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5 Years: March 2020-February 2025: Impact of Covid-19 Pandemic on India

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EDITORIAL

Five Years since First Lockdown (March 2020-February 2025)—Impact of COVID-19 Pandemic on India: Challenges and Opportunities

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Abstract
The COVID-19 pandemic has profoundly impacted India, presenting a dual spectrum of challenges and opportunities. This article explores the chronological timeline of events, beginning with the outbreak in China and its subsequent global spread, highlighting key dates and developments in India. It discusses the transformation of healthcare systems through expanded testing capabilities, triage systems, and the rapid adoption of online platforms and IT technologies. The manufacturing sector pivoted to produce essential supplies like masks and personal protective equipment (PPE) kits, while advancements in vaccine development and therapeutic treatments, including ventilators and oxygen supply, became pivotal in managing the crisis. The pandemic also catalyzed initiatives like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) for employment and highlighted new health challenges such as mucormycosis. Moreover, it spurred advancements in AI and machine learning, bolstered telemedicine adoption, and revealed lessons for future pandemics. The article concludes with recommendations for enhancing healthcare capacity, leveraging collaborations like the Swasth Express initiative and anticipating future pandemics through strategic policy frameworks.

Keywords: COVID-19, Pandemic impact, PPE, MGNREGA, AI and ML

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The nationwide lockdown in India, which was announced on 24 March 2020, was a significant and drastic measure in response to the escalating COVID-19 pandemic. With the country having about 1.38 billion people, the lockdown aimed to curb the spread of the virus and prevent overwhelming the healthcare system. The 21-day lockdown was enforced shortly after a 14-hour voluntary curfew on 22 March, which saw widespread participation in an effort to raise public awareness.

At the time of the lockdown's announcement, India had approximately 500 confirmed cases of COVID-19, a relatively low number compared to later spikes. However, given the potential for rapid community transmission and the risk to public health, the government took immediate action. The lockdown, which confined people to their homes, created significant challenges for millions of migrant workers and daily wage laborers, leading to a mass migration of people attempting to return to their hometowns. This movement was described as one of the largest migrations in India since the Partition of 1947.

Despite the initial hardships, the lockdown appeared to slow the growth of the pandemic. By 6 April, the doubling rate of cases had slowed to every six days, and by 18 April, this rate further decreased to every eight days. These early indicators suggested that the lockdown was having a positive impact in containing the spread of the virus, though challenges continued as the situation evolved over the subsequent months.

This period marked a significant moment in India's fight against COVID-19, with both successes and challenges as the country adjusted to the realities of a global pandemic.

Introduction

The COVID-19 pandemic has profoundly reshaped India's socio-economic and healthcare landscape, presenting a dual spectrum of challenges and opportunities. Originating in Wuhan, China, the virus swiftly evolved into a global health crisis, marking a watershed moment in modern history. This article provides a comprehensive exploration of the pandemic's timeline, tracing its trajectory from the initial outbreak to its far-reaching implications for India. Key dates and pivotal developments serve as signposts in understanding the country's response to this unprecedented challenge, reflecting critical milestones in India's journey through the pandemic.

As COVID-19 spread across continents, India experienced waves of infections that strained its healthcare infrastructure and tested its resilience. The response was multifaceted, encompassing rapid expansions in testing capabilities, the rapid adoption of innovative healthcare technologies, and unprecedented collaborations in vaccine development. These efforts were further complemented by societal adaptations such as remote work, digital education platforms, and community-driven initiatives designed to support vulnerable populations.

Amidst these challenges, the pandemic also presented opportunities for transformative change. India's manufacturing sector exhibited remarkable adaptability, pivoting to meet the surging

demand for essential medical supplies like masks, personal protective equipment (PPE), and medical devices. Advances in telemedicine and digital health solutions accelerated accessibility to healthcare services, particularly in remote and underserved areas.

Beyond healthcare, the pandemic catalyzed advancements in artificial intelligence (AI) and machine learning, driving innovations in predictive modeling, drug discovery, and epidemiological research. Lessons learned from managing the crisis underscored the importance of robust healthcare infrastructure, proactive policy frameworks, and international collaborations to mitigate future health threats effectively.

This article aims to explore into these facets of the COVID-19 pandemic's impact on India, offering insights into the country's journey through unprecedented challenges while illuminating pathways towards resilient and sustainable healthcare systems. By examining the chronological timeline and pivotal developments, we seek to unravel the complex interplay of responses, adaptations, and lessons learned that define India's experience during this global health crisis.

The COVID-19 pandemic has left an indelible mark on India, shaping a landscape fraught with challenges while uncovering opportunities for transformative change. This article presents a detailed exploration of the pandemic's timeline, from its initial outbreak in China to its global spread and profound implications for India. Key dates and pivotal developments underscore the progression of events, highlighting critical milestones in the country's response.

Chronological Overview of COVID-19 in India

The onset of the COVID-19 pandemic in India can be traced back to early 2020 when the first cases were reported, stemming from the initial outbreak in Wuhan, China. As the virus rapidly spread across the globe, India swiftly became one of the hotspots for transmission, prompting a series of escalating responses and critical milestones in its battle against the pandemic.

In January 2020, India recorded its first cases of COVID-19, coinciding with the global recognition of the virus's severity and potential for rapid transmission. The World Health Organization (WHO) declared COVID-19 a pandemic in March 2020, a pivotal moment that underscored the global scale of the crisis and triggered coordinated international efforts to contain its spread.

The Indian government responded with decisive actions, instituting nationwide lockdowns and imposing stringent containment measures to curb the escalating number of cases. These lockdown phases, announced periodically from March 2020 onwards, marked significant turning points in India's strategy to mitigate the spread of the virus and protect public health.

Throughout 2020 and into 2021, India navigated waves of infections, each posing new challenges to its healthcare infrastructure, economy, and social fabric. The country mobilized resources to expand testing capabilities, establish dedicated COVID-19 hospitals, and ramp up production of essential medical supplies such as ventilators, masks, and PPE.

Amidst these efforts, the development and deployment of COVID-

19 vaccines emerged as a critical milestone. India played a pivotal role in vaccine manufacturing and distribution, contributing to global efforts to achieve widespread immunization against the virus.

As the pandemic evolved, India also faced socio-economic repercussions, including disruptions to education, employment, and daily livelihoods. The emergence of new variants of the virus, such as the Delta variant, further challenged public health responses and underscored the need for continuous vigilance and adaptation in containment strategies.

Through these turbulent times, India's response to COVID-19 reflected a blend of resilience, innovation, and collaboration at both national and international levels. The journey continues as the country strives to navigate the complexities of emerging from the pandemic while preparing for future health challenges and building more resilient healthcare systems.

This chronological overview highlights the pivotal moments and responses that have shaped India's experience with COVID-19, underscoring the nation's evolving strategies and lessons learned in confronting one of the most significant global health crises in recent history.

Healthcare System Transformation

The COVID-19 pandemic triggered a rapid and profound transformation of India's healthcare systems, necessitating agile responses and innovative solutions to mitigate the virus's spread and manage its impact on public health.

Expanded Testing Capabilities

At the onset of the pandemic, India swiftly expanded its testing capabilities to detect and track COVID-19 infections. Initially limited, testing facilities were rapidly scaled up across the country, involvin both public and private sectors. The Indian Council of Medical Research (ICMR) played a pivotal role in approving and disseminating testing protocols, ensuring widespread access to diagnostic tools like RT-PCR and antigen tests. This expansion was crucial in identifying cases early, implementing targeted containment measures, and preventing widespread community transmission.

Triage Systems for Efficient Patient Care

To manage the influx of COVID-19 patients and optimize medical resources, healthcare facilities implemented triage systems. These protocols prioritized patient care based on the severity of symptoms, ensuring that critical cases received prompt attention while non-urgent cases were managed efficiently. This approach helped hospitals manage surges in patient admissions and allocate scarce resources such as ICU beds, ventilators, and medical personnel effectively.

Surge in Online Platforms and IT Technologies

The pandemic accelerated the adoption of online platforms and IT technologies within India's healthcare ecosystem. Telemedicine emerged as a critical tool for remote consultations, enabling healthcare providers to deliver essential services while minimizing physical contact. Teleconsultations became widespread, allowing patients to access medical advice, prescriptions, and follow-

up care from the safety of their homes. This shift not only ensured continuity of care but also reduced the burden on overburdened healthcare facilities.

Contact Tracing and Data Management

In response to the pandemic's rapid spread, India deployed robust contact tracing mechanisms facilitated by IT solutions. Mobile applications such as Aarogya Setu were developed to monitor and track potential exposure to COVID-19, providing real-time alerts and guiding individuals on preventive measures. These digital tools enabled authorities to identify and isolate cases swiftly, breaking chains of transmission and containing localized outbreaks effectively. Data management systems were enhanced to collate and analyze epidemiological data, guiding policy decisions and resource allocation based on evolving trends and hotspots.

The COVID-19 pandemic underscored the importance of resilience and adaptability in healthcare systems. India's swift adoption of expanded testing, triage systems, and digital health technologies demonstrated its capacity for rapid response in public health emergencies. Moving forward, investments in healthcare infrastructure, training healthcare professionals in pandemic preparedness, and sustained focus on digital health solutions will be crucial for strengthening India's healthcare resilience and ensuring timely responses to future health crises.

The transformation of India's healthcare systems during the COVID-19 pandemic has been marked by innovation, collaboration, and a commitment to enhancing public health outcomes. The adoption of expanded testing, triage systems, and digital health technologies has not only mitigated the impact of the pandemic but also laid a foundation for a more adaptive and responsive healthcare system capable of addressing future challenges effectively.

Manufacturing and Supply Chain Resilience

The COVID-19 pandemic posed unprecedented challenges to global supply chains and manufacturing sectors, but India's response showcased remarkable resilience and adaptability. The country's manufacturing sector swiftly pivoted to address critical shortages of essential supplies, while advancements in vaccine development and therapeutic treatments underscored India's capability to innovate and achieve self-reliance in healthcare equipment production.

Pivoting to Produce Essential Supplies

As the pandemic surged across the globe, India faced acute shortages of vital medical supplies such as masks, PPE kits, and medical devices. In response, the manufacturing sector demonstrated agility by rapidly shifting production lines to manufacture these essential items. Textile manufacturers repurposed their facilities to produce masks and PPE kits, ensuring healthcare workers had adequate protection on the frontlines. Pharmaceutical companies ramped up production of sanitizers, disinfectants, and essential medicines to meet increased demand, enhancing India's domestic supply chain resilience.

Boosting Vaccine Development and Production

India emerged as a global hub for vaccine production during the COVID-19 pandemic. The country's robust pharmaceutical industry, coupled with its experience in vaccine manufacturing, enabled rapid development, testing, and production of COVID-19 vaccines. Collaborative efforts between government agencies, pharmaceutical companies, and research institutions accelerated clinical trials and regulatory approvals, leading to the rollout of vaccines such as Covaxin, Covishield, and Sputnik V. This proactive approach not only supported India's vaccination drive but also facilitated vaccine exports to other countries, contributing to global immunization efforts.

Production of Medical Devices and Equipment

The pandemic highlighted the critical need for medical devices and equipment, particularly ventilators and oxygen supply systems, to treat severe COVID-19 cases. India's manufacturing sector responded by scaling up production of ventilators, ensuring adequate supply to hospitals and healthcare facilities across the country. Additionally, efforts were intensified to manufacture oxygen concentrators and cryogenic storage tanks, crucial for storing and transporting medical oxygen. These initiatives not only addressed immediate shortages but also enhanced India's capability to meet future healthcare demands.

The COVID-19 pandemic underscored the importance of manufacturing and supply chain resilience in responding to healthcare emergencies. India's proactive measures in pivoting manufacturing capabilities, boosting vaccine production, and scaling up medical equipment manufacturing have laid a strong foundation for future preparedness. Investments in research and development, strengthening healthcare infrastructure, and fostering collaboration between public and private sectors will be crucial for sustaining resilience and ensuring timely responses to future health crises.

India's manufacturing sector's agility and resilience during the COVID-19 pandemic have been pivotal in addressing healthcare challenges and mitigating the impact of the virus. The rapid adaptation to produce essential supplies, advance vaccine development, and enhance medical equipment manufacturing have not only strengthened India's healthcare capabilities but also positioned the country as a key player in global health security efforts. Continued investments and strategic initiatives will be essential to build on these achievements and safeguard public health in the years ahead.

Socio-Economic Impacts and Initiatives

The COVID-19 pandemic has profoundly impacted India's socio-economic landscape, exacerbating disparities and vulnerabilities while prompting innovative initiatives to mitigate its effects. This section explores the socio-economic impacts, key initiatives like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), and emerging health challenges such as mucormycosis.

Socio-Economic Impacts

The pandemic unveiled deep-seated socio-economic disparities across India.

Lockdowns and mobility restrictions imposed to curb the virus spread led to widespread economic disruptions. Informal sector workers, daily wage earners, and migrant laborers faced acute livelihood challenges as businesses shuttered and jobs were lost. The pandemic-induced economic slowdown resulted in job losses, income disparities, and worsened poverty levels, particularly affecting marginalized communities and rural areas.

Education sectors also faced significant disruptions as schools and universities shifted to online learning, exacerbating the digital divide and impacting learning outcomes, especially for students from disadvantaged backgrounds. Social norms and practices underwent transformations, with physical distancing measures affecting social interactions and community dynamics.

Initiatives like MGNREGA

In response to the economic fallout, the Indian government expanded the MGNREGA, aiming to provide employment opportunities and income support to rural households. The program witnessed increased demand as rural communities sought livelihood alternatives amidst the pandemic-induced economic downturn. MGNREGA provided critical relief by guaranteeing a minimum of 100 days of wage employment in rural areas, thereby bolstering household incomes and economic resilience.

Health Challenges: Mucormycosis (Black Fungus)

The COVID-19 pandemic brought to light new health challenges, with mucormycosis emerging as a serious secondary infection among COVID-19 patients. Also known as black fungus, mucormycosis is a rare but severe fungal infection that primarily affects individuals with weakened immune systems, often exacerbated by uncontrolled diabetes and prolonged steroid use. The surge in mucormycosis cases during the pandemic necessitated specialized medical treatments, including surgical interventions and antifungal therapies. Public health efforts focused on raising awareness about risk factors, early detection, and prompt treatment to mitigate the impact of this emerging health threat.

The socio-economic impacts of the COVID-19 pandemic underscored the need for resilient social safety nets, equitable access to healthcare, and robust crisis management strategies. Initiatives like MGNREGA demonstrated the importance of proactive government interventions in safeguarding livelihoods and supporting vulnerable populations during times of crisis. Investments in healthcare infrastructure, digital literacy, and socio-economic resilience will be crucial for building preparedness against future pandemics and ensuring inclusive growth across all segments of society.

The COVID-19 pandemic has reshaped India's socio-economic landscape, highlighting both vulnerabilities and opportunities for transformative change. The resilience shown through initiatives like MGNREGA and the response to emerging health challenges such as mucormycosis reflect India's capacity to adapt and innovate in times of adversity. Moving forward, sustained efforts in strengthening healthcare systems, enhancing social safety nets, and fostering inclusive economic growth will be essential

to mitigate future risks and build a more resilient society.

Technological Advancements and Lessons Learned

The COVID-19 pandemic accelerated technological advancements in India, particularly in artificial intelligence (AI), machine learning (ML), and telemedicine, while also revealing critical lessons for future preparedness.

Accelerated AI and Machine Learning Applications

AI and ML played pivotal roles during the pandemic, revolutionizing various aspects of healthcare and crisis management. AI-powered predictive modeling enabled authorities to forecast virus spread, anticipate healthcare resource needs, and plan effective response strategies. Machine learning algorithms facilitated rapid drug discovery and development, aiding in the search for potential treatments and vaccines against COVID-19. These technological tools not only expedited research processes but also enhanced healthcare management by optimizing patient care, resource allocation, and decision-making.

Surge in Telemedicine Adoption

Telemedicine emerged as a transformative solution to bridge gaps in healthcare access and delivery exacerbated by lockdowns and social distancing measures. In India, teleconsultations surged as healthcare providers adopted digital platforms to provide remote medical services. Telemedicine facilitated timely consultations, diagnosis, and follow-up care for patients, particularly in rural and underserved areas where access to healthcare facilities is limited. The pandemic underscored the importance of telehealth infrastructure and digital literacy in ensuring continuity of care and minimizing disruptions in healthcare services.

The COVID-19 pandemic highlighted several key lessons that are crucial for future pandemic preparedness and healthcare resilience:

- **Robust Healthcare Infrastructure:** Investment in robust healthcare infrastructure, including healthcare facilities, medical equipment, and digital health technologies, is essential to enhance capacity and response capabilities during health emergencies.
- **Proactive Policy Frameworks:** Governments need proactive policy frameworks that prioritize public health, ensure rapid response capabilities, and facilitate international collaborations for knowledge sharing and resource mobilization.
- **Digital Transformation:** The pandemic accelerated digital transformation across sectors, underscoring the importance of digital readiness, connectivity, and data-driven decision-making in crisis management and healthcare delivery.
- **Healthcare Access and Equity:** Efforts must focus on ensuring equitable access to healthcare services, particularly for vulnerable populations and remote communities, through innovative

solutions like telemedicine and mobile health technologies.

- **Resilience and Adaptability:** Building resilience and adaptability in healthcare systems is crucial to effectively mitigate the impact of future health crises, including emerging infectious diseases and health threats.

The COVID-19 pandemic propelled India towards significant technological advancements in AI, ML, and telemedicine, offering transformative solutions for healthcare delivery and crisis management. The lessons learned underscore the imperative for continuous innovation, investment in healthcare infrastructure, and proactive strategies to strengthen preparedness and resilience against future health emergencies. Embracing digital technologies and fostering international collaborations will be instrumental in shaping a resilient healthcare ecosystem capable of addressing global health challenges effectively.

Strengthening Healthcare Capacity

Investment in Healthcare Infrastructure: Allocate resources to enhance healthcare infrastructure, including hospitals, clinics, and medical facilities. Focus on upgrading medical equipment, expanding healthcare access in rural and underserved areas, and ensuring sufficient healthcare personnel.

- **Digital Health Transformation:** Accelerate digital health initiatives, including telemedicine and mobile health applications, to improve healthcare access and delivery. Invest in robust telecommunication networks and digital platforms for remote consultations, medical records management, and health monitoring.
- **Training and Capacity Building:** Prioritize training and capacity building for healthcare workers in infectious disease management, emergency response protocols, and use of advanced medical technologies. Foster partnerships with academic institutions and international healthcare organizations for knowledge exchange and skill development.

Anticipating Future Pandemics

- **Early Warning Systems:** Develop robust early warning systems for detecting and monitoring potential infectious disease outbreaks. Invest in surveillance infrastructure, data analytics, and global health partnerships to facilitate early detection and rapid response.
- **Pandemic Preparedness Plans:** Formulate comprehensive pandemic preparedness plans that integrate lessons learned from the COVID-19 pandemic. Define clear roles and responsibilities across government agencies, healthcare institutions, and community organizations for effective coordination and response.
- **Research and Development:** Support research and development in vaccines, therapeutics, and diagnostic tools for emerging infectious diseases. Establish research consortia, funding mechanisms, and regulatory frameworks to expedite innovation

and deployment during health emergencies.

Policy Formulation and Resilience

- **Policy Frameworks:** Develop adaptive policy frameworks that prioritize public health, healthcare equity, and resilience against health threats. Incorporate flexibility to adapt strategies based on evolving scientific evidence and epidemiological trends.
- **International Collaboration:** Strengthen international collaboration through platforms like the World Health Organization (WHO) and regional health networks. Foster information sharing, joint research initiatives, and resource mobilization to address global health challenges collectively.

Advancing healthcare capacity, fostering collaborative initiatives like Swasth Express, and preparing for future pandemics are essential for India's healthcare resilience. Strategic investments in infrastructure, digital health technologies, and pandemic preparedness will enable the country to mitigate risks, protect public health, and ensure equitable access to healthcare services. By embracing innovation, collaboration, and proactive policy measures, India can strengthen its healthcare system and safeguard population health in the face of future health emergencies.

Conclusion

While the COVID-19 pandemic brought unprecedented challenges to India, it also catalyzed transformative changes across healthcare, technology, and socio-economic spheres. By leveraging these experiences and implementing strategic recommendations, India can fortify its healthcare systems and readiness for future global health crises.

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ORIGINAL ARTICLE

Correlation of Baseline Clinical Characteristics as Risk Factors for Pneumonia in Children with Acute Lymphoblastic Leukemia (ALL)

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Abstract

Background: Pneumonia is a major cause of death during chemotherapy for acute leukemia. Here we are presenting the correlation of baseline characteristics and pneumonia in children with acute lymphoblastic leukemia (ALL) which affect the overall outcome of patients with ALL. **Methods:** We conducted a prospective observational study for one year and 6 months duration in which 77 pediatric patients with newly diagnosed acute lymphocytic leukemia (ALL) who underwent chemotherapy in a tertiary care hospital. **Result:** Twenty-eight of the 77 pediatric participants in the trial got pneumonia while receiving therapy. There were 41 children (53.2%) older than five years, and 36 (46.7%) less than five. 18% (14/77) of the children were T ALL, and 82% (63/77) were B ALL. The male to female ratio was 5.4:1. Of the patients, 75% (58/77) were classified as high risk and 25% (19/77) as low risk. CNS/testicular involvement occurred at some stage during treatment in 15% (12/77). Of the 37 pneumonia cases, fever was the most common presenting symptom (97%) followed by respiratory distress (60%) and ANC<500 (75%). Cough was the less frequent presenting complaint. Thus, radiographic criteria were taken into consideration in order to diagnose pneumonia. **Conclusion:** The risk factors for development of pneumonia in children with ALL were age<5yr, baseline TLC of >50,000, induction phase of chemotherapy and these were statistically significant in our study.

Keywords: Pneumonia, Acute leukemia, Pneumonia in ALL, Acute lymphoblastic leukemia

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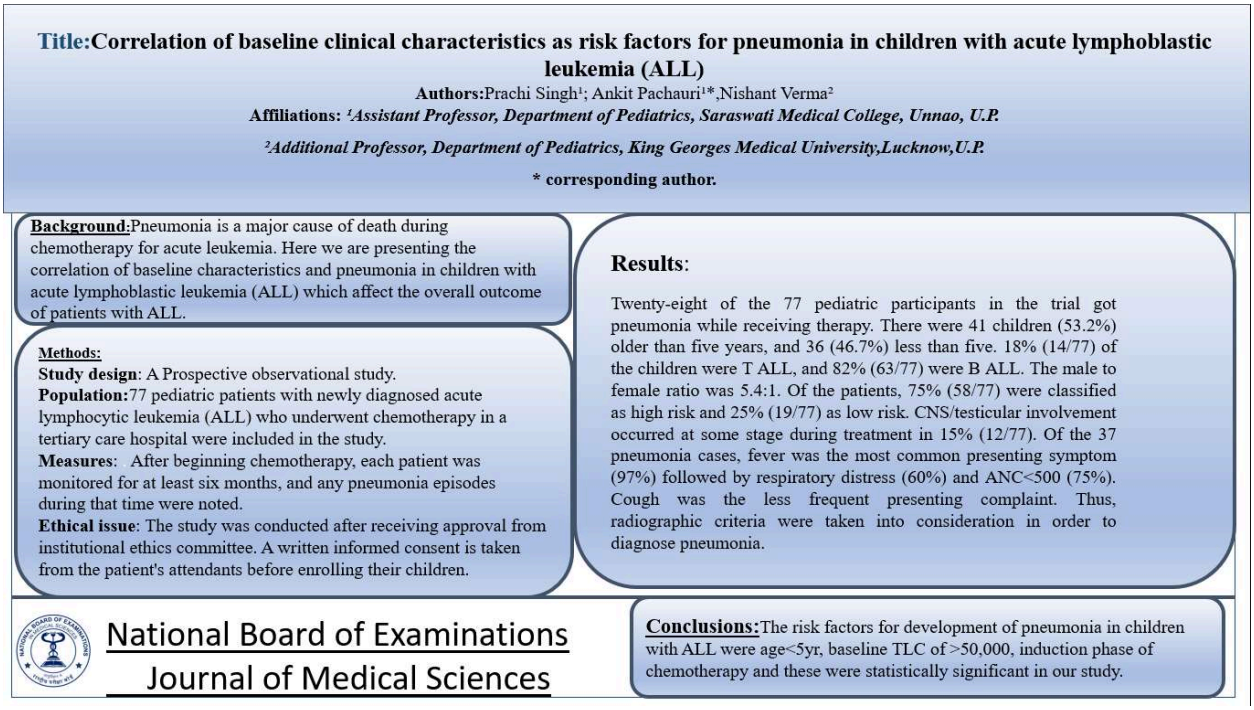
Graphical Abstract



Introduction

Acute leukaemia is a type of white blood cell cancer. Clinical symptoms of acute leukaemia are caused by the creation of aberrant (immature) white blood cells in greater quantities. Since these cells are aberrant, they don't guard against illnesses; instead, their proliferation reduces the creation of mature WBCs and other cell lines in the bone marrow's restricted space, which leads to anaemia, bleeding disorders, infections, and other problems. It is the most prevalent cancer among kids [1,2,3].

Children with impaired immune systems are more likely to experience respiratory tract infections, and their illness tends to progress more severely [4,5]. Despite significant improvements in chemotherapy treatments, leukaemia is one of the reasons of immunocompromised condition in children, which impacts the disease's cure rates. Therapy induced infection related complications in pediatric acute myeloid leukemia (AML) patients are well characterized [6-13]. However, there is limited data available on the prevalence, incidence, clinical features and outcome of pneumonia in children with acute lymphoblastic leukemia (ALL).

Burden of mortality due to respiratory infection is huge in children. Leowski estimated that acute respiratory infections caused 4 million child deaths each year [14]. Garenne et al. further refined these estimates by a study which revealed that between one-fifth and one-third of deaths in preschool children were due to or associated with acute respiratory infection [15].

Surviving ALL has significantly improved in developed nations, reaching 90%. The high incidence of acute infections, particularly pneumonias, continues to have a

detrimental effect on the prognosis of children receiving treatment for ALL in low- and middle-income nations like India [16-20].

High rates of severe infections are one factor contributing to these children's poor survival and morbidity in LMICs. Among these severe illnesses, pneumonias are the most frequent in children with ALL. Extended and intensified usage of chemotherapy medications is also linked to a higher risk of infection.

The purpose of this study is to estimate the relation of baseline characteristics with incidence of pneumonia in children with ALL.

Methods

Between January 2020 and March 2021, a total of 77 children with ALL who were admitted and received chemotherapy in the paediatric oncology unit division of the Department of Paediatrics, KGMU, Lucknow, were enrolled who met the inclusion criteria in this prospective cohort study. After beginning chemotherapy, each patient was monitored for at least six months, and any pneumonia episodes during that time were examined.

Approval from the Institutional Ethics Committee of the University Ref. code: 101 ECM II B- Thesis/P44 was taken and consent was taken from parents/relatives of enrolled patients.

Children (1-18yr) with a diagnosis of ALL on bone marrow morphology and flowcytometry were included in the study while children with pre-existing lung malformation, Children with mediastinal mass or with pleural effusion at the time of diagnosis of ALL were excluded. Newly diagnosed children with ALL admitted in pediatric oncology unit, meeting the inclusion and exclusion criteria and giving consent for participation in the study were prospectively enrolled. Their baseline characteristics were noted from their records and they were followed up prospectively till the end of study duration. Patients were managed according to standard treatment protocol under the guidance of the treating physician (3). If the child developed symptoms and signs (cough, fast breathing, retractions, cyanosis) suggestive of pneumonia during the study period, a Chest X ray was obtained to confirm the diagnosis of ‘Radiological Pneumonia’. The episode of pneumonia was managed as per the standard protocol. Outcome of each episode of pneumonia was recorded as cured or not cured. Standard definitions were used to define various conditions, for the purpose of this study ‘Pneumonia’ was referred only to children who had a radiologically confirmed pneumonia documented on a Chest X ray. Chest X ray was interpreted by two physicians independently (a pediatrician and a radiologist), and a child was labeled as ‘Pneumonia’ using the radiologically diagnosed pneumonia endpoints [21,22].

Data was recorded on standard case record form. Details of patients including age, sex, socioeconomic status, type, genetic forms, risk category, CNS involvement, initial TLC, and EOI (end of induction) MRD, phase of chemotherapy during which pneumonia episode occurred, radiological findings, clinical presentations of children with pneumonia, and outcome of ALL patients with pneumonia were recorded.

Statistical Analysis

Categorical variables were presented in number and percentage (%), and Odds ratios with 95% confidence intervals were calculated for selected variables as needed. Quantitative variables were compared using an unpaired t test between the two groups. Qualitative variables were compared using the chi-square or Fischer's exact test as appropriate. A p-value of <0.05 was considered statistically significant. The logistic regression analysis was done to find the independent factors associated with pneumonia in children with ALL. The data was entered in an MS Excel spreadsheet, and analysis was done using the Statistical Package for Social Sciences (SPSS) Version 24.0.

Results

Out of the 77 children receiving chemotherapy, there were 37 episodes of pneumonia among 28(36.4%) children who suffered from one or more episodes of pneumonia during the study period while, 49 (63.6%) children had no pneumonia episodes during the study period. 6(21.4%) children among the 28 affected by pneumonia 6 had >1 episodes, while rest 22(78.5%) suffered from a single episode of pneumonia. 36(46.7%) children aged <5 years while 41(53.2%) were >5yr of age. The male to female ratio was 5.4:1. 18% (14/77) children of T ALL and 82% (63/77) 63 of B ALL. 75% (58/77) patients were categorized as high risk while 25% (19/77) as low risk. 15% (12/77) had CNS/testicular involvement at some point during treatment.

Fever, either alone or in combination, was the most common presenting symptom in 36 (97.29%) of the pneumonia episodes. Cough was the presenting clinical characteristic in 23 (62.1%) of the incidents. In 22 cases of pneumonia (59.4%), the initial symptom was respiratory distress. In 28 cases of pneumonia, the absolute neutrophil count (ANC) was reduced (75.6%), whereas in 9 cases (24.3%), the ANC was normal.

Table 1. Distribution of clinical parameters in the 37 pneumonia episodes in children with ALL

Variable	**Category**	**No.**	**%**
Fever	No	1	2.7
	Yes	36	97.29
Respiratory Distress	No	23	62.1
	Yes	14	37.8
Cough	No	15	40.5
	Yes	22	59.4
ANC	<500	28	75.6

ANC- absolute neutrophile count; No. – number.

The majority of pneumonia occurrences occurred during the chemotherapy induction phase; that is, 22 incidents (59.4%) occurred during the induction phase, while 6 episodes (16.2%) occurred during the consolidation phase. Five (13.5%) of the pneumonia episodes were in the maintenance phase, three (8.1%) were during delayed intensification, and one (2.7%) occurred during interim maintenance.

Table 2. Distribution of occurrence of pneumonia episodes according to the phase of chemotherapy

Variable	**Category**	**No.**	**%**
Phase Of Chemo-therapy	**Induction**	22	59.4
	Consolidation	6	16.2
	Interim maintenance	1	2.7
	Delayed intensification	3	8.1
	Maintenance	5	13.5

The findings showed that children under the age of five had a 1.9-fold increased risk of contracting pneumonia, which was statistically significant. Males were 1.4 times more likely than females to get pneumonia, but there was no significant difference in the incidence of pneumonia between socioeconomic classes; that is, the incidence of pneumonia is about equal in both low and middle SES groups.

Table 3. Age, Gender and SES wise distribution of children suffering from pneumonia and their association

Variable		**Pneumonia**		P-value/R. R (CI)
		No	**Yes**	
		N **%**	N **%**	**0.04/1.9 (0-0.07)**
Age (Yrs)	**<5**	18 **52.8**	18 **47**	
	>5	30 **73.1**	11 **27**	
Sex	**F**	8 **72.7**	3 **27**	0.5/1.4 (0.5-3.8)
	M	41 **62.1**	25 **38**	
SES	**Low.**	44 **63.8**	25 **36**	0.9/0.9 (0.4-2.5)

	Mid.	5 **62.5**	3 **37**	

SES- socioeconomic status; Low. Lower SES; Mid.- Middle SES; F- female; M- Male; R.R- relative risk; C.I- confidence interval.

Pneumonia was more common in patients who presented with CNS/testicular involvement. The risk of pneumonia was calculated to be 1.5 times higher for patients in the high-risk group than for those in the standard-risk group. However, when significance tests were used, these results were not statistically significant.

Table 4. Correlation of CNS/Testicular involvement and risk group with pneumonia episodes in children with ALL

Variable		**Pneumonia**		**P-value/R. R**
		No	**Yes**	
		N **%**	N **%**	0.7/ 1.17
CNS/ Testicular +ve	**NO**	42 **65**	23 **35**	
	YES	7 **60**	5 **42**	0.3/ 1.5
Risk	**Std.**	14 **74**	5 **26**	
	High	35 **60**	23 **40**	

CNS/TESTICULAR +- CNS & testicular involvement present; Std.- standard risk; High- High risk; R.R – relative risk.

Our study found that children who presented with a baseline TLC of >50,000 had a quantitatively larger relative risk of developing pneumonia than their counterparts with a TLC of <50,000. This difference was also statistically significant. Although patients with EOI MRD+ had a higher quantitative incidence of pneumonia, statistical significance could not be confirmed when tests of significance were applied.

Table 5. Baseline Total leucocyte count and Minimal residual disease as risk factors for pneumonia

Variable		**Pneumonia**		**P-Value/ R. R**
		No	**Yes**	
		N **%**	N **%**	
TLC	**<50000**	37 **71**	15 **29**	**0.04/ 1.8**
	>50000	12 **48**	13 **52**	
EOI MRD	**Negative**	32 **68**	14 **32**	0.19/ 0.28
	Positive	11 **61**	6 **39**	

TLC-Total leucocyte count; EOI MRD- end of induction minimal residual disease; R.R- relative risk

Discussion

Immunocompromised children are more prone to develop respiratory tract infections and the disease course tends to be more severe in these children. One of the causes of immunocompromised status in children is leukemia, thus affecting the cure rates of the disease despite major advancements in chemotherapy regimens [1,2,3].

Pneumonia is the leading cause of de ath for children aged 1 to 59 months, with di arrhoea coming in second, illustrating the we ight of this illness [16,17,18].

Studies in various parts of the world show that on average, young children under 5 years of age suffer 4 to 6 episodes of acute respiratory infections per year and that one-third to a half of the outpatient pediatric consultations in developing countries are due to ARI. This count is higher in immunocompromised patients, like in leukaemia [16,17,18].

The diagnosis of pneumonia in leukemia can be difficult for many reasons: an impaired inflammatory response can reduce the clinical or radiological signs, therefore, here we chose radiological evidence to define a patient as having pneumonia [21,22]. Among these patients a higher incidence of pneumonia was seen in high-risk cases than the standard risk ones, which is due to higher doses and more intensive chemotherapy treatment plan followed in high-risk cases, which leads to a greater degree of myelosuppression in turn leading to higher incidence of pneumonia [6,7,8]. We also observed in our study that the maximum number of pneumonia episodes occurred during the induction phase of chemotherapy, i.e., 22 episodes (59.4%) out of the 37 episodes, as the induction phase

involves institution of more intensive chemotherapy than other phases therefore, higher myelosuppression occurs, which is why these children have lower absolute neutrophil counts. Therefore, these children have higher incidence of pneumonia in induction phase and over all higher incidence of fungal pneumonia due to immunocompromised state.

Our study looked at the following factors for a higher association with pneumonia: age (children aged >5 years vs. <5 years), gender (male and female), socioeconomic status, genetic translocations, baseline TLC (>50,000 or <50,000), CNS/testicular involvement, risk stratification, and MRD status at the end of induction.

Since there aren't many studies on pneumonia in pediatric acute leukaemia, we've attempted to compare a few pertinent studies here. In 2021, Mairuhu et al. came to the conclusion that risk stratification, chemotherapy phase, and neutropenia significantly influenced the incidence of hospital-acquired pneumonia in children with acute lymphoblastic leukaemia undergoing chemotherapy. This finding was fairly similar to our study, which found that higher incidence of pneumonia was observed in high-risk cases, chemotherapy induction phase, and lower neutrophil counts. However, because there were no two groups to compare, we were unable to ascertain the statistical significance of the association between pneumonia and induction phase and low ANC levels. Age, sex, nutritional condition, duration of hospitalisation, anaemia, and thrombocytopenia have not been found to be risk factors for hospital-acquired pneumonia in children [23].

According to Garracia et al., pneumonia was more common in people over 60, those with lower baseline platelet counts, low albumin levels, and neutropenia, but ALL was linked to a lower prevalence of pneumonia than AML.Since the adult population was the focus of this study, there is little correlation between it and ours [13]. Advanced age was found to be substantially correlated in another retrospective study by Specchia G et al.(24); however, since the study was carried out on adults, it is not very relevant to us.

Conclusion

The study demonstrates the risk factors which have been found to be associated with higher incidence, according to which an inference was made that pneumonia is a quite common complication in children with ALL with a higher incidence seen during induction phase of chemotherapy. We also concluded that age <5 yr and a baseline TLC>50,000 were significantly associated with increased risk of pneumonia.

Conflict of interest

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

Funding

No financial help has been taken during the study.

Strengths of the study

1. There have been very few studies conducted on pneumonia in children with ALL. We have determined the risk factors

for pneumonia which in turn affect the outcome in children suffering from ALL.
2. Whenever a child developed symptoms and signs (cough, fast breathing, retractions, cyanosis) suggestive of pneumonia during the study period, a Chest X ray was obtained to confirm the diagnosis of 'Radiological Pneumonia. A robust clinico-radiological definition of Pneumonia was used.
3. We did a prospective observational study while most of the other studies were recorded retrospectively.
4. There was no loss to follow up.

Limitations of the study

1. The children admitted here mostly come from a lower socio-economic-strata, thus higher risk of acquiring infections due to poor hygiene. In our study population 89% patients were of low socio-economic-strata (SES) while none of the patients were from upper SES.
2. Most of the children come from distant places for treatment and the families being poor, prolong the hospital stay of the child as they do not want to stay outside due to affordability issue, thus increasing the duration of infection exposure.

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ORIGINAL ARTICLE

Evaluating the Impact of Enteral Nutrition on Pediatric Outcomes in PICU Patients: A Study of Morbidity and Mortality Effects

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Abstract

Background: Nutritional support plays a crucial role in the care of critically ill patients, requiring careful consideration to ensure the optimal method of delivery for nutrient absorption. Any kind of illness whether acute (e.g. infections, trauma) or chronic leading to inflammation can trigger catabolism dur to stress causing elevation in metabolic rate and nutrient breakdown. It leads to higher morbidity and mortality by involving various critical organs at the same time such as respiratory failure and cardiac arrhythmias. Malnutrition can be seen as a common phenomenon in paediatric age group especially in paediatric intensive care unit (PICU) patients often increasing the patient's stay, further impacting recovery. **Aim**: Evaluating the impact of enteral nutrition on pediatric outcomes in PICU patients: a study of morbidity and mortality effects. **Discussion:** Various studies have linked malnutrition among PICU patients to longer hospital stays, extended mechanical ventilation and poor clinical outcomes. Achieving full nutritional support in PICU patients is now recognized as a critical marker of effective PICU management. Factors such as minimizing feeding interruptions, presence of a dedicated dietitian, the use of a post-pyloric route, and early initiation of feeding have all been shown to improve enteral protein delivery. **Conclusion:** This study was conducted on children aged 1 to 18 years in the PICU of a tertiary care hospital. Among the total patients enrolled in the study, full feeds were not achieved in 71 cases (57.3%), while 53 patients (42.7%) successfully attained full feeds.

Keywords: Enteral Nutrition, Dyselectrolemia, Outcome

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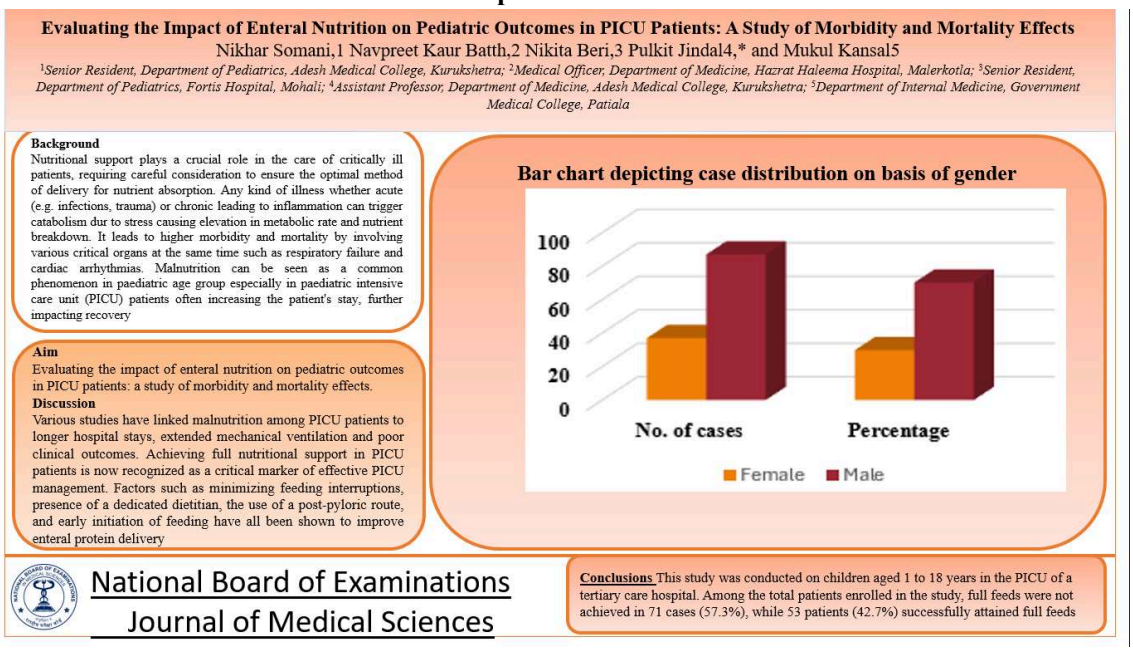
Graphical Abstract



Abbreviations

PICU : Paediatric Intensive Care Unit
EN : Enteral Nutrition
PN : Parenteral Nutrition
OG : Oro-Gastric
NG : Naso-Gastric
DAMA : Discharge Against Medical Advice

Introduction

Nutritional management in critically ill patients is a challenging and vital aspect of care. Malnutrition in patients within the Paediatric Intensive Care Unit (PICU) has been associated with prolonged mechanical ventilation, extended hospital stays, and poorer clinical outcomes [1]. Stress-induced catabolism, triggered by both acute and chronic illnesses, trauma, or inflammation, significantly raises the body's metabolic rate, leading to increased nutrient breakdown [2].

Additionally, certain medications may cause side effects like reduced appetite, nausea, and vomiting, further complicating nutritional intake [3]. Enteral nutrition (EN), which involves delivering a nutritionally complete formula through a tube into the stomach, duodenum, or jejunum, is commonly used for patients who are unable to meet their nutritional needs orally but still have a functioning gastrointestinal system [4].

Pathophysiology

Providing optimal nutritional therapy is a key objective in the PICU, as insufficient nutrition during critical illness in children is linked to an increased risk of multiple organ dysfunction, complications, prolonged hospital stays, and higher mortality rates [5]. The body's acute stress response to critical illness results in substantial protein breakdown, and inadequate protein intake exacerbates this by creating a negative nitrogen balance and leading to muscle loss [6].

In the Paediatric Intensive Care Unit (PICU), two methods are used to provide nutrition to critically ill children. The preferred method for those with a functioning gastrointestinal system is enteral nutrition (EN). EN involves

delivering a nutritionally complete feed through a tube placed in the stomach, duodenum, or jejunum [7]. It is suitable for patients who cannot eat enough orally but have a working digestive tract. EN plays a vital role in preserving gut function and integrity, and it boosts the production of immunoglobulin A, which may help protect against respiratory infections [8]. Delays in starting and progressing with enteral feeding can result in failing to meet energy and protein goals. Benefits of EN include maintaining the intestinal lining, reducing the risk of bacterial translocation, stabilizing hemodynamic, lowering infection rates, enhancing immune response, and ultimately decreasing morbidity and mortality in children [9].

However, some critically ill patients may not tolerate EN, leading to issues like nausea, vomiting, or, in rare cases, non-occlusive bowel necrosis. High volumes of gastric residuals can increase the risk of bacterial colonization and complications such as aspiration or ventilator-associated pneumonia [10].

The second method of feeding is parenteral nutrition (PN), which bypasses the digestive system by delivering nutrients intravenously. PN can be administered through a central or peripheral venous catheter and is used when the digestive system cannot handle nutrition. It is convenient since all nutritional components can be provided in one bag, without interrupting patient care [11].

However, PN comes with risks, such as hyperglycaemia, requiring glucose control, and a higher chance of infections like catheter-related bloodstream infections. PN may also be used alongside EN when the latter alone cannot meet the energy needs of the patient [12].

A study by Hamilton et al. assessed the impact of implementing an enteral nutrition guideline in the PICU, demonstrating a notable improvement in EN delivery and a reduced reliance on parenteral nutrition (PN). The study also found that a greater proportion of patients achieved their target energy intake goals earlier [13,14].

Materials and Methods

This was a prospective observational study done on 124 critically ill children having a PICU stay of at least 24 hours, to evaluate factors affecting enteral nutrition in children admitted in PICU of Department of Paediatrics, DMC&H, Ludhiana.

Inclusion criteria:

- Age between 1 to 18 years.
- Patients who gave Informed consent.
- Admission for more than 24 hours in PICU

Exclusion criteria

- Patients below 1 year.
- Duration of stay < 24 hours.

A total of 124 patients were enrolled during the study period. The initial steps involved determining the day feeds were started, selecting the appropriate feeding method, and inserting age-appropriate nasogastric (NG) or orogastric (OG) feeding tubes [15]. The volume of feeds in milliliters was recorded using a pre-structured proforma. Feed adjustments were made by the Chief Dietician based on the child's underlying medical condition. Full enteral nutrition (EN) was defined as 100% of the volume prescribed by the nutrition team [16]. If the prescribed volume could not be tolerated by the patient

during their stay in the PICU, it was classified as "full feeds not achieved." [17] Several factors were identified as barriers to effective enteral nutrition. Out of them, four factors were considered for comparison: dyselectrolemia, seizures, respiratory distress and shock [18,19].

Results

Table 1. Age distribution (in years)

Age (years)	No. of cases	Percentage
< 5	53	42.7%
5-10	36	29.0%
> 10	35	28.2%
Total	124	100%

Table 2. Gender distribution

Sex	No. of cases	Percentage
Female	37	29.8%
Male	87	70.2%
Total	124	100%

Table 3. Case distribution on basis of day of feed commencement

Days of starting feed	No. of cases	Percentage
< 3 days	56	45.2%
3-7 days	42	33.9%
> 7 days	6	4.8%
Not started	20	16.1%
Total	124	100%

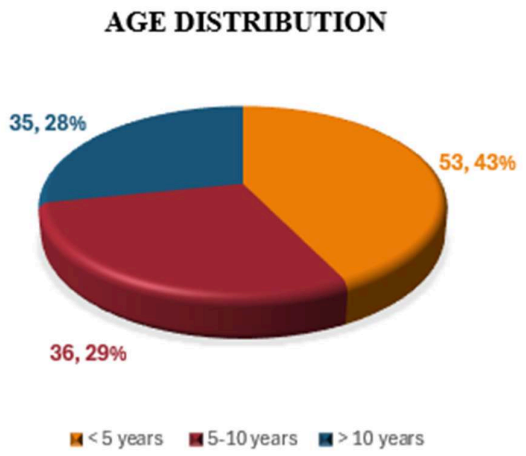


Figure 1. Pie chart depicting age (in years) distribution of cases and their percentage

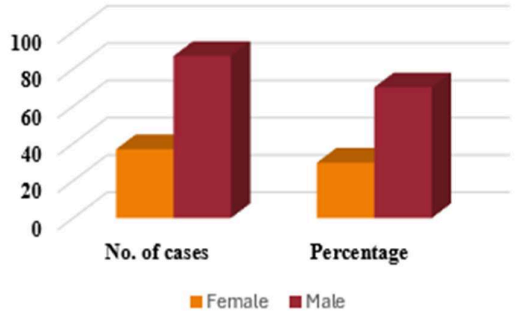


Figure 2. Bar chart depicting case distribution on basis of gender

Age distribution data analysis concluded 53 patients (42.7%) were under 5 years of age, 36 patients (29%) were aged 5 to 10 years, and 35 patients (28.2%) were over 10 years old as shown in Table 1 and Figure 1.

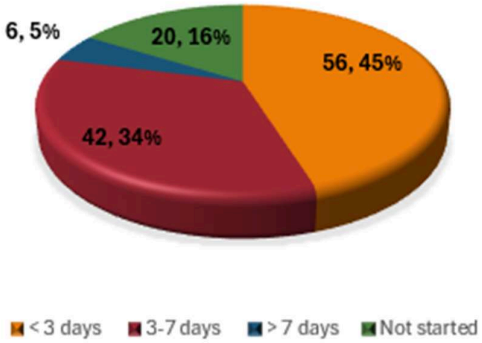


Figure 3. Pie chart depicting case distribution on basis of day of feed commencement

Among the 124 PICU subjects enrolled, 87 (70.2%) were male, while 37 (29.8%) were female as shown in Table 2 and Figure 2. Subsequently, feeding commenced within the first three days of admission for 56 patients (45.2%). An additional 42 patients (33.9%) began feeding between 3 and 7 days after admission, while only 6 patients (4.8%) started feeding after 7 days. Feeding was not initiated in 20 patients (16.1%) due to various reasons as shown in Table 3 and Figure 3.

Table 4. Case distribution on basis of mode of feeding

Mode of Feeding	No. of cases	Percentage
Oral	38	36.5%
NG	61	58.7%
OG	5	4.8%
Total	104	100%

Table 5. Case distribution on basis of full achievement of feeding

Full feed achieved	No. of cases	Percentage
< 3 days	24	19.4%
3-7 days	24	19.4%
> 7 days	5	4%
Not achieved	71	57.3%
Total	124	100%

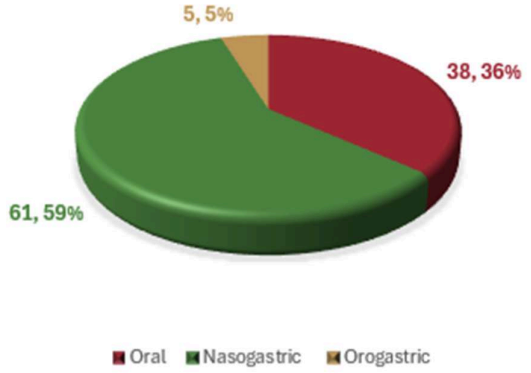


Figure 4. Pie chart depicting case distribution on basis of mode of feeding

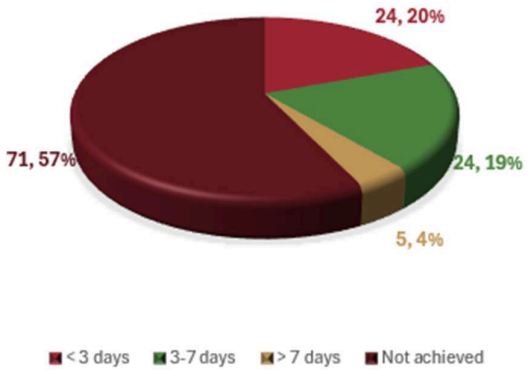


Figure 5. Pie chart depicting case distribution on basis of full achievement of feeding

Feeding was initiated in 104 out of 124 enrolled subjects (83.9%). Among these, 38 patients (36.5%) received direct oral feeds, 61 (58.7%) were fed via nasogastric tube, and 5 (4.8%) received Oro-gastric tube feeding as shown in Table 4 and Figure 4.

In this study, out of 124 enrolled PICU subjects, 71 patients (57.3%) did not achieve full feeding, while 53 patients (42.7%) successfully reached full feed. Among the total patients, full feeding was achieved within 3 days in 24 patients (19.4%), between 3 to 7 days in another 24 patients (19.4%), and after 7 days in 5 patients (4%). Of the 53 patients who achieved full feed, only 5 patients (9.4%) experienced a delay of more than 7 days as shown in Table 5 and Figure 5.

Table 6. Case distribution on basis of full achievement of feeding in different modes of feeding

Mode of feeding	Fully Achieved		Not Achieved		Total	P-value
	No. of cases	Percentage	No. of cases	Percentage		
Oral	28	52.8	10	19.6	38	0.001
NG	24	45.3	37	72.5	61	
OG	1	1.9	4	7.9	5	
Total	53	100	51	100	104	

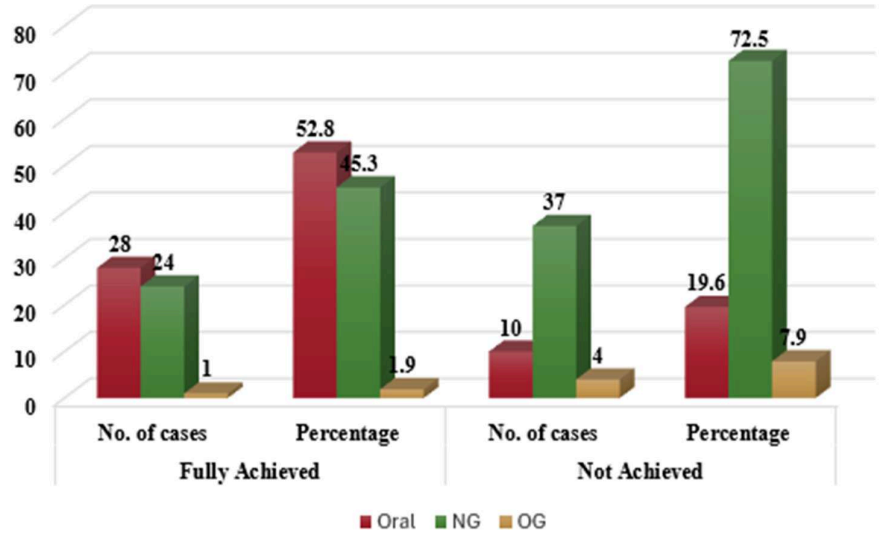


Figure 6. Bar chart depicting case and percentage distribution of achievement of feed in different modes of feeding

Out of 53 patients who achieved full feeding, oral feeding was initiated in 28 cases (52.8%), NG feeding in 24 cases (45.3%), and OG feeding in 1 case (1.9%). Among 51 patients who did not achieve full feeding, oral feeding was provided in 10 cases (14.1%), NG feeding in 37 cases (72.5%), and OG feeding in 4 cases (7.8%). The mode of feeding showed a statistically significant difference with a P value of 0.001 as shown in Table 6 and Figure 6.

Shock was observed in 24 cases (33.9%) where full feeding was not achieved, compared to 5 cases (9.5%) where full feeding was attained. The correlation between shock and the inability to achieve full feeding was statistically significant ($p = 0.002$) as shown in Table 7 and Figure 7. Additionally, respiratory distress was observed in 21 cases (29.6%) where full feeding was not achieved and in 18 cases (33.9%) where it was achieved. The correlation between respiratory distress and the inability to achieve full feeding was statistically significant ($p = 0.003$) as shown in Table 8 and Figure 8.

Table 7. Case distribution on basis of achievement of feeding in cases with shock

Feed	Fully Achieved		Not Achieved		Total	P-value
	No. of cases	Percentage	No. of cases	Percentage		
No shock	48	90.5	47	66.1	95	0.002
Shock present	5	9.5	24	33.9	29	

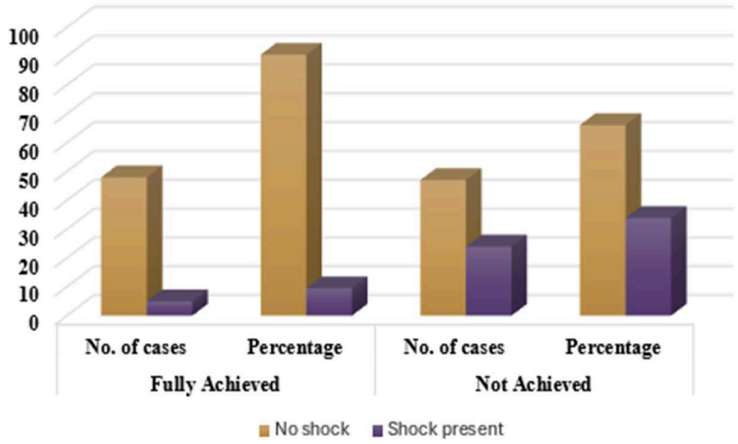


Figure 7. Bar chart depicting case and percentage distribution of achievement of feed in cases with shock

Table 8. Case distribution on basis of achievement of feeding in cases with respiratory distress

Feed	Fully Achieved		Not Achieved		Total	P-value
	No. of cases	Percentage	No. of cases	Percentage		
No Respiratory distress	35	66.1	50	70.4	85	0.003
Respiratory distress present	18	33.9	21	29.6	39	

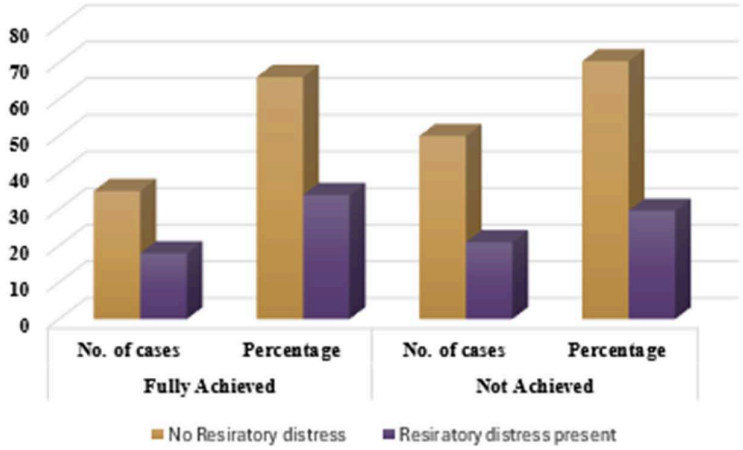


Figure 8. Bar chart depicting case and percentage distribution of achievement of feed in cases with respiratory distress

Table 9. Case distribution on basis of achievement of feeding in cases with dyselectrolemia

Feed	Fully Achieved		Not Achieved		Total	P-value
	No. of cases	Percentage	No. of cases	Percentage		
No Dyselectrolemia	45	84.9	64	90.1	109	0.001
Dyselectrolemia present	8	15.1	7	9.9	15	

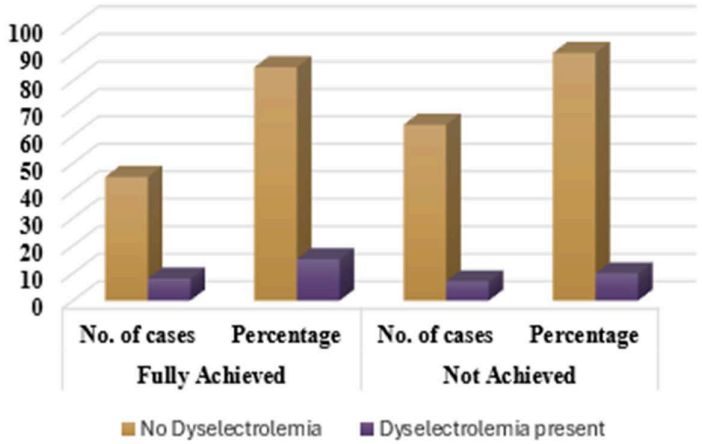


Figure 9. Bar chart depicting case and percentage distribution of achievement of feed in cases with dyselectrolemia

Table 10. Case distribution on basis of achievement of feeding in cases with seizures

Feed	Fully Achieved		Not Achieved		Total	P-value
	No. of cases	Percentage	No. of cases	Percentage		
No Seizures	49	92.4	65	91.5	114	0.005
Seizures present	4	7.6	6	8.5	10	

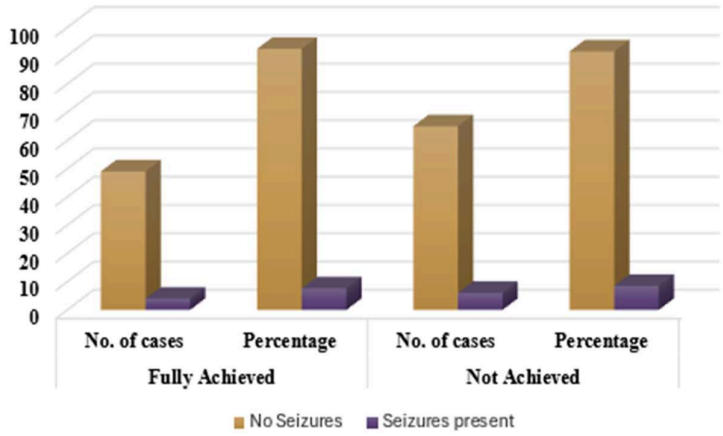


Figure 10. Bar chart depicting case and percentage distribution of achievement of feed in cases with seizures

Dyselectrolemia was observed in 7 cases (9.9%) where full feeding was not achieved, compared to 8 cases (15.1%) where full feeding was attained. The correlation between shock and the inability to achieve full feeding was statistically significant (p = 0.001) as shown in Table 9 and Figure 9. Additionally, seizures were observed in 6 cases (8.5%) where full feeding was not achieved and in 4 cases (7.6%) where it was achieved. The correlation between respiratory distress and the inability to achieve full feeding was statistically significant (p = 0.005) as shown in Table 10 and Figure 10.

Table 11. Outcome distribution

Outcome	No. of cases	%age
Discharged	95	76.60%
Died	14	11.30%
DAMA	15	12.10%
Total	124	100.00%

According to the study results, 95 cases (76.6%) were discharged, 14 cases (11.3%) succumbed, and 15 cases (12.1%) left against medical advice as shown in Table 11 and Figure 11.

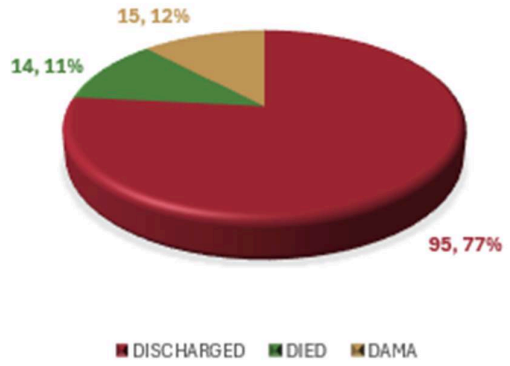


Figure 11. Pie chart of outcome distribution

Table 12. Cases and percentage distribution of outcomes on basis of achievement of feeding

Feed	Fully Achieved		Not achieved		Total	P-value
Outcome	**No. of cases**	**Percentage**	**No. of cases**	**Percentage**		
Discharged	53	100.00	42	59.2	95	0.001
Died	0	0.00	14	19.7	14	
DAMA	0	0.00	15	21.1	15	
Total	53	100.00	71	100	124	

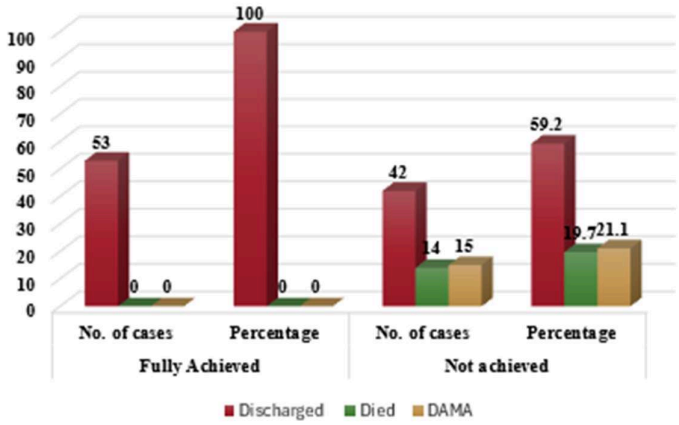


Figure 12. Bar chart depicting case and percentage distribution of outcomes

The association between enteral nutrition and outcomes showed a p-value of 0.0001. Among the 53 cases where full feeds were achieved, all 53 (100%) were successfully discharged. In contrast, of the 71 cases where full feeds were not achieved, 42 (59.2%) were discharged, 14 (19.7%) resulted in death, and 15 (21.1%) were discharged against medical advice as shown in Table 12 and Figure 12.

Conclusion

This study highlights that achieving full enteral nutrition plays a very critical role in improving outcomes for patients in the PICU. Among the total patients enrolled in the study, 53 patients (42.7%) successfully attained full feeds underscoring the importance of effective nutritional support in recovery. The findings emphasize the need for strategies to enhance feeding practices, optimizing care delivery and reducing interruptions which are integral to improving morbidity and mortality outcomes in critically ill pediatric population.

Future Scope

Enteral nutrition has been found and proven to have a positive impact on pediatric patients and therefore it provides us an opportunity of understanding and improving patient outcomes. Its scope can be widened via large multicenter trials to patients with specific conditions like sepsis, trauma, and chronic illnesses for its long-term effects on both mortality as well as morbidity in various pediatric populations. Additionally, valuable insights into optimizing nutritional strategies can be extracted by exploring the role of early versus delayed EN initiation and the impact of individualized feeding protocols. Studies focusing on the relationship between EN and immune function, infection rates, and recovery times may further enhance clinical practices. Furthermore, advancements in technology and precision medicine may allow for more tailored nutritional interventions, ultimately improving survival rates and quality of life for critically ill children.

Statements and Declarations

Conflicts of interest

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

Funding

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ORIGINAL ARTICLE

Evaluating a Decade of Research Excellence: A Bibliometric Analysis of Apollo Hospitals Group (2015-2024)

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Abstract

Background and Aims: Established in 1983, Apollo Hospitals has emerged as Asia's leading integrated healthcare provider, committed to delivering healthcare of international standards. This study conducts a bibliometric analysis of the Apollo Hospital Group's research output from 2015 to 2024, focusing on growth, impact, and collaborative efforts in healthcare research. **Methods:** Data from Scopus and SciVal was utilised to analyze bibliometric indicators such as scholarly output, citation metrics, and publication visibility over the past decade. **Results:** The Apollo Hospital Group experienced significant growth in research publications, increasing from 255 in 2015 to 794 in 2024, totalling 5,005 publications. The average citation count stood at 11.9 per publication, indicating strong engagement with the academic community. International collaborations were prominent, accounting for 26.4% of publications and achieving a high citation impact (27.3). The research garnered considerable visibility with 79,666 views, where 47.5% of the publications appeared in the top 50% of journals (Q1 to Q2) and 86.3% in the top 75% (Q1 to Q3). Notably, the average field-weighted citation impact rose from 0.73 in 2015 to 1.88 in 2024, reflecting their research's high quality and credibility. **Conclusions:** The analysis concludes that Apollo Hospitals has solidified its status as a key player in healthcare research, evidenced by substantial growth in productivity and impact. Strategic collaborations and high-quality publications have enabled the institution to contribute significantly to global healthcare knowledge advancement. Their commitment to research excellence reflects a dedication to improving healthcare outcomes and practices worldwide.

Keywords: Apollo Hospitals; Bibliometric Analysis; Healthcare Research; Publication Impact; Citation Metrics; International Collaboration; Field-Weighted Citation Impact.

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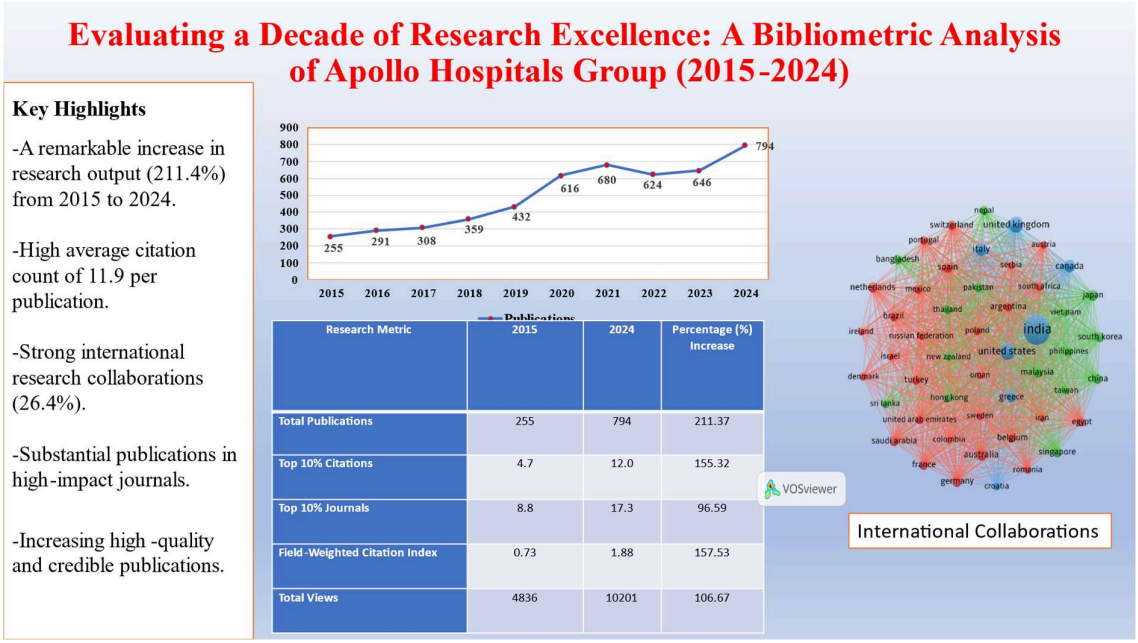
Graphical Abstract



Introduction

Established in 1983 by Dr. Prathap C. Reddy, Apollo Hospitals has emerged as Asia's leading integrated healthcare service provider, dedicated to providing healthcare of international standards accessible to all [1]. Guided by the mission statement, "*To bring healthcare of international standards within the reach of every individual*," Apollo Hospitals is committed to excellence in education, research, and healthcare for the benefit of humanity [2]. The organization has positioned itself robustly in clinical services, medical research, and education. The *Apollo Hospitals Research and Education Foundation* (*AHERF*) is pivotal in advancing healthcare knowledge and practice through rigorous inquiry and exploration. Apollo Hospitals' official journal, *Apollo Medicine* [3], has completed a glorious journey of 20 years and proves the Group's commitment to fostering research and publications in the biomedical field [4].

As the healthcare landscape continues to evolve, assessing the impact and productivity of research activities within a prominent health institution is essential. This study aims to analyze the bibliometric profile of the *Apollo Hospitals Group* from 2015 to 2024. By examining various bibliometric indicators—such as publication counts, citation metrics, and the distribution of publications across journals—this analysis seeks to provide insights into the research dynamics that have shaped Apollo Hospitals over the past decade. Additionally, the study aims to assess the impact of the Group's publications through citation analysis, encompassing metrics such as Field-Weighted Citation Impact (FWCI) and Citations Per Publication (CPP). By providing a comprehensive bibliometric analysis, this study aims to understand Apollo Hospitals' role in the global healthcare research landscape and its ongoing commitment to advancing medical knowledge and practice for the benefit of

society. The citation analysis involved comparing the citation counts and FWCI of Apollo's publications with the global average, providing a clear picture of the influence and impact of their research.

The evaluation of research excellence is a pivotal aspect of discerning the impact and contributions of academic institutions over time. Through a bibliometric analysis from 2015 to 2024, valuable insights into the research output and influence of the Apollo Hospitals Group can be gleaned. This examination of publication trends, citation counts, and collaboration networks offers a comprehensive understanding of the research landscape within the organization. Consequently, one crucial facet of evaluating research excellence lies in comprehending the vision and principles that underpin an organization's research activities. By aligning research outcomes with overarching principles and goals, researchers can effectively assess the relevance and impact of the group's endeavours within the broader context of healthcare research.

Several studies have provided insights into research productivity and collaboration in healthcare settings. For instance, the study conducted by Mahmoud et al. (2020) revealed increasing publication counts and impact factors across various medical specialities in Irish hospitals from 2007 to 2018 [5]. These findings offer valuable insights to guide strategic improvements in Irish health research and resource allocation for enhanced scientific output. Similarly, Alkhatip et al. (2020) presented a bibliometric analysis of pediatric anaesthesia research output from two Irish hospitals, revealing discrepancies in publication distribution, impact factors, and collaborative efforts [6]. The findings underscore the need for enhanced research planning and collaboration strategies to elevate the quality and quantity of anaesthetic publications in Irish pediatric healthcare institutions.

The study by Hu et al. (2024) also utilized CiteSpace software to conduct a comprehensive bibliometric analysis of research-oriented hospitals in China, revealing trends, collaboration patterns, and research hotspots [7]. The results suggest a need for enhanced interdisciplinary partnerships, targeted development strategies, and innovation to address challenges and optimize the construction and operation of research-oriented hospitals, ultimately improving healthcare outcomes for populations. Finally, the study by Tocora et al. (2024) conducted a scientometric analysis of leading clinics and hospitals in five Latin American countries to assess their scientific productivity and collaboration patterns [8]. The findings highlight institutions with high publication numbers, citations, collaborations, and patent applications, emphasizing the importance of identifying priorities for funding and support to enhance clinical research in Latin America and strengthen global health research initiatives. Some bibliometric studies focussing on government-run Indian medical institutes were conducted, such as those on Government Medical College & Hospital, Chandigarh [9], Government Medical College Jammu [10], All India Institute of Medical Sciences or AIIMS [11–15], National Institute of Mental Health and Neurosciences or NIMHANS [16], and Post Graduate Institute of Medical Education & Research or PGIMER [17]. However, such studies focussing on private/corporate healthcare institutions/ hospitals are lacking.

By synthesizing these insights, the current study aims to provide a nuanced understanding of the Apollo Hospitals Group's contributions to healthcare research, setting the stage for future investigations into its enduring impact and role in the global research community.

Methods

This study employs a comprehensive bibliometric analysis to assess the research contributions of the Apollo Hospital Group (covering 23 institutions: Institution id: 704522) over the past decade, specifically from 2015 to 2024. By utilizing Scopus data extracted via the SciVal last accessed on February 19th, 2025, we aim to derive insights into the quantity, quality, and impact of scholarly output produced by the organization. The methodology encompasses several key components, which are detailed below.

Data Collection

We systematically gathered data from the Scopus database, renowned for its extensive coverage of peer-reviewed literature across multiple disciplines. The analysis focused on publications authored by Apollo Hospital personnel, including articles, reviews, conference papers, and other scholarly works that contribute to the body of medical research.

Bibliometric Indicators

Several bibliometric metrics were utilized to evaluate the research output and its impact.

Publication Metrics

This includes total scholarly output, outputs in top citation percentiles, and publications in top journal percentiles. We analyzed the total number of publications and tracked the annual increase in output to understand growth trends over the decade.

Citation Metrics

We assessed citation counts, CPP, and FWCI. CPP provides a measure of average citations received by each publication. At the same time, FWCI allows for comparison against the global average for similar papers, thus contextualizing the impact of Apollo's research relative to other works in the field.

Views Metrics

This involves counting the total views of published works, outputs in top views percentiles, and average views per publication. These indicators gauge the visibility and engagement of Apollo's research within the academic and healthcare communities.

Journal Quartiles

Each publication was categorized according to journal quartile rankings (Q1, Q2, Q3, and Q4). Q1 and Q2 journals are recognized for their rigorous peer-review processes and high-impact factors. This classification helps assess the qualitative aspect of the research output.

Co-authorship and Collaboration Analysis

To evaluate Apollo Hospital's collaborative efforts, we analyzed co-authorship patterns, both nationally and internationally. The percentage of publications resulting from collaborations was calculated to elucidate the institution's engagement with other research entities. We specifically investigated the impact of international collaborations on citation

counts and CPP, recognizing that partnerships beyond national boundaries can enhance the visibility and credibility of research. The analysis revealed that Apollo Hospitals has engaged in significant international collaborations, particularly with USA and European institutions, significantly contributing to the institution's research impact. The VOSviewer co-authorship map was generated based on bibliographic data sourced from Scopus.

Statistical Analysis

The data were collated and statistically analyzed to identify trends, correlations, and significances. This analysis involved graphical representations, including trends of publication growth over the decade and distributions of publications across different journal quartiles. Average values and percentage distributions were computed to provide a comprehensive overview of the research landscape.

Interpretation of Results

The bibliometric indicators were interpreted within the healthcare research environment, considering global trends and shifts in research priorities. By examining the outcomes of this analysis, the study aims to identify strengths, areas for improvement, and future opportunities for research and collaboration within the Apollo Hospital Group. By leveraging these methodologies, the study aims to present a detailed and nuanced narrative of the Apollo Hospital Group's research productivity and impact over the past decade, shedding light on its contributions to healthcare and medical research.

Network Analysis

Utilizing VOSviewer 1.6.20 and leveraging the Scopus database with primary keys, a comprehensive network analysis of Apollo Hospital Group's research productivity was conducted. The study examined co-authorship, co-occurrence, citation, and co-citation patterns. By constructing networks encompassing the top 50 authors, affiliations, countries, keywords (co-occurrence), journals (co-citation), and the top 68 highly cited papers with more than 100 citations, VOSviewer unveiled complex relationships among contributors, affiliations, geographic regions, publications, and thematic areas within the realm of Apollo Hospitals Group's research output.

Results

The bibliometric analysis of the Apollo Hospital Group's research output over the past decade (2015-2024) reveals a remarkable trajectory of growth and influence within the healthcare sector. The findings indicate a consistent upward trend in scholarly publications, showcasing the organization’s escalating commitment to research (Table 1).

Table 1. Comparative Research Metrics of Apollo Hospitals Group from the year 2015 to 2024

Research Metric	2015	2024	Percentage (%) Increase
Total Publications	255	794	211.37
Top 10% Citations	4.7	12.0	155.32
Top 10% Journals	8.8	17.3	96.59
Field-Weighted Citation Index	0.73	1.88	157.53
Total Views	4836	10201	106.67

Publication Growth

The total number of publications authored by Apollo Hospitals increased significantly from 255 in 2015 to 794 in 2024 (211.37% increase), culminating in 5,005 publications over the analyzed period. This yields an average of 500.5 publications per year, highlighting a pronounced and sustained rise in research output, particularly in the last five years of the decade (Figure 1). This increase highlights Apollo Hospitals' proactive approach to contributing to medical knowledge and addressing pressing healthcare challenges.

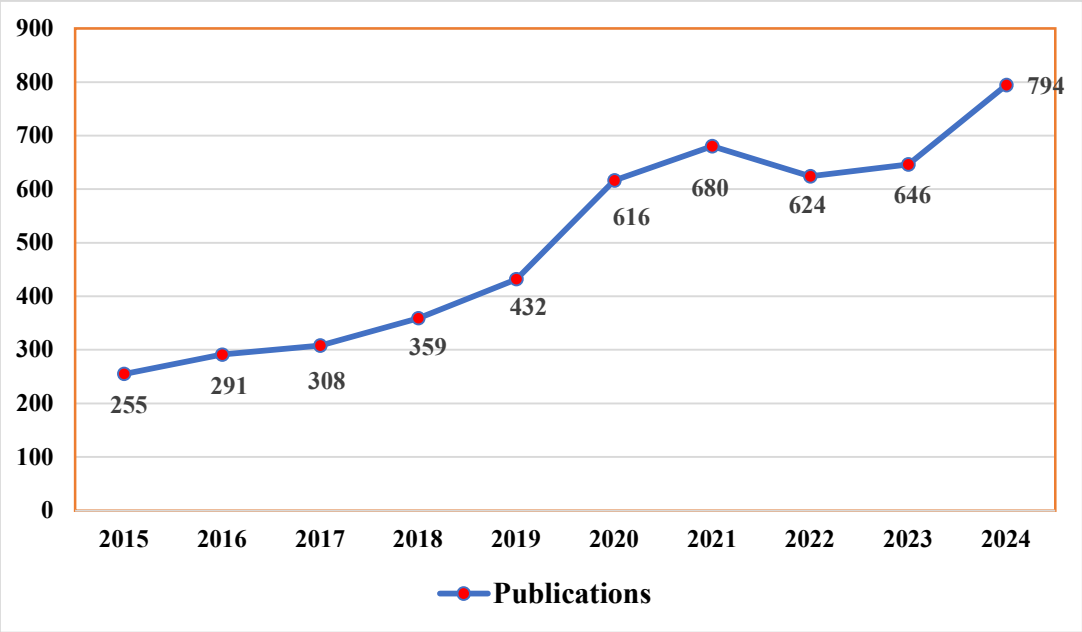


Figure 1. A rising trend of publications of Apollo Hospital Group authors in the last decade (Source: Sci Val)

Citation Impact

In conjunction with the growth in publication numbers, there has been a notable increase in total citations (n=59,333), reflecting productivity and the broader impact of the research conducted. The analysis indicates an average of 11.9 CPP and FWCI of 1.27. The FWCI rose from 0.73 in 2015 to 1.88 in 2024 (a percentage increase of 157.33), demonstrating substantial engagement with the academic community and a strong resonance of Apollo's research findings within relevant discourses (Table 1).

Collaborative Research

Collaboration emerged as a central pillar of the Apollo Hospital Group's research strategy. The analysis revealed that 44.4% of the publications resulted from national collaborations, while 26.4% were the product of international partnerships. Notably, international collaborations demonstrated a higher average CPP of 27.3 and FWCI of 2.91, suggesting that research produced in collaboration with global entities tends to receive greater recognition and validation (Table 2). This trend aligns with contemporary approaches in healthcare research that emphasize interdisciplinary and transnational collaboration as vital for tackling complex health issues.

Table 2. Geographical Collaboration of Apollo Hospitals Group Authors and their Impact

Geographical Collaboration	Percentage Involvement	Average Citations Per Publication (CPP)	Average Field Weighted Citation Impact (FWCI)
International	26.4	27.3	2.91
National only	44.4	7.9	0.88
Institutional only	22.1	4.2	0.39
Single author (no collaboration)	7.0	3.1	0.38

Figure 2 illustrates a citation-based collaboration network map showcasing the top 50 most productive organizations out of 9,570. Each organization had to have a minimum of 9 papers, leading to 57 organizations meeting these criteria. The Total Link Strength (TLS) of co-authorship links with other organizations was computed for all 58 organizations. The top 50 most productive organizations were selected for VOS viewer analysis based on the highest TLS. Among these organizations, Indraprastha Apollo Hospitals, New Delhi (n=2775) emerged as the leader, followed by Apollo Hospitals, Chennai (n=1159), Apollo Hospitals Hyderabad (n=419), and Apollo Hospitals Bangalore (n=388). This selection process resulted in the forming of five distinct clusters, interconnected by 375 links with a TLS of 2941. Cluster 1 comprises 21 organizations, followed by Cluster 2 with 10 organizations, cluster 3 with nine organizations, cluster 4 with seven organizations, and cluster 5 with three organizations.

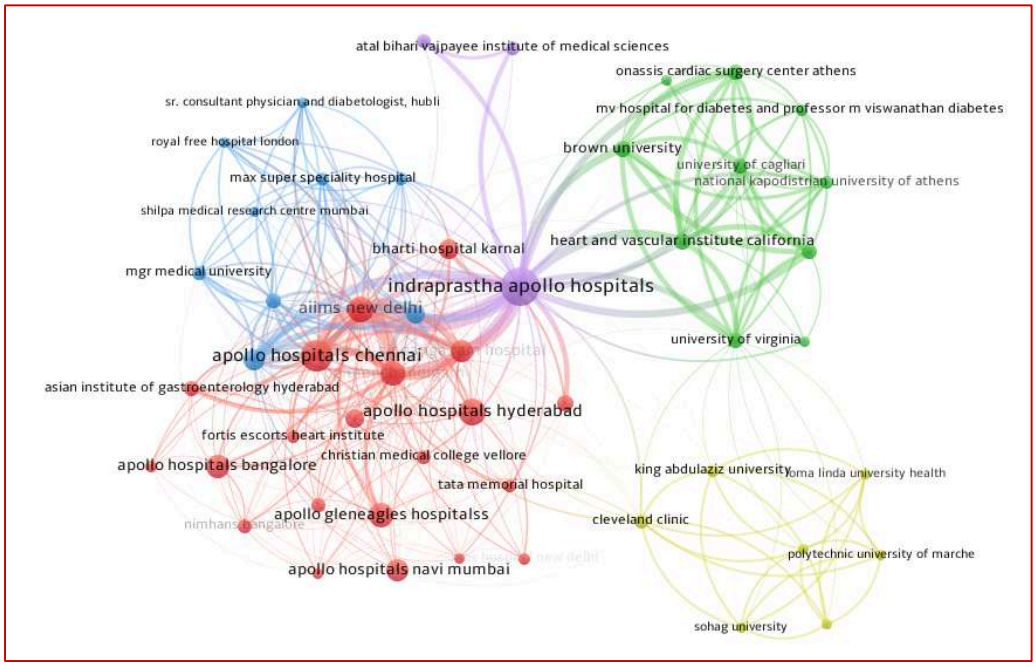


Figure 2. Collaboration Network of the Top 50 Institute Affiliations

The collaboration network analysis encompassed 166 countries. After applying a minimum threshold of 40 documents and 2000 citations per country, 50 countries were selected for further study. This analysis resulted in three distinct clusters: red (28 countries), green (15 countries), and blue (7 countries). The network included 1225 links and a TLS of 37,623, illustrating the scientific connections between the collaborating countries (Figure 3). Participants in Apollo Hospitals Group's scholarly output included the United States (n=633), the United Kingdom (n=537), Italy (n=300), Canada (n=246), and Australia (n=228), among others.

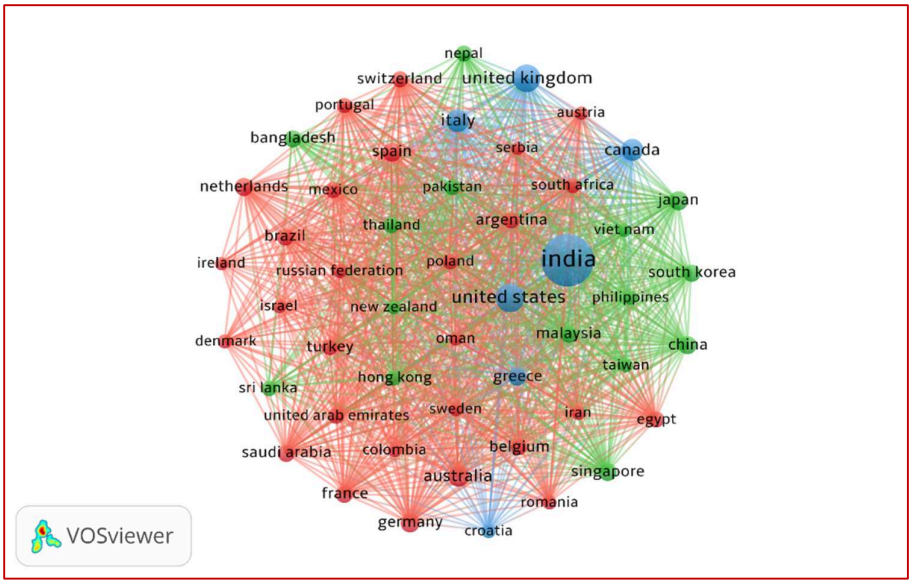


Figure 3. The International Scientific Collaboration Network of the Top 50 Countries

Prolific Authors

A detailed examination of the bibliometric profile of the top 20 prolific authors from Apollo Hospitals revealed diverse expertise and contributions. The total number of publications among these authors ranged from 40 to 377 (Table 3). In terms of publication productivity, the most significant contributions came from authors Vaishya, Raju (n=377), Vaish, Abhishek (n=152), and Khanna, Narendra Nath (n=103). This output concentration reflects the presence of highly active researchers within the institution who are at the forefront of generating significant knowledge in their respective fields.

Table 3. Bibliometric profile of the Top 20 prolific authors of Apollo Hospitals Group: 2014-2024 (Source: SciVal)

S.No.	Author's Name	Publications	Citations	Citations Per Publication (CPP)	Field-Weighted Citation Impact (FWCI)	h-index	Output in Top 10% Citation Percentiles (Field-Weighted)
1	Vaishya, Raju	377	7642	20.3	2.3	40	80
2	Vaish, Abhishek	152	2238	14.7	2.05	24	33
3	Khanna, Narendra Nath	103	3503	34	2.13	36	32
4	Goenka, Mahesh Kumar	90	1072	11.9	1.14	25	14
5	Ramakrishnan, N.	83	1093	13.2	1.63	27	8
6	Vijay, Vipul	79	780	9.9	0.59	17	1
7	Gowrishankar, Swarnalata	70	425	6.1	0.41	15	2
8	Sibal, Anupam	61	468	7.7	0.67	15	6
9	Agarwal, Amit Kumar	61	683	11.2	0.54	16	0
10	Sinha, Sanjay	61	193	3.2	0.76	10	7
11	Raj, Revathi	57	343	6	0.48	13	2
12	Chawla, Rajesh	55	1447	26.3	2.83	21	18
13	Bhattacharya, Saptarshi	53	75	1.4	0.51	12	6
14	Chowdhry, Mohit	48	240	5	0.23	11	0
15	Uppuluri, Ramya	47	291	6.2	0.52	13	1
16	Mehta, Ravindra M.	46	629	13.7	1.71	17	8
17	Sengottuvelu, Gunasekaran	45	265	5.9	0.86	10	3
18	Gopalakrishnan, Ram	41	391	9.5	0.71	17	5
19	Venkataraman, Ramesh R.	41	446	10.9	0.59	22	3
20	Sharma, Punit	40	312	7.8	1.28	31	5

The VOSviewer co-authorship map was generated based on bibliographic data from Scopus. The analysis focused on co-authorship among 25,774 authors, with a refined selection criteria of 50 authors who met a minimum threshold of 26 documents and 50 citations per author. This selection process formed seven distinct clusters, interconnected by 141 links with a TLS of 2763. Cluster 1 consists of 13 authors, followed by clusters 2 and 3 with 12 authors each, cluster 4 with six authors, cluster 5 with four authors, cluster 6 with two authors, and cluster 7 with one author, as shown in Figure 4.

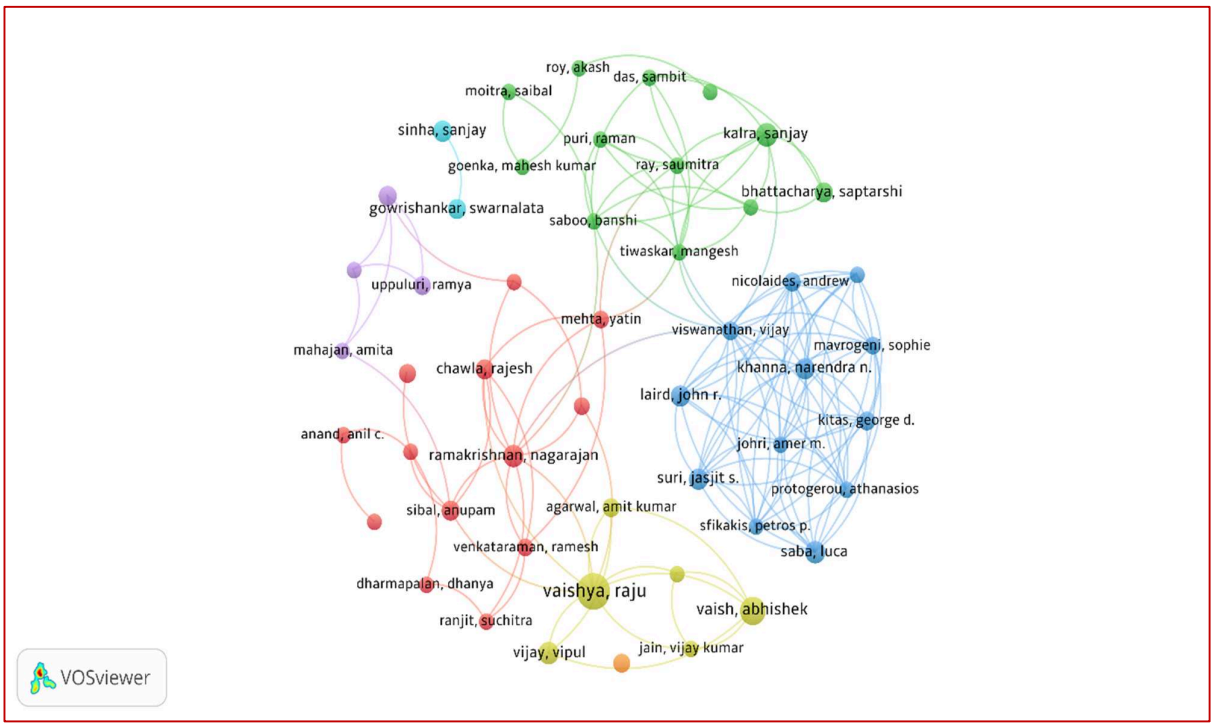


Figure 4. Network visualisation of co-authorship of the Top 50 Apollo Authors

Visibility and Engagement

The published works garnered considerable visibility, accumulating 79,666 views, translating to an average of 15.9 views per publication in Scopus. There has been a substantial increase of 106.67% in article views in the past decade (Table 1). This high level of engagement, coupled with a top 9.3% percentile ranking, signifies a strong interest in and relevance to Apollo's research within the healthcare discourse and academic communities. The average Field-Weighted views impact was 0.92 in 2015 and 1.98 in 2024 (average of 1.13).

Quality of Research

The quality of the research is further substantiated by its placement within the top 10% of journal percentiles: 11.8% for journals and 9.1% for citations. The number of Apollo Hospitals' publications in higher quartile journals (top 10%) has increased substantially over the last decade, with an increase of 96.59% from 2015 to 2024 (Table 1).

The quality of research output is further evidenced by the distribution of publications across journal quartiles, with 47.5% appearing in high-impact Q1 to Q2 journals and 86.3% in Q1 to Q3 journals. The number of Apollo Hospitals' publications in higher quartile journals has increased over the last decade (Figure 5).

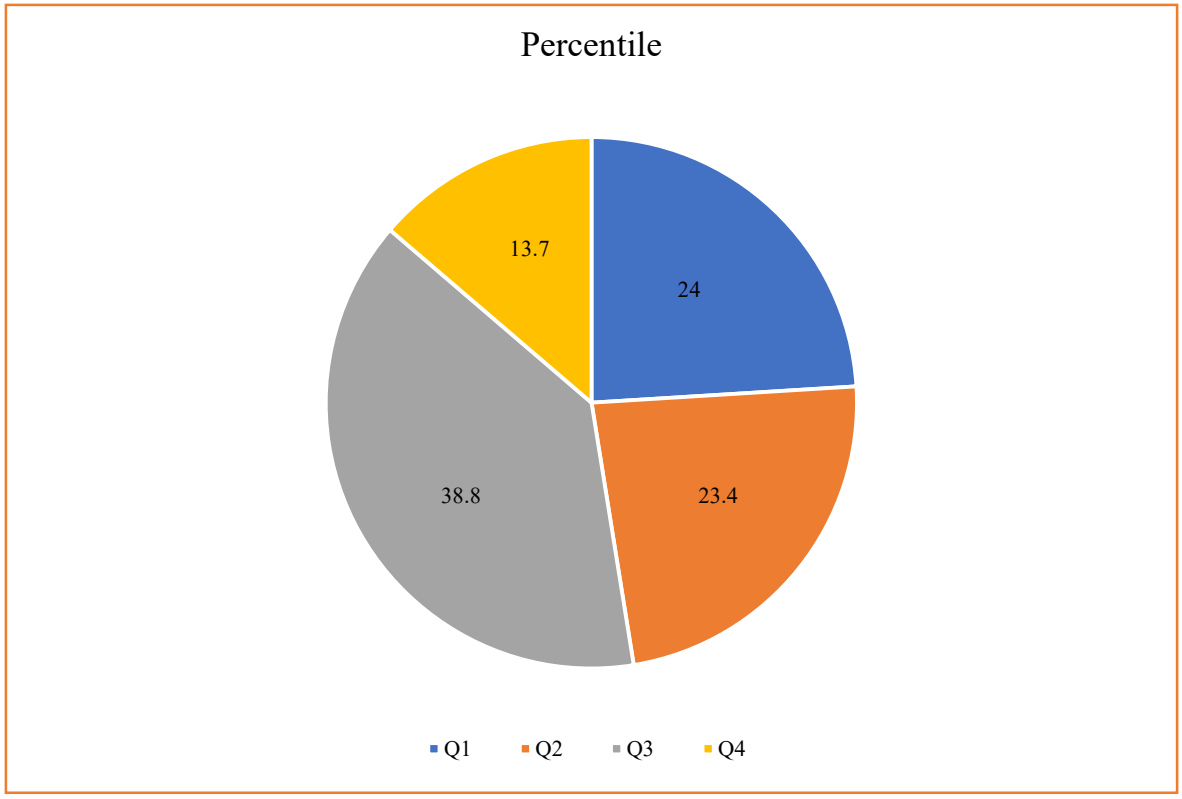


Figure 5. Journals quartile distribution of Apollo Hospitals' authors

This balanced output illustrates the institution's dedication to publishing in prestigious venues that adhere to rigorous peer-review processes. Additionally, the analysis reveals a positive trend in the average FWCI, which rose from 0.74 in 2015 to 1.84 in 2024 (148.6% increase). This increase indicates an enhancement in the quality and significance of the research and highlights the growing recognition of Apollo's contributions to the global medical community.

Subject Areas

Apollo Hospitals' authors primarily published on subjects related to Medical Sciences (96.0%), followed by Natural Sciences and Engineering and Technologies. Apollo's researchers have contributed to 443 Topic Clusters and 2,313 Topics in the last decade.

Policy Impact

5.1% of all publications for Apollo Hospitals' authors during 2015-2024 were cited by 602 prestigious global policy bodies, like NICE, World Health Organization (WHO), World Bank, PubMed Central (PMC), and several Nations' policy documents.

Funding

Three hundred seventy-four top-level funding bodies were linked to 10.1% of publications by the authors of Apollo Hospital Group. The top ten supporting organizations are the National Institutes of Health (NIH), Department of Science and Technology of India (DSTI), Indian Council of Medical Research (ICMR), Sanofi France, Johnson and Johnson (J&J), Pfizer, Ministry of Education, India, Astra Zeneca, Wellcome Trust, European Commission (EC).

Data Visualization Metrics

There were 2,814 mentions in the media received by Apollo Hospitals Group during the last decade, including National and International media sources.

Discussion

This bibliometric study presents insightful findings that illuminate the quality and impact of the research under examination. One of the study's primary outcomes is the impressive placement of the research findings in top-tier journals, with 11.8% of these journals belonging to the highest percentile - a clear indication of their stringent peer-review processes and academic rigour. Publishing in such prestigious journals suggests that the research has met high standards for originality, methodological soundness, and contribution to the field. This strong performance is supported by an average citation impact of 11.9 CPP, illustrating the relative influence of Apollo's research within similar disciplines. Publishing research in high-impact journals is a significant milestone for researchers, as these journals have a wide readership and high citation rates. High-impact research usually involves groundbreaking discoveries, significant advancements, and innovative solutions to pressing problems.

The bibliometric analysis reveals that 9.1% of Apollo Hospitals' publications are among the top 10% most cited globally, reflecting a significant output in the top citation percentiles. This metric serves as a critical measure of impact, demonstrating that the research has been recognised and actively referenced by other scholars, thus fostering further exploration and dialogue in the subject area. A high citation rate typically correlates with research that provides valuable insights, establishes theoretical frameworks, or introduces innovative methodologies that others are eager to build upon. A recent bibliometric study revealed a significant increase in publications from Indian medical institutions, particularly during and after the COVID-19 pandemic. Among private hospitals, authors affiliated with the Apollo Hospitals Group have notably led the publication count [18].

The group's publications garnered nearly 78,000 views in the Scopus database, highlighting the widespread interest in their research, particularly in clinical, arts, and humanities fields, where extensive citation may only sometimes occur. Notably, 9.3% of their publications ranked in the top 10% most viewed globally, with an impressive average of 15.9 views per publication. In 2024, the average FWCI of 1.88 indicates that Apollo's research receives 88% more citations than the global average for similar publications, further underscoring the quality and relevance of their work. An FWCI above 1.00 demonstrates a notable recognition for their contributions compared to the broader research landscape. Collectively, these findings emphasize Apollo Hospitals' influential presence in healthcare research and its

commitment to producing impactful and widely viewed publications.

Bibliometric studies play a pivotal role in scholarly communication by providing rigorous quantitative analyses that elucidate patterns in producing, disseminating, and utilising academic literature. Utilizing advanced statistical methods, these studies enable researchers to extract meaningful insights from extensive bibliographic datasets, facilitating the identification of trends within specific fields, understanding collaboration dynamics, and assessing the impact of both individual research outputs and collective knowledge within the academic community [19,20].

Another critical aspect of the bibliometric analysis is its reflection on the broader academic landscape. It highlights the interconnectedness of research outputs and how studies influence one another. In an era where collaboration and interdisciplinary approaches are increasingly encouraged, the visibility of influential research becomes crucial in shaping future inquiries and guiding funding priorities. Collaboration among researchers is essential for fostering innovation, sharing expertise, and addressing complex challenges. By working together, researchers can combine their strengths, overcome limitations, and generate more impactful research. Collaboration can take many forms, including co-authorship, joint projects, and knowledge sharing.

As the academic landscape evolves, marked by an unprecedented surge in research output and increasingly complex collaborative networks, the relevance of bibliometric studies has heightened. They have become essential tools for structured research evaluation, aiding funding agencies, academic institutions, and policymakers in decision-making related to resource allocation, academic promotion, and research strategy development. Moreover, bibliometric analyses foster interdisciplinary collaboration by mapping connections among researchers and their contributions, enhancing global visibility and sharing of academic work [21,22].

This study found a substantial and progressive increase in the publications by Apollo Hospitals' authors in the last decade, with an over three-fold increase between 2015 and 2024, culminating in 5,005 publications. Moreover, several of its authors are prolific researchers, and 13 have published over 50 papers in the last decade (Table 3). These prolific researchers have consistently produced high-quality, impactful work and are recognized as leaders in their field. The dynamic interplay between research and clinical practice is crucial for advancing healthcare. Research generates new knowledge and evidence-based practices translated into clinical settings to improve patient care. Conversely, clinical practice provides valuable feedback and data to researchers, informing future research directions and priorities. This integration leads to improved patient outcomes, enhanced quality of care, cost-effectiveness, professional development, and advancement of scientific knowledge.

Apollo Hospitals Group is also a pioneer in the postgraduate (PG) education and training for the students of the Diplomat of National Board (DNB) and Fellowship of National Board (FNB) programs. This is being offered at 24 locations across Apollo Group Hospitals, in 57 specialities and super specialities. Currently, there are PG 1173 students, and they account for around 10% of the total

number of PG students of the DNB in India [23].

We chose SciVal for our bibliometric data collection as it is a powerful research intelligence tool that offers a comprehensive analysis of research performance at various levels, including institutions, departments, and individual researchers, by using Scopus data. The Scopus database covers a wide range of scientific information by providing access to millions of articles, including from many international publishers [24,25]. It is also a powerful search tool to help find relevant information quickly and efficiently. It also provides multiple research bibliometrics, such as citation counts, h-index, and CiteScore, to evaluate the impact of research.

Study Limitations

While this bibliometric analysis provides valuable insights into the research contributions of the Apollo Hospitals Group, several limitations must be acknowledged. First, the study relies on data extracted from Scopus and SciVal, which may not capture all relevant publications, particularly those in non-indexed journals or regional publications. This limitation may underreport the total research output and its impact. Additionally, the study focuses on quantitative metrics such as publication counts and citation rates, which may not fully represent the quality or significance of the research findings. Qualitative assessments could provide deeper insights into the impact of the research on clinical practice and patient outcomes. Lastly, we could not compare the metrics with other private Indian institutions, similar to Apollo Hospitals.

Future directions

Building on the findings of this study, future research could explore a more nuanced analysis of the research context and its implications. Investigating specific focus areas within Apollo Hospitals' research output would be valuable, such as identifying emerging trends in healthcare technologies, public health initiatives, or patient care innovations. Additionally, conducting longitudinal studies that monitor the impact of significant publications on clinical practices and patient outcomes would enhance understanding of research efficacy. A comparative analysis with other leading healthcare institutions across Asia or globally could also shed light on the relative standing and contributions of Apollo Hospitals in the broader context of healthcare research. Exploring the impact of specific collaborations—both national and international—on publication quality and innovation could provide further insights into effective research strategies.

Relevance of the Study

This study is of significant relevance to multiple stakeholders in the healthcare sector. The analysis offers a comprehensive overview of Apollo Hospitals' research trajectory for researchers and healthcare practitioners, highlighting strengths in specific areas and paving the way for future collaborations. This study highlights the importance of research excellence in the healthcare sector and serves as a valuable eye-opener for both governmental and private institutions. Demonstrating the significant impact of organized research efforts, it underscores the necessity for policymakers and academic organizations—regardless of their affiliation—to prioritize and evaluate

research outputs systematically. Encouraging corporate hospitals to adopt this approach not only enhances their contributions to healthcare knowledge but also aligns with broader public health goals. Collaboration between governmental bodies and private entities could foster a more robust research ecosystem, ultimately improving patient care and healthcare outcomes on a larger scale.

Policymakers can benefit from understanding the contributions of prominent healthcare institutions in shaping healthcare policies and practices, emphasizing the importance of funding and supporting such research endeavours. Moreover, the findings underline the importance of international collaborations in enhancing research visibility and impact, which can serve as a motivational framework for other healthcare providers aiming to elevate their research profiles. Finally, this study contributes to the broader discourse on the importance of rigorous, high-quality healthcare research and its pivotal role in advancing medical knowledge for global health outcomes. This is essential for driving innovation and advancing knowledge in the respective field.

Conclusion

This bibliometric analysis highlights Apollo Hospitals' impressive growth and influence in healthcare research over the past decade. The substantial increase in research publications, from 255 (in 2015) to 794 (in 2024) and a total of 5,005 publications, demonstrates the institution's commitment to advancing medical knowledge. The average citation count of 11.9 per publication and a significant 26.4% of international collaboration outputs indicate strong academic community engagement. Moreover, the rise in field-weighted citation impact from 0.73 to 1.88 reflects the high quality and relevance of the research produced. Overall, Apollo Hospitals has established itself as a prominent contributor to global healthcare advancements, driven by strategic collaborations and a focus on high-quality research output. The study findings illustrate Apollo Hospitals' influential role in shaping healthcare research and practices both nationally and internationally.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

Role of Meniscal Pathology in the Development of Spontaneous Insufficiency Fractures of the Knee (SIFK): A Radiological Perspective

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Abstract

Introduction: Spontaneous insufficiency fractures of the knee (SIFK) are stress fractures occurring in weight-bearing joints, particularly the knee, due to underlying conditions like osteoporosis. These fractures typically affect elderly, postmenopausal women, individuals with obesity, or those with osteoporosis. Additional risk factors include diseases affecting collagen formation and systemic conditions like systemic lupus erythematosus and prolonged corticosteroid use. The medial femoral condyle is the most affected site, and patients frequently present with acute knee pain without any significant trauma. MRI plays a crucial role in diagnosing these fractures. **Materials and Methods:** This retrospective review of knee MRI reports from January 2013 to January 2020 was conducted in a tertiary care centre, included 85 cases of SIFK and 85 age and gender matched controls. The analysis included insufficiency fractures of the knee joint and assessment of the associated pathologies like meniscal tears, ACL degeneration and osteoarthritis. The Radiological findings were analyzed using SPSS v27 to evaluate the spectrum of findings**.** **Results:** Majority of the study population (59.4%) were females, with the medial femoral condyle being the most frequently affected site. Partial-thickness cartilage loss was the most common finding in both femoral and tibial cartilages, and posterior meniscal tears was observed in 78.8% of cases. ACL degeneration was present in 54.1% of cases, while osteoarthritis was present in 78.8%. The study also introduced a novel scoring system to evaluate the severity and association of insufficiency fractures with meniscal pathology and other related factors. **Conclusion:** A significant association between SIFK and underlying biomechanical and degenerative factors was well appreciated. A higher incidence of SIFK was observed among females, particularly after sixth decade of life. Meniscal extrusion and cartilage loss were the common associated factors in SIFK, emphasizing the importance of early detection and appropriate management of associated degenerative changes of the knee joint so as to prevent the progression into insufficiency fractures.

Keywords: Spontaneous insufficiency fractures, knee, meniscal pathology, osteoarthritis, MRI

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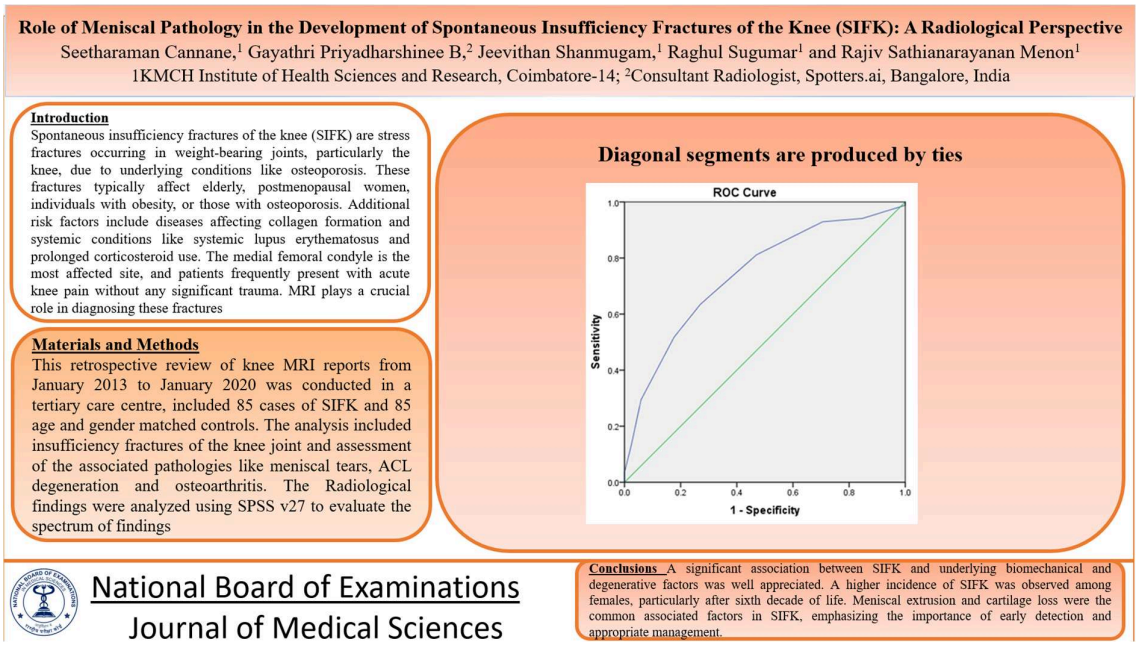
Graphical Abstract



Introduction

Insufficiency fractures, a type of stress fracture which is caused by normal or physiological stress applied to bones that are weakened by underlying conditions, such as osteoporosis or osteomalacia. These fractures generally impact the weight-bearing synovial joints - the hips, knees, and ankles, as well as the vertebrae and also the sacrum. Elderly, postmenopausal women, individuals with obesity and those with osteoporosis are the most commonly affected. Additional risk factors include diseases affecting collagen formation, such as Marfan syndrome and fibrous dysplasia, as well as systemic conditions like systemic lupus erythematosus, Paget's disease, and prolonged corticosteroid use. Insufficiency fractures may also occur in transplant recipients (renal and liver) and as a consequence of chemotherapy or radiation therapy [1].

Among weight-bearing joints, the knee is particularly prone to insufficiency fractures, with the medial femoral condyle being the most frequently affected site. Patients commonly present with an acute onset of severe knee pain without any preceding history of significant trauma [2]. Magnetic Resonance Imaging (MRI) plays a critical role in diagnosing these fractures. The hallmark finding in acute stages is a linear subchondral T1 hypo intensity accompanied by surrounding bone marrow edema on MRI. Without timely diagnosis and management, these fractures may progress to complications such as secondary osteonecrosis, subchondral collapse, or rapidly progressive osteoarthritis, potentially requiring surgical intervention or joint replacement [3-5].

Notably, insufficiency fractures of the knee (spontaneous insufficiency fractures of the knee, or SIFK) have been associated with meniscal pathology, particularly posterior root tears, which compromise the biomechanical stability of the joint [6-9]. Other contributing factors include osteoporosis9 and previous meniscectomy, which further alter the

biomechanical load distribution across the joint [10]. This interplay between insufficiency fractures and associated intra-articular pathologies underlines the importance of a comprehensive evaluation of the knee joint in affected patients.

This study was planned to understand the epidemiology and clinical findings of insufficiency fractures of the knee joint with a specific focus on the associations with meniscal pathology, particularly posterior root tears, as well as anterior cruciate ligament (ACL) tears, osteoarthritis, and articular cartilage degeneration using MRI findings so as to get insights that may aid in improving the early diagnosis and management strategies.

Materials and Methods:

This retrospective cross sectional study was conducted after obtaining approval from the Institutional Human Ethics Committee (IHEC) and adhered to ICMR ethical principles for research involving human participants.

MRI Knee reports from the hospital Radiology Information System (RIS) between January 2013 and January 2020 was retrieved using the keyword search for "insufficiency fracture". A total of 93 cases were obtained initially. Cases with suboptimal image quality, lack of subchondral low T1 signal intensity, or absence of bone marrow edema on inversion recovery sequences were excluded. A total of 8 cases were excluded based on these criteria, leaving 85 cases for inclusion in the study. Age- and gender-matched controls (n = 85) with no evidence of insufficiency fractures were selected to provide a comparative baseline. Matching was performed to minimize potential confounders and ensure comparability between groups.

The clinical data and imaging findings were systematically recorded using a standardized study proforma. Demographic information, including age, gender, laterality, and clinical history, was extracted from patient records. All imaging evaluations were performed by a musculoskeletal radiologist with 12 years of experience in MR imaging. The analysis included precise localization of insufficiency fractures within the medial femoral condyle (MFC), lateral femoral condyle (LFC), medial tibial plateau (MTP), and lateral tibial plateau (LTP). The fractures were further categorized based on their position in the sagittal plane (anterior, central, or posterior) and coronal plane (inner, mid, or outer). The size of the hypointense T1 line was measured in millimetres on both sagittal and coronal images.

Radiological findings were also assessed for joint effusion, meniscal tears (notably posterior root or radial tears), medial meniscal body extrusion (>3 mm or <3 mm), anterior cruciate ligament (ACL) degeneration or tears, articular cartilage loss, Baker's cysts, and osteoarthritic changes. Meniscal extrusion was quantified on coronal T1 images as the distance of extrusion from the medial tibial plateau. Articular cartilage loss was classified into categories: no loss, partial-thickness loss, full-thickness loss, or chondral fissures. Osteophytes were graded subjectively as none, small, moderate, or large.

All MRIs were performed using a 1.5 T MRI system (Philips Ingenia 1.5T) following a standard knee imaging protocol. The sequences included proton density (PD) with a TR/TE of 2100/30 ms, T1-weighted (TR/TE of 645/10 ms), and T2-weighted (TR/TE of 2500/100 ms). Subchondral fractures were identified by

linear hypointense signals on T1-weighted images with surrounding hyperintensity on inversion recovery sequences, indicative of marrow edema.

Data were analysed using SPSS v27 (IBM Corp.). Descriptive statistics were summarized as means with standard deviations and as frequencies and percentages for categorical variables. Group comparisons were conducted using the independent t-test for normally distributed continuous variables. Categorical variables were analysed using the Chi-square test. A p-value < 0.05 was considered statistically significant.

A new scoring system was developed with femoral articular cartilage loss (no cartilage loss =0, partial thickness loss = 1, full thickness loss = 2), Tibial articular cartilage loss(no cartilage loss =0, partial thickness loss = 1, full thickness loss = 2), Presence of radial tear(no tear = 0, presence = 2), Osteoarthritis (present =2, absent =0) and level of meniscal extrusion(less than 2 mm was given a score of 0, 2-4 mm as 1 and more than 4 mm as 2). ROC curve was drawn for the same and yonden cut off was calculated (Figure 1).

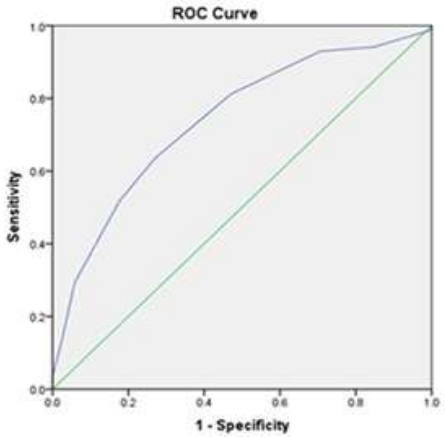


Figure 1. Diagonal segments are produced by ties.

Results

Out of the study population, 59.4% were females, and 54.1% had left-sided knee involvement. Partial-thickness cartilage loss was the most common finding in both femoral (63.5%) and tibial cartilage (67.6%), while full-thickness loss affected 33.5% and 26.5%, respectively. Posterior meniscal tears were prevalent in 78.8%, and radial tears were seen in 25.9%. (Table 1).

Table 1. Distribution of Study Population According to Socio Demographic Parameters

Parameter	Sub classification	FREQUENCY	PERCENTAGE
GENDER	MALE	69	40.6
	FEMALE	101	59.4

SIDE	LEFT	92	54.1
	RIGHT	78	45.9
CARTILAGE LOSS FEM ARTICUALR CARTILAGE LOSS	NO CL	5	2.9
	PARTIAL THICKNESS CL	108	63.5
	FULL THICKNESS CL	57	33.5
CARTILAGE LOSS TIB ARTICUALR CARTILAGE LOSS	NO CL	10	5.9
	PARTIAL THICKNESS CL	115	67.6
	FULL THICKNESS CL	45	26.5
POSTERIOR TEAR	NO	36	21.2
	YES	134	78.8
RADIAL TEAR	NO	126	74.1
	YES	44	25.9

ACL degeneration was observed in 54.1%, predominantly mild (43.5%). ACL and PCL tears were uncommon, with complete tears seen in only 1.8% for both ligaments. Osteoarthritis was present in 78.8% of cases, Baker's cysts in 30%, and joint effusion in 97.6%, mostly mild (72.4%). Osteophytes were identified in 95.9%, with 51.8% mild and 38.2% moderate (Table 2).

Table 2. Distribution of Study Population According to Clinical Findings

Parameter	Sub classification	FREQUENCY	PERCENTAGE
ACL DEGENERATION	NO	78	45.9
	MILD/MINIMAL	74	43.5
	MODERATE	8	4.7

	SEVERE	10	5.9
ACL TEAR	NO	155	91.2
	PARTIAL TEAR	12	7.1
	COMPLETE TEAR	3	1.8
PCL DEGENERATION	NO	156	91.8
	PARTIAL TEAR	11	6.5
	COMPLETE TEAR	3	1.8
OA FEATURES	NO	36	21.2
	YES	134	78.8
BAKERS	YES	51	30.0
	NO	119	70.0
JOINT EFFUSION	NO	4	2.4
	MILD/MINIMAL	123	72.4
	MODERATE	40	23.5
	SEVERE	3	1.8
H/O TRAUMA	NO	95	55.9
	YES	10	5.9
	NA (CONTROLS)	65	38.2
OSTEOPHYTES	NO	7	4.1
	MILD	88	51.8
	MODERATE	65	38.2
	SEVERE	10	5.9

There is no significant association between cases and controls with respect to Gender, side of the insufficient fracture, tibial articular cartilage loss, radial tear, posterior loss, ACL degeneration, Bakers, joint effusion and osteophytes using chi square test. There was a significant association between cases and controls in femoral articular cartilage loss, radial tear and OA Features. Full thickness Femoral cartilage loss was more prevalent in cases (63.2%) compared to controls (36.8%), establishing it as a strong predictor of insufficiency fractures. 41.17% of the cases had radial tear compared to 10.58% of controls. 95.29% of the cases had OA compared to 62.36% of controls.

The mean age of cases and controls was identical (60.87 ± 10.45 years), with no statistically significant difference ($p = 1.000$). Meniscal extrusion was significantly greater in cases (2.99 ± 1.76) compared to controls (2.15 ± 1.42), with a mean difference of 0.842 ($t = 3.422$, $p = 0.001$), indicating a strong association between meniscal extrusion and insufficiency fractures.

Receiver operator characteristics was drawn for the newly developed scoring system against fracture status (cases Vs controls). The area under the curve was 0.741 and P value was <0.001. The composite scoring system for predicting insufficiency fractures of the knee demonstrates moderate sensitivity (63.5%) and specificity (72.9%), for a score of 5, indicating its ability to accurately identify both cases and non-cases. Among those with a score of 5 or less, 54 had insufficiency fractures, while 23 did not, reflecting a positive predictive value (PPV) of 70.1%. Conversely, for scores above 5, 62 individuals were correctly identified as not having fractures, while 31 were misclassified, yielding a negative predictive value (NPV) of 66.7%. These findings suggest that the composite score is a reasonably reliable tool for assessing the likelihood of insufficiency fractures based on the parameters evaluated. It can be used as a screening tool (Table 3).

Table 3. Diagnostic accuracy of composite score index

	Insufficiency fracture of knee	
Composite Score	Present	Absent
Less than or equal to 5	54	23
More than 5	31	62
Sensitivity – 63.5%		
Specificity – 72.9%		
PPV – 70.1%		
NPV – 66.7%		

Discussion

This study highlights several important findings about spontaneous insufficiency fractures of the knee (SIFK) and their associated pathologies.

The current study demonstrated a higher incidence of SIFK in females, with a female-to-male ratio of 1.8:1. This is consistent with previous literature reporting a female predominance, with some studies citing ratios as high as 4.8:1 [7,20-24].

However, a few studies have shown an almost equal incidence between males and females [20]. The observed female predominance in this study aligns with findings that insufficiency fractures are more common in postmenopausal women due to reduced bone mineral density and hormonal changes that affect bone strength [20,21,23,25-27].

Age distribution in the study showed that SIFK was most common in the seventh decade of life, corresponding to the 60–69 age group. This pattern is consistent with existing literature, which also reports a peak incidence in older adults. Age-related decreases in bone quality and cartilage resilience likely contribute to this distribution [20,23,25-27].

The mid-third of the knee joint, both in the coronal and sagittal planes, was the most frequently affected location in SIFK cases in this study. This finding can be attributed to the central weight-bearing surface of the joint bearing the majority of the transmitted mechanical load, rendering it more susceptible to insufficiency fractures.

A significant association was noted between SIFK and meniscal pathology, particularly radial tears and meniscal extrusion. Meniscal extrusion was strongly associated with SIFK. This aligns with findings in the literature that describe meniscal root tears and radial tears as contributing factors to altered biomechanics and degenerative joint disease, leading to increased susceptibility to insufficiency fractures [22,24,26]. Previous studies have also shown that meniscal extrusion >3 mm correlates strongly with degenerative joint disease, radial tears, and complex meniscal tears [28,29].

Cartilage loss was another significant finding associated with SIFK in this study. Loss of articular cartilage disrupts the even distribution of mechanical forces across the joint, leading to increased stress on subchondral bone and a higher risk of insufficiency fractures. Biomechanical forces alter the meniscal and articular cartilage loss which contribute to the development of an insufficiency fracture.

Our study result also observed a strong evidence for the interplay between altered biomechanical forces and the development of insufficiency fractures in the knee joint. Our study also highlights the importance of evaluating associated joint pathologies such as meniscal tears, meniscal extrusion, and cartilage loss in patients with SIFK for a better understanding of their aetiology and further progression.

A novel scoring system was developed to aid in evaluating and quantify the severity and association of insufficiency fractures with meniscal pathology, articular cartilage loss, and other related factors. While this scoring system has been designed based on observed patterns and radiological findings among our study population, it currently lacks external validation or evidence from the current existing literature. Nevertheless, the scoring framework could serve as a foundational tool for future studies, facilitating a more structured and standardized evaluation in insufficiency fractures and their associated findings.

Conclusion

A significant association between spontaneous insufficiency fractures of the knee (SIFK) and underlying biomechanical and degenerative factors such as meniscal pathology, cartilage loss, and osteophytes

was observed. A higher incidence of SIFK was observed among females, particularly in their seventh decade of life, with the mid-third of the knee joint being the most frequently affected region. Meniscal extrusion, radial tears, and posterior root tears were strongly associated with SIFK, emphasizing their role in altering joint biomechanics and increasing stress on subchondral bone. Cartilage loss and osteophyte formation further contributed to the uneven distribution of load across the joint, predisposing it to these fractures.

Our study findings necessitate the importance of early detection and management of associated degenerative changes in the knee joint so as to prevent the progression of insufficiency fractures.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

A Retrospective Research on Intestinal Damage Due to Blunt Abdominal Trauma

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Abstract

Background: The main cause of morbidity and death is blunt abdominal trauma. Blunt abdominal injuries may initially be difficult to detect if there are no evidence of exterior damage or alterations in the patient's vital signs. A considerable amount of blood loss can occur without the abdomen changing noticeably. Blunt trauma can cause solid organ rupture and visceral injury, which can lead to hemorrhage, peritonitis, and associated pelvic injuries. The most commonly wounded organs are the spleen, small intestine, and liver. **Objectives:** To find out the etiology, manifestation, anatomical distribution, diagnostic method, management and outcome of intestinal injuries from blunt abdominal trauma. **Methodology:** The study comprised nearly 59 patients who underwent laparotomies over a three-year period to address intestinal damage brought on by acute abdominal trauma. The etiology, presentations, anatomical distributions, diagnostic methods, associated injuries, treatment regimens, and deaths of the patients were all investigated in a retrospective analysis. **Results:** There were about 60 major bowel and mesentery lesions from blunt abdominal injuries in about 59 people. The male to female ratio was 5.5:1, and the average age was 36.78 years. Approximately 60 persons suffered severe injuries. In addition, there were 12 significant seromuscular injuries, 7 mesentric, 11 colonic, and 1 duodenal injuries, and 50 small intestinal injuries, including 48 perforations. Car accidents resulted in injury to 33 people. The most common damage was a perforation at the antimesentric boundary of the small bowel. Treatment for colonic perforations involved anastomosis, healing of the perforation, and protective colostomy following resection. Ten (16.9%) people encountered serious issues, and two (3.38%) deaths were reported. **Conclusion:** Even though it may be difficult, early diagnosis of intestine injuries after severe abdominal trauma is essential due to its enormous infectious potential. Intestinal perforations are commonly associated with severe damage, which are probably the decisive variables in survival.

Keywords: infectious potential, injury, abdominal trauma, external trauma

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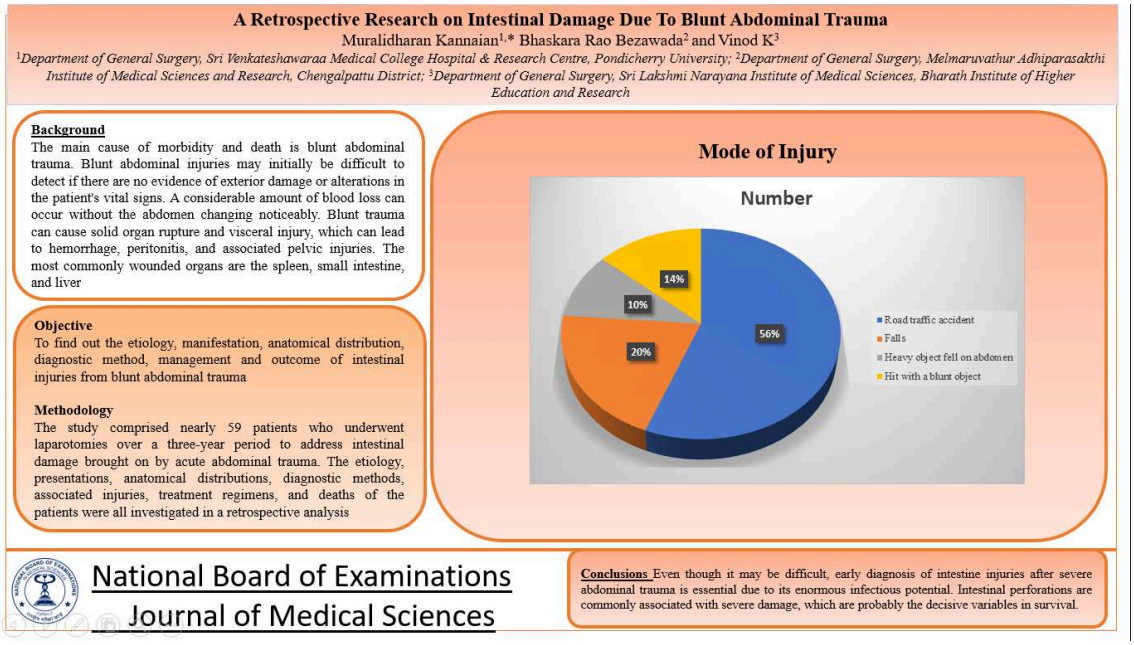
Graphical Abstract



Introduction

Blunt abdominal trauma is the leading cause of morbidity and death across all age groups. Blunt abdominal injuries may initially be difficult to detect if there are no evidence of exterior damage or alterations in the patient's vital signs. A considerable amount of blood loss can occur without the abdomen changing noticeably. Blunt trauma can cause solid organ rupture and visceral injury, which can lead to hemorrh age, peritonitis, and associated pelvic injuries. The most commonly wounded organs are the spleen, small intestine, and liver. Shearing damage caused by improperly fitted seatbelts is one kind of crush injury that can exhibit a recognizable seatbelt pattern of bruising [1].

Evaluation of serious intraabdominal pathology might be challenging. Although acute trauma from a variety of sources can produce intestinal disturbances, auto accidents are the most common aetiologic factor [2]. Blunt abdominal injuries are more common in rural areas, whereas penetrating injuries are more common in metropolitan areas [4]. Two forms of penetrating abdominal injuries that require different treatment strategies are stabbing wounds and gunshot wounds [5]. To lower mortality in cases of abdominal injuries, risk factors for death must be thoroughly identified and examined. In recent years, research has established a number of risk factors, including sex, the interval between an abdominal injury and surgery, shock at admission, and brain damage [3]. The experiences with blunt intestine injuries at a teaching hospital in Puducherry, India, are documented in this article.

Methodology

This retrospective study was conducted at a Puducherry-based private medical college. About 59 of the 284 patients treated for acute abdominal trauma throughout the course of the last three years (2020–2022) underwent laparotomies to

repair their intestinal and mesenteric lesions. Every patient with a blunt abdominal injury was included. Those with serosal tears that did not need to be removed or mesenteric injuries without intestinal ischemia were not included in our analysis. Following ethical permission, this retrospective study looked at the patients' age, sex, injury etiology, presentation, location, associated injuries, treatment, death, and morbidity. In our study we categorised the injury in to mainly two types - major and minor. Major injuries included: 1) bowel perforation or transection 2) ischemic bowel caused by a mesenteric injury that necessitated resection; and 3) seromuscular bowel wall injuries that also required resection.

Results

78 of the 284 patients who required laparotomies over a three-year period were hospitalized for serious abdominal injuries. In 59 people, there were significant mesentery and intestinal damage. 36.78 years old was the average age. The distribution of study participants by age group is shown in Table 1. The ratio of males to women was 5.5:1, with 50 men and 9 women.

Table 1. Age and Sex distribution of Patients with Intestinal Injury from Blunt Abdominal Trauma

Age (in Years)	Male	%	Female	%	Total	%
Below 20	4	6.78	0	-	4	6.78
20-30	11	18.64	1	1.69	12	20.34
30-40	23	38.98	6	10.17	29	49.15
40-50	9	15.25	0	-	9	15.25
50-60	2	3.39	2	3.39	4	6.78
60 Above	1	1.69	0	-	1	1.69
Total	50	84.75	9	15.25	59	100.00

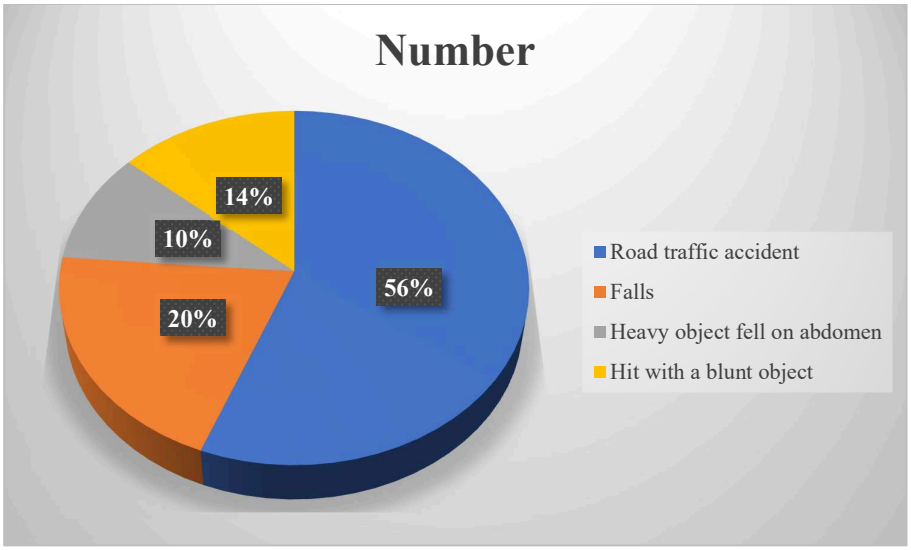


Figure 1. Mode of Injury

Among our study participants majority of about 33 (56%) cases included motor incidents on the roads. The remaining cases were caused by various accidents (Figure 1). Radiography of the plain abdomen and chest showed that 22 out of the 28 patients with 36 intestinal perforations had free peritoneal air. Ultrasonography was advised in five situations. The remaining individuals underwent laparotomies based solely on clinical findings.

Only in seven of the patients whose initial film taken within six hours of the event was negative was pneumoperitoneum found in films taken twelve hours after the injury. Because the injuries were not visible at the initial evaluation, the laparotomy was delayed for almost twenty-four hours in 10 of the cases. The average time from admission to laparotomy was 17.3 ± 21.5 hours. About 60 people were seriously injured, including 59 people. Furthermore, there were 50 small intestine injuries, including 38 perforations, 12 serious seromuscular injuries, and 7 mesentric, 11 colonic, and 1 duodenal injuries. The anatomical location of the injuries is shown in Table 3.

Table 3. Anatomic Location of Small Intestinal Injuries

	Number					
Site	Perforation	%	Serosal injury	%	Total	%
Duodenum	2	4	0	0	2	4
Close to DJ junction	13	26	4	8	17	34
Close to jejunoileal junction	8	16	2	4	10	20
Close terminal ileum	12	24	3	6	15	30
Scattered	3	6	3	6	6	12
Total	38	76	12	24	50	100

Table 4 shows that about 18 patients, or 30.5%, suffered related injuries. Intra-abdominal trauma caused the majority of the liver damage. According to this study, individuals with intestinal injuries were more likely to have liver damage, while those with acute abdominal trauma were more likely to have splenic injury. Most extra-abdominal injuries were related to the skeletal system.

Table 4. Associated Injuries

Site	**Number of patients**
Intra-abdominal	
Liver	6
Pancreas	2
Extra-abdominal	
Skeletal	7
Facio maxillary	2
Intra + extra abdominal	
Liver + skeletal	1

There were 38 perforations in the small intestine, including three in the duodenum. D4 sustained a grade II wound. The duodenal perforation was treated with gastrojejunostomy, feeding jejunostomy, and perforation repair. The numerous perforations and the three isolated holes required anastomosis and resection. The others were treated with primary closure. The small intestine's severe seromuscular injury required resection and anastomosis for treatment. The colon's two holes were repaired mostly. The transverse colon required exteriorization and resection, the sigmoid colon required resection and anastomosis with a protective colostomy, and the ascending colon's seromuscular injuries required resection and anastomosis. Anastomosis and excision were required due to the injury to the mesentery.

Table 5. Major Complications

Complications	**No of patients**	**Procedure done**	**Outcome**
Anastomotic leakage	3	Laparotomy + exteriorization	Survived
Anastomotic leakage + pelvic abscess	2	Laparotomy + abdominal drainage + exteriorization	Survived
Anastomotic leakage	1	-	Expired
Intra-abdominal abscess	1	Laparotomy + drainage	Survived
Burst abdomen + intra abdominal abscess	3	Laparotomy + drainage + closure	Survived

Approximately ten people (16.9%) had significant issues (Table 5). Minor issues like wound infection, chest infection, and prolonged ileus are not included in the table. Two people were killed out of the 59 patients. Deaths were 3.38% of the total. On top of that, both individuals had intra-abdominal organ injury. Immediately following the procedure, two people died. The immediate postoperative mortality were caused by significant blood loss resulting from the attendant organ damage. Two weeks later, the third patient, who also had anastomotic leakage, died.

Discussion

Injury to the intra-abdominal structures can be classified primarily into two categories: deceleration forces and compression forces.6. Compression or concussive forces can result from direct hits or external compression against a fixed object (like the spinal column or a lap belt). These forces can cause hollow organs to distort and temporarily increase intraluminal pressure, which can lead to their rupture. Deceleration pressures produce linear shearing and stretching between relatively stationary and free objects. As they separate from their mesenteric attachments, bowel loops can result in thrombosis and mesenteric rips,

which can harm the splanchnic vessels. Regardless of the mechanism, early detection of these lesions can be difficult. Unnoticed bowel injuries have a significant risk of infection, making them exceedingly deadly.

Annan recorded the first known instance of intestinal rupture brought on by violent trauma in America in 1837 [7]. According to earlier studies, these injuries are usually sustained by younger people and are usually the consequence of car crashes [7,8]. The latest experiment yielded similar results. Intestinal injury was seen in 20.7% of individuals in this study who had suffered violent abdominal trauma. With a rate of 5–15%, the intestine is the third most often injured abdominal organ in blunt trauma, which is consistent with findings from other series [9,10].

Most of the participants in this study had abdominal pain, discomfort, and distension. However, the features were vague in the initial examinations and weren't made evident until further abdominal examinations. Significant intestinal leakage into the peritoneal cavity or delayed presentation can increase morbidity. This has also been documented in other studies. As in prior investigations [11,12] the most commonly injured organ in this one was the small intestine. This study demonstrated that the distal ileum and proximal jejunum were more prone to perforation. This has also been mentioned in earlier works [13,14]. Nevertheless, certain studies have disproved this theory [15]. In a study with 60 patients, Dauterve et al. found that these zones accounted for fewer than half of the perforations [7]. However, his research does show that mesenteric injuries do occur more frequently at these sites. The results of the current investigation were comparable. Compared to colonic injuries, small intestine injuries were more frequent. This has also been documented in other studies [7,8,9].This is primarily due to its location and lack of redundancy, which prevents closed loops from developing.

Diagnostic testing can be used to evaluate patients who have suffered blunt abdominal trauma. These include computed tomography (CT), diagnostic peritoneal lavage (DPL), diagnostic laparoscopy (DL), and ultrasound (US). Ultrasonography is convenient, affordable, and non-invasive. What is known as a positive test [16] is evidence of parenchymal injury to solid organs or free fluid. For evaluating blunt abdominal injuries, DPL was once the recommended diagnostic method; however, CT imaging has recently replaced it, frequently [17]. DPL is an important adjuvant when intestinal injury is suspected [18]. Despite its sensitivity in identifying hemoperitoneum and associated hollow viscus damage, the increased frequency of non-therapeutic laparotomy associated with DPL has been criticized [16].

Extraluminal air and/or contrast extravasation on CT scans are results that are diagnostic for intestinal damage. The presence of free fluid without solid organ damage and small bowel thickening and dilatation are nondiagnostic but suggestive findings [20]. The presence of peritoneal fluid in the absence of obvious solid organ damage is a significant indicator of bowel damage, as several investigations have confirmed [21,22]. Small intestinal perforation may be diagnosed with CT with a 92% sensitivity and 94% specificity [20]. Laparoscopy's primary function in blunt abdominal trauma cases is diagnostic. Reports regarding therapeutic laparoscopy and the healing of intestinal perforations

have surfaced in recent years [23]. When a patient has acute abdominal trauma and is hemodynamically stable, laparoscopy is a safe and efficient way to identify intestinal damage. The best prognosis is provided by prompt surgical intervention and early identification of these lesions [24].

Treatment options include exploratory laparotomy, septic peritoneal fluid draining, and saline lavage of the wound. Antibiotics for prevention are essential [25]. Simple closure is usually adequate for a single small intestinal hole, but more serious injuries, like multiple perforations and gangrene from mesenteric lesions, usually require resection and anastomosis. Stoma development may be necessary for large bowel injuries, particularly in the left colon [11]. The death rate in this study was 3.38%. Between 10 and 30 percent of deaths are attributed to blunt intestine injury, according to reports [7]. Compared to previous studies, the decreased incidence of associated injuries in our study most certainly contributed to the lower mortality. Reports indicate a correlation between a rise in mortality and the number of connected injuries [11,26].

Conclusion

The study's findings supported the need of early detection and intervention. The most frequent injury, which happens more frequently in the small intestine than the colon, is a hole in the antimesenteric border. The likelihood of survival is often determined by associated injuries.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

To Interpret the Association of Chronic Low Back Pain with Modic Changes in MRI of Lumbar Spine Degeneration

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Abstract

Modic alterations are variations in the strength of the spinal bone marrow signal on magnetic resonance imaging (MRI), which are frequently linked to degenerative disc disease (DDD).This study's goal is to ascertain if lumbar disc degeneration and modic alterations in patients with persistent low back pain are related on magnetic resonance imaging. This study looked for the presence of modic alterations in degenerative disc diseases in 108 lumbar disc degeneration patients who volunteered for MRI of the lumbar spine for persistent, chronic low back pain. The result of our study are modic changes were associated with chronic low back pain. Type I modic changes are more commonly linked to acute inflammation and pain. Type 2 modic changes are associated with chronic inflammation. Type 3 modic changes are associated with advanced degenerative and sclerotic changes. Thus the conclusion of this study shows that modic changes more frequently at the end plates of lower Lumbar vertebrae at L4-L5 Level and L5-S1 level. Modic changes are complex phenomenon, occurred at multiple level more frequently with increasing in age suggesting these changes are degenerative disc diseases.

Keywords: MRI, Modic Changes, Degenerative disc disease

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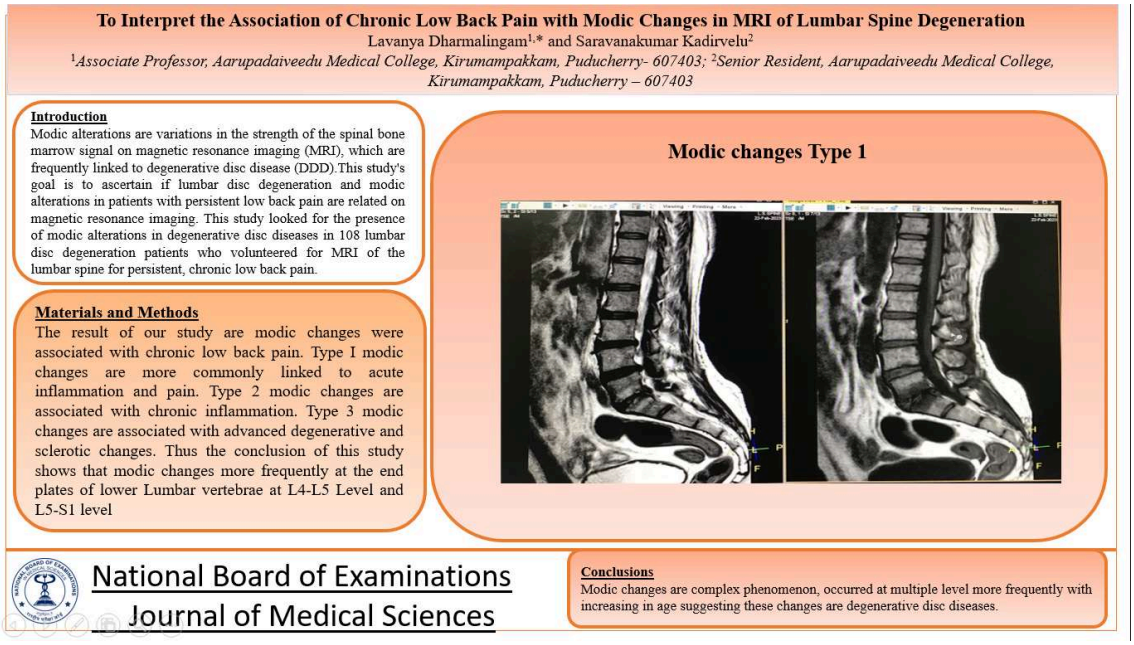
Graphical Abstract



Introduction

The healthcare system is greatly impacted by the incapacitating illness known as chronic low back pain [1]. Degenerative vertebral disc disease is linked to chronic low back pain (LBP), which can even occur in asymptomatic people. This emphasizes how crucial it is to correlate imaging results with clinical symptoms [2].

Degenerative vertebral disc disease includes herniated vertebral disc disease and degenerative alterations to the vertebral end plate [2]. Because of its abundance of neural components, the vertebral endplate, which serves as a thin contact between the disc and bone marrow [3], has the potential to cause discomfort [4]. For a definitive diagnosis of spinal disorders and low back pain, MRI has remained the gold standard [5]. The intricate interaction between the disc, vertebral body, end plate, and facets joints in the pathophysiology of low back pain has drawn a lot of interest since the invention of MRI [6].

Twenty-five years ago, De Ross and Modic described three different kinds of spinal marrow signals. Alterations on magnetic imaging resonance next to the end plate [(8)]. Sagittal spine echo is part of the MRI spine. Bone marrow edema can be seen by T1 rapid spin echo, T2 weighted imaging, T2 (sagittal and coronal) STIR (fat saturation), and T1 and T2 sequence for nerve root compression [9]. The following is the modic categorization. Type 1: linked to edema and inflammation in the vertebral end plate; the vertebral end plate appears hypointene on T2 weighed image and hyperintene on T1 weighted imaging Type 2: fatty replacement of the vertebral end plate and marrow, which manifests as a hyperintense signal of the vertebral end plate on T1 & T2 weighed images; Type 3: area of low signal of the vertebral end plates on both T1 and T2 weighted images [10]. The modic changes in spinal imaging

aid in diagnosis of degenerative spinal conditions, guides treatment decision such as surgical intervention or pain management strategies [11].

Material and Methods

This study was conducted in the Department of Radiology and Orthopedics at Aarupadaiveedu Medical College and Research Institute. The design of study is cross -sectional longitudinal study. The data of the patients were collected who had chronic low back pain subjected to MRI of lumbosacral spine caused by lumbar degenerative disease from MAY 2023 to April 2024. The 1.5 Tesla Philips MRI machine was used for the studies. TR/TE time of 650/22 milliseconds were used to generate the T1 and T2 weighted (sagittal and axial) sequences, and 2600/90 was used to obtain the T2 weighted pictures. For T1 and T2, the acquisition matrix was 192x256 and 256x256, respectively, with a field of view of 260 mm (pixel size: 1.02 mm). For the sagittal picture, the slice thickness and inter-slice gap were 4 mm and 0.4 mm, whereas for the axial slice, they were 3 mm and 0.3 mm.

Image Evaluation

Each of the MRI lumbosacral image was evaluated in detail for the presence and type of modic changes in the lumbar spine, starting with sagittal T1w images and moving on to T2w sagittal and axial images that were correlated for modic changes. The patients' MRI scans were reviewed from the electronic images on the MRI machine's computer system. All images were described by an experienced radiologist in accordance with a set spiral imaging protocol.

Modic classification as follows Type 1; vertebral end plate was hyperintene signal on T2 wighted images and hypointene signal on T1 weigted imaging characterising acute inflammation, edema and bone marrow changes, Type 2; hyperintense signal of vertebral end plate on T1 & T2 weighed image characterising chronic degenerative changes, fatty replacement and bone ma rrow changes, Type 3; area of low signal of vertebral end plates on both T1 and T2 Weighed image characterising advanced degenerative changes, sclerotic changes and bone thickening [11].

Results

The baseline study population consist of total 108 with chronic low back pain in lumbar degenerative disc disease. Out of 108 cases, 52(48%) were male and 56(52%) were female, 97(89%) had modic changes present and 11 individuals did not have any modic changes.

Among the end plate with modic changes 10 were Type I , & 76 were Type II being the most common type on our sample and 11 were of Type III modic changes. In 108 study participant below 30 age group (Male 2 , female2), 31-40 age group (Male-9, female 13) 41-50 (male-18, Female- 13) , 51-60 age group (male-10, female-17) Above 60 (male-13, female-11) (Figure 1 to 4; Table 1).

Figure 1. Modic changes Type 1

Figure 2. Modic Type 2

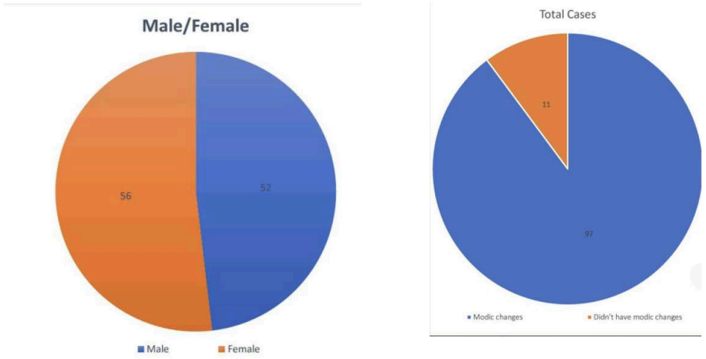


Figure 3. Modic Type 3

Table 1. Age-Wise Representation of Modic Changes

SEX	below 30	31-40	41-50	51-60	above 61	total
male	2	5	18	10	13	48
female	2	6	13	17	11	49
	4	**11**	**31**	**27**	**24**	**97**

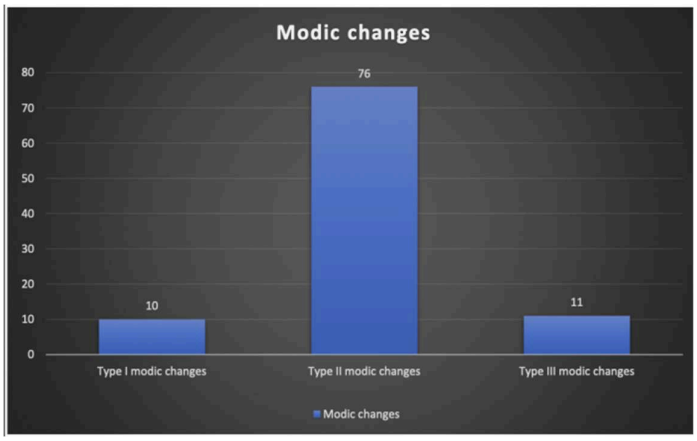


Figure 4: Graphic Representation of Modic Changes

In total 97 participant, vertebral end plates with modic changes, L2/L3-(10 end plates), L3/L4-(17 end plates), L4/L5 (38 end plates), L5/S1-(32 end plates).

There was significant relationship between the disc level and the presence of modic changes ($P<0.01$), the presence of modic changes was highest at L4/L5 level and L5/S1 level out of 108.

Discussion

As a result, our study demonstrates that in patients with chronic low back pain who have degenerative lumbar vertebral disease, modic alterations occur more commonly at the end plate. According to the study, 89% of the 108 patients with chronic low back pain who had degenerative illness had modic alterations.

Modic alterations are typical in middle-aged people but rare in children and young adults. According to the current study, there is a correlation between growing older and the occurrence of morphic alterations. In our study, end plates that were older than 40 years had a higher frequency of high frequency (58%).

The two the superior and inferior lumbar vertebral end plates were found to be impacted by the modic alterations in this investigation. Among the various lumbar segments, the distribution of modic alterations mostly took place in the bottom two lumbar levels.

The Lower Lumbar Vertebra (L4-L5 and L5-S1) is the most common, according to the study. Compared to the upper lumbar spine, the lower lumbar levels would be more likely to withstand the increased mechanical loading. Males with modic alterations were more prevalent than females. Males are more likely than women to engage in moderate to heavy physical labor, which puts larger repetitive stress loads on the lumbar spine [10]. Women will see more modic alterations, which may be related to osteoporosis brought on by hormone fluctuations. In this study, modic type II was the most prevalent, whereas modic types I and III had roughly Equal frequency

The modic changes occurred at multiple levels more frequently with involving the age suggesting these changes are degenerative. End plates is thin interference between bone marrow and disc and is rich in neural elements ,if any

loss of its integrity leads to degenerative events and probable cause of pain generators. Modic changes can be a useful diagnostic marker, however they should be considered in conjunction with clinical symptoms and other diagnostic findings for chronic back pain in patients with degenerative disc diseases.

Conclusion

This study shows that modic change more frequently at the end plates of lower lumbar vertebrae at L4-L5 level and L5-S1 level. Type II was the most common and modic Type I and Type III had more or less equal prevalence. Modic changes occurred at multiple level more frequently with increasing in age suggesting these changes are degenerative in nature. Thus the modic changes in spinal imaging aid in diagnosis of degenerative spiral conditions guide treatment decision such as surgical intervention or pain management strategy

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

Clinico-Radiological Correlation in Carpal Tunnel Syndrome: Evaluating the Efficacy of Shear Wave Elastography and Nerve Conduction Studies

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Abstract

Introduction: Carpal Tunnel Syndrome (CTS) is a prevalent peripheral entrapment neuropathy caused by the compression of the median nerve at the wrist, leading to symptoms such as intermittent paraesthesia, pain, and muscle weakness. The condition is more common in women and individuals aged 45–60 years. Diagnosis typically involves clinical signs, electrodiagnostic studies, and imaging. Recent studies suggest shear wave elastography as a potential tool for assessing tissue stiffness and grading CTS severity. This study aims to investigate the clinico-radiological correlation in CTS patients using shear wave elastography and nerve conduction studies. **Materials and Methods:** This prospective analytical cross-sectional study enrolled 40 adult participants diagnosed with CTS at a tertiary care center in Coimbatore over a two-year period. Ethical clearance was obtained, and informed consent was secured from all participants. High-frequency ultrasonography and shear wave elastography were used to evaluate the median nerve's cross-sectional area, stiffness, and shear wave velocity. Data from ultrasonography and elastography were recorded alongside clinical and demographic details. Statistical analysis was conducted using SPSS version 27.0, with significance set at $p \leq 0.05$. **Results:** The study included 40 participants (23 females and 17 males). The mean cross-sectional area of the median nerve was 0.12 sq.mm, with stiffness values of 120.62 kPa (axial plane) and 217.99 kPa (sagittal plane). A significant association was found between the cross-sectional area and nerve conduction study outcomes, with larger median nerve CSAs correlating with more severe impairment. But there was no significant association between nerve conduction and nerve stiffness. **Conclusion:** The study highlights the intricate relationship between demographic and clinical characteristics in determining nerve conduction study outcomes. Integration of nerve conduction studies with imaging techniques like ultrasound and elastography will provide a more comprehensive understanding about the nerve function, which improves the diagnosis and management of CTS.

Keywords: Carpal Tunnel Syndrome, Shear Wave Elastography, Nerve Conduction Studies, Ultrasonography, Median Nerve

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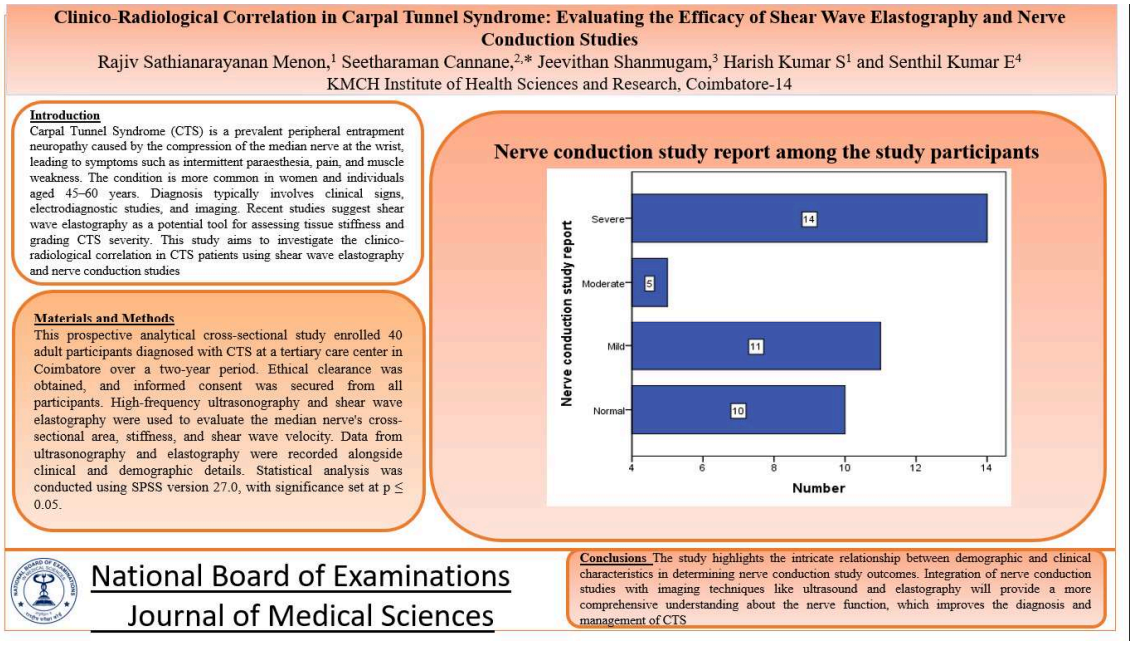
Graphical Abstract



Introduction

Carpel Tunnel Syndrome (CTS) is caused by compression of the Median Nerve at the wrist. It is a common peripheral neuropathy caused due to entrapment, significantly impairing nerve function. [1] Both acute and chronic presentations are possible, and chronic CTS is more common than acute [2]. Intermittent paraesthesia and/or discomfort in the lateral 4 fingers are is the most common symptom precipitated by repeated tasks like writing, typing, or clutching [3]. Other clinical manifestations include sensory loss, weakening of pollicis muscles and in extreme cases, atrophy of the thenar muscles [3]. The risk factors for CTS include pregnancy, obesity, diabetes mellitus, hypothyroidism, prolonged hemodialysis, and space occupying lesions like gangliomas and lipomas [2,4].

CTS is caused by damage to the myelin sheath and axons along with nerve compression, resulting in problems in intraneuronal circulation [4]. Females and people between the ages of 45 and 60 are more likely to develop CTS [5]. The functional handicap linked to CTS is more severe in India because of the country's emphasis on manual labour and delayed presentation due to a higher pain threshold [6].

Diagnosis relies on clinical signs (e.g., Tinel's and Phalen's tests), electrodiagnostic studies, and imaging. However, overlapping symptoms with conditions like flexor tenosynovitis necessitate supplemental tools [2,7]. Electrodiagnostic studies, though sensitive and specific, are invasive and uncomfortable for patients [7]. Ultrasonography, which measures the median nerve's cross-sectional area, is a painless alternative and correlates with CTS severity [8]. However, it lacks the ability to assess the functional impact on the nerve.

Recent studies highlight the potential of shear wave elastography to assess tissue stiffness and grade CTS

severity [9–11]. While promising, further research, especially in the Indian context, is required to validate its role as a substitute for nerve conduction studies. This study investigates the clinico-radiological correlation in CTS patients using shear wave elastography and nerve conduction studies.

Materials and Methods

40 adults who were diagnosed with CTS through Clinical assessment or Nerve Conduction Studies (NCS) were included in the study. The study was conducted over a period of 2 years, from June 2022 to 2024 at a tertiary care center at Coimbatore, Tamilnadu. Institutional Ethical committee approval was obtained and written informed consent was taken from all participants before the start of the study. Participants were explained about the study's objectives, methodology, and the voluntary nature of their involvement. The confidentiality of patient information was maintained throughout the study by of data anonymization.

This prospective analytical cross-sectional study was done to investigate the clinico-radiological correlation in CTS patients using shear wave elastography (SWE) and NCS. The study included patients aged 18 years and older who were referred to the radiology department with a confirmed diagnosis of carpal tunnel syndrome (CTS). Patients under the age of 18 or those with a history of prior surgical intervention for CTS were excluded from the study. A minimum sample size of 40 was determined through hypothesis testing for two means, utilizing a statistical power of 80% and a significance level (alpha error) of 5%, as reported by Park et al. [11]. A consecutive sampling methodology was utilized, enrolling all eligible patients referred throughout the study duration until the predetermined sample size was attained.

High-frequency ultrasonography and shear wave elastography (SWE) were employed to assess the cross-sectional area, rigidity, and shear wave velocity of the median nerve. Examinations were performed utilizing the SuperSonic Imagine Aixplorer Multiwave system, which was outfitted with a Super Linear SL15-4 transducer. Patients were positioned with their arms extended and palms supine and relaxed. The median nerve was evaluated in both transverse and longitudinal planes, with cross-sectional area measurements obtained proximal to the carpal tunnel. Shear wave elastography (SWE) was employed to characterize stiffness and shear wave velocity. Data obtained from ultrasonography and elastography were systematically documented in conjunction with clinical and demographic information within a structured pro forma.

All patients underwent ultrasonography and SWE after clinical diagnosis or confirmation through NCS. The cross-sectional area of the median nerve was assessed utilizing B-mode ultrasonography, subsequent to which rigidity and shear wave velocity measurements were acquired through elastography. To maintain uniformity, a standardized protocol was adhered to for all imaging and elastography evaluations. The data obtained from electrodiagnostic testing were subsequently compared with the results of ultrasonography and elastography in order to assess the clinico-radiological correlation.

Statistical analysis was performed utilizing SPSS version 27.0. Quantitative variables, including cross-sectional area,

rigidity, and shear wave velocity, were summarized utilizing means and standard deviations. The normality of the data was evaluated utilizing the Shapiro-Wilk test, and inferential statistics were conducted employing suitable non-parametric methods. The Kruskal-Wallis H test was used to compare variables between groups, while Spearman's correlation test evaluated the relationship between elastography parameters and NCS results. Statistical significance was set at $p \leq 0.05$, with double-checks performed to ensure data integrity before final analysis.

Results

A total of 40 participants (23 females and 17 males: 57.5% female and 42.5% males) were included in the study. The mean height of participants was 162.58 cm (SD: 10.55. The mean BMI was 29.14 (SD: 3.81). The mean cross-sectional area (CSA) of the median nerve was 0.12 sq.mm (SD: 0.04. The stiffness of the median nerve at the wrist joint in the axial plane had a mean value of 120.62 kPa (SD: 156.83). In the sagittal plane, the stiffness of the median nerve at the wrist joint had a mean value of 217.99 kPa (SD: 153.42) (Table 1).

Among the 40 study participants, 25% (n=10) had normal nerve conduction results. Mild abnormalities were noted in 27.5% (n=11), moderate in 12.5% (n=5), and severe abnormalities in 35% (n=14) of participants (Figure 1).

There was no significant difference between sex and BMI with the nerve conduction category suggesting a comparability in the study population taken. Also No significant correlations were found between height, BMI, or median nerve characteristics

The analysis of the association between nerve conduction study results and median nerve characteristics reveals notable findings for specific variables. The median nerve cross-sectional area showed a statistically significant difference across severity levels (P=0.045P = 0.045P=0.045), with the mean and median values progressively increasing from normal (0.10 ± 0.02, 0.10 [0.09–0.12]) to severe (0.14 ± 0.04, 0.13 [0.10–0.16]), indicating a correlation between nerve enlargement and worsening nerve conduction study outcomes. In contrast, the stiffness of the median nerve in both the axial and sagittal planes did not show statistically significant associations with nerve conduction study outcomes (P=0.102P = 0.102P=0.102 and P=0.236P = 0.236 P=0.236, respectively). However, higher mean stiffness values were observed in moderate and severe categories compared to normal and mild categories (Table 2).

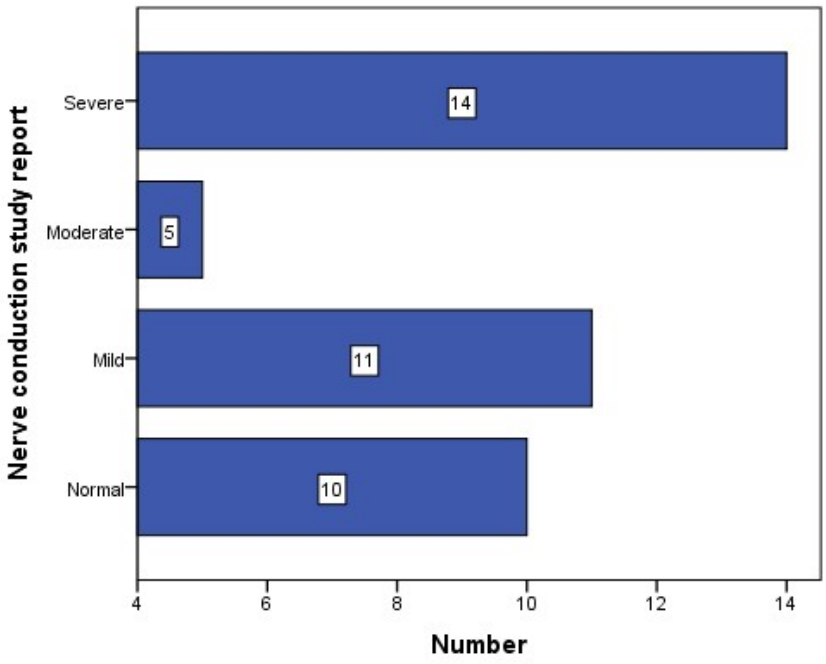


Figure 1. Nerve conduction study report among the study participants.

Table 1: Demographics and anthropometric data distribution

Variables	**Statistics**
Socio demographic characteristics	
Females: Males	23:17
Height, mean (SD), median (IQR)	162.58 (10.55) cm, 160.85 (154.25-170) cm
BMI, mean (SD), median (IQR)	29.14 (3.81), 28.45 (26.72-31.87)
Median Nerve Characteristics	
Cross-sectional area of median nerve , mean (SD), median (IQR)	0.12 (0.04) sq.mm, 0.11 (0.09-0.14) sq.mm
Stiffness of median nerve at the wrist joint in axial plane , mean (SD), median (IQR)	120.62 (156.83) kPa, 81.30 (35.50-120.80) kPa
Stiffness of the median nerve at the wrist joint in sagittal plane mean (SD), median (IQR)	217.99 (153.42) kPa. 176.10 (97.82-301.77) kPa

Table 2. Association between nerve conduction study with median nerve characteristics.

Variables	Nerve conduction study report	Mean (SD)	Median (IQR)	P value
Median nerve cross sectional area	Normal	0.10 (0.02)	0.10 (0.09-0.12)	0.045*
	Mild	0.11 (0.02)	0.10 (0.08-0.11)	
	Moderate	0.12 (0.03)	0.12 (0.08-0.13)	
	Severe	0.14 (0.04)	0.13 (0.10-0.16)	
Median nerve stiffness in axial plane	Normal	69.87 (57.04)	40.80 (34.55-113.05)	0.102
	Mild	58.35 (38.14)	52.40 (25-82.20)	
	Moderate	323.12 (364.91)	138.60 (24.65-713.85)	
	Severe	129.86 (82.95)	99.75 (72.60-216.12)	
Median nerve stiffness in sagittal plane	Normal	277.11 (197.23)	170.95 (117.47-524.20)	0.236
	Mild	178.44 (78.97)	179.50 (136.90-215.70)	
	Moderate	328.78 (181.69)	452.60 (131.05-464.60)	
	Severe	167.29 (131.27)	113.60 (68.92-247.40)	

*Significant P value

Discussion

The current study aimed to investigate the relationship between median nerve characteristics and nerve conduction study (NCS) outcomes. This study enrolled 40 participants with a slight female predominance, a demographic distribution consistent with prior research [11].

Our study also explored sex-based differences in NCS outcomes, with females generally showing a higher prevalence of severe NCS impairment compared to males. While sex did not reach statistical significance as a predictor of NCS outcomes, the observed differences suggest that anatomical and physiological differences between males and females may influence peripheral nerve function. For example, hormonal fluctuations in females may affect peripheral nerve physiology, potentially leading to a higher susceptibility to nerve compression or injury [12].

A high prevalence of overweight and obesity was observed inn our study. BMI has been strongly implicated as a risk factor for peripheral nerve dysfunction, particularly in CTS. Increased BMI leads to an accumulation of adipose tissue within the carpal tunnel, which may exert mechanical pressure on the median nerve, resulting in impaired conduction. Despite this well-established relationship, our study found no significant association between BMI and NCS outcomes. However, individuals with higher BMI tended to show worse nerve conduction parameters, with a notable trend toward more severe impairment among those with higher BMI values. Although not statistically significant, this trend aligns with previous research, suggesting that higher BMI may exacerbate nerve compression and dysfunction in peripheral nerve disorders [14].

The cross-sectional area (CSA) and stiffness of the median nerve, as measured by ultrasound and elastography, were key

variables in this study. These non-invasive imaging techniques provide important information about nerve morphology and biomechanics, which can be crucial in diagnosing peripheral nerve disorders such as CTS. The mean CSA of the median nerve in this cohort was 0.12 sq. mm, with a median of 0.11 sq. mm. Our findings revealed a significant association between CSA and NCS outcomes, where individuals with more severe NCS impairment exhibited larger median nerve CSAs [9].

The stiffness of the median nerve was assessed in both axial and sagittal planes, with mean stiffness values of 120.62 kPa and 217.99 kPa, respectively. Although no statistically significant correlation between nerve stiffness and NCS outcomes was found, a trend toward increased stiffness in individuals with more severe nerve impairment was observed. This trend suggests that nerve stiffness could be a marker of biomechanical changes occurring within the nerve, possibly due to fibrosis or other pathological processes associated with nerve compression or injury [11].

BMI is a well-documented risk factor for CTS and other peripheral nerve disorders, primarily due to the accumulation of excess adipose tissue, which can compress peripheral nerves, particularly in confined anatomical spaces such as the carpal tunnel. Although our study did not find a statistically significant association between BMI and NCS outcomes, the observed trend of worsening nerve conduction with increasing BMI supports the hypothesis that obesity may contribute to nerve dysfunction. In clinical practice, this suggests that individuals with higher BMI should be considered at higher risk for developing peripheral nerve disorders, and early interventions aimed at weight reduction may help mitigate this risk [13].

One of the most significant findings of this study was the correlation between median nerve CSA and NCS outcomes. Individuals with larger median nerve CSAs were more likely to have severe NCS impairment, suggesting that nerve swelling, as reflected by an increased CSA, is a key feature of more advanced nerve dysfunction. This finding is particularly relevant in the context of CTS, where nerve swelling due to compression within the carpal tunnel is a hallmark of the disease. The ability to non-invasively measure CSA using ultrasound provides clinicians with a valuable tool for assessing the severity of nerve involvement and monitoring disease progression or response to treatment.

The study has a few limitations. The relatively small sample size may limit the generalizability of our findings, and larger studies are needed to confirm these associations. Additionally, the cross-sectional nature of the study precludes any conclusions about causality. Moreover, while ultrasound and elastography provide valuable non-invasive measures of nerve morphology and biomechanics, these techniques are operator-dependent, and variability in measurement accuracy may influence the results.

Conclusion

There were no significant correlations between height, BMI, or median nerve characteristics (cross sectional area and stiffness). However, the study highlights the complex interplay between demographic and clinical characteristics in determining NCS outcomes. By integrating NCS with

imaging techniques such as ultrasound and elastography, we can obtain a more complete understanding of nerve function, leading to more accurate diagnosis.

Statements and Declarations

Conflicts of interest

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

Funding

No funding was received for conducting this study.

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REVIEW ARTICLE

Post-Publication Responsibilities of a Journal Author

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Abstract

Popularizing a scientific research paper after publication, so that it can get maximum exposure and citation, is a solemn responsibility of the researchers. They should aim to do so both among the scientific community as well as in the general public if there is a definite message for the masses. The scientific community can be informed by posts in academic networking sites (such as LinkedIn. ResearchGate and Mendeley), updating the departmental or institutional home page, and by ensuring that major abstracting and indexing services (e.g. Web of Science and Scopus) update the publication. The published articles reach a wider audience if they are in open-access journals. To convert the research to the general public we must translate complex research into easily digestible formats for a wider audience beyond academia. We can then use multiple means like a press release highlighting key findings of the research, sharing the publication link, with a summary on social media platforms using relevant hashtags, create engaging visuals like infographics or video summaries. Every time the research is presented from the podium, the publication should be mentioned with a hyperlink, so that people can photograph it and visit it later. The more popular the research is, the more likely it will get cited.

Keywords: LinkedIn, ResearchGate, ORCID, Video abstract, Podcast, Web of Science, Scopus

Corresponding Author: Kaushik Bhattacharya
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Introduction

Researchers are often of the opinion that once their research is published, their job is over. Now it is the responsibility of the journal to propagate it. Nothing can be further from the truth. Popularizing the published work is the job of the researchers themselves and in the age of social media, this is not at all difficult. Every research institution must have a master plan for publicizing the research. Marketing the research is just as important as conducting it, because nothing can be more unfortunate than having a publication that never got cited. Publishing in Open Access journals help, because of easy accessibility, as the readers need not pay a subscription fee to read the research [1].

Target Audience

It is very important to identify the target audience of the research. If it is so highly specialized that only a select group of researchers will understand its implications then the target is very limited, but if it is research that has implications for the well-being of a common man, then the strategy of publicizing this research will be very different as it has to reach a wider audience, which may not be conversant with scientific terminologies we must translate our complex research into easily digestible formats for a wider audience beyond academia. So, the press release or the video abstract should be simple, to the point, and target the lay audience.

Promote and raise the visibility of the published article

The true value and impact of a published paper can be greatly enhanced by promotion. The more people who read, cite, and benefit from the author's research, the more valuable the paper becomes. This in turn enhances the author's esteem and reputation. True, journals have their own impact factors, a scientometric index calculated by Clarivate that reflects the yearly mean number of citations of articles published in the last two years in a given journal, as indexed by Clarivate's Web of Science, but the author too can do wonders to the paper by targeting it to the correct audience. The impact of research papers is increasingly being scrutinized by funding agencies and so this 'beating our own drum' is perfectly in order [2].

How are journals helping in promoting research?

(a) Journals may ask authors to consider search engine optimization (SEO) in choosing titles for their papers and keywords, focusing on words and phrases that are most often searched.

(b) Journals often insist that the key terms in the title should not also be used as keywords, which broadens the number of terms that will return your paper as a "hit" in a search.

(c) Some publishers are allowing comments on papers, before or while they are published online so that reviewers, peers, and, invited domain experts can weigh in on the findings with any critiques or other commentary.

(d) Many publishers in their websites have a tool that summarizes how many times a study has been shared on social media, viewed on the site, or cited by others, creating a competitive marketplace of ideas pegged to getting high numbers for these metrics.

How to promote a research paper

1. **Email**: Emails should be sent to funding agencies, departmental heads involved in the research, institutional heads of all institutions involved, co-authors, persons whose contributions have been acknowledged in the paper, people who may not be partners in the present research but have contributed in your research journey in the past.
2. **Use social media**: Social media platforms such as X, Facebook, Telegram, and WhatsApp are where the author's friends and colleagues can be used in promotion [3].

   Social media visibility can be improved by:

   (a) Use of Hashtags: Employ relevant hashtags to increase visibility and reach a wider audience within your field.
   (b) Use of Infographics: Create infographics, short videos, or diagrams to simplify complex concepts. A "graphic abstract," which offers a readily available summary and a few interesting images can work wonders
   (c) Use of catchy and tweetable phrases to promote the research on various platforms. Journals often also ask to be used on these platforms.
   (d) Following and Followers: The researcher can follow people in their field and accounts of relevant journals, publishers, and professional societies. They can also follow anyone who posts about interesting things or who are interesting trendsetters themselves. This section in social media may further forward the author's post and propagate the research.
   (e) Choosing a handle: The name one uses for your social media account is one's "handle." For professionals and researchers they should use their name with a Dr. or Prof. prefixed to their name to further authenticate their research. Preferably they should use the same handle across all platforms on social media

3. **Update profile on professional and academic networking sites**: Sites such as LinkedIn, ResearchGate, Academia.edu, ORCID and Mendeley are invaluable for spreading the news of the author's latest publication. These are sites that invite people with similar interests and other researchers may find the author's research useful and cite in their own publication. Newer research ideas may blossom with other researchers, which can later assist the author to become a part of a multi-centric study and contribute to an international platform. The authors may also get an invitation for

a podium presentation of their research.

4. **Update the institutional/ departmental homepage website**: The home page of the department or the institution of the author should never be ignored. A summary of the research, which can be understood by all, along with a link to the published paper must be uploaded on these sites. This will tell all their colleagues about their research, and inspire others too.
5. **Contact the institution's press office with a summary of the paper**: Craft a concise press release that summarizes the most impactful findings and their implications for the public, and distribute it to relevant media outlets. The researcher should also be available to answer questions from journalists and actively seek opportunities to discuss their research on news platforms.
6. **Academic Blogging**: Write a lay summary of the paper (with a link to the full version) and send it to blogs in the subject area. One should use the DOI for easy access and sharing.
7. **Produce a video abstract**: A video abstract giving an accessible introduction to the article is invaluable for the television audience. The researcher can highlight the applied importance of their research for the health of the general public and if made professionally, this video abstract may be not only carried by television channels but the researcher may get an invitation to interact with either the anchor or even with a live audience.
8. **Produce a podcast**: The published research can be converted into an interesting podcast for the consumption of the general public and FM Radio stations are always looking for such out-of-the-box items and convert them into their USP. The researchers, after airing a few abstracts, can become the radio station's go-to person in matters of health.
9. **Mention the publication at conferences in posters and podium presentations**: Whenever the researchers get an opportunity to present their research from the podium or a poster board in a conference or in a webinar, they must have copies of the summary of their research, with a hyperlink to their published paper, to hand out to colleagues. Posters must carry the hyperlink to the paper and the presentation must have a slide showing a published paper with its hyperlink. Post Publication Peer Review (PPPR) is another modality to gain attention in the academic bodies about the published data [4].
10. **Check major abstracting and indexing services**: The authors must ensure that abstracting and indexing services like Web of Science and Scopus carry their paper with the correct details.

Summary

Popularizing and marketing research is the responsibility of the researchers and their responsibility is not over with the publication of the research. With social media at their disposal, they can target both a select audience of like-minded researchers as well as the masses at large. They have to mold their communication style depending on the audience, whether it's the general public, industry professionals, or fellow scientists and researchers. They have to emphasize the real-world implications and potential benefits of their research and track the reach and impact of their promotional efforts to refine their future strategy. Infographics, video abstracts, podcast, academic blogs all help in popularizing the research and get it cited.

Statements and Declarations

Conflicts of interest

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

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CASE SERIES

Functional and Structural Outcomes of Septorhinoplasty in a Tertiary Care Center

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Abstract

Introduction: Nose is the hallmark feature of a human face and it plays a pivotal role in both aesthetic harmony and essential physiological functions. Nasal obstruction is one of the common complaint in otorhinolaryngology, with significant affect in the quality of life. Septorhinoplasty is one among the surgical procedure which addresses both functional and aesthetic concerns of nasal obstruction. It improves nasal airflow and helps in achieving the normal contour. This study evaluates the functional and structural outcomes of septorhinoplasty at a tertiary care center. **Materials and Methods:** This case series was conducted at MES Medical College, Kerala, among 20 patients above 18 years of age who presented with external nasal deformity and nasal obstruction. Institutional Ethical clearance was obtained, and informed consent was secured from all participants. Preoperative evaluation of all the study participants were done (clinical history, ENT examination, and diagnostic nasal endoscopy). Functional and structural outcomes of all the participants were assessed using the Sino-Nasal Outcome Test (SNOT-22) and Rhinoplasty Outcome Evaluation (ROE) questionnaire, administered preoperatively and postoperatively. **Results:** Most patients (70%) were between 18 and 20 years of age, with a male predominance (80%). Preoperative SNOT-22 scores significantly reduced from a mean of 27.95 to 2.10 postoperatively indicating a better outcome after surgery. Similarly, ROE scores increased from a preoperative mean of 4.05 to 23.30 postoperatively, demonstrating a substantial improvement in patient-reported outcome and satisfaction. Complications were minimal, occurring in less than 5% of study partcipants. **Conclusion:** Septorhinoplasty significantly contributes for improvement of functional and aesthetic outcomes, with better patient satisfaction and minimal complications. This procedure effectively addresses nasal deformities and enhance overall well-being and quality of life.

Keywords: Septorhinoplasty, nasal obstruction, functional outcomes, aesthetic outcomes, patient satisfaction

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Introduction

The nose is a primary defining feature of a human face which plays a major role in maintaining essential physiological functions and aesthetic harmony. It is the entry point for the upper airway and helps in conditioning, filtration and humidification of the inhaled air. It also safeguards the lower airway against allergens and pollutants [1]. Nasal obstruction is a common presenting complaint in otorhinolaryngology department, which significantly impacts the quality of life [2]. Many patients who present with nasal obstruction, have external nasal deformities that requires surgical correction. Septorhinoplasty is one of the surgical procedure that is designed to address both the functional impairment caused by a deviated nasal septum and also the external deformation. It aims to improve nasal airflow while also achieving a natural appearance that synchronises with other features of the face [3-5].

The effectiveness of the procedure is measured not only by clinical improvements but also by patient satisfaction and enhanced quality of life [6]. The nasal reconstructive surgeries dates back to History of ancient India, where Father of Indian surgery, Sushrutha in his Sushruta Samhitha describes the techniques for nasal reconstruction [7,8]. Many modern techniques have developed since then and the latest being the transformation from closed to open rhinoplasty which was pioneered by Goodman and refined by Anderson [9,10]. Outcome of the surgery was evaluated in terms of external appearance, nasal obstruction, and overall quality of life after surgical procedure [11,12]. Patient-reported outcome measures plays a key role in evaluating the surgical success. The Sino-Nasal Outcome Test (SNOT-22) and the Rhinoplasty Outcome Evaluation (ROE) scale are the two widely used tools in rhinology for evaluating the outcomes of septorhinoplasty. The SNOT-22 questionnaire evaluates the severity of nasal symptoms and their impact on the patient's daily life [13], while the ROE scale assesses both functional and aesthetic outcomes, reflecting the patient's satisfaction with the surgical procedure [14]. These standardized validated tools provides a comprehensive understanding of the subjective improvements perceived by the study participants.

The procedure of Septorhinoplasty has both physical and psychological benefits. The procedure doesn't only resolve the functional impairment but also enhances facial aesthetics thereby leading to psychological well-being [15]. The Patient satisfaction measures depends on factors like occupation, social needs, and the psychological state of the study participant [16]. As such, measuring both objective and subjective outcomes is critical in assessing the success of the surgery. This study focuses on evaluating the functional and structural outcomes of septorhinoplasty, providing insights into its effectiveness in improving nasal function, external appearance, and quality of life.

Materials and Methods

This case series was conducted in a tertiary care teaching hospital after obtaining prior ethical clearance from the Institutional Human Ethics Committee. All participants over 18 years who presented to the outpatient department with Deviated nasal septum and external nasal deformity who were posted for septorhinoplasty surgery were contacted by the principal

investigator, briefed about the study objectives of the study, study procedure rights of the participant and other ethical concerns through a detailed Patient Information Sheet (PIS). Written informed consents was obtained after oral confirmation. Confidentiality was ensured and data was anonymized to uphold privacy. Exclusion criteria included individuals with cleft lip and palate, pre-diagnosed psychiatric disorders, or those unwilling to participate.

A detailed preoperative evaluation was performed which included a thorough clinical history, ENT examination, and diagnostic nasal endoscopy for all the study participants. Sociodemographic data and relevant clinical details were collected using a semi-structured proforma. Functional and structural outcomes of septorhinoplasty were assessed using the Sino-Nasal Outcome Test (SNOT-22) questionnaire [13] and Rhinoplasty Outcome Evaluation (ROE) questionnaire [14], administered preoperatively and at follow-up visits postoperatively.

An open surgical approach which ensured adequate exposure of all the nasal structures were performed uniformly by a senior surgeon. The surgery involved correction of septal deviations using techniques such as scoring, suturing, and placement of grafts to restore functional and structural balance. Caudal septal deviations were corrected by adjusting the strut for proper midline alignment. For patients with severe external deformities, cartilage grafts harvested from the nasal septum was used to support the nasal framework and to enhance the aesthetic outcome. The incisions were meticulously closed to minimize scarring, and proper nasal tip support was ensured to maintain structural integrity and long-term results. Postoperative care included nasal packing, if required, and regular follow-ups to monitor healing and assess outcomes.

Postoperative follow-ups were scheduled to collect data on improvements in nasal obstruction and external appearance. Outcomes were measured and compared using patient-reported questionnaires, providing both subjective and objective insights into surgical success.

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Continuous variables were expressed as mean and standard deviation, while categorical variables were summarized as frequencies and percentages. Wilcoxin signed Ranked test was used to find out the association between pre operative and post operative SNOT and ROE scores. A 95% confidence interval was applied for all analyses to ensure statistical significance.

Results

This case series was done among 20 patients to evaluate the functional and structural outcomes of septorhinoplasty. The data indicates that the majority of the patients 14 (70%) were under 20 years of age, with a male predominance 16 (80%). Most patients 9 (45%) had symptoms lasting 5–10 years. Common nasal dorsum abnormalities included deviation to the right 5 (25%) and left 4 (20%), with 3 (15%) presenting with a hump or hump with deviation to the right. Septal deviation was predominantly to the right 12 (60%). Open surgery was the preferred approach 17 (85%), with osteotomy performed in 17 (85%) of cases and camouflage techniques used in 9 (45%). Complications were minimal, occurring in only 1 (5%) of cases (Table 1).

Table 1: Demographic, Clinical, and Surgical Profile of Patients with Nasal Deformities

Parameter	Sub classification	Frequency	Percentage
Age(in years)	< 20	14	70
	21-30	5	25
	➢ 30	1	5
Sex	Male	16	80
	Female	4	20
Duration	Less than 1 year	1	5
	2-5 years	4	20
	5 -10 years	9	45
	11-15 years	2	10
	16-20 years	3	15
	More than 20 years	1	5
Dorsum	Hump	3	15
	Hump, Deviation to right	3	15
	Hump, Deviation to left	2	10
	Pseudo hump	2	10
	Deviation to right	5	25
	Deviation to left	4	20
	Bulbous deformity	1	5
Septum	DNS to right	12	60
	DNS to left	8	40
Surgery	Open	17	85
	Close	3	15
Osteotomy	Yes	17	85
	No	3	15
Complications	Yes	1	5
	No	19	95

The data reveals that the patients' ages ranged from 17 to 34 years, with a mean age of 20.75 ± 4.19 years. The duration of symptoms varied widely, from 0.5 to 24 years, with a mean duration of 9.33 ± 6.55 years. Preoperative SNOT-22 scores ranged from 6 to 47, with a mean of 27.95 ± 12.40, significantly improving postoperatively to a mean of 2.10 ± 1.52. Similarly, the ROE scores showed a marked increase from a preoperative mean of 4.05 ± 2.74 to a postoperative mean of 23.30 ± 0.73, indicating substantial improvement in patient-reported outcomes and satisfaction following nasal surgery (Table 2).

Table 2. Descriptive statistics of Clinical Parameters of Patients Undergoing Nasal Surgery

Parameter	Minimum	Maximum	Mean	Std. Deviation
AGE	17	34	20.75	4.191
DURATION	0.5	24.0	9.325	6.5500
SNOT 22 PREOP	6	47	27.95	12.403
SNOTT 22 POST OP	0	6	2.10	1.518
ROE PREOP	1	11	4.05	2.743
ROE POST OP	22	24	23.30	0.733

The analysis shows significant improvements in patient-reported outcomes following nasal surgery. The median SNOT-22 score decreased from 23 (IQR: 6–47) preoperatively to 2 (IQR: 0–6) postoperatively, with a mean rank difference of 10.5 and a Z value of -3.921 ($p < 0.001$), indicating a marked reduction in nasal symptom severity. Similarly, the median ROE score increased significantly from 3 (IQR: 1–11) preoperatively to 23 (IQR: 22–24) postoperatively, with a mean rank difference of 10.5 and a Z value of -3.935 ($p < 0.001$) (Table 3).

Table 3. Comparison of Preoperative and Postoperative Patient-Reported Outcomes Using Wilcoxin signed rank test

Scale	Group	Median	IQR	Mean Rank	Z value	p- value
SNOT 22	Preop	23	6-47	10.5	-3.921	<0.001
	Post op	2	0-6			
ROE	Preop	3	1-11	10.5	-3.935	<0.001
	Post op	23	22-24			

Discussion

The mean age was around 21 years. Similar results were obtained in other studies too. Sasindran et al in their study observed a mean age of 26.1 years. Majority of their study population were in the age of 11- 20 years [17]. Baser et al also found that the mean age of the study participants was 31.62 years [4]. Increased cosmetic concern among youngsters, Higher perception of body image, impact of nasal obstruction during development affects the quality of life, Higher perception of body image and greater potential for improvement are few reasons for surgery in young age [4,5,17]. Our study reported more male population. Similar results was observed by Baser et

al. [5]. In contrast Sandran et al. [17] and Simsek et al. [4] observed more than two third were females in their study. The mean duration of symptoms was 9.33 years. Sasindran et al. [17] observed a minimum duration of 6.33 years in their study. Significant reduction in nasal obstruction was observed in other studies too [2-5].

Significant reduction of the SNOT 22 score from 27.95 preoperatively to 2.10 post operatively, $P<0.001$) demonstrates the effectiveness of the surgical procedure in alleviating nasal obstruction, improvement of nasal function and enhancing the quality of life in patients who suffered from chronic nasal obstruction. Similar results were observed in multiple studies [2,3].

High patient satisfaction with the cosmetic results of surgery is demonstrated by the significant improvement in ROE ratings (from a preoperative mean of 4.05 to a postoperative mean of 23.30, $p < 0.001$). This enhancement shows how septorhinoplasty can help patients with their cosmetic concerns and restore facial harmony, which in turn promotes psychological well-being and increased self-esteem. Similar results were observed in other studies [5,17]. After surgery, the relief from long standing symptoms and improved cosmetic appearance are the main reasons for the improved patient satisfaction.

Limitations and Recommendations:

- The small sample size (n=20) limits generalizability, and future studies with larger cohorts could provide more comprehensive insights.
- Long-term follow-up would be beneficial to assess the durability of the surgical outcomes.
- Further research comparing open and closed surgical approaches could help refine indications for each technique.

Conclusion

Overall, the results of this case series confirm the significant benefits of septorhinoplasty in addressing both functional and aesthetic concerns, with minimal complications. These findings reinforce the role of septorhinoplasty as a transformative procedure for patients with nasal deformities. The high patient satisfaction with the cosmetic results underscores the importance of addressing both functional and aesthetic concerns to enhance overall well-being and rebuilding their self-esteem.

Statements and Declarations

Conflicts of interest

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

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CASE REPORT

Parathyroid Carcinoma: A Surgeon's Suspicion

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Abstract

Parathyroid carcinoma is a rare clinical entity. Its incidence is less than 1% of all primary hyperparathyroidism. It is a clinical challenge to distinguish between adenoma and carcinoma preoperatively; usually it is a intra operative and histological diagnosis. We present a patient with parathyroid carcinoma evaluated in our clinical setting and its management

Keywords: Parathyroid carcinoma, Hyperparathyroidism, Hypercalcaemia, Adenoma

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Introduction

Parathyroid cancer (PC) is one of the most uncommon tumors, accounting for 0.005% of all malignancies and fewer than 1% of parathyroid abnormalities. Only a few thousand cases have been recorded in the literature since De Quervain's first description in 1904 [1].

Even though most occurrences are sporadic, it has been linked to hereditary diseases such as hyperparathyroidism-jaw tumor syndrome (HPT-JT), multiple endocrine neoplasia-1 and 2A, and familial isolated hyperparathyroidism. The overlapping range of clinical and biochemical criteria makes it difficult to distinguish between benign and malignant tumors, and postoperative histology is frequently used to make the diagnosis [1].

The clinical appearance of parathyroid cancer is similar to that of primary hyperparathyroidism, and it includes hypercalcemia-related symptoms such as tiredness, bone and joint pain, nephrolithiasis, reduced glomerular filtration rate, osteoporosis, fragility fractures, and neurocognitive impairment [2].

Case presentation

A 39-year-old male residing in Tamilnadu, India with no comorbidities, referred to general surgery department by endocrinology specialist in suspicion of parathyroid adenoma causing primary hyperparathyroidism. Clinically he was asymptomatic; he had no family history of hypercalcemia or metabolic conditions. A physical examination revealed no palpable neck swelling. Laboratory investigation showed increased levels of parathyroid hormone (1098pg/ml) and calcium (11.6mg/dl). Tc99m sestamibi parathyroid scintigraphy showed well defined nodular soft tissue lesion measuring 3.1 in diameter posterior to left lobe of thyroid; features suggestive of functioning parathyroid lesion. The computed tomography (CT) scan of the neck revealed Heterogeneously differentially enhancing nodular lesions measuring 1.5cm and 1.7 cm in diameter, both the nodules are seen on the posterior aspect of the left inferior lobe of thyroid, and appear en masse as a single lobulated lesion, causing indentation on the posterior border of thyroid; suggestive of left parathyroid adenoma.

He was evaluated for surgery, after pre anesthetic and endocrinology clearance Left parathyroidectomy was performed.

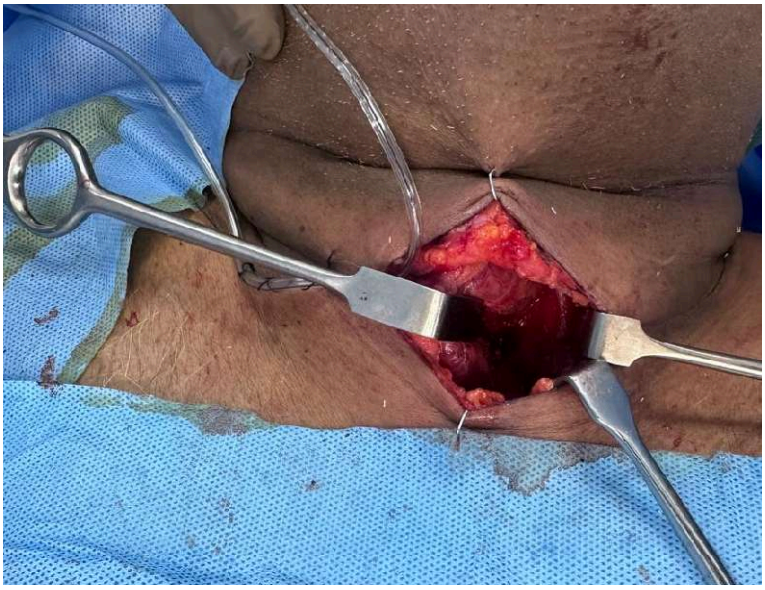

Figure 1. Site of skin incision

Figure 2. Postoperative specimen of parathyroid lesion

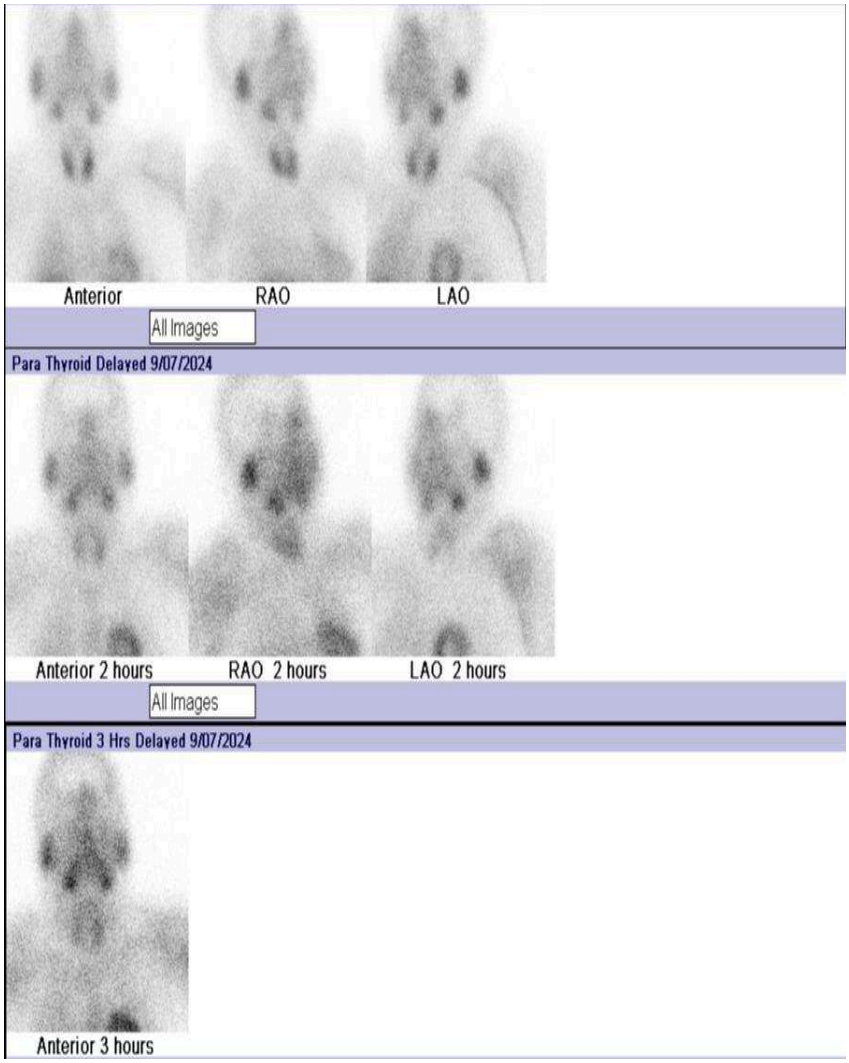

Figure 3. 99mTc-MIBI scan

Discussion

Parathyroid carcinoma is a challenging clinical diagnosis that is nearly always acquired only after a postoperative histological study, as in this case. PC is an uncommon condition that accounts for 0.1–5% of pHPT cases. Higher incidence is observed in Japan, with reports exceeding 5%. In Western nations, it typically accounts for less than 1% of pHPT cases; nevertheless, an Italian investigation found a PC incidence of 5.2% in patients undergoing pHPT.PC incidence has remained generally stable, with the exception of a minor rise in the number of patients with moderately symptomatic PC, most likely due to the discovery of hypercalcemia during biochemistry investigation [3].

The majority of PCs are sporadic; however, they can also occur in hereditary/syndromic settings [3]. The most prevalent mutation is in the cell division cycle 73 (CDC73) or hyperparathyroidism type 2 (HRPT2) genes, which were initially identified in 2002. In addition to being observed in occasional cases, it has shown a

syndromic connection which includes hyperparathyroidism-jaw tumor syndrome, familial isolated hyperparathyroidism, MEN2A and retinoblastoma genes [1].

The PC is frequently diagnosed following surgery based on histology, and the clinical spectrum is similar to that of its benign counterpart. In contrast to parathyroid adenoma, which manifests ten years later and is more common in women, parathyroid malignancies often manifest in the fourth to fifth decade without a sex predilection. Approximately 90% of PCs have hypercalcemia symptoms and are functionally active. These include skeletal symptoms like bone aches, pathological fractures, and brown's tumor; neurological symptoms like exhaustion, sadness, and anxiety; renal manifestations like nephrolithiasis and impaired renal function; and gastrointestinal dysfunction like bloating, constipation, or pancreatitis. In cancer, hypercalcemia and its related symptoms are typically more severe [1].

Patients should be assessed for parathyroid pathology if they exhibit hypercalcemia symptoms and signs, whether or not they have a palpable neck lump. Although there are no strict distinctions between benign parathyroid diseases and malignancies, PCs often have higher laboratory results. A cancer rather than an adenoma should be suspected if serum calcium levels are greater than 14 mg/dl and parathrmone (PTH) levels are more than five times normal. With PC, alkaline phosphatase levels are often greater than 300 IU/L. The imaging supports the malignancy diagnosis and aids in disease localization. It also aids in the detection of metastases and recurrence. [1].

Even while imaging tests (ultrasound, CT scan, MRI, PET) cannot definitively distinguish between adenoma and parathyroid cancer, higher-resolution anatomical studies are very helpful when malignancy is suspected. Contrast-enhanced computed tomography (CT) can show swollen lymph nodes and invasion of adjacent structures in addition to providing great details on the lesion's location and relationship to nearby structures. The best detail on the soft tissues of the neck can be obtained with magnetic resonance imaging (MRI) that uses gadolinium and fat suppression. This type of MRI can also be used to supplement other information, particularly when preoperative evaluation is being conducted [3].

It is presently advised to use Tc-MIBI scintigraphy as the initial radionuclide imaging technique. Cervical ultrasonography and 99mTc-MIBI together have an 81%–95% sensitivity in identifying hyper functioning parathyroid lesions. SPECT/CT is unable to visualize the smallest diseased glands; however, PET/CT can help detect them. 18FDG-PET/CT offers a high sensitivity for PC identification throughout all stages of the disease. Previous studies have employed 11C-methionine (MET) PET/CT as a second-line imaging modality following conventional imaging that yielded negative or equivocal results [2].

It is recommended to manage these uncommon tumors with a multidisciplinary team. Surgery is the primary treatment for parathyroid neoplasms; however, compared to adenoma, the extent of resection in PC is

more radical [7]. Sometimes it is challenging to distinguish between adenoma and cancer before surgery. In many situations, the postoperative diagnosis is a histological surprise. In order to undertake appropriate surgery at the time of first therapy, the surgeon must be alert to detect the sinister characteristics of malignancy intraoperatively. Carcinomas are typically larger, irregular, white masses with a fibrous capsule that can attach to or penetrate the thyroid lobe or adjacent fibro fatty tissue. Metastatic nodes are a pathognomonic sign of cancer. [6]. These patients should have their serum calcium levels regularly checked and supplemented as needed. As the bones are re-mineralized and the surviving parathyroid take up the function, the demand decreases [1].

Conclusion

Parathyroid carcinoma is an uncommon endocrine cancer. Although preoperative diagnosis is difficult, a neck tumor with symptoms and signs of local invasion and hypercalcemia may raise suspicions. The greatest probability of recovery is provided by complete surgical excision during the initial procedure. It is unclear what part adjuvant treatments like chemotherapy and radiation play. Recurrence is frequent, and the preferred course of treatment is surgical salvage of recurring or metastatic disease combined with medication control of hypercalcemia [1]. Prospective studies and trials must be established to establish management guidelines and enhance outcomes, despite the fact that this is difficult given the rarity of the condition.

Statements and Declarations

Conflicts of interest

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

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CASE REPORT

A Triple Whammy of Anorectal Malformation with Malrotation and Jejunal Atresia: A Case Report

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Abstract

The synchronous association of bowel atresia, intestinal malrotation, and anorectal malformation is rarely seen. Such neonates possess an embryologic, diagnostic, and therapeutic dilemma. Preoperative diagnosis of one in the presence of the other is seldom possible. The trifecta can be confirmed mostly on the operating table only. Thus, the clinician needs to be aware of the possibility of this combination in the presence of any two of these. A full-term neonate presented with the absence of a normal anal opening and multiple episodes of bilious vomiting. On examination, there was upper abdominal fullness and bilious aspirates from the nasogastric tube. A vestibular fistula was identified on perineal examination. The abdominal radiograph had a paucity of distal bowel gas raising a suspicion of proximal bowel atresia. On laparotomy, jejunal atresia type IIIb and malrotation of the midgut were found. Distal atresias were ruled out. A Ladd's procedure and jejuno-jejunostomy were done. The patient had an unremarkable recovery and posterior sagittal ano-rectoplasty was planned at a later stage. Such rarely described anomalies need to be analyzed to get a better understanding of the etiological and embryological basis of such anomalies. It is important to be cognizant of such an anomaly, in case of the defects are seen preoperatively for better planning and outcome.

Keywords: Anorectal Malformation, Malrotation, Intestinal atresia, Bowel atresia

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Introduction

Neonatal intestinal obstruction can be due to a plethora of causes emanating from some form of developmental abnormality in the gastrointestinal tract embryologically. The association of two separate abnormalities in the same patient has been well described. However, the presence of three separate congenital anomalies in the form of malrotation, jejunal atresia, and anorectal malformation simultaneously is seldom seen with only a few cases reported on the same [1–4]. The coexistence of these possible perilous anomalies poses both diagnostic and therapeutic challenges, as well as requires introspection into the understanding of the embryology of these anomalies. The possibility of synchronous association of these conditions should be kept in mind to avoid intraoperative surprise and to ensure better planning and outcome. We describe a neonate with synchronous jejunal atresia, malrotation of the gut, and vestibular fistula.

Case Report

A three-day-old female child with a birth weight of 1.9 kg born to a 25-year-old primigravida at 39 weeks period of gestation by normal vaginal delivery at home, presented to the casualty with a history of non-passage of stools since birth and bilious vomiting since day two of life. No antenatal scans were done. On examination, the neonate was afebrile, with cold peripheries, tachypnea, and tachycardia. There was mild upper abdomen distension and bilious nasogastric aspirates were obtained. There was an absent anal opening, well-developed gluteal folds, an anal dimple present, and a small perineal fistula just below the fourchette. Normal urethral and vaginal openings were present in the vestibule. Chest auscultation was unremarkable. Laboratory investigations revealed a hemoglobin of 15.8 g/dL, a total leucocyte count of $4.3*10^6$/L, a deranged renal function test (urea- 57mmol/L, creatinine- 1.64mg/dl), and a positive C-reactive protein. However, only mucous output was obtained with no meconium staining. An Abdominal radiograph revealed only a few air-fluid levels in the upper abdomen with a paucity of distal gas. Syringing was tried via the perineal fistula using an 8 Fr infant feeding tube, which could be freely inserted. A possible diagnosis of jejunal or ileal atresia along with perineal fistula was made (Figures 1 and 2).

Figure 1. Plain radiograph depicting a paucity of distal bowel gas done at age of 48 hours of life.

Figure 2: Clinical image of perineum showing vestibular fistula and an absent normal anal opening.

After optimum preoperative optimization and informed consent, the patient was taken up for exploratory laparotomy. Intraoperatively, a jejunal atresia type IIIb (apple peel atresia) with a wide mesenteric defect, and grossly dilated proximal jejunum was found. There was an unexpected associated malrotation of the gut as well. The distal small bowel was completely collapsed with subsequent unused microcolon. Distal atresia was ruled out. Ladd's procedure without appendicectomy and end-to-back jejuno-jejunal anastomosis was done. Post-operatively washes via the fistula and hegar dilation of the fistula were started. The child started passing stools by postoperative day three and nasogastric aspirates decreased gradually. Given clinical suspicion of sepsis along with thrombocytopenia, antibiotics were upgraded; though blood cultures were negative. Slow feeding was instituted from postoperative day five and gradually incremented. The child was discharged on oral feeds with a further plan of posterior sagittal anorectoplasty at a later stage.

Discussion

Congenital anomalies of the gastrointestinal system are one of the more commonly seen congenital anomalies. However, an association of three separate gastrointestinal anomalies in the same patient is comparatively rare. The rarity of this association is explained by the different embryological basis.

Jejunoileal atresia has been attributed to a result of late intrauterine mesenteric vascular occlusions initially by Louw and Barnard[5] and later confirmed in studies on fetal rabbits, dogs, sheep, and chick embryos. Malrotation of the gut, though more commonly seen along with duodenal atresia, can be associated with jejunoileal or colonic atresia as well. The anomalous bowel rotation and fixation leading to midgut volvulus in the intrauterine period can be thought of as the cause of associated type IIIb small bowel atresia.[6] Anorectal malformations, on the other hand, are embryologically related to abnormal hindgut development with impaired septation of the cloaca into the dorsal anorectum and the ventral urogenital tract.[7]

Only a few such cases with a triple association of malrotation, intestinal atresia, and anorectal malformation have been described in the literature. A tabular representation of the individual case findings has been done (Table 1). A variety of associated cardiac, gastrointestinal, and chromosomal anomalies have been described. The correction of malrotation of the gut and a stoma is life-saving for these patients. In case of proximal atresia, duodeno-duodenostomy or jejuno-jejunostomy depending on the atresia location is done. Upfront anoplasty can be done alongside for low anorectal malformations, or definitive repair can be done at a later stage in case of high anomalies. As per the literature review, the prognosis of these patients is satisfactory in most cases.[8] Further studies are required to fully comprehend the embryological basis of synchronous association of these anomalies.

Table 1. A table highlighting the demography, clinical presentation, evaluation, management, and outcome of patients having a combination of malrotation of the gut, intestinal atresia, and anorectal malformation

S. no	Publication	Age at presentation	Sex	Birth details	Birth weight	Local examination	Other Associations	Intraoperative findings	Surgery	Complications	Outcome
1	Ismail et al.	2 days	Male	Full-term, NVD	2600g	Imperforate anus, without perineal fistula with well-formed gluteal cleft and anal dimple	ECHO-normal	Malrotation, type I Bland-Sutton-Louw colonic atresia, ARM	Ladd's procedure, double barrel colostomy	Death	Expired by 72 hours post-operative
2	Kumar et al.	5 days	Female	Full-term, NVD	2100g	Absent anal opening, recently sutured midline perineal wound	ECHO-normal, USG KUB-normal	Malrotation, type IV multiple intestinal atresia	Ladds' procedure, multiple resection anastomosis, high sigmoid colostomy	-	Accepting full orals by 2 weeks post-operatively
3	Morikawa et al.	-	Female	Full-term, Cesarean section	2986g	Anocutaneous fistula	Mild facial characteristics of holoprosencephaly with cleft lip and ocular hypotelorism	Anorectal malformation, malrotation, segmental dilatation of the colon, duodenal stenosis.	Ladd's procedure, endorectal pull-through of the transverse colon proximal to the dilated segment, and cut-back anoplasty	Two months postoperatively- the patient had repeated non-bilious emesis. UGI contrast study and UGI endoscopy- duodenal stenosis,	Underwent duodenoduodenostomy at the age of 8 months. Thriving well at 6 years of age.
4	Morikawa et al.	-	Female	Full-term, NVD	2156g	Imperforate anus	Trisomy 21, cleft palate, large patent ductus arteriosus (PDA)	Duodenal atresia with annular pancreas	Duodenoduodenostomy, Ladd's procedure, and colostomy at the level of the ascending colon	PDA ligation on POD 7. PSARP at the age of 6 months followed by colostomy closure with Nissen fundoplication.	Tolerating enteral feeding through the gastrostomy due to swallowing problems. Bowel movements well controlled with daily enema and good continence.
5	Nitta et al.	1 day	Female	Full-term, NVD	3510g	absent anus apparent anal dimple present. No fistula	-	Membranous atresia of the sigmoid colon	Resection of the atretic colon with a double-barreled sigmoid colostomy	-	Perineal anoplasty at 7 months. Colostomy closure with appendicectomy at 9 months of age.
6	Index case	3 days	Female	Pre-term, NVD	1916g	Absent anal opening, developed gluteal folds, anal dimple present, perineal fistula	SGA	Jejunal atresia type IIIb, Malrotation	Ladd's procedure without appendicectomy, end-to-back jejuno-jejunal anastomosis		

ARM (Anorectal Malformation), ECHO (Echocardiography), NVD (Normal Vaginal delivery), PDA (Patent ductus arteriosus) POD (Postoperative day) PSARP (Posterior sagittal anorectoplasty) SGA (Small for gestational age), UGI (Upper Gastrointestinal), USG KUB (Ultrasound Kidney ureter bladder)

Conclusion

In patients with bowel atresia along with anorectal malformation, a high index of suspicion should be kept for associated malrotation of the gut. Despite the presence of three possibly morbid congenital anomalies simultaneously, a good outcome can be achieved with timely intervention.

Conflict of interest

The authors declare no potential conflicts of interest concerning research, authorship, and/or publication of this article.

Ethics approval

Consent for publication was obtained from parents and the case review was approved by the Institute Ethics Committee.

Consent for publication

Written informed consent was obtained from the patient's parents for the publication of this case report and accompanying images.

Competing interests

The authors declare that they have no competing interests.

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LETTER TO THE EDITOR

What is 'Not' Research?

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Dear Editor,

This is in response to the article titled *"ManuScript Rejection sYndrome (MiSeRY): An Author's Nightmare,"* published in Volume 2, Issue 9, 2024 of *NBEJMS* [1]. First of all, I congratulate the authors for addressing such an important and often overlooked issue, particularly in the context of young medical residents who are required to publish or present scientific papers as part of their postgraduate examination requirements. The article is both timely and valuable for the journal's target audience, offering insights that will surely resonate with many aspiring authors trying to cope up with the pressures of academic publishing.

To further build on the points discussed in the aforementioned article [1], burnout has been steadily increasing among doctors, particularly residents, due to a variety of factors that complicate their lives. These include the delayed mean age at which they have steady income compared to their peers. Moreover, the prolonged pursuit of education/training, often spanning 10-15 years, which frequently comes at the expense of a social life and personal well-being adds to their troubles [2]. The repeated rejection of manuscripts by journals or abstracts by scientific committees at conferences can add significant stress, further contributing to burnout among residents and young doctors. This additional pressure exacerbates the already challenging demands of their training and professional development.

Another important question worth discussing is: What is research, and what is the purpose behind it? Research is a systematic inquiry aimed at seeking knowledge, truth, and understanding an issue/problem at hand in a methodical way. The root cause of *ManuScript Rejection sYndrome (MiSeRY)* often extends beyond the decisions of editorial teams/reviewers; it lies in a fundamental misunderstanding of the nature of research and its purpose. Research is inherently iterative, leading to more questions than we begin with, and this

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process instils intellectual humility, allowing us to appreciate the little yet significant aspects of the science we pursue.

Every well-reasoned rejection following peer review provides an opportunity to improve the quality and scientific rigor of our methods, and we should appreciate the reviewers for sharing their valuable insights. The CACHE *(Cool down, Analyse the letter, Consider options and HEad on!)* approach proposed by the authors is a valuable tool for building resilience against rejection. However, plain rejections without any explanation, especially when citing a 'lack of novelty' or 'dearth of space', can be disheartening. To mitigate this, predetermined checklists can help assess the suitability of our work before submission. Many journal management systems now offer, or editorial boards mandate, pre-submission checks, such as the CARE checklist for case reports, which ensures that the work meets essential criteria [3].

In the present scenario, many manuscript rejections (excluding those from predatory journals that publish anything for a fee) occur because researchers are focused on publishing to meet external demands. Medical faculty often aim for publications to secure promotions, while postgraduates pursue them to qualify for exams. This approach, driven by the need to meet these requirements, often results in lower-quality work and a lack of genuine contribution to scientific knowledge. The idea of being a true clinician-scientist is alien to our work culture except in a few reputed institutions in our country.

I have also noticed a clear trend among medical students pursuing the USMLE pathway as International Medical Graduates (IMGs). Many of these students engage in research primarily to bolster their CVs rather than out of a genuine passion for discovery. They often target highly regarded journals to meet residency application requirements and impress selection committees, treating research as merely a stepping stone rather than a true pursuit of knowledge.

Moreover, it is disturbing to see collaborations between individuals who may live thousands of miles apart and have never participated in data collection, lab work or performed genuine statistical analysis. These individuals often become authors simply because they can buy an authorship from a set of people who excel at paraphrasing and utilizing AI tools available on the internet in 'creating manuscripts.' This practice raises questions about the authenticity and integrity of the research being published in journals which has become a launch pad for students to be identified on PubMed.

Similarly, many researchers aim to publish in high-impact, well-indexed journals simply to amass a number of papers, reducing research to a checklist item rather than a meaningful contribution to science. Another concerning trend is the rise of ghost-writing and the infiltration of the publishing industry by external agencies. Researchers, under immense pressure to publish, sometimes turn to ghostwriters or pay for pre-written papers, further diminishing the integrity of the research process. This has created an unholy nexus between academic institutions, industry publishers, and ghost-writing services. Many high-profile journals, despite their reputations, are complicit in this, allowing papers to pass through for the sake of maintaining a steady stream of submissions and revenue.

In recent years, the quality of research in the medical field has noticeably declined, marked by a rise in pseudo-research and copycat projects. Alarmingly, some high school-level work is being misrepresented as legitimate medical research. Many researchers begin with preconceived conclusions and then attempt to manipulate data to support their claims, ultimately compromising the integrity of their work. When such manuscripts land in the hands of an average reviewer, who is understandably frustrated by this toxic trend of self-deception, the decision to reject these submissions appears justified. This approach can help streamline academic publishing by promoting higher standards and encouraging genuine contributions to the field.

Research, at its core, is a means to seek knowledge, advance understanding and serve the larger society with solutions for existing problems, but for some, it has become an end in itself—a tool to achieve external rewards such as promotions, grants, or prestige. This shift has led to a rise in publications driven by the desire for personal gain rather than a genuine pursuit of scientific discovery, eroding the true value and purpose of research.

The existence of predatory publishing houses further exacerbates the problem amidst mushrooming new journals every year. These publishers accept anything for a price, flooding the academic world with low-quality research that may hold little scientific value. They prey on desperate researchers who need publications to advance their careers but lack the means or time to produce quality work. As a result, the scholarly community is saturated with publications that prioritize visibility and profit over substance.

Even systematic reviews and meta-analyses, once regarded as valuable tools for consolidating knowledge, are increasingly being reduced to repetitive exercises by some individuals. Instead of providing new insights, these researchers often recycle existing data to inflate their publication count and enhance their visibility in databases like PubMed. Such practices contribute to intellectual stagnation, where the emphasis shifts from advancing understanding to merely creating a façade of productivity.

When research questions are framed by individuals with sufficient experience in a field, they tend to be relevant to pressing issues. However, when imposters frame illusory pseudo-research questions for doing systematic reviews/meta-analysis, the result is often a collection of useless information that either gathers dust on a desk or remains in the lab without ever translating into practical applications. This disconnect not only undermines the value of research but also hampers genuine progress in the field.

This manuscript rejection syndrome, while frustrating, serves as a valuable reminder to reflect on the true purpose of publishing with each rejection we encounter. I have personally felt the sting of rejection from prestigious journals, which has compelled me to reevaluate my motivations and consider the broader challenges within the publishing industry. It’s clear that sometimes it is the quality of my work that comes under scrutiny, rather than my capabilities as a researcher.

After reading this perspective article on manuscript rejection syndrome, I must admit that this is the first time I have encountered such a comprehensive discussion on this subject. It reinforces my belief that high impact factors and journal

indexation are primarily meant to enhance the visibility of a researcher's high-quality work, rather than being used to merely inflate the profile of an individual researcher.

It has also become a trend for researchers to focus on popular or fashionable topics that are likely to attract global attention, rather than pursuing subjects that hold deeper personal or scientific meaning for them which is another often-unaddressed source for rejection owing to high volume of publication in that arena. This is often done in the pursuit of popularity or recognition, rather than contributing meaningful advancements to their field.

The h-index of authors, journal impact factor, citation scores, journal rankings, grant funding, patents, altmetrics, and recognitions like the *"world's top 2 percent researchers"* list all come with their own advantages and disadvantages in methodology. These shortcomings deserve discussion in medical schools to help students avoid losing sight of what truly matters. While these metrics may indicate a researcher's "price" or perceived net worth, the true value of a researcher lies in their originality, innovation, curiosity for discovery, impact on society or their specific field, integrity and ethical conduct, focus on quality over quantity of publications, adaptability, and mentorship, among other essential qualities.

In addition, with the rise of AI writing tools, the publishing industry is poised to face an influx of AI-generated papers that will require stringent checks for quality and purpose. One of the major challenges in scientific publishing today is balancing the demand for faster publication with the risk of higher error and retraction rates. This rush could potentially lead to an increase in retracted papers.

Recently, I encountered a situation where a reviewer uploaded my manuscript to ChatGPT for evaluation and then simply forwarded the AI-generated response back to me. This raises serious concerns about the review process and the responsible use of AI in academic publishing.

The most puzzling aspect of this whole publishing process is the increasing expectation for researchers to pay for publication (to make it open access), even after spending years toiling over their work. The commercialization of scientific publishing has led to a situation where large groups of industry publishers are dictating what gets published, and by extension, what constitutes valuable science. This growing power dynamic raises the question of whether science is being shaped by researchers or by those who control the gates of publication [4]. I don't want to delve into all the issues that plague research and development industry and intellectual property rights here.

It's important to recognize that significant breakthroughs in research don't happen overnight. Scientific progress is often incremental and rarely phenomenal, with each generation building on the work of those before them. Many researchers contribute valuable insights and advancements, yet their efforts often go unnoticed, overshadowed by those seeking credit or attention. True progress in science involves passing the torch to the next generation, knowing that even small contributions play a crucial role in the larger journey of scientific discovery.

In conclusion, I believe it is essential to emphasize the true purpose of research to residents, particularly by exploring how significant breakthroughs in

their respective fields have occurred. Understanding the current trends and approaches to tackling existing problems is crucial. Residents should be encouraged to choose challenging dissertation topics rather than simply repeating or redoing their seniors' work. This shift will serve as a vital first step in grasping what true research entails. I believe this is precisely why dissertation work has been integrated into postgraduate training.

Conflicts of interest

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

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