exercise (87%), dyslipidemia (86%), arrhythmias (65%), alcohol consumption (65%), hypertension (85%), smoking (80%) and diabetes (56%) can lead to stroke and this awareness of risk factors is higher than the 50% reported by previous studies from India and abroad [9–12]. This is probably because Kerala has the highest literacy rate in India and the health education activities by the government and non-governmental organizations at the community level were commendable. Hypertension was identified by 85 % as a risk factor for stroke and this finding is consistent with studies from India and other countries where Hypertension was the best recognised risk factor [13–21].

Regarding the awareness about stroke symptoms, more than 50 percent of the participants were aware of the popular FAST acronym regarding stroke which includes face weakness, arm weakness, speech problems and time to call ambulance. Most common symptom identified was facial weakness (94%) followed by speech disturbances (86%), weakness of arms and legs (84%) and loss of balance (75%). Even though awareness about the common symptoms of stroke were good among the participants, uncommon symptoms like visual symptoms were less recognized (53%). Awareness about such uncommon warning signs of stroke should be included in the stroke awareness programmes [22,23].

Regarding the question to which hospital, you will take a patient with stroke, 159 (57.4%) answered medical college hospital. Comparable responses were seen in other studies [24,25] except in Korean subjects [26] where only 46% of them mentioned that they would visit a hospital. 25% of the respondents answered that they will take the stroke suspected patient to a nearby clinic and proper awareness is required in this matter to highlight the importance of taking the patient to a centre where facility for thrombolysis is available.

81% participants responded that first aid should be given to patients who developed stroke and 30% responded that food and drinks can be given to a patient who developed stroke. Proper health education is necessary, as unnecessary first aid attempts will produce further delay in taking the patient to the hospital for optimum treatment. Also trying to feed a semi-conscious or un conscious patient may lead to development of aspiration pneumonia as silent aspiration is common in acute stroke patients [27].

98% of participants responded that they will call an ambulance immediately if they come across a patient with stroke. This awareness is better than many developed nations where 60-94% reported that they would call EMS (Emergency Medical Services) [28,29] and (92%) responded that immediate care is necessary for a patient who developed stroke and this knowledge is higher than other Indian studies [30,31].

Regarding thrombolysis treatment, 57% persons answered that they are aware of thrombolysis treatment for stroke. Regarding the time interval from onset of stroke for thrombolysis treatment, 94 % answered that within 4.5 hours and this shows that adequate knowledge about receiving immediate treatment is present in the participants. Knowledge regarding thrombolysis treatment is better than other Indian studies where only 10% is aware of

clot lysis treatment and only 5% is aware of the golden hour to rush to the hospital [32]. Even though 57 % of the participants are aware of thrombolysis treatment remaining 42% are unaware of this modality of treatment and hence proper public health education activities are necessary in this matter.

Regarding transient ischemic attacks, even though 55% answered that it is a predictor of stroke, 45% does not have any idea about it and hence proper awareness programme in this is also necessary.

Most of the studies in literature did not address the issue of knowledge about the rehabilitation.66% of the respondents were aware of rehabilitation in stroke and 60% answered that it hastens recovery. Findings of our study are similar to a study from Iran where 60% were aware of the effectiveness of rehabilitation methods such as speech therapy and physio-therapy in improving stroke complications [33].

This response is better than many other studies from abroad where only 50% were aware of the necessity of chronic disease management and 37% were aware of the importance of physiotherapy [34]. A study from Malaysia states that rehabilitation was an important part of stroke management [35]. Physical therapy (73%) and traditional treatments (43%) were the most frequently selected rehabilitation preferences in the high school students and college students in an Indian study [36]. Higher level of education may be the reason for better awareness among the public about the importance of rehabilitation in stroke.

There are not much studies in the literature about the awareness of the public regarding home care of stroke patients. Home care is an integral part of primary health care (Freeman, 2016) [37]. Our study shows that the respondents have good awareness about home care of bed ridden stroke patients like knowledge about Ryles tube feeding (89%), keeping the patient in sitting position while feeding (78%), frequent change of posture to prevent bed sores (89%), catheterisation in patients with difficulty in passing urine (88%) and that urinary catheter should be changed every month (86%).

Many studies did not address knowledge of public about complications after stroke. Respondents of our study has good knowledge about various complications like venous thrombosis of legs (62%), muscle contracture (68%), aspiration pneumonia (57%), keratitis (50%) and depression (58%). As per the best of our knowledge, this is very first study of its kind, which addressed the community's awareness of complications of stroke and home care of stroke patients.

Respondents have good knowledge regarding risk factors, common symptoms of stroke and thrombolysis treatment. But more awareness is necessary in certain areas like uncommon symptoms and TIA, necessity of taking the patient to a tertiary care centre immediately without any attempt for first aid.

Limitations

1. The sample size was small, and the results do not reflect the overall situation of the country.
2. Using the "don’t know" option in open-ended questions may have caused more respondents to choose it without thinking about the right answer.
3. Leading questions like time interval for thrmbolysis from stroke onset may have caused more respondents to give correct answer.

Conclusion

This review highlights the importance of increasing public awareness about uncommon stroke symptoms, risk factors and the emergency response that is required. Efforts should be made to educate the public regarding thrombolysis treatment which has radically changed the perception and management of stroke patients and rehabilitation so that people make more rational and beneficial health care decisions. Continued, and intensified educational efforts to promote knowledge of stroke, particularly among high-risk groups, should be encouraged and promoted.

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

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ORIGINAL ARTICLE

Oral Health Surveillance System in India: Need and Proposal

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Abstract

Public health surveillance is described as the ongoing systematic collection, analyzing, and interpreting of the data, closely integrated with the transmission of these data to public health practitioners, doctors, and policymakers responsible to prevent and manage disease as well as injury. Both developed and developing nations are becoming aware of the significance of information from efficient surveillance systems for allocating resources and evaluating programs. Over the past few decades, there was a significant change in oral health profiles around the world. Indicators of oral health have improved in many countries, but not in India. An organized system for providing, monitoring, and evaluating oral health care services is needed in India. Draft National oral health policy 2021 has mentioned specific objectives: (a) by 2025, establish baseline data on the burden of oral diseases in the nation, (b) by 2030, the mortality and morbidity from dental and oro-facial diseases reduce to 15%, (c) By 2025, community-based awareness initiatives and practices for oral health will be covered by the healthcare system by a factor of 50%, and by 2030, by a factor of 70%, (d) the creation of an electronic database at district-level on components of the health system by 2025. A well-defined oral health surveillance system in India will serve the purposes (a) to provide standardized recording procedures, standards, and techniques to collect, analyze and interpret the oral health data at the state and central levels (b) to prioritize oral diseases or conditions that will be the focus of oral health surveillance or disease elimination, (c) to digitally monitor and evaluate the progress of nation's oral health care programs.

Keywords: Disease surveillance systems, Oral health, Screenings, Surveillance, Monitoring

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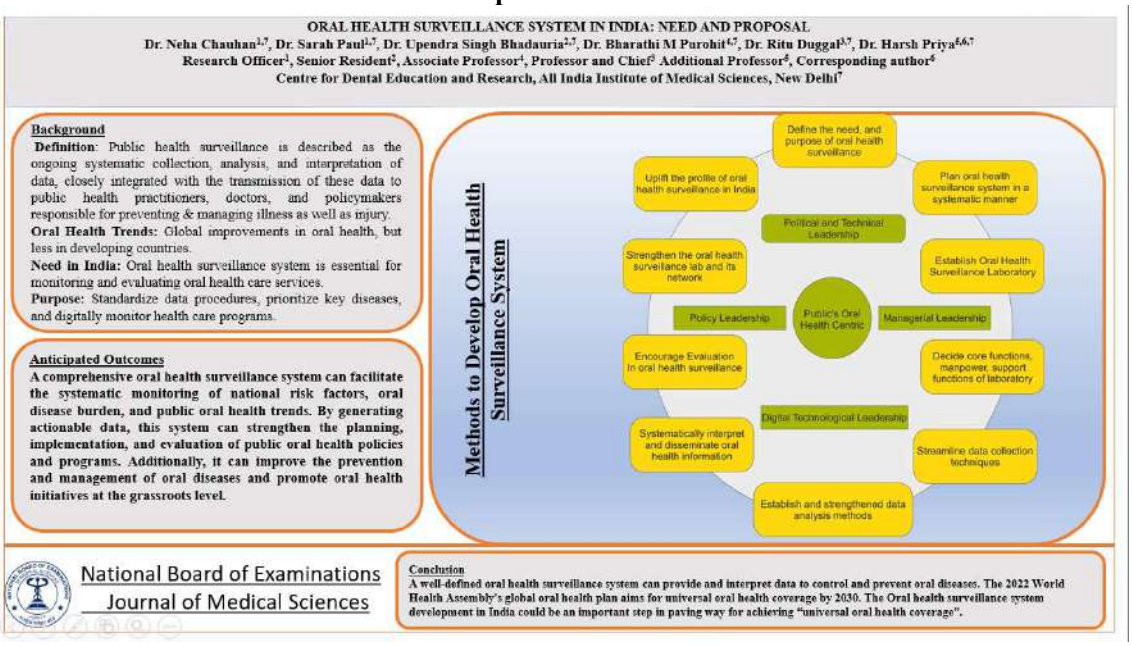
Graphical Abstract



Introduction

Public health surveillance is described as the ongoing systematic collection, analyzing, and interpreting of data, closely integrated with the transmission of these data to public health practitioners, doctors, and policymakers responsible to prevent & manage illness as well as injury [1]. Public health surveillance provides estimates of the health state and behavior of people that are serviced by "ministries of health, finance, and donors". Public health surveillance aims to give organizations a factual foundation to define priorities, design programs, and policies, and take measures to improve and protect public health [2].

Ongoing Public Health Surveillance

Both developed and developing nations are becoming aware of the significance of information from efficient surveillance systems for allocating resources and evaluating programs.

The CDC ("Centres for Disease Control and Prevention"), a global public health surveillance leader, is transforming and modernizing CDC's surveillance systems and methods in collaboration with other public health organizations. Delivering real-time information is being made easier by advancements in fundamental surveillance technologies. The National Violent Death Registration System, "Molecular Surveillance," and "Million Hearts," all projects of the CDC, have strengthened public health surveillance. The outcomes of these projects include the more rapid characterization of infectious disease threats, rapid outbreak detection, efficient investigations for large infectious disease outbreaks, improved state and national coverage, and integration of various data sources by utilizing the already-existing healthcare quality data required for Medicare and other health insurance payments and electronically reported clinical quality measures to improve national health surveillance [3].

The IDSP (Integrated Disease Surveillance Programme) is a national

disease surveillance program in India that involves both the state and central governments. Its goals include early disease identification and long-term disease monitoring to support effective policy decisions. With the help of the World Bank, it began in 2004 [4]. Every state has surveillance units in operation. Data from medical schools, clinics, hospitals, labs, and other locations are used to track and report illnesses. Under this plan, a geographic information system (GIS) is utilized. Data on "P" probable, "S" syndromic, and "L" laboratory formats are being obtained utilizing standard case definitions. Inputs from remote sensing, historical data, and meteorological data are also included in the data collection. Weekly statistics on diseases that are prone to outbreaks are gathered under IDSP (Monday–Sunday). The Rapid Response Teams (RRT) investigate any rising trend of infections to identify and contain the outbreak. In November 2019, the IHIP (Integrated Health Information Platform) was introduced in several states to enhance digital surveillance capabilities [4,5].

Operating oral health surveillance

The governments of nations such as the United States and Japan, give great importance to Oral health surveillance to evaluate the incidence of oral ailments among their population.

The NOHSS ("National Oral Health Surveillance System") was created in cooperation between ASTDD ("Association of State and Territorial Dental Directors") and the CDC's Division of Oral Health. NOHSS aims to monitor oral disease burden, oral health care utilization, and community water fluoridation levels.

In NOHSS, oral health data is collected under Adult, Child, and Water fluoridation indicators. Adult indicators comprise dental visits, complete teeth, teeth cleaning, and loss of 6 or more teeth. Child indicators comprise caries experience, untreated tooth decay, and dental sealants. Water fluoridation indicators include the % of population that uses fluoridated water provided by public water systems. The 2019 oral health surveillance report evaluates trends between 1999-2004, identifies oral health disparities based on certain sociodemographic variables, and gives national estimates for several methods of oral health status for the years 2011 to 2016 [6,7].

Japan has a well-defined system for monitoring oral health, which is followed by development of an oral health strategy and the examining and assessment of outcomes. "Ministry of Health, Labour and Welfare", Japan conducted Japan Survey on Dental Illnesses every six-year, data on the nation's dental health i.e., frequency of edentulism, fillings, dental caries, cavities, the number of missing permanent teeth, implants, prosthetics, temporomandibular disorders, oral hygiene practices, bite quality, and fluoride administration is gathered by oral examination and interviews. The survey done in 2016 was the 11th in the series. Data on national oral health indicate that during the past few decades, the oral health of the people of Japan has improved, addressing regional disparities in oral health, lowering healthcare costs, establishing long-term emergency dental services during disasters, and creating an innovative tele-dental process for remote regions having no approach to dentists are some of the challenges and opportunities that need to work on in the future [8-10].

Trends of oral health diseases in India

Dental caries prevalence varied from 23.0 - 71.5 percent in 12-year-olds and from 48.1 - 86.4 percent in adults aged 35 to 45, based on biannual multi-centric oral health study done by "Ministry of Health and WHO" in India in 2007–2008. However, the frequency of dental caries in elders aged 65-74 varied from 51.6 percent to 95.1 percent. The prevalence of periodontal disorders in adults and the elderly, respectively, ranged from 15.32% to 77.9% and 19.9% to 96.1%.[13]

As per The Global Oral Health Status Report (GOHSR) 2022, India experienced significant oral health challenges. The total number of cases for caries of permanent teeth was 366,858,183, representing 18.1% of the global caseload. Severe periodontal disease affected 221,084,427 individuals, accounting for 20.3% of cases worldwide. Caries of deciduous teeth were prevalent in 98,199,025 cases, or 18.9% of the global total. Edentulism impacted 34,905,533 people, making up 9.9% of the worldwide cases. Additionally, lip and oral cavity cancer affected 327,648 individuals in India, constituting 23.4% of the global caseload.

Development of Oral health surveillance system in India- Why it is needed?

Globally Approx 3.5 billion people have been impacted by oral diseases and conditions [11]. Over the past few decades, there has been a significant change in the oral health profile around the world. Indicators of oral health have improved in many countries, but not in India [12,13].

In India, oral disorders are one of the leading sources of disability and impact people of all ages, regardless of their socioeconomic status [14]. According to Singh et.al. [15], challenges to accessing dental care in India are: (a) shortage of public awareness of significance of oral health, which is seen by many as unrelated to and secondary to general health (b) geographic distance posed as a hurdle for many people to have access to dental healthcare providers (c) Many people cannot afford dental care.

The biannual multi-centric oral health survey 2007-2008 was the last national oral health survey done in India. There is a significant dearth of valid and reliable data for assessing community oral health needs. An organized system for providing, monitoring, and evaluating oral health care services is needed in India [11,12,16].

Draft National oral health policy 2021 has mentioned specific objectives: (a) by 2025, establish baseline data on the burden of oral diseases in the nation, (b) by 2030, the mortality and morbidity from oro-facial and dental diseases reduce to 15%, (c) by 2025, 50 percent increase in community-based awareness programmes as well as processes for oral health via health care, and 70 % by 2030. (d) by 2025, The construction of an electronic information database on health system components at district level [12].

A well-defined oral health surveillance system in India will serve the purposes (a) to provide standardized recording procedures, standards, and techniques to collect, analyze and interpret the oral health data at the central and state levels (b) to prioritize oral diseases or conditions that will be the focus of oral health surveillance or disease elimination, (c) to digitally monitor and evaluate the progress of nation's oral health care programs.

Proposals for instituting an oral health surveillance system in India (Figure 1)

Assessment of a public's oral health status is one of the main purposes of oral health surveillance. The identification and development of a collection of indicators that assess the key aspects of oral health status is one approach to addressing this issue. To be used at the state, local, and national levels, such a set was created in the United States [17,18].

Methods

Once the necessity and purpose of surveillance system were established, strategies for collecting, analyzing, exchanging, and utilizing the data should be developed and put into operation.

Steps in planning an oral health surveillance system in India [17]

1. Establish objective:

Objectives of the oral health surveillance system can be:

1. Estimate the extent of oral disease in India.
2. Identify which groups of individuals are most susceptible to risk.
3. Analyze the effectiveness of oral health programs and policies that have been implemented.
4. Monitor changes in indicators of oral health.
5. Enhance prevention and management of oral diseases as well as promotion of oral health activities at the grass root level.
6. Enhance the use of new digital technologies for data collection and sharing processes for the surveillance of oral health.
7. Strengthen surveillance laboratory infrastructure, referral networks, and Community-based oral health surveillance.

2. Develop case definitions

Establish oral health surveillance activities to ensure that important indicators of oral health (Dental Caries status & Treatment Need, Oral Cancers, Malocclusion Status, Periodontal Disease status, and other oral mucosal conditions, Dental Fluorosis status, Other conditions: Extra Oral Lesions; TMJ Assessment; Hypoplasia and Enamel Opacities; Prosthetic Need & Status; and Community need for immediate Referrals and Care) are recorded using standardized methods with consideration for national and international comparability.

3. Data collection

Concerned authorities can develop an oral health evaluation and individual questionnaire to evaluate oral health and collect data on etiologic variables associated with individual practices, knowledge, and awareness of oral health. Data can be collected through basic screening annual surveys.

4. Standardization

For each data element, instruments for data collection must use generally accepted and when appropriate, computerized formats to facilitate the ability to analyze and compare the obtained data with that collected by other systems, for example, census and other surveillance data.

5. Field testing

To facilitate the implementation of an efficient oral health surveillance system

and prevent variations during system implementation on a large scale, surveillance systems and processes must be developed, refined, and field-tested.

6. Data analysis

The majority of modern surveillance systems are maintained electronically. An oral health surveillance laboratory can be established at the central level, and the oral health experts' team can be appointed for the laboratory to organize the data collection, coordination, and analysis of these various systems. In an oral health surveillance laboratory, surveillance data may be stored and preserved.

7. Interpretation and Dissemination

The results of the oral health surveillance can be shared with concerned programs and decision-makers through published reports, presentations, and briefings.

Reports can include current oral health information and any available trends. All reports are digitally accessible on authorized websites.

8. Evaluation

Evaluation is essential as it encourages the optimum utilization of public health resources. The analysis will identify indicators that may no longer be important for the public's oral health. It can also discover critically important new indicators, increase effectiveness to prevent duplication in data collection, and determine whether oral health surveillance is meeting its objectives.

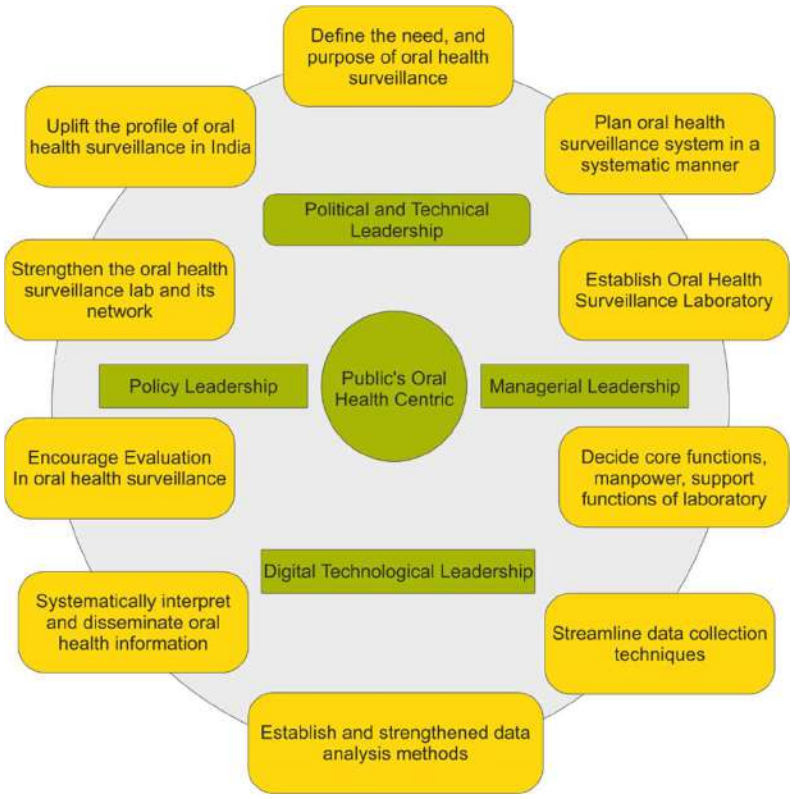


Figure 1. Proposals for instituting an oral health surveillance system in India [19]

Anticipated Outcomes

A well-developed oral health surveillance system will enable systematic tracking of the nation's burden of risk factors, oral disease, and trends in public oral health. Surveillance generates "data for action" and will enhance public oral health policies and programs' planning, implementation, and evaluation. Prevention and management of oral diseases and promotion of oral health activities at the grass root level will also be enhanced.

Building an Optimal Oral Health Surveillance System in India: Challenges Ahead

It has been demonstrated that oral diseases and other NCDs (Non-Communicable Diseases) share behavioral risk factors, such as excessive sugar consumption, alcohol consumption, bad dietary habits, and smoking. Main NCDs like diabetes mellitus and cardiovascular illnesses have been found associated with poor dental health. Non-communicable disease surveillance is not given considerable attention in India. The IDSP has a division for NCDs that focuses on diabetes, cardiovascular disease, and cancers and includes surveillance and other pilot projects. However, there is still work to be done to fully integrate surveillance for NCD risk factors, disease, and mortality rates [20,21].

Conclusion

Oral health is an essential indicator of overall health, well-being, and quality of life. Even though oral diseases are mostly preventable, they still pose a serious health threat to many countries and have a lifelong effect on individuals, resulting in pain, discomfort, disfigurement, and even death. The main burden of oral diseases in India is caused by periodontal disorders, dental caries, and oral malignancies. A well-defined oral health surveillance system can provide and interprets data to facilitate the control and prevention of oral diseases. In 2022, World Health Assembly established the global oral health plan to provide "universal oral health coverage" for all persons and communities by 2030. This strategy comprises a monitoring framework for tracking progress and measurable targets to be achieved by that year. The Oral health surveillance system development in India could be an important step in paving way for achieving "universal oral health coverage".

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

Funding

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ORIGINAL ARTICLE

Evaluation of Inverse Planned and Forward Planned Intensity Modulated Radiotherapy Techniques in Breast Cancer

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Abstract

Introduction: The objective of this study is to compare the dosimetric parameters of radiation to the whole breast between the two intensity-modulated radiotherapy (IP IMRT) techniques, i.e. Inverse planned IMRT (IP IMRT) and Forward Planned IMRT (FP IMRT) with regard to target coverage (PTV) and irradiation of organs at risk (OAR). **Material and Methods**: Plain and Contrast enhanced computed tomography (CECT) datasets were created for 41 patients treated with whole breast radiation therapy. CT simulation and treatment is performed using deep inspiratory breath hold technique (DIBH). Radiotherapy treatment Planning is done using Eclipse Treatment Planning System (version 13.7) with a prescription dose of 40 Gy in 15#. The developed treatment plans were subjected to objective comparison of PTV and OARs using dose volume histograms (DVH). **Results:** IP IMRT plans provided better coverage (99.5% vs 97.6%), comparable though higher maximum dose (Dmax 45.0 VS 44.1 Gy), higher hot spot (PTV105% 49.2 vs 33), lower volumes receiving 20, 25, 30 Gy (V20, V25, V30) for heart, more homogeneous (homogeneity index 0.10 vs. 0.14) and conformal dose distribution (conformity Index 1.0 vs 0.98) compared to FP IMRT. Regarding OAR dosimetry it is observed that FP IMRT showed reduced mean dose to Coronary artery (LADCA), Contralateral Lung (CL), Contralateral breast (CB) along with reduction in low dose region (V5) to all OARs under study. It was also observed that Monitor units used and planning time were lower for FP IMRT. **Conclusion:** On weighing different dosimetric factors, both the techniques have displayed their own advantages and disadvantages. Choosing a planning technique needs to be customized taking into consideration various factors such as breast topography, size and volumes of breast, availability of expertise planning skills and resources.

Keywords: Breast cancer, Intensity-Modulated Radiation therapy, DIBH Method, Hypofractionation

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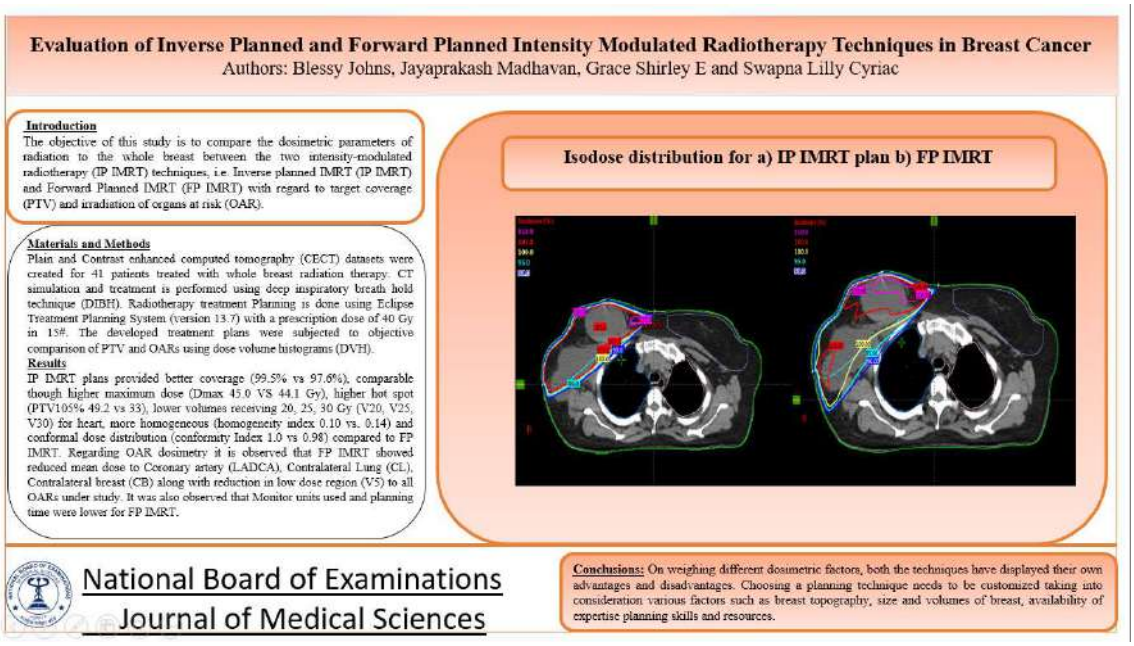
Graphical Abstract



Introduction

It has long been the standard of practice for women who have had Breast Conservation Surgery (BCS) to have their entire breast irradiated for Early Breast Cancer (EBC) [1]. The Early Breast Cancer Trialists Collaborative Group (EBCTCG) meta-analysis demonstrated local control and survival gains which serves as the groundwork for this practice [2].

Evolution of radiotherapy (RT) from Conventional 2D Wedge technique to three dimensional conformal radiotherapy (3D CRT) over the years is based on improving clinical outcome by maximizing therapeutic ratio ie maximum tumor control with minimal normal tissue complications. 3D CRT has the disadvantage of inhomogenous dose distribution, resulting in hotspots and normal tissue toxicity despite having good local control [3]. Hence novel radiation therapy technologies have been developed to address these issues, which lead to advances including Intensity modulated radiation therapy (IMRT), volumetric modulated arc therapy (VMAT), lately electronic tissue compensation (Ecomp) [4].

IMRT is a technique that lowers normal tissue toxicity while delivering highly conformal radiation with better dose homogeneity. Treatment intensification is possible using IMRT since IMRT permits selective dose escalation within gross tumor volumes with acceptable toxicity (simultaneous integrated boost) [5]. The two common descriptors for IMRT are forward planning "fields in field" IMRT (FP IMRT) and inverse planning IMRT (IP IMRT). The parameters of beams with respect to number, direction, aperture, and weights in IP IMRT are determined by inverse planning optimization to meet adequate target coverage while meeting OAR dose constraints goals. The FP IMRT planning technique create subfields in open field by placing MLC (Multileaf Collimator) to hot

areas at the same time making sure target coverage is achieved by viewing isodose distribution in beams eye view (BEV) projection.

Another advancement in breast cancer RT technology is Respiratory gating (RG) techniques, including deep inspiration breath hold (DIBH) which has led to decreased incidence of RT induced Cardiovascular disease [6]. The purpose of using radiation during a deep breath hold is based on the observation that during a deep breath diaphragm flattening and lung expansion cause the distance between the breast and chest wall to reach its maximum. Timing radiation in DIBH has shown reduction in radiation dose to heart, ipsilateral lung and LADCA (Left anterior descending coronary artery) compared to free breathing in several studies [7].

In this study, radiation dose to breast which is PTV and adjacent normal tissue (OAR) are compared between IP IMRT and FP IMRT techniques incorporating DIBH prescribed for hypofractionation schedule which is the current standard of care in practise.

Materials and Methods

Patient Selection

This study was a prospective observational research project done from September 2018 to June 2019 conducted at KIMS Cancer centre, Trivandrum post Institutional human ethics committee (IHEC) approval. Females less than 70 years who have undergone BCS for early breast cancer with ECOG Performance Status 0-1 and comfortable breath hold lasting for 15 seconds were included. Twenty cases of the left sided and twenty one cases of the right sided breast cancer, with different breast volumes and separations were chosen.

Immobilization and CT simulation

Whole breast and post-operative surgical scars were marked with radio-opaque wire. Patients were counseled regarding the process of acquiring breath hold and trained prior to the planning CT scan. Patients were immobilised in supine position using vacuum cushion (vaclok), with head turned to the opposite side and both arms lifted above the shoulders.

On the day of simulation, patient's ability to hold their breath without any discomfort in treatment position was assessed. Free breathing scans followed by DIBH planning scans both plain and contrast enhanced CT scans (CECT) of slice thicknesses of 3 mm were obtained. The vertical displacement of chest wall during respiratory movement is measured to set the threshold. The reproducibility of breath hold threshold is verified by taking CBCT images during entire breathhold and compared with threshold obtained at simulation. Treatment was done by placing a block with reflective markers on the chest wall below the xiphoid process. The camera system linked to linear accelerator is automatically set to hold beam when patient's breathing fall outside of the acceptable threshold. This ensures patient is treated in deep inspiration.

Target Volumes

CT images is transferred to a planning system with an Eclipse External Beam Planning software. Image registration and delineation of gross tumour volume (GTV), PTV and OARs are carried out according to the RTOG Consensus guidelines for delineating target and normal structures for breast cancer in plain CT images [8].

Breast CTV consists of the apparent glandular breast tissue seen by

CT, as well as the palpable breast tissue marked with radio-opaque markers during CT simulation and the Lumpectomy CTV. The intact breast PTVs were restricted to 5mm under the skin surface, to exclude the buildup region from the PTV. The contralateral breast PTV consists of apparent CT glandular breast tissue seen by CT. Lung volumes were contoured with auto segmentation with manual verification. The heart was contoured from below the level where the pulmonary trunk divides into the left and right pulmonary arteries to its lower limit near the diaphragm [9]. The Liver was delineated slice by slice based on RTOG upper abdomen contouring guidelines [10]. Contouring of Left anterior descending branch of coronary artery (LADCA) was done according to heart atlas by Feng et al. [9].

Treatment planning

For each dataset, two distinct IMRT plans (IP IMRT and FP IMRT) were generated and compared against each other independent of original plan used for treatment to minimise variability in contouring and planning and to make more suitable for comparability. For consistency all planning was done with same physicist. The planning was done by hypofractionation schedule of 40 Gy in 15# so as to meet the planning objective shown in Table 1.

Table 1. Dose-Volume Constraints for Planning Whole Breast Hypofractionated Radiotherapy

Structure	Criteria
Breast CTV	PTV 95% ≥ 95% D_{max} ≤ 46Gy
Heart	V20Gy ≤ 5% (L), V20 <0%(R) V10Gy ≤ 30% (L), V10Gy ≤ 10% (R) Dmean ≤ 4 Gy
LADCA	Dmax ≤ 30Gy Dmean ≤ 6Gy
Lung (IL)	V20Gy ≤ 15% V10Gy ≤ 35% V5Gy ≤ 50%
Contralateral lung (CL)	V5Gy ≤ 10%
Contralateral breast (CB)	Dmax ≤ 310 cGy D5% ≤ 186Gy
Liver	Dmean <20 Gy

CTV = clinical target volume, D% = dose that receives the % the volume, VGy = volume that receives the dose in Gy, D_{mean} = mean dose D_{max}, = maximum dose, LADCA- Left Anterior Descending branch of Coronary artery, L-Left sided breast cancer, R-Right sided Breast cancer

Inverse planning IMRT (IP IMRT)

Technique

IP IMRT optimized plans were generated using 7 different photon beam direction at an interval of approx 20 degree so as to achieve optimal target coverage keeping exit and entry dose to OAR minimal (Figure 1). Further the planner proceeds for refinements by manual fluence editing for expanding PTV coverage, bring down OAR doses or scaling down/eliminate hotspot.

Forward planning IMRT (FP IMRT)

Two open tangential fields of equal weights were created with the "isocentre" of the treatment machine placed at the centre of the midline joining two opposing fields (Figure 2). Subfields were generated by manually placing MLC to hot areas without compromising PTV coverage by viewing isodose on BEV projection using 95% dose cloud. The hot areas are kept in check by aided visualization of 110% dose cloud in BEV Projection.

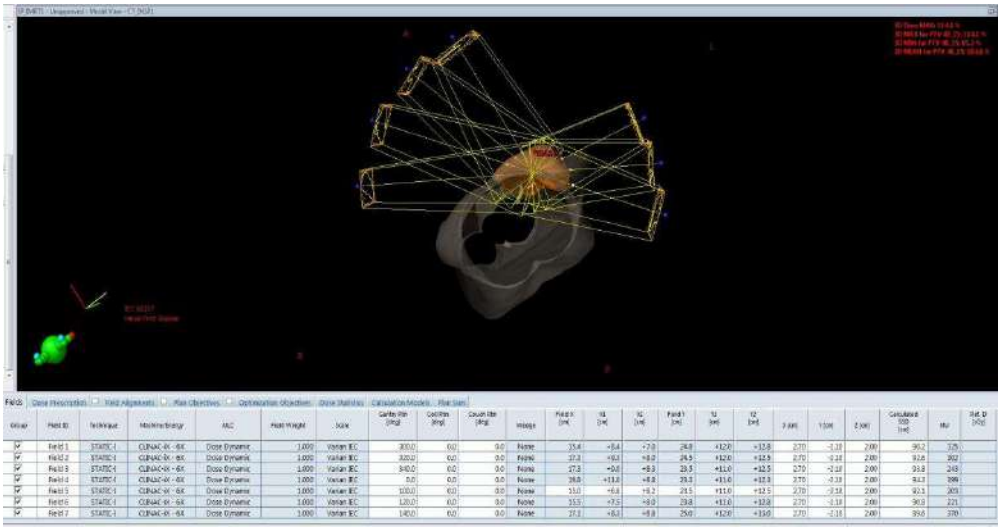


Figure 1. Beam Arrangements for IP IMRT.

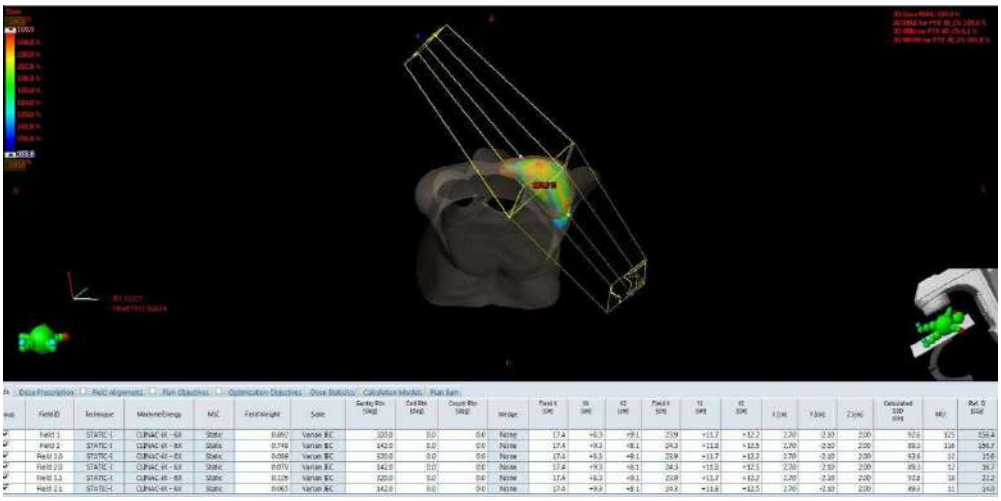


Figure 2. Beam arrangement for FP IMRT plan

Plan comparison and statistical analysis

PTV and OARs were compared objectively using DVH. The parameters were analysed using student's t-test with p value significance testing.

Evaluation parameter for PTV

The parameters listed in Table 2 were utilized to compare the plans with respect to PTV and OAR.

Table 2. Plan Evaluation parameters of PTV and OARs

Plan Evaluation Parameters	
PTV	PTV coverage of 95% with prescription isodose line of 95% (PTV95%) Maximum dose delivered to the target volume (D_{max}) Target Volume receiving 90%, 99% and 105% of dose ($V_{90\%}$, $V_{99\%}$, $V_{105\%}$) Homogeneity index (HI) Conformity index (CI)
Heart	Mean dose to the Heart (D_{mean}) Volume of Heart receiving 5Gy,20Gy,25Gy,30Gy (V_5, V_{20}, V_{25}, V_{30})
LADCA	Maximum dose(D_{max}) Mean dose (D_{mean})
Lung(IL)	Mean dose to the lung (D_{mean}) Volume of Lung receiving 5Gy and 20 Gy (V_5 and V_{20})
Contra lateral Breast(CB)	Mean dose to the contralateral Breast(D_{mean}) Volume of contralateral breast receiving 5Gy (V_5)
Contra lateral Lung(CL)	Mean dose to the contralateral lung(D_{mean}) Volume of Contralateral lung receiving 5Gy (V_5)
Liver	Mean dose to Liver(D_{mean})
Monitor units	MU

Homogeneity index (HI) in PTV is defined as per ICRU 83 as HI = (D2%–D98%)/D50%. D2%, D50% and D98% are the doses of 2%, 50% and 98% volume of the PTV, where D2% represents the dose corresponding to 2% target volume and is taken as the maximum dose; D98% represents the dose corresponding to 98% target volume in DVH, and is considered as the minimum dose and D50% represent the prescribed dose. Idea HI is 0. A lower HI is suggestive of more homogeneous dose distribution across the PTV. Conformity index (CI): CI as defined by ICRU 83 is CI=Volume of PTV covered by 95% isodose curve/Volume of PTV.CI of 1 is ideal.

Results

The dosimetric parameters of PTV and OAR with respect to IP IMRT and FP IMRT is tabulated below (Table 3).

Table 3. Comparison of dosimetric parameters for PTV

Radiation dose parameters	IP IMRT	FP IMRT	P value
PTV 95%	99.5	97.6	0.000
Dmax	45.0	44.1	0.000
V90%	99.9	99.6	0.000
V99%	98.3	84.1	0.000
V105%	49.2	33.0	0.000
Homogeneity index	0.10	0.14	0.000
Conformity index	1.00	0.98	0.000

Significant at 0.01 level

PTV Dosimetry

Comparable good dose coverage was achieved by both FP IMRT and IP IMRT, delivering more than 95% of recommended dose to greater than 95% of the breast PTV. Comparison between groups showed PTV receiving atleast 95% of prescribed dose (PTV 95%) was significantly higher with IP IMRT (99.5%) compared to FP IMRT (97.6%). In addition, volume of Breast receiving 90% of dose V90% (99.9% vs 99.6%) and 99% of dose V99%(98.3% vs 84.1%) was significantly better with IP IMRT compared to FP IMRT (Table 3). The FP IMRT plan produced a much reduced hot spot (V105%) within the breast volume than IP IMRT (49.2% vs 33%). It can be seen that the IP IMRT plans had Dmax in the range 111-113% (mean 112%). For the FP IMRT plan, Dmax ranged from 109-111% (mean 110%).

Conformity Index was significantly better for IP IMRT where ideal CI of 1 was achieved compared to FP IMRT (0.98). Comparison between groups showed a better Homogeneity Index for IP IMRT (0.10) compared to FP IMRT (0.14). Figure 3a shows homogenous isodose distribution and more hot dose regions within PTV for IP IMRT compared with FP IMRT (Figure 3b).

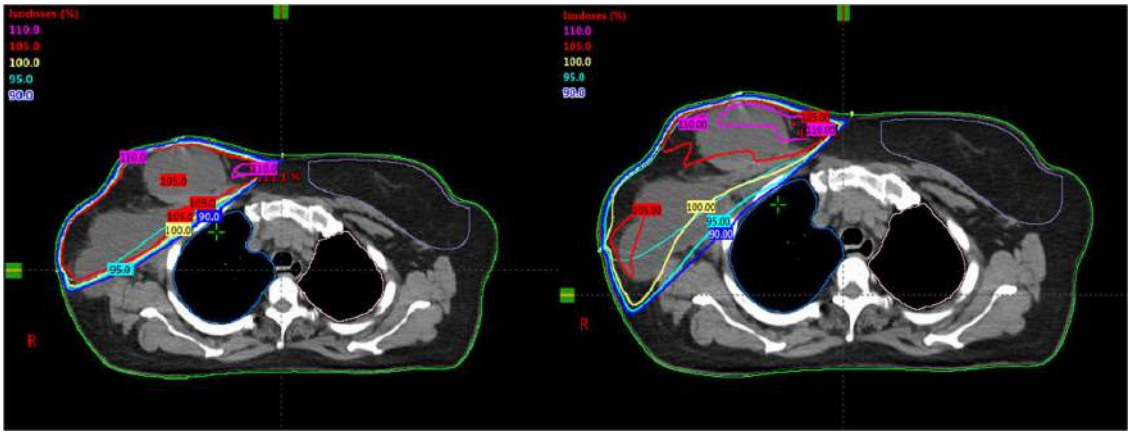


Figure 3. Isodose distribution for a) IP IMRT plan b) FP IMRT

OAR Dosimetry parameters

Table 4 presents a comparison of the dosimetric parameters for OARs for the two techniques of planning.

There is significant increase in Mean heart doses for left (4.08 vs 2.12) and right (2.02 vs 0.55) breast when comparing for IP IMRT with respect to FP IMRT. The low dose of heart i.e. volume of heart receiving 5 Gy (V5) was higher for IP IMRT for both left (28.1 vs 7.13) and right breast cancer (9.01 vs 0.02) with respect to FP MRT as shown in Figure 4. However, in-terms of Heart V20,V25,V30 it was observed that FP IMRT was higher than IP IMRT for right and left side of breast ($p<0.01$) as shown in Table 4. In addition, mean dose and maximum dose to LADCA for left and right breast irradiation when compared between two techniques has shown an edge for FP IMRT (Dmean 5.18 (L), 1.20 (R) vs 2.08 (L), 0.30 (R)), Dmax (7.99(L), 1.99 (R) vs 5.11 (L), 0.52 (R)).

Table 4. Comparison of dosimetric characteristics for OAR

OAR		IP IMRT(L)	IP IMRT(R)	FP IMRT(L)	FP IMRT(R)	P value
Heart	Dmean	4.08	2.02	2.12	0.55	0.000**
	V5	28.1	9.01	7.13	0.02	0.000**
	V20	0.72	0.00	2.45	0.00	0.010 (L)*,-
	V25	0.31	0.00	1.97	0.00	0.005 (L)**
	V30	0.10	0.00	1.51	0.00	0.005 (L)**,-
LADCA	Dmean	5.18	1.20	2.08	0.30	0.000**
	Dmax	7.99	1.99	5.11	0.52	0.043* (L), 0.00** (R)
Ipsilateral lung (IL)	Dmean	7.1		6.8		0.363**
	V5	43.5		27.9		0.000**
	V20	9.1		13.6		0.000**
Contralateral Breast (CB)	Dmean	0.69		0.15		0.000**
	V5	0.79		0.13		0.000**
Contralateral lung (CL)	Dmean	0.69		0.14		0.000**
	V5	0.06		0.00		0.002**
Liver	Dmean	1.57		1.30		0.500*
Monitor Units (MU)		1685.2		308.8		0.000**

(L)-left breast cancer,(R)-Right breast cancer

**: - Significant at 0.01 level, *: - Significant at 0.05 level

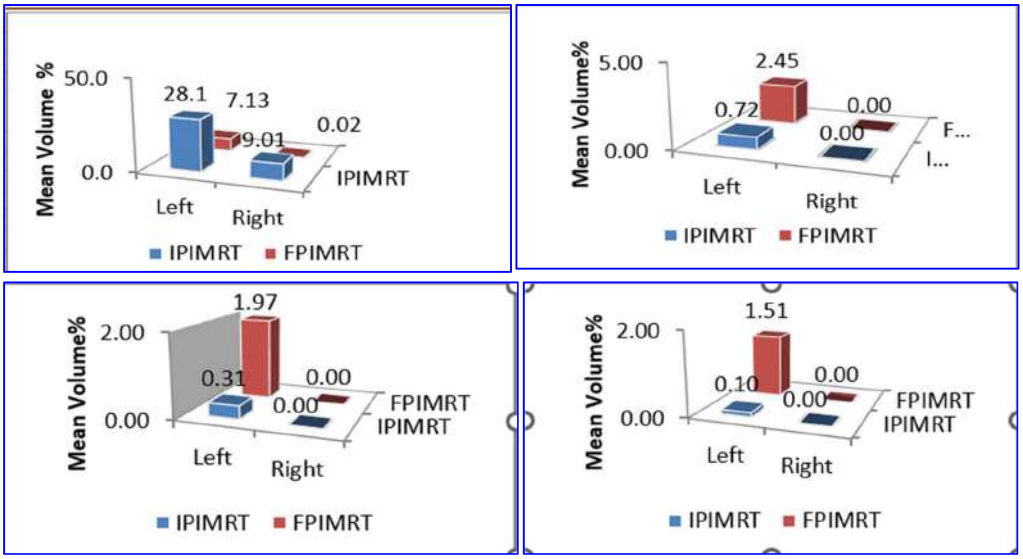


Figure 4. Comparison of Volume of heart [%] receiving 5Gy, 20 Gy, 25 Gy and 30 Gy for Left and right sided Breast Cancer

In terms of volumes of OAR receiving 5 Gy FP IMRT has shown significant lower value ie IL (43.5 vs 27.9), CL(0.06 vs 0.00) and CB (0.79 vs 0.13) for P<0.01) as shown in Table 4. With respect to V20 for the Ipsilateral lung, IP IMRT had an edge over FP IMRT technique (9.1 vs 13.6). Mean dose (Dmean) to CB (0.69 vs 0.15) and CL (0.69 vs 0.14) is better for FP IMRT. The mean dose to liver for right sided breast cancer did not show any significant difference (1.57 vs 1.3). Monitor units (MU) used for treatment was significantly more for IP IMRT (1685.2 vs 308.8). Figures 5 and 6 shows the DVH pattern display from which the dosimetric characteristics described above were obtained. DVH for OAR shows a concave dose distribution which amounts to better dosimetry with sparing of critical organs at risk adjacent to the target volume.

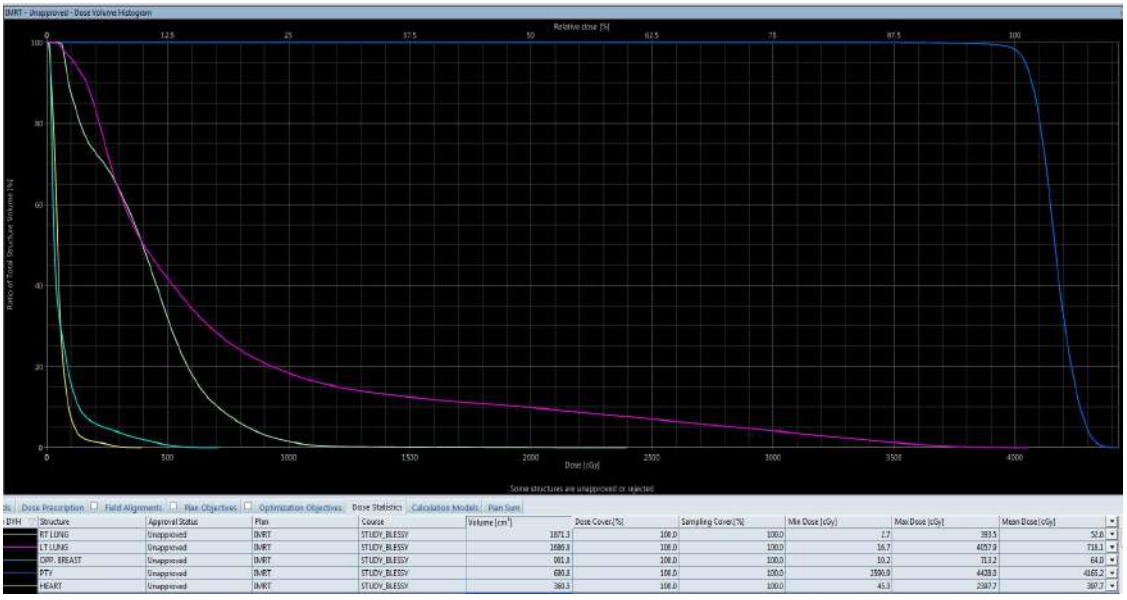


Figure 5. Dose Volume Histogram of IP IMRT plan

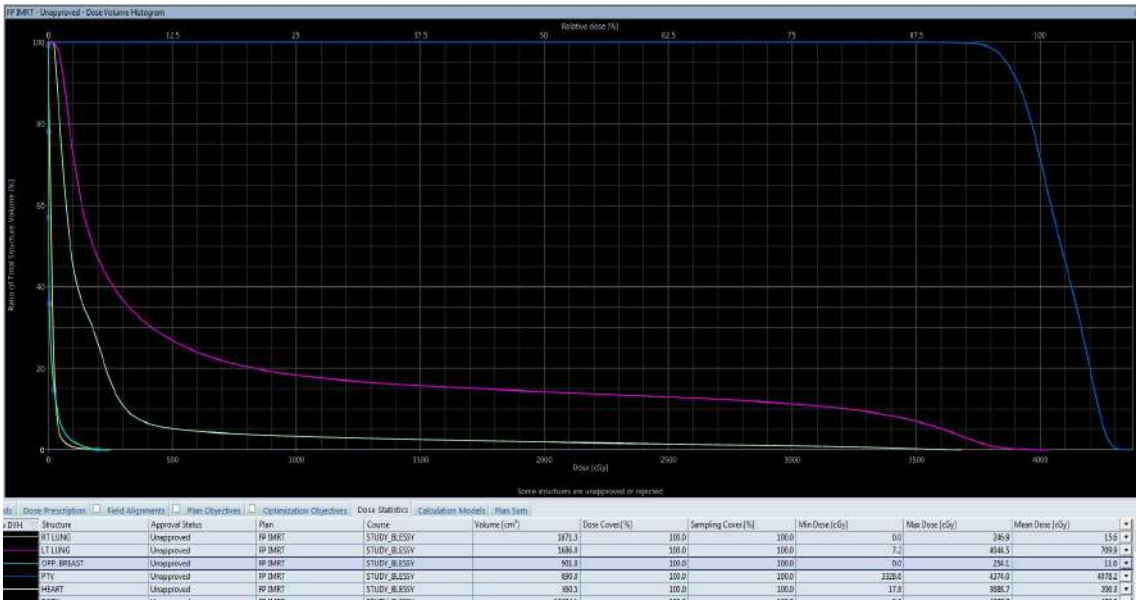


Figure 6. Dose volume Histogram of FP IMRT plan

Discussion

Concerning planning target volume, though FP IMRT and IP IMRT achieved target dose coverage delivering prescribed dose to PTV, coverage was better with IP IMRT technique. Figures 5 and 6 shows DVH for planning target volume for both the techniques. The maximum dose for IP IMRT plans exceeded 110% of the prescription dose. Therefore, FP IMRT technique produced a much smaller hotspot inside the breast volume (Figure 3b). Additionally, IP IMRT plan showed better homogeneity and conformity in comparison to FP IMRT. Figure 3a show more homogenous and conformal dose distribution within PTV for IP IMRT technique. DVH of PTV in Figure 5&6 exhibit a more steep drop off of dose at the PTV border for IP IMRT which means volume of normal tissues exposed to high dose is reduced significantly for IP IMRT. These results are close to other studies conducted by Al Rahbi et al. [11] and Elzawawy et al. [12].

Long term complication of concern in breast radiotherapy is RT induced cardiovascular damage. The risk is linearly increased as a function of mean heart dose (MHD) with an estimated risk of 7.4% with every 1 Gy increase in MHD [13]. Regarding dosimetry of Heart in our study, FP IMRT has shown a notable decrease in MHD for both right and left sided breast cancer. The volume of tissue receiving low-dose i.e. atleast 5 Gy was significantly reduced with FP IMRT technique for both right and left sided breast cancer. The relative volume of Heart receiving high dose 20 Gy, 25 Gy and 30 Gy was higher for FP IMRT.

Coronary arteries is similar to spinal cord in terms of structural organization of subunits both deemed as “serial subunit” organ. In other words, damage to any part of the artery might have potentially fatal consequences even if the entire coronary artery is not exposed to radiation. As a result, DVH factors which are helpful in estimating CAD risk is maximum and mean dose as demonstrated

by Taylor et al. [14]. It is concluded in several studies the importance of reducing dose to LAD branch of coronary artery have been demonstrated to reduce incidence of RT induced cardiac events. It is observed in our study that the mean dose and maximum dose for coronary artery were higher for left and right sided breast cancer for IP IMRT technique.

Meta analysis showed RT for breast cancer dramatically increased the risk of non breast cancers with a RR of 1.22 [15]. The risk remained high even after 5 years with a RR of 1.22 [15]. Regarding lung toxicity, incidental radiation exposure to ipsilateral lung has shown to increase radiation pneumonitis and lung fibrosis. Study demonstrated late toxicity when more than 40% of lung volume received at least 10 Gy and more than 20% of lung received at least 20 Gy [16]. In our study mean dose to the ipsilateral lung did not show significant difference between both techniques. Volume of ipsilateral lung receiving 5 Gy was lower for FP IMRT compared to IP IMRT. Volume of ipsilateral lung receiving 20 Gy was lower for IP IMRT technique with two techniques showing an advantage of V20 less than 20Gy. With respect to dose contralateral lung, mean dose to CL and volume of CL receiving 5 Gy was significantly low for FP IMRT technique.

Long-term risk of developing a second primary breast cancer on the opposite side was shown in earlier studies which was inversely related to age at exposure and was dose dependent. One study showed increased risk in women under 40 who received >1 Gy to CB. Recent treatment techniques like IMRT has led to lower CB doses, hence less risk of developing breast cancer in unirradiated breast. Mean dose to the contralateral breast was less than 1 Gy for both the techniques with significantly low dose for FP IMRT. Volume receiving atleast 5 Gy is more for IP IMRT technique compared to FP IMRT. Dose to liver was studied in 21 patients with right sided breast cancer. Regarding dose to the Liver, the mean dose to the Liver was not significant between forward and inverse planned IMRT techniques.

Regarding monitor units various studies demonstrated FP IMRT techniques did not require as many MUs as IP IMRT techniques [11]. IP IMRT plans were shown to increase overall MUs, which is shown to increase volume exposed to low dose with respect to normal tissues. In our study monitor unit used was significantly lower for FP IMRT technique. IP IMRT used 5 times more monitor units compared to FP IMRT.

Limitations

There are certain limitations our study. Our study used dose measured from treatment planning system. More accurate measurements are obtained if independent dose verification of phantom were incorporated. In addition dosimetry of boost was not done for PTV to keep study simple with less complex planning skills to save time and expertise. Besides our study did not take into account clinical outcome with respect to treatment.

Conclusion

Our study showed IP IMRT provides better target coverage, conformity and homogeneity, as well as low high dose volumes to heart and lung compared to FP IMRT radiation planning technique. However, this superior target coverage comes at the expense of increase

in hot regions with in the PTV and increase in low dose exposure to OARs. This along with increased monitor units is a concern with respect to increase incidence of RT induced second malignancy. FP IMRT also has shown an optimal target coverage with reduction in hotspot within breast and reduction in low dose volumes to OARs. Reduction in MU and shorter planning and treatment times and need for less QA procedures are added advantages which increases throughput of patients through Linear Accelerator in case of FP IMRT.

Resource limitation is a concern that hinders adoption of IP IMRT in developing countries. In this context adjuvant breast radiotherapy with FP IMRT technique can be adopted as simple and equally efficient planning technique for whole breast irradiation in patients with Breast cancer.

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Conflict of Interest

The authors declares that they do not have conflict of interest.

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ORIGINAL ARTICLE

Penetration of M-Health Apps and Devices among Undergraduate Medical Students in Puducherry: A Cross-Sectional Study

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Abstract

Background: With advance in technologies, there is a notable shift in healthcare industry towards integrating mobile health solutions. Medical students are at the forefront to be proficient in the use of cutting-edge medical technologies. This study gives insight about the penetration of m-health among the budding young doctors of Puducherry. **Materials and Methods:** A facility based analytical cross-sectional study was conducted among 390 undergraduate medical students over a period of two months (Aug-September 2023). Pre-tested semi-structured questionnaire was used to estimate the m-health app/device user, usage pattern and attitude towards m-health apps/devices. Data collected in google form and descriptive statistics was done using MS Excel 2019. Chi square test was applied to find the association between study participant characteristic and m-health app/device user. **Results:** Proportion of the participants using m-health app was 31.8%. The M-health devices used by the participants were smartphone (100.0%), smartwatch (54%), wrist band (32.2%), blood pressure monitoring device (13.7%). They were using for physical fitness (85.5%), clinical training (32.3%) and disease monitoring (26.6%). Around half 46% of the participants were using it for at least once in a day. Majority (91.1%) were highly confident and confident on the results provided by m-health apps/devices. Proportion of male participants using were higher compared to the female participants. **Conclusion:** Around one-third of the participants are using m-health. Almost majority for physical fitness. Male gender was associated with m-health app use. Though there are few downsides with the advancing technology it will be addressed with its evolution.

Keywords: m-Health applications, Smartphones. Medical students

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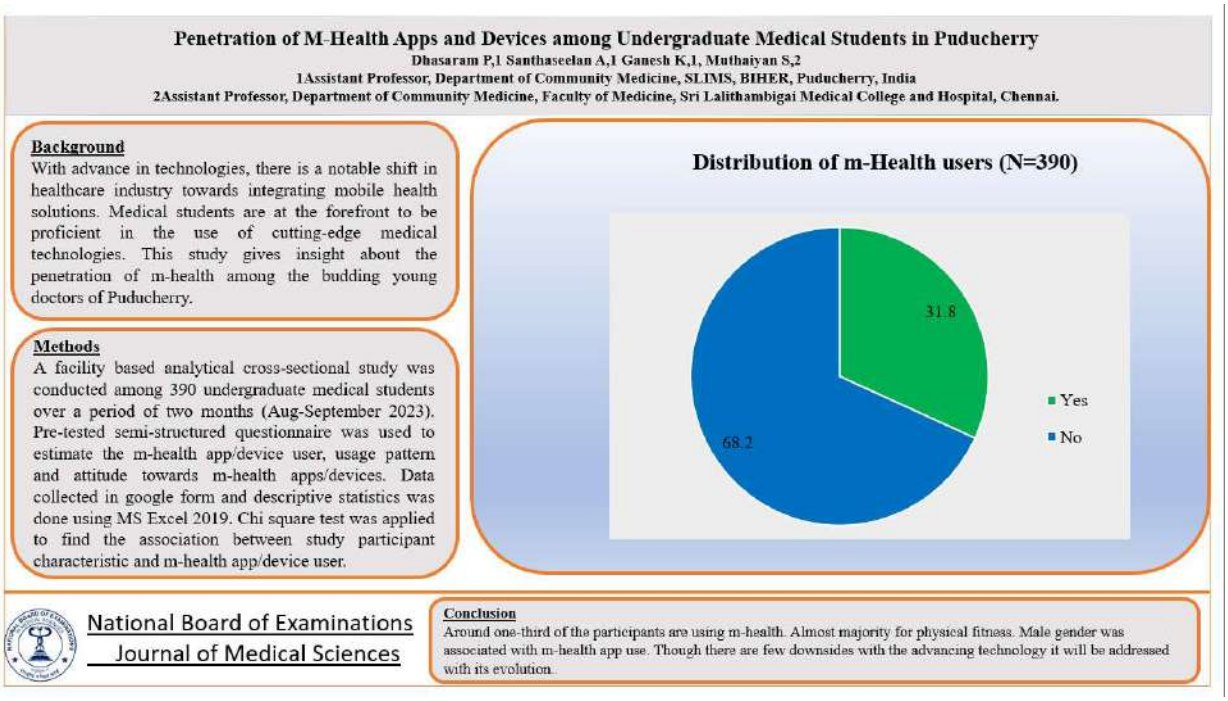
Graphical Abstract



Introduction

M-health has evolved due to uprising development in the information and technology causing a great impact on the different fields of health system. Programmatic Integration, financial support, electronic linkages to health system remains as the sustainable solutions of m-health. The World Health Organization (WHO) has defined m-health as “medical and public health practice supported by mobile device such as mobile phones, patient monitoring devices, personal assistants and other wireless devices” [1]. Innovation in medical technology, rapid expansion of mobile networks, task shifting and other health system needs, unprecedented growth of mobile phone users are the influencing factors for mHealth. M-health applications have gained wide acceptance in the field of medical education by improving the performance and knowledge acquisition of students in medical schools. Smartwatch, Wristband, smartphones, laptops, Android tablets, iPads are some devices which can used for M health applications [2,3].

According to recent data from Google, India ranks among the top five countries for search terms like ‘mobile health', ‘health apps’, ‘medical apps’ and ‘m-Health’. This confirms that the Indian population is interested in M-health [4]. In India, there are 74 approved mhealth websites and apps which were listed in the National health portal (NHP) for mHealth. National health portal India, AIMS–WHO CC ENBC, Health You Card, mhealth basics, Safe Pregnancy and Birth, Mobile-Family Planning tool, TB detect (mobile app and website), iTriage Health, Newborn care are some of the apps in NHP for mHealth [5,6]. Apps like Parkinson mPower study app and Autism & beyond study app helps us to understand further information about the disease [5]. In recent times, apps like UpToDate is used worldwide in improving

quality of care, efficiency and patient safety. It is the world's most used Clinical decision support system at the point of care [6]. Safe Pregnancy and Birth app provides a great information on how to stay healthy during pregnancy, talks about danger signs during pregnancy, birth and after birth. What to do when danger signs arises Instructions for community health workers with step by step explanation such as "How to take blood pressure", "how to treat someone in shock", "how to stop bleeding" [6]. In spite of M-health benefits, there are some shortcomings noted in rural India like poor phone access, lack of reliable power, poor smartphone user rates and poor internet connectivity. This study intends to measure the penetration of m-health in provider centric purview (medical students) to get the insight about its use and shortcomings. The objective of this study is to find the proportion of medical students using m-Health apps and devices in a medical college of Pondicherry.

Materials and Methods

A cross-sectional study was conducted among the undergraduate medical students of South India over a period of 2 months (August-September 2023). The participants were MBBS students enrolled from 2017-2022 were considered as the sampling frame for this study. Considering an assumption that 50% of the study participants will use m-Health apps and m-health devices, with absolute precision of 5%, power 80% the final sample size was calculated to be 390. Of the 950 total students, 390 participants were selected by simple random sampling using computer generated random number table. After obtaining written informed consent from the study participants the data was collected in self-administrated, pre-tested questionnaire through online platform (Google form). Pre-testing of the questionnaire was conducted among the 20 undergraduate medical students recently graduated from the same institute. Content validity of the questionnaire was obtained from the subject experts of Community Medicine of Professor level. Questionnaire comprised on general information about study participants and specific questions related to m-health. The study variable includes name, gender, age, year of MBBS, recent exam grade and the outcome measures were proportion of m-health apps, device users, duration of usage and attitude towards m-health. Data were collected in MS EXCEL 2019, checked for error and coding was done for the variables. SPSS statistics 16.0, Chicago, USA was used to analyze the data. Quantitative variables were expressed in mean standard deviation and qualitative variables were expressed in proportions. Chi-square test was applied to test the association between general characteristics of study participants and m-health users.

Results

In our study, total number of participants recruited were 390. Out of which 171 are male and 219 are female participants. Majority 56.4% are females. Out of 390 participants, majority, 58.2% i.e. 225 members are of more than 20 years of age and 165 are less than or equal to 20 years. The distribution of class of study indicates 87 are first year students, 78 second year, 102 third year, 65 final year and 65 are CRMI (Table 1).

Table 1. Characteristics of study participants [N=390]

S. no	Variable		N	%
1	Age	≤20	165	41.8
		>20	225	58.2
2	Gender	Male	171	43.6
		Female	219	56.4
3	Year of MBBS	I	87	22.3
		II	78	20.0
		III	102	26.2
		IV	63	16.2
		CRRI	60	15.3
4	Percentage of Marks obtained in recent University Exam	<60%	43	11.0
		60-75%	197	50.5
		>75%	63	16.2
		Not Applicable*	87	22.3

*Not appeared in University Examination

Among the 390 participants included in the study 10.8 % have scored <60% in university exams, 50.3% have scored 60-75% and 16.7% above 75% of university marks. Of all participants 87 first year students are not considered in this category as they have not appeared for exams yet. (Table 1). In our study of the total 390 participants, it was found that around one third (31.79%) of the participants were using M- health apps and around two third (68.2%) were not using M – health apps (Figure 1).

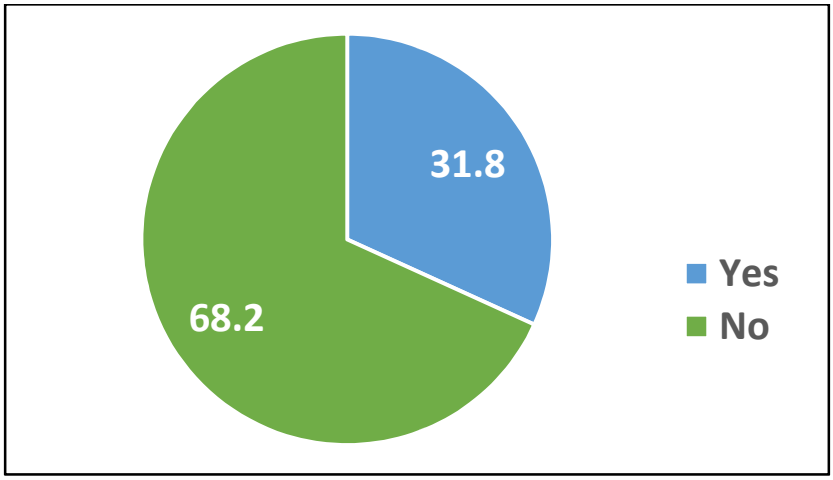


Figure 1. Proportion of participants using mHealth apps (N=390)

Among the 124 m-health app users, all the participants were using smartphones, around half of the participants (54%) are using smart watch, around one third (32.2%) are using wrist band and around one tenth (13.7%) used Blood pressure monitoring devices for fitness, health promotion, disease prevention and disease monitoring.

Of the total 124 m-health app users it was found that more than three-fourth (85.48%) of the participants were using m-health for physical fitness, around one-third (32.25%) of the participants were using m-health for clinical training and around one-fourth (26.61%) were using for disease monitoring (Figure 2).

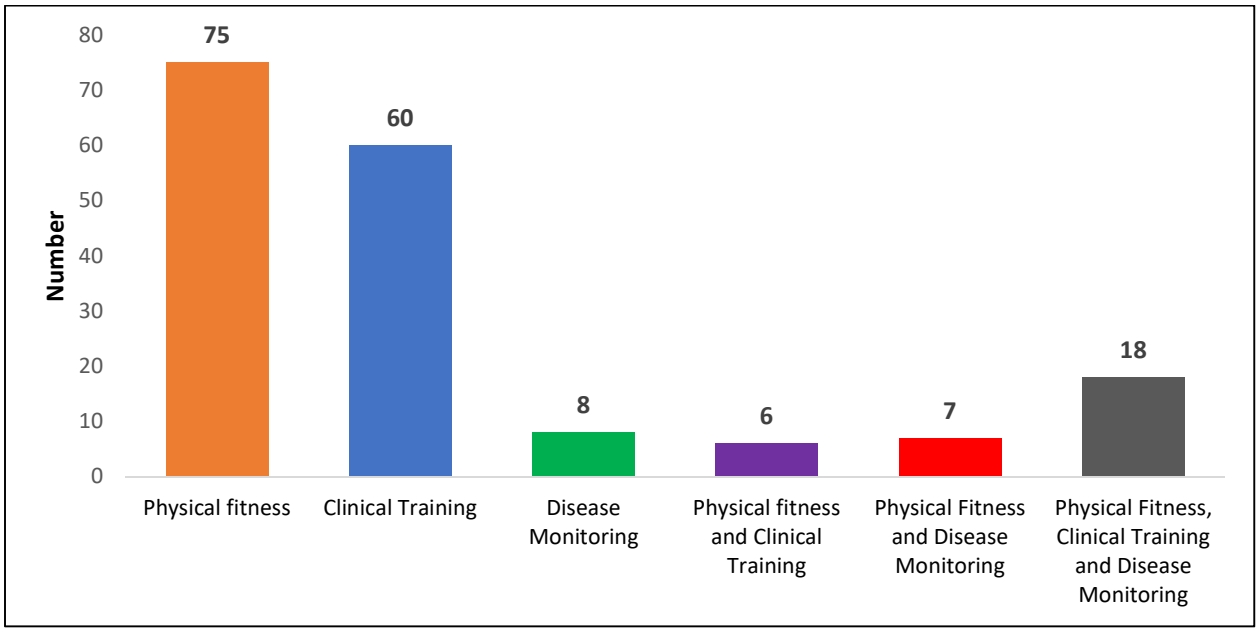


Figure 2. Domains of m-health apps preferred among users (N=124)

Table 2: Usage pattern of M- health apps/ devices among the users

SL No	Variable	Duration	n	%
1.	Duration of use in a day (average)	<30mins	83	66.93
		30mins to 1 hour	33	26.61
		1-3 hours	7	5.64
		>3hours	1	0.8
2.	Duration of use in a week	Several times a day	28	22.58
		Once or twice a day	30	24.19
		2-3 times a week	39	31.45
		Once a week	27	21.77

The usage pattern of m-health apps and devices among our study participants is depicted in Table 2. Of the total 124 m-health users it was found two- third 83 (66.93%) of the participants are using m-health apps for less than 30 minutes. Around half of the participants 58 (46.77%) were using this app/device at least once in a day.

The participants are assessed for their trust and privacy in the results provided by the m-health apps. 17 (13.7%) of the participants are highly confident, 96 (77.42%) are confident and 11 (8.9%) are less confident in the results provided by the m-health apps. Around half of the participants 70 (56.4%) are also aware of the security policy and chances of security breach in the data captured. But none were aware about the reporting mechanism in the occurrence of security threat.

The main driving factor for m-health apps are easy accessibility (55.6%), to get the knowledge in less time (45.16%) and accuracy (39.5%). The barriers in m-health apps/devices are internet connectivity, high data consumption, electricity power shortage for charging, customer support, increase in screen time.

The attitude of the study participants towards the m-health apps/devices shows that they consider this as a new revolution in healthcare (93.5%). It is seen that majority (91.1%) are ready to share and motivate their friends to use m-health apps or devices in future.

The proportion of male participants using m-health was higher compared to the female participants (38.6% vs 26.5%). This difference was found to be statistically significant. No other characteristic of the study participant had significant association with the m-health use (Table 3).

Table 3. Association between m-health use and characteristics of participants (N=390)

Variable		**m-health apps/devices user**		**pValue**
		User (n=124)	**Non-user (n=266)**	
Age	≤20	49 (29.7)	116 (70.3)	0.446
	>20	75 (33.3)	150 (66.7)	
Gender	Male	66 (38.6)	105 (61.4)	0.010
	Female	58 (26.5)	161 (73.5)	
Year of MBBS	≤ II MBBS	51 (30.9)	114 (69.1)	0.747
	>II MBBS	73 (32.4)	152 (67.6)	

Discussion

Mobile health apps and other modes of m-health are emerging field in aspects of delivering early healthcare intervention. They help in easy identification and screening of at-risk individuals. Currently available m-health apps are stand alone. They do not require continuous monitoring by medical professionals. Although M-health apps are aimed at, "at risk" population, our study participants are medics students. The aim of our study is to find proportions of Medical students in a medical college of Puducherry using these apps for their own health fitness and other purposes. In our study among 390 participants inclusive of all years of MBBS students it was found that 31.7% students are using m health apps and again 31% are using mm-health devices. It is a facility-based study when participants are selected through simple random sampling.

When compared to our study, Gajendra Singh et al conducted a cross-sectional study in Bangalore and it was found that 59% of undergraduate students were using m health apps [13]. Thus difference may be due to low sample size (n=120) of the study including only 2nd and 3rd year students. The results of the study by Ventola CL identifies the purpose for which HCP use such apps and devices. Searching for accurate and clinically significant data was one among the most popular causes [14].

In our study 85% i.e. majority were using m-health apps/devices for physical fitness in contrast to study done by Gajendra Singh et.al. [13] (2019) where it was found that around half of the participants were using it for fitness. The usage has increased as per our study which is conducted in ongoing COVID pandemic scenario after three waves of which have taken a toll on us. The pandemic has made individuals aware of the famous saying, "health is wealth."

According to the Ventola CL [14] 85% medical students use such apps and devices for clinical purposes or information's once in a day. In comparison to our study only one-fourth of the users are using such apps and devices once in a day. The difference could be due to geographical difference in conduct of the study.

According to a descriptive study conducted in Saudi Arabia by Mishael Alhusseini et al. (2021) on students' perceptions towards m-health applications for education in medical colleges, around 22.2% uses it for around an hour a day [8]. Similarly around 1/4th of the participants included in our study spend at least an hour a day. These similar results could be due to inclusion of medical students as study population in both the studies.

In contrast to our study which shows about 1/5th of users uses such apps and devices for all purposes like clinical training, learning, physical fitness monitoring, the study conducted by Mishael Alhusseini et al. showed that 14.5% of users use it for all purposes and 39.8% for only learning [8]. In comparison to our study it was found that majority 85.48% are using them for only physical fitness monitoring which could be attributed to the increased awareness of healthy body in the current scenario of the pandemic [11].

In our study the main barriers for m-health penetration were security issues, privacy in data captured, internet connectivity, high data consumption and

electricity power for charging the devices. Similarly, in a study by Jembai et al. [15] among medical students of Malaysia, it was highlighted that around one-third of the participants reported privacy as a hindering factor for acceptance. 21.3% were not confident on the results provided my m-health technology. But in our study, it was reported 8.9% were not confident on the results. This difference might be because of geographical variation. The updates provided by the apps to fix the bugs also could have contributed in reliability of the results [15].

India is currently undergoing urbanization. And there is a steady population growth going on. Amid such evolving situations along with the ongoing pandemic HCP and health care facilities are unable to meet the demands of the country due to considerable gap between demand and suppl, due to inadequate doctor patient ratio. “Doctor patient ratio for India – the reality” an article written by Madhav Deo et.al states that in India, the overall doctor population ratio is 1:1800, which is lower than that the ratio of 1:1000 suggested by 'High Level Expert Group (HLEG) for Universal Health Coverage' constituted by the Planning Commission, and endorsed by WHO. In order to narrow down this gap, amidst the current situation of evolving pandemic m-health applications can act as bridge [4,12,13]. In current scenarios of pandemic where maintaining social distance has become a key step in prevention of spread, m -health technology can impact substantially on health outcomes of the forever increasing demand for better health care curated to perfection. The underserved health care due to financial deficits and other difficulties when dealt with easily available and cost-effective apps and devices could act revolutionary in the developing countries like India [9,13]. Among our study participants 93.5% holds same view that it could be revolutionary in health care.

Conclusion

From our study it is evident that around one-third of the medical students are using m-health apps and devices and almost majority for physical fitness and around one-fourth for clinical training and disease monitoring. Amongst the users this evolving platform is considered as potentially beneficial tool though few downsides like security breach and network connection are well known. More the penetration of the m-health apps and devices through sharing of its benefits by its users to the non-users will improve the coverage and avoid the human error in diagnostics and health promotion. Further research is needed to address the barriers in expansion of m-health.

Statements and Declarations

Conflict of Interest

The authors declares that they do not have conflict of interest.

Funding

No funding was received for conducting this study.

Author’s contributions

All the authors participated in the process of concept building, literature search, presentation and approval of initial design, data collection, analysis, report writing,

editing, reviewing and approving the final manuscript.

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ORIGINAL ARTICLE

Enhancing Global Biomedical Research: Educational Strategies for Bridging the Gap between HICs and LMICs

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Abstract

There is a pressing need to address the noticeable disparity in biomedical research output between High-Income Countries (HICs) and Low-Middle Income Countries (LMICs). This imbalance raises urgent concerns about equity and the impact on global health. Despite being home to most of the global population, LMICs face numerous challenges that hinder their ability to contribute significantly to research. This review explores the factors contributing to the disparities and proposes potential solutions to address this global imbalance. A comprehensive strategy is needed to tackle the differences in biomedical research productivity between high-income and low-middle-income nations. Enhancing global partnerships, ensuring fair allocation of resources, and prioritizing the development of research capabilities are crucial measures in nurturing a more diverse and influential worldwide biomedical research landscape. Closing this divide is essential for advancing scientific inclusivity and tackling the health issues economically disadvantaged countries face.

Keywords: Research; Developing Countries; Publications; Biomedical Science

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Summary

What was already known?

- There is a significant gap in the amount of biomedical research produced by HICs compared to LMICs. LMICs need more resources, infrastructure, and trained personnel, hindering their ability to conduct research.

Why this study was needed?

- A recent review needs to be conducted to summarize the factors causing this imbalance, and this study aims to identify specific solutions to bridge the gap.

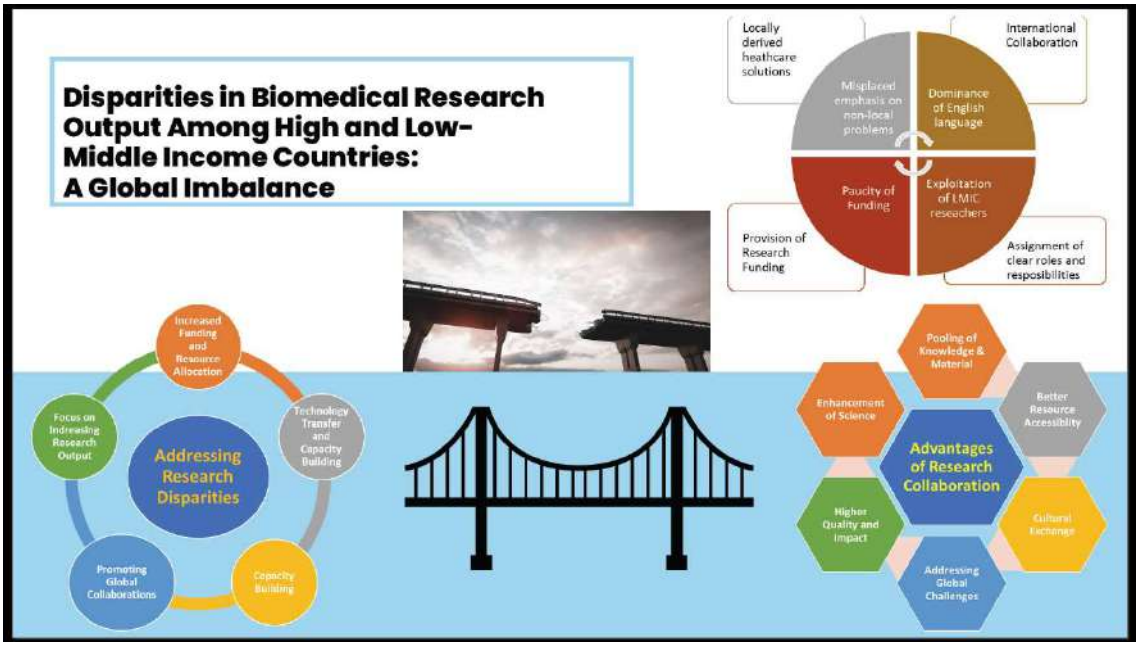
What this study adds?

- This study offers a fresh perspective by providing a comprehensive analysis of the factors creating the disparity in biomedical research output. It proposes recommendations to address the identified challenges, offering a new approach to bridging the gap between HICs and LMICs.

How this study might affect research, practice, or policy?

- This study can encourage collaboration between HIC and LMIC institutions and urge funding bodies to provide a fair allocation of resources for research, potentially directing more funding towards LMICs.
- The study's emphasis on building research capacity in LMICs can encourage policy decisions to invest in education and training programs for researchers in those countries.

Graphical Abstract



Introduction

Research is pivotal in advancing healthcare and enhancing our understanding and treatment of various diseases. It is also an essential indicator of a country's scientific and academic capabilities. The World Bank categorizes economies into these groups based on Gross National Income (GNI). As of July 2021, the World Bank's classifications were: Low income: Less than $1,045 per capita GNI; Lower-middle income: $1,046–$4,095 per capita GNI; Upper-middle income: $4,096–$12,695 per capita GNI; and High income: More than $12,695 per capita GNI [1]. LMIC and HIC are abbreviations for low- and middle-income countries and high-income countries, respectively. A noticeable disparity in research output between HICs and LMICs raises concerns about equity and the impact on global health [2]. Despite being home to most of the global population, LMICs face numerous challenges that hinder their ability to contribute significantly to research. It has led to a significant gap, known as the "10/90 gap," where only a tiny portion of global health research funding is allocated to addressing the health problems affecting most of the world's population, particularly low-income people [3]. Despite various stakeholders' efforts, this gap persists.

This review aims to explore the factors contributing to the disparities in biomedical research output between HICs and LMICs and propose potential solutions to address this global imbalance. These disparities need to be addressed as they significantly impact global health.

Challenges

Healthcare systems in HICs often possess advanced infrastructure, well-trained healthcare professionals, and comprehensive access to medical technologies. However, these advantages come with their own set of challenges. The high costs associated with these systems can strain healthcare budgets and potentially lead to over-reliance on technology. Additionally, the complex administrative structures can create inefficiencies and hinder care delivery.

On the other hand, LMICs face their unique challenges in healthcare. Access to healthcare facilities, a need for more trained personnel, and a scarcity of essential medical resources can impede the delivery of quality care. Furthermore, these countries often need help with budgetary constraints, infectious disease burdens, and inadequate preventive care measures.

Addressing these disparities requires tailored strategies that consider each country's specific circumstances. It is crucial to ensure equitable and effective healthcare delivery. This approach can be achieved through collaborative efforts, international partnerships, and targeted investments. By working together, countries can bridge the gaps in healthcare and promote more equitable contributions to global research efforts.

Factors Contributing to Disparities

The disparities in research output between LMICs and HICs are influenced by various factors, as outlined in Table 1.

Table 1. Contributing Factors for disparities in research output of High-Income and Low-Middle Income countries

Contributing Factors	High-Income Countries	Low-Middle Income Countries
Funding for Research & Development	Substantial resources	Limited resources
Infrastructure & Technology	Well-established institutions and facilities	Limited facilities
Education Systems	Existing robust education systems	Inadequate education systems
Collaborative Networks	Established extensive networks	Poor collaborating networks
Research Productivity	Dominate publications in high-impact journals	Limited research output
Research Priorities and Global Health	Different disease profiles compared with Low and Low-middle-income countries	Different disease profiles compared with High-Income countries

Funding Limitations

The unequal distribution of funds between HICs and LMICs significantly influences the research output gap. HICs allocate substantial financial resources to Research and Development (R&D), allowing them to engage in large-scale, innovative research endeavours. Conversely, LMICs often face financial constraints that impede their ability to conduct extensive research. Developed nations have more financial resources for biomedical research, enabling them to invest in cutting-edge technologies, state-of-the-art infrastructure, and comprehensive training programs. In contrast, many developing countries need more funding, which limits their competitiveness in the global research arena.

Infrastructure and Technological Constraints

The absence of sophisticated research infrastructure and state-of-the-art technology in LMICs contributes to the existing disparities in research output. High-income countries boast well-established research institutions with cutting-edge facilities, enabling their scientists and researchers to conduct groundbreaking work. Conversely, LMICs need help in obtaining and sustaining such infrastructure.

Collaborative Networks

Developed countries have the advantage of being part of extensive national and international collaborative networks, facilitating the exchange of knowledge and initiating joint research

projects. On the other hand, UMICs LMICs need help establishing and sustaining such global partnerships, which hinders their access to a wide range of perspectives and expertise.

Publications and Citation Discrepancies

The evaluation of research productivity is commonly based on the number of publications and citations. Developed nations are predominant in the scientific literature, with their academic institutions and researchers consistently contributing to high-impact journals. Conversely, scholars from developing countries often need help gaining recognition, affecting their citation rates and overall influence.

Research Priorities and Global Health

Global health inequalities persist as research priorities frequently mirror the prevalent diseases in more affluent regions, overlooking illnesses that disproportionately affect individuals in resource-constrained settings.

Challenges and Solutions in Research of Low-middle-income countries

Challenges

LMICs face numerous challenges in improving healthcare and research. In addition to limited access to high-quality care, these countries contend with competing health priorities, fragile health systems, and conflicts. Another significant obstacle is the need for more evidence generation and research within LMICs. However, one crucial aspect of addressing these challenges is recognizing and taking ownership of the problem of insufficient local evidence by all stakeholders involved. This recognition makes them feel more responsible and motivated to contribute to the solution. Collaboration between HICs-LMICs and LMICs-LMICs can be instrumental in overcoming these challenges. Such partnerships can increase resources, capacity building, and long-term productivity [4].

HICs possess robust economies, advanced infrastructure, and high living standards. Their citizens generally have access to quality healthcare, education, and a comfortable standard of living. These nations also contribute significantly to Research and Development (R&D) efforts. In contrast, LMICs face economic challenges that hinder their rapid development. They often struggle with issues such as poverty, limited access to education, and inadequate healthcare infrastructure. The relationship between a country's Gross Domestic Product (GDP) and biomedical research output is complex. While higher GDP generally leads to increased funding for R&D, the connection is not linear. Other factors, including government policies, education, and healthcare infrastructure, also play crucial roles in research productivity on a global scale. A study on Asian countries found that those allocating more funds to R&D tend to have better research outcomes, including more publications, citations, and h-index in various science and social science subjects [5].

Publishing research in prestigious journals presents another hurdle, as these journals often have high rejection rates. LMIC researchers must also improve their ability to conduct randomized controlled trials (RCTs). They are often compared unfavourably to such studies, necessitating a defence of their study choices and the robustness of their evidence. Another challenge arises from the expectation that every surgical innovation must align with the five stages of the IDEAL framework,

which may only sometimes be feasible for affordable solutions. Despite successfully publishing affordable ideas, a significant gap exists between their publication and their actual dissemination and adoption in LMICs. It compels researchers to develop a roadmap that effectively bridges this gap [6].

Academic publishing is a crucial part of a clinician's career. Writing a scientific article can be challenging, but it strengthens research, writing, and communication skills. It also helps clinicians critically evaluate literature and apply new knowledge in patient care [7]. One of the main limiting factors found in publishing has been limited skills in English writing and editing. Apart from other reasons for publication bias, poor use of English is also cited as a reason for the rejection of submitted articles. This does not appear surprising since 90% of international journals are published in the English language. Analysis of 70 orthopaedic journals indexed in Medline assessing the country of origin of publications showed 50% of journals were published in the US, 40% in the UK and only 10% from the East and Latin America. This over-representation of UK-English-based and US-English-based publications in the literature may be one of the reasons for language bias and subsequent rejection of a manuscript from non-English practising authors [8].

Solutions

LMIC researchers need help conducting research within their resource-limited environments. One of the initial difficulties they encounter is the lack of external assistance, which forces them to find solutions to pressing issues independently. To navigate these challenges, researchers can apply the principles of Global Surgery, such as leveraging Occam's razor and adopting a "Modify-Simplify-Apply" approach. Additionally, they must disseminate their research through scientific papers for peer review and acceptance within the professional community. There needs to be a template or guideline for documenting low-cost and frugal innovations, which poses another obstacle, prompting researchers to create their own [6].

Bridging the Gap

Bridging the gap in research output between LMICs and high-income countries, HICs are paramount in creating a more balanced and fairer global scientific environment. It can be achieved by addressing financial limitations, enhancing infrastructure, advocating for education, and fostering international partnerships. By implementing the following strategies (Figure 1), the international community can make significant progress in narrowing the disparities and fully utilizing the valuable research contributions from various regions.

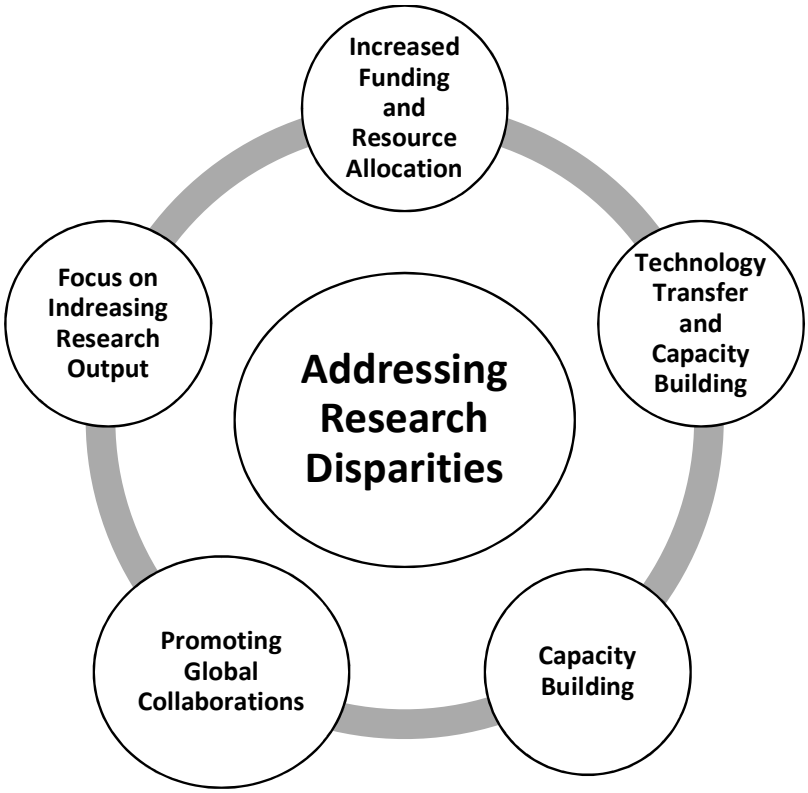


Figure 1: Strategies to address the disparities in the research output between High and Low-Middle Income Countries

Enhanced Research Resource Allocation and Funding

To address the research output gap, international organizations, governments, and philanthropic foundations must enhance their support by allocating more funding and resources to LMICs. It can be achieved through various means, such as providing financial assistance to local research initiatives, investing in research infrastructure development, and offering scholarships to promote education and skill development among researchers in these countries.

Providing Financial Assistance to Local Research Initiatives involves direct funding and investment in infrastructure. Direct funding can take the form of grants allocated to specific research projects led by local institutions in LMICs, such as the Gates Foundation supporting malaria research of US$140 million as a commitment over four years for African institutions [9]. Additionally, fellowships can provide financial support to individual researchers in LMICs, exemplified by the Wellcome Trust's offering to scientists in sub-Saharan Africa of $40 million over five years [10]. Collaborative research funding supports joint projects between LMICs and HICs, as demonstrated by the NIH Fogarty International Center's partnerships between US and African researchers on HIV/AIDS [11].

Technology Transfer

Efforts to bridge the technological gap between HICs and LMICs should prioritize technology transfer initiatives. These initiatives should focus on

facilitating the exchange of knowledge and expertise between the two groups. By promoting the transfer of technology, LMICs can benefit from the advancements made by HICs, enabling them to overcome technological barriers and enhance their research capabilities. Research infrastructure development involves providing funds for laboratory equipment and facilities, like the World Bank's support for a new research center at the University of Nairobi [12].

Capacity Building

Capacity-building programs hold great potential in empowering researchers in low-resource settings. These programs aim to equip researchers with the necessary skills and tools to conduct high-quality research. By providing training and support, capacity-building initiatives can help researchers in LMICs overcome challenges related to limited resources and enhance their research capacity. Furthermore, investing in robust data collection and analysis infrastructure is crucial, as exemplified by the Global Fund's support for data management systems for HIV surveillance in LMICs [13].

Promoting Global Collaborations

Promoting inclusive collaborations is essential in integrating LMICs into the global research community. Initiatives that foster partnerships, mentorship programs, and joint research projects can contribute to a more equitable distribution of knowledge and resources. While developed nations have well-established research ecosystems that encourage collaboration and provide ample opportunities for scientists, LMICs often face barriers such as limited access to international collaborations, cutting-edge facilities, and a supportive research environment. These barriers can be overcome by promoting global collaborations, allowing LMICs to actively contribute to and benefit from the global research community.

Establishing connections between HICs and LMICs in biomedical research has yielded significant results. For instance, the African Center of Excellence for Malaria Research in Kenya [10] has cultivated strong partnerships with leading research institutions in Europe and North America, leading to collaborative research projects and high-impact publications in top-tier biomedical journals. Similarly, the India-US Science and Technology Cooperation has fostered collaborations between Indian and American researchers in biotechnology, nanotechnology, and climate change, resulting in high-impact publications [14]. Brazil's participation in the Human Genome Project has strengthened its domestic biomedical research capabilities and led to fruitful collaborations with researchers from developed countries, as evidenced by joint publications in prestigious scientific journals [15].

Growth of research output

The data provided in this study indicates that developing countries still have a significant distance to cover in order to contribute a more balanced share to the global scientific community. However, there are reasons for optimism. Despite limited financial resources, many developing nations exhibit remarkably high levels of scientific productivity. Increased investment in scientific research by developing countries could yield positive results, mainly if these publications target high-impact journals [16]. While progress is still being made, connections are

gradually being established between HICs and LMICs in biomedical research.

With significant investments in agriculture, aviation, and biofuels, Brazil has seen a surge in research output. Brazilian researchers increasingly publish in top-tier journals such as Science, Nature, and The Lancet. India's focus on information technology and pharmaceuticals has fuelled a rapid expansion of scientific publications [17]. Indian researchers have made substantial contributions to nanotechnology, biotechnology, and space science, with numerous studies appearing in high-impact journals [18]. South Africa's investments in medical research, particularly HIV/AIDS and tuberculosis, have led to many South African scientists publishing in renowned medical journals [19].

Global Health and Surgery

Interest in global health is on the rise. Hodson et al. have identified key challenges in global health, including the lack of direct funding available for scientists in LMICs, the focus on issues selected by HICs rather than local solutions to local problems, the dominance of the English language in scientific literature, and the exploitation of team members from LMICs**.** In order to address these challenges, several strategies are proposed, such as seeking solutions relevant to local contexts, fostering collaborations between institutions in HICs and LMICs, providing funding for team members from both types of countries, and clearly defining roles and responsibilities for all team members [20].

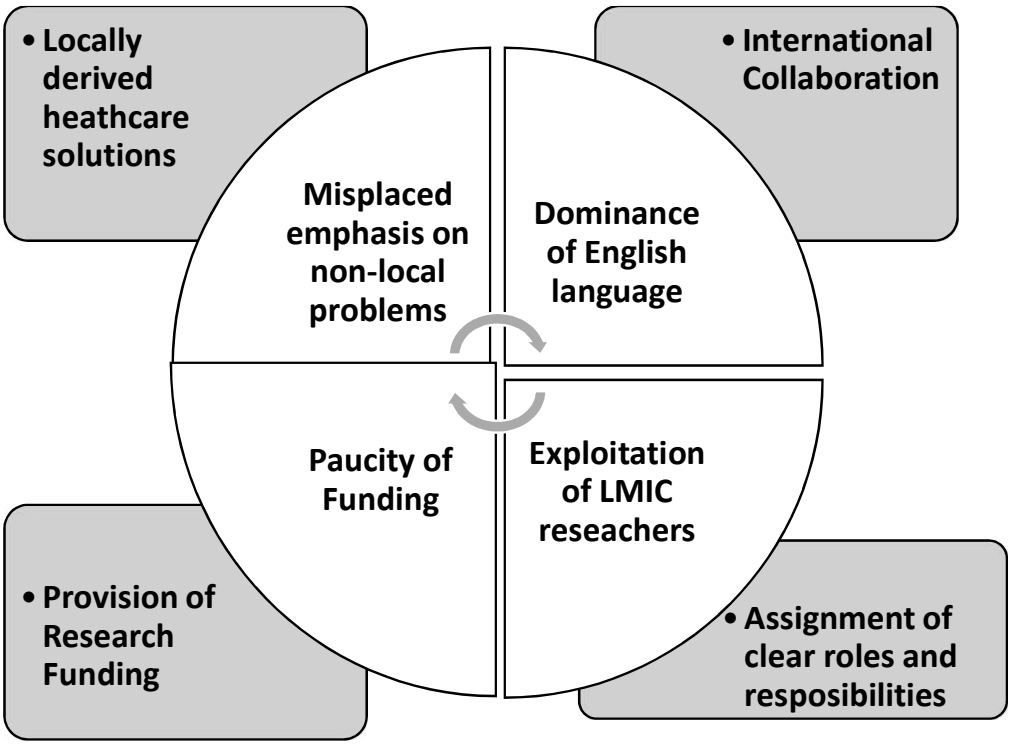


Figure 2. Problems and solutions to the global health problems (Adapted from Hodson et al. [20])

The lack of proper surgical care goes far beyond the immediate suffering it causes. It creates a ripple effect with severe economic and social consequences. Untreated surgical conditions can lead to lost productivity, financial hardship, and a strain on healthcare systems. Socially, these conditions disrupt education, employment, and family life, widening the gap between social classes. Public health is also impacted, as preventable surgical diseases can contribute to the spread of infections and other health problems. Thankfully, global surgery initiatives are working to change this. By highlighting the critical role of surgery and advocating for increased investment, they aim to reduce preventable deaths and disabilities, strengthen healthcare systems with better infrastructure and trained personnel, and ultimately promote equitable access to essential surgical care for everyone, regardless of background. In essence, ensuring access to surgery is fundamental to achieving universal health coverage, reducing global health disparities, and improving the overall well-being of populations worldwide.

Global surgery initiatives are dedicated to enhancing surgical care and accessibility worldwide. These efforts address disparities in surgical outcomes, infrastructure, and workforce across different regions. The main objectives include improving surgical capacity, ensuring safety, and equitably distributing resources to meet global populations' diverse surgical needs. Collaboration among healthcare professionals, organizations, and governments is essential for advancing global surgery and achieving sustainable enhancements in surgical care. Despite the progress, the journey towards achieving equal access to surgical care is ongoing. The global community must work together to ensure that everyone has access to surgical equity [21]. Research disparities exist between the global north and south due to unequal access to resources, funding, and educational opportunities. Historical and systemic factors, including colonial legacies, also contribute to these disparities. Addressing these imbalances should focus on promoting inclusivity, supporting research infrastructure, and fostering global collaboration. Collaboration between the global north and south is essential. A study tracking data from 82 natural science journals indicated a significant imbalance in north-south authorship, with a ratio heavily favouring the global north by almost 3 to 1. It was emphasized that there is still a significant gap in global north-south research equity [22].

Importance of Research Collaboration

Research collaboration is considered crucial in biomedical research [23]. The advantages of international research collaborations are multifaceted (Figure 3), as these help advance science and address complex global challenges by leveraging diverse expertise.

Figure 3. Perceived Advantages of Research Collaboration

It enhances the pooling of knowledge and resources, whereby researchers from different countries can bring unique perspectives, skills, and experiences on a common platform. Collaborative research allows for the integration of diverse ideas, methodologies, and data, fostering a richer understanding of complex phenomena. This 'collective intelligence' often leads to more comprehensive and innovative research outcomes. It increases the number of co-authors and the citation index and overall increases the productivity of the researchers. A study of six leading journals found that the authors who published collaborative studies produced superior manuscripts in higher impact factors journals [24].

Furthermore, international collaboration can facilitate access to resources like funding, research facilities, and specialized equipment [25-27]. This collaborative effort can accelerate research progress and may also be cost-effective. In addition, such global collaboration helps promote cultural exchange and mutual understanding amongst researchers, contributes to knowledge dissemination,

and is instrumental in addressing global challenges.

However, to ensure ethical research collaborations, it is crucial to address issues such as fair attribution, intellectual property, conflict of interest, data sharing, power dynamics, cultural sensitivity, open science, and conflict resolution [28,29].

Conclusion

A comprehensive strategy is needed to tackle the differences in biomedical research productivity between high-income and low-middle-income nations. Enhancing global partnerships, ensuring fair allocation of resources, and prioritizing the development of research capabilities are crucial measures in nurturing a more diverse and influential worldwide biomedical research landscape. Closing this divide is essential for advancing scientific inclusivity and tackling the health issues economically disadvantaged countries face.

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

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Ethical Approval

Not required for such bibliometric study

Data availability

The raw data is available with the corresponding author.

Author's contribution

RV: Conceptualization, Data Analysis, Literature Search, Manuscript writing, editing and final approval. DS: Conceptualization, Data Curation and Analysis, Literature Search, Manuscript writing, editing and final approval. AS/BP/MM/AV: Data Analysis, Literature Search, Manuscript writing, editing and final approval.

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Use of AI Technology: During the preparation of this manuscript, the authors used Gemini, and Grammarly for the literature search and to improve the readability and language. After using this tool, the authors reviewed and edited the content and took full responsibility for the contents of this article

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IMAGES

Fluorosis Masquerading as Compressive Myelopathy

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Abstract

A 60-year-old woman from Cuddalore presented with restricted neck movements, progressive difficulty in walking, and lower limb weakness, leading to bed confinement. Clinical examination revealed spastic paraparesis, brisk reflexes, and sensory deficits below the hips. Laboratory investigations indicated renal insufficiency and elevated urine fluoride levels. Imaging demonstrated calcifications of sacroiliac, sacrospinous ligaments, interosseous membrane, and posterior longitudinal ligament, with osteosclerosis and osteoporosis. Differential diagnoses included Ankylosing Spondylitis and Diffuse Idiopathic Skeletal Hyperostosis. However, the unique pattern of ligament calcification and elevated fluoride levels supported a diagnosis of fluorosis. This case underscores the importance of considering fluorosis in patients from endemic areas with spastic paraparesis and characteristic radiological findings. Posterior decompression via laminectomy was performed, emphasizing the need for awareness of fluorosis as a potential cause of cervical compressive myelopathy.

Keywords: Fluorosis, posterior longitudinal ligament calcification, interosseous membrane calcification, osteosclerosis, Diffuse idiopathic skeletal hyperostosis (DISH)

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A 60 year female, diabetic for 10 years, housewife from Cuddalore, presented with restricted neck movements for 1 year, difficulty in walking for 6 months- knee pain aggravating on movement, weakness of both lower limb for 1 month- difficulty in sitting up from lying down position, bed bound for 1 month, no movement of legs and loss of sensation over both lower limbs for 1 month. No bladder and bowel involvement. No involvement of upper limb. Similar complaints are reported in her parents. Higher mental function, cranial nerves normal. Bulk normal, increased tone in both lower limbs, lower limb power 1/5 across all joints. All deep tendon reflexes were brisk except ankle jerk, Hoffman and wartenberg reflex positive. All sensory modalities reduced below hip. Normal cerebellar and skull, spine examination. Provisional diagnosis considered was cervical compressive myelopathy. Complete hemogram normal, urea-95 mg/dl, creatinine-4.2 mg/dl, urine routine and microscopy normal and USG KUB showed bilateral shrunken kidney. Nerve conduction study showed Bilateral Sural sensory axonal neuropathy probably secondary to diabetes mellitus. Fundus normal. Urine fluoride levels measured to be 2.6 parts per million (Normal<1). Imaging showed calcification of sacroiliac, sacrospinous ligament (Figure 1A), calcification of the interosseus membrane (Figure 1B), increased bone density (osteosclerosis), osteoporosis, thickening of the compact bone, ossification of the tendon and ligament attachments and ossification of posterior longitudinal ligament (Figure 1C). Water fluoride levels were >1.2 ppm and patient few family members who share same water source had similar symptoms. We have notified the Public Works Department regarding the non-endemicity and to take necessary steps to check Water fluoride levels of that particular region and decide on need for defluoridation technique. Posterior decompression via laminectomy done. Post procedure patient was able to walk without support and symptomatically better at 3 months follow up. Differential diagnosis to be considered in this case were Ankylosing spondylitis (AS) and Diffuse idiopathic skeletal hyperostosis (DISH). AS will have sacroiliitis, romanus lesion, syndesmophytes, classical interspinous ligament calcification with reduced disc space. DISH will have syndesmophytes with classical anterior longitudinal ligament calcification with preserved disc space. The unique features of fluorosis are the classical posterior longitudinal ligament, interosseous membrane, sacrospinous and sacrotuberous ligament calcification with preserved disc space. Excessive fluoride concentration in drinking water causes activation of both osteoblasts and osteoclasts resulting in increased bone turnover by aberrantly activated osteoblasts, activates parathyroid hormone pathway leads to poorly woven bone matrix, periosseous tissue ossification and immature bone deposition. In endemic areas, sclerosed osteophytes/ thick ligaments due to fluorosis can cause compressive myelopathy [1,2,3] and cause restrictive neck movements, progressive spastic quadriparesis similar to our case. Non-skeletal features of fluorosis include increased thirst, depression, infertility, abdominal pain, constipation, bloating, loss of appetite and myopathy [1]. Fluorosis is endemic in geographical fluoride belt which includes 22 countries – India, China, Japan, Saudi Arabia, Pakistan, Middle east, Argentina, Mexica and North- East African countries [3]. Normally it gets incorporated into the enamel hydroxyapatite crystals and

reduces enamel demineralization and prevents caries formation. It is double edged sword as excess fluoride interferes with enamel mineralization, maturation leading to soft, pitted and pigmented enamel. Bony deposition of fluoride causes bony sclerosis, osteoporosis and ligament calcification. Absence of dental fluorosis does not exclude fluorosis as in our case.

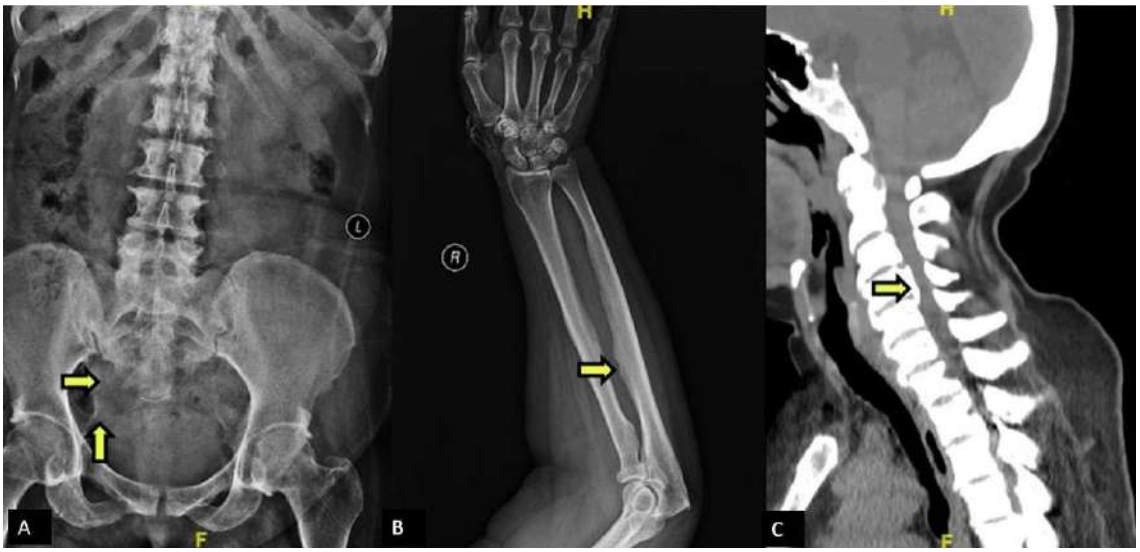

Figure 1. **1A** Xray pelvis AP view showing calcification of sacroiliac ligament (marked by arrow) and sacrospinous ligament (marked by arrow); **1B** Xray of right forearm anteroposterior view showing interosseous membrane calcification (marked by arrow); **1C** Computed Tomography spine (CT spine) showing ossification of posterior longitudinal ligament (Marked by arrow)

Learning points

In patients presenting with progressive spastic paraparesis or quadriparesis with progressive spastic paraparesis/ quadriparesis with neck pain, brisk reflexes, interosseus calcification in Xray forearm and posterior longitudinal ligament calcification- cervical compressive myelopathy-Fluorosis must be considered.

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

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LETTER TO THE EDITOR

Legalizing Virtopsy: A Vital Alternative to Conventional Autopsy for Medico-Legal Organ Donation Cases

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Virtopsy, a term combining 'virtual' and 'autopsy,' employs imaging techniques commonly used in clinical medicine, such as computed tomography (CT) and magnetic resonance imaging (MRI), to ascertain the cause of death. This method, also referred to as digital autopsy by some forensic pathologists, serves as an alternative to traditional autopsies. It offers a thorough and systematic examination of the entire body, is less time-consuming, improves diagnostic accuracy, and respects religious sensitivities. Essentially, it involves the application of imaging methods combined with 3D conversion and photogrammetry to achieve the objectives of a medico-legal autopsy [1].

During the 1990s, Richard Dirrhöfer, former head of the Department of Forensic Medicine at the University of Bern in Switzerland, initiated the virtopsy project to document the human body in an objective manner during medico-legal autopsies. In 2003, the British Museum approached his team to conduct an autopsy on a 3000-year-old mummy named Nesperennub without compromising the body. Since then, this technique has been adopted by many countries and is considered a supplementary tool for autopsies, offering a variable degree of certainty [2].

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In 2019, the then Union Health Minister Dr. Harsha Vardhan, mentioned in the parliament of India about the government's intention to introduce virtual autopsy, or virtopsy at AIIMS, Delhi. The project was officially launched at AIIMS Delhi during the second wave of COVID-19 in 2020. A comparator study was conducted, involving both traditional and virtual autopsies in hundreds of cases. This study validated and standardized the virtopsy technique, proving it to be a significant humanitarian relief by ensuring dignified management of the deceased. Notably, the postmortem of celebrity comedian Raju Srivastava was conducted using virtopsy, and these reports are now commonly accepted by courts, similar to conventional autopsy reports [3].

Although virtopsy is not a novel concept in forensic pathology, its routine implementation in our country remains elusive due to several challenges. High initial costs and the reluctance of rigid judicial and law enforcement agencies have hindered its adoption. Even in some of the most advanced jurisdictions, such as certain states in America, the financial burden of traditional autopsies is recognized as significant. There is a growing consensus on the necessity to embrace new technologies to reduce costs and enhance the scientific and humane aspects of forensic work. By integrating virtopsy, we can better honour the emotional and religious values of the next of kin, treating the mortal remains of their loved ones with greater respect and sensitivity. However, it is imperative to acknowledge that in cases where a traditional full autopsy is deemed necessary, it should be conducted without hesitation, ensuring that professional standards and thoroughness in forensic investigations are maintained.

Not to digress from our present topic, In medico-legal organ donation cases in India (cadaveric organ donation), once the second brain death declaration is made by the designated team of doctors, the forensic surgeon is contacted to approve the case for organ retrieval. Before granting approval, the forensic surgeon receives a requisition for an autopsy and reviews the entire file to determine if the case is suitable for organ retrieval. If approved, the retrieval process is conducted. After the organ retrieval is complete, the body is handed over to the autopsy surgeon, who then conducts the autopsy and subsequently releases the body to the relatives through police [4]. However, there have been occasional instances where the autopsy surgeon failed to intervene post-retrieval, either by not conducting an autopsy or/and by not opening the cranial cavity. There are a bunch of reasons why proceeding for a traditional autopsy post retrieval seems really difficult. Firstly, the organ retrieval process itself takes a lot of time. Following the second brain stem death declaration, the retrieval process itself often takes 1-2 days, as it hinges on the availability of transplant teams. Subsequently, if an autopsy is required post-retrieval, it adds another 4-6 hours for completion, further prolonging the wait for the deceased's relatives. Compounding this issue is the fact that many corporate hospitals where organ retrieval occurs lack adequate facilities for conducting conventional autopsies. Moreover, transporting the body to a nearby autopsy facility is time-consuming, exacerbating the distress of grieving families who have already endured a lengthy wait. More to that, in some instances, legal heirs consent to organ donation only if no traditional autopsy is performed. Virtopsy offers a legal and

respectful solution in such cases. Transplant coordinators face challenges managing brain death certifying teams, transplant teams, police and autopsy surgeons, making time management difficult. Virtopsy streamlines this process, increasing chances of organ donation in medico-legal cases by addressing legal and logistical issues, ensuring a smoother and more efficient procedure like in Non Medico Legal Cases.

These logistical challenges and practical concerns are compelling us to advocate for virtual autopsy as a viable alternative to traditional autopsy in medico-legal organ donation cases, whenever and wherever feasible. Virtual autopsy saves considerable time while achieving the necessary objectives. Moreover, most hospitals now possess the imaging facilities required to conduct whole-body Postmortem CT and MRI scans, which are integral to the virtual autopsy procedure. This approach not only enhances efficiency but also ensures comprehensive documentation of findings, supporting transparency and serving as a safeguard against allegations, particularly in regions like India where scrutiny of corporate hospital practices is intense.

Instead of remaining passive observers in medico-legal organ donation cases—where our role often ends with receiving an honorarium, conducting traditional autopsies, and sometimes facing allegations of signing death certificates after minimal examinations—we, as forensic surgeons, can enhance the significance of our work by advocating for full virtual autopsies immediately after organ retrieval. This proactive approach allows us to actively participate throughout the organ donation process, ensuring that our expertise serves a crucial purpose. Depending on the circumstances, we can opt for minimally invasive or partial autopsies, utilizing image guidance when necessary to achieve the objectives of a comprehensive medico-legal examination. This adaptive approach enables us to make informed decisions on a case-by-case basis, optimizing our involvement in organ donation program while upholding professional standards in forensic pathology.

The profession of forensic pathology is currently at a crossroads, and we must embrace change to stay relevant and create value for ourselves. The question is, to be or not to be? At this critical juncture, some advocate for abandoning traditional autopsies entirely in all medicolegal (MLC) organ donation scenarios, suggesting that we simply sign a death certificate based on antemortem radiology and medical records. Conversely, another perspective argues that the decision to conduct an autopsy in organ donation MLC cases should be left to the discretion of the autopsy surgeon.

However, placing the entire responsibility on the autopsy surgeon to decide between a full, limited, or no autopsy could lead to significant controversy and reputational issues. Instead, it should be mandated by law that at least a virtopsy be performed in these cases. This approach ensures a thorough and standardized examination, mitigating potential conflicts and enhancing the integrity of the medico-legal process.

Regarding the legality of virtopsy-based autopsy reports, Sections 65A and 65B of the Indian Evidence Act, along with corresponding changes in the new criminal codes, support the use of imageology/photographic/videographic records as evidence, provided the reporting is done by an autopsy surgeon trained in

forensic radiology [4]. The concept of no-scalpel or minimally invasive autopsies gained significant importance during the COVID-19 pandemic to reduce the spread of infection. Needless to say, virtopsy is also one such non-invasive/minimally invasive method as envisaged by the ICMR during the pandemic days.

Implementing virtopsy for medico-legal organ donation cases presents several challenges, such as the costs involved and the need for forensic pathologists to acquire new skills as forensic radiologists. To mitigate the additional costs, we can utilize existing infrastructure at corporate hospitals or institutions where organ retrieval is performed. However, viewing images in 3D, employing photogrammetry, and using devices for minimally invasive autopsies may still incur some reasonable additional costs.

To address the skills gap, efforts should be made to provide comprehensive training. A one-time training program for all forensic pathologists can be initiated, along with continuous professional development programs in forensic radiology for autopsy surgeons. Additionally, forensic radiology should be more thoroughly integrated into postgraduate curricula to ensure future pathologists are well-versed in these techniques. Training for virtual autopsy requires a solid understanding of radiological aspects, making it essential to involve radiology faculty alongside the forensic department at the medical college level. Radiologists should teach basic radiology, including CT application and precautions. Post-mortem changes and their interpretation should be mutually discussed and practiced until forensic specialists gain full skill and experience.

In conclusion, to remain compliant with the law, uphold professional standards, and ensure ethical practice in our profession, adopting virtopsy becomes a categorical imperative in dealing with MLC organ donation cases.

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

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PERSPECTIVE

ManuScript Rejection sYndrome (MiSeRY): An Author's Nightmare

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Abstract
With majority of the medical journals having a rejection rate of more than 80% of submitted manuscripts, it does come as a shock and grief to the author who had a lot of expectations before submission. Though most of the literature available does mention how to overcome the lacunae in the manuscript before considering resubmission in another journal, none addresses the mental agony and setback the author faces and the way to overcome this setback. Every author should develop immunity and be adequately mentally prepared to overcome this misery. A question- answer session between an eager enthusiastic author, a highly experienced reviewer, and the final authority Editor is presented for guidance.

Keywords: Manuscript Rejection Syndrome, Depression, Rejection blues, Rejection resilience

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With an average rejection rate of various top-tier journals between 80 and 85% of manuscripts by the editorial board of medical journals [1] and around 20%–30% of the submitted manuscripts being rejected without even a peer review (desk rejection), it comes with a sense of disbelief, shock, anger, denial, frustration, and depression to a new medical author who has an extremely high expectation from the journal. This condition is called as ManuScript Rejection sYndrome (MiSeRY) [2]. The first outburst of the author occurs towards the Editorial Board members and the reviewers of the journal. There have been instances of reviewers being abused by the author quoting "I am sorry that I did not accept your review this time and I hope you find success somewhere else in fulfilling your sadistic bloodthirsty appetite for reviews" [3]. There is grief-like emotional aggression and an impulsive hunger to write back and appeal in a fit of anger. The author is in denial as the reason for the manuscript being rejected appears confusing to him as most of the time the reason quoted is "Currently we are unable to publish all of the papers due to large no. of submissions..."

With the National Medical Commission's postgraduate medical education regulations 2023 making it mandatory for a postgraduate student to publish a manuscript as first author in a journal during their period of study [4], the mental agony of manuscript rejection should be made aware to these young minds. There are reports of manuscript rejection leading to promising individuals to abandon their careers in academic medicine [5]. Repeated rejection leads to impostor syndrome and burnout.

The 5 stages of grief, called 'Rejection blues' after the manuscript being rejected are - Stage 1- Denial of the rejection- it 'cannot' happen! Stage 2- Anger and frustration on the decision - the reviewers are ignorant! Stage 3 - Bargaining and renegotiating this decision- maybe the author contemplates resubmitting it unchanged to a better journal. Stage 4 – Depression and a sense of hopelessness. Stage 5 - Acceptance of the decision [6]. There is another phase that has not been published till now that often occurs in most of the immature innocent young authors. Once the author calms down, there is the 6th 'Stage of Escapism' when the same paper is sent for acceptance to a predatory or fraudulent medical journal for fast-track publication to add substance to the Curriculum vitae.

In a medical college 'publish or perish' scenario, the postgraduate student works in coordination with the Ethics committee approval, the departmental hierarchy, and the unit head or the head of the department as coauthor in the final submission of the dissertation topic as a research paper compiling the data of 3 years in the journal, any rejection becomes a 'blot' and a personal failure with negative weight, low self-worth, and decreased academic performance.

The management of MiSeRY needs special attention apart from handling the 'flaws and loopholes in the manuscript as advised by the peer reviewers on the research topic. While the academic part of the manuscript can be taken care of by the author after rejection, it's the mental agony and psychological setback that needs proper

attention and guidance from mentors. Every new author should be taught about the perils of manuscript rejection by the mentor/guide just like a pharmacology teacher teaches the side effects of a drug or a surgeon learns about the postoperative surgical complications. The way out is the CACHE approach (= **C**ool down, **A**nalyse the letter, **C**onsider options and **HE**ad on!) [**7**].

Every author must be made aware of the rejection rates of a journal before submission as well as see how common this problem of manuscript rejection rates among peers and mentors and finally, they should understand the common minimum manuscript rejection rate to attain perseverance – what is termed as "rejection resilience" [8].

The modus operandi of getting over this depression is to always have a three-tier selection of journals before submission - Class 1 – those with impact factors between 5 and above, Class 2 – journals having impact factors between 2 to 5 and Class 3- journals with less impact factor but having good citations and high acceptance rates. Hence, the author is mentally prepared to switch down the gears once he faces rejection from the highly sought-after journals. The personal and professional life of the author should not face the disturbance or turbulence of manuscript rejection and the expectations from the editorial board to accept any manuscript at first sight should be kept at a bare minimum. Finally, as a last resort, a psychiatrist's help may be sought to get over the doom of acute depression. The New England Journal of Medicine gives the most common reason for rejection as "*The space available for correspondence is very limited, and we must use our judgment to present a representative selection of the material received. Many worthwhile communications must be declined for lack of space",* it also indirectly gives a reason for a bailout route for the author who needs to move on to another alternative journal for another submission giving little space to depression after manuscript rejection. Many journals offer 'Article Transfer Service' guidance to authors where there is an efficient transfer process, shortening the path from acceptance to publication. In summary, Manuscript Rejection Syndrome is like an epidemic that needs to be fought by taking adequate precautions and preventive measures, and at the end of the day, one should develop immunity.

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CASE REPORT

Azathioprine Induced Acute Pancreatitis in a Patient with Lichenoid Dermatitis

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Abstract

Acute pancreatitis (AP) is an inflammatory condition, characterized by elevated levels of amylase and lipase, with manifestation of acute abdominal pain and acute with high mortality and morbidity rates. The most common causes of AP other than gallbladder stones and alcohol include hypercalcemia, infections, hypercalcemia, and drugs. One such drug associated with AP is azathioprine. Azathioprine for dermatologic lesions are used as steroid sparing immunomodulatory agents. Here in, we report such an unusual case of azathioprine induced acute pancreatitis.

Keywords: Lichenoid dermatitis, drug-induced acute pancreatitis, azathioprine, idiosyncrasy DIP

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Introduction

Acute inflammation of the pancreas, commonly known as acute pancreatitis, stands as a significant cause for hospital admissions globally related to gastrointestinal issues. The death rate associated with this condition hovers around 5% [1], although this figure can fluctuate based on the severity of the disease and the patient's overall health condition. The origins of this ailment are diverse, with gallstones and alcohol consumption being the primary culprits. However, other factors such as high lipid levels in the blood, infections, elevated calcium levels, certain medications, and autoimmune responses also play a role. Medication-induced acute pancreatitis represents roughly 2% of these cases and is usually classified as mild to moderate in terms of severity [2].

Several medications have been linked to the onset of acute pancreatitis, including but not limited to acetaminophen, corticosteroids, metronidazole, azathioprine (AZA), mercaptopurine, and diuretics like thiazides.

In gastroenterology practice, azathioprine (AZA) along with its derivative 6-mercaptopurine (6-MP) are recognized for their effectiveness in managing Crohn's disease (CD), especially when corticosteroids are deemed unsuitable for long-term maintenance due to their potential side effects [3]. Azathioprine has received approval for treating various inflammatory disorders affecting the skin.
The drug azathioprine is sanctioned for use in conditions such as pemphigus vulgaris, systemic lupus erythematosus, and dermatomyositis. Additionally, it is frequently employed in an off-label capacity to address a range of conditions including atopic eczema, bullous pemphigoid, pyoderma gangrenosum, chronic actinic dermatitis, cutaneous vasculitis, among other skin-related issues.

Case Report

Case History/Examination

A 55year old female presented to our gastroenterology department with complaints of acute onset epigastric and umbilical, deep boring continuous abdominal pain, which was associated with nausea and vomiting and pain aggravated with food intake with radiation to back and decreased on sitting and leaning forward position.

Patient did not give any history of trauma, breathing difficulties, previous surgeries, similar complaints in past, no comorbidities, no significant family history with normal bowel, bladder habits prior to the onset of symptoms and no addictions.

Three months prior to onset of symptoms, patient consulted a dermatologist for complaints of gradual onset generalised itching and darkening of skin and was clinically diagnose as having lichenoid dermatitis for which patient was treated initially with topical emollients and anti- histamines with poor response. For this patient was started on oral steroids which were gradually tapered over 4 weeks along with other supportive treatment. Patient improved symptomatically. So on further follow up, patient was started on azathioprine 50mg OD (as steroid sparing agent) after doing baseline investigations and patient was continued on topical applications. 15 days after starting this patient presented to us with abdominal pain.

Status of skin lesion at presentation in Figures 1 and 2.

On examination: PR- 90/min, BP-110/70mm Hg, Temp-98.6 F

Spo2- 98% in room air, RR-16/min

Per abdomen- soft, no localised tenderness with no organomegaly with bowel sounds present

Other system examinations was found to be within normal limits.

Based on the above patient was clinically diagnosed to be having acute pancreatitis.

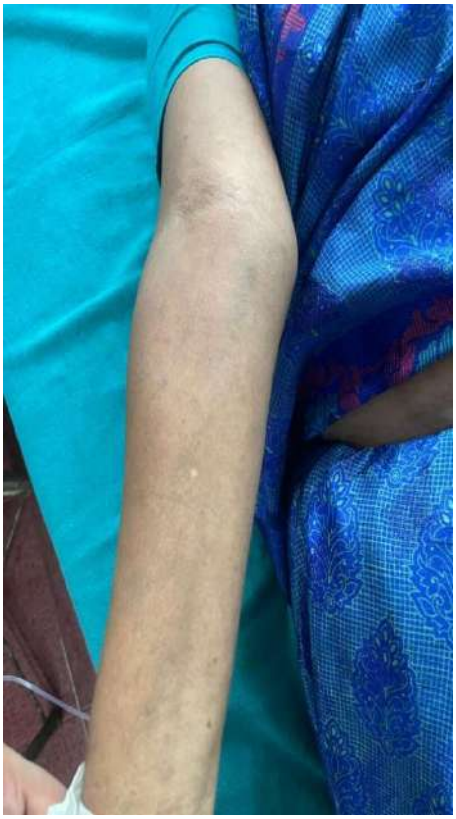

Figure 1. Lesions on limbs.

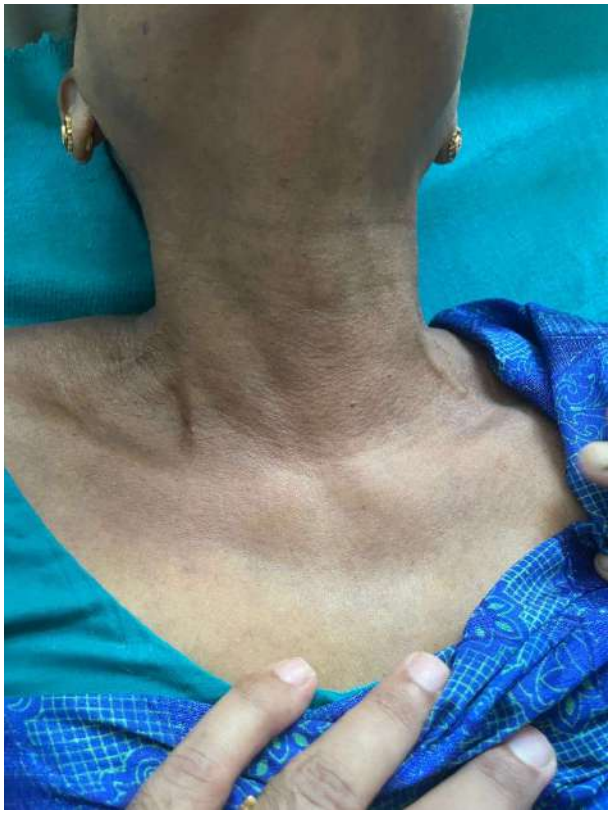

Figure 2. Lesions on neck and upper chest.

Methods

Investigations

Hb-12.4 g/dl

Total wbc count- 16310 cells/mm3

PCV -40.1%

ESR- 52/ 1st hour

Total bilirubin-0.5mg/dl

SGOT/SGPT- 20/19

ALP-95 IU/ml

Blood urea/S.creatinine- 44/ 0.7

Na+/K+- 136/3.6

Serum amylase- 550.1 IU/L

Serum lipase -3293.2 IU/L

S. ca2+: 8.4 mg/dl

Fasting lipid profile: total cholesterol: 190mg/dl, LDL- 117 mg/dl, HDL -52 mg/dl

IGG4 – 1.1.g/L

CT abdomen

Impression

Bulky pancreas is seen. Significant peripancreatic fluid and inflammation is seen. Oedematous second and third part of duodenum seen.

Features are suggestive of acute pancreatitis. No evident located collections.

The diagnosis was confirmed as Acute pancreatitis – mild severity Probable aetiology- Drug induced (Azathoprine)

Patient was admitted and was treated with iv fluids, analgesics and other supportive treatment. Azathioprine was discontinued. Patient was discharged when patient became asymptomatic and was taking oral feeds. Patient was asked to follow up in OPD. In subsequent follow ups patient remained asymptomatic.

Conclusion and Results

Our case highlights the importance of having a good clinical history to diagnose uncommon causes of acute pancreatitis.. AZA should be held at the time of admission in patients with high clinical suspicion of DIAP while waiting for a workup to rule out other common causes of pancreatitis. Our patient had an uncomplicated hospital course with discontinuation of AZA and conservative management. Our patient did not develop any further episodes acute pancreatitis and is under regular follow up. Whether AZT was definitely indicated for our patient's dermatologic condition is unsure. Till now no flare up of patient's skin lesions and the patient is comfortable with the current condition of her skin.

Discussion

The condition known as acute pancreatitis presents a serious health challenge, with its mortality rates ranging widely from 1% to 30% [4], depending on various factors. A multitude of drugs have been identified as potential triggers for pancreatitis, acting through different mechanisms. These include immune system-mediated hypersensitivity, direct damage to cells, accumulation of harmful metabolites, reduced blood supply (ischemia), formation of blood clots within vessels (intravascular thrombosis), increased thickness of pancreatic fluids, and unpredictable reactions unique to the individual [5]. This has been presented in Figure 3.

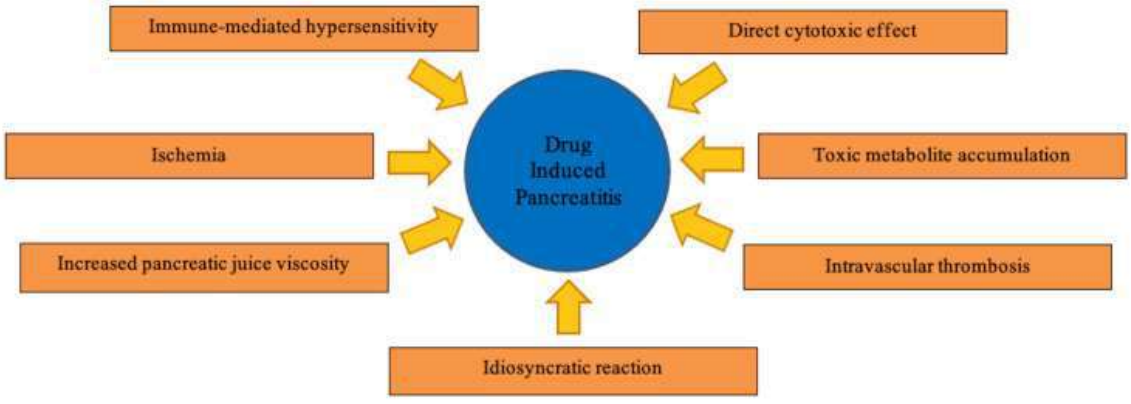

Figure 3. Possible mechanisms for drug induced acute pancreatitis

AZA is a known medication that can cause idiosyncratic DIP [6]. Studies of inflammatory bowel disease patients on AZA revealed an incidence of AZA-induced pancreatitis of 7.5%, with a mean time of 25 days until developing pancreatitis from drug initiation, and a mean dose of 88 mg.

Risk factors for developing AZA-induced pancreatitis are shown in Table 1.

Smoking
Concomitant budesonide use
Single daily dose of azathioprine
Genetic variants in the HLA gene region
Crohn's Disease

Risk factors for azathioprine-induced pancreatitis [7]

Identifying drug-induced acute pancreatitis (DIAP) poses a diagnostic challenge. A definitive diagnosis of DIAP necessitates the exclusion of other potential causes, onset of pancreatitis following drug exposure, resolution after stopping the drug, and recurrence upon re-administration of the drug [8]. However, most documented instances lack rechallenge data, which is pivotal in establishing causation. Moreover, the prevalence of other illnesses that can lead to acute pancreatitis often complicates the determination of a drug's role.

It's crucial for medical professionals to recognize the array of medications that may lead to DIAP and to consider this diagnosis when faced with cases of acute pancreatitis that have no apparent cause. Typically, patients with DIAP experience a relatively mild and non-threatening progression of the condition, with a generally positive outlook for recovery [9]As AZT pose a risk for pancreatitis, the indications for its use in clinical practice should be ver well defined.

Statements and Declarations

Conflicts of interest

The authors declares that they do not have conflict of interest.

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Ethical Disclosure

Informed consent obtained from patient before publication.

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CASE REPORT

Short Stature with Type-1 Diabetes: A Clinically Observed Case in Patients Suffering From Mauriac Syndrome

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Abstract
Mauriac syndrome (MS) is an exceptionally rare disorder occurring in poorly controlled Type 1 diabetic patients. The consequences include dwarfism, obesity, hepatomegaly, delayed puberty, growth failure and higher levels of transaminase enzyme. We report a case of an adolescent female with classical features of Mauriac syndrome.

Keywords: Growth Failure, Tanner Staging, Over- insulinization, Cushing Syndrome, diabetic cheiroarthropathy, Glucose Monitoring

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Introduction

The global survey claim that the present population are at higher risk of developing diabetes and its related complications. MS is one such rare disorder with a silent feature of glycogenic hepatopathy leading to poor control over type 1 diabetes mellitus (DM) [1]. The patients will have features such as growth retardation (growth failure), obese conditions, hepatomegaly and cushingoid facies. Furthermore, a delayed pubertal menstruation, dyslipidaemia, elevated transaminases and proximal muscle wasting were also observed in such patients [2].

Such type of cases mainly occurs in female and in adolescence, but reports also suggested that the relatively higher cases are observed in children of younger age [3]. All these features can be reversed with the use of insulin injection therapy, instigating prompt control over blood glucose fluxes [4], diet and regular physical exercise.

In our study, one such clinical feature of Mauriac syndrome was observed and the data recorded in a female patient of 18 years age group.

Case Report

This is a case report of an 18 year old female having poorly controlled T1DM from almost one decade. The patient had poorly controlled blood glucose levels and history of growth failure. Our detailed investigations ruled out the history of DKA and the inheritance of diabetes from her family.

The child was subjected to physical examination, with the following observations like short statured height of 132cm (falling below 3rd percentile) and the body weight of 57 kgs. On continuation, the investigational findings depicted BMI of ~32.71, hepatomegaly, Tanner stage I (pre-pubertal) pubertal delay. Along with these features patient was found to have cushingoid face, protuberant abdomen, proximal myopathy, diabetic cheiroarthropathy and scleroderma. On fundus examination, mild to moderate non proliferative diabetic retinopathy was observed.

Laboratory reports revealed the following information: Haemoglobin-(10.4g/dl), fasting blood glucose (FBS-300mg/dl), post prandial blood glucose (PPBS-400 mg/dl), total cholesterol (200 mg/dl), LDL cholesterol (150 mg/dl), HDL cholesterol (23 mg/dl), VLDL cholesterol (50 mg/dl) and triglycerides (160 mg/dl). Likewise, the liver function test depicted total protein, albumin, aspartate transaminase, alanine transaminase, alkaline phosphatase values of 6.4 g/dl, 3 g/dl, 130 U/L, 110 U/L, 170 U/dL respectively. Further the key electrolytes analysis such as calcium, serum sodium, potassium and chloride was found to be 8.1 mg/dl, 130 mmol/L, 4.75 mmol/L, 96.4 mmol/L respectively. The ketone bodies was found to be nil in the urine sample. The Haemoglobin A1C (HbA1C) was as high as 15 mg/dl indicating poorly controlled diabetes.

Table 1.

Hormone Profile	Values
Vitamin D	5.05ng/ml
FSH	4.8μIU/ml
LH	1.8μIU/ml
T3,T4,TSH	Normal

The ultrasound (USG) scan showed evidence of fatty liver and a hypoplastic uterus. The bone age of 14 was confirmed by executing X-ray studies of both the wrist and long bones.

Immediately after diagnosis and laboratory analysis reports, the patient was infused with basal bolus insulin to lower the elevated sugars levels. Over the period of 4 months of monitoring FBS, PPBS and HbA1C were brought up to ~120 mg/dl, 186 mg/dl and 8%, respectively.

Discussion

In the year 1930 a French clinician by name Pierre Mauriac identified Mauriac Syndrome in a 10 year old girl having Type-1 DM with characteristic growth failure and delayed puberty [4]. The MS patient manifests to have some unexpected symptoms closely relating to obesity, hepatomegaly, Cushingoid face, elevated serum liver enzymes, growth retardation, pubertal delay with warning signs of DM.

The pathophysiologic findings primarily suggested that glycogenic hepatopathy, hyperglycaemia and over-insulinization were the reason for liver enlargement and it's impaired functioning [5].

The precise cause of delayed growth is considered to be multifactorial, occurring as one of the subtle features of MS. The cardinal reason could be low glucose tissue metabolism, altered hormone receptor action, hypercortisolism, decreased GH and IGF-1 [1,6].

Genetics of MS

It can be said that a person suffering from MS has increasing incidence to develop type-1 DM leading to insulin deficiency, in-turn high sugar levels. But on the other hand there is no evidence of a diabetic patient having risked with Mauriac conditions. This rules out the possibility that elevated glucose levels may not be the potential reason for developing MS.

An adolescent boy was detected to have severe MS linked with mutation of exon 9 of Phosphorylase kinase (PHK) G_2 gene, which is the catalytic subunit of the enzyme Glycogen Phosphorylase kinase (PhK), the first enzyme in the pathway of glycogen metabolism [7].

Moon face is often associated with Cushing's syndrome mainly resulting due to glycogen deposition (with pituitary adrenal axis intact).

Liver biopsy in the setting of MS demonstrates steatosis and glycogen deposition, though the findings can vary in presentation [8]. Hyperglycaemia and Low insulin levels caused by poor T1DM leads to fatty acid deposition in the liver that roots to hepatomegaly and characteristic liver biopsy identifications. By controlling the overall glycaemic conditions in an individual these findings could be reversed [9].

A group of clinicians lead by Mauriac concluded a Nil report related to hypothalamic pituitary dysfunction with respect to growth failure [10] and growth failure regresses with adequate insulinization in patients with MS. However, on continuation of treatment with insulin further resulted in deterioration of retinopathy and nephropathy [11].

Pubertal issue leading to menstruation delay in MS can be normalized by controlled insulin therapy. For instance, a clinical team lead by Traisman were able to demonstrate successful sexual development and pregnancies in a 22 years old MS Patient [12].

Conclusion

MS is a rare complication emphasizing the poorly controlled DM in adolescence aged population. The unlikely causes of the MS could be reversed by prompt insulin dosing and timely glucose monitoring. This could be an ideal approach to treat the subject leading to high indexed clinical outcome with lesser life-threating complications.

Ethics Declarations

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This study did not receive any funding.

Conflict of Interest

The authors declare that they have no competing interests.

Ethics approval, Consent to participate, Consent to publish, Availability of data and material, Code availability

Not applicable.

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