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has extended
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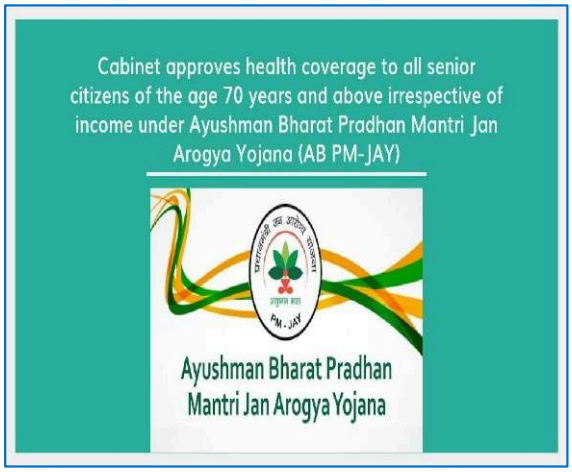
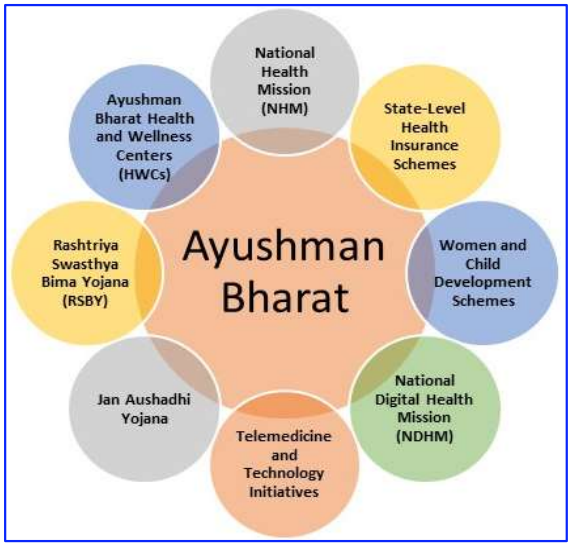
irrespective of income under the flagship scheme
Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY)





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EDITORIAL

Ayushman Bharat: The Pradhan Mantri Jan Arogya Yojana (PM-JAY)

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World Health Organization (WHO) lists the qualities of a good healthcare system [1]:

- **Safe and effective:** The care that is delivered takes into account individuals' unique needs, preferences, and values.
- **Timely:** Wait times have been minimized to avoid potentially harmful delays in care.
- **Equitable:** All residents and citizens are able to access the care they need.
- **Integrated:** The full range of healthcare services are available throughout a person's life.
- **Efficient:** Benefits have been maximized and waste has been minimized.

Ayushman Bharat
https://dashboard.abdm.gov.in/abdm/

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Launched on September 23, 2018 Ayushman Bharat, popularly referred to as, MODICARE, is a transformative healthcare initiative launched by the Government of India with the aim to provide universal health coverage (UHC) and meet the targets set by the Sustainable Development Goals (SDGs). It was launched in alignment with the recommendations of the National Health Policy 2017 and focuses on ensuring that no one is left behind when it comes to accessing healthcare services [2].

The scheme marks a shift from a fragmented, sectoral approach to healthcare delivery towards a more comprehensive, need-based system. It aims to address healthcare holistically, covering key aspects like prevention, promotion, and ambulatory care. This comprehensive approach operates at three levels: primary, secondary, and tertiary care. It integrates preventive, promotive, and curative healthcare services through two key components (Figure 1):

Figure 1. WHO – Qualities of a good healthcare system

Health and Wellness Centres (HWCs)

- Announced in February 2018, aiming to transform 1,50,000 Sub Centres and Primary Health Centres into Comprehensive Primary Health Care (CPHC) hubs.
- Focuses on maternal and child health, non-communicable diseases, free essential drugs, and diagnostic services.
- Promotes health awareness and disease prevention at the community level.

Pradhan Mantri Jan Arogya Yojana (PM-JAY)

- Launched on September 23, 2018, in Ranchi, Jharkhand, as the world's largest health assurance scheme.
- Provides ₹5 lakh health coverage per family per year for secondary and tertiary care hospitalization to over 12 crore poor and vulnerable families (~55 crore beneficiaries).
- Cashless and paperless treatment across public and private empanelled hospitals in India.
- Covers pre-hospitalization (3 days), post-hospitalization (15 days), diagnostics, medicines, surgeries, ICU, and medical implants.
- No family size, age, or gender restrictions; pre-existing conditions covered from day one.
- Replaced the Rashtriya Swasthya Bima Yojana (RSBY) of 2008, ensuring wider and more inclusive coverage.

As of March 30, 2025, Ayushman Bharat continues to bridge healthcare gaps, reducing out-of-pocket medical expenses and enhancing accessibility for India's underserved populations.

Health and Wellness Centres (HWCs)

In February 2018, the Government of India announced the establishment of 1,50,000 HWCs across the country by transforming existing Sub Centres and Primary Health Centres (PHCs). The goal is to provide Comprehensive Primary Health Care (CPHC) and make healthcare more accessible by bringing services closer to the communities. These centres aim to deliver a range of essential services, which include both maternal and child health services and the management of non-communicable diseases (NCDs). Additionally, HWCs offer free essential drugs and diagnostic services to ensure that the communities receive comprehensive care at minimal or no cost.

These centres are designed to serve as hubs for primary healthcare services, focusing not only on treatment but also on prevention and health promotion. The HWCs aim to cater to the primary health needs of the entire population within their respective areas, thereby enhancing access, universality, and equity in healthcare.

The core emphasis of HWCs is on health promotion and prevention, aiming to improve the overall health of individuals by encouraging healthier behaviors and choices. These centres actively engage with and empower communities to make informed decisions that reduce the risks of chronic diseases, such as diabetes, hypertension, and cardiovascular conditions. This initiative is part of the larger effort to reduce morbidity and improve the overall health status of the population. By focusing on prevention and promoting healthy lifestyles, HWCs seek to reduce the burden of chronic diseases and help communities maintain long-term well-being.

Pradhan Mantri Jan Arogya Yojana (PM-JAY)

The PM-JAY, a key component of Ayushman Bharat, was launched by the Hon'ble Prime Minister of India, Shri Narendra Modi, on 23rd September 2018 in Ranchi, Jharkhand. This scheme is designed to provide financial protection against catastrophic health expenses to vulnerable and low-income families in India.

PM-JAY is the world's largest health assurance scheme, targeting over 12 crore poor and vulnerable families, which amounts to approximately 55 crore beneficiaries—about 40% of India's population. The scheme provides a health cover of Rs. 5 lakh per family per year for secondary and tertiary care hospitalization. It specifically targets the economically disadvantaged, and the families covered under PM-JAY are identified based on the deprivation and occupational criteria from the Socio-Economic Caste Census (SECC) 2011. The criteria help determine eligibility for rural and urban households.

Before it was renamed as PM-JAY, this scheme was known as the National Health Protection Scheme (NHPS) and it subsumed the earlier Rashtriya Swasthya Bima Yojana (RSBY) launched in 2008. The scope of PM-JAY also extends to include families that were covered under RSBY but were not present in the SECC 2011 database.

One of the most notable features of PM-JAY is that it is fully funded by the Government of India, with the cost of implementation being shared between the Central and State Governments. This ensures that the financial burden of healthcare is alleviated for the economically weaker sections of society,

enabling them to access high-quality medical treatment for severe illnesses and conditions.

The challenge of caring for a billion

- India is the second most populous country in the world.
- The death rate has declined & birth rates continue to be high in most of the states.
- Health care structure in the country is constantly being upgraded to address the needs of an increasing population.

Burden of Disease in the New Millennium: A Twin Challenge

India faces a dual burden of disease, with continuing and emerging infectious diseases alongside a rising prevalence of chronic degenerative conditions. Addressing infectious diseases demands stronger public health programs, while the growing incidence of non-communicable diseases (NCDs)—driven by increasing life expectancy—necessitates robust healthcare infrastructure. Human development indicators such as longevity, literacy, and GDP per capita play a crucial role in shaping health outcomes, as longer life expectancy is closely linked to income and education levels.

With a rapidly expanding population of 1.4 billion, India's demographic structure presents unique challenges: 25.5% of the population is under 14 years, 34% falls within the 15–35 age group, and the elderly (65+ years) have increased from 3.8% in 1990 to 6.6% in 2021. This demographic transition underscores the urgent need for comprehensive healthcare strategies to manage both communicable and non-communicable diseases while ensuring sustainable human development [3] (Figure 2).

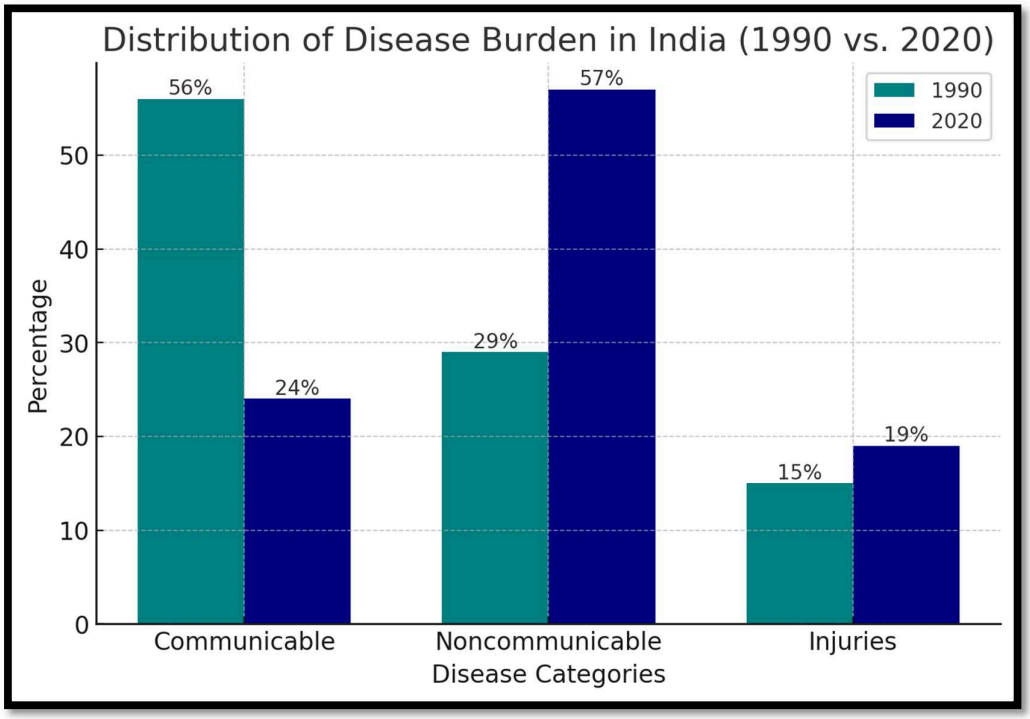

Figure 2. Shift in the disease burden in India between 1990 and 2020, highlighting the increase in noncommunicable diseases (NCDs) and the decline in communicable diseases.

Over 4.5 crore families to be benefitted

The Union Cabinet, chaired by Prime Minister Shri Narendra Modi, has extended health coverage for all senior citizens aged 70 years and above, irrespective of income, under the flagship scheme Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB PM-JAY).

This aims to benefit approximately 4.5 Crore families with six (6) crore senior citizens with 5 Lakh rupees free health insurance cover on a family basis. With this approval, all senior citizens of the age 70 years and above irrespective of their socio-economic status would be eligible to avail the benefits of AB PM-JAY. The eligible senior citizens would be issued a new distinct card under AB PM-JAY [4].

The senior citizens of the age 70 years and above belonging to families already covered under AB PM-JAY will get an additional top-up cover upto ₹5 lakh per year for themselves (which they do not have to share with the other members of the family who are below the age of 70 years). All other senior citizens of the age 70 years and above will get a cover upto ₹5 lakh per year on a family basis. Senior citizens of the age 70 years and above who are already availing benefits of other public health insurance schemes such as Central Government Health Scheme (CGHS), Ex-Servicemen Contributory Health Scheme (ECHS), Ayushman Central Armed Police Force (CAPF) may either choose their existing scheme or opt for AB PMJAY. It has been clarified that senior citizens of 70 years and above who are under private health insurance policies or Employees' State Insurance scheme will be eligible to avail benefits under AB PM-JAY [5] (Figure 3).

Figure 3. Pradhan Mantri Jan Arogya Yojana (Logo)

AB PM-JAY is the world's largest publicly funded health assurance scheme which provides health cover of Rs. 5 lakh per family per year for secondary and tertiary care hospitalization to 55 crore individuals corresponding to 12.34 crore

families. All members of the eligible families irrespective of age are covered under the scheme. The scheme has covered 7.37 Crore hospital admissions including 49 percent women beneficiaries. The public has benefited to the extent of over Rs. 1 Lakh crore under the scheme.

The expansion of cover to senior citizens of the age of 70 years and above was earlier announced by Hon'ble Prime Minister Shri Narendra Modi in April 2024.

The AB PM-JAY scheme has witnessed continuous expansion of the beneficiary base. Initially, 10.74 crore poor and vulnerable families comprising the bottom 40% of India's population were covered under the scheme. Later, the Government of India, in January 2022 revised the beneficiary base under AB PM-JAY from 10.74 crore to 12 crore families considering India's decadal population growth of 11.7 % over 2011 population. The scheme was further expanded to cover 37 lakh ASHAs/AWWs/AWHs working across the country and their families for free healthcare benefits.

Taking the mission ahead, AB PM-JAY would now provide free healthcare coverage of Rs 5 lakh to all citizens of the age-group of 70 years and above across the country.

Ayushman Bharat – A Flagship Initiative by the Government of India

Ayushman Bharat was launched with the vision of UHC as recommended by the National Health Policy 2017. It aims to address the healthcare needs of the entire population through two key components: HWCs and PM-JAY (Figure 4).

Figure 4. Five-Levels Step Ladder to Achieve Universal Health Coverage

Health and Wellness Centres (HWCs)

Announced in 2018, the initiative aims to transform 1,50,000 Sub Centres and Primary Health Centres into HWCs to provide Comprehensive Primary Health Care (CPHC) closer to people's homes. These centres offer maternal and child health services, non-communicable disease (NCD) management, and free essential drugs and diagnostic services. The focus is

on health promotion and disease prevention, encouraging individuals to adopt healthy behaviors to reduce the risk of chronic illnesses.

Pradhan Mantri Jan Arogya Yojana (PM-JAY)

PM-JAY, the world's largest health assurance scheme, provides ₹5 lakh annual health coverage per family for secondary and tertiary hospitalization to over 12 crore poor and vulnerable families (~55 crore beneficiaries). It aims to reduce the financial burden of catastrophic medical expenses and ensure access to quality healthcare services. Beneficiary households are identified based on deprivation and occupational criteria from the Socio-Economic Caste Census (SECC) 2011 for both rural and urban areas [6,7] (Figure 5).

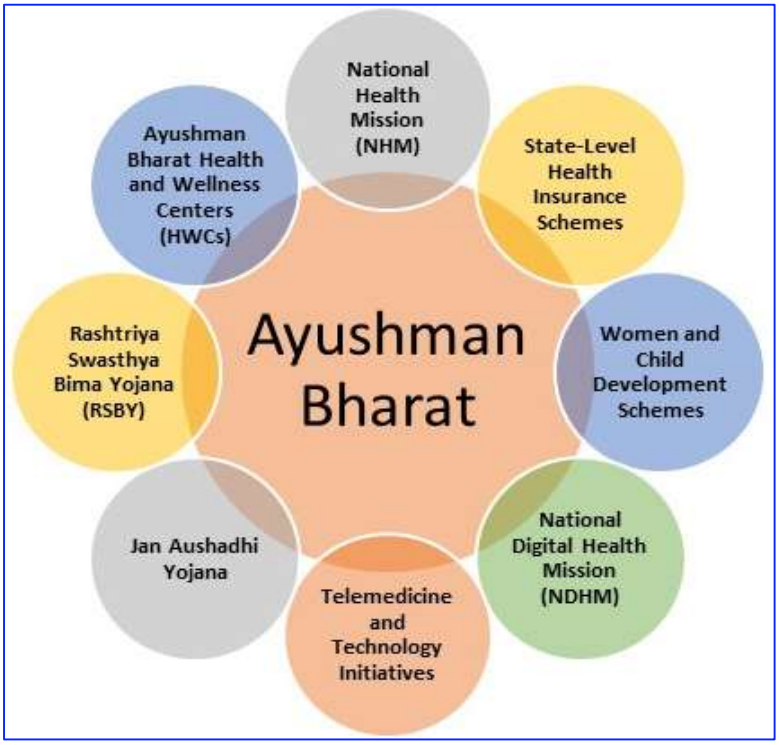

Figure 5. Key-features of PM-JAY

Ayushman Bharat – The India Context

Ayushman Bharat has been instrumental in expanding health insurance coverage to over 50 crore people, ensuring greater healthcare access for the economically disadvantaged.

PM-JAY: Bridging Healthcare Gaps and Enhancing Well-being

The PM-JAY plays a crucial role in reducing healthcare disparities, improving health outcomes, and enhancing the overall well-being of the population. By providing financial protection against catastrophic health expenses, PM-JAY ensures that economically vulnerable families have access to quality healthcare without facing financial hardship. The scheme has contributed significantly to increasing public health insurance coverage, reducing inequality in healthcare access, and improving early disease detection and treatment.

The Indian Context: Rationale for Ayushman Bharat

India, classified as a Lower Middle-Income Country (LMIC), faces inconsistent socio-economic and health indicators that impact healthcare accessibility. The private sector dominates healthcare services, accounting for nearly 70% of all visits and holding 50% of total hospital beds. This heavy reliance on private healthcare leads to high out-of-pocket (OOP) expenses, pushing many households into financial distress. Addressing these challenges, Ayushman Bharat was introduced to provide comprehensive health coverage and ensure equitable access to medical services for all citizens [6,7].

Foundation and Necessities of Ayushman Bharat

The National Health Policy (NHP) 2017 laid the foundation for Ayushman Bharat, responding to critical healthcare challenges. The initiative aims to tackle changing health priorities, such as the rising burden of non-communicable diseases, and catastrophic health expenditures that push millions into poverty. Additionally, the emergence of a robust healthcare industry and enhanced fiscal capacity have enabled the government to expand healthcare coverage and infrastructure, ensuring quality medical care for all sections of society [8].

Increased Government Expenditure on Healthcare

The Indian government has significantly increased its investment in healthcare, reflecting its commitment to strengthening the public health system. Government healthcare expenditure grew by 137% year-on-year, rising from ₹94,452 crore in 2020-21 to ₹2,23,846 crore in 2021-22. This substantial increase underscores the focus on improving healthcare accessibility, affordability, and infrastructure across the country, aligning with the goals of Ayushman Bharat to provide UHC [9].

PM-JAY: A Standalone Program with Integrated Support

While PM-JAY operates as an independent initiative, it is complemented by various national and state-level healthcare schemes that align with its objectives. These schemes, each with distinct eligibility criteria and objectives, play a crucial role in strengthening healthcare services. Effective coordination and integration of these initiatives ensure seamless healthcare delivery across India. However, their implementation varies across states, allowing flexibility to cater to local healthcare needs [10].

Key Features and Benefits of PM-JAY

PM-JAY provides cashless healthcare services, ensuring beneficiaries receive free medical treatment at empaneled hospitals. The scheme is designed to mitigate catastrophic health expenditures, which push nearly six crore Indians into poverty annually. It covers up to three days of pre-hospitalization and 15 days of post-hospitalization expenses, including diagnostics and medications. With no restrictions on family size, age, or gender, PM-JAY offers comprehensive coverage from day one, ensuring pre-existing conditions are covered.

The scheme is portable across India, enabling beneficiaries to access cashless treatment at empaneled facilities nationwide. It includes 1,393 medical procedures, covering expenses such as

drugs, supplies, diagnostic services, physician fees, room charges, surgery costs, ICU fees, and other hospital services. Additionally, public hospitals receive reimbursements on par with private facilities, strengthening public healthcare infrastructure [9,10].

Scope of Benefits Under PM-JAY

PM-JAY covers a wide range of medical and healthcare services, including medical examinations, treatment, consultations, and hospitalization. It also provides free medicines, medical consumables, non-intensive and intensive care services, diagnostic and laboratory investigations, and medical implantation services where necessary. Beneficiaries receive accommodation benefits, food services, and post-hospitalization follow-up care for up to 15 days, ensuring comprehensive healthcare support [8-11].

PM-JAY Beneficiaries: Rural and Urban Coverage

India's rural population (909.38 million) and urban population (438.18 million) experience varying levels of healthcare access. Rural areas face challenges such as limited access, longer travel times, healthcare disparities, and inadequate preventive care. To address these issues, PM-JAY prioritizes rural beneficiaries based on socio-economic vulnerability, covering:

Rural Beneficiaries-PMJAY- Coverage

- Households with only one room made of kucha materials
- Households with no adult members aged 16 to 59
- Families without an adult male in the 16-59 age group
- Households with disabled members and no able-bodied adult
- SC/ST households
- Landless households reliant on manual labor for income

In urban areas, PM-JAY benefits are extended to workers in the unorganized sector, including:

- Ragpickers, beggars, and domestic workers
- Street vendors, cobblers, hawkers, and other service providers
- Construction workers, plumbers, masons, painters, welders, security guards, and coolies
- Sanitation workers, sweepers, and gardeners
- Handicraft workers, tailors, artisans, and home-based workers
- Drivers, transport workers, rickshaw pullers, and cart pullers
- Shop assistants, waiters, peons, and delivery helpers
- Electricians, mechanics, repair workers, washermen, and watchmen

Standardized Health Assurance and National Portability

PM-JAY ensures a uniform health assurance system and national portability of healthcare services, allowing beneficiaries to access treatment anywhere in the country without financial barriers.

Ayushman Bharat Card (ABC) vs. Ayushman Bharat Health Account (ABHA)

PM-JAY beneficiaries receive an Ayushman Bharat Card (ABC), which grants them access to free healthcare services at empaneled public and private hospitals nationwide. The Government of

India fully subsidizes the scheme, ensuring that eligible families receive cashless treatment.

In contrast, the Ayushman Bharat Health Account (ABHA), introduced under the Ayushman Bharat Digital Mission (ABDM) in September 2021, is available to all citizens, regardless of their income. ABHA assigns a unique 14-digit healthcare identification number, enabling individuals to store and manage medical records, treatment history, diagnostics, and prescriptions digitally on a centralized platform. This seamless digital system enhances healthcare accessibility and efficiency.

PM-JAY Financing and State-Level Flexibility

PM-JAY is fully funded by the government, with costs shared between the Central and State Governments in a 60:40 ratio. States have flexibility in:

- Implementation models
- Utilization of beneficiary data
- Co-branding and expanding coverage
- Increasing benefit amounts and revising treatment packages
- Reserving healthcare packages for public hospitals
- Managing IT systems and hospital reimbursements
- Implementing PM-JAY at the Ground Level

Successful implementation of PM-JAY involves three key components

- **Hospital Empanelment** – Ensuring a wide network of public and private hospitals provide cashless treatment.
- **Patient-Level Processes** – Streamlining beneficiary identification, treatment authorization, and claim settlements.
- **IT-Enabled Back-End Systems** – Digital tools to manage patient records, hospital claims, and real-time tracking of healthcare services.

Integration of digital solutions, strengthening hospital networks, and improving beneficiary identification, PM-JAY continues to enhance healthcare accessibility, affordability, and quality for millions across India (Figures 6 and 7).

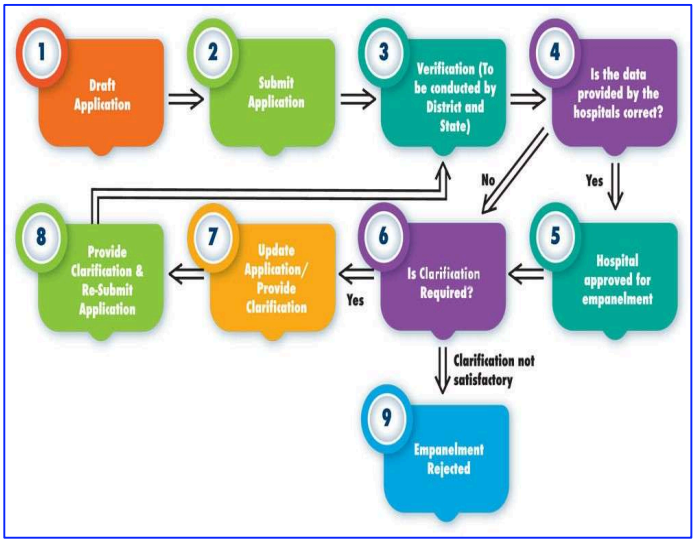

Figure 6. Hospital Empanelment - well-structured process

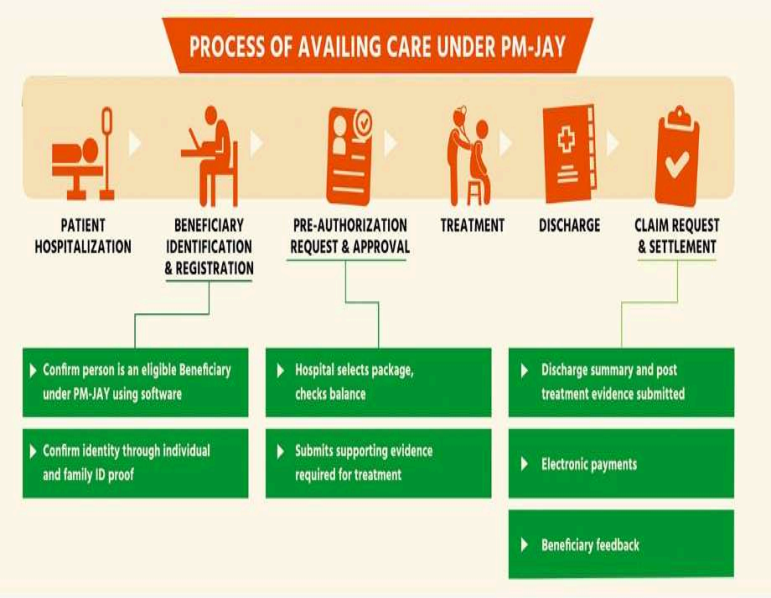

Figure 7. Patient Level Process of availing care – well-structured process

PM-JAY Awareness and Outreach

PM-JAY is an entitlement-based healthcare scheme, meaning beneficiaries do not need to undergo an advance enrolment process to access its benefits. To promote awareness, **"Ayushman Bharat Diwas"** is observed, reinforcing the initiative's impact and reach. To ensure eligible families are well-informed, ASHA workers, ANMs, and Gram Sevaks conduct entitlement checks in approximately three lakh villages across India. Awareness is further enhanced through official communication methods, including PM letters, family cards, and unique family IDs. Additionally, the government provides a dedicated online portal (www.pmjay.gov.in) to facilitate easy access to scheme-related information and services (Figures 8 and 9).

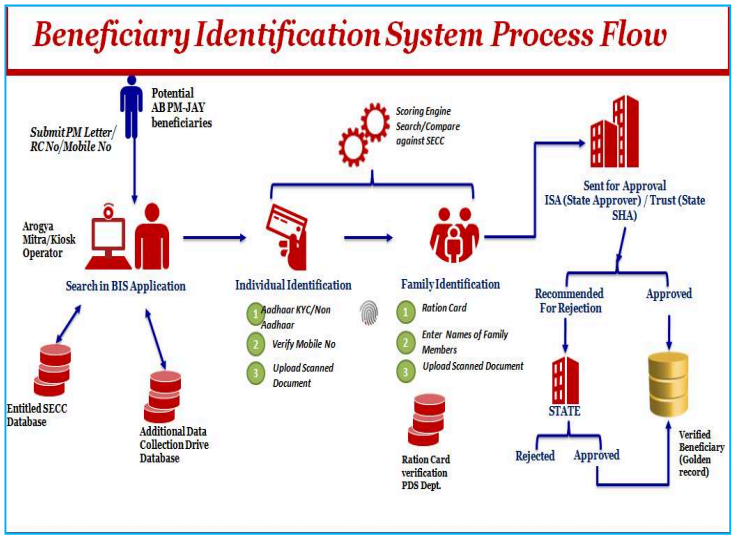

Figure 8. Beneficiary identification system: process flow

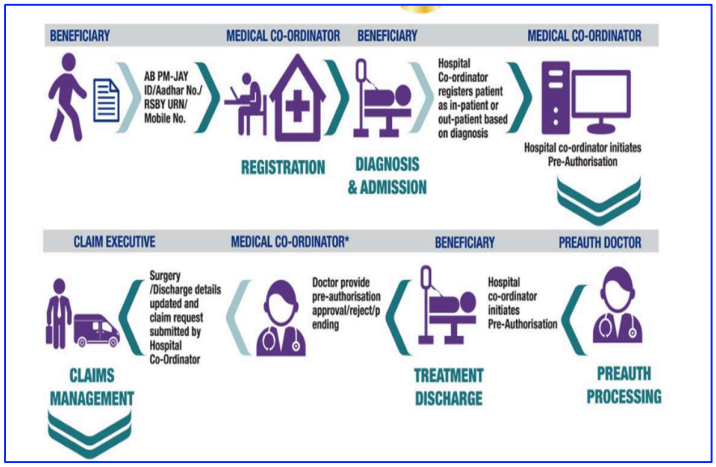

Figure 9. PMJAY- IT System - well-structured process

PM-JAY Support Systems

To sustain and strengthen PM-JAY, a robust support system has been established, focusing on capacity development, monitoring and evaluation, fraud prevention, and grievance redressal.

Capacity Development

PM-JAY emphasizes institutional capacity building, ensuring that healthcare providers and administrative systems are well-equipped to manage the program effectively. This involves:

- Establishing sustainable institutional structures for long-term impact.
- Enhancing human resource capabilities through training and skill development.
- Implementing knowledge management strategies and using appropriate tools to sustain expertise and efficiency.

Monitoring and Evaluation

A strong monitoring and evaluation framework ensures transparency and efficiency in PM-JAY operations. Important components include:

- Transaction management for smooth claims processing.
- Provider management to oversee empaneled hospitals.
- Support function management, covering capacity development, grievance redressal, fraud prevention, and call center operations.
- Fraud Prevention and Control

To maintain the integrity of PM-JAY, fraud detection and prevention mechanisms operate at both policy and operational levels. A National Anti-Fraud Unit oversees:

- Fraud detection, control, and policy implementation at a systemic level.
- Operational fraud prevention through IT-based monitoring and audits.
- A grievance redressal system that provides a structured approach for beneficiaries to report issues.
- A dedicated call center, offering assistance for queries, complaints, and support services.

India's SaaS Market Growth

India's Software-as-a-Service (SaaS) market is experiencing rapid growth, solidifying its position as a global leader in cloud-based solutions. By 2030,

the SaaS market in India is projected to reach $50 billion in annual recurring revenue (ARR), nearly quadrupling its current size. This exponential growth is driven by rising digital adoption, increased cloud computing investments, and the global shift toward subscription-based software solutions.

Ongoing Developments in Healthcare

Primordial and Primary Prevention

Primordial and primary prevention are essential strategies for promoting health, but they function at different levels. Primordial prevention focuses on addressing the root causes of health problems by improving social, economic, and environmental determinants. It aims to prevent the emergence of risk factors by fostering healthy behaviors early in life and creating supportive environments. This proactive approach not only reduces the burden on healthcare systems but also enhances the overall well-being of individuals and communities [12-14].

On the other hand, primary prevention targets individuals already exposed to risk factors and seeks to prevent the onset of diseases by managing those risks. Important interventions include:

- Vaccination programs to prevent infectious diseases.
- Preventive measures for long-term conditions, such as the use of statins to lower heart disease risk.
- Lifestyle modifications, including promoting healthy diets and physical activity.
- Health education to empower individuals to make informed choices.

While primordial prevention works at the upstream level, reducing the likelihood of risk factors developing, primary prevention operates downstream, managing existing risks before they lead to disease.

The Growing Burden of Noncommunicable Diseases (NCDs) and Mental Health

Noncommunicable diseases (NCDs), including cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases, are the leading cause of death globally, accounting for 74% of all deaths. Each year, over 15 million people die prematurely due to NCDs, with 85% of these deaths occurring in low- and middle-income countries. Despite global efforts, only 6% of countries are currently on track to meet Sustainable Development Goal (SDG) target 3.4, which aims to reduce NCD-related mortality.

Mental health conditions are increasingly recognized as a crucial component of NCD prevention and control. Mental disorders such as anxiety, depression, and psychosis are linked to other major NCDs, including cancer, diabetes, cardiovascular, and respiratory diseases. The impact of mental health on physical health is significant, affecting treatment adherence, disease progression, and overall health outcomes.

The Impact of Communicable Diseases

Communicable diseases remain a major public health challenge, particularly in low-income countries and marginalized populations. Diseases such as HIV/AIDS, tuberculosis (TB), malaria, viral hepatitis, and neglected tropical diseases (NTDs)

continue to cause high mortality and morbidity:

- HIV/AIDS has claimed 36.3 million lives globally.
- Tuberculosis remains the second deadliest infectious disease, causing 1.5 million deaths annually.
- Malaria disproportionately affects children under five, accounting for 77% of malaria-related deaths in 2020.
- More than 1 billion people received treatment for at least one NTD in 2020.

The **COVID-19** pandemic has further reversed progress in the fight against communicable diseases, disrupting healthcare services and increasing mortality rates. Recognizing the burden of these diseases, the SDGs include specific targets to end epidemics of AIDS, TB, malaria, and NTDs, while also addressing hepatitis and other infectious diseases [12].

The Connection Between NCDs and Mental Health

Both NCDs and mental health disorders contribute significantly to the global healthcare burden and often occur together [13-20]. Research highlights strong bidirectional links between mental illness and NCDs:

- Poor mental health exacerbates modifiable risk factors for NCDs, such as unhealthy diets, physical inactivity, tobacco use, and alcohol consumption.
- Mental illness increases the risk of developing NCDs, while NCDs can worsen mental health conditions.
- Depression and alcohol use disorders influence the onset, management, and progression of chronic diseases.
- Patients with major physical illnesses, such as hypertension (29%), myocardial infarction (22%), diabetes (27%), and cancer (33%), have a higher prevalence of major depression.
- Patients with psychotic disorders have a life expectancy two decades shorter than the general population due to coexisting cardiovascular diseases, diabetes, and metabolic complications caused by antipsychotic medications.

Integrating Mental Health into the NCD Care Agenda

Despite growing evidence linking mental health and NCDs, mental health care is often excluded from NCD management strategies. This lack of integration leads to higher healthcare costs and poorer health outcomes. In the U.S., conditions such as heart disease, trauma-related disorders, cancer, asthma, and mental disorders were among the costliest healthcare expenses between 1996 and 2006, with mental health expenditures seeing the highest increase.

If mental health care is not systematically included in NCD prevention and treatment programs, existing NCD initiatives will be less effective and more expensive. The World Economic Forum estimates that NCDs, including mental disorders, will cause a global economic loss of $47 trillion over the next two decades. While high-income countries currently bear most of the economic burden, low- and middle-income countries will face increasing costs as their populations grow [16].

The Collaborative Care Model: An Integrated Approach

To address the growing burden of NCDs and mental health disorders,

healthcare systems must adopt new organizational and clinical approaches [17]. The Collaborative Care Model is emerging as a promising solution that integrates mental health services into primary healthcare.

Important aspects of this model include:

- Task-sharing among healthcare providers, with specialists supporting primary care physicians and community health workers.
- Routine screening for mental health conditions in NCD patients.
- Education and self-management programs to empower patients.
- Evidence-based pharmacological and psychosocial treatments tailored to individual needs.
- Long-term follow-up and monitoring to ensure adherence and improved outcomes.

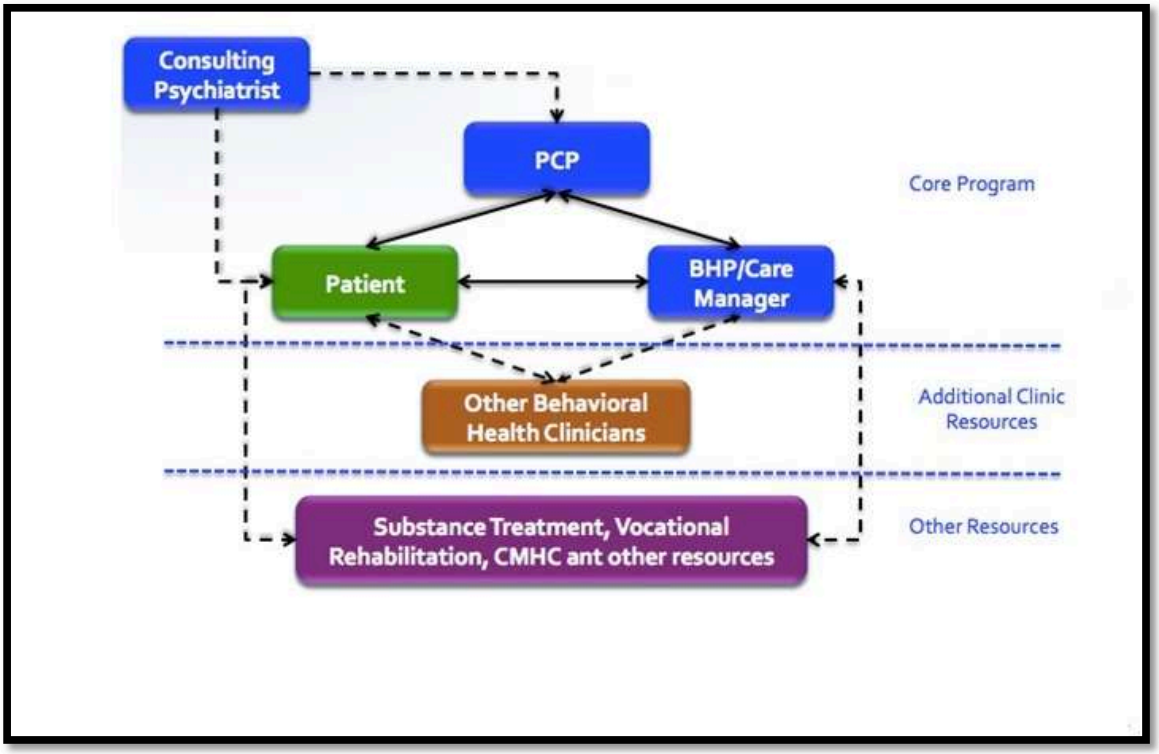

Figure 10. Collaborative care model. [17]

Collaborative care has proven highly effective for managing single conditions, such as depression in primary care settings, and is increasingly being used to treat comorbid depression in patients with cancer, diabetes, and hypertension. By integrating NCD and mental health care, this approach not only strengthens healthcare systems but also improves patient outcomes and reduces costs.

The interconnected nature of NCDs, mental health disorders, and communicable diseases calls for comprehensive, integrated healthcare strategies. Strengthening primordial and primary prevention, addressing mental health within the non-communicable disease (NCD) framework, and implementing collaborative care models are crucial steps in achieving better

health outcomes and economic sustainability worldwide.

Conclusion

In conclusion, India's Ayushman Bharat initiative has made commendable progress in advancing universal health coverage (UHC) by enhancing access to healthcare across both urban and rural areas. Through a proactive strategy, Ayushman Bharat addresses the disparities in healthcare availability, access, and quality, particularly in underserved rural regions. The program has had an immediate and profound impact, improved healthcare access and offering financial protection, while also driving healthcare infrastructure development. The scheme has not only demonstrated its effectiveness in enhancing healthcare equity but also proved invaluable during the COVID-19 pandemic by safeguarding millions of individuals with financial coverage.

Despite its success, India continues to face several ongoing challenges in healthcare. As the most populous country in the world, India grapples with a rapidly increasing population, with high birth rates and a declining death rate in most states. The healthcare system is continuously being upgraded to meet the demands of this growing population. To address these challenges, a multifaceted has been adopted by the Government of India, including a stronger focus on prevention and early diagnosis, linking Ayushman Bharat with regional healthcare schemes, and expanding public awareness campaigns to ensure that the intended beneficiaries make full use of the services [21].

The burden of disease in the new millennium presents a **twin epidemic:** a) continuing or emerging infectious diseases, which require ramped-up public health programs, and b) chronic degenerative diseases, driven by demographic transitions and increased life expectancy, necessitating improvements in health infrastructure.

Additionally, key human development indicators such as longevity, literacy, and GDP per capita reflect the complex challenges posed by India's rapidly growing population, which currently stands at 1.46 billion, with 25% of children under 14 years of age and a 7.2%- over 65 years of age- ever growing elderly population.

The complexity of the interconnected health issues—non-communicable diseases (NCDs), mental health disorders, and communicable diseases—necessitates a more comprehensive and integrated approach to healthcare.

Strengthening **primordial and primary prevention**, integrating mental health into the NCD framework, and implementing collaborative care models will be key to achieving long-term health improvements and ensuring economic sustainability.

By addressing these challenges directly and refining its approach, Ayushman Bharat has the potential to fulfil its mission of providing equitable and cost-effective healthcare services to all, making significant contributions toward achieving UHC and supporting the broader objectives of the Sustainable Development Goals.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

Laparoscopic Cholecystectomy Under Regional Anaesthesia (Thoracic Spinal): Is It Feasible?

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Abstract

Introduction: Laparoscopic cholecystectomy is classically done under General Anaesthesia as a gold standard. But in this era where regional anaesthesia is gaining more prominence, we wondered about the safety and efficacy of regional anaesthesia for doing Laparoscopic Cholecystectomy. It is considered to have an advantage over General Anaesthesia (GA), especially in cases where a higher risk of morbidity due to GA is present. It also provides excellent pain relief postoperatively, reducing the usage of opioid analgesics and shortening duration of stay. **Aims:** To evaluate the safety and efficacy of Thoracic Spinal Anaesthesia in Laparoscopic Cholecystectomy through a Surgeon Satisfaction Score (SSS), intra op monitoring and post operative care. **Methods and Materials:** 45 cases of Chronic Calculous Cholecystitis belonging to ASA Grade I and II, without any comorbidities underwent Laparoscopic cholecystectomy under Thoracic spinal anaesthesia in Tezpur Medical College and Hospital, a tertiary care center. After the surgery, a Surgeon Satisfaction Score was calculated with following parameters - I) Absence of conversion to GA II) Absence of intra operative movements III) Abdominal relaxation during the surgery IV) Absence of Post operative complications after surgery and V) Timely discharge from hospital using 5-point Likert's scale. Likewise, intra op and post op vitals were monitored and analysed. **Results:** Thoracic Spinal anaesthesia was found to be adequate for surgery in all but one patient. Intraoperatively, two patients who experienced right shoulder pain received Inj Ketamine 25 mg and Inj Midazolam 1 mg. Two patients were given Mephenteramine 6 mg for hypotension. One patient was given Inj Atropine 0.6 mg for Bradycardia. Surgeon Satisfaction Score was Excellent for most patients. One patient was converted to General Anaesthesia. Postoperatively, three patient required antiemetic for nausea and vomiting. Two patients suffered urinary retention. 42 patients were discharged within 24 hours of surgery. **Conclusion:** Laparoscopic Cholecystectomy is feasible under Thoracic Spinal Anaesthesia with excellent Surgeon Satisfaction and minimal post operative complications for healthy patients and minimizes post operative hospital stay.

Keywords: Laparoscopic Cholecystectomy, Regional Anaesthesia, Thoracic Spinal Anaesthesia, Satisfaction Score

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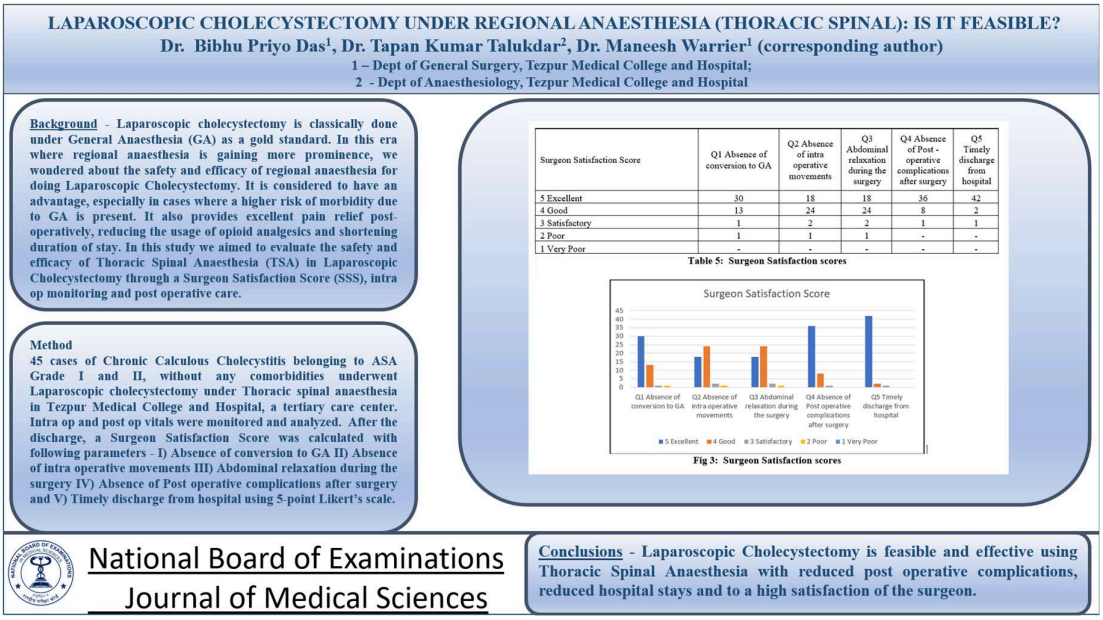
Graphical Abstract



Introduction

Laparoscopic Cholecystectomy is the gold standard surgical treatment for a case of gallstone disease. With the rise of Regional Anaesthesia, which involves blockade of central neuroaxis and/or peripheral nerve plexuses, it is now possible to achieve anaesthesia adequately without impairing the consciousness of the patient, allowing earlier recovery and discharge from hospital. However, even with the advent of newer methods of anaesthesia, Laparoscopic Cholecystectomies are still carried out under General Anaesthesia (GA) globally.

The aim of this study is to evaluate the safety and efficacy of Thoracic Spinal Anaesthesia (TSA) in Laparoscopic Cholecystectomy, through a Surgeon Satisfaction Score (SSS), intra op vitals monitoring and post operative care.

Materials and Methods

The study was approved by Ethical Committee of Tezpur Medical College and Hospital. Informed consent was taken from all participants of this study after detailed explanation of the procedure, its risks and benefits, and requirement of conversion to GA if needed. Inclusion criteria for this study were patients who were planned for elective Laparoscopic Cholecystectomy, aged between 18 years and 60 years, whose BMI were in between 18.5 and 23 and with ASA Grade I and II, with no co-morbidities. Exclusion criteria for the study were cases with Choledocholithiasis, Ca Gall bladder, Gall bladder perforations and Gall stones in pregnancy, ASA grading above II, spinal deformity, coagulopathies, allergy to local anaesthetics and those who refused consent for Thoracic Spinal Anaesthesia for Laparoscopic Cholecystectomy.

After detailed and thorough Pre-Anaesthetic check-ups, 45 patients were then taken up for surgery. The patients were premedicated with Intravenous Pantoprazole 40 mg and Ondansetron 4 mg, multi-parameter monitor connected and preoperative baseline heart rate, blood

pressure, MAP, ECG and SPO2 were recorded. The patients were placed in sitting position. Under aseptic precautions, sub-arachnoid space puncture was done at T9-T10 or T10-T11 level. 2 ml of isobaric levobupivacaine 0.5% with fentanyl 25 microgram was injected and patients were then made to lie in supine position. The sensory level was assessed with pin prick sensation and motor block was assessed with modified Bromage score. The vitals were recorded every 5 min till the completion of surgery. The procedure was started only when the minimum block extent included the T4 to L2 dermatomes evaluated by pinprick. Laparoscopic Cholecystectomy was performed as a standard four port technique.

Intra-operatively, all patients were co-loaded with 500ml of isotonic fluid. Oxygen supplementation was given through Hudson face mask with 6 litres of oxygen per minute. All patients were sedated with Inj Midazolam 1mg. Inj. Ketamine 25 mg was given if patient complained of shoulder tip pain. Hypotension (20% fall from baseline), was managed with Inj. Mephenteramine 6 mg and IV fluids bolus. Bradycardia (<50/min) was managed by Inj. Atropine 0.6mg. In postoperative period, sensory and motor function of upper and lower limb were assessed to rule out any neurological deficit.

Postoperative pain was assessed regularly using a visual analog scale (VAS) from 0 to 10, with 10 being most severe, for 24 hours. Intramuscular Diclofenac 75mg, a NSAID was used as analgesic if the VAS > 4 and supplemented with Inf. Paracetamol 1000 mg, if necessary. Patients were followed up and discharged after 24 hours if no complications were present and 48 hours if needed for any reason. Follow up of the patients was performed at the end of the second and fourth postoperative week.

A Surgeon Satisfaction Score, based on Likert's scale was assessed on 5-point scale with the points representing the following levels of satisfaction - **5) Excellent; 4) Good; 3) Satisfactory; 2) Poor; 1) Very poor**.

The parameters considered for Surgeon Satisfaction were I) Absence of conversion to GA II) Absence of intra operative movements III) Abdominal relaxation during the surgery IV) Absence of Post operative complications after surgery and V) Timely discharge from hospital.

The data collected was analysed using SPSS 16 software package. For continuous variables, mean and standard deviation were calculated. Absolute numbers and percentages were used for quantifying qualitative data.

Results

45 patients underwent Laparoscopic Cholecystectomy under spinal anaesthesia in Surgery OT of Tezpur Medical College, performed by two surgeons of Surgical unit 1 (Table 1).

Table 1. Distribution of the patients according to Age, Sex and ASA category

Variables	Number (N)	Percentages (%)
Age Category		
<20 years	2	4.4
21-30 years	7	15.6
31-40 years	23	51.1
41-50 years	10	22.2
51-60 years	3	6.7
Sex		
Male	9	20
Female	36	80
ASA I	40	88.9
ASA II	5	11.1

Analysis of Demographic data revealed a female preponderance among patients, with 36 females and 9 males included in the study. This corroborates the existing literature[1]. It was observed that majority of the study participants were in 31-40 years of age - 23 (51.1%). The mean age of the study participants 36.8 ± 8.71years with minimum age being 18 years and maximum age being 55 years. Most of the study participants 40 (88.9%) belonged to ASA I group. The mean body mass index was 20.91 ± 1.12 kg/m^2. The minimum body mass index of the study participants was 18.58 kg/m^2 and the maximum 22.97 kg/m^2.

All patients tolerated spinal anaesthesia well, and T3 was the highest degree of sensory blockade reached and lowest level reached was L3 (Table 2).

Table 2. Duration of Operative time and Pneumoperitoneum time

Variables	Pneumoperitoneum time (in minutes)	Operating time (in minutes)
Mean ± Standard deviation	33.3 ± 3.70	42.86±3.95
Minimum	18	36
Maximum	39	63

The mean operating time was found to be 42.86 ± 3.95 minutes and the time for when patient was under pneumoperitoneum was found to be 33.3 ± 3.70 minutes. An average of 1000 ml of isotonic fluid was infused throughout the operative procedure.

-

Intra operative vitals were measured at regular intervals and plotted against a graph with respect to time as given below (Figure 1 and Table 3).

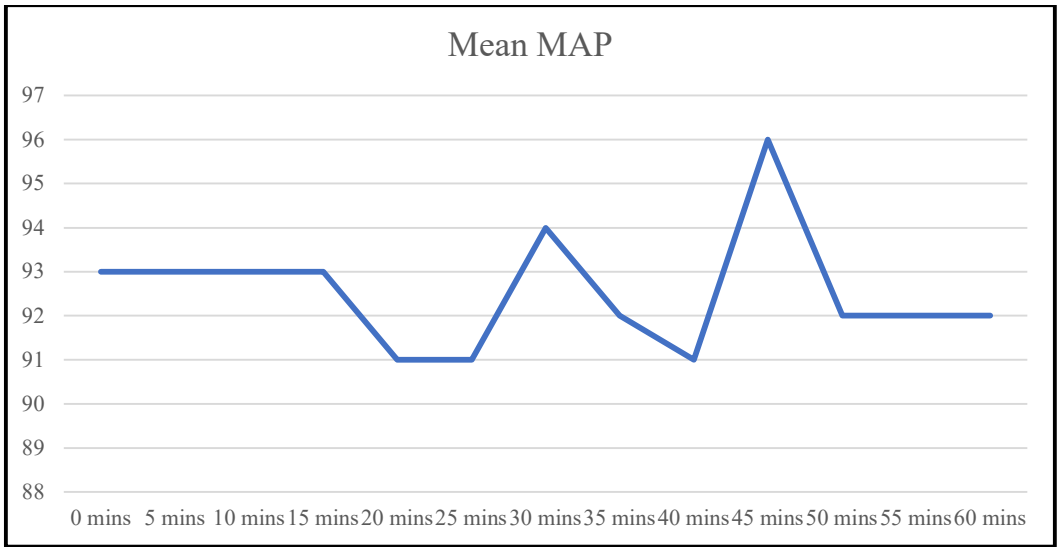


Figure 1. Chart showing variation of mean BP with respect to time

Table 3. Variation of mean BP with respect to time

Time	MAP	PR (beats/min)	sPO2 (%)
0	93	82	100
5	93	85	100
10	94	83	100
15	94	81	100
20	92	88	100
25	92	86	100
30	94	82	100
35	93	83	100
40	91	86	100
45	96	85	100
50	108	90	100
55	97	82	100
60	101	82	100

The mean BP with respect to time was plotted and charted. There was an increased incidence of reduced BP after administration of Thoracic Spinal anaesthesia possibly due to sympathetic blockade. Two patients developed hypotension which were corrected by Inj Mephenteramine 6 mg and one patient

developed bradycardia and was managed by Inj. Atropine 0.6 mg. Other patients did not have any major changes in the intra operative vital parameters. The mean O2 remained 100% due to delivery of oxygen through Hudson's mask.

One case was converted into GA due to I nadequate muscle relaxation and analgesia. Two patients presented with shoulder tip pain intra operatively which was managed with Inj. Ketamine 25 mg and Inj. Midazolam 1 mg iv. Peri-oral pruritis was present in two patients which was self-limiting (Table 4).

Table 4. Intra-operative complications

Shoulder pain	2
Hypotension	2
Hypertension	0
Bradycardia	1
Abdominal discomfort/pain	1
Pruritis	2
Respiratory Distress	0
Need for Ketamine	2
Need for Midazolam	2

In the post operative period, one patient developed nausea and two patients developed vomiting that was taken care of with Inj. Ondansetron 4mg. Two patients had urinary retention and needed indwelling catheter for 24 hrs. No patient developed Post Dural Puncture Headache.

Most patients had a VAS score of 3 or less after a period of 6 hours, and gradually developed pain at wound site the following day, which was easily managed by oral NSAIDs. However, 3 patients developed severe pain on the first day, with VAS score greater than 5 after 6 hours, that required administration of Inj. Diclofenac 75 mg IM (Tables 5 and 6; Figure 2).

Table 5. Post-operative complications

POST OPERATIVE COMPLICATIONS	**NUMBER**
Post operative Nausea and Vomiting	3
Urinary Retention	2
Severe wound site pain	3

Table 6. Post-operative VAS scores

VAS	2 hr	4 hr	6 hr	12 hr	24 hr
1	34	30	25	26	29
2	9	12	10	10	11
3	2	3	5	6	3
4	0	0	2	3	2
5	0	0	1	0	0
6	0	0	2	0	0

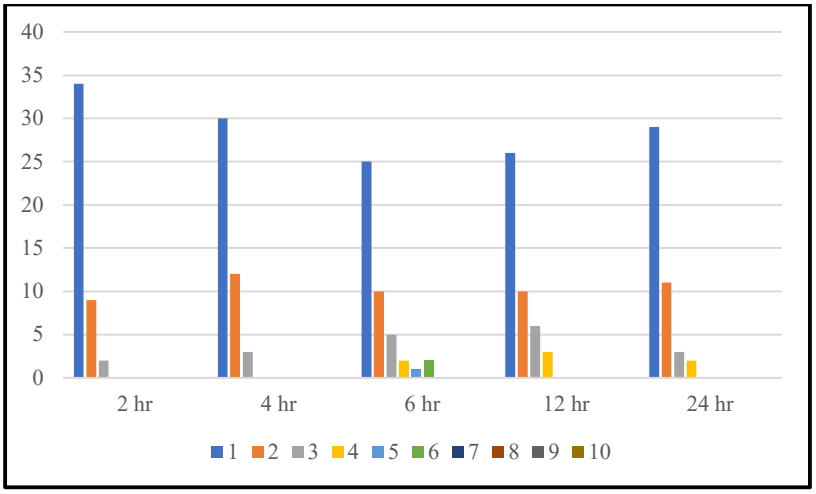


Figure 2. Post-operative VAS scores

A surgeon satisfaction score was calculated from a questionnaire that was filled at the time of discharge and compiled. Overall ease of doing surgery was measured as an average of the scores of each question. The scores were excellent for 36 cases, Very Good for 8 cases and Poor for 1 case which was converted to GA due to inadequate analgesia and muscle relaxation (Table 7 and Figure 3).

Table 7. Surgeon Satisfaction scores

Surgeon Satisfaction Score	Q1 Absence of conversion to GA	Q2 Absence of intra operative movements	Q3 Abdominal relaxation during the surgery	Q4 Absence of Post - operative complications after surgery	Q5 Timely discharge from hospital
5 Excellent	30	18	18	36	42
4 Good	13	24	24	8	2
3 Satisfactory	1	2	2	1	1
2 Poor	1	1	1	-	-
1 Very Poor	-	-	-	-	-

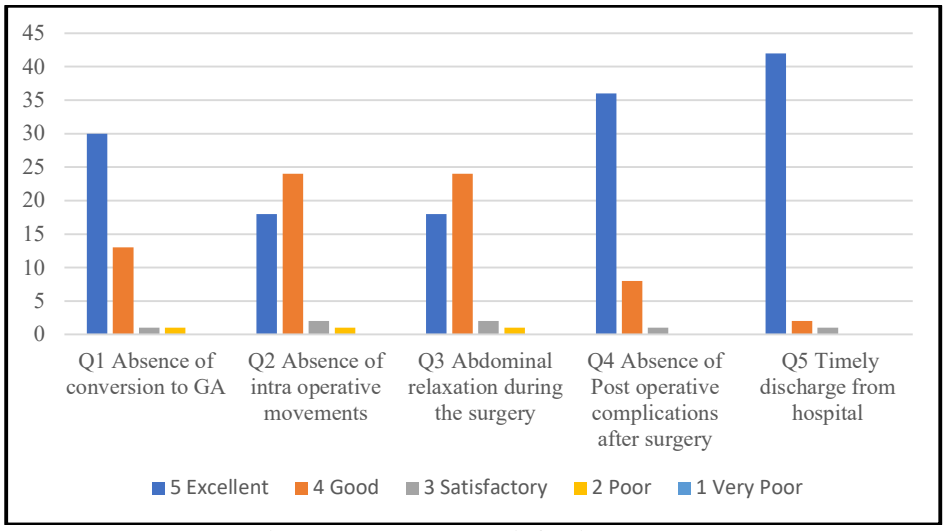


Figure 3. Surgeon Satisfaction scores

Forty-two patients were eligible for hospital discharge after 24 hours, two patients who developed vomiting were observed for 48 hours and discharged. One patient who was converted to General Anaesthesia due to difficulty in surgical procedure was discharged after 72 hours. There was no major morbidity and mortality observed in patients included in the study.

Discussion

Laparoscopic cholecystectomy is now a days considered gold standard for treating symptomatic cholelithiasis that is usually done under general anaesthesia but patients with major medical problems especially with hyperreactive airway disease and lung pathology who cannot withstand general anaesthesia and develop intra operative and postoperative complication , thereby increasing morbidity and mortality [2,3]. Van Zundert et al. reported that segmental spinal anaesthesia

can be used safely in patients with severe lung diseases. In our study we administered segmental thoracic spinal anaesthesia at lower level(T9-T11) which had the advantage of minimum haemodynamic fluctuation and less intra operative and postoperative complication.

In our study, all patients belonged to ASA 1 and 2 categories with no co morbidities with female preponderance and with normal BMI.

General anaesthesia has some limitation in patients with respiratory pathology and anticipated difficult intubation where it can interfere with the airway and cause threat to the pulmonary mechanics. Previous studies carried out by different authors compared GA vs thoracic spinal and reported that thoracic spinal anaesthesia leads to early ambulation, less haemodynamic fluctuation and greater patient satisfaction and greater surgical satisfaction [4].

In our study, two patients developed hypotension and one patient developed bradycardia. Literature shows that anaesthesia at lower thoracic levels with low volume of isobaric local anaesthetics causes exclusive blockade of thoracic fibres and sparing lumbo-sacral fibres so less venous pooling and low incidence of hypotension [5], even though it is a well-documented [6,7] adverse effect.

There was no problem in respiratory status of the patients due to the minimal and transient nature of the motor blockade in Thoracic spinal anaesthesia, a fact that is supported by literature [4,8]. The patients maintained Spo2 of 100 percent on routine oxygen supplementation with 5 litres of oxygen.

One patient developed right shoulder pain, due to the effect of pneumoperitoneum and the patient being awake, which caused him to perceive the sensation. The patient was managed by sedation, following which the surgery was uneventful.

One patient had to be converted to general anaesthesia as the patient was extremely anxious, and consciously contracted his abdomen, which made the surgery difficult. Consequently, abdominal relaxation was less. Tzovaras et al and Sinha et al also mentioned similar difficulties in their study [9,10].

Regarding post operative complications, post operative nausea vomiting most commonly encountered in three patients. The incidence, however is lesser than when conducted under general anaesthesia or open technique. However, urinary retention was found two patients, and this adverse effect is unique to spinal anaesthesia [11]. However, it was manageable and patient regained their normal bladder function the following day and was discharged with no negative outcome.

The VAS scores calculated at 6-hour interval post-surgery revealed severe pain require rescue analgesia in three patients. This could be due to inadequate drug delivery or faulty technique. Most of the similar studies revealed improved VAS scores in post operative period allowing for early mobilization and discharge [12-14]. Thus, Thoracic anaesthesia gives better outcomes in the post operative period and also upholds the principles of ERAS, reducing hospital stay.

Most patients, were discharged just within 24 hours of hospital stay. With further refinements and experience, it is possible to convert laparoscopic cholecystectomy to day case surgery, which is slowly but surely being adopted in many centres.

Conclusion

Laparoscopic Cholecystectomy is feasible and effective using Thoracic Spinal Anaesthesia with reduced post operative complications, reduced hospital stays and to a high satisfaction of the surgeon.

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.

Ethical Approval

The study was approved by Ethical Committee of Tezpur Medical College and Hospital.

Informed Consent

Informed consent was taken from all participants of this study after detailed explanation of the procedure, its risks and benefits, and requirement of conversion to GA if needed.

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ORIGINAL ARTICLE

Clinico-Etiological Profile of Goitrous Children of a Coastal Area and the Association Between Urinary Iodine Concentration and Thyroid Autoimmunity

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Abstract

Background: Iodine deficiency is unlikely to be a main cause of goitre in a coastal area, with a predominant sea food eating population. At the same time, excess iodine may cause thyroid autoimmunity and hypothyroidism via the Wolff-Chaikoff effect. Measurement of Urinary Iodine Concentration (UIC) per day is an excellent substitute for assessing the iodine intake. The objectives of this study are to describe the clinico-etiological profile and to determine the correlation between Urinary Iodine Concentration and thyroid autoimmunity in goitrous children below 12 years of age attending a tertiary care institute in a coastal area. **Materials & Methods:** It was a cross-sectional analytical study in a coastal tertiary care institute. Children attending the department of Pediatrics were screened for goitre. UIC and thyroid autoimmunity were ascertained using standard techniques. **Results:** Nearly 1/3rd of goitrous children had thyroid autoimmunity. The median Urinary Iodine Concentration (UIC) of the study area was 210 µ/L, which is above adequate level, as per WHO grading. **Conclusion:** Thyroid autoimmunity is an important cause for goiter in children from this coastal area and a high iodine intake may be contributing to this. Hence, the salt iodization in coastal areas may need a reconsideration. However, further community-based studies may help to provide an epidemiological level of recommendation regarding the iodine supplementation (salt iodization) in coastal areas.

Keywords: Autoimmune thyroiditis, Excess urinary iodine, Goitre in children, Median Urinary Iodine Concentration, Salt iodisation

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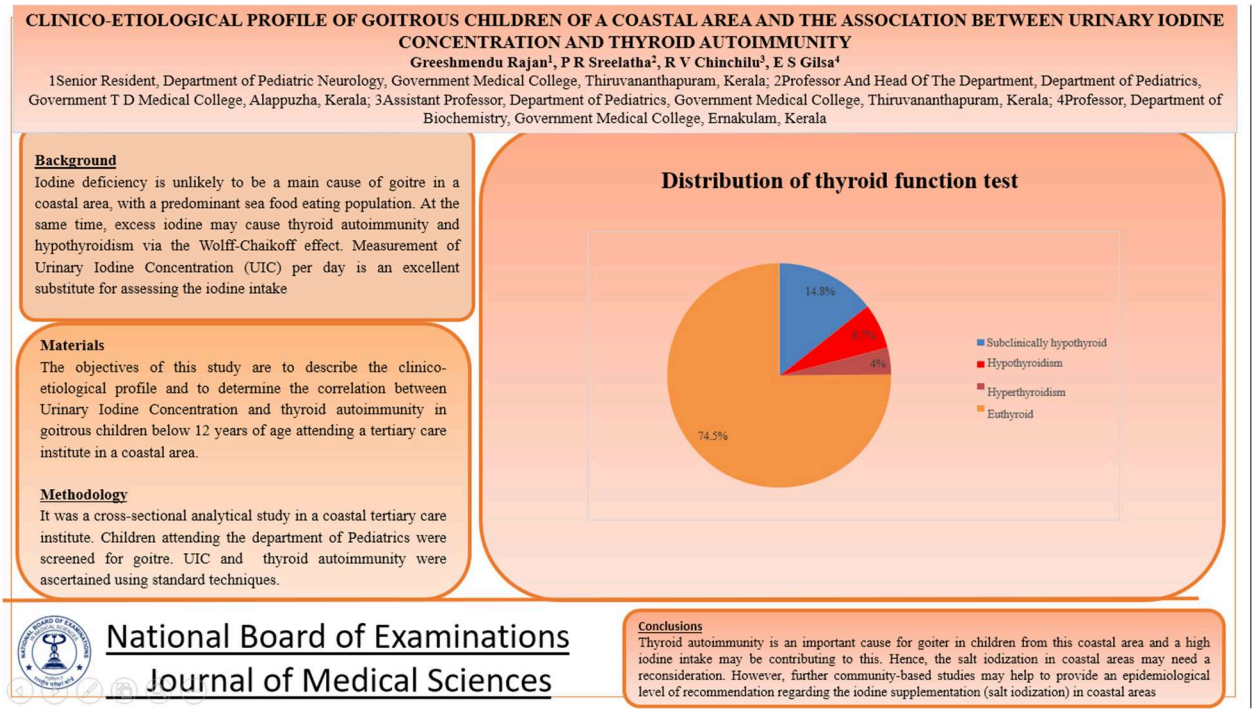
Graphical Abstract



Introduction

One of the most prevalent endocrine conditions affecting children is thyroid dysfunction. Goitre is often seen in children with thyroid disorders. They may have a hyperthyroid, hypothyroid, or euthyroid presentation [1]. Iodine deficiency is the most frequent cause of goitre in children worldwide. However, persistent autoimmune thyroiditis is frequently cited as the most frequent cause of pediatric goitre in regions with adequate iodine intake [2]. Iodine is a necessary micronutrient for healthy human growth and development. According to assessments by the Indian Council of Medical Research and the Directorate General of Health Services, 337 of 414 districts had an endemic status for iodine deficiency disorders, meaning that their frequency was greater than 5%. Aiming to reduce the prevalence of iodine deficiency disorders to less than 5%, the National Iodine Deficiency Disorders Control Programme (NIDDCP), which is being implemented in all States and Union Territories, was started by the Indian government in recognition of the overall seriousness of the situation. [3] A study conducted in Ethiopian school children revealed that the median UIC was 518 micrograms/liter, raising concerns about the potential for excessive iodine intake. According to the study, the prevalence of pediatric goitre has dramatically decreased since nationwide salt iodization was implemented. However, it also considers the possibility that school children may have consumed too much iodine based on their UIC level. [4] Chronic exposure to excessive iodine from water or poorly managed salt is a risk factor for hypothyroidism in free-living people, despite the fact that universal salt iodization has remarkably reduced goitre

rates. To prevent thyroid disorders, it is crucial to keep an eye on the levels of iodine in salt and drinking water [5]. Goitre, hypothyroidism, hyperthyroidism, and/or thyroid autoimmunity can all be brought on by excessive iodine consumption. An increase in iodine consumption, often at intakes only marginally above physiological needs, may make people who already have thyroid illness or have previously been exposed to iodine deficiency more vulnerable to thyroid problems [6].

Numerous research has been carried out to demarcate causes of childhood goitre, and iodine deficiency is a well appreciated etiology of endemic goitre. Investigating the etiology of goitre with highlight on iodine status is pertinent in this context, particularly for schoolchildren in coastal areas, who are less likely to suffer from an iodine deficit due to their diet of predominant seafood. We therefore designed this study with intention to demarcate the profile of goitrous children and to ascertain the relationship between Urinary Iodine Concentration and thyroid autoimmunity along with estimating the median UIC among the school children of a coastal area. This study aims to describe the clinico-etiological profile of goitrous children in a coastal area and evaluate the correlation between urinary iodine concentration and thyroid autoimmunity and thus to assess whether excessive iodine intake contributes to thyroid autoimmunity in this population.

Materials and Methods

It was a cross sectional analytical study conducted among out patients and in patients in the age group of 1 to 12 years attending the Department of Paediatrics, Government TD Medical College Hospital, Alappuzha from December 2018 to November 2019.

Inclusion Criteria

Case definition - Goitre is defined as the condition where there each of the lateral lobe of the thyroid gland is larger than the terminal phalanx of the thumb of the person examined.

The WHO goitre grading system is as follows [7]:

Grade 0	Goitre is not palpable or visible even when the neck is extended
Grade 1	When the goitre is palpable
Grade 1A	Goitre detected on palpation
Grade 1B	Goitre palpable and visible when neck extended
Grade 2	Goitre visible when neck is in the normal position
Grade 3	Large goitre visible from distance

Thus, children, in the age group 1 to 12 years, having goitre equal to or above grade 1b were included in the study.

Exclusion Criteria

Children on thyroxine supplementation or anti thyroid medications.

Sample Size

The sample size was calculated based on a study conducted by Boyages et al, in a study sample of goitrous children. [8] The formula applied is 4pq/d2 Where, P is the prevalence of anti-thyroid antibody positivity, and d is the precision (20 percentage of prevalence). The prevalence of thyroid autoimmunity in the study group was 60 %. A dropout of 10 percentage is expected. The thus calculated sample size is taken to be 74.

Study Procedure

Initially, the medical officers and the residents were sensitised to screen visually for goitre. All the children so detected to have goitre were then evaluated by the principal investigator alone. Children with goitre (grade 1B or above) in the age group of 1 to 12 years were enrolled in the study. The screening was based on visual inspection alone. All details about the study were explained to the subjects and their parents and a written informed consent was obtained from the parent if the child was below 7 years of age, whereas assent was obtained from the child, if the child was above 7 years of age. The clinico-epidemiological profile of children detected with goitre was then ascertained. We used the recall method to delve into the subjects' dietary history, which included the frequency of intake of both goitrogens and foods high in iodine. For ascertaining serum FT4, TSH, serum anti-TPO positivity 5 mL of blood was collected from each child, and was rotated at 5000 rpm for 10 minutes, and serum was separated. The serum samples were stored in deep freezer at -20 degree Celsius, or could also be contained in room temperature if not for more than a period of 24 hours. The parameters were ascertained using Fully Automated Immuno-assay Analyser by Beckman Coulter access 2 (FDA approved chemiluminescence method). The lot number of reagent used was 871023, and batch number was V5P8SPT6J92QK5JJSV. For estimation of urinary iodine, WHO recommended Method A, based on colourimetry using Ammonium persulfate as reagent was employed. Minimum amount of urine needed was 250 microlitre per sample, and the urine samples were also stored in deep freezer at –20 degree Celsius. Ultrasonography of the thyroid gland was done with reference to the gross morphology and echotexture, and was done by a single radiologist using Siemans 2 D Ultrasonography.

Data Analysis

All the data was entered in Microsoft Excel Sheet and analysed using SPSS version 22. Qualitative variables were expressed in percentages and quantitative variables were summarized in mean with standard deviation, and median where necessary. The tests of significance used were unpaired t test for quantitative variables and chi square test for qualitative variables. Pearson’s correlation coefficient was used to ascertain the

association between Urinary Iodine Concentration and anti TPO. A p value of less than 0.05 was considered to be statistically significant

Results

The study included 74 children with goitre, of whom 50 were girls (male: female ratio of 1:2). With a range of 3 to 12 years, the average age at presentation was 9.36 years +/- 2 years. Forty children (54%) were aged more than 10 years. Table 1 shows the distribution of the goitre grade. Thirty-three children (44.6%) in the study sample had a family history of thyroid dysfunction manifested as goitre, or a history of thyroid-related drug use or thyroid surgery. Goitre lasted an average of 5 +/- 7.3 months. It was shown from the diet history that children with higher grades of goitre (grades 2 and 3) consumed more goitrogens and iodine, albeit this difference was not statistically significant. The study sample's mean FT4 value was 0.94 +/- 0.68 ng/dL. The study sample's mean TSH level was 6.7 +/- 20.8 micro-IU/mL. Tables 2, 3, and Figure 1 show the distribution of thyroid function tests. Of the children, 55 (74.5%) were euthyroid. Three children (11%) were biochemically hypothyroid out of the 26 children with a history suggestive of hypothyroidism.

Three children had a history suggestive of hyperthyroidism, among which one child was biochemically hyperthyroid. She complained of having large eyes, tremors, and weight loss. She had tremor and eye signs during evaluation. Her TSH was low and her FT4 had increased. Additionally, she tested positive for anti-TSH and anti-TPO receptor antibodies. Thyroid gland ultrasonography revealed heterogeneous echotexture in 31 children (41.9%), which was suggestive of autoimmune thyroiditis. Nineteen (61%) of these children were anti-TPO positive. Among the five children with hypothyroidism, three children (60%) were having UIC indicative of iodine intake above requirement, and one child (20%) was having anti TPO positivity. Among the 11 children with subclinical hypothyroidism, nine children (82%) were having UIC indicative of iodine intake above requirement, and six children (54.5%) had anti TPO positivity.

Thyroid autoimmunity

Thyroid autoimmunity (anti-TPO positivity) was seen in 27 children (36.5%) in the study sample. Eleven of these children (39.1%) had grade 2 goitre, twelve (4.3%) had grade 3 goitre, and fifteen (56.5%) had grade 1b goitre. Goitre lasted for an average of seven months. Compared to children who were anti-TPO negative, those who were anti-TPO positive consumed more iodine-rich food.

Nine children (33.3%) among the children with thyroid autoimmunity were subclinically hypothyroid. Three children (11%) had a history of hyperthyroidism among which 1 child was biochemically hyperthyroid.

Iodine intake and thyroid autoimmunity

Among the 27 children with anti-TPO positivity, 13 children (48.5%) were having an iodine intake above the requirement. Five children (18.5%) had excessive iodine intake. Nine children (33.3%) had adequate iodine nutrition. This difference was found to be

statistically significant (p<0.0001). The quantitative levels of UIC and anti-TPO were correlated. Pearson's correlation coefficient was 0.496 (p-0.0002). Thus, there was a moderately positive correlation that was statistically significant (Figure 3). Figure 4 illustrates the relationship between thyroid autoimmunity and urinary iodine concentration.

Urinary Iodine Concentration

The median UIC was 210 micrograms/Litre, which as per the WHO implies an iodine intake above the requirement [7]. Urinary iodine concentration in 47 children (63.5%) were higher than 200 micrograms/liter (p-0.01). This indicated that 63.5% of the children were consuming more iodine than was recommended. Figure 2 depicts the distribution of UIC. Thyroid dysfunction was observed to be more common in children whose urine iodine concentration was greater than 200 micrograms/liter than in those whose concentration was less than 200 micrograms/liter (Table 4).

When compared to children with UIC levels below 200 micrograms/liter, children with UIC levels of 200 micrograms/liter or more had a greater percentage of thyroiditis as per USG. Twenty-one children (44.7%) had USG findings of thyroiditis among children with more than adequate iodine intake (UIC >/= 200 micrograms/L), while only ten children (37%) had USG findings of thyroiditis among children with UIC<200 micrograms/L (p>0.05).

It was discovered that children with UIC levels greater than 200 micrograms/L had a higher percentage of anti-TPO positivity. The association between UIC and thyroid autoimmunity was found to have an odds ratio more than 1, indicating that UIC levels greater than 200 micrograms/L were associated with an increased risk of thyroid autoimmunity (Table 5).

Table 1. Distribution of grade of goitre in the study sample

Grade of goitre	**Frequency (%)**
1b	38(51.4%)
2	33(44.6%)
3	3(4.1%)
Total	74(100%)

Table 2. Distribution of FT4 of the study sample

FT4	**Frequency**	**(%)**
Decreased	5	6.8%
Normal	66	89.2%
Increased	3	4.0%
Total	74	100%

Table 3. Distribution of TSH of the study sample

TSH	**Frequency (%)**	**P value**
Decreased	2(2.7%)	<0.0001
Normal	58(78.4%)	
Increased	14(18.9%)	
Total	74(100%)	

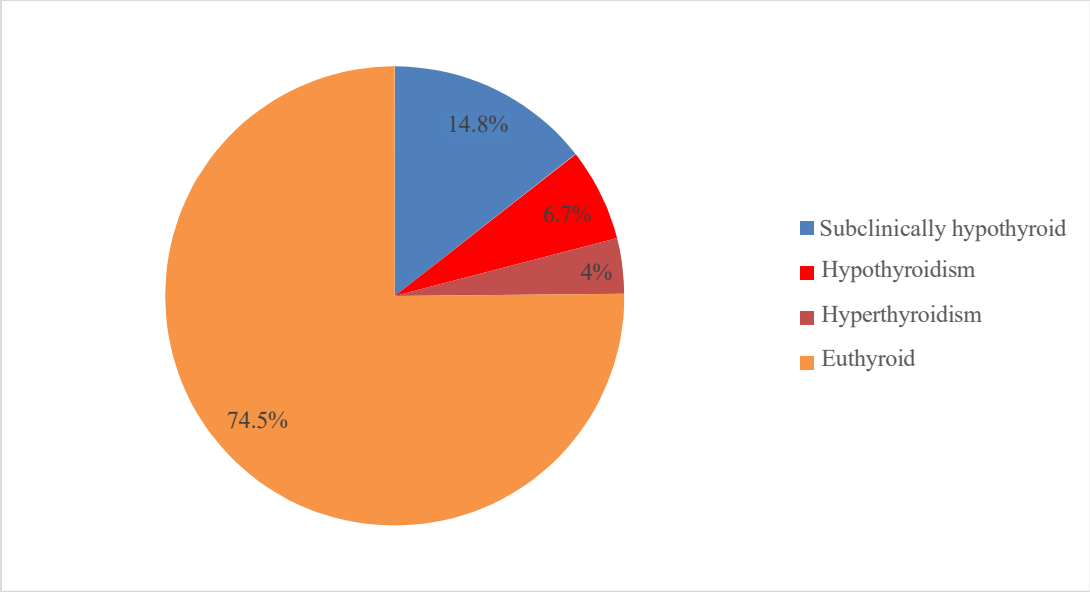


Figure 1. Distribution of thyroid function test

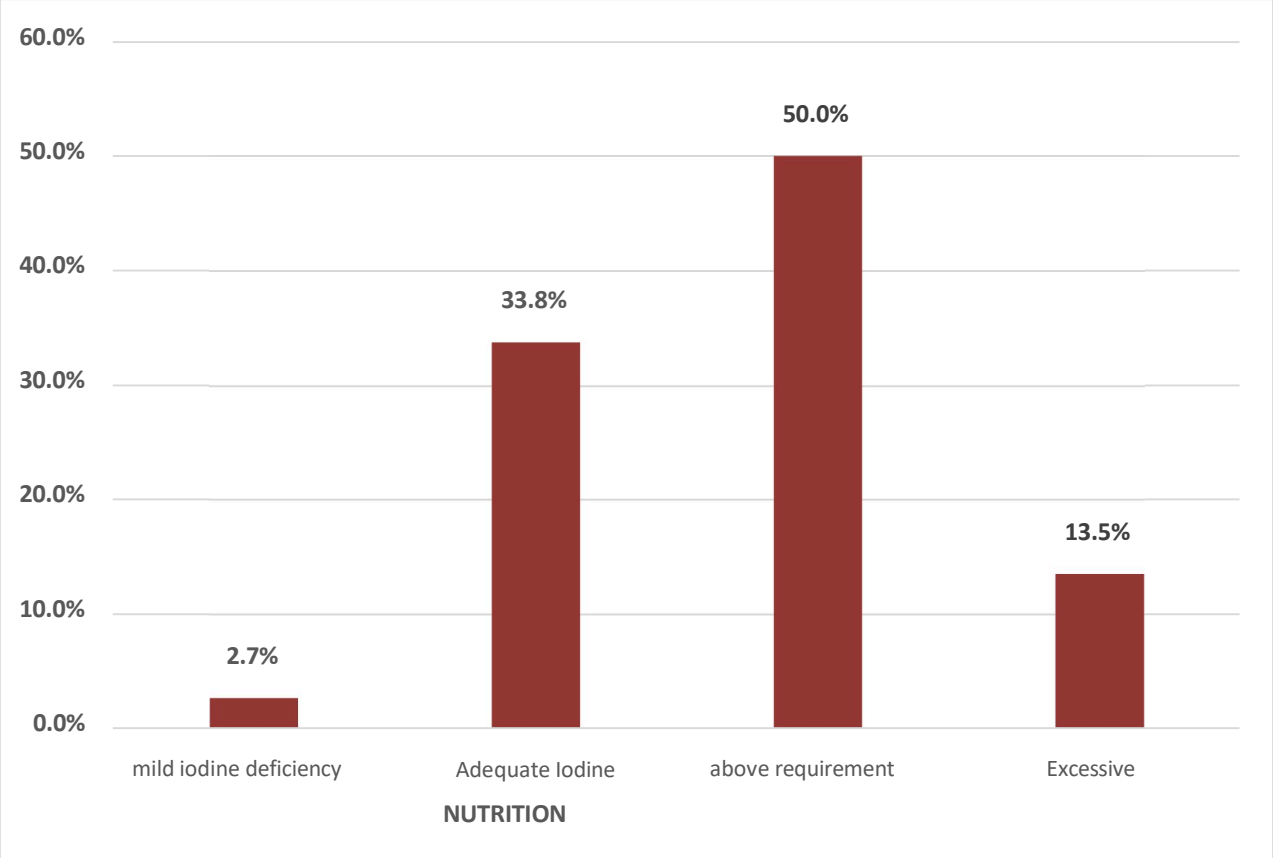


Figure 2. Distribution of UIC

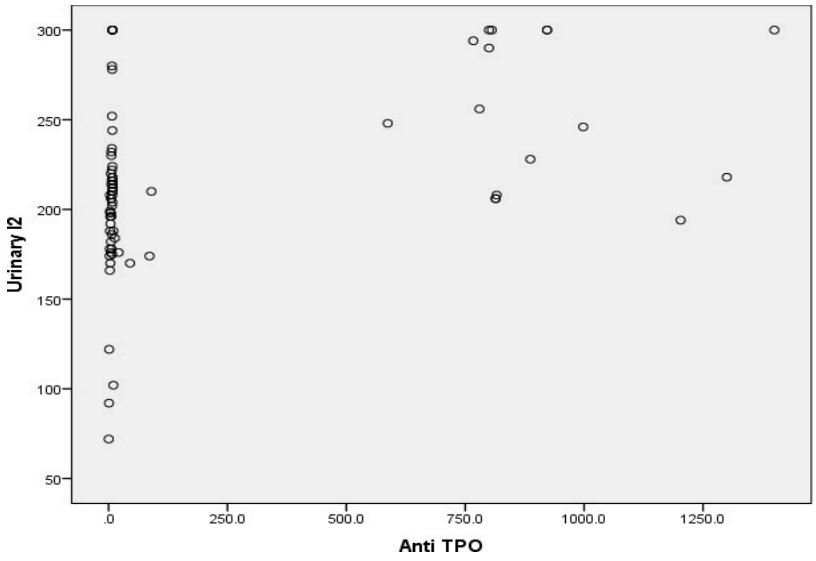


Figure 3. Scatter diagram showing moderately positive correlation between anti TPO and Urinary Iodine Concentration

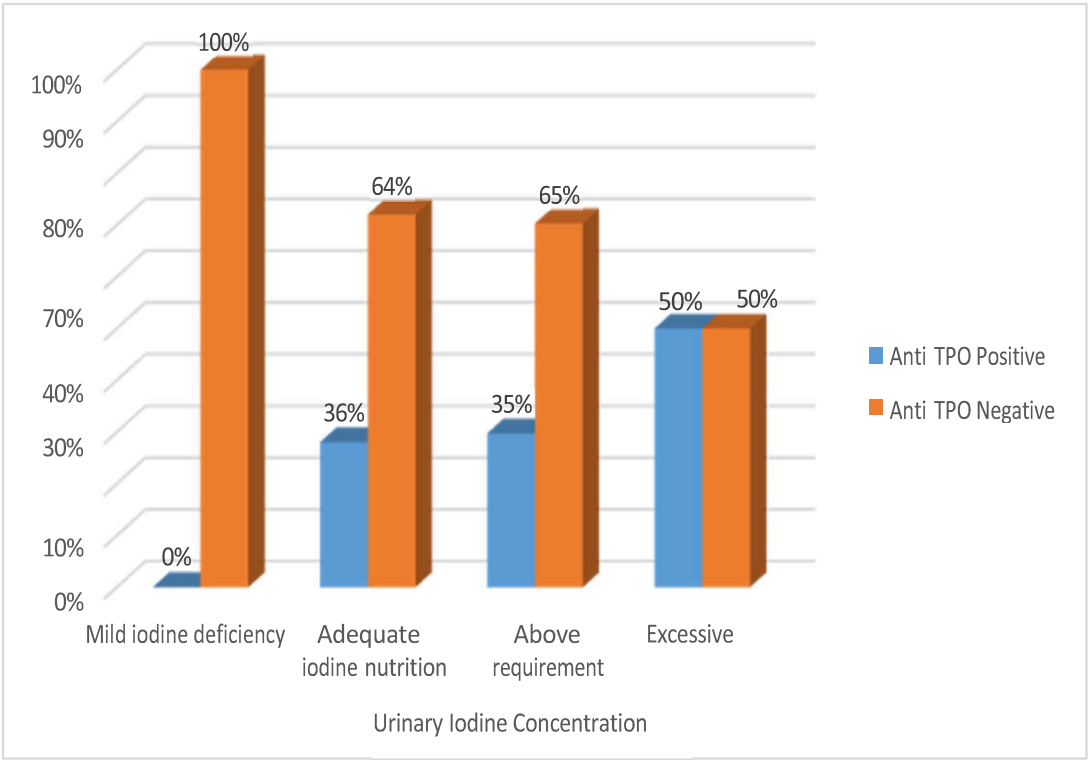


Figure 4. Chart showing relation between thyroid autoimmunity and Urinary Iodine Concentration in the study sample

Table 4. Urinary Iodine Concentration and thyroid dysfunction of the study sample

Urinary Iodine Concentration (micrograms/Litre)				**p value**
		<200	**≥200**	
Euthyroid	Frequency	21	34	0.413
	%	77.8%	72.3%	
Subclinical hypothyroid	Frequency	2	9	
	%	7.4%	19.2%	
Hypothyroid	Frequency	2	3	
	%	7.4%	6.4%	
Hyperthyroid	Frequency	2	1	
	%	7.4%	2.1%	

Table 5. Odds ratio showing relation between UIC and thyroid autoimmunity

			Anti TPO		Odds Ratio	p value
			Negative	Positive		
Urinary Iodine Concentration	<200	Frequency	18	9	1.241	0.6
		%	66.60%	33.40%		
	>200	Frequency	29	18		
		%	61.70%	38.30%		

Discussion

The clinico-epidemiological profile of the goitrous children is defined by our investigation. The children's traits are in line with earlier numerous research that found that girls and adolescents were more likely to develop goitre [1,7]. This study highlights that goitre may run in families. Previous research on goitre has addressed genetic variables [8]. One well-known fact is that goitre can result from dietary iodine deficiency [9]. Although not statistically significant, our discovery that children who consumed more iodine-rich food had higher goitre grades suggests that goitre can be brought on by an overabundance of iodine.

Excessive iodine consumption can result in thyroid autoimmunity, goitre, hyperthyroidism, and hypothyroidism [6]. A significant proportion of children in our study was having anti TPO positivity. Nearly 42% of the goitrous children were having a USG thyroid suggestive of autoimmune thyroiditis whereas only 36.5% of the goitrous children had thyroid autoimmunity depicted in serum. The reason why there is this discrepancy could be that thyroid autoimmunity was determined only using anti TPO positivity. Autoimmune thyroiditis as an etiology for goitre has been appreciated especially in adolescents. Thyroid peroxidase antibodies and thyroglobulin antibodies mark thyroid autoimmunity. This affects around 10% of the general population. Autoimmune thyroiditis has a major impact on the growth and development of children and adolescents [10]. It can cause hypothyroidism, hyperthyroidism, and can predispose to developing thyroid malignancy, lung malignancy, gastrointestinal malignancy and urogenital malignancy [11]. 66% of the children with thyroid autoimmunity had UIC levels above 200 micrograms/liter, which indicates an iodine consumption beyond the recommended level, according to our study. This further clarifies that excessive iodine consumption can cause autoimmune thyroiditis, as does the moderate positive correlation between thyroid autoimmunity and UIC suggests. Furthermore, since the odds ratio is greater than 1, we can conclude that consuming too much iodine may increase the risk of thyroid autoimmunity. According to a study, in Chinese children, excessive iodine supplementation has raised the incidence and severity of autoimmune thyroiditis [12]. The median UIC in our study was 210 micrograms/L wich is higher than that obtained in a study among the school children in Gonda [13]. Given that our sample's median UIC showed an iodine intake over the recommended level, we speculate that coastal regions, where seafood is abundant, may be more susceptible to excessive iodine intake. In a cross-sectional study carried out in Ethiopian schools, Elias et al. found that the children's median UIC was significantly higher above the acceptable threshold (518 micrograms/liter). Additionally, 45.1% of the salt samples were found to be too iodinated. He opined that ensuring homogenous iodization of salt is crucial [4].

Conclusion

Thyroid autoimmunity is a predominant cause for goiter in school children and iodine deficiency is negligible in goitrous children of this coastal area. Thyroid autoimmunity was significantly higher in children with higher iodine intake. In light of our findings, we recommend that iodine intake be closely watched, particularly in coastal regions. A noteworthy achievement in reducing the incidence of goitre and iodine deficiency is the National Iodine Deficiency Disorders Control Programme (NIDDCP). We would like to draw attention to the program's third and fourth goals, which are to conduct resurveys to evaluate iodine deficiency disorders and the effects of iodated salt every five years in the districts and to monitor the iodine content of salt and urinary iodine concentration in laboratories, respectively.

Limitations

There are various limitations to our investigation. We are unable to reach an epidemiological level of recommendation due to the small sample size. To draw any similar findings, more population-based research is required. Because of the patients' financial limitations, we were only able to perform the anti-TPO titre to diagnose thyroid autoimmunity and not the thyroglobulin antibody levels. The source of the consumed excess iodine could not be delineated as a quantitative estimation of the iodine content of diets was beyond the scope of our study.

Statements and Declarations

Ethical Approval

Approval was obtained from the Institutional Ethics Committee (ECR/122/Inst/KL/2013/RR-16). Date and certificate number of IEC clearance- 13/11/2018 ; 42/2018.

Informed Consent

Written informed consent of parent (if the child is below 7 years of age) or assent from the child (if the child is above 7 years of age) was taken. Expenses of the investigations of all the study participants if any, was incurred by the researcher. Confidentiality of the information obtained was assured throughout the study.

Conflicts of interest

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

Funding

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ORIGINAL ARTICLE

A Study on Pregnancy with Disseminated Intravascular Coagulation and its Fetomaternal Outcome

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Abstract

Background: Obstetric bleeding continues to be the leading cause of maternal death worldwide, and the cornerstone of treatment is early detection of the factors that contribute to hemorrhage and early management of the underlying pathological process. Disseminated intravascular coagulation (DIC) is the most significant pregnancy-related condition that causes bleeding with a high rate of maternal mortality and morbidity. **Aims and objectives:** To find out common causes of DIC in pregnancy. To know the obstetric interventions. To evaluate the maternal and fetal outcome in DIC cases. **Methods:** From January 2012 to December 2015, our institute conducted a retrospective analysis of 90 cases of pregnancy with DIC in order to identify the different aetiology and problems linked to DIC that result in maternal death and morbidity as well as to examine the perinatal outcomes of pregnant women with DIC. **Results:** Three percent of our study has DIC. DIC was frequently caused by abruption (36%), hemorrhage (34%), severe hepatic failure (6%), preeclampsia (18%), and infection (6%). In 89 (98%) postnatal patients and 1 (02%) prenatal patient. DIC emerged as a composite severe maternal morbidity result. HELLP (8.13%), placenta previa (2.66%), embolism (1.33%), uterine rupture (11.6%), abruption (27.9%), PIH (17.4%), PPH (34%), and sepsis (33.7%). Women with hemorrhage had a considerably higher composite maternal morbidity result than those with abruption and preeclampsia, out of the three most common causes (abruption, hemorrhage, and preeclampsia). **Conclusions:** High rates of death and morbidity are linked to DIC, a sign of serious obstetrical problems. This morbidity may be decreased by identifying the underlying causes, conducting an early diagnosis, and actively managing DIC.

Keywords: fetomaternal, intravascular coagulation in pregnancy, Maternal morbidity, DIC

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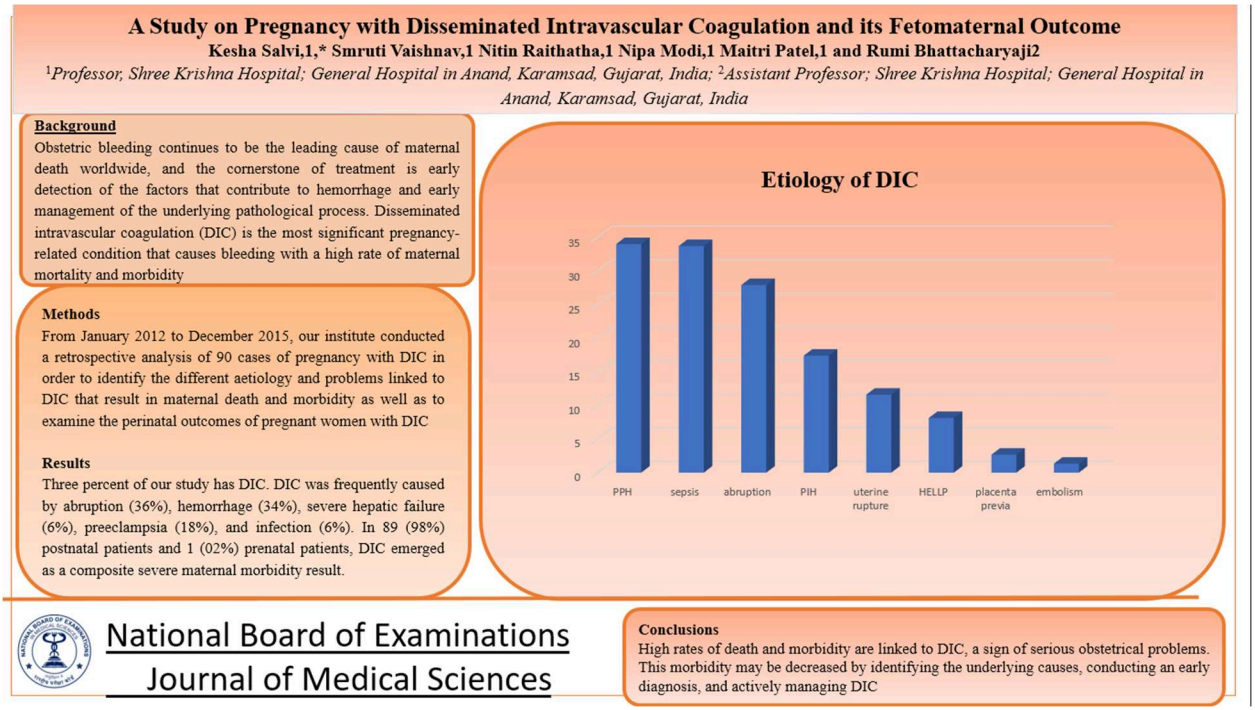
Graphical Abstract



Introduction

The primary cause of maternal mortality worldwide is still obstetric bleeding; therefore, early detection of the conditions that contribute to bleeding and prompt treatment of the underlying pathological process are essential components of care. The most significant disorder connected to pregnancy that causes bleeding and has a high prevalence of maternal death and morbidity is disseminated intravascular coagulation [1-3]. Joseph DeLee first identified and documented the risks associated with obstetrical disseminated intravascular coagulation in 1901, following a fatal case of hemorrhagic diathesis with placental abruption [4]. According to the International Society of Thrombosis and Haemostasis, DIC is as follows: An acquired syndrome characterized by intravascular coagulation activity and loss of localization brought on by a variety of circumstances [5,6]. It may start in the microvasculature and damage it to the point where organ dysfunction results from severe enough damage. Up to 1% of hospitalized individuals may have DIC, according to estimates. DIC is always a secondary phenomenon that might result from cancer to obstetrical mishaps [6]. DIC is linked to a number of obstetrical conditions, including as placenta previa, severe preeclampsia/eclampsia, HELLP syndrome, PPH, retained dead baby, delayed miscarriage, septicemia, amniotic fluid embolism, acute fatty liver of pregnancy, and disruption [7-9]. Deep vein thrombosis (DIC) was caused by a systemic coagulation activation, which was followed by microvascular thrombosis, widespread fibrin deposition, and organ failure [10]. Clinical manifestations of DIC can range widely, from overt and uncontrollable bleeding to microvascular damage and thrombosis. Clinicians working in obstetrics

may find it easier to diagnose and treat DIC patients early on if they are aware of the antecedents linked to the disorder [11]. The second most prevalent severe maternal morbidity indication, according to reports, was DIC. It was linked to about one-fourth of maternal fatalities. According to a 2015 study by Cunningham, the causes of DIC included sepsis, major obstetric hemorrhage 23 to 30:1000, acute fatty liver of pregnancy 1:10000, abruption 1:200, and AFE 2:10000. Bleeding, shock, acute renal failure, pleural effusion, pulmonary oedema, haematuria, hepatic encephalopathy, cardiac arrest, hypoxic brain damage, and other complications are associated with DIC [13]. Here, from January 2012 to December 2015, our institute conducted a retrospective study on 90 cases of pregnancy with DIC in order to identify the different aetiology and complications linked to DIC that result in maternal mortality and morbidity as well as to investigate the perinatal outcome in pregnant women with DIC.

Material and Methods

A retrospective cross-sectional study was carried out from January 2012 to December 2015 at the Obstetrics and Gynecology department of Shree Krishna Hospital (SKH), Karamsad, Gujarat, India. Inclusion criteria: Women who are pregnant and have been admitted to our hospital due to DIC. Women who are pregnant and have coagulation abnormalities or bleeding issues are excluded. Process There were 23014 antenatal indoor patients in total over this time. of which about ninety cases of diabetic eye disease were identified.

The demographic information collected included the age, parity, education, socioeconomic status, address, gestational age at delivery, method of birth, number of hospital days, and maternal weight of the affected lady. Laboratory testing includes routine assays (full blood count, blood group, blood sugar, urine routine microscopy, and HIV/HBsAg status). Platelet count, PTINR/aPTT, serum fibrinogen, BTCT, FDP, and Ddimer are among the assays that are unique to DIC.

The presence of overt DIC was assessed using the ISTH DIC scoring technique, which assigns points based on factors such as elevated fibrin-related marker, prolonged prothrombin time, decreased platelet count, and fibrinogen level. The institutional ethics committee provided ethical approval. Analysis of statistics SSPS and Microsoft Excel were used for data analysis.

Results

The frequency of DIC at our institution was 3%. There were 58 (64%) emergency patients and 32 (36%) booked patients in the current study; the emergency patients had a higher prevalence of DIC. Eighty-four percent of the patients were found to be between the ages of 20 and 30. In 1 (02%) prenatal and 89 (98%) postnatal patients, DIC developed. PPH (34%), sepsis (33.7%), abruption (27.9%), PIH (17.4%), uterine rupture (11.6%), HELLP (8.13%), placenta previa (2.66%), and embolism (1.33%) were the most common causes of DIC (Figure 1).

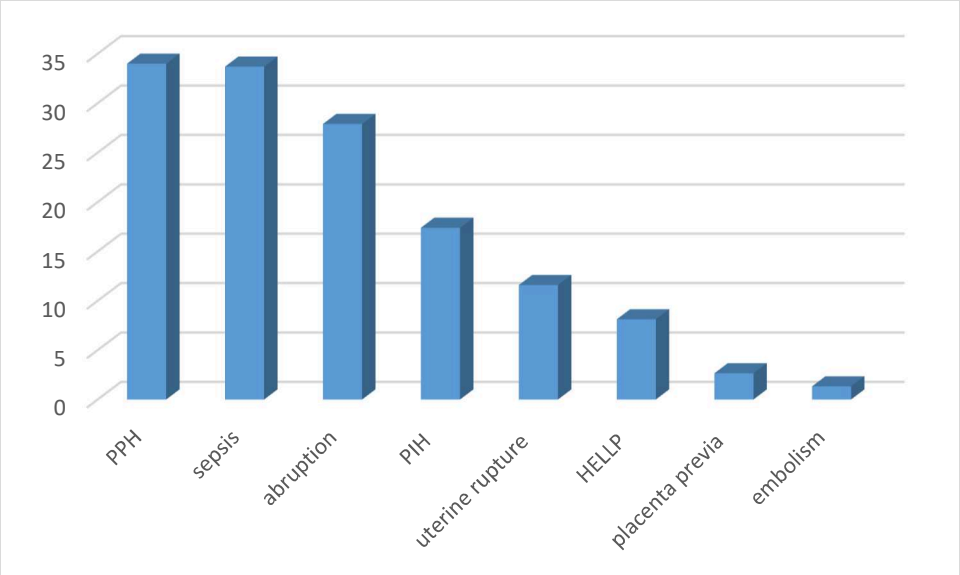


Figure 1. Etiology of DIC

The main causes of DIC in vaginal deliveries are atonic PPH and septicemia, whereas abruption, placenta previa, and intrapartum hemorrhage cause DIC in cesarean sections. The most frequent causes of a caesarean section were severe preeclampsia/eclampsia, abruption, and placenta previa. A cesarean was required in each of these situations (Figure 2).

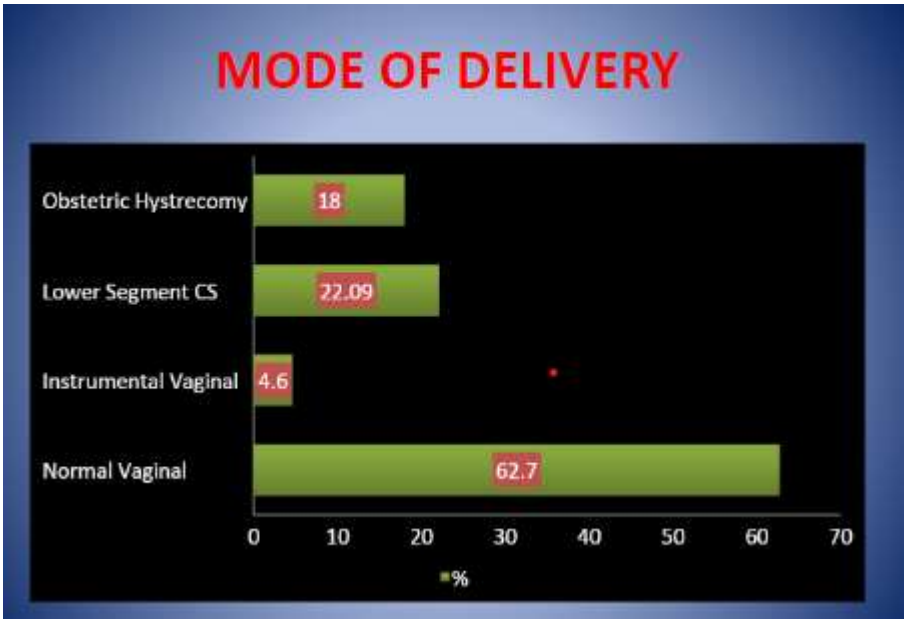


Figure 2. Mode of delivery

In the current study, 22% of patients had a caesarean section, 62.7% had a vaginal delivery, 58% needed to be admitted to the intensive care unit, 32% received a huge blood transfusion, 18% had a hysterectomy, and 9.3% had dialysis. Compared to other causes, hemorrhage (85%) and abruption (56%) require more extensive blood transfusions (Figure 3).

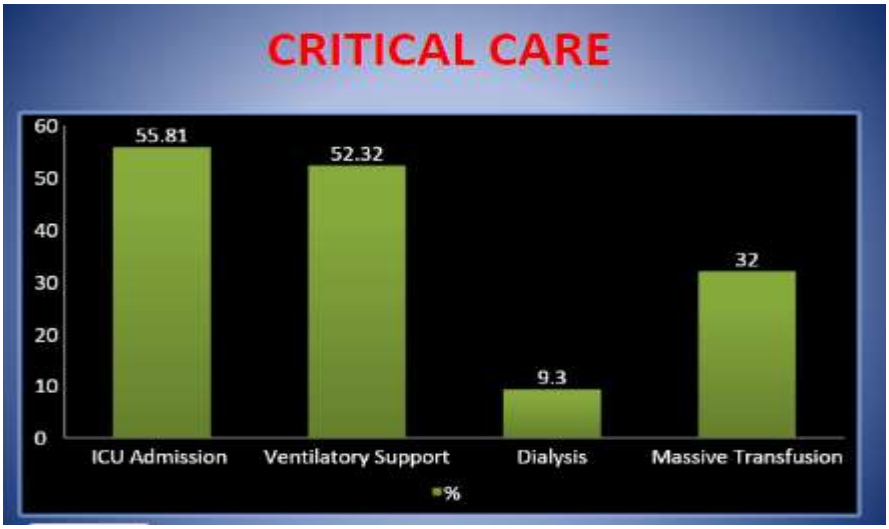


Figure 3. Critical care

In the majority of instances, medical therapy, surgery, and blood product replacement were employed, as shown in statistics 3 and 4 (Figure 4).

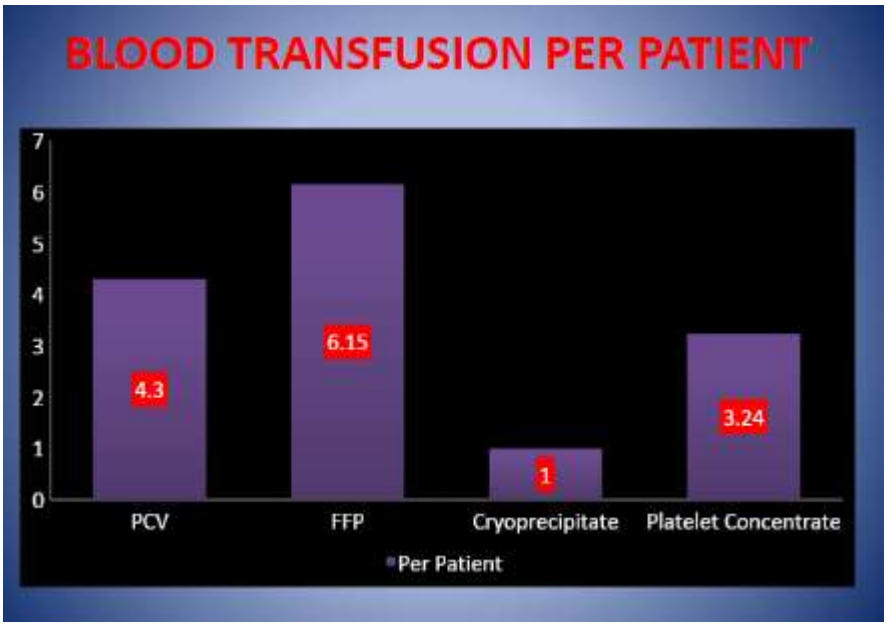


Figure 4. Blood transfusion per patient wise distribution

In addition to uterotonics that include oxytocin (100%), misoprostol (40%), ergometrine (20%), and prostaglandins (37%), antibiotics (100%) and inotropic support (44%). Blood and blood products were administered to nearly every patient. The largest rate of transfusions of blood and blood products occurred after hemorrhage, which was followed by abruption (Figure 5).

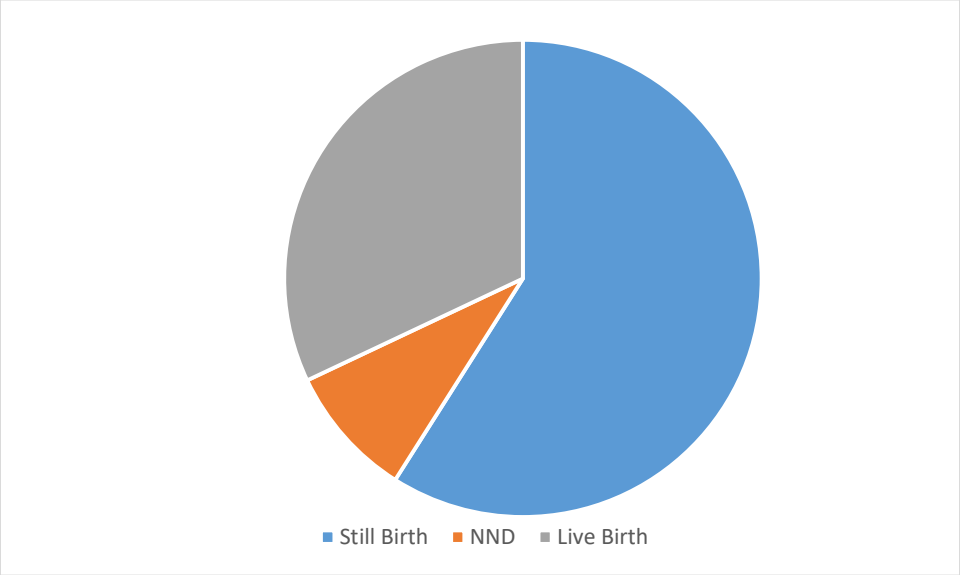


Figure 5. Perinatal out come

Ninety moms gave birth to a total of ninety babies, of which 53.3% were stillborn, 8.13% were NND, and 29% were live births. In our study, 17% of maternal deaths have a case fatality of 16%, meaning that 1 patient out of every 6 was at risk of passing away. Six (80%) of the eight were emergency patients, while only two (20%) were booked patients. The case fatality rate was greater (10%) for emergency patients than for scheduled patients (6%), which may indicate that maternal outcomes are impacted by prenatal treatment. Haemorrhage accounted for 50% of deaths most frequently.

Discussion

In our institute, the prevalence of DIC was 3% from January 2012 to December 2025. Accurate DIC incidence is unknown due to the multiplicity of criteria and the varied severity of the condition. Our investigation was contrasted with Rattray et al.'s investigation.14principal causes of DIC in the current investigation. The most frequent causes of DIC were placenta previa (2.66%), embolism (1.33%), uterine rupture (11.6%), HELLP (8.13%), abruption (27.9%), PIH (17.4%), PPH (34%), and sepsis (33.7%). Here, hemorrhage refers to blood loss brought on by damage to the

vaginal canal, uterine atonicity, or placenta previa. My research yielded no instances of AFE. The causes of DIC in the study by Rattray et al. matched our findings: PPH (29%), AVH (8%), sepsis (6%), preeclampsia (14%), and abruption (37%).14 in the current study, caesarean section was performed on 22.9% of patients, vaginal delivery on 62.7% of patients, ICU admission was necessary for 55.81% of patients, massive blood transfusion was administered to 32% of patients, hysterectomy was performed on 18% of patients, and dialysis was performed on 9.3% of patients. This was in good comparison to a study by Rattray et al., which performed caesarean sections on 22 (44%) and vaginal deliveries in 27 (66%) patients, ICU admission was necessary for 20 (41%), and dialysis was performed on 41% of patients. 29 (59%) patients received major blood transfusions, 9 (18%) had hysterectomy procedures, and 3 (6%), dialysis. Hemorrhage (85%) and abruption (56%) require more significant blood transfusions than other causes.

Blood and blood products were administered to nearly all of the patients (a total of 487 units of blood products and 177 units of blood). The highest rate of transfusion of blood and blood products was observed in cases of hemorrhage, which was followed by abruption. Six maternal deaths in all occurred in our analysis, of which only two were scheduled patients and four were emergency cases. In my study, hemorrhage accounted for 50% of the deaths, followed by severe preeclampsia/eclampsia (25%), and septicemia. These findings suggest that hemorrhage is still the primary cause of maternal morbidity and fatality. The current study has limitations because it was a single-centric investigation with a limited sample size. Therefore, the findings might not apply to the entire nation.

Conclusion

Plasma is life-saving. Thirty days and 48 hours after starting FFP, MMT decreased the overall amount of blood products used. Preventative cardiopathy is crucial because the majority of deaths occur within six hours! It's interesting to note that the maternal mortality rate for DIC related to placental abruption and other reasons is less than 1%, compared to 76% and 23% for hemorrhagic shock and sepsis, respectively. This means that early referral to a tertiary care center can potentially save one or both lives. As a result, we need to approach illnesses known to induce DIC with a high degree of suspicion because, left untreated, modest DIC can quickly develop into fulminant hemostatic failure. Since DIC is always a secondary event, managing it mostly involves identifying and eliminating the trigger as well as offering supportive care.A mother's life can be saved by early detection and intensive treatment for diabetic ketoacidosis (DIC), a late manifestation of obstetric disease.

Statements and Declarations

Conflicts of interest

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

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REVIEW ARTICLE

Significance of Preventive Health Checkups in Enhancing Well-Being: A Comprehensive Review

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Abstract

Background and Aims: Preventive health checkups (PHC) are crucial in modern healthcare, aimed at early detection of health risks to facilitate timely intervention. This review evaluates the significance and impact of PHC in enhancing individual well-being in light of increasing lifestyle and environmental health risks. **Methods:** A comprehensive review of current literature on PHC was conducted, analyzing studies related to early disease detection, intervention, and health promotion. **Results:** PHCs empower individuals by identifying potential health risks before symptoms manifest, enabling proactive lifestyle modifications. The Centre for Disease Control also supports routine preventive measures, correlating them with improved health indicators. Research indicates that annual physical examinations can significantly lower all-cause mortality risk by 45% and improve chronic disease recognition, though some studies did not find a reduction in overall mortality. Factors influencing PHC effectiveness include financial literacy and targeted interventions for high-risk populations. Concerns regarding inappropriate use of PHC exist, with potential issues of over-diagnosis and false results highlighted in the literature. **Conclusions:** Preventive Health Checkups plays a vital role in early detection of health issues and promotion of overall well-being. While not a substitute for a healthy lifestyle, PHCs can complement healthy habits by providing essential insights. Future public health initiatives should focus on targeted PHC for individuals who stand to benefit most, ensuring that resources are used efficiently and effectively to improve health outcomes.

Keywords: Preventive Health, Disease, Lifestyle Risk Factors, Chronic Disease Prevention, Health Screening, Public Health Policy, Non-Communicable Diseases

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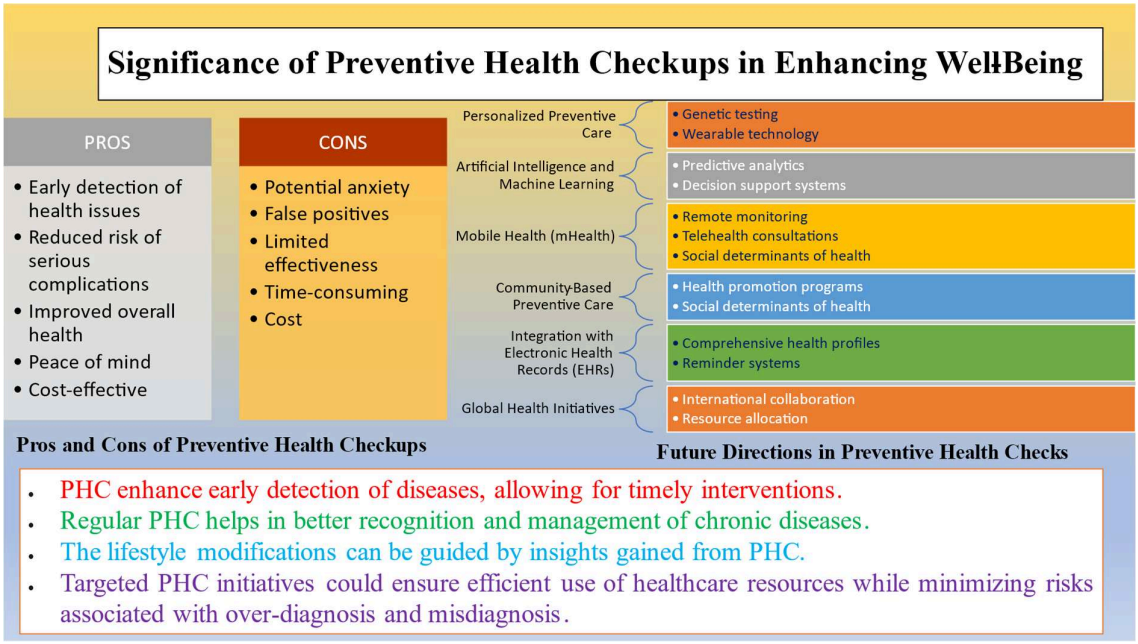
Graphical Abstract



Key Highlights

- Preventive Health Checkups (PHC) enhance early detection of diseases, allowing for timely interventions that can lead to improved health outcomes.
- Regular PHC helps in better recognition and management of chronic diseases, contributing to reduced morbidity and mortality, especially in high-risk populations.
- The lifestyle modifications, such as diet and exercise, which can be guided by insights gained from PHC, help in promoting overall well-being.
- There is a need for targeted PHC initiatives that focus on individuals who would benefit the most, ensuring efficient use of healthcare resources while minimizing risks associated with over-diagnosis and misdiagnosis.

1. Introduction

Preventive health checkups (PHC) form an indispensable pillar of modern healthcare. These routine evaluations aim to identify potential health risks early on, allowing for timely intervention and prevention of serious illnesses. The PHC serves as a proactive approach to healthcare, empowering individuals to take control of their well-being. By detecting diseases or conditions in their early stages, these screenings offer a greater chance of successful treatment and improved outcomes. One of the primary advantages of PHC is its ability to identify potential health risks before symptoms manifest, giving individuals a sense of control and the opportunity to take proactive measures. This early detection allows for lifestyle modifications, dietary changes, or medical interventions to mitigate risks and reduce the likelihood of developing chronic diseases. Furthermore, PHC plays a crucial role in maintaining overall health and well-being. Regular checkups can also help to alleviate anxiety and stress associated with unknown health conditions [1-5].

The National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP) of the Centers for Disease

Control and Prevention (CDC), USA, are supportive of routine preventive care like blood pressure checks and cancer screenings, as they believe it can help detect problems early. CDC is committed to linking medical care to community resources that can help people prevent or slow down chronic diseases, avoid complications, and reduce the need for more health care. Their efforts have led to improvements in leading health indicators like high blood pressure control, physical activity, and teen pregnancy [1]. Lal et al., in a cross-sectional study, concluded that PHCs are an essential component of healthcare, as they can detect diseases early and thereby help reduce morbidity and mortality. Furthermore, they reported that financial literacy promotes PHC usage and helps reduce risky health behaviors like smoking, lack of exercise etc [2].

Pathak et al., in a meta-analysis, reported that annual physical examination was significantly associated with a 45% lower hazard of all-cause mortality for all participants [3]. Krogsboll et al., in a systematic review, found that health checks helped in a 20% increase in new diagnoses. However, they did not find the PHC to reduce morbidity or mortality [4]. Lis et al. also did not find PHC to reduce mortality or cardiovascular events. However, they found that they were associated with ‘increased chronic disease recognition and treatment, risk factor control, preventive service uptake, and improved patient-reported outcomes’ [5].

The PHC involves a comprehensive assessment of an individual's physical and mental health. This may include routine screenings for conditions like diabetes, high blood pressure, cholesterol levels, and certain types of cancer. Additionally, these checkups can provide insights into lifestyle factors such as diet, exercise habits, and stress levels, which play a significant role in maintaining optimal health. While PHCs offer numerous benefits, they are not a substitute for a healthy lifestyle. Regular exercise, a balanced diet, and adequate sleep remain fundamental to maintaining good health. The PHC can complement these healthy habits by providing valuable insights and guidance.

Despite the apparent benefits of PHC, there have been concerns and doubts about its efficacy for the general population. Honnekeri et al. commented that an 'inappropriate use' of PHC is not beneficial as it is not only a financial and resource burden but may also lead to over-diagnosis and treatment and sometimes wrong diagnosis due to false-positive and negative results [6]. Krogsboll et al. also did not support the use of PHC in a general population. However, they advised for the continuation of public healthcare initiatives [5]. Khera et al. found limited and heterogeneous benefits of PHC. However, they can help in improving health behaviour and educate patients [7]. Christoffersen et al. advocated ‘Targeted' PHC for those who would benefit from attending and have adequate resources [8]. Si et al. observed the usefulness of PHC in high-risk patients [9].

This review aims to evaluate the significance and impact of PHC in enhancing individual well-being amidst increasing lifestyle and environmental health risks. It synthesizes current literature and practices surrounding PHC, assessing their role in early detection, intervention, and overall health promotion. The review also examines the benefits and potential drawbacks of these checkups, considering factors such as cost, time, and psychological impacts. It identifies

populations that would benefit most from regular screenings and outlines the essential components of comprehensive checkups.

2. Methodology

A comprehensive review of the literature regarding preventive health checkups (PHC) was done from 1st to 8th December 2024 to ensure scientific rigour and comprehensive coverage of the topic. The literature search was conducted across multiple academic databases, including PubMed, Scopus, Embase, Google Scholar, and databases specific to public health and preventive medicine, such as the Cochrane Library. The search strategy included a combination of keywords and phrases pertaining to preventive health checkups, such as "preventive health screenings," "early detection," "health promotion," "chronic disease prevention," and "healthcare policy." The search was limited to articles published in English.

We included only peer-reviewed articles, systematic reviews, meta-analyses, and clinical guidelines, focusing on diverse populations, including high-risk groups such as those with familial predispositions or lifestyle risk factors. Research that directly addressed the significance, outcomes, or components of preventive health checkups or related interventions was included. We excluded non-peer-reviewed articles, grey literature such as opinion pieces and editorials, and studies that did not specifically address PHC or that focused solely on treatment methods rather than preventive strategies.

Once the relevant articles were identified based on the established criteria, data extraction was performed. Essential information, including study design, population demographics, health outcomes measured, types of checkups evaluated, and overall conclusions were documented.

3. Results and Discussion

3.1 Who Should Undergo Preventive Health Checkups?

The PHC are advisable for everyone, but specific groups may benefit more from regular screenings based on their health risks (Figure 1). Individuals with a family history of diseases such as heart disease, diabetes, cancer, or hypertension are at a higher risk and should consider frequent checkups. Those engaging in unhealthy behaviours, like smoking, excessive alcohol use, poor diet, or insufficient physical activity, should prioritize preventive care to mitigate their increased risk of health issues.

As the risk of chronic diseases escalates with age, individuals over 40 should undergo regular checkups to identify and manage potential health concerns, while those with existing medical conditions, including diabetes, hypertension, or heart disease, require regular monitoring to prevent complications. Additionally, gender-specific screenings are recommended at specific intervals, such as mammograms and Pap smears for women and prostate exams and colonoscopies for men, to help detect potential health issues early.

Evidence-based recommendations suggest that young adults prioritize annual physicals, Sexually Transmitted Infections (STI) screenings, and mental health check-ins. In contrast, middle-aged adults should focus on annual physicals, cancer screenings (colonoscopy, mammogram, PSA test), and cardiovascular risk assessments. Older adults should continue regular cancer screenings, including osteoporosis screening, and vision and

hearing should be monitored. Ultimately, family history, lifestyle factors, and individual health needs influence the frequency and type of screenings, making it crucial to consult with a healthcare provider for personalized recommendations. Regular PHCs are considered essential for the early detection and prevention of diseases, contributing to improved health outcomes.

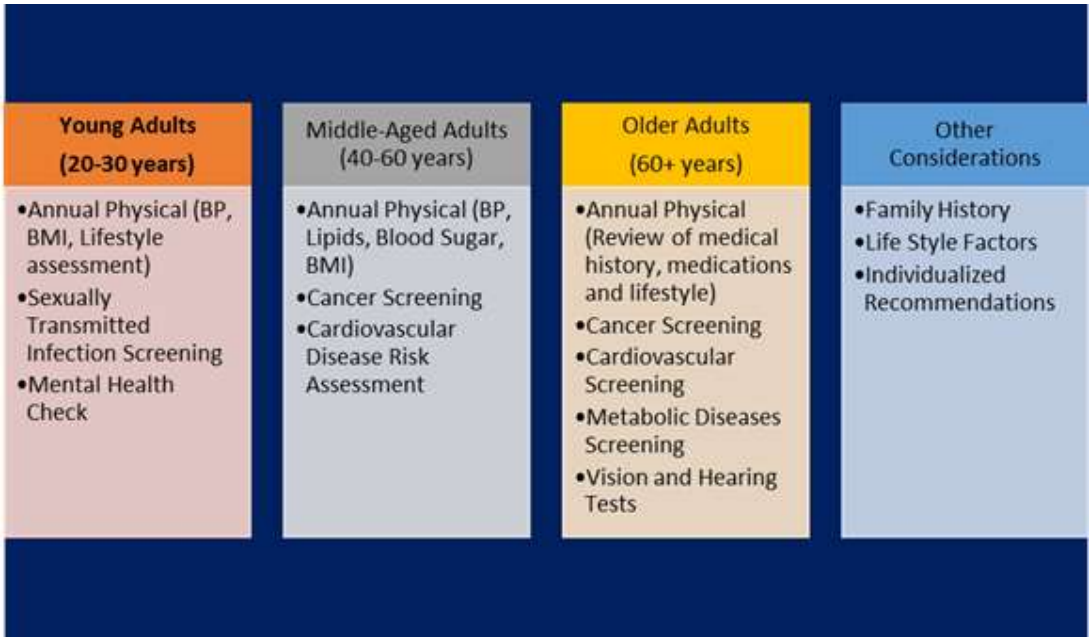


Figure 1. Preventive Health Checks for different age groups

3.2 Common Conditions Detected by Preventive Health Checks

The PHC is crucial in the early identification and management of a wide array of health conditions, significantly improving the effectiveness of treatments (Table 1). These checks can uncover cardiovascular issues such as hypertension, dyslipidemia, and heart disease. They are also vital in detecting diabetes, particularly type 2 diabetes (T2D) before serious complications arise. Furthermore, they play a vital role in the early discovery of various cancers, including breast, cervical, colon, prostate, skin, and potentially lung cancer for high-risk groups, through recommended screenings like mammograms, Pap smears, colonoscopies, and low-dose CT (Computed Tomography) scans. Besides these, preventive screenings can identify kidney and liver disease, thyroid disorders, osteoporosis, and sexually transmitted infections, which can all benefit from early intervention.

Preventive health checkups play a pivotal role in managing non-communicable diseases (NCDs). The NCDs are a major global health challenge, claiming the lives of 41 million people annually, constituting 74% of global deaths. Seventeen million people succumb to NCDs before reaching the age of 70, with a disproportionate 86% of these premature deaths occurring in LIC and LMICs, with

77% of all NCD deaths reported from these regions. Cardiovascular diseases emerge as the leading cause of NCD mortality, accounting for 17.9 million deaths yearly, followed by cancers (9.3 million), chronic respiratory diseases (4.1 million), and diabetes (2.0 million, including diabetes-related kidney disease deaths). Together, these four disease groups contribute to over 80% of all premature NCD deaths. Risk factors such as tobacco use, physical inactivity, harmful alcohol consumption, unhealthy diets, and air pollution significantly elevate the likelihood of NCD-related mortality [10]. Effective responses to NCDs necessitate a multifaceted approach encompassing detection, screening, treatment, and palliative care. Sathiyamoorthi et al. studied 337 participants from Southern India who underwent a routine PHC and detected 12.3% with T2D and 37.7% with prediabetes. In addition, 54.1% were found to have anaemia, 42.2% with dyslipidemia, 11.5% with hypothyroidism, 27% with liver disorders and 6.5% with renal disorders. These cohorts were not aware of these underlying conditions [11].

Global health initiatives by organizations like the World Health Organization (WHO) and the United Nations (UN) aim to combat NCDs by promoting healthy lifestyles, ensuring timely access to healthcare, and addressing social determinants of health to reduce inequalities. Addressing the underlying risk factors and promoting PHC are critical strategies for significantly reducing the burden of NCDs and improving global health outcomes.

Table 1: Common Conditions Detected by Preventive Health Checks

Condition	Description
Cardiovascular conditions	Hypertension, dyslipidemia, heart disease.
Diabetes	Type 2 diabetes (T2D).
Cancer	Breast cancer, cervical cancer, colon cancer, prostate cancer, skin cancer, lung cancer.
Other conditions	Kidney disease, liver disease, thyroid disorders, osteoporosis, sexually transmitted infections

Some case scenarios illustrate how individuals successfully leveraged insights from PHC to improve their health outcomes:

- A 45-year-old man used early detection of prediabetes during his PHC to adopt healthier lifestyle changes, preventing T2D.
- A woman in her late 30s benefited from routine screenings that led to the early detection of breast cancer, allowing for timely treatment.
- A 60-year-old woman, informed of her high blood pressure, engaged in dietary changes and stress management techniques, significantly improving her health.
- A 50-year-old man who lowered his cholesterol through lifestyle adjustments and a young woman who recognized and sought help for her

mental health challenges following screening.

- A 55-year-old man benefitted from a colonoscopy prompted by PHC discussions, resulting in the removal of precancerous polyps.

These case scenarios highlight the valuable role of PHC in facilitating proactive health decisions and improving overall well-being.

3.3 Essential Components of Preventive Health Checkups

Comprehensive PHC encompasses a variety of essential components aimed at assessing and promoting overall health **(Table 2)**. It starts with a physical examination, which includes measuring vital signs (e.g., blood pressure, heart rate, respiratory rate, and temperature), along with evaluating body mass index (BMI) to determine weight status. The physical exam also involves a thorough evaluation of different body systems, including the heart, lungs, abdomen, and skin. Laboratory tests play a crucial role, with blood tests assessing various markers like blood cell counts, cholesterol, glucose levels, and kidney and liver function. Urinalysis is conducted to detect signs of infection, kidney disease, or other conditions.

Screenings are tailored based on age and risk factors, including cancer screenings like mammograms, Pap smears, colonoscopies, and prostate exams, as well as cardiovascular screenings such as electrocardiograms (ECG) and lipid profiles for cholesterol levels, diabetes screenings through blood tests, and bone density tests for osteoporosis risk.

Additionally, a health history and lifestyle assessment are conducted to review medical and family health history, as well as lifestyle factors such as diet, exercise habits, smoking, alcohol consumption, and stress levels. Health education and counselling provide valuable information on healthy lifestyle choices, disease prevention, and support for making lifestyle changes.

Table 2. Preventive Health Checkup Components

Component	Description
Physical Examination	Measurement of vital signs, height, weight, and evaluation of body systems.
Laboratory Tests	Blood tests, urinalysis, and other diagnostic tests.
Screenings	Cancer screenings, cardiovascular screenings, diabetes screening, and others.
Health History and Lifestyle Assessment	Review of medical history, family history, and lifestyle factors.
Health Education and Counselling	Providing information and guidance on healthy lifestyle choices.
Specialized Screenings	Genetic testing, advanced imaging techniques, and functional medicine screenings.
Early Detection Techniques	Liquid biopsies, biomarkers, wearable health devices.
Personalized Lifestyle Recommendations	Nutrigenomics, personalized exercise plans, stress management techniques.

Advancements in PHC offer a more in-depth approach, incorporating specialized screenings like genetic testing and advanced imaging techniques to identify predispositions to diseases and detect abnormalities early. Early detection techniques such as liquid biopsies and biomarkers, along with wearable health devices, help in monitoring health metrics for potential issues. Personalized lifestyle recommendations, including nutrigenomics for dietary advice based on genetic makeup, personalized exercise plans, and stress management techniques, contribute to a tailored approach to preventive care. These advanced checkups (Table 2) aim for increased early detection, personalized care, and proactive health management, although they might involve higher costs and require specialized expertise.

The following examples illustrate the wide-ranging impacts of PHC across various demographics and health conditions, emphasizing their importance in promoting long-term health and well-being.

- *The Diabetes Prevention Program (DPP):* The DPP was a landmark study that demonstrated the effectiveness of preventive health measures in reducing the incidence of T2D among high-risk individuals. Participants with elevated blood sugar levels were assigned to either a lifestyle intervention group or a control group. Those in the lifestyle intervention group engaged in regular physical activity received dietary counselling and achieved modest weight loss. Results showed that participants in the lifestyle group had a 58% reduction in the development of diabetes over three years, emphasizing the importance of early detection and proactive lifestyle changes [12]. Gilmer and O'Connor highlighted the need for early detection of diabetes and prediabetes through screening [13]. Duan et al. suggested economic models supported targeted screening for diabetes and prediabetes [14].
- *Breast Cancer Screening in Women:* Numerous studies have underscored the effectiveness of routine mammograms in detecting breast cancer at an early stage when treatment is most effective. For example, a 2019 study published in JAMA Oncology indicated that women who underwent regular mammography screenings had a 40% lower likelihood of dying from breast cancer compared to those who did not participate in screenings. This case highlights the critical role of preventive health checkups in early detection and the potential for better health outcomes [15].
- *Cardiovascular Risk Assessments:* A case study involving a cohort of middle-aged adults showed that regular cardiovascular risk assessments, including cholesterol and blood pressure monitoring, led to significant reductions in heart disease and stroke incidents. Participants who received tailored advice based on their risk profiles implemented lifestyle modifications, such as improved diet and increased physical activity, resulting in a 30% decrease in heart disease rates over five years compared to a control group that did not have regular assessments [16].
- *HPV Vaccination and Cervical Cancer Screening:* In a public health initiative focusing on young women,

a combination of HPV vaccination and regular cervical cancer screenings demonstrated a marked impact on reducing the incidence of cervical cancer. A study showed that communities that implemented both strategies saw a significant drop in cervical cancer rates, highlighting the importance of not just screening but also preventive measures like vaccinations as part of a comprehensive health approach [17,18].

- *Mental Health Screenings:* A program aimed at college students incorporated regular mental health screenings into student health services. This initiative led to the early identification of anxiety and depression among students who may otherwise have gone untreated. The implementation of counselling services and wellness programs resulted in increased help-seeking behaviour and improved mental health outcomes, illustrating the importance of preventive health checkups in recognizing and addressing psychological conditions [19].
- *Pediatric Preventive Care:* A case study focusing on pediatric preventive care demonstrated that children who received regular well-child visits and screenings were more likely to have timely vaccinations and early identification of developmental delays. These early interventions helped reduce long-term health issues and ensure better overall development, emphasizing the lifelong benefits of preventive health care starting from a young age [20].

3.4 Pros and Cons of Preventive Health Checkups

The PHC offer several advantages, including the early detection of potential health issues when they are typically easier to treat, reducing the risk of severe complications from untreated conditions, and promoting overall health by encouraging healthy lifestyle choices and informed health decisions. They also provide a sense of peace of mind through proactive health management. In the long term, these checkups can be cost-effective by preventing the need for more expensive treatments for advanced diseases [1-5].

However, there are downsides to consider [6-8]. Some individuals may experience anxiety at the prospect of undergoing screenings, and there is the potential for false positives, which can lead to unnecessary stress and further testing. While beneficial, PHC might not prevent all health problems. They can also be time-consuming and involve upfront costs, which may be a barrier for some people. Overall, the benefits of PHC generally outweigh the cons, but it is essential to consider these factors when planning for healthcare (Figure 2).

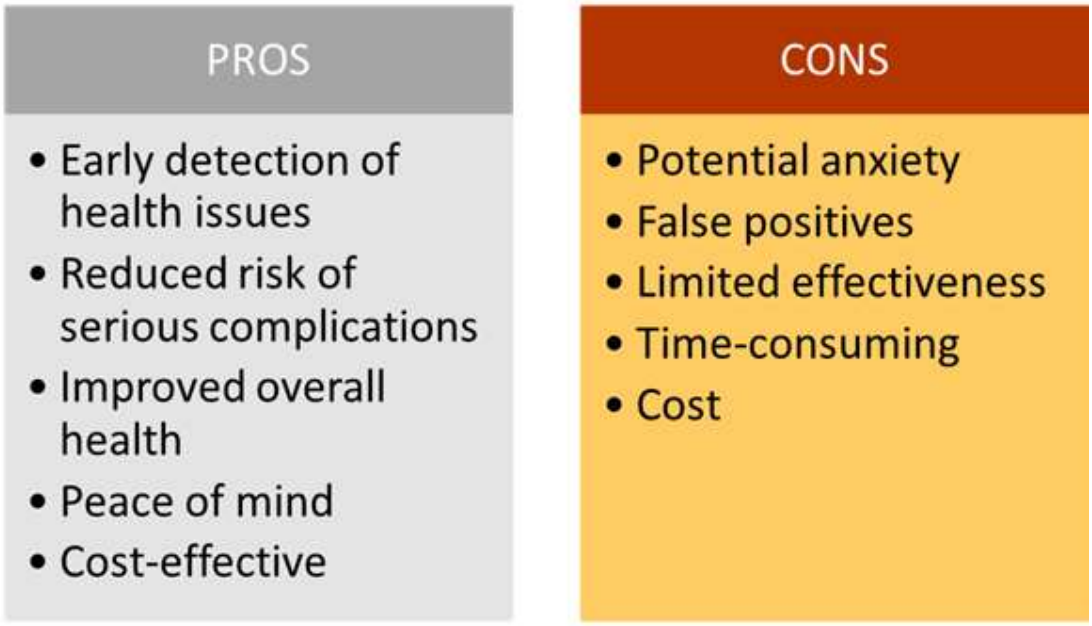


Figure 2. Pros and Cons of Preventive Health Checkups

3.5 Prevalence of Preventive Health Checks Worldwide

The prevalence of PHC worldwide shows significant variation across regions, primarily influenced by economic development, healthcare infrastructure, cultural beliefs, and government policies. In high-income countries (HICs), PHCs are well-established and widely accessible, supported by government-funded programs and health insurance coverage that make preventive care more affordable. Middle-income countries (MICs) display a varying prevalence of such checks, with some nations advancing through government initiatives. However, financial barriers and limited access in certain areas persist, especially for low-income populations. Low-income countries (LICs) face the most challenges, with PHC being less prevalent due to limited healthcare resources and infrastructure, financial constraints, and notable disparities between urban and rural areas [21-23]. Langlois et al. believed that primary healthcare is cost–effective in achieving universal health coverage (UHC). However, these systems are not robust in many LICs and LMICs and, therefore, fail to provide comprehensive, people-centred, integrated care. They observed several challenges and limiting factors like the increasing burden of NCDs, under-resourced and poorly supported healthcare infrastructure, 40% of healthcare expenses were borne as out-of-pocket expenditure and inadequate health insurance schemes [21]. Cultural factors also play a significant role in the uptake of preventive health checks in these countries.

Globally, there is an increasing awareness of the importance of preventive health, spurred by international initiatives from organizations like the WHO and the World Bank, aimed at promoting preventive health and reducing NCDs. The expansion of digital health technologies, such as telemedicine and mobile health applications, is also improving access to preventive care, particularly in remote areas. Despite the progress being made in

many MICs and LICs, continued efforts are necessary to overcome the challenges that remain and ensure that everyone, regardless of their location or economic status, has the opportunity to benefit from preventive health care.

Around the world, countries have implemented various PHC programs tailored to their unique healthcare systems, economic capabilities, and public health needs. In HICs, such as the United States (US), the Affordable Care Act provides for no-cost annual checkups and screenings for insured individuals [24]. The National Health Service (NHS) of the United Kingdom (UK) offers accessible PHC, including screenings for cervical, breast, and bowel cancers [25]. The publicly funded healthcare system of Canada ensures universal access to preventive health services, including regular checkups and screenings [26].

The MICs and LMICs have also made strides in providing preventive health services. India's National Health Mission, encompassing the National Rural Health Mission and the National Urban Health Mission, focuses on primary healthcare services, including PHC, for rural and urban populations [27]. Brazil's public healthcare system, Sistema Único de Saúde, offers cancer screenings and cardiovascular checkups among its preventive health services [28]. South Africa's Department of Health promotes preventive health through initiatives like the National Health Insurance Scheme, aiming for universal healthcare access [29].

In LICs, efforts to enhance preventive health are ongoing. Kenya's National Health Strategy emphasizes improving access to preventive health care, particularly in rural areas [30]. Bangladesh's government has launched health programs focusing on maternal and child health, highlighting preventive care [31]. Nigeria's National Health Policy prioritizes primary and preventive care services, with efforts to improve access, especially in rural communities [32].

3.6 Disparities in Preventive Health Checks in HICs and LMICs

The disparities between HICs and LMICs in terms of PHC are significant, impacting public health outcomes (Table 3). In HICs, these checks are broadly available and accessible, supported by well-developed healthcare infrastructures and regular intervals of comprehensive screenings. Conversely, in LMICs, access is often hindered by economic, geographic, and infrastructural constraints, making preventive checks less comprehensive and more infrequent. Quality of care in HICs is generally high, driven by professional standards and modern equipment, whereas in LMICs, it varies widely due to resource limitations. While the cost in HICs is often offset by insurance or government programs, in LMICs, it poses a significant barrier, especially for those in poverty.

Table 3. Disparities in Preventive Health Checks Between High-Income Countries (HICs) and Low Middle-Income Countries (LMICs)

Factor	HICs	LMICs
Availability and accessibility	Wide availability and accessibility	Limited access due to factors such as poverty, geographic location, and lack of healthcare facilities.
Scope and frequency	Comprehensive checks, regular intervals	Less comprehensive checks, lower frequency.
Quality of care	High-quality of care	Varying quality of care, depending on resources and infrastructure.
Cultural factors	Generally supportive of preventive health	May have cultural beliefs or practices that hinder the acceptance of preventive care.
Cost	Often covered by insurance or government programs	It can be expensive for individuals, particularly those living in poverty.

Low Middle Income Countries (LMICs) face several challenges in implementing PHC, including limited financial and infrastructural resources, a shortage of healthcare professionals, and geographic barriers that exacerbate rural-urban disparities (Table 4). Cultural and social factors, alongside weak health systems and insufficient data, further complicate the delivery of preventive services. Global health challenges like pandemics and climate change strain these systems further. Addressing these issues requires a comprehensive approach, including increased healthcare investment, infrastructure improvement, enhanced access, and culturally sensitive health education, alongside international cooperation to strengthen LMICs' PHC capabilities.

Table 4. Challenges in Preventive Health Checks in Low-Middle-Income Countries

Challenge	Description
Limited resources	Financial constraints, infrastructure deficits, shortage of healthcare professionals.
Geographic barriers	Rural-urban disparities, infrastructure challenges.
Cultural and social factors	Health beliefs and practices, social inequalities, and lack of health education.
Health system challenges	Weak health systems, limited data and information.
Global health challenges	Pandemics, epidemics, climate change.

3.7 Solutions to Overcome Challenges in Preventive Health Checks in Developing Countries

To effectively address the challenges faced by developing countries in rolling out PHC, a comprehensive strategy that involves strengthening healthcare systems, expanding access to preventive care, addressing social determinants of health, improving cultural sensitivity, leveraging technology, and fostering international cooperation is needed (Figure 3).

Figure 3: Solutions to Overcome Challenges in Preventive Health Checks in Developing Countries

Investing in healthcare infrastructure, enhancing governance, and developing the healthcare workforce are crucial steps to strengthen healthcare systems. To expand access, community-based programs and mobile clinics could be established, and financial support and health insurance coverage for preventive care could be provided. Addressing social determinants requires efforts in poverty reduction, education, and gender equality to improve overall access to preventive care. Culturally sensitive approaches, including community engagement and collaboration with traditional healers, can help make preventive health programs more acceptable and effective. Technology, through telemedicine and mobile health applications, offers innovative ways to overcome geographical and logistical barriers, improving access to preventive services. Finally, international cooperation through partnerships and resource mobilization can support the implementation and expansion of preventive health programs in developing countries. Together, these strategies can enhance the delivery of PHC and improve public health outcomes.

3.8 Psychological Barriers to Adopting Preventive Health Practices

While the benefits of PHC are well-documented, numerous psychological barriers can impede individuals from engaging in these essential health practices (Figure 4).

Figure 4. Psychological Barriers to Adopting Preventive Health Practices

The major psychological barriers that hinder individuals from seeking PHC include fear of a potential diagnosis, health anxiety, and a perceived lack of control over health outcomes can lead to avoidance behaviors. Cognitive dissonance, where individuals hold conflicting beliefs about health, can also contribute to neglecting preventive care. Social influences and cultural norms can further discourage individuals from seeking medical attention. In a study from South India, it was found that only 1/3rd of the respondents have previously done PHC. The prominent barriers against getting a PHC were 'non-awareness, idleness, and uncomfortable testing, while the motivators are insurance or work-related factors, doctor's advice, and the presence of a health ailment' [33].

Additionally, the demands of modern life, including stress and time constraints, can make it challenging to prioritize preventive health. To address these barriers, we suggest strategies such as

education, counselling, community engagement, and patient-centred approaches. By understanding and mitigating these psychological factors, healthcare professionals can encourage individuals to prioritize preventive health and improve overall well-being.

3.9 The Role of the Private Sector in Preventive Health Checks in Developing Countries

The involvement of the private sector in providing PHC in developing countries is growing, driven by the expanding middle class and the corresponding increase in demand for healthcare services, including preventive care [10,34]. This trend is also fuelled by the profit potential private entities see in preventive health, encouraged by the global emphasis on the importance of such care and facilitated by technological advancements in medical diagnostics that enable affordable and accessible services. Private healthcare providers are increasingly establishing clinics and hospitals in both urban and rural areas, broadening the availability of preventive health services. Moreover, public-private partnerships (PPPs) are being formed, allowing governments and private entities to combine their strengths in delivering comprehensive preventive health services. In the realm of health insurance, private companies are creating affordable plans that cover preventive care, thereby expanding access to a more significant segment of the population.

Additionally, the private sector's investment in the development of innovative health technologies and diagnostic tools is enhancing efficiency and reducing the costs of preventive health checks. While the private sector's role in enhancing preventive health services in developing countries is significant, it is crucial to ensure that these services are equitably accessible to individuals across all income levels and geographic areas. To avoid the emergence of a two-tiered healthcare system, governments and international organizations need to strive for universal access to preventive care, ensuring that advancements in healthcare reach all segments of the population.

3.10 Research Gaps in Preventive Health Checkups

Despite the progress made in preventive healthcare, there are several areas where further research is needed to optimize the effectiveness and reach of PHC **(Table 5).** First, there is a need for more comprehensive studies on the long-term cost-effectiveness of these programs to better understand their financial sustainability and benefits over time. Additionally, more comparative studies between different models of PHC are needed, which could help identify the most efficient and practical approaches. Another area requiring attention is the development of tailored interventions that take into account individual risk factors, genetic predispositions, and lifestyle choices, as well as cultural and social determinants of health behaviour. This personalized approach to prevention could significantly enhance the efficacy of health interventions. The challenges of scaling up successful preventive health programs to benefit larger populations and ensuring their sustainability also demand further research. This includes identifying effective financing models and implementation strategies that can support the long-term operation of these programs.

Table 5. Research Gaps and Future Directions in Preventive Health Checkups

Research Gap	Future Direction
Cost-effectiveness studies	Conduct long-term cost-effectiveness analyses, compare different models, and explore personalized pricing strategies.
Tailored interventions	Develop personalized preventive health strategies based on genomics, lifestyle factors, and cultural preferences.
Implementation challenges	Scale up successful programs, ensure sustainability through adequate financing, and address cultural and social factors.
Global health inequalities	Address disparities through targeted interventions, community-based programs, and international collaboration.
Emerging health challenges	Develop preventive strategies for climate change, pandemics, and mental health.
Personalized preventive care	Integrate genomic medicine and digital health technologies into preventive checkups.
Expanding access	Implement community-based programs, mobile health units, and public-private partnerships.
Improving quality and effectiveness	Develop evidence-based guidelines, implement quality assurance measures, and promote professional development.
Addressing emerging health challenges	Develop preventive strategies for climate change, pandemics, and mental health.
Global health equity	Address disparities through targeted interventions, community-based programs, and international collaboration.

Moreover, addressing global health inequalities remains a pressing issue, with research needed to understand the barriers to access and develop strategies to ensure equitable distribution of preventive healthcare services across different regions and populations. Lastly, the emergence of new health challenges, including new diseases and risk factors, alongside the impact of rapidly changing environments such as climate change and urbanization, calls for ongoing research. This research should continually adapt and update preventive measures to meet evolving health needs.

Controversies surrounding PHC often arise from debates over the necessity and effectiveness of various screenings for different demographics. Critics argue that not all screenings are universally beneficial; some may lead to over-diagnosis or unnecessary anxiety, particularly in low-risk populations. For example, discussions about the appropriateness of routine mammograms or prostate cancer screenings have led to differing recommendations based on age, gender, and individual risk factors. There are concerns that blanket recommendations may not consider the nuances of personal health histories or the potential harms of false positives. Additionally, disparities in access to healthcare resources can further complicate the effectiveness of PHC, as not all communities have equal access to advanced screening technologies or follow-up care. As a result, while PHC are designed to promote health and prevent disease, the ongoing debates highlight the need for tailored screening guidelines and

individualized approaches that consider demographic and contextual factors to optimize health outcomes across diverse populations.

The effectiveness of PHC can vary significantly due to several factors that contribute to differing study outcomes. Variations in study design, participant demographics, frequency and type of screenings, and health literacy levels can all impact results. The effectiveness of PHC is also influenced by the quality of follow-up care, socioeconomic barriers, and psychological effects, such as anxiety related to health risk information. Additionally, issues like over-diagnosis and cultural attitudes towards health can further complicate their effectiveness. Understanding these complexities is essential for accurately assessing the roles of PHC in improving health outcomes and for guiding future public health initiatives.

3.11 Future Directions in Preventive Health Checkups

The landscape of PHC is on the brink of transformation, propelled by technological innovations, research breakthroughs, and evolving healthcare practices **(Figure 5).** A significant shift towards personalized preventive care is underway, with genetic testing and wearable technology at the forefront, enabling the identification of individuals at high risk for certain diseases and providing real-time health data [35-41]. Simultaneously, artificial intelligence (AI) and machine learning (ML) are revolutionizing preventive care through predictive analytics and decision support systems, enhancing the accuracy of health risk predictions and supporting healthcare providers in making informed care decisions. Further innovations include mobile health applications that offer remote monitoring and telehealth consultations, making preventive care more accessible and convenient. Community-based preventive care is gaining traction, emphasizing health promotion programs and addressing social determinants of health to tackle health disparities.

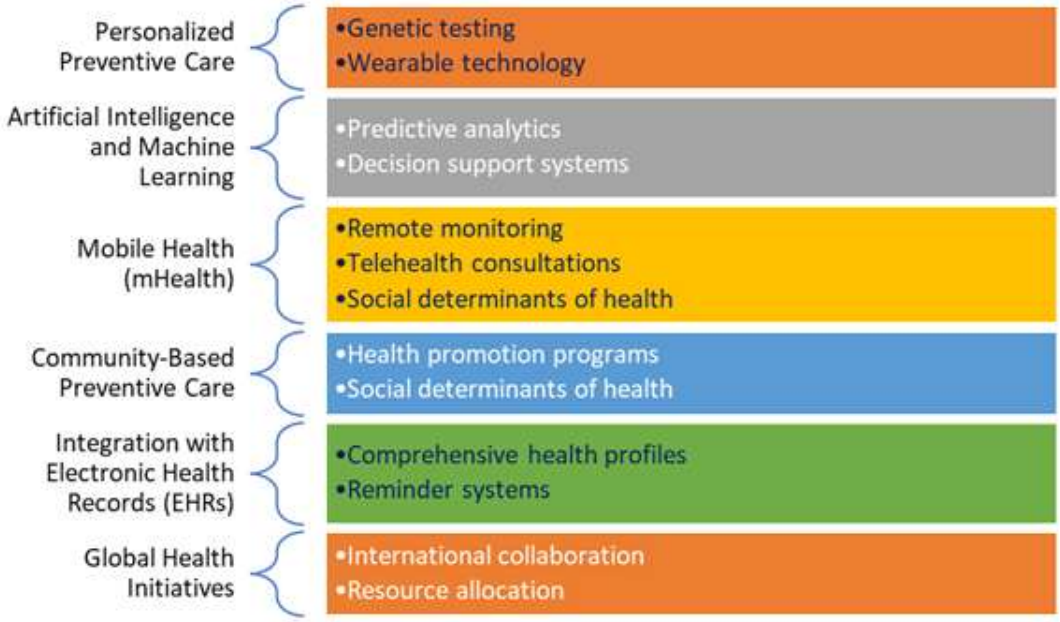


Figure 5. Future Directions for Preventive Health Checks

The integration of electronic health records (EHR) facilitates personalized care recommendations and automated reminders for screenings, while global health initiatives promote international collaboration and equitable access to preventive services. Despite these advancements, the future of preventive health checks face challenges, including concerns about data privacy, accessibility of technology, genetic discrimination, and the balance between personalized care and individual autonomy. Resource constraints, such as the cost of new technologies and a shortage of healthcare professionals, along with cultural and social factors like health literacy and beliefs, pose additional hurdles. Unintended consequences, such as an overreliance on technology and a false sense of security, also warrant attention. To navigate these challenges, a strategic, collaborative, and ethically grounded approach is essential.

PHC fit within larger public health strategies as essential tools for holistic health promotion, emphasizing early detection and proactive management of health risks. By integrating discussions about community health resources and support systems into the PHC framework, healthcare providers can enhance the effectiveness of these checkups, ensuring individuals have access to the resources needed to implement lifestyle changes and maintain their well-being. This comprehensive approach should enable communities to foster a culture of prevention, ultimately leading to healthier populations and reduced healthcare costs over time.

3.12 Limitations

Despite its comprehensive analysis, this review has several limitations that should be recognized. Firstly, the variability in study methodologies and definitions of preventive health checkups across the included literature can complicate the interpretation of results and reduce generalizability. Additionally, while the review highlights the potential benefits of PHC, it may not adequately address the long-term psychological impacts and the burden of healthcare costs associated with over-diagnosis and unnecessary treatments. Furthermore, the focus on high-risk populations may overlook the potential advantages for the general population, leading to an incomplete understanding of PHC's broader applicability. Lastly, the rapidly evolving nature of healthcare practices and public health policies means that the findings may require continual updating to reflect current evidence and trends in preventive care.

4. Conclusion

This review emphasizes the critical role of preventive health checkups (PHC) in enhancing individual well-being through early disease detection and intervention. The findings suggest that PHC can significantly decrease health risks and improve health outcomes, particularly when utilized by high-risk populations. While PHC is associated with better chronic disease recognition and treatment, some studies indicate it may not universally lower mortality rates. Furthermore, the review highlights that the efficacy of PHC is influenced by factors such as financial literacy and targeted healthcare initiatives. Despite concerns regarding over-diagnosis and resource allocation, PHC remains a valuable component of public health. Ultimately, a balanced approach combining routine checkups with healthy lifestyle

practices is essential for optimal health management.

Statements and Disclosures

Conflict of Interest

None of the authors have any competing interests to disclose.

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Ethical Approval

Not required for such bibliometric study

Data availability

The raw data is available with the corresponding author

Author's Contribution

RV: Conceptualization, Data Analysis, Literature Search, Manuscript writing, editing and final approval; AS: Conceptualization, Data Curation and Analysis, Literature Search, Manuscript writing, editing and final approval; SV, SK, SS, SSR: Data Curation and Analysis, Literature Search, Manuscript writing, editing and final approval; PCR: Conceptualization, Manuscript editing, and final approval.

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Use of AI tool

Authors declare to have used Grammarly software to enhance the grammar and readability of the article, but have rechecked its contents before submission. We take the full responsibility of the contents and confirm that all the tables and figures are original and have not been copied from any published sources.

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ORIGINAL ARTICLE

A Study on Screening for Deep Vein Thrombosis in Post Operative Patients

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Abstract

Introduction: Deep vein thrombosis (DVT), a significant post-operative complication leads to severe outcomes, including pulmonary embolism, which is often fatal. Several researches indicate that the prevalence of DVT varies geographically, with a comparatively lower prevalence among Asian populations compared to Western counterparts. Risk factors for DVT include malignancy, pregnancy, prolonged immobilization, and endothelial damage arising due to surgical interventions. This study aims to investigate the incidence of DVT in post-operative participants undergoing major abdominal surgeries and evaluate the associated risk factors so as to highlight the importance of timely prophylaxis and screening. **Methods:** This cross-sectional study was conducted at a tertiary care teaching hospital, among a total of 100 participants who underwent elective or emergency major abdominal surgeries for a time duration of minimum half an hour. A structure study proforma was used as a study tool, and the primary outcome of interest was the occurrence of DVT in the lower limbs, assessed using bilateral lower limb Doppler ultrasonography on postoperative days 3 and 5. Data were analyzed using SPSS version 27. **Results:** Our study observed that 21% of participants developed DVT, with the highest occurrence among those with pregnancy-related complications (100%), followed by trauma/injury (22.22%), and gastrointestinal perforations (19.04%). The duration of surgery was directly proportional to DVT occurrence. Additionally, none of the participants who received prophylactic low molecular weight heparin (LMWH) developed DVT. **Conclusion:** This study highlights the significant incidence of DVT in major abdominal surgery procedures, emphasizing the importance of early identification and preventive measures, particularly among high-risk subgroups. Routine DVT prophylaxis and targeted interventions to improve surgical outcomes and patient safety are to be considered in major abdominal surgeries.

Keywords: Deep vein thrombosis, prophylaxis, major abdominal surgery, risk factors

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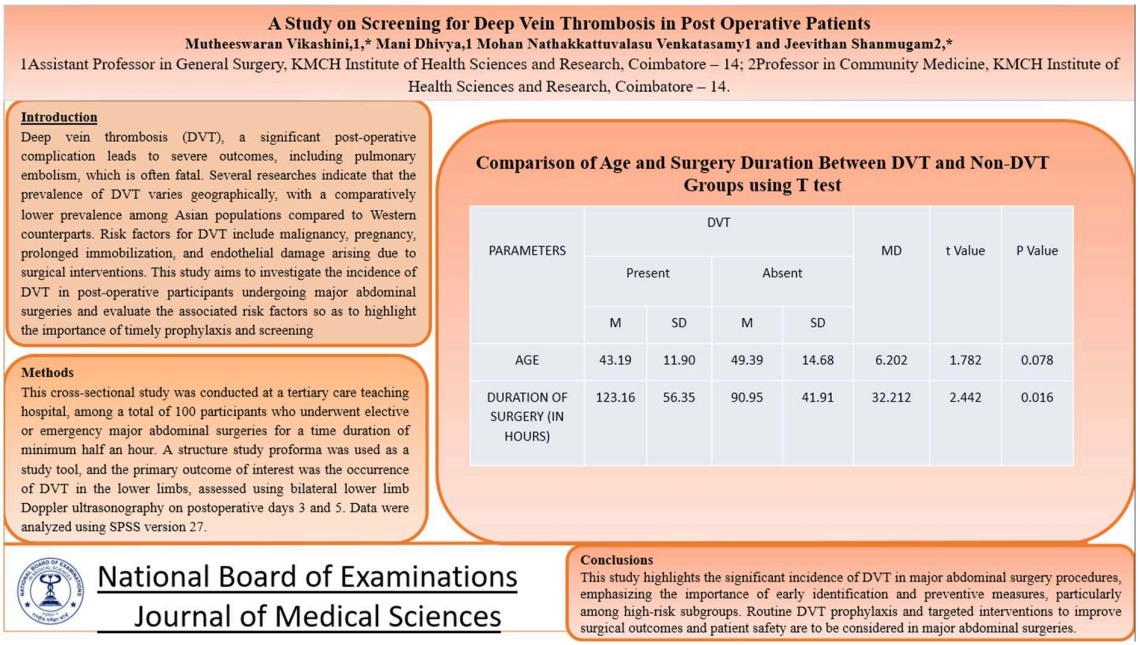
Graphical Abstract



Introduction

Deep vein thrombosis (DVT) a significant post-operative complication which may even lead to severe fatal outcomes including pulmonary embolism [1]. Studies indicate that the prevalence of DVT varies with ethnicity with Asian populations reporting lower incidences compared to Western counterparts [2,3]. Malignancy, pregnancy, prolonged immobilization, and endothelial damage from surgical interventions are major risk factors for DVT [2].

Deep vein thrombosis (DVT) s considered to occur due to the interplay of risk factors outlined in Virchow's triad: venous stasis, endothelial injury, and hypercoagulability. Prolonged immobility, surgery, trauma, cancer, obesity, and genetic predispositions such as Factor V Leiden are the common causes associated with the occurrence of DVT. Hormonal influences due to Pregnancy/oral contraceptives intake further increases the risk. The usual location of thrombus is in the lower limbs, with potential complications of pulmonary embolism and post-thrombotic syndrome [4].

Colour Doppler Ultrasound is regarded as the gold standard for DVT diagnosis. It is a non-invasive procedure and an effective means to identify asymptomatic cases and facilitate timely intervention [5]. Despite these advancements in diagnostic techniques and prophylaxis, DVT still goes undetected in high-risk participants due to the absence of symptoms [5,6].

Preventive strategies include the use of low molecular weight heparin (LMWH) which have been shown to significantly reduce the risk of thrombus formation in post-operative participants. However, the administration of prophylaxis varies, particularly in emergency surgeries, which affects the overall outcome [7,8]. This study aims was designed to find out the incidence of DVT in post-operative participants undergoing major abdominal surgeries, and

understand he associated risk factors among those undergoing major abdominal surgery.

Materials and Methods

The cross sectional study was conducted at a tertiary care teaching hospital, involving participants from the departments of General Surgery, Vascular Surgery, Surgical Gastroenterology, and Obstetrics and Gynaecology. Institutional Human Ethics Committee (IHEC) clearance was obtained prior to the start of the study and all ethical procedures were adhered to, including providing participants with a Patient Information Sheet (PIS) and obtaining written informed consent (IC). A total of 100 willing participants who underwent elective or emergency major abdominal surgeries lasting more than 30 minutes during the period from January 2019 to October 2020 were included in the study. Participants who underwent head, neck, and orthopaedic surgeries, those in the paediatric age group, those ambulated early, and those on anticoagulant therapy were excluded. Data were collected using a predesigned structured study proforma, which included demographic details, clinical variables, surgical details, and the administration of Low molecular weight Heparin (LMWH) as prophylaxis. The primary outcome of interest was the occurrence of deep vein thrombosis (DVT) in the lower limbs, which was assessed using bilateral lower limb Doppler ultrasonography on postoperative days 3 and 5. DVT was defined by the presence of a non-compressible, hyper-echoic thrombus in the venous column. Data were recorded in Microsoft Excel and analyzed using SPSS version 27. Categorical variables were expressed as percentages, and continuous variables as mean ± standard deviation. The chi-square test was used to evaluate associations between categorical variables, while the Student's t-test was applied for continuous variables, with a p-value of <0.05 considered statistically significant.

Results

A total of 100 participants were included in the study, with a mean age of 48.09 ± 14.33 years (range 17-79 years). The majority (70%, n=70) were males, with the highest age distribution in the 51-60 years group (31%). The mean duration of surgery was 116.40 ± 55.05 minutes, with most surgeries being of emergency type (80%) and a significant portion lasting 1-2 hours (38%). Prophylactic low molecular weight heparin (LMWH) was administered to 75% of the participants, while 25% did not receive it. Deep vein thrombosis (DVT) was detected in 21% of participants (n=21), with 95.23% of cases being unilateral and 4.77% bilateral; left-sided DVT was the most common (62%). Carcinoma-related complications (28%) and gastrointestinal perforations (21%) were the leading diagnoses (Table 1).

Table 1. Demographic and Clinical Characteristics of Study Participants and DVT Outcomes

		F	%
Age (in years)	Less than 20	2	2
	21-30	11	11
	31-40	22	22
	41-50	18	18
	51-60	31	31
	61-70	13	13
	More than 70	3	3
Sex	Male	70	70
	Female	30	30
Duration	Less than one hour	31	31
	1 – 2 hr	38	38
	2-3 hrs	23	23
	3- 4 hrs	8	8
Heparin	Given	75	75
	Not Given	25	25
Type of surgery	Emergency	80	80
	Elective	20	20
DVT	Present	21	21
	Not present	79	79
DVT side	Left	13	13
	Right	7	7
	Bilateral	1	1
Diagnosis	Carcinoma related Complication	28	28
	Gastro-intestinal Perforation (Gastric/DU/ Jejunum / Ileal)	21	21
	Trauma / Injury (Blunt injury or stab injury)	18	18
	Hernia related complication	8	8
	Pregnancy related complication	7	7
	Intestinal Obstruction	7	7
	Others	11	11

The study found that out of 100 participants, 21% developed deep vein thrombosis (DVT), with varying occurrence across different diagnoses. Notably, pregnancy-related complications had the highest DVT occurrence at 100%, followed by trauma/injury at 22.22%, gastrointestinal perforations at 19.04%, and carcinoma-related complications at 17.85%. Hernia-related complications and

intestinal obstructions showed no cases of DVT. Among the "Others" category, 9% experienced DVT. These results highlight the significant risk of DVT in specific conditions, particularly pregnancy-related complications, underscoring the need for targeted preventive strategies in high-risk groups (Table 2).

Table 2. Distribution of DVT based on diagnosis

Diagnosis	Frequency	DVT Occurrence	% of DVT
Carcinoma related Complication	28	5	17.85
Gastro-intestinal Perforation (Gastric/DU/ Jejunum / Ileal)	21	4	19.04
Trauma / Injury (Blunt injury or stab injury)	18	4	22.22
Hernia related complication	8	0	-
Pregnancy related complication	7	7	100.0
Intestinal Obstruction	7	0	0
Others	11	1	9%
Total	**100**	**21**	

The comparison of age and surgery duration between participants with and without deep vein thrombosis (DVT) revealed notable differences. The mean age of participants without DVT was higher (49.39 ± 14.68 years) compared to those with DVT (43.19 ± 11.90 years), but this difference was not statistically significant (MD = 6.202, t = 1.782, p = 0.078). However, the mean duration of surgery was significantly longer in participants with DVT (123.16 ± 56.35 minutes) compared to those without DVT (90.95 ± 41.91 minutes), with a statistically significant difference (MD = 32.212, t = 2.442, p = 0.016) (Table 3). The incidence of DVT is high in participants who underwent emergency surgeries for trauma, chronic obstruction, prolonged labour which is about 75% when compared to 15% in those who had elective surgeries. There is no significant difference in the incidence.

Table 3. Comparison of Age and Surgery Duration Between DVT and Non-DVT Groups using T test

PARAMETERS	**DVT**				**MD**	**t Value**	**P Value**
	Present		**Absent**				
	M	**SD**	**M**	**SD**			
AGE	43.19	11.90	49.39	14.68	6.202	1.782	0.078
DURATION OF SURGERY (IN HOURS)	123.16	56.35	90.95	41.91	32.212	2.442	0.016

The analysis revealed significant associations between gender, heparin administration, and the occurrence of deep vein thrombosis (DVT). A higher proportion of males were in the non-DVT group (75.9%) compared to the DVT group (47.6%), whereas females were more represented in the DVT group (52.4%) compared to the non-DVT group (24.1%). This difference was statistically significant ($\chi^2 = 6.341$, p = 0.012). Additionally, none of the participants who received heparin developed DVT, while all DVT cases (100%) occurred in participants who did not receive heparin, showing a highly significant association ($\chi^2 = 79.747$, p = 0.000). These findings highlight the protective effect of heparin prophylaxis and the potential influence of sex on DVT risk (Table 4).

Table 4. Association between Sex and Heparin Administration with DVT Occurrence using chi-square test

PARAMETERS	Sub category	DVT				CSV	P VALUE
		Absent		Present			
		F	%	F	%		
SEX	Male	60	75.9	10	47.6	6.341	0.012
	Female	19	24.1	11	52.4		
HEPARIN	Not given	4	5.1	21	100.0	79.747	0.000
	Given	75	94.9	0	0.0		
Procedure	Emergency	18	22.5	62	77.5	0.542	0.46
	Elective	3	15	17	85		

The incidence of DVT is high in participants who underwent emergency surgeries for trauma, chronic obstruction, prolonged labour which is about 22.5% when compared to 15% in those who had elective surgeries. There is no significant difference in the incidence.

Discussion

In our study, the mean age of participants was 48.09 ± 14.33 years, with the highest incidence of deep vein thrombosis (DVT) observed in the 51-60 years age group (31%). The risk of DVT is known to increase with age, particularly in individuals over 50 years, as also reported in studies conducted in South India and other parts of the country, which highlight similar age distributions for DVT occurrence [1,2]. Gender distribution revealed a male predominance (70%), yet a higher proportion of females developed DVT (52.4% of DVT cases) compared to males (47.6% of DVT cases). While males are traditionally considered at higher risk for DVT, certain risk factors like pregnancy, prolonged labor, and hormonal influences may contribute to the increased incidence in females [2,3].

The overall incidence of DVT in our cohort was 21%, which is higher than that reported in some Indian studies. For instance, a study conducted in South India documented a lower postoperative DVT incidence, possibly due to differences in surgical populations and varying use of prophylaxis [1]. Emergency surgeries had a higher incidence of DVT compared to elective surgeries, consistent with findings that acute conditions, limited preoperative

optimization, and associated comorbidities in emergency cases predispose participants to thrombus formation [4,5].

The study found that longer surgery durations were associated with a higher risk of DVT, with a mean duration of 90.95 ± 41.91 minutes in the non-DVT group compared to 123.16 ± 56.35 minutes in the DVT group ($p = 0.016$). Similar difference was observed in other studies [2,6].

A significant finding was that none of the participants who received prophylactic low molecular weight heparin (LMWH) developed DVT, while all cases occurred in participants who did not receive it ($p < 0.001$). This underscores the well-established effectiveness of LMWH in reducing thrombotic events, as corroborated by both national and international guidelines on venous thromboembolism management [3,7].

All the participants with pregnancy-related complications (100%), followed by trauma/injury (22.22%), gastrointestinal perforations (19.04%), and carcinoma-related complications (17.85%) had DVT. These conditions are associated with hypercoagulable states, venous stasis, and endothelial injury, which are the core components of Virchow's triad which leads to occurrence of DVT [2,8,9].

Conclusion

Deep Vein Thrombosis is one of the complications arising after a major abdominal surgery. The influence of risk factors such as emergency surgeries, pregnancy-related complications, trauma, and carcinoma on DVT occurrence has been well documented from this study also. The protective role of prophylactic low molecular weight heparin (LMWH) has also been established. Routine screening for DVT, LMWH in high risk patients undergoing abdominal surgeries are recommended.

Statements and Declarations

Conflicts of interest

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

Funding

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ORIGINAL ARTICLE

Comparative Study of Bupivacaine- Dexmeditomidine and Bupivacaine-Fentanyl with Bupivacaine Plain as Local Infiltration for Postoperative Analgesia After Abdominal Hysterectomy Under Subarachnoid Block

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Abstract

Introduction: Abdominal hysterectomy is a common surgical procedure associated with significant postoperative pain. Effective pain management is crucial to enhance recovery and reduce opioid dependency. Multimodal analgesia, including local wound infiltration with adjuvants, has been explored to optimize pain control. This study compares the efficacy of bupivacaine alone, bupivacaine with fentanyl, and bupivacaine with dexmedetomidine for postoperative analgesia in patients undergoing abdominal hysterectomy. **Materials and Methods:** This hospital-based observational study was conducted at MES Medical College over one year. A total of 81 patients undergoing elective abdominal hysterectomy under subarachnoid block were randomly allocated into three groups: Group B (20 ml of 0.25% bupivacaine), Group F (20 ml of 0.25% bupivacaine with 20 mcg fentanyl), and Group D (20 ml of 0.25% bupivacaine with 20 mcg dexmedetomidine). Postoperatively, hemodynamic parameters, pain scores using the Numeric Rating Scale (NRS), time to first rescue analgesia, and total rescue analgesic consumption were assessed over 24 hours. SPSS 15 was used for statistical analysis. A p value < 0.05 was considered as significant. **Results:** Among the groups, demographic characteristics and duration of surgery were comparable. Group D demonstrated a significantly prolonged duration of analgesia (5.4 ± 1.2 hours) compared to Group F (3.1 ± 1.1 hours) and Group B (2.6 ± 1.3 hours) ($p < 0.001$). The time to first rescue analgesia was longest in Group D (7.6 ± 1.5 hours) ($p < 0.001$). Total rescue analgesic consumption was lowest in Group D, followed by Group F, and highest in Group B ($p < 0.001$). Adverse effects were minimal across all groups. Hemodynamic stability was also seen among all groups. **Conclusion:** The addition of dexmedetomidine to bupivacaine for local wound infiltration provides superior postoperative analgesia compared to fentanyl or bupivacaine alone, with a significantly prolonged analgesic duration and reduced need for rescue analgesics. Dexmedetomidine is a promising adjuvant for improving postoperative pain management in abdominal hysterectomy.

Keywords: Postoperative analgesia, bupivacaine, dexmedetomidine, fentanyl, abdominal hysterectomy

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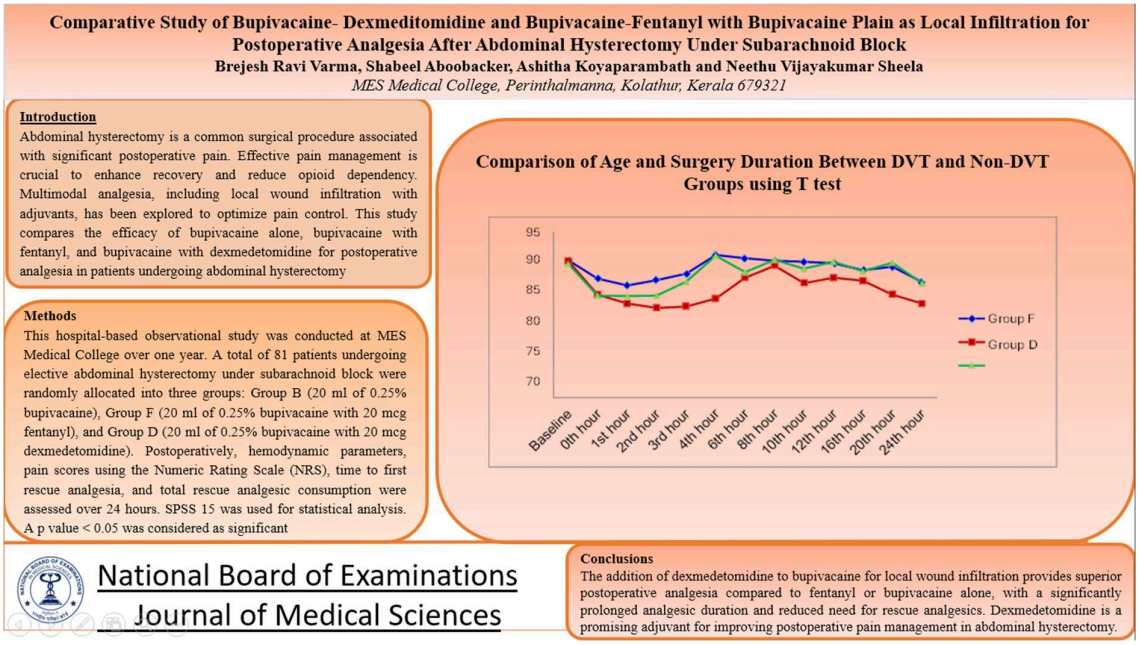
Graphical Abstract



Introduction

Abdominal hysterectomy is the second most common surgery in females after caesarean section [1]. Surgical removal of the uterus, along with the fallopian tubes, ovaries, and cervix, is a widely accepted treatment for uterine malignancies and various common non-malignant uterine conditions, including abnormal uterine bleeding, fibroid uterus, vaginal prolapse, and adnexal masses [2]. The aetiology of pain following abdominal surgery is multifactorial, encompassing abdominal wall damage, visceral trauma, inflammation, and peritoneal irritation. The somatic innervation of the anterior abdominal wall originates from T6–L1, while the skin below the umbilicus derives its innervation from T11–L1. The peritoneum is a metabolically active organ that responds to surgical insult with both local and systemic inflammatory responses. Peritoneal nociceptors, which become activated due to surgical injury and intraperitoneal inflammation, contribute significantly to visceral pain [3]. The abdominal incision can cause moderate to severe pain, especially in the immediate postoperative period, and its intensity varies among individuals. Postoperative pain generally lasts up to 48 hours [4]. Acute postoperative pain after abdominal surgeries can increase morbidity, leading to restricted breathing efforts, inadequate coughing, secretion retention, reduced functional residual capacity, early airway closure, and even segmental or lobar collapse [5].

The prevalence of acute postoperative pain varies widely. Reported global prevalence ranges from 14% to 70%, depending on pain intensity, type of surgery, and anesthesia used. One study documented postoperative pain prevalence following abdominal surgeries as 84.17%, 92.5%, and 66% on days 1, 2, and 3, respectively [6] which is overwhelmingly high.

Multimodal analgesia (MMA) involves the combination of different classes of medications with varying pharmacological mechanisms, leading to

additive or synergistic effects to alleviate postoperative pain and its sequelae. Regional analgesic techniques are one of the most important components of multimodal pan management. It includes local anesthetic wound infusion, epidural or intrathecal analgesia (single-shot or continuous), and peripheral nerve blockade. Of the above, wound infusion has emerged as an effective approach for improving postoperative pain and reducing the need for intravenous or oral opioids, especially in patients undergoing open abdominal surgeries. Local anaesthetic infiltration is a simple, safe, cost-effective, and widely used method for postoperative analgesia. Adjuvants like Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), Dexmedetomidine, Clonidine, Epinephrine, Opioids, Steroids, Ketorolac, and Magnesium sulphate, can be added to local anesthetic agents to improve the quality and duration of analgesia. Commonly used local anesthetics for infiltration anesthesia include 0.5–1.5% Lignocaine, 0.125–0.5% Bupivacaine, and 0.2–0.5% Ropivacaine [7]. Dexmedetomidine is an alpha-2 adrenoreceptor agonist. It produces analgesia by reducing norepinephrine release and by exerting an alpha-2 receptor-independent inhibitory effect on nerve fibre action potentials [8]. Fentanyl is a synthetic μ-opioid agonist with minimal histamine-releasing properties and is considered a superior drug for peripheral analgesia [9].

This study aims to compare the duration of post operative analgesia after local bupivacaine –fentanyl infiltration and bupivacaine – dexmedetomidine to plain bupivacaine. This study also assesses the severity of pain among the three groups. The study is done to also evaluate the postoperative requirements of intravenous rescue analgesics (NSAIDs/Opioids). As the impact of postoperative pain on recovery and overall patient well-being is high, identifying an optimal analgesic technique that provides prolonged pain relief while minimizing opioid dependence is crucial. This study is important as to explore effective pain management strategies. Thereby enhancing patient comfort, reducing complications, and improving postoperative outcomes.

Materials and Methods

This was a hospital based observational study conducted at MES Medical College. This study was done among patients undergoing elective abdominal hysterectomy under subarachnoid block. After obtaining Institutional Human Ethics Committee approval, the study was conducted over a period of one year. Written informed consent was obtained from all participants before start of the study. Patients were recruited based on defined inclusion and exclusion criteria.

Patients were divided into three groups depending on the wound infiltration technique used postoperatively. Group B received 20 ml of 0.25% bupivacaine, Group F received 20 ml of 0.25% bupivacaine with 20 mcg fentanyl (0.4 ml), and Group D received 20 ml of 0.25% bupivacaine with 20 mcg dexmedetomidine. The study included patients aged 35 to 60 years with ASA grades I and II who voluntarily participated. Patients with a history of opioid or substance abuse, failed spinal anesthesia, prolonged surgeries exceeding three hours, difficulty in pain assessment, height below 150 cm, BMI over 30 kg/m², or hypersensitivity to local anesthetics,

dexmedetomidine, fentanyl, NSAIDs, or opioids were excluded.

The minimum sample size required for the study was determined using a sample size estimation formula from a similar previous study by Swathi Singh et al. A total of 81 patients meeting the inclusion criteria were selected using a non-probability convenience sampling technique, with consecutive patients being enrolled until the target sample size was reached.

Pre-anesthetic evaluation was conducted a day prior to surgery, during which patients were educated about the Numeric Rating Scale (NRS) for pain assessment. On the day of surgery, patients were secured with an 18G intravenous cannula and started on IV fluids. Anti-aspiration prophylaxis (IV pantoprazole and IV metoclopramide) and prophylactic antibiotics (IV cefotaxime) were administered. Blood was cross matched, and arrangements were made for transfusion if necessary. In the operating room, standard ASA monitors, including pulse oximetry, non-invasive blood pressure, and ECG, were attached, and baseline vitals were recorded. Spinal anesthesia was administered using 3 ml of 0.5% heavy bupivacaine at the L3-L4 interspace with a 25G Quincke's spinal needle. All patients received IV paracetamol 1g preoperatively and postoperatively every six hours.

At the end of surgery, the respective wound infiltration drug combinations were administered along the surgical wound as decided by the anaesthesiologist in that operating room following the departmental protocols. Postoperatively, patients were monitored in the recovery room and subsequently in the ward for 24 hours. Hemodynamic parameters, including heart rate, blood pressure, respiratory rate, oxygen saturation, and pain scores, were recorded at 0 hours, every hour for the first four hours, every two hours for the next 12 hours, and every four hours thereafter. The duration of analgesia was defined as the time from local infiltration to the first reported pain requiring rescue analgesia. Severity of pain was assessed using NRS, and the time to the first rescue analgesic dose, frequency of further doses, and additional analgesic requirements were noted. The observations were made by an independent observer who was blinded to the selection of infiltration drug combination used in that particular subject.

Rescue analgesia was administered when NRS was equal to or greater than 4. Diclofenac sodium 75 mg IV diluted in 100 ml normal saline was given as the first-line rescue analgesic over 15 minutes. If analgesia was still inadequate, IV tramadol 50 mg diluted in 100 ml normal saline was administered over 10 minutes.

Data were recorded using a structured proforma and analysed using SPSS version 15. Quantitative data were expressed as means and standard deviations. The statistical significance of analgesic requirements was determined using one-way analysis of variance (ANOVA), with a p-value of <0.05 considered statistically significant

Results

The demographic characteristics, including age, height, weight, and BMI, were comparable across Groups F, D, and B, with no statistically significant differences ($p > 0.05$). Similarly, the duration of surgery did not differ significantly among the groups ($p = 0.206$). There was no significant difference

between the groups with respect to ASA classification. However, significant differences were observed in pain-related parameters. The time of onset of pain was longest in Group D (5.4 ± 1.2 hours) compared to Group F (3.1 ± 1.1 hours) and Group B (2.6 ± 1.3 hours), with a highly significant difference ($p < 0.001$). The time to first rescue analgesic was also significantly longer in Group D (7.6 ± 1.5 hours) compared to Group F (4.5 ± 1.8 hours) and Group B (3.4 ± 1.2 hours) ($p < 0.001$). Subsequent rescue analgesic time intervals followed a similar trend, being longest in Group D (10.9 ± 6.6 hours) compared to Group F (9.2 ± 2.2 hours) and Group B (6.2 ± 2.3 hours), showing statistical significance ($p < 0.001$). The total number of rescue doses was lowest in Group D (1.9 ± 0.6) compared to Group F (3.7 ± 1.1) and Group B (4.7 ± 0.7), again indicating a significant difference ($p < 0.001$). Additionally, the interval between the first and second dose was longest in Group D (5.4 ± 3.4 hours) followed by Group F (4.7 ± 1.2 hours) and shortest in Group B (2.9 ± 1.4 hours), with statistical significance ($p < 0.001$). These findings suggest that Group D demonstrated the most prolonged analgesic effect with a reduced need for rescue analgesia, while Group B required the highest number of rescue doses with the shortest analgesic duration (Table 1).

Table 1. Comparative Analysis of Analgesic Efficacy and Rescue Analgesia Requirements Among Groups F, D, and B

	Group F (n=27)		Group D (n=27)		Group B (n=27)		p
	mean	SD	mean	SD	mean	SD	
AGE	45.8	3.9	43.0	9.1	46.1	7.1	0.247
HEIGHT (cm)	161.1	8.2	162.0	8.0	163.1	7.3	0.667
WEIGHT (kg)	62.6	13.5	63.5	10.9	64.0	10.0	0.910
BMI (kg/m^2)	23.7	3.6	24.1	2.3	24.0	2.2	0.887
Duration of Surgery	1.3	0.3	1.2	0.2	1.2	0.2	0.206
Time of onset of pain (in hours)	3.1	1.1	5.4	1.2	2.6	1.3	<0.001
Time of first rescue analgesic (in hours)	4.5	1.8	7.6	1.5	3.4	1.2	<0.001
Subsequent	9.2	2.2	10.9	6.6	6.2	2.3	<0.001
Total number of rescue doses	3.7	1.1	1.9	0.6	4.7	0.7	<0.001
Interval between 1st and 2nd Dose	4.7	1.2	5.4	3.4	2.9	1.4	<0.001

Significant differences in heart rate were observed at the 3rd, 4th, 20th, and 24th hours post local infiltration, with Group D showing consistently lower mean heart rates at these time points compared to Group F and Group B. Additionally, Group B exhibited a trend of lower heart rates over 24 hours compared to baseline values, while Group D showed the most pronounced decline, indicating a possible sustained bradycardic effect in this group (Figure 1).

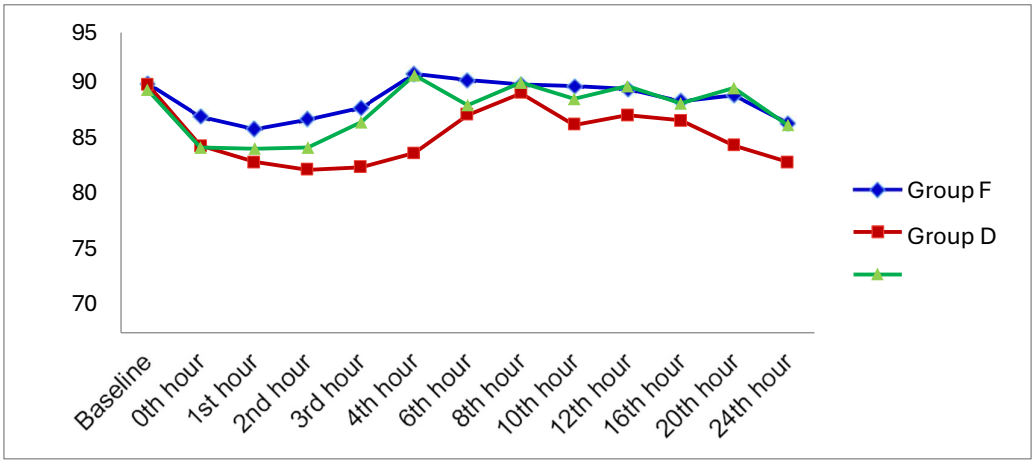


Figure 1. Heart Rate

While there were no major overall changes in respiratory rate across the 24-hour period, statistically significant differences were observed at the 4th, 8th, 20th, and 24th hours. Group B exhibited higher respiratory rates at the 4th and 8th hours compared to the other groups, while Group D tended to have slightly lower values, suggesting potential differences in respiratory response among the groups (Figure 2).

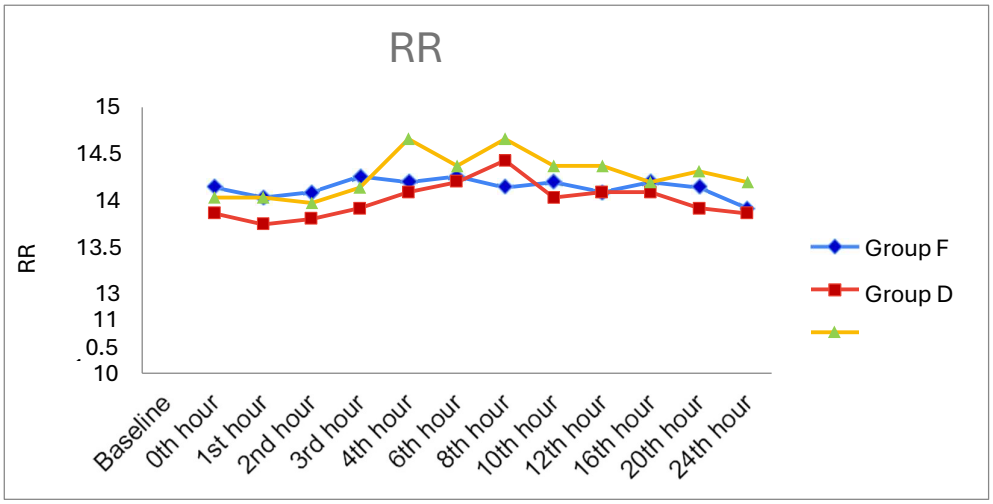


Figure 2. Respiratory Rate

There were no significant differences in SpO2 levels among the three groups at any time point during the 24-hour period. This indicates that despite variations in other haemodynamic parameters, oxygen saturation remained stable across all groups, suggesting adequate respiratory function and oxygenation in all patients (Figure 3).

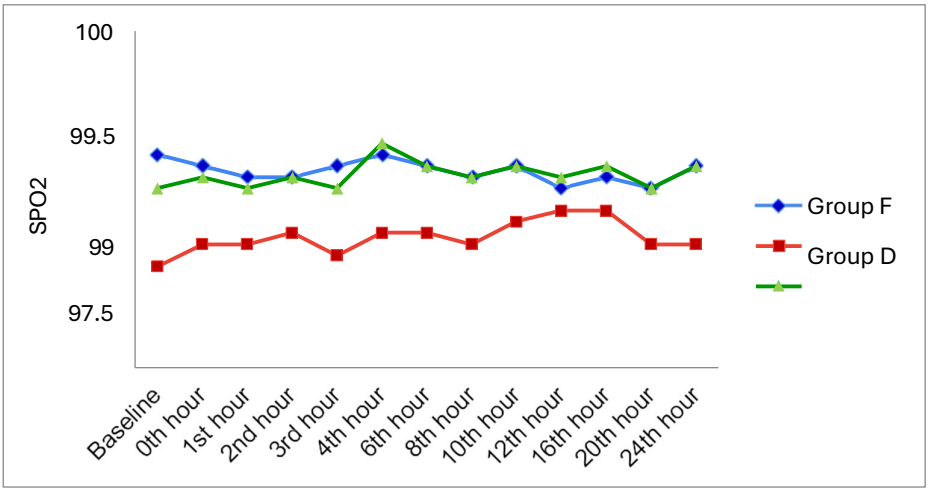


Figure 3. SPO2

Systolic Blood Pressure (SBP) were significantly lower as was noted at the 4th, 6th, 20th, and 24th hours post infiltration, particularly in Group D, which consistently exhibited the lowest mean SBP values at these intervals. Despite these differences, all groups showed an overall trend of lower SBP compared to baseline, suggesting a lesser sympathetic response induced rise in SBP, due to improved pain relief following local infiltration, with Group D experiencing the most pronounced decline (Figure 4).

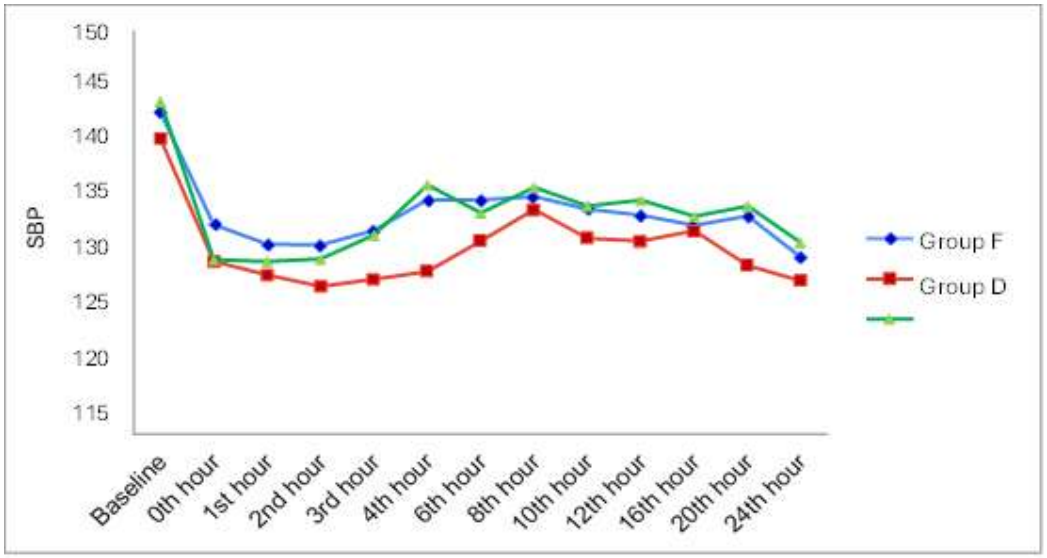


Figure 4. Comparison of SBP at different intervals

Significant changes in Diastolic Blood Pressure (DBP) were observed at multiple intervals, specifically at the 1st, 3rd, 4th, 6th, 12th, 16th, 20th, and 24th hours. Group D consistently demonstrated lower DBP values than the other groups, with the most pronounced differences at the 3rd and 4th hours. This suggests a more substantial reduction in vascular resistance and better blood pressure regulation in Group D compared to Groups F and B (Figure 5).

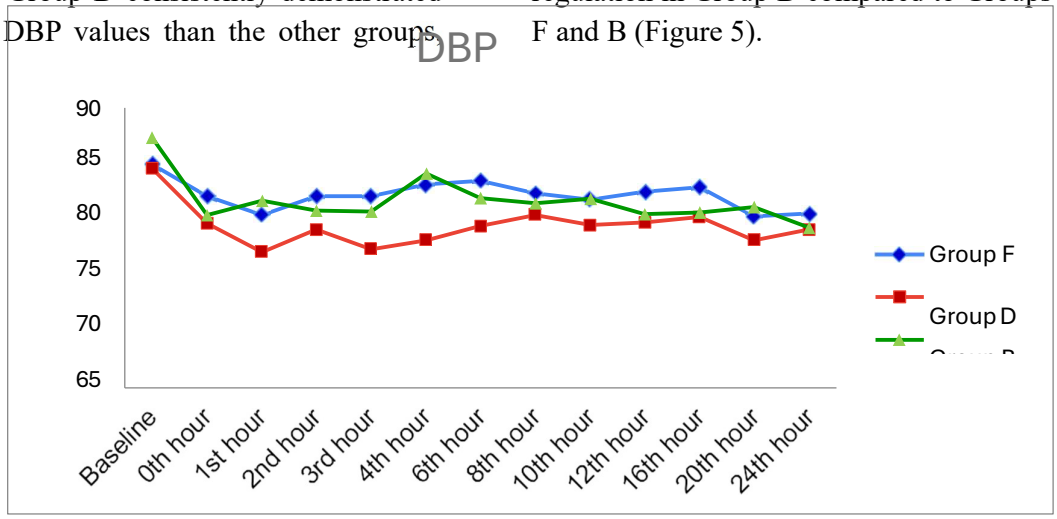


Figure 5. Comparison of DBP at Different Intervals of Time

Discussion

Abdominal hysterectomy with or without salpingo-oophorectomy is associated with moderate to severe postoperative pain, which is most intense during the first 48 hours. Surgical incision initiates an acute inflammatory response, triggering cytokine release that stimulates nociceptors and enhances pain perception. Suboptimal postoperative pain management can lead to complications such as increased morbidity, anxiety, impaired physical activity, prolonged hospitalization, and increased healthcare costs [10]. Multimodal analgesia, which combines different analgesic drug classes and techniques, is now the recommended approach for postoperative pain management. Local infiltration at the incision site is one of the very effective methods for controlling postoperative pain. Various adjuvants have been used to prolong analgesic duration and improve wound infiltration quality [11].

The present study demonstrated that the addition of dexmedetomidine to bupivacaine (Group D) provided the longest duration of analgesia compared to bupivacaine-fentanyl (Group F) and bupivacaine alone (Group B). The time to first onset of pain and the time to first rescue analgesic were significantly longer in Group D ($p < 0.001$). These findings are similar to previous studies which demonstrate the peripheral analgesic effects of dexmedetomidine and fentanyl [5]. Similar results were reported by Neha Kadayan et al., which showed that the addition of dexmedetomidine significantly extended postoperative analgesia and reduced rescue analgesic requirements [5].

Hemodynamic parameters showed significant differences among the three groups. Group D exhibited significant lower heart rates and blood pressure, suggesting a potential bradycardic and hypotensive effect. Despite these changes, oxygen saturation levels remained stable across all groups. There was no significant impact on respiratory function. These findings are consistent with studies that have evaluated the effects of dexmedetomidine and fentanyl on postoperative analgesia and hemodynamics [12,13].

Conclusion

The current study demonstrates that adding dexmedetomidine to bupivacaine for local wound infiltration following abdominal hysterectomy significantly prolongs postoperative analgesia compared to bupivacaine-fentanyl and bupivacaine alone. Patients in the study group experienced a delayed onset of post-surgical pain, reduced need for rescue analgesics, and better pain control over a 24-hour period. Fentanyl also provided superior analgesia compared to bupivacaine alone. The effect was less pronounced than dexmedetomidine. The use of dexmedetomidine as an adjuvant in local infiltration not only enhances pain relief but also minimizes opioid consumption. Minimal opioid consumption results in reduction of opioid-related side effects. Additionally, the hemodynamic stability observed with dexmedetomidine suggests that it can be safely used without significant adverse effects.

Statements and Declarations

Conflicts of interest

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

Funding

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ORIGINAL ARTICLE

Burden, Challenges, and Perceptions of Parents Towards Online Classes During Covid-19 Pandemic: A Cross-Sectional Study From Coimbatore, Tamil Nadu

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Abstract

Background: During the COVID-19 pandemic, Indian educational institutions closed, prompting the need for online learning to maintain social distancing. Parents' views on online education for young children can influence the quantity and quality of their learning experiences at home. **Objectives:** To explore the burden, challenges, and perceptions of parents about their children attending online classes. **Methods:** This cross-sectional study, approved by the Ethical Committee, was carried out among parents of school-going children in Western Tamil Nadu between September 2020 and January 2021. This survey was conducted using Google Forms and social media, involving 450 parents, with a response rate of 39.3%, and analysed using IBM SPSS 27.0. **Results:** Around 40% of children used laptops as their primary tool for online education. Many children spend less than half of their total screen time on virtual learning. The majority of parents, around 61.6%, considered online education essential for their child, while a significant 81.4% believed that online teaching programs were not as effective as traditional classroom teaching. **Conclusions:** The study in Coimbatore highlights parent's challenges and perceptions during the COVID-19 pandemic, emphasizing the importance of their voices in shaping educational policies.

Keywords: Online education, parents, school children.

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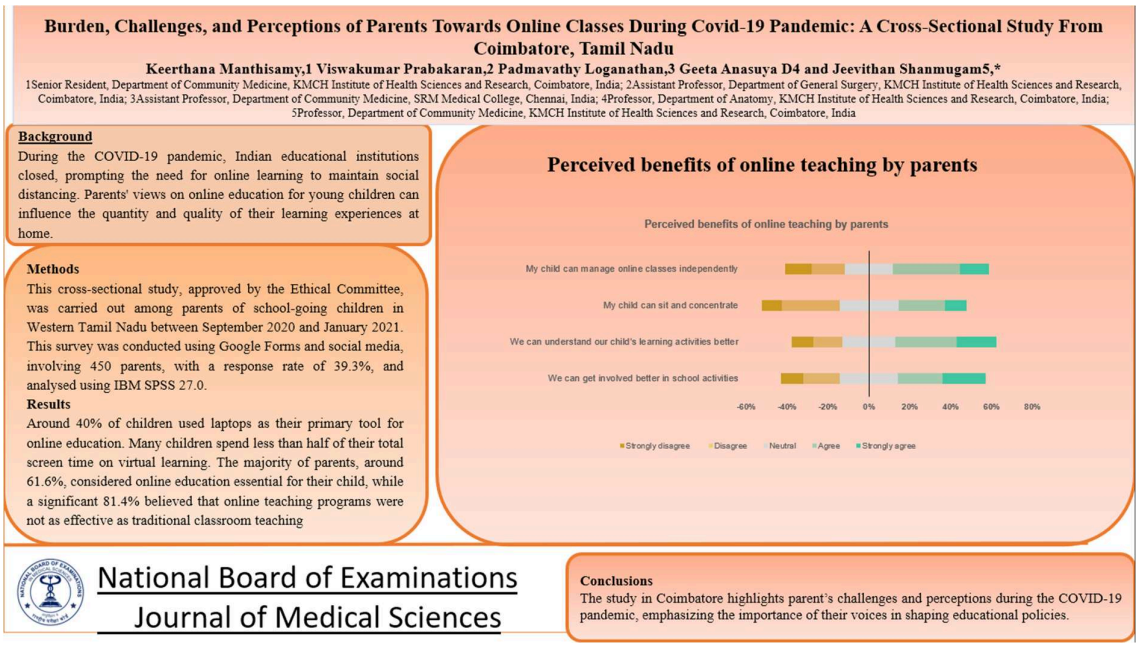
Graphical Abstract



Introduction

Traditional face-to-face education uses chalk and board, while online education utilizes computer-communication technology to enhance the learning environment [1]. Online education is not just technology integration replacing teachers; it simplifies and enhances learning by making it more flexible and simpler [2]. Face-to-face education is regarded as superior as it enables teachers to adapt their methods based on students' immediate feedback [3].

Utilizing technology effectively offers numerous benefits, including universal access, class recording, efficient communication through chats, multimedia content, reduced travel time, and prevention of coronavirus spread [4]. Online teaching faces challenges in terms of logistics, technical, and financial aspects [5]. Furthermore, it lacks emotional and humanistic education [6].

In March 2020, the World Health Organization declared COVID-19 as a pandemic [7]. This transition has significantly impacted not only students and teachers but also parents [8]. Homeschooling has prompted parents to adopt new roles, emphasizing the importance of parental involvement in their children's online education, as it enhances their dedication and academic performance [4,9]. Parents' attitudes and beliefs about online learning impact children's learning experiences, as they must clarify doubts [10]. Hence, this study aimed to explore the burden, challenges, and perceptions of parents about their children attending online classes.

Materials and Methods

The ethical committee approved this cross-sectional study (IEC No: 34/IHEC/2020). The study was conducted among parents of school-going children in Western Tamil Nadu between September 2020 to January 2021. A voluntary opt-in sampling included parents who had consented to participate in the study, had a

smartphone with internet access, and accompanied their child primarily during online classes. The study excluded parents who were incapable of reading or typing in English, as well as any caregivers besides the parents.

A web-based survey was used to gather data because of COVID-19 regulations. Using Google Forms, the survey tool was developed and shared on social media. Before the study began, participants were asked to digitally sign a consent form, in which it was explained that the data would be kept anonymous and used only for academic research. The link to the questionnaire was sent to 450 parents, out of which, a total of 177 responded (response rate 39.3%).

A semi-structured questionnaire was designed and its face and content validity evaluated. Data on demographic details, electronic devices used, burdens, and challenges faced by parents were collected. On a five-point Likert scale, parents' perceptions of the benefits and impacts of online learning were scored as follows: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1).

Statistical Analysis

IBM SPSS 27.0 was used to analyze the data. Frequencies and percentages have been used to summarize categorical variables, while the median and interquartile range have been used to summarize continuous variables.

Results

Demographic details of children

Of the parents surveyed, 50.3% (n=89) had only one child. Thirty percent (n=53) of the children belonged to the 1st–3rd standard. Private education accounted for 99.4% (n=176) of student enrolment. 73.4% (n=130) were found in the CBSE syllabus (Table 1).

Table 1. Demographic details of children

Variables	**Responses**	**Number (n)**	**Proportion (%)**
Number of child/ children attending online classes	1	89	50.3
	2	84	47.5
	3	4	2.3
Children's level of study	Pre-primary	43	24.3
	1 -3	53	29.9
	4 -6	41	23.2
	>7	40	22.6
School type	Government	1	0.6
	Private	176	99.4
Education Board	CBSE	130	73.4

	ICSE/IGCSE	33	18.6
	Others*	14	8.0
Gadgets brought for online education	Desktop/ Laptop	55	31.1
	Mobile/ iPad	71	47.5
	Modem/ Internet access/ Upgrade bandwidth	90	50.8
	Web camera, Headphone & speakers	83	46.9
	Furniture (chair, desk, table)	29	16.4

*Others- Montessori, state board, Waldorf, matriculation, International Baccalaureate.

Use of electronic devices in online teaching

Nearly forty percent (n=70) of children used laptops as their primary gadget for online education, followed by mobile (27.1%), iPad (23.2%), desktop (11.3%), and TV (1.7%). The median hours of online sessions each day were 180 minutes (90-240). Three hundred minutes per day (180-420) was the median amount of screen time. A significant proportion of children (n = 94) dedicated only a small amount of time (<50%) to virtual learning when compared to total screen time.

The burden and challenges faced by parents regarding online classes

Almost sixty-two percent (n=109) of parents said that online education was necessary for their child. Almost half of the children expressed interest in attending online lessons. Before beginning online classes, 80.8% (n=143) of school management provided complete guidelines. Over half of the parents have made additional investments in online teaching. Owing to online classes, three-fourths of parents have purchased new electronic devices. Table 1 lists the devices that parents have brought. During lockdown, 63.8% (n=113) of parents (either one or both) said they work from home. Of them (n=113), 80.5% of respondents found difficulty in managing their work and children's online classes. 77.4% of parents stated that their homes provided a suitable place for children to learn. 79.7% (n=141) of parents said they took precautions to prevent their kids from playing games or going to unapproved websites. Their children have developed dry eye (12.4%), eye strain (58.8%), fatigue (20.3%), headache (22.6%), neck pain (23.7%), backache (9.0), anxiety (17.5%), and weight gain (50.3%) as a result of increased screen time on electronic devices.

Perceived impact of online teaching by parents on their children

The majority of parents (47.7%) believe (strongly agree + agree) that their child can manage online classes independently, but some express doubts about their child's focus during learning activities. While a notable percentage of parents (33.3%) believe their child can sit

and concentrate well, a similar proportion (37.8% - disagree + strongly disagree) express doubts about their child's ability to focus during learning activities.

A larger proportion of parent said (strongly agree+ agree) that their children had increased, screen time (84.7%), altered sleep patterns (71.7%), altered daily routine (88.1%), altered dietary habits (67.8%), and reduced physical activity (78%). Most parents believe online teaching programs are not as effective as classroom teaching (81.4%), a lack of supervision (41.3%), and guidance from teachers affects assignment completion (59.3%). Most parents acknowledge the difficulty of managing children at home (72.9%) (Figures 1-3).

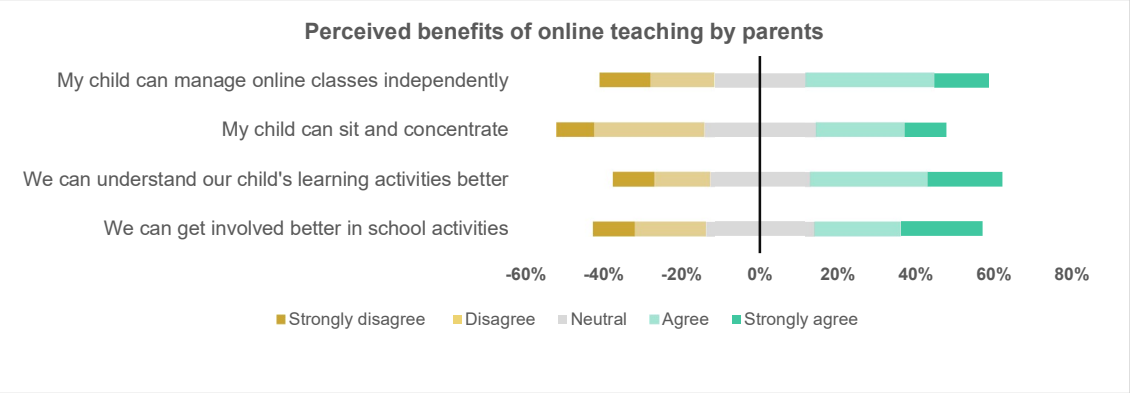


Figure 1. Perceived benefits of online teaching by parents.

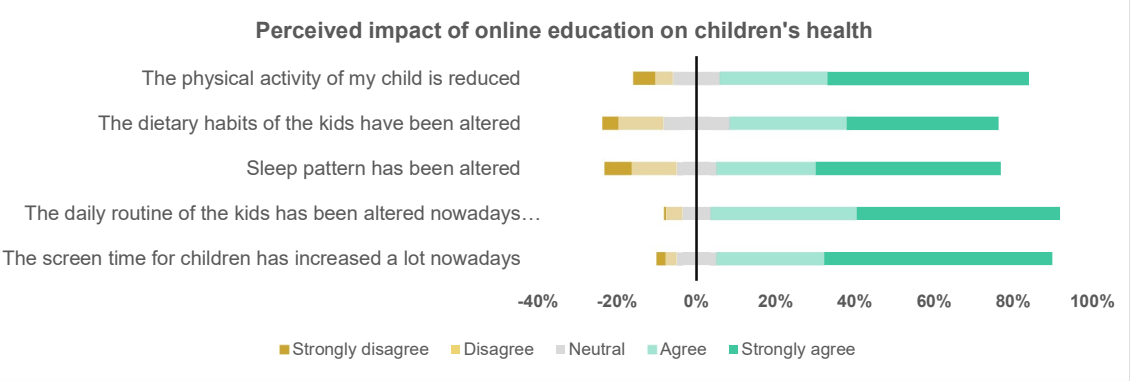


Figure 2. Perceived impact of online education on children's health.

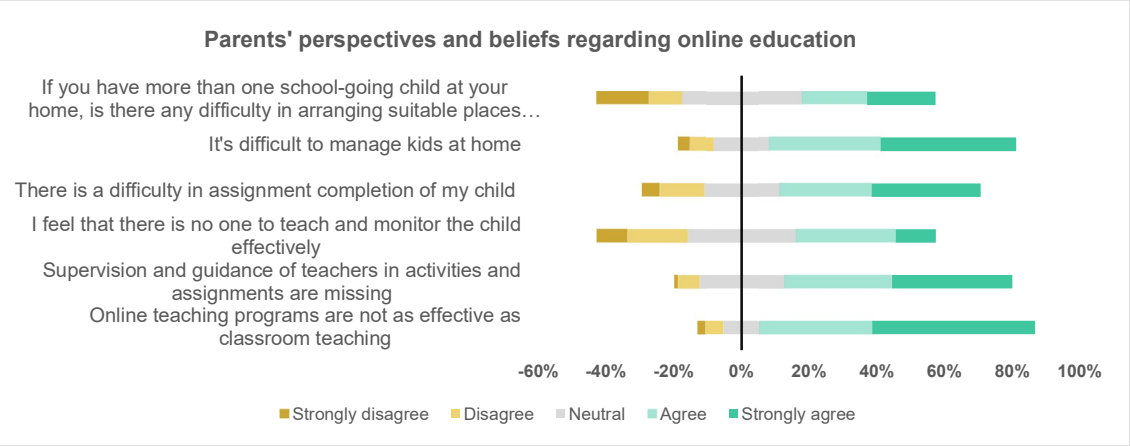


Figure 3. Parents' perspectives and beliefs regarding online education

Discussion

Online learning offers several benefits and drawbacks in addition to limiting the spread of COVID-19. The burden, challenges, and perspectives of parents toward online education were evaluated in this study. The children in this study come from the CBSE Board in 73.4% of cases. In the prior study, the CBSE board comprised 86% of the child population, indicating that the CBSE board offered early online classes during COVID-19 [11]. A paradigm shift toward competency-based medical education (CBME) has occurred in education during the last 20 years [12].

Laptops were the primary device utilized by 39.5% of children. Yet, 74.4% of respondents to a web-based cross-sectional study by Grover et al. in 2021 utilized smartphones, and 27.7% used computers, for their online learning [13]. More than half of the parents increased their spending on virtual learning. These results are consistent with the earlier survey, in which 54.4% of parents voiced concerns about rising school expenses [14]. Three-fourths of parents have bought new electronics because of online classes. However, in a study by Selvaraj et al., 89.4% of participants said they already owned the necessary electronic devices, and only 8% bought new ones [15].

The Indian government states that in 2020 [16], preschoolers should not be encouraged to take online courses on their laptops or mobile devices. For them, radio and television can serve this function. To reduce screen time and its negative effects on children, the guidelines suggest a maximum of 30-minute sessions for pre-primary students, not more than two sessions of 30-45 minutes each for classes 1 through 8, and not more than four sessions of 30-45 minutes each for classes 9 through 12. However, the mean hours for pre-primary (2.1), classes 1–8 (2.9), and classes 1–9 (3.6) in this study are greater than the suggested hours.

For 80.5% of the parents surveyed, balancing work and their kids' online classes was a struggle. A study by Garbe et al. (2020) found similar results, with 72% of participants reporting that they had struggled to balance their responsibilities [17]. Parents (41.3%) in this study reported that there is a lack of teacher supervision and guidance for assignments and activities. Similar results, with 55.6% of

participants expressing concern that their child's use of online learning will be hampered by the physical absence of a mentor [2]. Screen time has increased, according to 84.7% of parents surveyed. Comparable results were observed in a prior study, wherein 68.9% of participants reported an increase in the duration of their screen media use [13]. Approximately 20% of parents testify in a Ludji et al. 2021 study that their children would rather play online games on their smartphones than use them for educational purposes [4]. These results may indicate that children's screen time has increased as a result of inadequate supervision.

Seventy-eight percent of parents in this study said their kids were not as active as they used to be. 53.8% of participants in a cross-sectional study conducted in 2022 said they thought online learning encourages kids to lead sedentary lives [11]. The majority of respondents in this study (88.1%) reported changing their daily routine. A qualitative study conducted by Bhamani et al. [18] revealed similar results. The results were in opposition to a study conducted by Rathaliya et al. in which 58.5% of parents reported that during the COVID-19 pandemic, distance learning had encouraged their children to adhere to daily routines [11]. Regarding the effects on a child's physical health, earlier research revealed comparable findings, indicating that taking classes online could cause headaches, neck pain, eye strain, backaches, and decreased physical activity as well as changes in eating and sleeping patterns [13,18,19].

48.1% of respondents in this study strongly agreed with the statement "online teaching is not as effective as classroom teaching," while 33.3% agreed. These results were in line with a study by Jony et al. [2], which found that 44.4% of respondents agreed and 27.8% strongly agreed that online teaching cannot be compared to traditional teaching. This study had certain limitations. Self-reported instruments, which could have been biased, were used to evaluate perception, burden, and challenges. Parents with smartphones and English language proficiency were the only participants in the study.

Conclusions

The COVID-19 pandemic has highlighted parents' challenges in online education, including device accessibility, work-life balance, and screen time limitations. Parents also worry about the impact on children's well-being due to decreased physical activity and disruptions to daily routines. The perceived ineffectiveness of online teaching compared to traditional methods is a major concern. A comprehensive approach involving equitable device access, clear screen time guidelines, and routine consistency strategies is needed to address these issues. Collaborative efforts between educators, policymakers, and parents are crucial.

Acknowledgment

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Ethical Approval

The ethical committee approved this cross-sectional study (IEC No: 34/IHEC/2020).

Authors' contribution

All authors have contributed equally.

Statements and Declarations

Conflicts of interest

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

Funding

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REVIEW ARTICLE

Declining Interest in a Career in Medicine: Exploring Multifaceted Factors

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Abstract

The decline in interest in the medical profession among the new generation is a complex issue influenced by various factors. This article explores the multifaceted reasons behind this phenomenon and proposes some strategies to address this concerning trend. Understanding these factors and taking appropriate measures is crucial for ensuring the future sustainability of the healthcare workforce and a healthy population.

Keywords: Declining interest in medicine, medical education challenges, work-life balance in healthcare, financial burden of medical training, healthcare workforce sustainability

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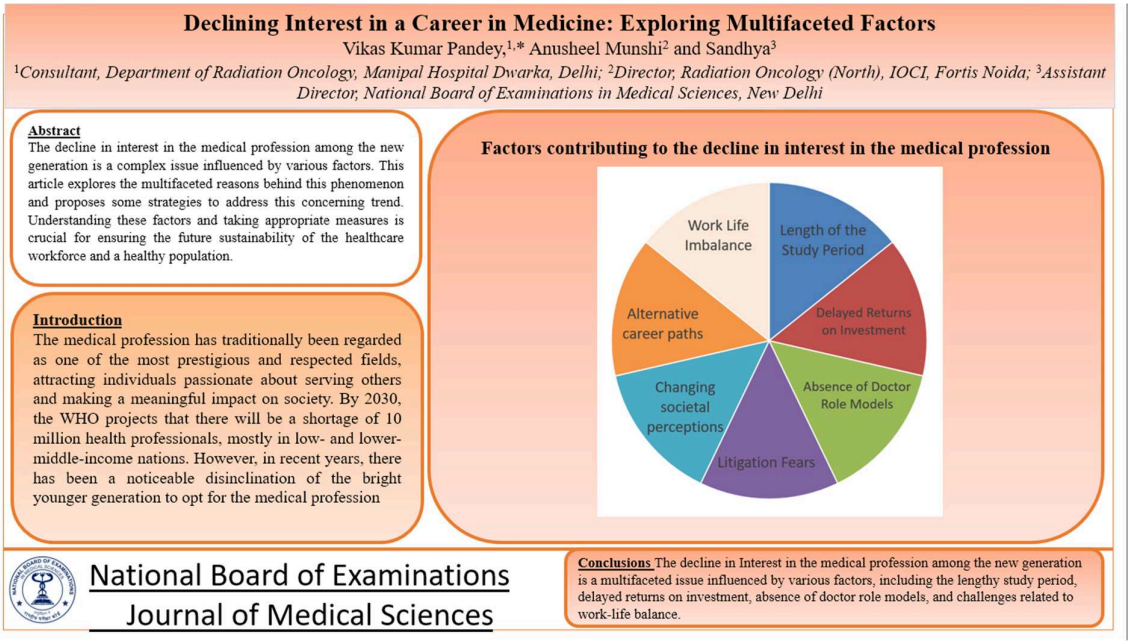
Graphical Abstract



Introduction

The medical profession has traditionally been regarded as one of the most prestigious and respected fields, attracting individuals passionate about serving others and making a meaningful impact on society [1]. By 2030, the WHO projects that there will be a shortage of 10 million health professionals, mostly in low- and lower-middle-income nations [2]. However, in recent years, there has been a noticeable disinclination of the bright younger generation to opt for the medical profession [3]. The rising number of unfilled spots in both undergraduate med schools and postgraduate residency programs is concerning, as evidenced by a 4.7% decline in med school applicants in the United States and an increase in the number of vacant seats in med schools in India from 197 in 2021-22 to 202 in 2022-23 [4,5,6]. This decline in the quality and quantity of medical personnel poses significant challenges to the future sustainability of healthcare and has significant implications for the quality of patient care. In this research paper, we examine the various factors contributing to the decline in Interest in the medical profession among the new generation (Figure 1).

Length of the Study Period

One of the primary factors contributing to the decline in interest in the medical profession among generations is the long study period required to become a qualified doctor. Medical education typically involves extensive undergraduate studies, followed by several years of medical school and residency training [7]. This prolonged duration can deter individuals from seeking faster career paths or hesitating to such a demanding educational journey. GenZ and Gen Alpha typically want quick outcomes and results for their efforts, something a step-wise medical study curriculum needs to offer. The average length of medical training has certainly contributed to a decline in medical school applicants [8].

Figure 1. Factors contributing to the decline in interest in the medical profession

Delayed Returns on Investment

The present-day world is getting more and more materialistic. Delayed returns on investment are another significant factor contributing to the decline in Interest in the medical profession. Medical education incurs substantial financial costs, including tuition, living expenses, and educational materials. Additionally, the prolonged duration of medical training means that aspiring doctors spend several years incurring debt without the opportunity to earn a stable income. A study published in the Journal of American College found that medical graduates often face significant financial burdens, with many experiencing high levels of stress and anxiety related to student loan debt [9]. The Association of American Medical Colleges (AAMC) reports that the typical four-year cost of attendance is from $255,000 to $337,000 [10]. A 2018 LANCET research found that the expense of training doctors in India more than quadrupled, from USD 35,000 in 2008 to USD 70,000 (about 60 lakhs in Indian rupees) [11]. The prospect of delayed financial stability can dissuade individuals from pursuing a career in medicine, especially when alternative professions offer quicker returns on investment.

Absence of Doctor Role Models

The present generation is more impressionable than ever and needs role models. Whether it is the traditional media or the hugely popular social media, sportspersons, movie stars, business people, and entrepreneurs are hailed as

stars, their success stories splashed all over and were most talked about. Only an odd corner talks about a medical achievement, with minimal glorification of the concerned doctor. This is certainly a quantum fall from some years ago when doctors and the medical profession were high. A study of Norwegian registry data indicated that only 8% of medical students had parents who were doctors. [12]. This decline in familial exposure to the medical profession is concerning, signifying that doctors are not running in families anymore. It also means that many young individuals are not very impressed by the rewards and challenges of a medical career, even with a doctor as a parent.

Challenges Related to Work-Life Balance

The demanding nature of a medical career, characterized by long hours, high-stress levels, demanding commitment, and limited work-life balance, is another deterrent for the new generation [13]. Present day generation hears and talks about prioritizing a healthy work-life balance and seeks professions that offer flexibility and autonomy. However, the hierarchical structure of the medical profession, coupled with the pressure to excel academically and professionally, too many administrative tasks, and insufficient salary can impede work-life balance and contribute to burnout among healthcare professionals [14]. The lack of work-life balance in the medical profession and the growing violence against doctors can dissuade individuals, especially those prioritizing family and personal life, from pursuing a career in medicine [15].

Litigation Fears

Of late, medical science has become infamous for litigation [16]. This trend, which started in the West, has rapidly gained traction across the world. Unsatisfied patients or families can easily approach courts and forums regarding any incidence of possible deficiency in care. This, unfortunately, is the only aspect of medical care that gets maximum media coverage in the present times. Comparatively, there is a much lesser litigation threat for professions such as business, engineering, aviation-chartered accountants, etc. Further, in many cases, doctors are at the receiving end of violence, which is an even more worrisome trend [17,18].

Other Contributing Factors

Peer pressure for quick success, significant ethical issues in medical research, funding challenges in medical research and pharma industry as the new drivers of medicare.

It has been noted that a significant number of students in India exhibit a preference for pursuing a profession in medicine due to the influence exerted by their parents, resulting in a lack of intrinsic desire [19]. Upon successfully passing the admission test, individuals must attend a demanding five-year training program at a medical school, followed by a one-year internship, before obtaining their degree. The current inclination towards specialization has resulted in an extended duration of the study term. The selection of medicine as a professional path is a complex choice, and not all intellectually gifted individuals may pursue a career in medicine. The student population exhibits a diverse array of familial backgrounds [20]. After all this the doctors are put in peer

pressure for quick success compared to their counterparts.

The allure of medicine is fading, shadowed by ethical dilemmas and financial constraints. The once-revered field faces a decline in interest, with aspiring professionals deterred by the profound ethical issues in medical research [21]. Moreover, funding challenges plague the industry, hampering innovation and discouraging potential recruits. The pharmaceutical industry's influence looms large, shaping healthcare agendas and priorities [22].

Strategies for path correction

Addressing the decline in Interest in the medical profession among the new generation requires a multifaceted approach that addresses the various factors contributing to this trend. Some potential strategies are listed in Table 1.

Table 1. Strategies for path correction

Addressing the problem	
Increasing the visibility of doctor role models	• Promoting mentorship programs • Outreach initiatives • Public awareness campaigns • Showcasing diverse experiences and contributions of doctors
Improving work-life balance	• Implementing progressive policies and practices within healthcare organizations • Promoting work-life balance • Flexible scheduling of work/ telemedicine options • Support programs for physician wellness. We are increasing the number of postgraduate seats.
Enhancing financial incentives	• Financial incentives • Loan forgiveness programs • Scholarships and competitive salaries

Conclusion

The decline in Interest in the medical profession among the new generation is a multifaceted issue influenced by various factors, including the lengthy study period, delayed returns on investment, absence of doctor role models, and challenges related to work-life balance. Addressing this trend requires collaborative efforts from stakeholders across the healthcare industry, including educational institutions, healthcare organizations, policymakers, and professional associations. By implementing targeted

strategies to address the root causes of the decline in Interest in medicine, we can inspire the next generation to pursue careers in healthcare and ensure the future sustainability of the healthcare workforce.

Authors' Contributions

Conceptualization: VKP and AM; Data Curation: VKP and AM; Methodology/formal analysis/validation: VKP, AM and SR. Project administration: VKP, AM and SR.

Conflicts of interest

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

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REVIEW ARTICLE

Anti-Aging, Amortality and Immortality: The Latest Keywords in Aesthetic Surgery

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Abstract
Aging is a fundamental aspect of life and often associated with illness, incapacitation, decrepitude, and death. Naturally, it is a human tendency to avoid it, or at least, postpone it. Research on anti-aging is taking place at various levels. This ranges from biochemistry, cell biology, and molecular biology which includes research on mitochondrial DNA and oxidative stress, and research on cellular and molecular replacement interventions, to animal studies, and human studies. Their aim is to change the rate of human aging in the days to come. The nutraceuticals industry with its super foods and vitamins, the plastic surgeons with their head to toe anti aging and body contouring surgeries almost everyone is lending a hand to stop aging. However, there are plenty of ethical issues with this research and it is only ethical if we can live longer both physically and mentally and not aim for amortality or immortality. Radically extending life or reversing aging will gradually decrease the number of working hands and increase the number of dependent individuals and perhaps the population. We will then have to evolve newer economic, cultural and political norms because there will be no fresh minds to solve newer problems.

Keywords: Anti aging, Amortality, Ethics of anti aging

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Introduction

With the advancement of technology we humans have the audacity to believe that all problems have a solution and any constraint is a problem waiting to be solved. Technology, we believe, is that magic wand, which will make all problems disappear, even aging and death. We have collapsed time, crushed space and with newer technologies are ensuring that if we can dream it, we can achieve it. The gap between our reach and our grasp is fast closing. Defeating aging and defying mortality will be the ultimate bastion which we hope to conquer one day. Super foods, vitamins, anti-oxidants have flooded our markets with fancy promises and plastic surgeons can do magic to rejuvenate every part of the body from scalp down to the feet. Worn out joints are getting replaced by new ones but the aging brain is still not ready to go on back gear.

Virtual life after death

It may appear weird and even absurd to some but technology has already begun to change how people think about life after death. Technology companies are helping people to manage their digital lives after their demise. Apple, Google and Meta are now offering tools to allow someone you trust to access your online accounts after your death and run it as you had desired. Microsoft has patented a software that can harvest someone's digital data – such as texts, emails and social media posts – and use them to create a chatbot. This chatbot can then respond in ways that sound just like the deceased person. This may seem like science fiction, but let us not forget that limb replantation was in writer René Goscinny and illustrator Albert Uderzo's comic series Asterix And Obelix in 1959 and in just 3 years in 1962 Ronald Malt did the first limb replant! As Artificial Intelligence (AI) continues to improve, it will be far more easier to create the digital versions of people after they die. Conmen are using this trick to commit digital frauds even today! However, plenty of challenges still remain. What if a digital clone says or does something online that the deceased would have never said or done in real life? There are ethical issues, still to be solved.

In South Korea a technology company is trying to ensure that AI that will potentially allow anyone to converse and interact with the dead. This is AI version of planchette and in 2020, a Korean documentary crew in association with VR producers helped a grieving mother to "reunite" with her dead daughter [1].

Amortality and Immortality

The idea of an infinite life span does not mean humans will be immortal. It means they will be "amortal." Immortal beings are immune to death from aging or physical harm, but amortal beings are only immune to the effects of aging and disease. They will still be able to die to catastrophic damage to their bodies. However, the wide availability of amortality, giving individuals seemingly unlimited time to learn and grow and accomplish any goal, contains a hidden danger, best described by Parkinson's Law, which describes that any task will automatically fill the time allotted to it. Thus, unlimited time may cause procrastination on an epic timeline. Near

limitless time may lull some individuals into putting their ambitions off perpetually. They will fall into the trap of thinking tomorrow will always be available. The reality is that accidents would still happen, and the odds are that given enough time, every individual would eventually die with ambitions unfulfilled and accomplishments unachieved.

Research

Society directs technology, and new technology then shapes society. It is a relationship that has existed since ages and has brought about three industrial revolutions, the first with steam engines, the second with electricity and assembly line production and the third with computers and internet. With Autonomous robots, Simulation, Big data and Analytics, Augmented Reality, the Cloud, Cyber security, Additive manufacturing, Internet of things and Artificial Intelligence we are in the midst of the fourth industrial revolution and we have now challenged the concept of aging. Why can't we live longer and healthier is our new research question. In our attempt to answer this we have indulged in human and animal studies in the fields of biochemistry, cell biology, and molecular biology (mitochondrial DNA and oxidative stress and cellular and molecular replacement interventions), research with adipocyte and bone marrow-derived stem cells, to name a few.

The idea of defeating the aging process has moved from speculative science fiction to potential reality. The pharmaceutical industry is helping us with a dazzling variety of creams, serums, lotions, and gels that promise to remove all blemishes of age. The nutraceutical industry is flooding us with superfoods [2], vitamins and minerals galore [3] that assure us everlasting youth. The fitness industry is bombarding us with fitness routines and newer generation gyms are pushing and even punishing our bodies in every new way to stay fit and young. Plastic surgeons are offering a head-to-toe maintenance and rejuvenation programme by both non-surgical and surgical means. Thus whereas peels, botox, fillers, PRP and nanofat [4] are there for the less adventurous, hair transplant [5], browlift [6], blepharoplasty [7], facelift [8], brachyplasty [9], breast lift [10], thighs [11] and buttocks [12] and abdominoplasty are for those more dedicated to the cause of everlasting youth. The joints afflicted by degenerative diseases are being routinely replaced successfully and hair transplant has come as a boon for age-related baldness.

Autologous fat grafting, as practiced by aesthetic surgeons, is not just a biological filler anymore, but rejuvenation offered by the adipocyte-derived stem cells may be the first genuine regenerative surgery. Scientists may soon be able to modify human stem cell lines in the laboratory and create pancreatic cell lines for diabetics and thyroid cell line for hypothyroid patients. Gene therapy or other allied techniques can be used to carry chemotherapy drugs to target cancer cells and be used in composite tissue allotransplantation to overcome the problem of immune rejection. Stem cells could be engineered to express genes that enhance the immune system's ability to attack cancer cells. Scientists might also be able to replace

damaged genes by gene editing technology and even substitute new genes in stem cell lines to treat diseases. Techniques like CRISPR-Cas9 allow us to precisely target and modify specific genes within a cell, and thus correct genetic defects. Plastic surgeons are collaborating with the basic researchers in the field of stem cell research and gene therapy. The choice stares at us - either we control the gene technology today or be prepared to be redesigned by it tomorrow.

Nature is not pleased

Nature is not to be tamed so easily. The number of people suffering from cancer and dementia are on the rise. The latter is surely a sad state where the body has stayed young and fit but the mind has simply refused to accompany in the same youthful way! The desire to conquer mortality actually desperately stems from our fear and vulnerability that our transient existence in this earth evokes. We want to matter well beyond the flickering reality of our brief stay in our bodies. In a way this research on anti-aging and immortality is less of a scientific mission and more of a psychological confession.

Our ancient Hindu scriptures consider creation, preservation, and destruction as an essential cycle and the three assigned Gods, Brahma, Vishnu, and Mahesh ensure that this cycle continues uninterrupted. Every generation brings newer ideas, newer discoveries, and further progress. Imagine a world in which people refuse to die or get old. Radically extending life or reversing aging will gradually decrease the number of working hands and increase the number of dependent individuals. We will then have to evolve newer economic, cultural, and political norms because there will be no fresh minds to solve newer problems.

Ethics

The ethical arguments against anti-aging medicine are plenty [13]:

- inequity: the poor die young by the millions, while the rich refuse to age;
- denying aging's immutability;
- dominating nature, altering and commodifying ourselves;
- overpopulation: carrying capacity concerns and the rights of future people to be born;
- ennui: with no natural deadline, life itself outlives its value;
- ageism: prejudice against the old and the young.

However, there are some compelling reasons to go ahead with anti-aging research:

- beneficence: duties to maintain health and prevent disease and death;
- efficiency: slowing down aging would reduce the rates for all of the most common causes of death in developed societies;
- limited autonomy: freedom to purchase anti-aging medicines that may or may not work, so long as they are not harmful;
- improved quality of life: more active, healthier, and wiser (two propositions supporting this argument - that anti-aging medicine would allow for a longer, more active, healthier, and fuller life

- wisdom comes from experience, and experience can lead to better quality of life.

So, how do we strike a balance? It appears that if our aims are beneficence, efficiency, and stick to drugs with proven track record and lead a better quality life, then only longer life is better life.

Environment

Another factor which we are not considering is the environment. True, birth rates are falling in developed countries but not in developing ones to the same extent. How much will people living extra long and healthy lives consume? Already 100 billion animals are slaughtered for 8 billion humans annually. There are more animals raised for food than in the wild. What about the implications of their energy consumption? Can planet earth even afford healthy human longevity? May be, there will be answers to these questions in the future, but we need to ask these questions today.

The finiteness of life is very special. It brings closure to this journey and without this closure life is incomplete and no meaning. The old can pretend to look young, but looking young and being young are two very different things. Is the stubborn refusal of the old to make way for the new not an extreme form of selfishness? Immortality is terrifying; it is just a scary life sentence within one's body. It takes an extreme amount of narcissism to even believe in this theory and strive for it to succeed. Being trapped in eternity without escape is what I call Ashwathama syndrome. In Mahabharata when the great Kaurav warrior used his celestial weapon to try to kill an unborn Pandava child, Lord Krishna gave him a festering wound and cursed him with immortality [12]. Let us all blaze briefly, splutter and fade away and give this earth to the next generation.

Conclusion

Anti-aging medicine and anti aging research needs a rationale and an ethical framework. It should be funded and regulated carefully with the aim reducing the incidence and prevalence of many diseases thus allowing longer, fuller, healthier, and more meaningful lives. Amortality should be the ultimate goal but the benefits of this research should not be confined only to those who can afford it. But all these extra days on earth will only be enjoyable if the brain stays alert and young.

Authors' contribution

Conception and design of the study – Surajit, Neeta, Neela; Acquisition of data- Surajit, Neela, Neeta, Suraji; Drafting of the article – Kaushik, Neela, Neeta, Surajit; Critical revising – Surajit, Neeta; Final approval- Kaushik, Neela, Neeta, Surajit

Statements and Declarations

Conflicts of interest

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POINT OF VIEW

Rethinking Pesticide Suicide Prevention in Southeast Asia Region: Strategies Beyond Bans

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Abstract

Suicide prevention is one of the key targets for all countries mandated under the Sustainable Development Goals by the United Nations. Amongst several methods of suicide, abusing agrochemicals for self-harm is commonplace in Eastern societies. Undeniably, pesticide self-poisoning has reached gargantuan proportions and has become a public health problem in Southeast Asian countries and more particularly in India. A complete ban on Highly Hazardous Pesticides (HHPs) as categorized by WHO seems to be a simple solution but the pesticide industry and the governments have their own reservations. One important argument put forward by them is that these agrochemicals are essential for agricultural productivity, which is primal to solve the hunger problem for the society at large. Hence, it is important to explore alternative strategies beyond bans to tackle this pesticide suicide in the interest of all. This paper explores the use of technology and predictive AI-based surveillance for pesticide abuse risk and integrating it with tele-counselling, along with proper gatekeeper training for vendors, to enhance prevention efforts.

Keywords: Pesticide Suicide, Artificial Intelligence, Mental Health, Risk Surveillance

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In today's world suicide is a pressing issue due to increasing loneliness and reduced human connections. The reasons for suicide are manifold, with financial distress being one of the most common factors in Eastern societies. The Southeast Asia Region (SEAR), comprising of eleven low and middle-income countries (LMIC) and representing about 26% of the global population, accounts for 39% of the world's suicides. Unfortunately, the SEAR has one of highest reported suicide rate, at 17.7 per 100,000 people. It is also pertinent to mention that this number could be an underestimate of the actual number of suicides on ground, owing to heterogenicity in reporting unnatural deaths, variations in research methodology and incomplete health data collection systems [1].

Pesticide poisoning and hanging are the most common methods of suicide in this region [2,3]. The prevalence of pesticide ingestion as a usual method of suicide can be attributed to several factors. These economies are largely agrarian, with pesticides readily available in the market and easily stored in agricultural fields or in households. Moreover, the high lethality of these substances, combined with limited access to healthcare facilities, increases the likelihood of a successful suicidal attempt [2].

Several highly hazardous pesticides (HHPs), as categorised by the WHO, are still in use in these countries e.g. paraquat, aldicarb, carbofuran etc. While bans have been considered an effective method for preventing pesticide misuse for self-harm [4], they are not always universally acceptable or a perfect panacea for all stakeholders in the agricultural industry [5]. Many out of the box strategies to prevent pesticide abuse have been proposed and implemented with varying degrees of success, though often on a limited scale. These include restricting access to pesticides by using community storage systems or providing locked storage boxes in households. Additionally, gatekeeper training for retailers, along with limiting the sale of pesticides to single-use amounts, has been suggested to further reduce the risk of misuse [2,6].

Studies suggesting that pesticide bans reduce suicides often rely on incomplete or context-specific data, failing to consider variations in reporting systems, cultural attitudes towards reporting suicide and the classification of deaths in a jurisdiction. Furthermore, banning essential agrochemicals without providing viable alternatives can harm farmers economically, disrupting livelihoods and financial health of agrarian communities. A more nuanced approach is needed to address the accessibility of harmful substances without undermining their legitimate agricultural uses.

A technology-driven framework for pesticide regulation (Figure 1) is urgently required in the SEAR to mitigate suicides by pesticide ingestion. This approach should be complemented by measures such as promoting safe storage practices and encouraging the sale of pesticides in single-use quantities, thereby reducing accessibility and misuse while ensuring agricultural needs are met responsibly. Technology can provide a practical and effective alternative to outright bans by improving pesticide surveillance. The majority of people who use pesticides for suicide typically gain access by

purchasing them from local retail outlets [7-9].

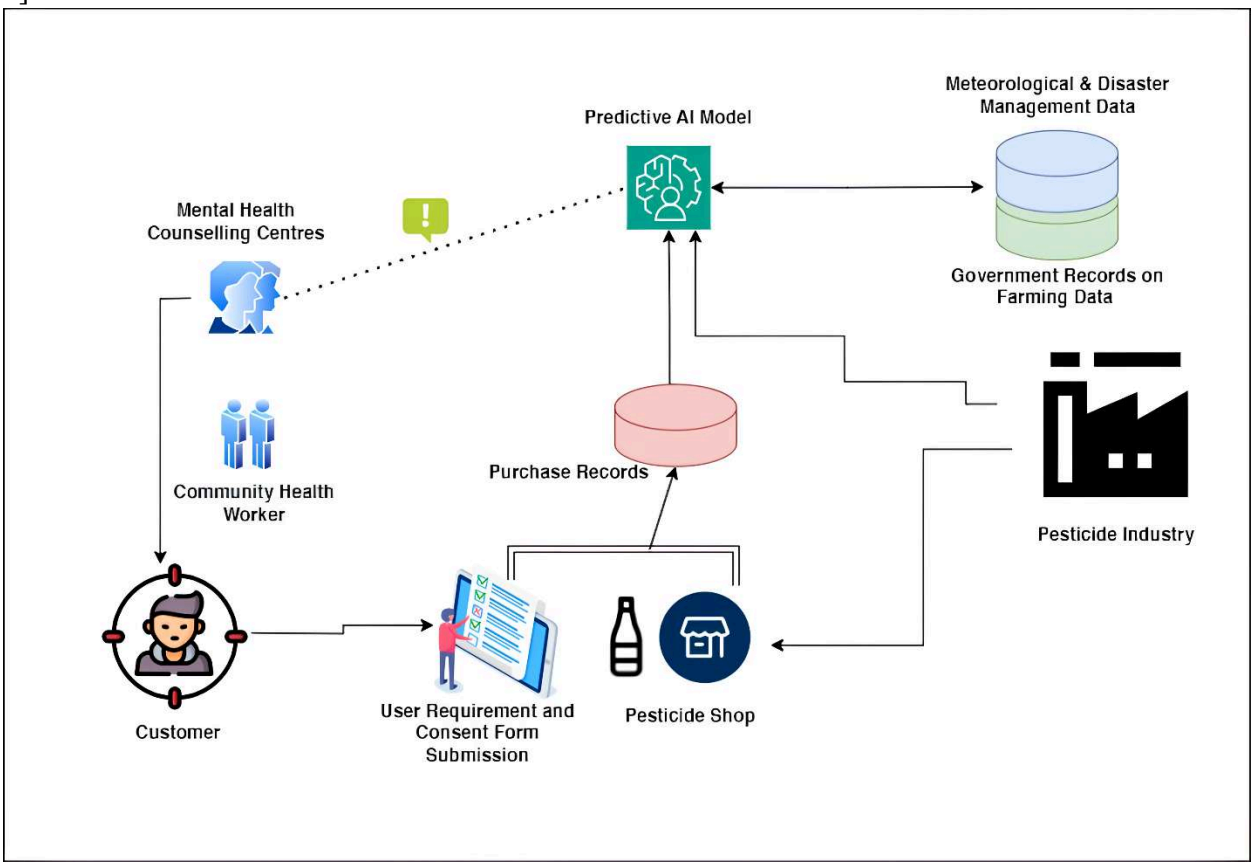

Figure 1. Risk Assessment workflow diagram using AI Predictive Model The pesticide industry and vendors play a critical role in ensuring responsible sales of hazardous pesticides. Customers must complete a digital consent form, providing crop details and social identification to link pesticide use with farming activities and support regulatory oversight. An algorithm cross-references this data with governmental records and uses AI to analyse questionnaire responses, detecting signs of mental distress. If a potential risk is identified, the system alerts the nearest suicide gatekeeper for intervention. When necessary, individuals receive a call from mental health care worker for further support. Some potential questions apart from suicide risk assessment include:

- Have you consulted an agricultural expert about the appropriate pesticide for your crop?
- Which pesticide do you need, and for how much land?
- Did you call the national farmer call centre regarding the pesticide suggestion?
- Have you purchased pesticides for this crop before? If yes, when?

Some countries require a prescription to buy certain pesticides to prevent misuse and protect public health. In Brazil, an agronomist's prescription is needed for hazardous pesticides. The European Union restricts some pesticides to certified professionals. In the United States, the EPA classifies certain pesticides as "Restricted Use," allowing only licensed applicators to buy them. Sri Lanka has also enforced

prescription-based sales for some pesticides to reduce suicides. These regulations help control pesticide use, prevent poisoning, and lower the risk of self-harm. Prescription-based dispensing of pesticides and the verification of a farmer's status are currently far from feasible in these countries owing to several infrastructural limitations in the LMIC. A mandatory data collection QR code on every pesticide container sold at retail stores can be a starting point. Vendors and/or customers (could be a potential victim of pesticide ingestion) would scan the QR code to record essential data, including customer identity, purpose of purchase, and intended use etc. to name a few. The system would incorporate a brief mental health semi structured questionnaire [8] (standardised by mental health professionals in local language) to identify potential suicide risks. Vendors could serve as gatekeepers if properly trained to recognize and restrict the sale of pesticides to intoxicated or suspicious individuals. Nevertheless, it is essential to make it a legal requirement for vendors to collect data and link them to a broader tech and AI-based ecosystem to ensure effective monitoring and regulation.

Data collected from pesticide transactions can be connected to a real-time monitoring system powered by AI-driven risk assessment and community engagement. If the system detects suspicious or high-risk purchases—such as the customer/buyer having signs of mental distress—it can trigger alerts to local community health workers, family members, or mental health helplines, facilitating timely intervention to prevent suicides. For online purchases, similar checks and data integration would ensure compliance with safety protocols, especially given the rising trend of non-agricultural individuals purchasing pesticides from e-marketplaces to commit suicide.

Predictive AI can analyse patterns to identify risks, while vendors, trained under the regulatory framework, would act as key gatekeepers in mitigating these risks, supported by technology to reduce their burden. This system creates a comprehensive, tech-enabled approach to suicide prevention, connecting community resources for swift action.

No purchasing transaction should be completed until the buyer/customer fills out a mandatory questionnaire and watches a video on the safe use of pesticides. Additionally, all purchases must be linked to a digital database, and even cash transactions must comply with a QR-based registration of buyer/customer information. While this process may seem cumbersome initially, optimizing the questionnaire and data collection following a pilot project and vendor sensitization can make it practical. It is undeniable that expanding this project on a massive scale needs to tap on the behavioural bottlenecks in optimal implementation due to socio-cultural factors prevalent in the LMIC.

Going by the "polluter pays" principle or the doctrine of strict liability, the pesticide manufacturing companies should be held accountable for funding the necessary tech and AI infrastructure to support this system. The basic version of the system is estimated to cost ₹8–12 lakh INR ($10,000–$15,000), covering essential software development, database integration, and low-cost infrastructure. Annual maintenance is projected at $1,200–$2,500. Privacy should

be ensured through data encryption, role-based access controls, and compliance with National IT regulations, with data stored on local servers to reduce costs while maintaining security. Training vendors and gatekeepers on system use and flagged case management will add ₹50,000–₹1 lakh ($600–$1,200) to the budget altogether to have a system in place without compromising core functionality.

In India, existing systems like Kisan Call Centres and Tele-MANAS (Tele Mental Health Assistance and Networking Across States) provide a foundation that can be integrated into a comprehensive pesticide regulation framework. By sharing the data collected from vendors with these helpline operating systems in real-time, we not only can restrict access to pesticides but also offer counselling to the person in need at the same time. This way, we are not just preventing misuse of pesticides for self-harm but bringing mental health support closer to the suffering individual.

One more point worth mentioning here is that if there is a blanket ban on these pesticides, people may resort to different means/method of suicide. However, vendor-based surveillance will become a *high impact intervention node* as it capitalises on tapping on the *critical behavioural leverage point*. It could be exploited as one of the key rate-limiting steps in preventing suicide in rural areas. This vendor-based surveillance enables us to identify and intervene with individuals contemplating suicide at the right time before they are successful in their agenda. As a next step, this system could be integrated with meteorological and disaster management departments. These departments can share their data with vendors. This data can help vendors stay informed about natural calamities or drought-induced crop failures. Such events may lead to an increased risk of pesticide purchases for self-harm. By receiving timely alerts, vendors can be more vigilant and intervene when necessary.

This tech-oriented and AI driven model has its own challenges ranging from privacy, acceptance at vendor level, to scalability. But it offers a balanced approach to regulating agrochemicals without resorting to complete bans. It uses technology to raise awareness and involve all key stakeholders—producers, vendors, buyers, health workers, and policymakers—in recognizing the risks of pesticide misuse and working together to prevent pesticide-related suicides.

There are multiple data privacy issues emerging from this paradigm, and vendors need to be sensitized to act professionally. Moreover, the country's digital data protection laws should be strictly enforced while handling this data.

A brief SWOT analysis of the proposed policy:

Strength: This model does not require a large physical setup to tackle the problem. The entire intervention is virtual, utilizing existing infrastructure, and any additional costs for new infrastructure are minimal.

Weakness: Persuading stakeholders and ensuring vendor adaptability to the new model could be challenging, despite government support.

Opportunity: This approach has the potential to prevent many deaths. Furthermore, we can engage freelance collaborators, including experts in pesticide science, mental health, and public policy, to contribute to effective solutions.

Threat: Resistance from pesticide companies may pose a significant challenge to implementation.

By integrating tele mental health helplines, predictive AI, and community-based interventions, this framework addresses one of the root causes of pesticide misuse by restricting access. For the time being, the companies and the governments should be at least ready to adopt such strategies if they aren't happy to ban pesticides outrightly in view of the increasing productivity to tackle the food needs of the growing population.

Although bans may appear to be the most straightforward solution to the issue of pesticide-based suicides, we should also consider other viable alternatives that don't create unwarranted resistance from governments or companies. A technology-driven regulatory system that incorporates data collection, artificial intelligence, and community engagement offers a practical and a thinkable solution.

By working in the areas of public education and pesticide risk assessment, and employing real-time intervention, Southeast Asian countries can move toward a pesticide abuse-free future. This approach enables targeted interventions, improving both access control and ensures mental health support to the needy. This in a way, is better and effective for all the stakeholders involved.

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Conflicts of interest

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CASE REPORT

Symptomatic Hyponatremia following Acute Urinary Retention

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Abstract

Background: Hyponatremia due to acute urinary retention is not a common condition. Moreover, symptomatic hyponatremia requires management with hypertonic saline and other supportive measures mostly in ICU settings.

Case report: We report a case of symptomatic hyponatremia secondary to acute urinary retention probably due to release of vasopressin due to urinary bladder distension which was managed with urinary bladder catheterization and other supportive measures leading to resolution of hyponatremia.

Conclusion: Acute urinary retention can lead to hyponatremia which may be corrected by treatment of the cause and other supportive measures.

Keywords: urinary retention, Hyponatremia, Inappropriate ADH syndrome, vasopressins, urinary bladder

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Introduction

Hyponatremia is a common as well as fatal condition in patients presenting to Emergency Department (ED). But hyponatremia associated with acute urinary retention is not a well-known entity. We hereby report a patient who presented with symptomatic hyponatremia and which improved gradually following relief of urinary retention and other supportive measures.

Case Report:

A 48 years old female presented to our Emergency Department (ED) with complaints of inability to pass urine for last 2 days. It was associated with 3 bouts of vomiting since last 12 hours before presentation to ED. Her next of kin also reported that she became extremely sleepy and sometimes drowsy over the last 24 hours. They also reported that she developed intermittent episodes of fever 5 days back which subsided after taking antipyretics. She was a known diabetic but not on any regular medication for the same. On examination she was sleepy but arousable, disoriented with a Glasgow Coma Scale score (GCS) of E3V4M6. She was afebrile and recorded a BP of 130/62 mmHg and a pulse rate of 86/min. Abdominal examination revealed distension of urinary bladder extending almost up to the umbilicus. No other abnormalities were noticed. Blood gas analysis showed normal acid-base status but Na^+ levels were 107 meq/L. ECG showed normal sinus rhythm. She was immediately catheterized with 14 F Foley catheter following which 1200ml of urine was drained. To look for cerebral edema, NCCT head was done which showed a normal study. After sending blood samples for CBC, KFT, serum electrolytes, she was admitted to the HDU for further evaluation and treatment. Initial laboratory investigation results were as follows:

Table 1. List of initial laboratory investigation reports

Hb	10.9 g/dL
TLC	4400/mm^3
Platelet count	1.67 lakhs/mm^3
RBS	231 mg/dL
Blood urea	16.76 mg/dL
Creatinine	0.73 mg/dL
K^+	3.6 meq/L
Na^+	107 meq/L
Cl^-	71 meq/L
Total Protein	6.5 g/dL
Albumin	4.55 g/dL
Total bilirubin	0.6 mg/dL
Direct bilirubin	0.2 mg/dL
SGOT	65.8 U/L
SGPT	40.1 U/L
Alkaline Phosphatase	154.6 U/L
Uric acid	3.1 mg/dL
CRP	8.4 mg/dL

Urine analysis showed hazy appearance with large number of pus cells. Ultrasound of abdomen did not reveal any abnormality. Work-up for hyponatremia revealed low Plasma osmolality (220.89 mosm/L), urine spot Na^+- 31 meq/L and increased urine osmolality (125.84 mosm/L). as she was clinically euvolemic with no history of diuretic or hormonal therapy, a probable diagnosis of Syndrome of Inappropriate ADH (SIADH) was considered. Her thyroid profile, and Random cortisol levels were in the normal range. She had no history of prior malignancy, pulmonary disease, hormonal deficiency, neurological disorder or insult. She also had no history of recent surgery was not on any drugs. Initially she was infused with 500ml 0.9% NaCl in the ED, but after the diagnosis of SIADH she was kept on fluid restriction. Over the next 5 days, her sodium levels normalized gradually as shown in Table 2.

Table 2. Improvement of serum Na^+ levels from day 1 to day 6 of hospitalization.

Day 1 Na^+	107 meq/L
Day 2 Na^+	111 meq/L
Day 3 Na^+	119 meq/L
Day 4 Na^+	121 meq/L
Day 5 Na^+	123 meq/L
Day 6 Na^+	131 meq/L

She was also started on empirical Intravenous Ceftriaxone in view of possible urinary tract infection (UTI). Her urine output and KFT remained normal throughout. She also became more awake, alert, oriented and remained afebrile. She was discharged on the 6^{th} day with Na^+ level of 131 meq/L, K^+- 3.6 meq/L and Cl^- levels of 104 meq/L and was advised to follow up in Endocrinology OPD after 48 hours.

Discussion

SIADH is a disorder related to impaired excretion of water due to inadequate suppression of ADH leading to hyponatremia [1]. Hyponatremic patients with euvolemia, hypoosmolality in plasma and raised urine osmolality and urine Na^+ (usually >40 meq/L) should be suspected of SIADH. There are many causes of SIADH viz central nervous system disorders, malignancies, drugs, recent surgery, pulmonary disease, hormonal deficiency, HIV infection, Hereditary SIADH and Idiopathic [2]. In our case the hyponatremia got gradually corrected following urinary catheterization and fluid restriction. The likely mechanism of which could be release of vasopressin in response to distension of urinary bladder. Similar findings were also reported by Parikh J et al and Galperin I et al where hyponatremia ensued secondary to urinary retention [3,4]. The differential diagnoses of such presentation are CNS infections, hypoglycemia, hyperglycemia, uremia etc. which were ruled out by clinical examination, laboratory and imaging modalities. The cause of urinary retention was possibly due to UTI causing urethritis and urethral edema as other causes like pelvic organ prolapse, pelvic mass were ruled by clinical and ultrasound examination [5,6]. Apart from urinary catheterization, fluid restriction was one of

the mainstays of therapy for hyponatremia. The total fluid intake of the patient was 1 litre per day for 6 days aiming for a negative fluid balance of 500-700ml per day and thus a cumulative negative fluid balance of 3600 ml was achieved over a period of 6 days. We have highlighted this case as such conditions do not require aggressive treatment and can be easily managed with simple measures. Further this case also helps us to understand the different mechanisms which can lead to hyponatremia.

Conclusion

SIADH is one of the most common causes of euvolemic hyponatremia due to varied known etiologies. But SIADH related hyponatremia secondary to urinary retention and urinary bladder distension is less common and should be suspected in patients presenting with altered sensorium and acute urinary retention.

Conflict of Interest

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

Authors Contribution

All authors contributed equally in conceptualization, data curation, formal analysis, methodology, project administration, investigation, resources, software, validation, visualization, writing of original draft, review and editing, and supervision.

Informed Consent

Informed consent was obtained from patient and legal heirs of the deceased patient involved in the study for publication.

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CASE SERIES

Enterolithiasis: A Rare Cause of Small Bowel Obstruction

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Abstract

Enterolithiasis is characterized by the formation of gastrointestinal stones, leading to symptoms such as abdominal pain, distention, nausea, and vomiting. This case examines two instances of enterolithiasis, detailing their clinical presentations, diagnostic processes, and treatment approaches. The first case involves a 67-year-old woman with partial improvement after conservative management for intestinal obstruction. The second case describes a 55-year-old diabetic woman with small bowel obstruction and pneumobilia. Both cases required surgical intervention, resulting in successful outcomes and no recurrence over a six-month follow-up. This study highlights the importance of timely diagnosis and appropriate surgical management to prevent complications**.**

Keywords: Enterolith, Small bowel obstruction, Gallstone Ileus, Enterolithotomy, Surgery

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Introduction

Enterolithiasis, the formation of stones within the gastrointestinal tract, manifests with symptoms such as abdominal pain, distention, nausea, and vomiting. The condition primarily affects adults and can be categorized as primary or secondary based on the origin of the stones [1,2]. Enteroliths were first identified on imaging by Pfahler and Stamm in 1915 [3]. The prevalence of primary and secondary enterolithiasis varies widely, ranging from 0.3% to 10% [4]. Primary enteroliths form within the intestines, often in areas of stasis such as diverticula, and are influenced by factors such as diverticular disease, altered luminal propagation, and specific luminal pH conditions [5]. On the other hand, secondary enteroliths typically result from gallstones migrating into the intestines through biliary-enteric fistulas, leading to obstruction. This case explores the clinical presentations, diagnostic processes, and treatment strategies for two patients with enterolithiasis, emphasizing the necessity of prompt and effective management to prevent complications and improve patient outcomes.

Case 1

Clinical Presentation

A 67-year-old woman presented to the surgical outpatient department with a 10-day history of generalized abdominal pain, distention, vomiting, and constipation. Initially managed conservatively at a local hospital, her symptoms showed partial improvement with infrequent passing of flatus. She had a history of abdominal surgery for intestinal obstruction 10 years prior. Upon examination, her respiratory rate was 20 breaths per minute, and oxygen saturation was 96% in room air. Her abdomen was soft and mildly distended with audible bowel sounds. Laboratory tests were unremarkable. Imaging studies, including an abdominal X-ray, revealed two radiopaque calculi mimicking bladder stones (Figure 1a). However, a contrast-enhanced computed tomography (CECT) scan indicated that the radio-opaque stones in the pelvic area were two enteroliths (3x2 cm and 2x2 cm) floating near the terminal ileum, with one located in a diverticulum. There was no evidence of pneumobilia or radio-opaque gallstones. The gallbladder and surrounding structures appeared normal. The patient was admitted and treated with intravenous fluids and analgesics. She underwent a midline laparotomy, during which two stones were found: one proximal to a stricture and another within a diverticulum. Enterolithotomy (Figure 1b,1c) with diverticulectomy and strictureoplasty was performed, and the site was repaired with polyglactin 910, 3-0 suture in a single layer. The postoperative course was uneventful, and the patient was discharged on the seventh postoperative day. A six-month follow-up showed no complications.

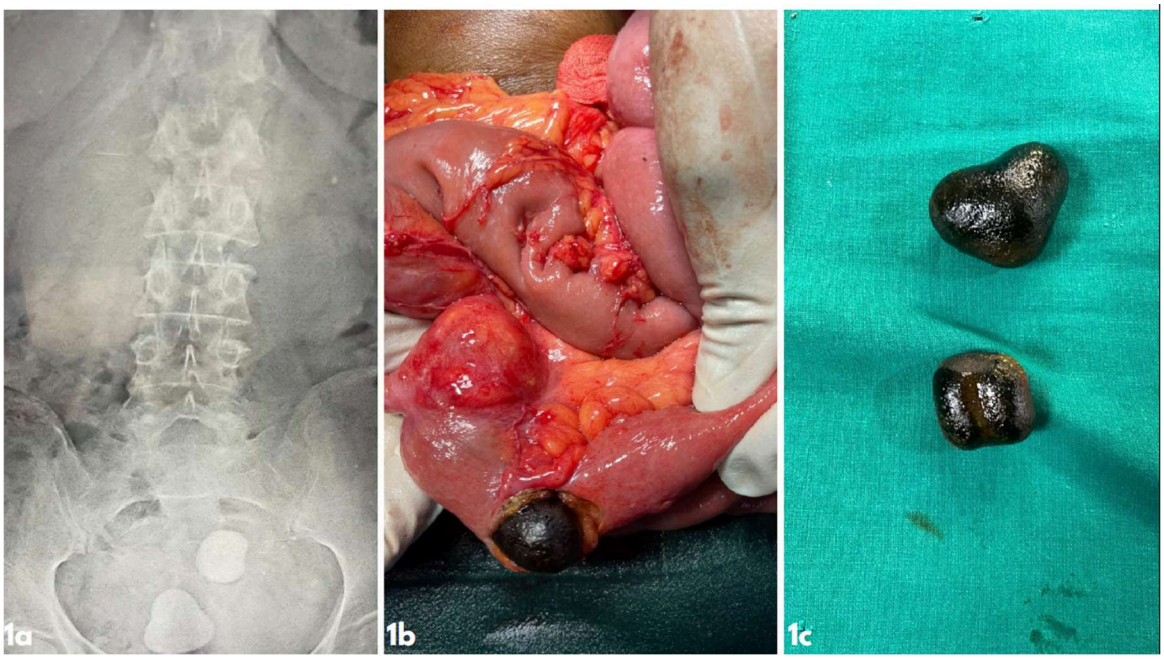

Figure 1. Primary enterolith; 1a: Abdominal X-ray revealing two radio-opaque calculi in the pelvis; 1b: Enterotomy showing enteroliths with associated stricture and diverticula; 1c: Extracted enteroliths.

Case 2

A 55-year-old woman with a history of diabetes mellitus presented to the surgical outpatient department with a 5-day history of generalized abdominal pain, progressive distention, nausea, vomiting, and constipation. The patient was admitted to the Intensive Care Unit for sepsis with jaundice and acute kidney injury. She had no prior history of abdominal surgery. Upon examination, her respiratory rate was 24 breaths per minute, and her oxygen saturation was 92% in room air. Her abdomen was soft and mildly distended with absent bowel sounds. Laboratory tests revealed hyperglycemia, jaundice, and raised serum creatinine. Initial imaging studies, including an abdominal X-ray, revealed signs of small bowel obstruction (Figure 2a). A contrast-enhanced computed tomography (CECT) scan showed indications of intestinal obstruction (Figure 2b). Evidence of pneumobilia indicated a biliary-enteric fistula (Figure 2c). The gallbladder showed signs of chronic cholecystitis with the presence of additional smaller gallstones. The patient was admitted for further management and was treated with intravenous fluids, analgesics, and insulin for glucose control. A midline laparotomy was performed, revealing multiple stones. The surgical team performed an enterotomy to remove the stones and repaired the site using polyglactin 910, 3-0 suture in a single layer. We did not repair the fistula at the initial operation but repaired it after one and a half. The post- operative course was uneventful, and we discharged the patient on the 7th post operative day. A patient was asymptomatic at 6 month follow up.

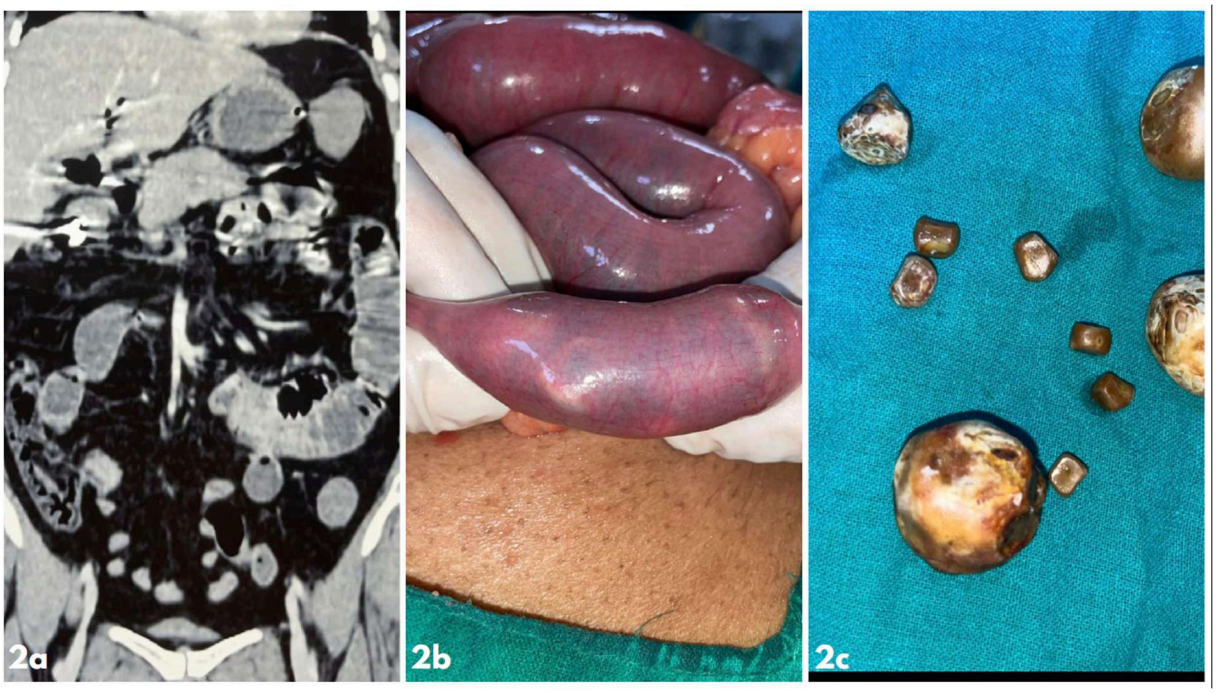

Figure 2. Secondary enterolith; 2a: Computed tomography scan displaying pneumobilia and small bowel obstruction; 2b: Small bowel showing the impression of a stone; 2c: Multiple gallstones removed via enterotomy.

Discussion

Enterolithiasis is a rare condition of the gastrointestinal tract. The term "enterolith" means stones formed within the intestine, and these can be broadly classified into primary and secondary enteroliths based on their origin and composition [1,2]. Knowledge about etiopathology, clinical presentation, investigation is crucial for effective treatment and prevention of complications. Enteroliths were first described on imaging by Pfahler and Stamm in 1915 [3]. The prevalence of primary and secondary enterolithiasis ranges between 0.3% and 10% [4]. Primary enteroliths form within the intestines themselves, typically in areas of stasis such as diverticula or strictures. Conditions predisposing to primary enterolith formation include diverticular disease, altered intestinal motility, Crohn's disease, tuberculosis, anastomotic strictures, and low luminal pH [5]. The stones can be composed of cholic acid or calcium salts such as calcium phosphate, calcium oxalate, and calcium carbonate. In contrast, secondary enteroliths are formed outside the intestinal tract and migrate within the intestine and the most common being gall stone. That is associated with biliary-enteric fistula formation.

The clinical presentations differ depending on the stone's size, location, and number of stones. Common symptoms include abdominal pain, distention, nausea, and vomiting [6,7]. These symptoms can be acute or insidious in onset and may lead to

complications such as intestinal obstruction, which was observed in the presented cases. The tumbling nature of the stones can result in recurrent obstruction in gall stone ileus, posing a significant challenge in clinical management [8]. In both cases mentioned here. Patients were presented with abdominal pain, distention, vomiting and constipation which are cardinal symptoms of Intestinal obstruction secondary to enterolithiasis. Gallstone less than 2 cm in size can pass spontaneously into the large intestine [9]. 90% of obstructing gallstones are larger than 2 cm in diameter, with the majority exceeding 2.5 cm [10].

Radiological imaging plays a pivotal role in diagnosing enterolithiasis. The radio-opacity of enteroliths is influenced by their calcium content, with calcium-rich stones appearing more radio-opaque than cholic acid stones. Initial diagnostic workup typically includes plain abdominal X-rays, which may reveal radio-opaque stones. However, more detailed imaging such as contrast-enhanced computed tomography (CECT) scans provides comprehensive information about the size, number, and exact location of the stones and any associated diverticula or strictures. In the presented cases, both abdominal X-rays and CECT scans were instrumental in identifying the enteroliths and guiding subsequent surgical intervention.

The optimal treatment of enterolithiasis focuses on removing the enterolith and addressing the underlying pathology to prevent the future formation of enteroliths. Surgery involving crushing and milking the stone down to the colon is the least invasive approach [9]. If unsuccessful, an enterotomy may be performed proximal to the obstruction site to remove the enterolith [11]. In more complicated cases, a resection of the segment involved may be considered. Treatment options include enterolith removal and addressing the underlying cause. Expectant management is limited and may be considered for symptomatic enteroliths <2 cm without luminal compromise. Open surgery with enterolithotomy and manual removal is the mainstay of treatment, although successful laparoscopic surgeries have been reported. Endoscopic electrohydraulic lithotripsy has been successful in some cases [12]. To prevent stone recurrence, underlying pathology for compromised intestinal motility should be treated with medical, endoscopic, or surgical interventions.

Conclusion

These cases underscore the complexity and clinical significance of enterolithiasis. Prompt diagnosis, appropriate surgical intervention, and comprehensive postoperative care are crucial for successful management. Addressing the underlying causes of stone formation is essential to prevent recurrence and improve patient outcomes. The insights gained from these cases contribute to the growing body of knowledge on enterolithiasis and provide valuable guidance for clinicians managing this challenging condition.

Informed Consent

Written informed consent was taken from the patients for the publication of these

images. This is not a research article and does not require ethical committee approval.

Conflicts of interest

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

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