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Union Budget 2026-27:
Healthcare Gains in the Context of "Viksit Bharat"

The Viksit Bharat vision — a long-term national development strategy converging economic growth, human capital, and resilience — reflects in several healthcare components of the 2026-27 budget

Union Budget 2026-27: Hon'ble Prime Minister of India Shri Narendra Modi gathers economic experts to chart strategy ahead of budget

"Budget has special focus on mental health and combating mental illness..." Union Minister JP Nadda

Healthcare Workforce Expansion
The budget pledges the addition of **100,000 allied health professionals (AHPs)** — a significant boost to India's healthcare delivery capacity and quality.

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(Contents Continued)

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EDITORIAL

Union Budget 2026–27: Realising the 'Trinity of Mission in Healthcare'-Service, Education, Research- in India through Regional Medical Hubs & towards Viksit Bharat 2047

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The Union Budget 2026–27 is not merely an infrastructure initiative; it is the articulation of a Trinity of Missions essential for India's transition towards a *Viksit Bharat*.

In healthcare, nations do not become developed by spending more alone—but by building systems where care heals, education sustains, and research propels the future. Union Budget 2026–27, for the first time in recent memory, places all three within a single national vision (Figure 1).

Figure 1. Union Budget 2026-27: Hon'ble Prime Minister of India Shri Narendra Modi & Hon'ble Union Finance Minister Smt. Nirmala Sitharaman

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Healthcare as National Infrastructure:

- What emerges from Union Budget 2026–27 is a reframing of healthcare—from a sectoral obligation to **national infrastructure**, comparable in importance to transport, energy, or digital networks. The *trinity of mission*—care, education, and research—provides the conceptual glue for this transformation.
- If implemented with institutional discipline, outcome-based monitoring, and federal cooperation, Regional Medical Hubs could become the **defining healthcare legacy of this decade**, anchoring India's journey towards *Viksit Bharat* not merely as a healthier nation, but as a **knowledge-driven, globally competitive healthcare leader**.

Why the Public-Private Partnership Model:

- The public sector anchors equity, regulation, and national priorities;
- The private sector further improves efficiency, capital, and innovation.

Figure 2. "Budget has special focus on mental health and combating mental illness..." Union Minister JP Nadda

Beyond incremental allocations and scheme expansions, Union Budget 2026–27 articulates a structural idea—one that brings together **Care Delivery, Knowledge Creation, & Innovation** into a single, scalable national architecture (Figure 2).

At the heart of this vision lies the proposal to establish Regional Medical Hubs, developed through public–private partnerships (PPPs) and conceived as **integrated healthcare complexes** combining **advanced medical care**, **medical education and training**, and **research and innovation**.

From Fragmentation to Integration

India's healthcare system has historically evolved in silos. Clinical services, medical education, and research have often progressed independently—sometimes competitively, rarely synergistically. The Budget 2026–27 proposal seeks to reverse this fragmentation.

By embedding **tertiary and quaternary care hospitals**, **teaching institutions**, and **research ecosystems** within a single hub, the government signals a shift towards **systems-based healthcare development**. This mirrors global best practices, where academic medical centres act as anchors for regional health, talent, and innovation ecosystems.

The Regional Medical Hub model thus represents a deliberate move away from stand-alone hospitals or isolated medical colleges towards **living healthcare ecosystems**.

Union Budget 2026-27

Highlights of the Healthcare Sector Gains & Strategic Priorities

1. Record Healthcare Allocation

- For the first time, the healthcare budget crosses **₹1 lakh crore**, signalling healthcare as a priority in fiscal policy.

2. Affordable & Accessible Treatment

- **Customs duty waived** on 17 essential cancer drugs and **exemptions on medicines for 7 rare diseases**, reducing treatment costs for patients.

3. 'Biopharma Shakti' Initiative

- A **₹10,000 crore** programme to strengthen **biopharmaceutical manufacturing & innovation**, including biologics and biosimilars. The goal is to reduce dependency on imports, promote affordable drugs, and position India as a **global biotech hub**—all aligned with Viksit Bharat's economic and health security ambitions.

4. Healthcare Workforce Expansion

- The budget pledges the addition of **100,000 allied health professionals (AHPs)** — a significant boost to India's healthcare delivery capacity and quality.

5. Regional Medical Hubs for Medical Tourism

6. Ayurveda & Traditional Medicine Support

7. Education, Training & Research

- New institutions and training pathways for AHP disciplines.
- Strengthened research ecosystem via **New Biopharma labs and allied health education initiatives** (e.g., courses and multi-skilled caregiver programs).

8. Focus on Mental Health

Medical Education and Workforce Sustainability

The First Pillar: Advanced Medical Care

The first pillar—**advanced medical care facilities**—addresses both domestic and global imperatives. For Indian citizens, these hubs promise access to high-end diagnostics, specialised interventions, post-acute care, and rehabilitation within regional geographies, reducing dependence on metropolitan centres.

For the global community, these hubs strengthen India's position as a **medical value travel destination**, supported by Medical Tourism Facilitation Centres, continuity-of-care infrastructure, and AYUSH integration. Healthcare here is not only a social service but also a **strategic export sector**.

The Second Pillar: Medical Education and Training Institutions

These are the most critical for long-term sustainability. India's healthcare expansion has repeatedly been constrained not by intent but by **human resource bottlenecks.**

Embedding medical colleges, nursing schools, and allied health professional (AHP) training programmes within Regional Medical Hubs creates a virtuous cycle:

- **Clinical load enriches training quality**
- **Training pipelines ensure workforce availability**
- **Workforce density improves care outcomes**

This model directly addresses the chronic imbalance between infrastructure creation and skilled manpower deployment.

The Third Pillar

From Periphery to Core

The third pillar—**research and innovation infrastructure**—elevates healthcare from service delivery to **knowledge generation**. Clinical research units, biopharma linkages, digital health platforms, and translational laboratories integrated within care environments shorten the distance between bench and bedside.

This is particularly relevant as India seeks leadership in **biologics, biosimilars, digital health, and precision medicine**. Research embedded in real-world clinical ecosystems is not only more relevant but also more equitable.

Healthcare Gains in the Context of "Viksit Bharat"

The *Viksit Bharat* vision—a long-term national development strategy converging economic growth, human capital, and resilience—is reflected in several healthcare components of the 2026-27 budget:

A. Human Capital Development

- Improved healthcare access and workforce expansion elevate productivity and life expectancy, which are core to a developed society.

B. Economic Integration

- Biopharma Shakti and medical tourism hubs tie healthcare with **manufacturing growth and services exports**, boosting GDP and global competitiveness.

C. Affordability & Equity

- Lower drug costs and expanded care infrastructure support equitable health outcomes, reducing catastrophic health spending and widening insurance reach.

D. Innovation & Research

- Prioritization of biopharma, allied health training institutions, and integrated ecosystems accelerates innovation—a pillar in India's *Viksit Bharat* socio-economic blueprint.

PPPs as Enablers, Not Substitutes

The emphasis on **public–private partnerships** deserves careful interpretation. The Budget does not envisage PPPs as a withdrawal of the state but as a **capacity multiplier**.

If governed transparently and aligned with public health goals, PPP-led Regional Medical Hubs can avoid the pitfalls of commercialisation while retaining the benefits of scale and speed.

Mental Health and Regional Equity: Deepening the Vision

Complementing the hub-based approach, the Budget's announcement of **NIMHANS-2** and the upgradation of national mental health institutes as regional apex centres signals a broader understanding of healthcare as **human capital protection**.

Regional Equity and Inclusive Development

The focused attention on **Purvodaya States and the North-East** further aligns healthcare expansion with regional equity and employment generation.

The Union Budget 2026–27 initiatives ensure that integration is not confined to disciplines, but extends to **geographies and populations** historically underserved.

A focused emphasis has been placed on **Purvodaya States and the North-Eastern Region**, with the objective of:

- Empowering vulnerable populations to access quality mental health and trauma care
- Addressing regional disparities in specialist healthcare availability
- Accelerating local development through **health-led employment generation**

Contribution to *Viksit Bharat*

Collectively, these initiatives:

- Integrate healthcare delivery with education, research, and tourism
- Advance mental health as a core component of human capital
- Promote balanced regional development
- Position healthcare as both a **social good and an economic growth engine**

The Union Budget 2026–27 thus operationalises the *Viksit Bharat* vision by embedding healthcare within India's long-term strategy for productivity, resilience, and global leadership.

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ORIGINAL ARTICLE

Evaluation of the Wound Healing Effect of Topical and Oral Trigonella Foenum-Graecum Seed Oil on Burn Wound in an Animal Model

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Abstract

Background: Burn injuries cause substantial morbidity due to inflammation, infection, and delayed healing. Although silver sulfadiazine (SSD) is widely used for partial-thickness burns, its drawbacks and the lack of a universal standard highlight the need for alternatives. Fenugreek (*Trigonella foenum-graecum*) seed oil has anti-inflammatory, antioxidant, antimicrobial, and pro-healing effects, and may also improve glycemic control—an added benefit for patients with metabolic impairment. **Aims and Objectives:** This study aimed to compare the wound-healing efficacy of topical and oral fenugreek seed oil with SSD in Wistar rats with partial-thickness burns. Primary objectives included assessing wound contraction and histopathological healing. Secondary objectives included evaluating fasting blood glucose levels to determine systemic effects. **Methodology:** Thirty healthy male Wistar rats were randomly divided into five groups (n=6): control (saline), SSD 0.01% ointment, topical fenugreek oil, oral fenugreek oil (1 ml/kg/day), and combined topical plus oral fenugreek oil. Partial-thickness burns were created using a molten-wax model. Treatments were given twice daily for 21 days or until full epithelialization. Wound area was measured on days 4, 9, 14, 18, and 21 to determine contraction. Fasting glucose was assessed on days 1 and 21. Histology evaluated angiogenesis, inflammation, collagen formation, and epithelial repair. **Results:** All groups showed progressive wound contraction, with Groups C (topical fenugreek), D (oral fenugreek), and E (combined therapy) demonstrating significantly faster healing ($p<0.001$ from day 14). Group E achieved complete wound healing in all animals by day 21. Blood glucose levels significantly decreased in Groups A, B, D, and E ($p<0.05$), with the greatest reductions in D and E. Histopathology confirmed reduced inflammation, organized collagen, and complete epithelial regeneration in Groups C, D, and E, with Group E showing the most consistent results. **Conclusion:** Fenugreek seed oil, particularly when administered both topically and orally, significantly improved wound contraction, histological healing, and glycemic control in partial-thickness burn injuries in rats. These findings support its potential as a multifunctional adjunct or alternative to SSD, especially in patients with metabolic disorders. Further clinical studies are recommended to validate efficacy, optimize dosing, and ensure safety in human burn management.

Keywords: Burn wound healing, *Trigonella foenum-graecum*, Fenugreek seed oil, Silver sulfadiazine, Wound contraction, Histopathology

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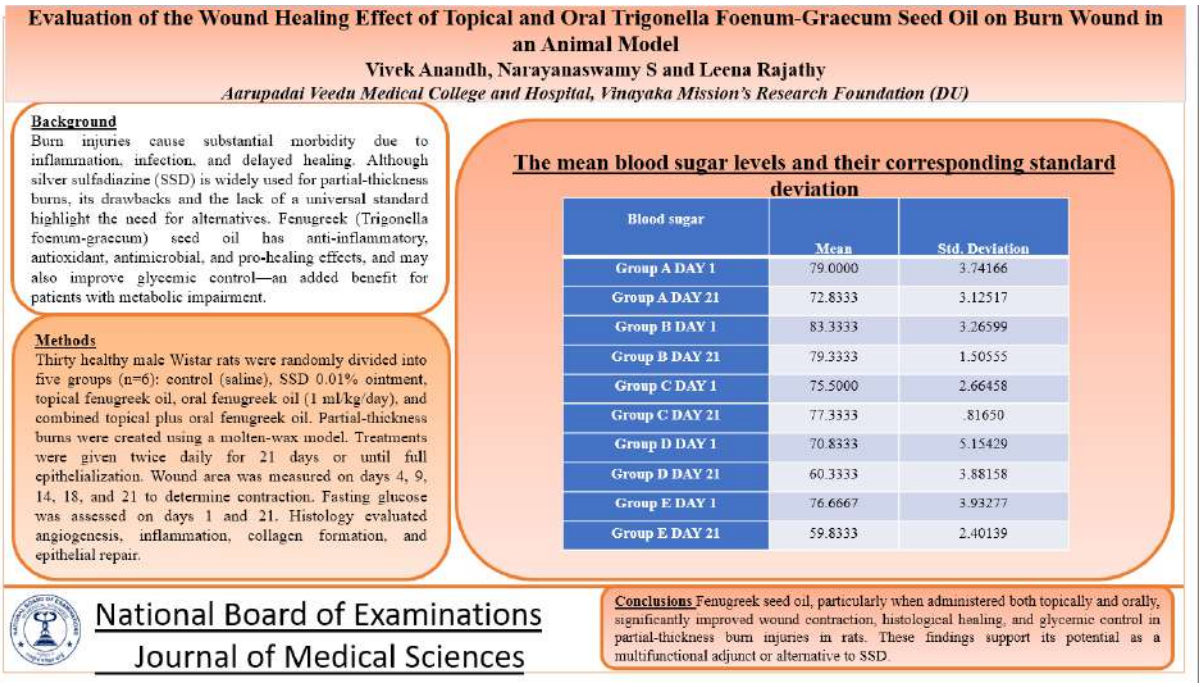
Graphical Abstract



Introduction

Rats are commonly used in burn studies because they are inexpensive and easy to manage, but their healing pattern differs markedly from humans. Human wounds close mainly through re-epithelialization, whereas rats heal largely by contraction due to the panniculus carnosus—a subcutaneous muscle humans lack—which accelerates collagen deposition and wound shrinkage. As a result, rats show faster closure times and rarely develop systemic complications such as sepsis or immunosuppression, which are more typical in larger animal models. These differences make rats useful for rapid mechanistic research but limit how directly the results translate to human burn healing [1–7].

Burns are skin injuries caused by exposure to high heat or caustic chemicals, with thermal and chemical sources being the most common [8]. They are a critical care challenge due to their association with inflammation, tissue destruction, infection, and in severe cases, mortality and long-term disability [9–11]. Burn wounds are classified based on depth: superficial (first-degree), partial-thickness (second-degree), and full-thickness (third-degree) [12–14]. Superficial burns affect only the epidermis and usually heal within five days, whereas partial-thickness burns extend into the dermis and are further divided into superficial and deep partial-thickness types [15–17]. Superficial partial-thickness burns are red, blistered, and very painful, typically healing within 1–3 weeks without surgery, whereas deep partial-thickness burns extend deeper into the dermis, appear dry or dull red, and heal more slowly, often with scarring. Full-thickness burns affect all skin layers and typically require surgical intervention like skin grafting.

Treatment of partial-thickness burns often involves topical agents such as silver sulfadiazine (SSD), silver-impregnated foam dressings, and zinc hyaluronan gels [18–20]. SSD has been the primary agent due to its antibacterial properties, though it

can cause systemic side effects such as methemoglobinemia, neutropenia, and crystalluria [5–7]. There is currently no universally accepted gold standard for treating partial-thickness burns; treatment decisions are typically based on clinician experience and institutional protocols. The lack of controlled comparative studies across various dressings and healing stages limits the strength of evidence supporting any single modality. Additionally, pediatric treatments must consider the cognitive risks of repeated anesthesia during dressing changes. Oxidative stress—through the action of oxygen free radicals—is a known inhibitor of wound healing. In this context, fenugreek (Trigonella foenum graecum), a herb traditionally used for its antidiabetic and digestive benefits, is gaining attention due to its anti-inflammatory, antioxidant, antimicrobial, and wound-healing properties [23–27]. It shows promise in promoting fibro-connective tissue regeneration and organized epidermal healing in burn wounds.

Aim

To assess and contrast the effectiveness of oral and topical Trigonella foenum graecum seed oil with silver sulfadiazine in wound healing in order to determine which is superior. This study sought to determine how SSD and topical and oral Trigonella foenum graecum seed oil affected the rates of histological and clinical healing of skin burn lesions using a rat model.

Objectives

Primary Objective

In animal models of burns, to evaluate the ability of topical and oral Trigonella foenum graecum seed oil to improve wound healing.

Secondary Objectives:

- To assess the wound healing by calculating wound contraction
- To evaluate the histopathological examination of healed wounds for a better conclusion

Materials and Methods

Wistar albino rats were used as study subjects in this experimental animal investigation, which was carried out at the Central Animal House, AVMC. Thirty male Wistar rats in good health were chosen according to certain inclusion criteria, such as having no prior skin lesions or diseases. The study did not include female rats or any ill animals. With a significance level (α) of 5%, an effect size of 1.0, and a statistical power of 90%, the sample size of 30 was determined using G*Power version 3.1 software [28]. Using a basic random sample procedure, the rats were split into five groups of six animals each. To ensure impartial distribution, group allocation was carried out using the GraphPad online random number generator.

Animals were obtained from Biogen Laboratory Animal Facility in Bangalore after receiving consent from IRC and IAEC. They were kept in an animal house at a temperature of 23±3ºC for seven days. Blood samples were sent for biochemical analyses, and animals are rigorously inspected for any health problems and other co-morbidities. On the fourth day, mononuclear cell infiltration and necrotic tissue-based scab formation were evident in all groups. In addition to inflammatory cells penetrating beneath the scab, early attempts at epidermal regeneration were observed. The dermis included hyperemic arteries, but there were no hair, sweat, or sebaceous follicles. After shaving the rat's dorsal surface, the skin

underneath was cleaned with 70% ethanol. Partial thickness burn wound models were employed [28].

A 2-cm metal cylinder filled with 80 °C molten wax was applied to create partial-thickness burns. Each rat was positioned on its back for 10 seconds during the procedure. Wound size was traced on transparent paper on days 4, 9, 14, 18, and 21, then transferred to 1 mm^2 graph paper to calculate the wound area.

Initial wound size minus the size of the wound on a certain day / initial wound size x 100 is the percentage of wound contraction.

Wound healing progresses through four overlapping stages: hemostasis, inflammation, proliferation, and remodeling. Disruptions in any phase can either delay or exaggerate repair. Prolonged inflammation—common in conditions like type 2 diabetes and peripheral vascular disease—slows healing, while excessive tissue growth can lead to hypertrophic scars or keloids.

Group Allocations

Healthy Wistar albino rats (200–250 g) of the Male sex were used for the experiment.

Six animals in each group.

- Group I: Control (normal saline).
- Group II: Topical ointment silver sulfadiazine 0.01% (standard).
- Group III: Topical trigonella foenum graecum seed Oil
- Group IV: Trigonella foenum graecum seed Oil (oral) @ 1 ml/kg body weight/animal
- Group V: Topical Trigonella foenum graecum seed oil + Trigonella foenum graecum seed Oil (oral) @ 1 ml/kg body weight/animal

Study duration: 30 days

All medications were administered every day for 21 days, or until full epithelization, whichever came first. The applications were completed twice a day during the follow-up period. Following the therapy, all of the animals were killed after 21 days of research. Samples of the rats' healed skin were taken for histological examination, and blood was drawn for biochemical examination.

Biochemical investigation

All animals were prepared for the collection of blood samples by warming their tails with a hot water cloth for around five minutes in order to promote vasodilation. In order to reduce the danger of infection, the rats were then gently restrained and their tails were cleaned using alcohol swabs. After locating the lateral tail vein, a 23–25 gauge needle with the bevel facing up was cautiously inserted at a shallow angle. A syringe's suction was used to pull blood into a collection tube. Following collection, a sterile cotton swab was used to gently press until the bleeding stopped. After being collected, the blood samples were placed in vacutainers and submitted for analysis, which included measuring the fasting blood glucose levels [29, 30, 31].

Histopathological Examination

On day 21, rats were put to sleep, and their healed skin samples were removed and placed in a 10% buffered formalin solution. The samples underwent standard histopathology procedures before being embedded in paraffin blocks. Haematoxylin and eosin staining was used to assess the slices (5 μm) from the blocks under a light microscope for angiogenesis, inflammatory cell infiltration, collagen

buildup and granulation tissue, and epithelialization.

Statistical Methods

For statistical analysis, the students' t-test and one-way analysis of variance (ANOVA) were employed. A value of $P < 0.05$ was considered statistically significant (Table 1).

Table 1. Dose of Ketamine and Xylazine calculated exactly to each rat's body weight

Rat b.w	**Xylazine (10 mg/kg b.w)**	**Ketamine (80 mg/kg b.w)**
150 g	0.06 ml	0.24 ml
200 g	0.08 ml	0.32 ml
250 g	0.13 ml	0.40 ml
300 g	0.15 ml	0.48 ml
350 g	0.18 ml	0.56 ml
400 g	0.20 ml	0.64 ml
450 g	0.23 ml	0.72 ml

(b.w. - Body weight); Xylazine: 1 ml = 23.32 mg; Ketamine: 1 ml = 50 mg

Results

Table 2. Wound size distribution of the five test Groups on days 4, 9, 14, 18 and 21

Group	Animal No.	4th Day	9th Day	14th Day	18th Day	21st Day
A	1	2.1	1.8	1.6	1.1	0.5
A	2	2.1	1.8	1.6	0.9	0.5
A	3	2.2	1.7	1.5	1	0.5
A	4	2	1.8	1.4	0.8	0.4
A	5	1.9	1.5	1.3	0.8	0.4
A	6	2	1.9	1.5	0.7	0.4
B	1	2	1.6	1.2	0.6	0.2

B	2	2.3	1.7	1.2	0.5	0
B	3	2.1	1.8	1.1	0.8	0
B	4	2.1	1.7	1.1	0.8	0
B	5	2.2	1.6	0.9	0.7	0
B	6	2.1	1.7	0.9	0.6	0.1
C	1	2.2	1.8	1.1	0.3	0
C	2	2.1	1.7	1.1	0.5	0.2
C	3	2.1	1.6	0.9	0.3	0
C	4	2	1.8	1	0.5	0.2
C	5	2	1.7	1	0.6	0
C	6	1.9	1.5	1	0.5	0.2
D	1	2.2	1.8	1	0.8	0.2
D	2	2	1.6	1	0.8	0
D	3	2.1	1.7	1	0.7	0.2
D	4	1.9	1.5	0.9	0.6	0
D	5	2.2	1.6	0.9	0.6	0.2
D	6	2	1.5	0.8	0.5	0
E	1	2.1	1.6	0.9	0.7	0.1
E	2	2	1.6	0.9	0.6	0
E	3	1.9	1.4	1	0.6	0
E	4	1.8	1.3	0.8	0.5	0
E	5	2.1	1.5	0.9	0.5	0
E	6	2.2	1.6	0.8	0.4	0.1

The Table 2 shows across all groups (A–E), a consistent reduction in wound size over time was observed, indicating progressive healing. In Group A, wound sizes decreased from 1.9–2.2 cm on the 4th day to 1.5–1.9 cm by the 9th day, 1.3–1.6 cm on the 14th day, 0.7–1.1 cm on the 18th day, and finally 0.4–0.5 cm by the 21st day. Group B showed a similar trend, starting at 2.0–2.3 cm on day 4, reducing to 1.6–1.8 cm by day 9, 0.9–1.2 cm on day 14, and eventually reaching 0.5–0.8 cm on day 18 and 0.0–0.2 cm by day 21. Group C began with wound sizes of 1.9–2.2 cm on day 4, which declined to 1.5–1.8 cm by day 9, 0.9–1.1 cm by day 14, 0.3–0.6 cm on day 18, and 0.0–0.2 cm by day 21. Group D also demonstrated steady healing, with initial sizes of 1.9–2.2 cm on day 4, followed by 1.5–1.8 cm on day 9, 0.8–1.0 cm on day 14, 0.5–0.8 cm on day 18, and 0.0–0.2 cm by day 21. Lastly, Group E started with wound sizes of 1.8–2.2 cm on day 4, reduced to 1.3–1.6 cm on day 9, 0.8–1.0 cm on day 14, 0.4–0.7 cm on day 18, and finally decreased to 0.0–0.1 cm by day 21. These results collectively demonstrate effective wound healing across all experimental groups over the 21-day observation period (Table 3).

Table 3. The mean wound contraction values and their corresponding standard deviations at different time points (4th, 9th, 14th, 18th, and 21st day) for all the Groups

	Groupson Day 4	Groups on Day 9	Groupson Day14	Groupson Day 18	Groupson Day 21
Mean	2.0633	1.6467	1.0767	.6433	.1467
Std. Deviation	.11592	.13830	.23589	.18696	.17564

The data illustrates a steady decrease in mean wound contraction values over time, starting from 2.0633 on the 4th day and progressively reducing to 0.1467 by the 21st day, indicating consistent wound healing across all groups. The standard deviation, which reflects the variability in wound contraction measurements, begins at a relatively low value of 0.11592 on the 4th day, suggesting minimal variation among samples at the outset. It slightly increases to 0.13830 on the 9th day and rises further to 0.23589 on the 14th day, showing greater variability during the middle phase of healing. This variability peaks at 0.18696 on the 18th day before slightly declining to 0.17564 by the 21st day. Overall, the data reflects a clear trend of decreasing wound size over time, accompanied by moderate fluctuations in variability, particularly during the intermediate healing stages, suggesting a generally consistent and effective healing process (Table 4).

Table 4. The ANOVA results for wound contraction at different time points (9th, 14th, 18th, and 21st days)

ANOVA for wound contraction at different time points						
Day		Sum of Squares	df	Mean Square	F	Sig.
9TH	Between Groups	409.272	4	102.318	4.327	.009
	Within Group	591.136	25	23.645		
	Total	1000.408	29			
14TH	Between Groups	3194.075	4	798.519	33.142	<.001
	Within Group	602.347	25	24.094		
	Total	3796.423	29			
18TH	Between Groups	1359.700	4	339.925	9.897	<.001
	Within Group	858.623	25	34.345		
	Total	2218.322	29			
21ST	Between Groups	2075.444	4	518.861	25.649	<.001
	Within Group	505.733	25	20.229		
	Total	2581.177	29			

ANOVA results show significant differences in wound contraction between groups at all time points from the 9th to the 21st day. On the 9th day, a p-value of 0.009 and F-value of 4.327 indicate statistical significance. By the 14th day, the differences are highly significant with a p-value < 0.001 and F-value of 33.142. Similarly, on the 18th day, a p-value < 0.001 and F-value of 9.897 confirm significant group differences. On the 21st day, very high significance is observed with a p-value < 0.001 and F-value of 25.649 (Table 5).

Table 5. The mean blood sugar levels and their corresponding standard deviations for five Groups (A, B, C, D, and E) measured on Day 1 and Day 21

Blood sugar	**Mean**	**Std. Deviation**
Group A DAY 1	79.0000	3.74166
Group A DAY 21	72.8333	3.12517
Group B DAY 1	83.3333	3.26599
Group B DAY 21	79.3333	1.50555
Group C DAY 1	75.5000	2.66458
Group C DAY 21	77.3333	.81650
Group D DAY 1	70.8333	5.15429
Group D DAY 21	60.3333	3.88158
Group E DAY 1	76.6667	3.93277
Group E DAY 21	59.8333	2.40139

The data presents the mean blood sugar levels and corresponding standard deviations for Groups A to E on Day 1 and Day 21. On Day 1, Group A had a mean of 79.00 (SD: 3.74), Group B 83.33 (SD: 3.27), Group C 75.50 (SD: 2.66), Group D 70.83 (SD: 5.15), and Group E 76.67 (SD: 3.93), showing varying degrees of baseline blood sugar and variability. By Day 21, most groups exhibited decreased blood sugar levels: Group A dropped to 72.83 (SD: 3.13), Group B to 79.33 (SD: 1.51), Group D to 60.33 (SD: 3.88), and Group E to 59.83 (SD: 2.40), all indicating reductions with improved consistency. Group C, however, showed a slight increase to 77.33 (SD: 0.82), but with the least variability among all groups. In summary, Groups D and E demonstrated the most significant decreases in blood sugar, while Groups A and B had moderate reductions, and Group C showed a minor increase with minimal variation, indicating an overall trend of blood sugar reduction with differing consistency across groups (Table 6).

Table 6. The t-test results & p-values in blood sugar levels between Day 1 and Day 21

Blood sugar	t-test	p value
Group A DAY 1 - DAY 21	5.89	0.00
Group B DAY 1 - DAY 21	3.10	0.01
Group C DAY 1 - DAY 21	-1.81	0.07
Group D DAY 1 - DAY 21	10.97	0.00
Group E DAY 1 - DAY 21	7.18	0.00

The paired t-test showed changes in blood glucose from Day 1 to Day 21 for each group. Groups A and B demonstrated significant reductions (A: $t = 5.89$, $p = 0.00$; B: $t = 3.10$, $p = 0.01$). Group C showed no meaningful change ($t = 1.81$, $p = 0.07$). Group D had a marked and highly significant decrease ($t = 10.97$, $p = 0.00$). Group E also showed a significant reduction ($t = 7.18$, $p = 0.001$).

In conclusion, blood sugar levels in Groups A, B, D, and E significantly decreased, whilst Group C showed no discernible change. This implies that most groups' blood sugar levels were more significantly impacted by the intervention or time effect, with Group D and Group E seeing the biggest drops.

Histopathological Examination

Excised wound tissues were examined histologically. In Group A, animals 1, 2, and 6 showed healing, while 3–5 displayed inflammatory changes with no repair. In Group B, animals 1, 2, and 5 healed, animals 3 and 4 showed fibrinopurulent exudate, and animal 6 had dense neutrophilic and lymphocytic infiltration without healing. In Group C, all animals except number 4 showed healing. In Group D, animals 1–4 and 6 healed, while animal 5 had an ulcer with no repair. In Group E, all six animals showed complete healing. Overall, Groups C, D, and E demonstrated markedly better wound healing than Groups A and B.

Discussion

The current experimental study explored the efficacy of various interventions on wound contraction and blood glucose regulation in Wistar rats over a 21-day period. Across all five groups (A–E), a progressive reduction in wound size was observed, with Groups C, D, and E demonstrating the most rapid and complete healing by the 21st day. This indicates that the applied treatments, particularly in the latter three groups, facilitated wound closure more effectively. Such progressive wound contraction is typically attributed to decreased inflammation, increased fibroblast activity, collagen deposition, and angiogenesis—key components of the proliferative and remodeling phases of wound healing [32].

Quantitative analysis using ANOVA further confirmed the significant differences in wound healing across groups, especially from Day 9 onwards. The differences became highly significant by Day 14 ($p < 0.001$), indicating that the

interventions started exhibiting maximum efficacy during this intermediate healing phase. These findings align with those of Bakhtiari et al., who noted that plant-based therapies often show delayed but sustained wound-healing effects due to their action on modulating cytokine responses and enhancing granulation tissue formation [33]. Additionally, the reduced wound size in Groups D and E correlates with literature supporting the use of natural agents—such as fenugreek or silver-based formulations—for their antimicrobial, antioxidant, and anti-inflammatory actions [34].

The mean wound contraction data also demonstrated a consistent downward trend from Day 4 (mean 2.06 cm) to Day 21 (mean 0.14 cm). This progressive reduction, accompanied by slight variations in standard deviation over time, reflects the uniformity and reliability of the healing process across different groups. Variability peaked slightly during the proliferative phase (Day 14–18), which could correspond to individual biological responses to interventions. This observation is supported by Eming et al., who noted that variability in healing responses often arises during tissue remodeling when fibroblasts, keratinocytes, and immune cells are actively proliferating and migrating [35].

Importantly, the interventions also impacted systemic physiology, as seen in the fasting blood glucose levels. Groups D and E exhibited the most significant reductions in blood glucose by Day 21, which may suggest the antidiabetic potential of the treatments used in these groups. Trigonella foenum-graecum (fenugreek), in particular, has been widely studied for its glucose-lowering properties through mechanisms involving improved insulin sensitivity, delayed carbohydrate digestion, and enhanced peripheral glucose uptake [36]. The combination of glycemic control and accelerated wound healing is particularly valuable, especially in diabetic populations where chronic hyperglycemia impairs angiogenesis, collagen deposition, and immune function, thereby delaying wound closure [37].

T-test analysis confirmed statistically significant blood glucose reductions in Groups A, B, D, and E ($p < 0.05$), with the most prominent effects in Group D ($t = 10.97$) and Group E ($t = 7.18$). In contrast, Group C showed a slight, non-significant increase in glucose levels, possibly indicating a lack of systemic metabolic effect despite good wound healing. This could suggest that the intervention in Group C was locally effective on wound sites but had limited systemic influence. Such divergence is consistent with studies by Ahmad et al., which demonstrated that not all phytochemicals produce both local and systemic benefits, and their bioavailability and pharmacokinetics can vary considerably [38].

Histopathological findings further corroborated the quantitative results. Complete wound healing was noted in all animals of Group E, followed by significant healing in most animals of Groups C and D. In contrast, inflammatory markers and fibrinopurulent exudates were frequently observed in Groups A and B, indicating incomplete or delayed healing. The presence of neutrophilic and lymphocytic infiltration in these groups suggests persistent inflammation, which can hinder epithelial regeneration and extracellular matrix remodeling. These results mirror those of Sharma et al., who highlighted the importance of timely resolution of

inflammation in ensuring efficient wound healing [39].

Conclusion

This experimental study demonstrated that *Trigonella foenum-graecum* (fenugreek) seed oil, especially when administered both topically and orally (Group E), significantly enhanced wound contraction, histological healing, and blood glucose reduction in Wistar rats with partial-thickness burn injuries. Groups C, D, and E achieved faster and more complete wound closure compared to the control (Group A) and silver sulfadiazine-treated group (Group B), with Group E showing complete healing in all animals. The dual benefits of local wound repair and systemic glycemic control, particularly in Groups D and E, highlight the potential of fenugreek as a multifunctional therapeutic agent for burn management, especially in metabolically compromised states. Histopathology confirmed reduced inflammation, organized collagen deposition, and epithelial regeneration in these groups, supporting the observed quantitative outcomes. These findings suggest that fenugreek oil—alone or in combination with systemic administration—may be a valuable adjunct or alternative to conventional burn treatments.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

An Institutional Study on Knowledge, Attitudes, and Practices Related to Biomedical Waste Management Among the MBBS and Dental Interns

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Abstract

Background: Biomedical waste management is an important aspect of infection control in health care. Improper management of biomedical wastes can lead to serious health hazards to health professionals, patients, and the community, besides environmental hazards. Because interns in medical and dental streams are usually at the frontline and deal with biomedical wastes constantly, their knowledge, attitudes, and practices are crucial for the safe management of wastes. **Objective:** To assess the knowledge, attitudes, and practices related to biomedical waste management among medical and dental interns in a teaching institution. **Methods:** Between May and August of 2024 totally 201 interns (123 MBBS and 78 Dental) at the teaching college in the Chengalpattu district of Tamil Nadu participated in a cross-sectional study. A structured, pre-tested questionnaire with knowledge, attitude and practice components was used to gather the data. Chi-square tests were used to compare KAP levels between MBBS and dental interns and descriptive statistics were used to summarize responses. **Results:** Good knowledge was observed in 78.9% of MBBS interns as compared to 42.3% of dental interns, which is statistically significant ($p < 0.001$). Positive attitude was observed in 63 MBBS interns and in 60 dental interns, and the intergroup difference was statistically significant ($p < 0.001$). Good practice was followed by 75.6% of MBBS interns and by 57.7% of dental interns, which is again statistically significant ($p < 0.001$). Waste segregation practices and needle disposal practices were found to be satisfactory, but the use of PPE and knowledge about the duration of waste stored were very unsatisfactory. **Conclusion:** The overall awareness about and practice of biomedical waste management was satisfactory among the interns; however, there were significant gaps in operational knowledge and consistent safe practices. Increased practical training, refresher sessions periodically, and continuous monitoring throughout the internship period are recommended for ensuring safety and effectiveness in biomedical-waste handling in health institutions.

Keywords: Biomedical waste management, Knowledge attitude and practice, Medical interns, Dental interns, Infection control

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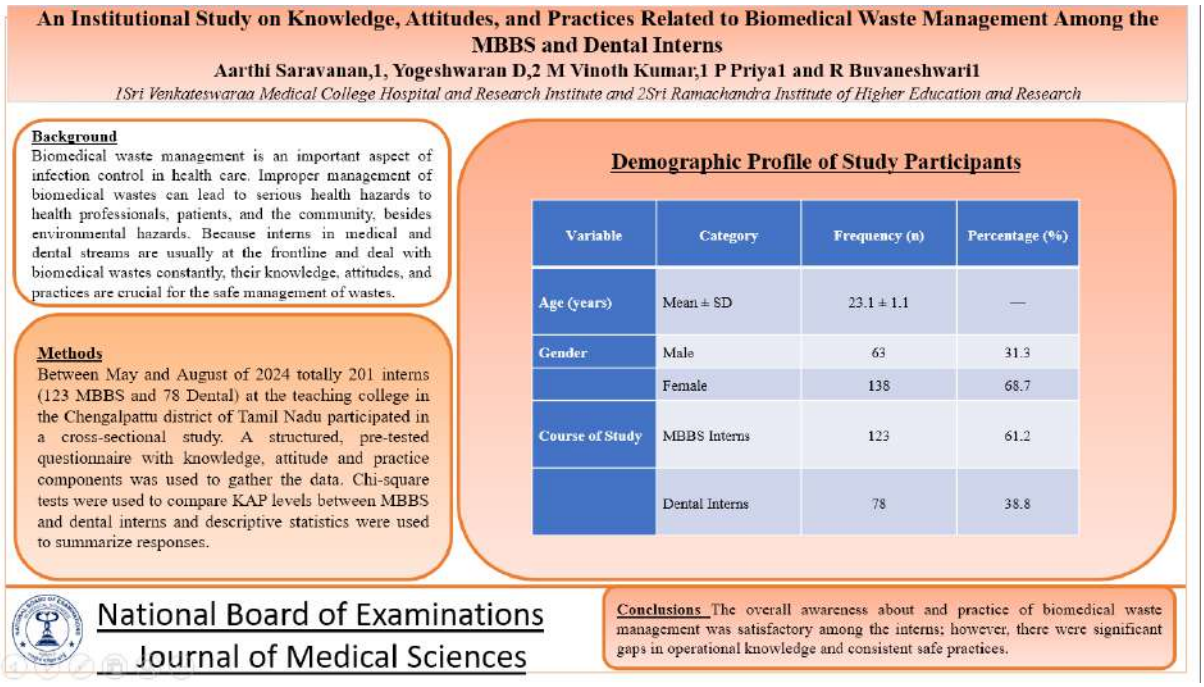
Graphical Abstract



Introduction

Biomedical waste includes all kinds of wastes generated from medical activities including those from healthcare institutions, research facilities, and laboratories. Compared to general waste, biomedical wastes pose a much greater risk for injury and infection since they could be carriers of pathogens, chemicals and other hazardous materials [1]. This is one category of wastes whose management is considered of paramount importance to avert serious health and environmental implications. It is estimated that approximately 15% of total wastes generated in healthcare facilities are hazardous, infectious, toxic, or radioactive [2]. Thus infectious wastes would include body fluids, sharp objects contaminated with them laboratory items, pathological wastes as well as single-use disposable items contaminated with agents that may be noxious.

Improper management of biomedical waste may lead to severe adverse effects not only to human health but also to the environment. This includes risks like the release of chemical or biological hazards into the environment and the dissemination of drug-resistant microorganisms. This could further lead to major public health problems such as the spread of infections and contamination of natural resources. Thus, proper disposal and management of biomedical wastes are highly necessary to ensure safety for the patients, health professionals and the community in general.

It was only in 1998 that biomedical waste management was recognized to be of grave importance when regulations were introduced for the first time in India. These laid down a codified framework for safe handling and disposal of BMW. Then came subsequent modifications towards improving the methodology of handling and assimilating better international standards for compliance. More recently the Government of India issued the detailed guidelines in 2016 and 2018 referred to as the BMW Management (BMWM) Principle Rules and BMWM Amendment

Rules, respectively [3]. These provided a step-by-step method for the management of BMW segregation, collection, transportation and storage followed by treatment by autoclaving or incineration before final disposal [4].

Segregation separates hazardous waste from general waste at the generation site to prevent cross-contamination. Collection is defined as a process in which the segregated waste is collected through a systematic gathering for safe transport. Waste transportation should move the waste from the place of generation to the treatment or disposal facility without causing any spillage and resultant exposure. Storage involves the keeping of the waste for a temporary period in specified areas until it undergoes treatment. Finally, treatment in most cases involves either autoclaving or incineration that seeks to neutralize the harmful properties of the waste before its final disposal [5]. Any deviation or improper handling along this chain leads to severe health and environmental hazards.

The importance of effective BMW management extends beyond pressing environmental and health issues. Medical interns and other healthcare workers experience long-term health issues and occupational hazards as a result of BMW management's poor training and practices. Early career practices become deeply rooted habits that can be challenging to break later in life. This emphasizes how crucial it is to teach good waste management techniques from the beginning of medical education.

Interns are starting to move from classroom theory to real-world application in clinical settings at this point in their professional development. Both patient safety and environmental protection depend on their comprehension of and adherence to BMW management procedures. Therefore, the study evaluates medical interns' knowledge, attitudes and practices regarding BMW management in order to identify knowledge and practice gaps, assess attitudes regarding BMW management and provide insight into how well current training programs enable respondents to manage BMW safely. This information will therefore aid in the creation of more effective teaching methods and enhance BMW management techniques among aspiring medical professionals. To assess the knowledge, attitude and practice of biomedical waste among medical interns in teaching colleges

Methods

This is a cross-sectional study conducted for three months from May 2024 to August 2024, among the medical and dental interns of a teaching college in Chengalpattu district Tamil Nadu. All interns who had completed their final MBBS or BDS examinations and were posted for compulsory rotatory internship during the study period were included in the eligible population. Exclusion criteria: All interns unwilling to give consent were excluded.

There were 150 interns in the institution of whom 150 MBBS interns and 78 dental interns volunteered and met the inclusion criteria, giving a total sample of 201 participants. Institutional Ethics Committee approval was obtained prior to the start of the study. The participants were recruited by a complete enumeration method. Informed consent was obtained from all the respondents.

Data were collected through a structured, pre-tested questionnaire containing three components. The first

component elicited information on the sociodemographic profile. The second one was to assess knowledge, attitude and practice related to biomedical waste management. The knowledge section included questions on biomedical waste management rules, colour coding, methods of treatment and disposal of waste. The attitude portion measured perceptions about responsibility, workload, safety, etc. The practice section included items on segregation, colour coded disposal, use of PPE, needle disposal, reporting of sharp injuries and training received. Before administering the questionnaire, the purpose of the study was explained and strict confidentiality of the response was ensured.

Knowledge scores were categorized as good knowledge (a total of ten or more correct responses) and poor knowledge (less than ten correct responses). Attitude scores were categorized as either positive or negative based on favourable or unfavourable responses towards BMW management. Practice was categorized as good practice if interns correctly reported at least two core components for safe handling of BMWs, segregation, use of PPE, proper needle disposal, and reporting of injuries. Those that reported less than two safe practices were categorized as having poor practice.

All responses were entered on Microsoft Excel and analysed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA). For the purpose of data analysis, categorical variables were summarised as frequencies and percentages, whereas continuous variables were expressed as mean ± standard deviation. The association between knowledge, attitude and practice levels with the field of study (MBBS or Dental) was assessed by the chi square test. A value of $p< 0.05$ was considered to be statistically significant.

Results

This study is done to evaluate the knowledge, attitude and practice of medical interns towards biomedical waste management

Table 1. Demographic Profile of Study Participants

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	23.1 ± 1.1	—
Gender	Male	63	31.3
	Female	138	68.7
Course of Study	MBBS Interns	123	61.2
	Dental Interns	78	38.8

Table 1 shows that the sample comprised 201 interns with a slightly higher representation of females 68.7% as opposed to 31.3% males. The average age for the respondents was 23.1 years showing a fairly homogenous age group which is expected from newly graduated medical and dental interns. The MBBS interns were in the majority at 61.2% while dental interns comprised 38.8% of the sample. This is indicative of the institutional composition during the study period and offers an even distribution to evaluate knowledge, attitudes and practices regarding biomedical waste management in both the medical and dental streams.

Table 2. Frequency Distribution of Knowledge Component of the Study Participants

S.No	VARIABLE	MBBS Correct	MBBS Wrong	Dental Correct	Dental Wrong	MBBS % Correct	Dental % Correct
1	Awareness of BMW management rules	121	2	72	6	98.40%	92.30%
2	Types and sources of BMW	119	4	66	12	96.70%	84.60%
3	Health hazards associated with BMW	116	7	68	10	94.30%	87.20%
4	Human anatomical waste disposal	96	27	46	32	78.00%	59.00%
5	Catheter & urine bag disposal	99	24	36	42	80.50%	46.20%
6	Needles, scalpels & blades disposal	116	7	56	22	94.30%	71.80%
7	Ampoules & metallic implants disposal	107	16	49	29	87.00%	62.80%
8	Biohazard symbol identification	109	14	65	13	88.60%	83.30%

9	Need to disinfect waste before disposal	118	5	73	5	95.90%	93.60%
10	Human tissues & organs treatment	100	23	47	31	81.30%	60.20%
11	Treatment method for catheters & urine bags	37	86	19	59	30.10%	24.30%
12	Maximum storage time for BMW	18	105	8	70	14.60%	10.30%
13	Universal precautions followed	121	2	70	8	98.40%	89.70%

Table 2 shows that MBBS interns consistently performed with higher knowledge on most domains of biomedical waste management compared to Dental interns though there is considerable variation within both groups on specific topics. Overall awareness about the regulations concerning BMW, sources of origin and resultant health hazards among the two cohorts is good reflecting a strong grasp of concepts. However there is a significant decline in accuracy on items that involve practical application of colour coding and disposal of specific waste categories with particularly low scores amongst Dental interns on catheters, urine bags, sharps and metallic implants. Performance is poorest on knowledge of treatment methods for some categories of waste and maximum permissible storage time for biomedical waste where both cohorts scored low. These reflect poor familiarity with day-to-day operations crucial for daily compliance and infection control. There is reasonable awareness of universal precautions and the need for disinfection but the overall pattern reflects a requirement for more systematic hands-on training in BMW to improve practical competencies and assure compliance with regulatory norms.

Table 3. Frequency Distribution of Attitude Component of the Study Participants

S.NO	CHARATERISTICS	VARIABLE	MBBS	DENTAL	FRE-QUENCY	PER-CENTAGE (%)
1.	BMW management is an important issue and must be strictly followed	Strongly agree	33	18	33	26.8
		Agree	1	3	1	0.8
		Neutral	3	10	3	2.4
		Disagree	77	10	77	62.6
		Strongly disagree	9	19	9	7.3
2.	All healthcare staff are responsible for BMW management and segregation	Strongly agree	44	29	44	35.8
		Agree	2	11	2	1.6
		Neutral	6	5	6	4.9
		Disagree	65	16	65	52.8
		Strongly disagree	6	14	6	4.9
3.	Colour coding system is a simple method of segregation of BMW	Strongly agree	53	36	53	43.1
		Agree	1	11	1	0.8
		Neutral	6	14	6	4.9
		Disagree	57	28	57	46.3
		Strongly disagree	6	9	6	4.9
4.	Biomedical waste management increases financial burden on hospital	Strongly agree	19	11	19	15.4
		Agree	38	26	38	30.9
		Neutral	46	29	46	37.4
		Disagree	5	8	5	4.1
		Strongly disagree	15	9	15	12.2
5.	Biomedical waste management is an extra burden on work	Strongly agree	15	14	15	12.2
		Agree	55	26	55	44.7
		Neutral	27	19	27	22
		Disagree	4	2	4	3.3
		Strongly disagree	22	18	22	17.9
6.	Willing to attend educational programme on BMW management	Strongly agree	62	29	62	50.4
		Agree	3	11	3	2.4
		Neutral	37	14	37	30.1
		Disagree	17	35	17	13.8
		Strongly disagree	4	5	4	3.3

The attitude of the interns regarding BMW management also showed a marked variation. Only 33 respondents 26.8% strongly agreed that BMW management and the need for strict adherence to rules are important while a large majority of 77, 62.6% disagreed with it. The pattern of response was similar regarding perceived responsibility 44, 35.8% strongly agreed that BMW management is the responsibility of all the staff working in any healthcare facility while 65, 52.8% did not agree with it. Opinion regarding colour coding was divided, as 53, 43.1% strongly agreed that colour coding provides an easy way of segregation, while 57, 46.3% disagreed with this. Many interns found BMW management a burden: 57, 46.3% strongly agreed that BMW management increases the financial load on hospitals, and 70, 56.9% strongly agreed to additional workload. Encouragingly, there is a willingness to know better: 62, 50.4% strongly agreed to interest in participating in educational programmes on BMW management; 37, 30.1% were indifferent and 21, 17.1% were unwilling. All these trends put together mean that awareness and perceived responsibility are lacking and also reveal a clear opportunity for focused training programs (Table 3).

Table 4. Frequency Distribution of Practice Component of the Study Participants

S.NO	CHARACTERISTICS	VARI-ABLE	MBBS	DENTAL	FRE-QUENCY	PER-CENTAGE
1	1.Do you segregate general waste from clinical waste?	Yes	118	71	189	94
		No	5	7	12	6
2	2.Do you dispose of BMW waste in specific colour coded containers?	Yes	121	73	194	96.5
		No	2	5	7	3.5
3	3.Do you discard used needle in needle destroyer?	Yes	102	71	173	86.1
		No	21	7	28	13.9
4	4.Do you wear PPE while handling BMW?	Yes	73	48	121	60.2
		No	50	30	80	39.8
5	5.Have you ever undergone training for biomedical waste management?	Yes	77	42	119	59.2
		No	46	36	82	40.8
6	6.Do you record and report needle stick and sharp injuries?	Yes	109	70	179	89.1
		No	14	8	22	10.9

7	7.Have you taken vaccination against hepatitis B?	Yes	119	69	188	93.5
		No	4	9	13	6.5

Most of the interns followed appropriate BMW handling practices Waste segregation was done by 189 respondents (94%) and 194 respondents (96.5%) used colour-coded containers appropriately. Needle disposal practices were followed by 173 respondents (86.1%) though the use of PPE was considerably lower at 121 respondents (60.2%). Training gaps were apparent with only 119 respondents (59.2%) having received BMW-specific training. Reporting of needle-stick injuries was high at 179 respondents (89.1%) and hepatitis B vaccination coverage was strong with 188 respondents (93.5%) being protected. These findings indicate that while there is a generally favorable level of basic compliance there is a need for improved PPE use and wider training coverage (Table 4).

Table 5. Comparison of Knowledge, Attitude and Practice Levels between MBBS and Dental Interns Using Chi-square Test

Component	**Category**	**MBBS (n = 123)**	**Dental (n = 78)**	**Chi-square value**	**p-value**
Knowledge	Good knowledge (≥10 correct)	97 (78.9 %)	33 (42.3 %)	**27.91**	**< 0.001**
	Poor knowledge (<10 correct)	26 (21.1%)	45 (57.7 %)		
Attitude	Positive attitude (favourable beliefs toward BMW management)	63(55.3%)	60 (69.0%)	**3.90**	**<0.001**
	Negative attitude (unfavourable beliefs	51(44.7%)	27(31.0%)		

	toward BMW management)				
Practice	Good practice (Segregation + PPE + Needle disposal + Reporting injuries)	93 (75.6 %)	45 (57.7 %)	**7.12**	**< 0.001**
	Poor practice (<2 positive items)	30 (24.4 %)	33 (42.3 %)		

Table 5 presents the comparison of biomedical waste management-related KAP among MBBS and Dental interns indicating that all three domains have statistically significant differences. MBBS interns had higher knowledge (78.9%) compared to dental interns (42.3%) and the difference was statistically significant ($p < 0.001$). A similar trend in practice is evident with MBBS interns showing 75.6% with good practice scores versus 57.7% among dental interns ($p < 0.001$). While the proportion with a positive attitude was higher among MBBS interns, the chi-square test indicates that the overall distribution of attitude is statistically different ($p < 0.001$). Overall MBBS interns consistently score higher in all three elements compared to dental interns indicating better preparedness and compliance with biomedical waste management standards.

Discussion

Medical interns are practicing doctors who work entirely in their field and they are also at a very critical juncture of their lives where they shift gear from theoretical implementation to the application of medical knowledge in real practice situations. If medical interns are able to gain sufficient training and exposure regarding BMW management they will implement this knowledge in their practice as doctors later on in their lives. This will ensure that they never fall short of awareness regarding BMW management guidelines thereby leading to effective healthcare practices in a healthier environment for everyone in the long run. As medical interns engage with biomedical waste in different healthcare facilities, assessing their awareness and implementation of this awareness will help understand whether the current programs for training them have been effective or not and what improvements are required in the current waste management practices in healthcare facilities addressing this gap with the help of this current research work itself.

The interns in the current study showed adequate basic knowledge about BMW regulations in line with past studies conducted in West Bengal where 98% of the medical students were aware of BMW regulations [6]. Specific operating knowledge was relatively poor. Just 14.6% of the interns were able to give the correct storage period for BMW. This is very poor compared to the results obtained in Jammu and Kashmir [7] where nearly 60% of the interns were aware of this information. There appears to be deficiencies in the procedural part of BMW handling.

Attitudinal pattern reveal some critical gaps. Even though only 35.8 percent agreed on the responsibility of all healthcare personnel toward BMW management previous studies conducted in Khammam and Navi Mumbai have shown a remarkable level of agreement above eighty percent [8,9]. Apparently there could be some institutional factors in play which affect these perceptions in some way. Although a belief on the financial burden caused by BMW management of 62.9 percent is evident in the findings of previous studies in Jammu and Kashmir a far lower percentage is provided in our study [7].

Secondly generally satisfactory and inefficient practices can be identified from these findings. Both high incidence of this study of segregation use of needle destroyer and use of PPE can be compared to that of Rajkot in terms of similar level of practices [10]. However use of PPE was significantly low compared to that of COVID-19 pandemic in Puducherry (97.7 percent) [11] and recent national studies [12]. These findings form an integral part of an essential safety gap since PPE forms an integral point of preventing occupational exposure.

The training exposure was limited since only 62.6 percent of the internship pupils had completed BMW training. As was indicated by previous research conducted by Saini et al. [9], Mathur et al. [13] and Pandey et al. [14] there was an element of consistency to support the fact that structured training is an essential component for increased knowledge and good practices being practiced. The possibility that training programs conducted are not contributing to practical aspects being indicated by high theoretical knowledge being practiced incompletely.

Overall this research has proved that while knowledge domains are strong comparatively there are deficiencies in attitude and practical inconsistent practices that require designing and implementing effective training approaches. Furthermore emphasis on improving practical training methods, implementing periodic competency evaluation, and maintaining collective responsibility on all counts within the entire health care personnel may translate into improved compliance and prudent practices concerning the disposal of infectious wastage. This research was conducted in a single teaching institution that might restrict the applicability of the findings of this research to general practice. The approach of using a self-administered questionnaire might pose a challenge regarding potential desirable bias within the research that may indicate overreporting of best practices. As a cross-sectional research project, this particular research does not have the ability to quantify knowledge domain or behavior modification. Also in this research direct observation on site did not take place and might have provided more authentic information regarding the practices of BMW management.

Conclusion

The results from this study have shown that a relatively good level of knowledge and moderate compliance with key practices related to the management of biomedical waste exists in the interns whereas significant gaps are observed regarding knowledge on operational procedures and practices related to consulting and utilizing protection. Attitudinal variability especially on shared responsibility and workload also confirms the importance of reinforcement during internships.

Though the intern showed good practices for trash management and disposal of needles there are still areas of concern regarding PPE use and training opportunities. This reveals that even though knowledge has been created there is still some way to go before implementation is at an optimal level. The internship process should be combined with training and repeated practices so that optimal compliance of medical graduates regarding trash management protocols can be ensured.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

Serum Magnesium and Micronutrient Profiles in Severe Acute Malnutrition: A Cross-Sectional Study in a Tertiary Care Centre

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Abstract

Background: Severe acute malnutrition (SAM) is a major public health challenge associated with high morbidity and mortality. Micronutrient deficiencies, particularly magnesium, zinc, and copper, play a crucial role in clinical deterioration, yet their assessment is often overlooked in routine care. **Objectives:** To assess serum magnesium and other micronutrient profiles in children with SAM and evaluate their prevalence and distribution in relation to clinical and anthropometric characteristics. **Methodology:** A cross-sectional study was conducted among 70 children aged 6–59 months admitted with SAM to a tertiary care centre. Detailed clinical evaluation, anthropometric measurements, and laboratory investigations, including serum magnesium, zinc, and copper levels, were performed. Micronutrient deficiencies were classified based on established reference cut-offs. Data were analysed using SPSS 26.0. **Results:** The majority of children were aged 12–23 months (34.3%) and male (55.7%). Severe wasting was evident with a mean MUAC of 11.33 ± 0.50 cm. Mean serum magnesium was 1.78 ± 0.47 mg/dL, zinc 72.79 ± 31.18 µg/dL, and copper 99.99 ± 42.46 µg/dL. Magnesium deficiency (<1.6 mg/dL) was detected in 44.3% of children, zinc deficiency (<70 µg/dL) in 37.1%, and copper deficiency (<80 µg/dL) in 37.1%. Anaemia (mean haemoglobin 9.23 ± 1.99 g/dL) and low serum albumin (3.05 ± 0.59 g/dL) were also common. **Conclusion:** The present study concludes that children with SAM exhibit a high burden of micronutrient deficiencies, particularly magnesium, zinc, and copper, reflecting significant biochemical compromise. Routine screening and correction of these deficiencies should be prioritized to improve clinical outcomes in SAM.

Keywords: Severe acute malnutrition, Micronutrient deficiency, Serum magnesium

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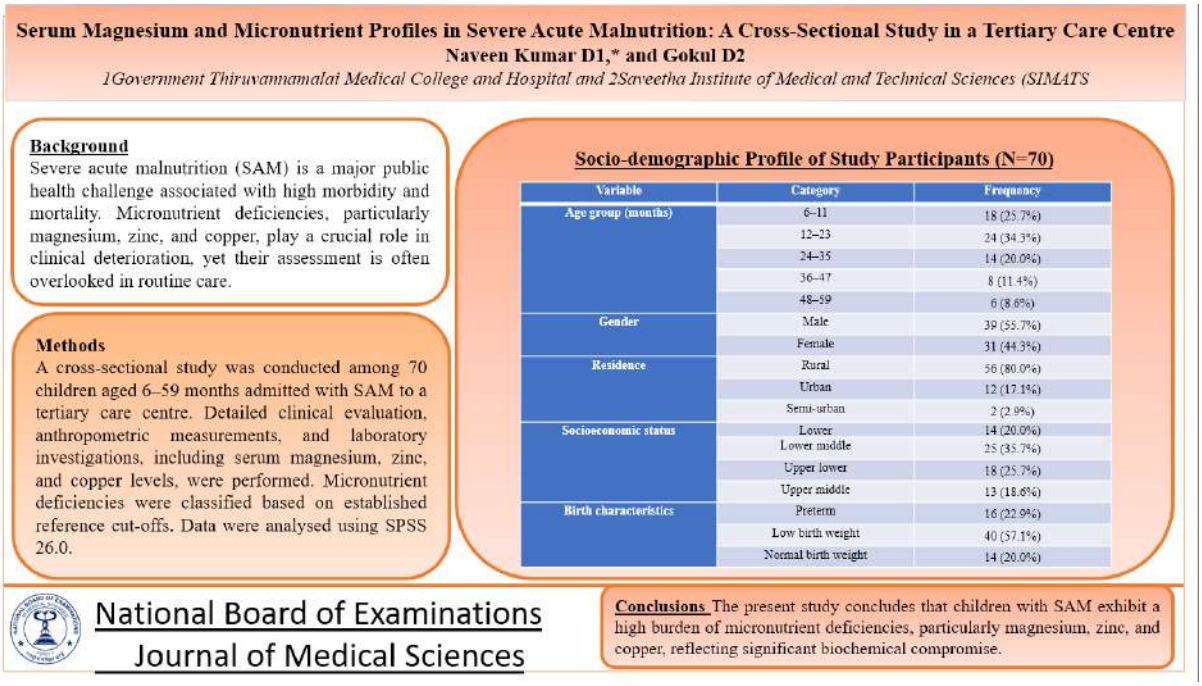
Graphical Abstract



Introduction

Severe acute malnutrition (SAM) remains one of the most critical public health challenges in developing countries, affecting approximately 16 million children under five years of age globally [1,2]. The condition is characterized by severe wasting, manifested by a weight-for-height z-score of less than -3 standard deviations or a mid-upper arm circumference of less than 115 mm, or by the presence of bilateral pitting oedema [1]. Despite significant advances in understanding the pathophysiology and management of SAM, mortality rates remain unacceptably high, ranging from 5% to 20% in hospital settings, with micronutrient deficiencies playing a substantial role in this elevated mortality [3,4].

Micronutrients, though required in minute quantities, are essential for numerous physiological processes, including immune function, growth, development, and cellular metabolism [5]. Children with SAM frequently exhibit multiple micronutrient deficiencies due to inadequate dietary intake, increased requirements during catch-up growth, impaired absorption secondary to enteropathy, and increased losses through diarrhoea and infections [6,7]. Among the various micronutrients, magnesium occupies a unique position as the second most abundant intracellular cation and serves as a cofactor for more than 300 enzymatic reactions [8]. Magnesium deficiency in SAM has been associated with increased risk of mortality, impaired recovery, cardiac arrhythmias, and neuromuscular dysfunction, yet it remains underrecognized and inadequately addressed in routine clinical practice [9,10].

The prevalence of hypomagnesemia in children with SAM varies widely across different studies, ranging from 20% to 80%, depending on the population studied and diagnostic criteria employed [9,11]. Similarly, deficiencies of other critical micronutrients including zinc, copper, selenium, and vitamins have been

documented with variable frequencies in malnourished children [6].

Current World Health Organisation (WHO) guidelines for the management of SAM include supplementation with a multi-micronutrient preparation, but these recommendations are based on limited evidence regarding the actual prevalence and severity of specific micronutrient deficiencies in different populations [1]. Furthermore, serum magnesium levels are not routinely measured in most resource-limited settings due to a lack of awareness, unavailability of laboratory facilities, and financial constraints [10]. This results in a significant gap between the actual micronutrient status of children with SAM and the standardized treatment protocols being implemented. The present study was therefore undertaken to assess serum magnesium levels and other micronutrient profiles in children with SAM admitted to a tertiary care center, and to correlate these findings with clinical characteristics and outcomes.

Methodology

Study Design and Setting

This cross-sectional observational study was conducted in the Pediatric Intensive Care Unit and Nutritional Rehabilitation Centre of a tertiary care teaching hospital in South India over a period of 18 months. The study was approved by the Institutional Ethics Committee and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or legal guardians of all study participants after explaining the study objectives, procedures, and potential risks and benefits in their vernacular language.

Study Population

Children aged 6 months to 59 months admitted with a diagnosis of SAM according to WHO criteria were screened for eligibility

Sample Size Calculation

Based on a previous study by Singhal et al. [9] reporting hypomagnesemia prevalence of 35% in children with SAM, with an absolute precision of 11% and confidence level of 95%, the minimum required sample size was calculated to be 63 using the formula $n = Z^2pq/d^2$. Accounting for a potential 10% dropout rate, a total sample size of 70 children was planned for the study.

Inclusion Criteria

Children meeting the following criteria were included: age between 6 and 59 months; diagnosis of SAM as per WHO criteria; parents or guardians willing to provide informed consent; and children admitted within 24 hours of presentation to the hospital.

Exclusion Criteria

Those who received micronutrient supplementation within the previous 4 weeks, chronic kidney disease, congenital heart disease, or other chronic systemic illnesses, received diuretic therapy within the past 2 weeks, severe dehydration requiring immediate fluid resuscitation or parents or guardians unwilling to provide consent were excluded from the study

Clinical Assessment

A detailed clinical history was obtained including age, sex, duration of illness, feeding practices, immunization status, and associated symptoms. Sociodemographic information including

parental education, occupation, family income, and household food security status was recorded using a structured questionnaire. Thorough physical examination was performed documenting vital signs, anthropometric measurements, presence of edema, signs of micronutrient deficiencies (such as dermatosis, hair changes, angular stomatitis, pallor), and associated complications.

Anthropometric Measurements

Weight was measured using a calibrated electronic weighing scale (accuracy ±10 g) with children wearing minimal clothing. Recumbent length (for children <24 months) or standing height (for children ≥24 months) was measured using an infantometer or stadiometer (accuracy ±0.1 cm). MUAC was measured at the midpoint between the acromion and olecranon process of the left arm using a standard MUAC tape. All measurements were performed in duplicate by trained personnel and the average value was recorded.

Laboratory Investigations

Blood samples (5 mL) were collected within 24 hours of admission after antiseptic precautions under aseptic conditions. Samples were collected in trace element-free vacutainers after an overnight fast (or at least 4 hours of fasting in younger infants). Blood was allowed to clot at room temperature for 30 minutes and then centrifuged at 3000 rpm for 10 minutes. Serum was separated and stored in aliquots at -80°C until analysis. All samples were processed within 2 hours of collection [6]. Serum magnesium levels were measured using the xylidyl blue colorimetric method on an automated biochemistry analyser (Beckman Coulter AU680). Serum zinc levels were measured by atomic absorption spectrophotometry and serum copper and selenium levels were measured using inductively coupled plasma mass spectrometry

Data Analysis

Data were entered into Microsoft Excel 2019 and analysed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on distribution. Categorical variables were expressed as frequencies and percentages.

Results

Table 1. Socio-demographic Profile of Study Participants (N=70)

Variable	Category	Frequency
Age group (months)	6–11	18 (25.7%)
	12–23	24 (34.3%)
	24–35	14 (20.0%)
	36–47	8 (11.4%)

	48–59	6 (8.6%)
Gender	Male	39 (55.7%)
	Female	31 (44.3%)
Residence	Rural	56 (80.0%)
	Urban	12 (17.1%)
	Semi-urban	2 (2.9%)
Socioeconomic status	Lower	14 (20.0%)
	Lower middle	25 (35.7%)
	Upper lower	18 (25.7%)
	Upper middle	13 (18.6%)
Birth characteristics	Preterm	16 (22.9%)
	Low birth weight	40 (57.1%)
	Normal birth weight	14 (20.0%)

A total of 70 children were included in the study. The majority belonged to the 12–23-month age group (34.3%), followed by 6–11 months (25.7%). More than half of the children were males (55.7%). Most participants resided in rural areas (80%), and only 17.1% were from urban settings. Socioeconomic assessment revealed that 35.7% belonged to the lower-middle class and 25.7% to the upper-lower class. Regarding birth characteristics, 22.9% of the children were preterm, while low birth weight was observed in 57.1% of the study population. (Table 1)

Table 2. Anthropometric and Laboratory Parameters of the Study Population (N = 70)

Parameters	**Mean ± SD**	**Median**	**Min–Max**
Height (cm)	77.81 ± 11.34	75	49–102
Weight (kg)	7.09 ± 2.05	6.55	2.5–12
MUAC (cm)	11.33 ± 0.5	11.3	10.3–12.2
Haemoglobin (g/dL)	9.23 ± 1.99	9.7	4.9–12.9
Albumin (g/dL)	3.05 ± 0.59	3.1	1.4–4.2

The mean height and weight of the children were 77.81 ± 11.34 cm and 7.09 ± 2.05 kg, respectively. Mid-upper arm circumference (MUAC) showed severe wasting, with a mean of 11.33 ± 0.50 cm. The mean haemoglobin level was 9.23 ± 1.99 g/dL, indicating a high burden of anaemia. Serum albumin levels were also low, with a mean of 3.05 ± 0.59 g/dL, reflecting poor nutritional status. (Table 2)

Table 3. Serum Micronutrient Levels Among Children with SAM (N = 70)

Serum	**Mean ± SD**	**Median**	**Min**	**Max**	**95% CI**	
					Lower	**Upper**
Ferritin	34.25 ± 28.81	28.85	3.40	126.10	27.38	41.12
Zinc	72.79 ± 31.18	78.35	15.60	145.40	65.36	80.23
Magnesium	1.78 ± 0.47	1.70	1.10	2.90	1.67	1.89
Copper	99.99 ± 42.46	92.50	22.70	198.90	89.86	110.11

The mean ferritin level was 34.25 ± 28.81 ng/mL, while the mean serum zinc was 72.79 ± 31.18 µg/dL. Serum magnesium levels averaged 1.78 ± 0.47 mg/dL, and copper levels were 99.99 ± 42.46 µg/dL. Wide ranges were noted across all micronutrients, indicating heterogeneous biochemical profiles among children with SAM. (Table 3)

Table 4. Distribution of Serum Micronutrient Levels Among Children with SAM (N = 70)

Micronutrient	**Category**	**N (%)**
Serum Zinc (µg/dL)	< 70 (Low)	26 (37.1%)
	70–115 (Normal)	40 (57.1%)
	> 115 (High)	4 (5.7%)
Serum Magnesium (mg/dL)	< 1.6 (Low)	31 (44.3%)
	1.7–2.2 (Normal)	26 (37.1%)
	> 2.3 (High)	13 (18.6%)
Serum Copper (µg/dL)	< 80 (Low)	26 (37.1%)
	80–190 (Normal)	42 (60.0%)
	> 190 (High)	2 (2.9%)

Zinc deficiency (<70 µg/dL) was observed in 37.1% of children, while 57.1% had normal zinc levels. Magnesium deficiency (<1.6 mg/dL) was seen in 44.3% of participants, with 37.1% having normal values. Similarly, 37.1% of children had copper deficiency (<80 µg/dL), and 60% had normal copper levels. A smaller proportion showed elevated levels for all three micronutrients (Table 4).

Discussion

The present study revealed a high prevalence of micronutrient deficiencies among children with severe acute malnutrition, with hypomagnesemia observed in 44.3% of participants and zinc deficiency in 37.1%. These findings are consistent with previous reports highlighting the substantial burden of micronutrient deficiencies in this vulnerable population. Singhal et al. reported hypomagnesemia in 35% of children with SAM in their hospital-based study, which aligns closely with our observations [9]. The mean serum magnesium level in our study was 1.78 ± 0.47 mg/dL, comparable to the findings of Hother et al., who documented low serum magnesium concentrations in hospitalized Ugandan children with SAM and established a significant association between electrolyte abnormalities and mortality risk [10].

The prevalence of zinc deficiency observed in our cohort was similar to that reported by Srinivasan et al. in their cross-sectional study of severely malnourished children in rural Malawi, where multiple micronutrient deficiencies were documented alongside toxic element accumulation [6]. Their study emphasized the complex interplay between nutritional deficiencies and environmental exposures in contributing to the pathophysiology of SAM. The mean serum zinc level in our study (72.79 ± 31.18 µg/dL) was notably lower than reference values for healthy children, indicating substantial zinc depletion in this population. Our finding of copper deficiency in 37.1% of children, with a mean copper level of 99.99 ± 42.46 µg/dL, resonates with the observations of Bailey et al., who described the global epidemiology of micronutrient deficiencies and highlighted the widespread nature of these deficiencies in resource-limited settings [5].

The heterogeneous biochemical profiles noted in our study participants, with wide ranges across all measured micronutrients, reflect the variable nutritional insults and metabolic derangements characteristic of SAM. The mean haemoglobin level of 9.23 ± 1.99 g/dL in our cohort indicates a high burden of anaemia, which is frequently associated with multiple micronutrient deficiencies including iron, folate, and vitamin B12. Bhutta et al. in their comprehensive review on severe childhood malnutrition emphasized that micronutrient deficiencies contribute significantly to increased morbidity and mortality, supporting the need for routine screening and targeted supplementation strategies [3]. The low mean serum albumin level (3.05 ± 0.59 g/dL) observed in our study reflects the protein-energy malnutrition and hepatic dysfunction commonly seen in SAM, which can further impair micronutrient metabolism and utilization. The high proportion of children from rural areas (80%) and lower socioeconomic strata in our study, combined with the elevated prevalence of low birth weight (57.1%), underscores the multifactorial aetiology of SAM where poverty, food insecurity, and

adverse perinatal factors converge to create vulnerability to severe malnutrition and its associated complications. The mean MUAC of 11.33 ± 0.50 cm in our study population indicates severe wasting, consistent with WHO diagnostic criteria for SAM, and highlights the critical nutritional status of these children requiring urgent intervention [2].

Limitations

The single-centre study setting may limit the generalizability of findings to other geographic regions with different dietary patterns, disease burdens, and healthcare systems. Serum micronutrient levels may not accurately reflect total body stores or intracellular concentrations, particularly for magnesium, where less than 1% of total body content is present in serum. The study did not assess other important micronutrients such as vitamin A, vitamin D, folate, and vitamin B12, which are also commonly deficient in children with severe acute malnutrition. The lack of a control group of well-nourished children from the same geographic area limits the comparative interpretation of the findings. Finally, financial constraints prevented assessment of functional markers of micronutrient status such as enzyme activities or clinical response to supplementation, which would have provided a more comprehensive understanding of the clinical significance of the observed deficiencies.

Conclusion

The present study demonstrates a high prevalence of micronutrient deficiencies among children with severe acute malnutrition, with hypomagnesemia observed in 44.3% and zinc deficiency in 37.1% of participants. The mean serum magnesium level of 1.78 ± 0.47 mg/dL and mean serum zinc level of 72.79 ± 31.18 µg/dL indicate substantial depletion of these critical micronutrients in the study population. Additionally, copper deficiency was present in 37.1% of children, with a mean copper level of 99.99 ± 42.46 µg/dL. The severe wasting evidenced by mean MUAC of 11.33 ± 0.50 cm, coupled with low mean haemoglobin (9.23 ± 1.99 g/dL) and serum albumin levels (3.05 ± 0.59 g/dL), reflects the profound nutritional compromise in these children. These findings underscore the critical need for routine screening of serum magnesium and other essential micronutrients in this vulnerable population, as these deficiencies may contribute significantly to adverse outcomes and mortality. Future research should focus on longitudinal studies examining the impact of targeted micronutrient supplementation on clinical outcomes, recovery rates, and long-term neurodevelopmental consequences in children with SAM. Additionally, cost-effective strategies for routine micronutrient screening in resource-limited settings warrant further exploration to bridge the gap between current clinical practice and evidence-based management of severe acute malnutrition.

Ethical Approval

The study was approved by the Institutional Ethics Committee (IEC/2022/PED/045) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from parents or legal guardians of all study participants after explaining the study objectives, procedures, and potential risks and benefits in their vernacular language.

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Conflicts of interest

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

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ORIGINAL ARTICLE

The Prevalence, Determinants of Contraceptive Use, and Unmet Need for Family Planning among Married Women of Reproductive Age in a Rural Tertiary Care Field Practice Area of Tamil Nadu

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Abstract

Background: In India, most women know about contraception, but many still do not use it. This results in a large unmet need for family planning. Knowing the local reasons helps plan better interventions. **Objectives:** 1. To assess the prevalence of contraceptive use among married women of reproductive age. 2.To identify determinants and barriers contributing to unmet contraceptive need. **Methods:** A community-based cross-sectional study was done for six months in the field practice area of a tertiary care teaching hospital in Tamil Nadu. Using systematic random sampling, 360 married women aged 15–49 years were included. Information was collected using a pretested structured proforma. **Results:** The mean age of participants was 24.34 ± 3.69 years. Most women were aware of contraception (78.1%), but only a smaller proportion were currently using it (28.3%). The main reasons for use were financial reasons (98.0%) and spacing between pregnancies (98.0%). The common barriers were feeling that contraception was “not important” (50.4%) and family influence (44.2%). Socioeconomic status was significantly related to contraceptive use (p=0.007). After adjustment, women from the upper middle class were less likely to use contraception (AOR 0.26; 95% CI: 0.08–0.81), while graduates were more likely to use contraception (AOR 3.64; 95% CI: 1.53–8.68). **Conclusion:** There is a clear difference between knowing about contraception and actually using it. Education and socioeconomic status strongly affect contraceptive use. Family-based counseling and locally suitable behavior-change interventions are needed to reduce unmet need.

Keywords: Contraceptive use, Unmet need, Family planning, Married women, Socioeconomic factors

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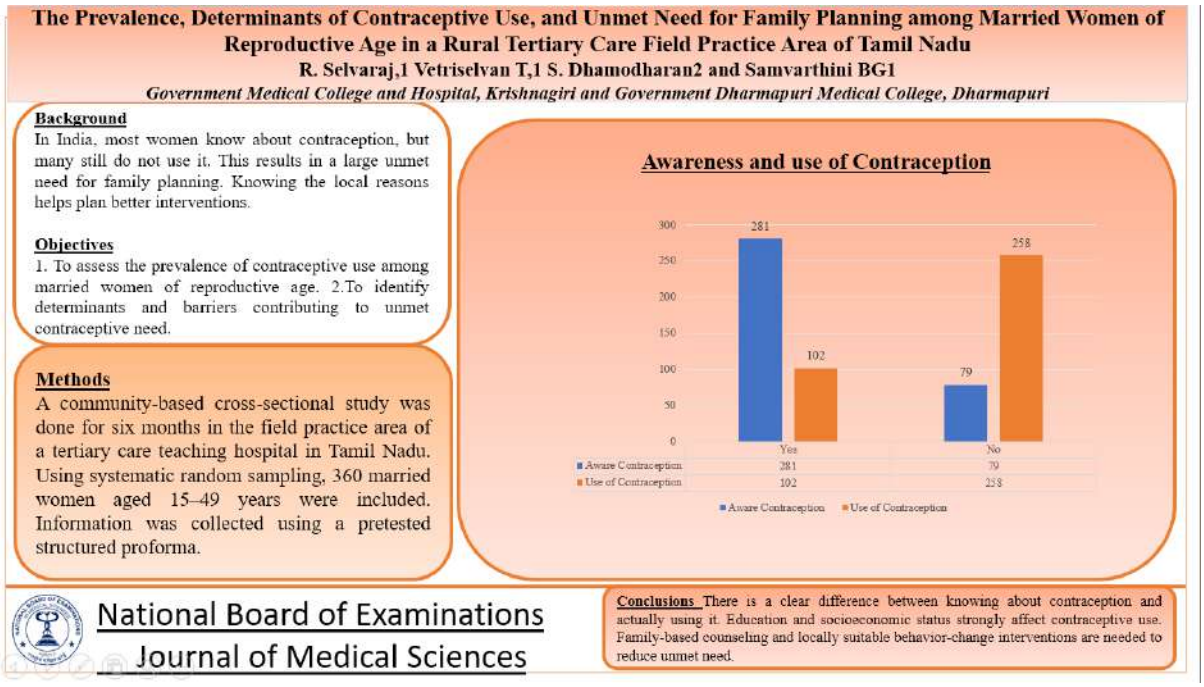
Graphical Abstract



Introduction

Contraception is an important part of reproductive health. It helps couples decide how many children to have and how much gap to keep between births. This helps reduce illness and deaths in mothers and children. Family planning also prevents unwanted pregnancies, unsafe abortions, and high-risk pregnancies, and supports women's education and ability to work [1,2]. Worldwide, nearly 257 million women of reproductive age still have an unmet need for contraception, even though effective methods are available [1]. Many barriers reduce contraceptive use, such as fear of side effects, social and cultural opposition, poor quality of services, and decisions being controlled by gender-related factors, especially in low- and middle-income countries [3,4].

India started the world's first national family planning program in 1952. Over time, it has expanded through policies like the National Population Policy (2000), National Health Policy (2017), and the National Health Mission, with a focus on reproductive rights and informed choice [5,6]. Although awareness of contraception in India is almost universal (98.8%), actual use differs across regions and socioeconomic groups [7]. As per NFHS-5, contraceptive use among married women aged 15–49 years is 66.7%, and modern methods account for 56.5% of use, while the total fertility rate is 2.0 [7]. Studies from different parts of India show that education, socioeconomic status, family pressure, and preference for a male child strongly influence whether contraception is used [8–10]. However, local data from rural Tamil Nadu are still limited.

Therefore, it is important to understand the local reasons for contraceptive use and non-use so that community-based interventions can be planned effectively. This study was done to assess the prevalence, determinants, and unmet need for family planning among

married women of reproductive age in a rural field practice area of a tertiary care hospital in Tamil Nadu.

Materials and Methods

Study Design and Setting

A community-based cross-sectional study was conducted in the rural field practice areas attached to Government Medical College and Hospital, Krishnagiri (GMCK), Tamil Nadu.

Study Period

Six months (April to September 2025).

Study Population

Married women aged 15–49 years residing in the study area.

Sample Size

Based on NFHS-5 contraceptive prevalence (70%), with 5% absolute precision and 95% confidence level, the minimum required sample size was calculated as 336. A total of 360 participants were enrolled.

Sampling Technique

Systematic random sampling was employed. GMCK Rural field practice area, Shoolagiri health block was taken. Out of total 2,101 household, every 6th house was selected and starting house was selected randomly, From each selected household, one eligible respondent meeting the inclusion criteria was enrolled in the study. If a selected household did not have an eligible participant or consent was not obtained, the next household was approached to maintain the sample size.

Data Collection Tool

A pretested structured proforma covering sociodemographic details, reproductive history, awareness and practice of contraception, influencing factors, and barriers. Questionnaire was validated using pilot study

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS. All quantitative data were expressed in mean and standard deviation. All qualitative data were expressed in frequency and percentages. Associations were tested using test of significance chi-square test, independent t-test, Multi-variable analysis: logistic regression. For all practical purposes p-value <0.05 was considered statistically significant.

Results

The average age of the participants was 24.34 ± 3.69 years, and the average age at marriage was 20.50 ± 3.16 years. Most of the participants were women (86.4%). Many had high school or primary education, and most belonged to the lower middle socioeconomic class (Table 1). About 78.1% of participants had heard about contraception, but only 28.3% were currently using any contraceptive method (Figure 1). This shows a clear gap between knowledge and actual use, indicating a considerable unmet need.

The main reasons for using contraception were financial reasons (98.0%) and spacing between pregnancies (98.0%). Other common reasons included limiting family size (64.7%) and partner's choice (59.8%). Medical reasons such as previous pregnancy complications or chronic illness were reported only by a few participants (Table 1). The commonest reasons for not using contraception were

the respondents thinking it was "not important" (50.4%), family influence (44.2%), and preference for a particular gender of the child (30.2%). Cultural beliefs and social stigma also discouraged contraceptive use (Figure 2).

Socioeconomic status was significantly related to contraceptive use ($\chi^2 = 14.31$; $p = 0.007$) (Table 2). There was no significant difference in current age between users and non-users ($p = 0.416$). However, users had a higher age at marriage (21.02 vs 20.29 years; $p = 0.048$) and higher spouse age at marriage (26.03 vs 25.00 years; $p = 0.017$) (Table 3). In the multi-variable adjusted analysis, education and socioeconomic status showed important links with contraceptive use. Compared with the reference SES group, participants from the upper middle class were less likely to use contraception (AOR 0.26; 95% CI 0.08–0.81; p=0.02), while the upper class, middle class, and lower middle class showed no significant difference (p>0.05). Regarding education, graduates were more likely to use contraception than the reference education group (AOR 3.64; 95% CI 1.53–8.68; p=0.004), whereas high school, higher secondary, and illiterate categories were not significantly associated with contraceptive use (Table 4).

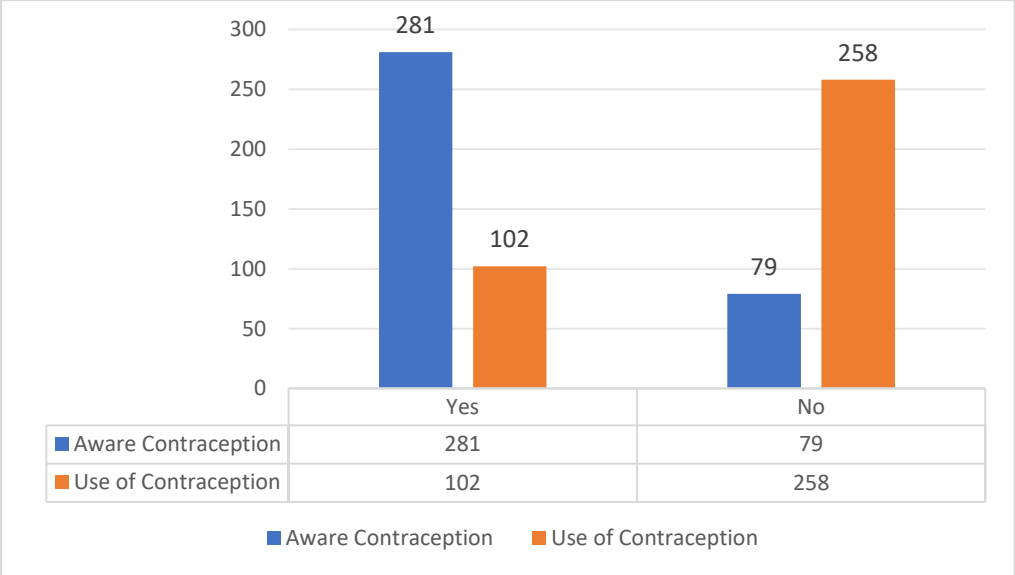


Figure 1. Awareness and use of Contraception.

Table 1. Factors influencing contraceptive use among current users (N=102)

Factors Influencing contraception use	**N**	**Percent**
Career Growth	37	36.3%

Financial reasons	100	98.0%
Limit Family size	66	64.7%
Gap between pregnancy	100	98.0%
Partners Choice	61	59.8%
Complications in previous pregnancy	6	5.9%
Chronic Medical condition	3	2.9%
Fear of RTI/STI	1	1.0%
Easy accessibility	25	24.5%

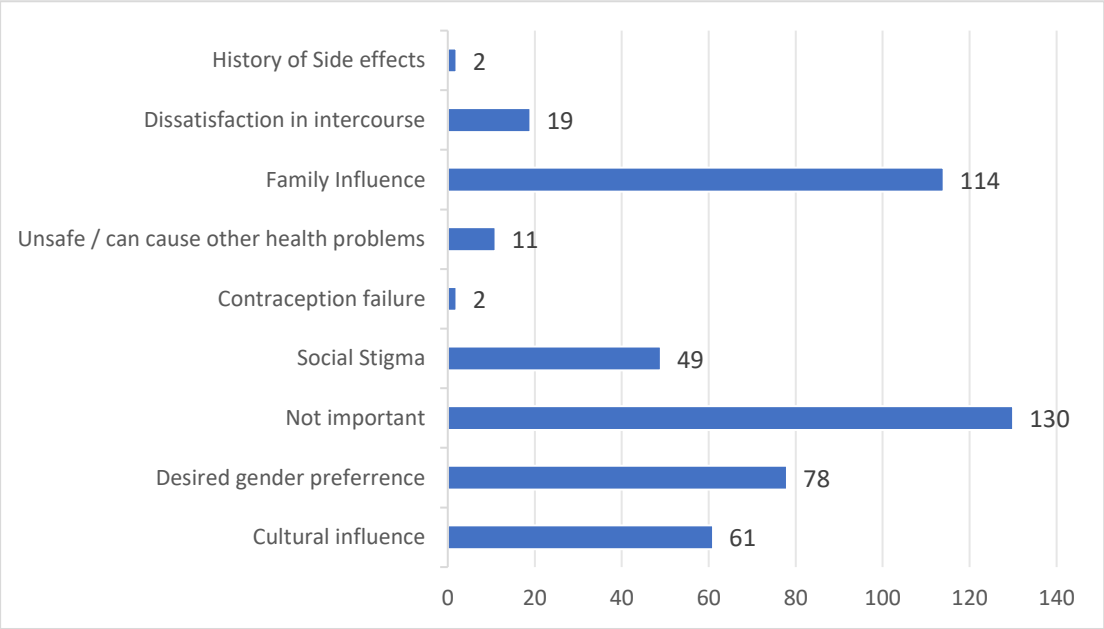


Figure 2. Barriers to contraceptive use among participants

Table 2. Association between socioeconomic status and current temporary contraceptive use (Yes/No) among married women (N=360).

Socio Economic Status	**Current_ Temporary**		**Total**	**Chi Square Value**	**p value**
	No	**Yes**			
Upper Class	8	4	12	**14.31**	**0.007***
	66.7%	33.3%	100.0%		
Upper Middle Class	79	16	95		
	83.2%	16.8%	100.0%		
Middle Class	79	26	105		
	75.2%	24.8%	100.0%		
Lower Middle Class	77	49	126		
	61.1%	38.9%	100.0%		
Lower Class	15	7	22		
	68.2%	31.8%	100.0%		
Total	258	102	360		
	71.7%	28.3%	100.0%		

Table 3. Comparison of mean age, age at marriage, and spouse age at marriage between contraceptive users and non-users (independent t-test).

Variables	**Current_Temporary**	**N**	**Mean**	**Std. Deviation**	**t value**	**p value**
Age	No	258	24.24	3.709	-0.815	0.416

	Yes	102	24.59	3.643		
Age at marriage	No	258	20.29	3.288	-1.982	**0.048 ***
	Yes	102	21.02	2.743		
Spouse age at marriage	No	258	25	3.918	-2.39	**0.017 ***
	Yes	102	26.03	2.936		

Table 4. Multivariable logistic Regression for predictors of current contraception use (Adjusted OR with 95% CL)

Predictor	Category (vs reference)	Adjusted OR (AOR)	95% CI for AOR	p value
SES	SES (Upper Class)	0.54	0.11 – 2.66	0.447
	SES (Upper Middle Class)	0.26	0.08 – 0.81	**0.02***
	SES (Middle Class)	0.55	0.19 – 1.55	0.255
	SES (Lower Middle Class)	1.37	0.51 – 3.68	0.534
Education	**Education (Graduate)**	3.64	1.53 – 8.68	**0.004***
	Education (High School)	1.54	0.80 – 2.95	0.194
	Education (Higher Secondary)	1.32	0.62 – 2.78	0.47
	Education (Illiterte)	0.59	0.18 – 1.98	0.392

Discussion

The present study shows a clear gap between knowing about contraception and actually using it among married women of reproductive age. Even though awareness is high, contraceptive use is still low. This is mainly due to social and cultural beliefs, family pressure, and the feeling that contraception is not important, similar to other Indian studies [8,9,11].

Education was found to be an important factor that increased contraceptive use. This shows that women with better education are more confident and informed to make decisions about family planning [10,12]. The link between socioeconomic status and contraceptive use also suggests that family planning strategies should be planned according to local needs, instead of using the same approach for everyone.

To reduce unmet need, it is important to provide counseling that involves the family, encourage male participation, and correct myths and cultural fears about contraception [3,13]. Including these steps within existing public health programs can improve contraceptive use and help improve maternal and child health in similar rural areas.

Strengths and Limitations

Strengths

This study had a community-based design, which helped in understanding the real situation of contraceptive use among women in the general population rather than only among hospital attendees. In addition, the use of multivariable analysis allowed identification of independent factors influencing contraceptive use, while controlling for the effect of other variables, thereby strengthening the validity of the findings.

Limitations

Since it was a cross-sectional study, it could only show associations and not a cause–effect relationship. Also, the information was self-reported by participants, which may have been affected by recall errors or the tendency to give socially acceptable answers Social desirability bias.

Conclusion

Even though many women know about contraception, only a few are actually using it, leading to a large unmet need for family planning. Contraceptive use is strongly influenced by education and socioeconomic status. Improving community-based counseling, involving family members, and reducing social and cultural barriers are important steps to increase contraceptive use.

Ethical Approval

Ethical approval was obtained from the Institutional Scientific Committee (GMCK/ISC/APPRO/04/2025/03).

Informed Consent

Informed consent was secured from all participants, and confidentiality was maintained.

Conflicts of interest

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

Funding

No funding was received for conducting this study.

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ORIGINAL ARTICLE

Evaluation of Mannheim Peritonitis Index in Predicting Morbidity and Mortality in Patients with Peritonitis Due to Hollow Viscus Perforation: A Prospective Observational Study

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Abstract
Introduction: Peritonitis occurring due to hollow viscus perforation is considered as a life-threatening surgical emergency associated with significant Morbidity and Mortality. Early recognition of high-risk patients is necessary for timely intervention and optimal use of available limited resources. The Prevailing Mannheim Peritonitis Index (MPI) is considered as a disease-specific scoring system to predict the clinical outcomes in patients with peritonitis using clinical parameters and intra-operative details. **Materials and Methods:** This cross sectional study was conducted in a tertiary care set up in Western Tamil Nadu. The study participants included adult patients who presented with peritonitis secondary to hollow viscus perforation which was confirmed intra-operatively. MPI scores were calculated for all the study participants and were categorized as three groups (<21, 21–29, and >29. **Results:** A total of 131 study participants were included in the study. The mean age was 53.49 ± 14.26 years. The mean MPI score observed was 21.36 ± 6.36. Around 42% of participants had any one morbidity. Mortality was observed in 3.1% of the study population. As the MPI scores increased, significantly higher rates of renal complications, ICU admission, prolonged hospital stay, and overall morbidity ($p < 0.05$) were observed. MPI demonstrated excellent predictive accuracy for mortality (AUC 0.978) and moderate accuracy for morbidity (AUC 0.704). **Conclusion:** The Mannheim Peritonitis Index is a simple, reliable, and cost effective prognostic tool in predicting morbidity and mortality among patients diagnosed with peritonitis due to hollow viscus perforation. The ease of application and strong predictive accuracy makes this scele as a valuable tool in predicting the Outcome, particularly in resource-limited settings for early risk stratification and management planning.

Keywords: Peritonitis, Hollow viscus perforation, Mannheim Peritonitis Index, Morbidity, Mortality

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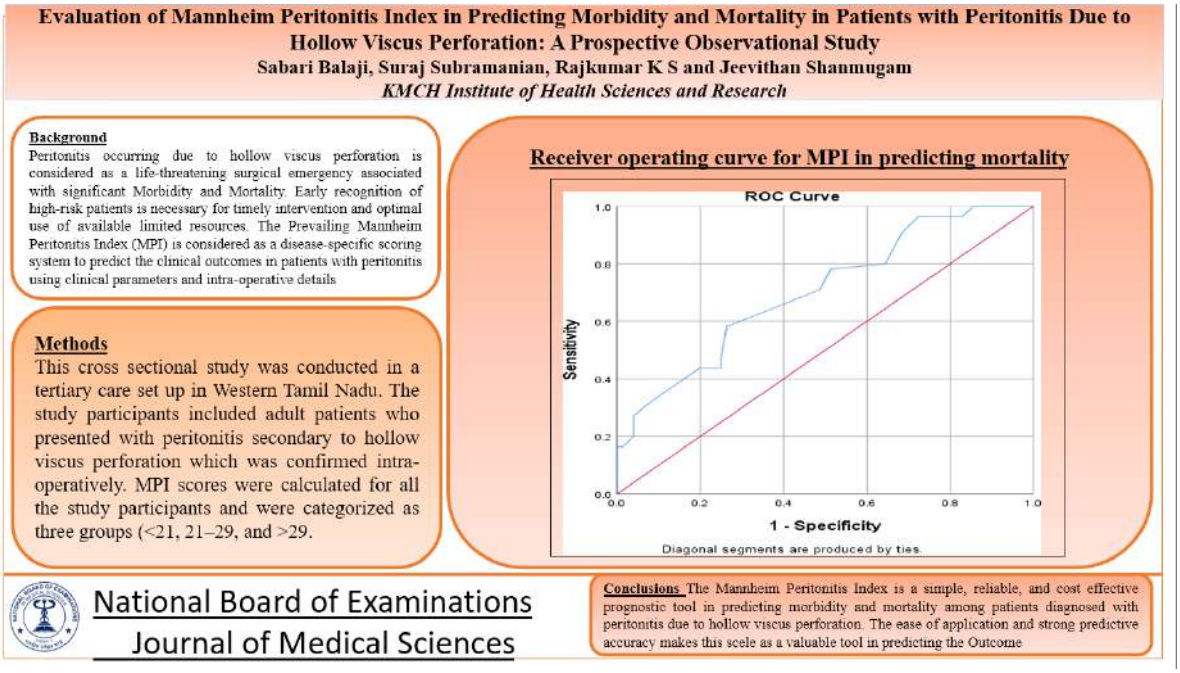
Graphical Abstract



Introduction

Peritonitis is defined as the inflammation of peritoneum and/or peritoneal cavity, which commonly results due to bacterial contamination that originates from the gastrointestinal tract [1]. Peritonitis is a life-threatening surgical emergency and it represents a major proportion of acute abdomen cases presenting to emergency departments [2]. Approximately 25% (one-fourth) of acute abdominal emergencies are attributed to perforations of the Gastrointestinal tract, with reported mortality rates ranging between 6% and 27%, depending on the severity of disease and timing of intervention [3-5].

In spite of the recent advances in surgical techniques, antibiotic therapy, and also critical care support, perforation peritonitis still continues to pose a significant diagnostic and therapeutic challenge, particularly among low- and middle-income countries [6]. Delayed presentation along with advancement of the disease at admission, widespread peritoneal contamination, and associated organ dysfunction contribute to the increased morbidity and mortality. Early surgical intervention remains the cornerstone in the management, and timely identification of those with high risk is crucial for optimizing perioperative care and resource allocation [1].

Several scoring systems has been developed to assess the disease severity and to predict the outcomes in patients diagnosed with peritonitis which includes the Acute Physiological and Chronic Health Evaluation (APACHE II), Sepsis Severity Score, Peritonitis Index Altona, Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM), and the Mannheim Peritonitis Index (MPI). Among these, MPI is a disease-specific scoring system designed exclusively for patients with peritonitis using simple

clinical and intraoperative parameters [7]. Developed by Wacha and Linder in 1983 through a retrospective analysis on 1253 patients, MPI incorporates eight independent prognostic factors and it categorizes patients according to predicted risk of morbidity and mortality. Literature suggests that MPI scores exceeding 26 have been shown to have significantly higher mortality rates [8].

The Mannheim Peritonitis Index has gained acceptance worldwide due to its simplicity, cost-effectiveness, and ease of application, particularly in resource-limited settings where the access to advanced investigations and intensive care facilities are restricted [7]. MPI does not require any complex laboratory parameters or any specialized equipment and it can be calculated intra-operatively, thereby allowing early risk stratification and guiding in postoperative management decisions. Although several International literatures have validated the prognostic utility of MPI, there is a relative paucity of in Indian literature regarding the accuracy of MPI in predicting morbidity and mortality among patients with peritonitis due to hollow viscus perforation [1].

The present study was undertaken to evaluate the effectiveness of the Mannheim Peritonitis Index in predicting postoperative morbidity and mortality in patients with peritonitis due to hollow viscus perforation and to assess its utility as a practical prognostic tool in a tertiary care setting.

Materials and Methods

This Cross sectional study was conducted in the Department of General Surgery at a tertiary-care teaching hospital in Coimbatore, India, between November 2020 to December 2021. Adult patients aged 18 years and above who presented with clinical features of peritonitis due to hollow viscus perforation, which was then subsequently confirmed by intra-operative findings were included in the study. Patients with traumatic hollow viscous perforation and patients with other significant comorbid illnesses likely to independently affect outcomes were excluded from the study.

Prior to the commencement of the study, Scientific and Ethical committee approval for the study were obtained. All eligible participants were informed in detail about the nature and purpose of the study. Patient information sheet was provided to each participant and adequate time was given to read and understand them. All ethical issues pertaining to the study was addressed as per Helsinski Declaration. Written informed consent was obtained from all participants after they confirm the participation in the study. Patient data was confidential and the standard of care was maintained irrespective of the participation in the study.

Consecutive recruitment of all eligible patients was done in the study period. Detailed clinical history was collected using a structured proforma. Demographic details, duration of symptoms, clinical examination findings, intraoperative observations were noted and postoperative period was monitored. The Mannheim Peritonitis Index (MPI) score was calculated for each patient based on predefined criteria, taking the age, sex of the partcipant, duration of peritonitis, presence/absence of organ failure, malignancy, origin of sepsis, extent of peritonitis, and the nature of peritoneal exudate into consideration. The total MPI score was derived by adding the individual

risk factor scores. Based on the total score, patients were categorised into three risk categories: MPI <21, MPI 21–29, and MPI >29.

All patients had appropriate surgical intervention according to the underlying pathology and were followed by standardized postoperative management. They were followed up during their hospital stay, upto a month after surgery for other outcomes. Mortality was defined as death occurring during the stay in hospital following surgery. Morbidity was defined as the occurrence of one or more postoperative complications including renal or pulmonary or wound-related complications, requirement for admission in intensive care unit, or prolonged hospital stay exceeding six days.

Renal complications, pulmonary complications, wound complications, ICU admission, duration of hospital stay, overall morbidity, and mortality were taken as outcome variables, while MPI score served as the primary explanatory variable. Data were coded and entered in Microsoft Excel and analyzed using SPSS 27. Descriptive statistics was used to summarize baseline characteristics and outcomes and Mean/standard Deviation was used for continuous variables and categorical variables being expressed as frequency and percentage. Association between MPI score categories and outcomes were assessed using the chi-square test. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the predictive performance of MPI for mortality and morbidity. Sensitivity, specificity, positive predictive value, negative predictive value, diagnostic accuracy, and area under the curve were calculated with corresponding confidence intervals. A p value of less than 0.05 was considered statistically significant.

Results

Table 1 summarizes the baseline demographic and clinical characteristics of the study population and also the distribution of Mannheim Peritonitis Index (MPI) scores. The mean age of the study population was 53.49 ± 14.26, with more than two thirds (68.7%) above 50 years, and a male preponderance (69.5%). A majority of participants (71%) presented with generalized peritonitis and around 96.1% had purulent or fecal contamination. The mean MPI score was 21.36 ± 6.36, with nearly half of the participants (47.3%) classified in the intermediate-risk category (MPI 21–29) and approximately one-tenth in the high-risk category (MPI >29), indicating a heterogeneous population suitable for prognostic stratification using MPI.

Table 1. Baseline demographic, clinical characteristics, and MPI distribution of the study population (N = 131)

Variable	Value
Age (years), mean ± SD	53.49 ± 14.26
Age >50 years	90 (68.7%)
Male sex	91 (69.5%)
Pre-operative duration >24 h	27 (20.6%)
Generalized peritonitis	93 (71.0%)
Purulent/Fecal exudate	126 (96.1%)
Organ failure	22 (16.8%)
Malignancy	10 (7.6%)
MPI score, mean ± SD	21.36 ± 6.36
MPI <21	55 (42.0%)
MPI 21–29	62 (47.3%)
MPI >29	14 (10.7%)

Overall morbidity was 41.9%, showing the significant percentage of complications associated with peritonitis due to hollow viscus perforation. Renal complications were the most common (19.1%), followed by pulmonary (15.3%) and wound-related complications (14.5%). Nearly one-fifth (19.1%) of patients needed Intensive care and nearly half had prolonged hospital stay exceeding six days (49.6%). Despite the high morbidity, the overall mortality rate was relatively low at 3.1%, which shows timely surgical intervention and post-operative care (Table 2).

Table 2. Post-operative outcomes in the study population (N = 131)

Outcome	n (%)
Overall morbidity	55 (41.9%)
Renal complications	25 (19.1%)
Pulmonary complications	20 (15.3%)
Wound complications	19 (14.5%)
ICU admission	25 (19.1%)
Prolonged hospital stay (>6 days)	63 (49.6%)
Mortality	4 (3.1%)

As depicted in Table 3, there was a clear and gradual increase in adverse post-operative outcomes with rising MPI score categories. Renal complications, ICU admission, prolonged hospital stay, and overall morbidity were significantly more common in participants with higher MPI scores ($p < 0.05$). Overall morbidity increased from 30.9% in patients with MPI <21 to 78.6% in those with MPI >29. It is to be noted that all deaths in the study occurred only in patients with MPI scores greater than 29, showing a strong association between mortality and increased MPI scores.

Table 3. Association between MPI score categories and post-operative outcomes (N = 131)

Outcome	MPI <21	MPI 21–29	MPI >29	p value
Renal complications	5 (9.1%)	14 (22.6%)	6 (42.9%)	0.010
Pulmonary complications	4 (7.3%)	13 (21.0%)	3 (21.4%)	0.096
ICU admission	8 (14.5%)	10 (16.1%)	7 (50.0%)	0.008
Prolonged stay (>6 days)	20 (36.4%)	38 (61.3%)	5 (50.0%)	0.027
Overall morbidity	17 (30.9%)	28 (45.2%)	11 (78.6%)	0.005
Mortality	0	0	4 (28.6%)	—

Table 4 shows the diagnostic performance of MPI in predicting outcomes. MPI showed commendable predictive accuracy for mortality at a cut-off value of ≥29, with high sensitivity and specificity. This was supported by receiver operating characteristic (ROC) curve analysis, where Figure 1 shows an area under the curve (AUC) of 0.978, highlighting the discriminative ability of MPI for mortality prediction. For morbidity prediction, MPI showed moderate predictive performance at an optimal cut-off of ≥20.5, with Figure 2 demonstrating an AUC of 0.704, showing acceptable but comparatively lesser discriminative ability for predicting post-operative complications.

Table 4. Diagnostic accuracy of MPI in predicting mortality and morbidity

Parameter	Mortality (MPI ≥29)	Morbidity (MPI ≥20.5)
Sensitivity	100.0%	70.9%
Specificity	92.1%	51.3%
Positive predictive value	28.6%	51.3%
Negative predictive value	100.0%	70.9%
Diagnostic accuracy	92.4%	59.5%
AUC (ROC)	0.978	0.704

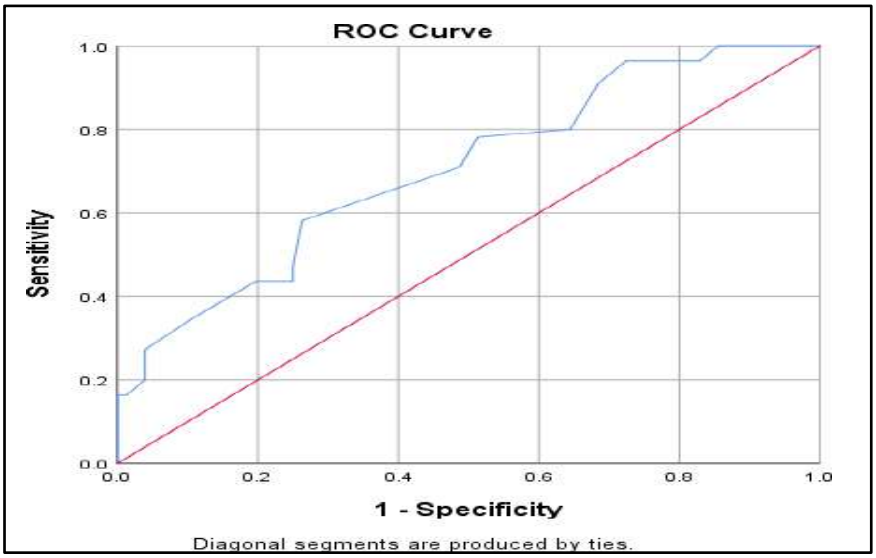


Figure 1. Receiver operating curve for MPI in predicting mortality (N=131)

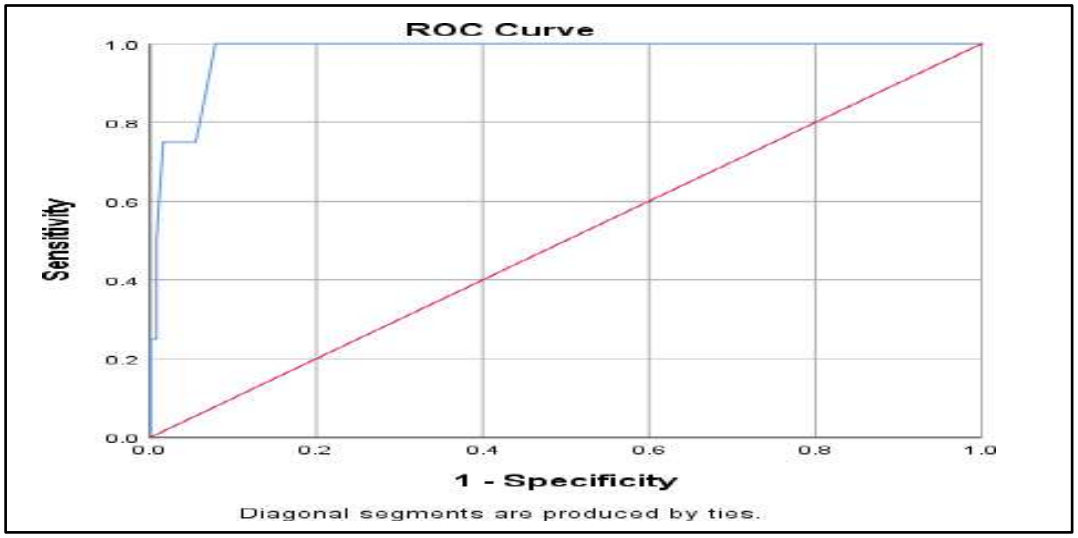


Figure 2. Receiver operating curve for MPI in predicting mortality (N=131)

Discussion

Hollow viscus perforation causing peritonitis is a major surgical emergency even in this era. It is associated with significant morbidity and mortality, especially in low- and middle-income countries due to delay in presentation and limited access to advanced critical care facilities [9,10]. Early identification of high-risk individuals is important to guide timely surgery, better postoperative management and improve outcomes. Prognostic scoring systems play an important role in this context by enabling objective assessment of disease severity [11].

In our present study, majority of participants were elderly (more than 50 years), with a male predominance. Results of several Indian studies on perforation peritonitis were also consistent with our results [12-15]. Advanced age has been consistently associated with poor outcomes in peritonitis due to decrease in physiological reserve and increased prevalence of comorbidities [15]. The predominance of generalized peritonitis and purulent or fecal contamination in our cohort suggests delayed presentation, a pattern that was frequently reported in developing countries [13,16]. Our results highlight the continued challenge of late diagnosis and referral, which adversely affects the prognosis.

A key strength of our study is the demonstration of a linear positive association between increasing Mannheim Peritonitis Index (MPI) scores and adverse postoperative outcomes. Participants with higher MPI scores experienced a significantly higher rates of renal complications, ICU admission, prolonged hospital stay, and overall morbidity. Similar associations have been reported in many Indian and international studies which reinforces the reliability of MPI as a prognostic tool [4,17-22]. Our finding that all deaths occurred exclusively in participants with MPI scores greater than 29 further underscores a strong predictive value of MPI for mortality which is consistent with observations by Wacha and Linder [8.,23,24].

The excellent predictive accuracy of MPI for mortality observed in this study, as reflected by a high area under the ROC curve, is comparable to reports obtained from both national and international Studies [15,17-22,25-27]. A major advantage of MPI lies in its ease of assessment and its reliance on clinical and intraoperative parameters, making it suitable for resource-limited settings [7,28]. Unlike APACHE II and POSSUM, MPI scoring system doesn't require extensive laboratory data or postoperative physiological monitoring, allowing early risk stratification at the time of surgery.

However, while MPI showed an excellent predictive accuracy for mortality, its predictive ability for morbidity is not significant, consistent with previous studies done in the past [19,20,22]. Postoperative morbidity is influenced by many factors along with disease severity at presentation, surgical technique, perioperative care, nutritional status, and hospital-specific practices. The relatively lower specificity for morbidity prediction in the present study is explained by this, and highlighting the limitation of MPI when used as a standalone tool for predicting non-fatal complications.

Conclusion

Our study findings support using Mannheim Peritonitis Index as a simple, reliable, and cost-effective prognostic scoring system for peritonitis secondary to hollow viscus perforation especially in resource poor settings. Early identification of high-risk patients can be done using MPI, and they may benefit from aggressive surgical and postoperative management, closer monitoring, and intensive care support. Its ease of use and strong predictive value make it specially of wide use in limited resource setting, where timely decision-making is life saving and for better patient outcomes.

Statements and Declarations

Conflicts of interest

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

Funding

No funding was received for conducting this study.

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ORIGINAL ARTICLE

Assessment of Utilization Pattern of Ante Natal Maternal & Child Health Kits Provided by the Government Among Post Natal Mothers in Tamil Nadu

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Abstract

Background: Maternal nutrition and antenatal care are critical determinants of maternal and neonatal outcomes. Tamil Nadu implements maternity benefit schemes providing cash assistance and antenatal maternal and child health (MCH) kits; however, evidence on their utilisation remains limited. **Methods:** A community-based cross-sectional study was conducted among 180 postnatal mothers who delivered within the preceding six months in a selected block of Tamil Nadu. Participants were selected by simple random sampling from Primary Health Centre records. Data were collected using a pretested interviewer-administered questionnaire assessing socio-demographic characteristics, antenatal care, utilisation of MCH kits and maternal–neonatal outcomes. **Results:** The mean age of participants was 23.75 ± 4.23 years. Early antenatal registration was reported by 87.8%. Anaemia (28.3%) and previous caesarean section (17.1%) were common high-risk conditions. Among eligible mothers, 48.9% spent 50–75% of cash assistance on nutrition. Although 78.0% received nutrition kits, only 30.3% reported complete consumption, while 51.9% consumed them partially. Institutional delivery was universal, 78.1% of newborns had normal birth weight, and 4.8% required resuscitation. **Conclusion:** Despite good antenatal coverage and scheme reach, utilisation of nutritional components of MCH kits remains suboptimal. Strengthening nutrition counselling and behaviour change communication is essential to improve maternal nutrition and neonatal outcomes.

Keywords: Antenatal care, Maternal nutrition, MRMBS, Nutrition kits, Tamil Nadu

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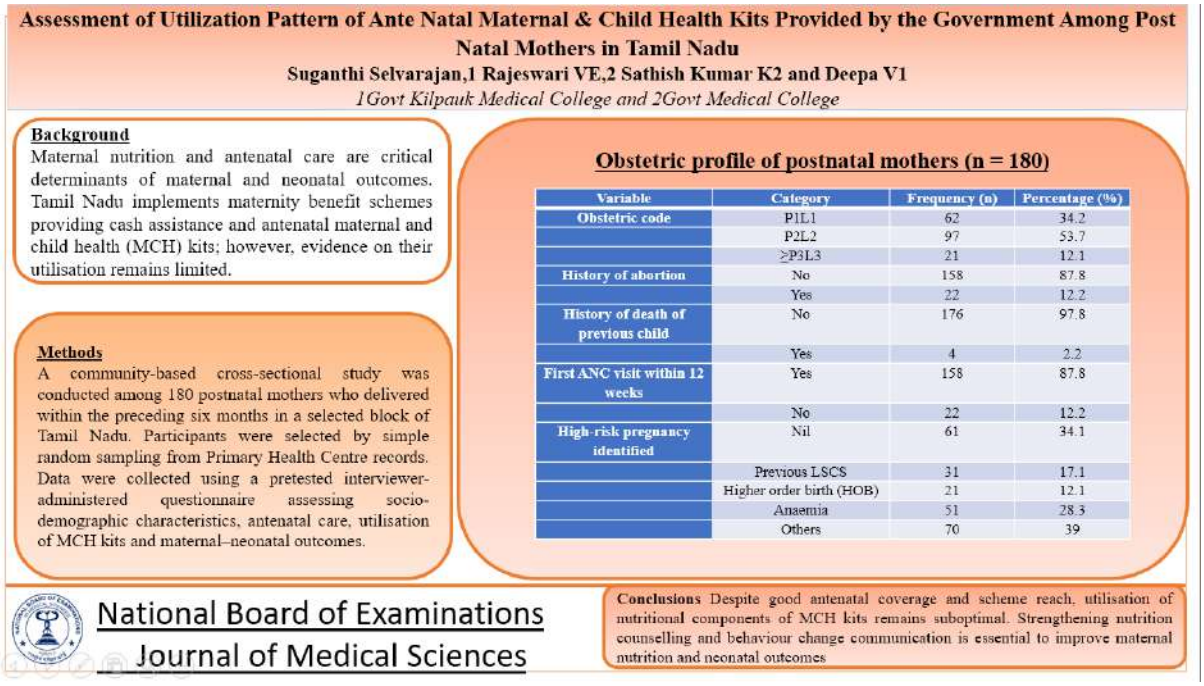
Graphical Abstract



Introduction & Background

The government of India and Tamil Nadu has implemented programs that distribute ante-natal and post-natal health kits to support mothers in managing their health during pregnancy and after childbirth. One of the main schemes among these is MRMBS. Dr Muthulakshmi Reddy Scheme (MRMBS) is a maternity benefit scheme was launched by Government of Tamil Nadu in 1987 with the aim of help in getting nutritious food to avoid low birth weight babies [1]. It was integrated with PMMVY – Pradhan Mantri Mathru Vandhana Yojana of GoI in 2017 with shared funding of the programme [2]. It is initiated for additional income for nutrition during pregnancy and for partial wage compensation for three months after childbirth. Apart from financial assistance, the program will also ensure better health and nutrition of the pregnant mother and unborn child. Every eligible beneficiary will get a nutritional kit. This kit will contain health mix, dry dates, iron tonic, protein biscuits, ghee, disinfectants, towel and albendazole tablets. Previous study reports that most of the benefitted mothers delivered normal weight babies and the results confirm 99% significance between the beneficiaries and the weight at birth of the child [3].

Despite this sustained public health initiative and the awareness efforts, the prevalence of low birth weight in Tamil Nadu remains a public health concern, indicating the need for the continued emphasis on the maternal nutrition and health education among the expectant mothers [4]. Antenatal MCH kits are designed in such a way to provide essential support throughout their pregnancy; however, variations in the utilization of these servies may occur due to multiple factors such as differences in the awareness levels, accessibility of the kits, and also the prevailing socio-cultural practices [5]. Evaluating how these kits are being utilized by the beneficiaries can also help in identifying the opportunities to strengthen

its implementation strategies and to optimize service delivery. Furthermore, insights into the utilization patterns can also support the evidence-based refinement of these existing programmes, thereby enhancing their responsiveness to the maternal and child health needs and also contributes to improved health outcomes in Tamil Nadu.

Previous studies from Tamil Nadu have reported varying levels of awareness and utilisation of maternity benefit schemes and nutrition kits. Lakshmi and Rajkumar observed suboptimal awareness regarding maternity benefit schemes among antenatal women in rural Tamil Nadu, while Swamynathan et al. reported that although most beneficiaries received nutrition kits, utilisation and awareness regarding components varied considerably [5,6]. Praveena also highlighted gaps between scheme coverage and effective nutritional utilisation, emphasizing the need for program strengthening [7].

Accordingly, this study was undertaken to primarily assess the pattern of utilization of the antenatal MCH kits provided free of cost by the Government of India and Government of Tamil Nadu among tribal post-natal mothers, and to examine the association between kit utilization and maternal and child health outcomes. This study also aimed to document current utilization practices and identify potential gaps, with the objective of promoting optimal use of government-provided antenatal supplements and supporting favorable maternal and child health outcomes.

Methodology

A community-based observational cross-sectional study was conducted over a period of six months among postnatal mothers residing in a selected block of a selected district in Tamil Nadu. Multi-stage random sampling was used to identify the block for the study. One block was selected by simple random sampling from the district, and eligible postnatal mothers were selected by simple random sampling from PHC beneficiary lists. As this was a single-block study, findings are representative only of the study area and not generalisable to the entire state.

The study population comprised postnatal women who had delivered within the preceding six months and were eligible for benefits under the Dr. Muthulakshmi Reddy Maternity Benefit Scheme (MRMBS).

Postnatal mothers who were eligible for MRMBS and who were willing to participate in the study were included. Mothers who did not provide consent and those with psychiatric illnesses that impaired comprehension or ability to respond to the questionnaire were excluded from the study. The sample size was calculated to be 180 participants based on a previous study by Swamynathan et al., which reported that 82% of mothers had received nutrition kits under the maternity benefit scheme [6]. A simple random sampling technique was employed to select participants from the list of MRMBS beneficiaries obtained from the respective Primary Health Centres (PHCs) in the study area.

Data was collected using a pretested and pre-validated interviewer-administered questionnaire in the local vernacular language. Information was obtained on socio-demographic characteristics, obstetric history, antenatal care utilization, receipt and utilisation of cash assistance and nutritional kits, and maternal and neonatal outcomes. Following data

collection, participants were provided health education focusing on postnatal care, personal hygiene, and appropriate maternal and infant nutrition.

The study variables included age, education, occupation, socio-economic status, religion, type of family, number of cash instalments received and proportion utilized for nutrition, utilisation details of individual nutritional items in the kit, maternal weight gain during pregnancy, pregnancy outcome, gestational age at delivery, birth weight of the newborn, and requirement of resuscitation or neonatal intensive care.

The primary outcome variable was utilisation of antenatal MCH kit components (categorised as complete, partial or non-utilisation). Secondary outcomes included maternal weight gain, gestational age at delivery, birth weight and neonatal resuscitation requirement. Data were analysed using SPSS version XX. Descriptive statistics were used to summarise socio-demographic and obstetric variables. Associations between utilisation of kit items and selected maternal and neonatal outcomes were assessed using Chi-square test. Logistic regression analysis was performed to explore predictors of utilisation. A p value <0.05 was considered statistically significant.

Results

A total of 180 women were included in this study. The mean age of the participants was 23.75 years (SD = 4.23). Majority of the women had completed high school education (63.4%), followed by graduates (22%). Most participants were homemakers (78%), while 12.2% were engaged in agriculture.

The mean age of husbands of these women was 26.8 years (SD = 4.43). Nearly half of the husbands had completed higher secondary education or diploma (46.3%), while 17.1% were graduates or above. All participants were married and living with their husbands. 46.3% belonged to nuclear families, while remaining participants lived in joint or other types of families. According to BG Prasad socio-economic classification, majority belonged to the middle (51.2%) and lower middle (41.5%) socio-economic classes (Table 1).

Table 1. Socio-demographic characteristics of the participants (n = 180)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean (SD) = 23.75 (4.23)		
Education	Middle school	13	7.3
	High school	114	63.4
	Higher secondary / Diploma	13	7.3
	Graduate and above	40	22.0
Occupation	Homemaker	140	77.8
	Agriculture / farming	26	14.4
	Clerical / Shop owner	9	5

	Teacher/ Semi-professional	5	2.8
Husband's age (years)	Mean (SD) = 26.8 (4.43)		
Husband's education	Primary school	4	2.4
	Middle school	4	2.4
	High school	57	31.7
	Higher secondary / Diploma	83	46.3
	Graduate and above	31	17.1
Type of family	Nuclear	83	46.3
	Joint	35	19.5
	Three-generation / others	62	34.2
Socio-economic status	Upper middle	13	7.3
	Middle	92	51.2
	Lower	75	41.5

In terms of obstetric profile, 53.7% of women were P2L2 i.e. two deliveries with two live children currently, followed by 34.2% P1L1. A history of abortion was reported by 12.2%, and 2.4% had a history of death of a previous child. The first antenatal visit within 12 weeks of gestation was reported by 87.8% of participants. High-risk pregnancy conditions were identified in several participants, with anemia (28.3%) and previous LSCS (17.1%) being the most common; multiple risk factors were noted in some women (Table 2).

Table 2. Obstetric profile of postnatal mothers (n = 180)

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
Obstetric code	P1L1	62	34.2
	P2L2	97	53.7
	≥P3L3	21	12.1
History of abortion	No	158	87.8
	Yes	22	12.2
History of death of previous child	No	176	97.8
	Yes	4	2.2

First ANC visit within 12 weeks	Yes	158	87.8
	No	22	12.2
High-risk pregnancy identified*	Nil	61	34.1
	Previous LSCS	31	17.1
	Higher order birth (HOB)	21	12.1
	Anaemia	51	28.3
	Others	70	39

*Multiple responses possible

Majority (78.0%) were eligible for benefits under the MRMBS scheme. Among those who received cash assistance, 48.9% reported spending 50–75% of the amount on nutrition. Nutrition kits were received by 78.0% of participants; among them, 77.14% received two kits, while the rest received only one kit. More than half of the mothers (56.1%) were able to recall three or more items included in the MRMBS nutrition kit, while 43.9% recalled fewer than three items. Varied awareness regarding the benefits of individual items in the kit was present among the participants: 60.1% knew the nutritional benefits of dates, 58.5% were aware of the role of health mix in improving nutrition, whereas knowledge regarding albendazole for deworming was comparatively lower (43.0%). With respect to utilisation, only 30.3% of mothers reported complete consumption of all nutrition kit items. Almost half of the mothers (51.9%) consumed the items partially, while 17.8% reported non-utilisation. The most common reason for incomplete utilisation was dislike of taste or smell (31.0%), followed by fear of gastrointestinal side effects (13.8%) and discouragement from family members (6.9%). In contrast, compliance with tablet albendazole was high, 90.3% reporting consumption. (Table 3)

Table 3. Nutritional kit and cash assistance details among postnatal mothers (n=180)

Variable	Category	Frequency (n)	Percentage (%)
MRMBS eligibility	Yes	140	78.0
	No	40	22.0
Proportion of cash assistance spent on nutrition	>75%	31	17.2
	50–75%	88	48.9
	<50%	61	33.9
Nutrition kits received	Yes	140	78.0
	No	40	22.0
Number of nutrition kits received (n=140)	1 kit	32	22.86
	2 kits	108	77.14
Number of items in the kit recalled by the mother			
< 3 items		79	43.9
≥ 3 items		101	56.1
Knowledge regarding benefits of kit components			
Health mix – improves nutrition		105	58.5
Dates – improves haemoglobin / nutrition		108	60.1
Tablet Albendazole – deworming		77	43.0
Utilisation of kit items (excluding Albendazole)			
Fully consumed		55	30.3
Partially consumed		93	51.9
Never consumed		32	17.8
Reasons for non-/partial utilisation*			
Disliked taste or smell		56	31.0
Fear of side effects (e.g. gastritis)		25	13.8
Advised by family members not to consume		12	6.9
Tablet Albendazole consumption			
Yes		163	90.3
No		17	9.7

* Multiple responses.

Institutional delivery was universal among the study participants. Majority of the deliveries occurred in the public health sector (78.1%), with 31.7% conducted at tertiary care hospitals, followed by 29.3% at secondary care facilities and 17.1% at primary care hospitals. Private sector deliveries accounted for 21.9%. The mean pre-pregnancy weight of mothers was 46.75 ± 6.7 kg, which increased to 55.35 ± 7.9 kg in the third trimester, with an average gestational weight gain of 8.6 ± 2.7 kg. Most deliveries were full-term (95.1%), and normal vaginal delivery was the predominant mode (61.0%), while 39.0% underwent caesarean section. All pregnancies resulted in live births. 78.1% of newborns had a normal birth weight (≥2.5 kg), while 21.9% had low birth weight of < 2.5 kg. Only 4.8% of newborns required resuscitation at birth, indicating overall favorable perinatal outcomes (Table 4).

Table 4. Delivery details and maternal & child health outcomes among study participants (n = 180)

Variable	Frequency (n)	Percentage (%)
Place of delivery		
Public sector – Primary care hospital	31	17.1
Public sector – Secondary care hospital	53	29.3
Public sector – Tertiary care hospital	57	31.7
Private sector	39	21.9
Details of weight gain during pregnancy		
Pre-pregnancy weight (kg), Mean (SD)	46.75 (6.7)	—
Last measured weight in III trimester (kg), Mean (SD)	55.35 (7.9)	—
Average weight gain during pregnancy (kg), Mean (SD)	8.6 (2.7)	—
Full-term delivery		
Yes	171	95.1
No (Preterm)	9	4.9
Mode of delivery		
Normal vaginal delivery	110	61.0
Caesarean section	70	39.0
Birth weight		
≥ 2.5 kg	141	78.1
< 2.5 kg	39	21.9
Resuscitation required at birth		
Yes	9	4.8
No	171	95.2

Inferential analysis showed no statistically significant association between utilisation of nutrition kit components and selected socio-demographic or maternal outcome variables. Although this limits causal interpretation, it suggests relatively uniform program reach across population subgroups. The primary objective of this study was descriptive—to document utilisation patterns and identify implementation gaps—which was achieved through detailed assessment of coverage, awareness and consumption practices.

Discussion

The present study assessed the utilisation pattern of antenatal maternal and child health (MCH) kits provided under the Dr. Muthulakshmi Reddy Maternity Benefit Scheme (MRMBS) and examined associated maternal and neonatal outcomes among postnatal mothers in Tamil Nadu. The findings are discussed mainly in comparison to state and national standards like NFHS-5 and in the context of programmes like RMNCAH+N and objectives of MRMBS.

The mean age of the study participants was 23.75 ± 4.23 years, with the majority in the early twenties, reflecting the typical reproductive age pattern observed in India. NFHS-5 [7] reports that nearly half of Indian women give birth before 25 years of age, particularly in rural and semi-urban settings. Early childbearing, although socially normative, continues to pose increased health and nutritional risks, highlighting the importance of timely antenatal care and nutrition support emphasized under the RMNCAH+N framework [9].

The mean age of husbands was higher than that of the women, with most having completed higher secondary education or above. Spousal education and age maturity may have positively influenced maternal healthcare utilization by facilitating informed decision-making and financial support. This may partly explain the high proportion of early ANC registration observed in this study.

Family structure showed a predominance of joint and three-generation families (53.7%). While joint families can provide social support during pregnancy, they may also influence intra-household allocation of food and healthcare decisions. RMNCAH+N emphasizes family-centric approaches and community engagement to address such socio-cultural determinants of maternal health.

Socio-economic assessment revealed that most participants belonged to the middle and lower-middle classes. Although extreme poverty was not observed, these groups remain nutritionally vulnerable. NFHS-5 [8] reports persistent maternal undernutrition and anaemia even among non-poor households, indicating that economic status alone does not ensure adequate maternal nutrition, highlighting the relevance of targeted nutrition interventions such as nutrition kits and cash assistance under MRMBS.

Among those eligible for MRMBS, over one-third spent less than 50% on nutrition reflects competing household priorities and highlights the limitations of cash-based interventions alone. Receipt of nutrition kits by most eligible women further strengthens the programmatic impact, particularly as in-kind support ensures direct nutritional benefit. Nevertheless, variation in the number of kits received suggests gaps in continuity, possibly due to late registration, supply-side constraints, or high-risk obstetric conditions requiring differential follow-up.

Utilisation pattern of MRMBS nutrition kits revealed a gap between scheme coverage and effective consumption. Although most women received nutrition kits, only 30.3% reported complete consumption of all dietary components, while over half of the participants consumed them partially. Awareness regarding the benefits of kit components ranged from 43 % to 60.1%. This might be due to disinterest from the mothers' side to know the details or inadequate counselling during handing over the kits. These findings also suggest that provision of supplements alone is insufficient without sustained and intense behaviour change communication [7].

In contrast, compliance with tablet albendazole was high (90.3%), reflecting better acceptance of medical interventions compared to food-based nutritional supplements. This highlights the need to improve taste, smell or local acceptability and family-level behaviour change for nutritional components of the kit.

Institutional delivery was universal in the study population, with 78.1% of deliveries occurring in public sector facilities, predominantly at secondary and tertiary care hospitals. This is again similar to the NFHS-5 [8] findings for Tamil Nadu, which reports near-universal institutional delivery coverage.

Maternal weight gain during pregnancy was moderate, with a mean gestational weight gain of 8.6 ± 2.7 kg, which is lower than recommended standards. Despite this, 95.1% of deliveries were full-term and 78.1% of newborns had normal birth weight (≥2.5 kg). These relatively favourable outcomes may be attributed to timely antenatal care, institutional delivery and utilisation of nutritional interventions. However, low birth weight in 21.9% of newborns indicates that maternal undernutrition remains a concern, consistent with NFHS-5 observations.

The caesarean section rate was 39.0%, which is considerably higher suggesting an increasing LSCS trend as reported in NFHS-5 data for Tamil Nadu. While access to emergency obstetric care is essential, this finding highlights the need for rationalisation of caesarean deliveries through strengthened supervision.

Further inferential tests and regression analysis on the data showed that there is no significant association between the utilisation of the items in the kit and any other socio-demographic or other study variables. This suggests equitable program reach [6], non-discriminatory service delivery and minimal differential access or utilisation based on individual maternal characteristics. It also implies that programmatic factors such as universal design, standardized kit composition and consistent service delivery through the public health system may have played a more decisive role in determining utilization.

Despite equitable access achieved by RMNCAH+N and MRMBS, the observed suboptimal full consumption of nutrition kit components and persistence of low birth weight in a subset of newborns suggest that behavioural, counselling-related, and acceptability factors, rather than access alone may be limiting the impact of the intervention. Strengthening interpersonal communication by frontline workers [10] and improving palatability and acceptability of kit components may therefore be critical to translating coverage into improved nutritional outcomes. Convergence between ICDS, health services, and maternal benefit schemes

remains crucial to achieve the RMNCAH+N vision of comprehensive, equitable and life-cycle–based maternal care.

The study has some limitations such as its cross-sectional study design could not establish temporal or causal relationships between nutrition interventions and MCH outcomes. Information on expenditure of cash assistance on nutrition was self-reported, making it susceptible to recall bias and social desirability bias. Also, anemia and nutritional status were primarily based on recorded or reported information, without any laboratory confirmation.

Future studies on this area can adopt longitudinal / cohort designs to assess the impact of MRMBS and nutrition interventions on birth outcomes and maternal nutritional status. Qualitative exploration of household decision-making regarding cash utilization can provide deeper insights into barriers to optimal nutrition spending. Detailed exploration of taste preferences and perceived side effects was beyond the scope of this quantitative study; qualitative methods such as focused group discussions or in-depth interviews may provide deeper insights.

Conclusion

The study demonstrates high coverage of antenatal care services, institutional delivery, and maternity benefit schemes among postnatal mothers in Tamil Nadu, reflecting effective implementation of the MCH programmes and MRMBS. However, utilisation of nutritional components of the MCH kits remains suboptimal despite good scheme coverage. Partial consumption, limited awareness of benefits and socio-cultural barriers continue to affect maternal nutrition and may contribute to residual low birth weight. Strengthening nutrition counselling, improving acceptability of supplements and ensuring behavioural change in the community are essential to enhance the impact of maternal nutrition interventions and improve maternal and neonatal outcomes.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

Five-Factor Personality Profiles of Violent and Non-Violent Offenders in a South Indian Prison Setting

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Abstract

Background: Violent crime presents a significant global public health challenge, underscoring the importance of understanding associated personality traits to improve risk assessment, prevention strategies, and rehabilitation efforts for prisoners. **Objective:** To explore personality profiles in the South Indian prison population, aiding in the development of culturally sensitive risk assessment tools to understand personality traits linked with criminal behaviour. **Methods:** An observational cross-sectional study was conducted among 60 convicted prisoners at Central Prison, Cuddalore, Tamil Nadu, from January to March 2025. Data were collected using a semi-structured proforma and the NEO-FFI-3 personality inventory. **Results:** An analysis of 60 inmates revealed a psychological profile of extremely low agreeableness (83.3%) and conscientiousness (91.7%), with high neuroticism. This was pronounced among the 53 violent offenders, yet paradoxically, 92.5% had no prior incarcerations. These offenders typically came from a low socioeconomic background (54.7%) and were unskilled (49.1%). A stark educational contrast existed: 34% of violent offenders held a university degree, an achievement absent in the non-violent group, 57.1% of whom were skilled workers with zero unemployment. **Conclusion:** The study identifies key sociodemographic patterns, offence profiles, and personality traits among convicted prisoners in South India, guiding tailored rehabilitation and minimize recidivism.

Keywords: Prison, Personality, NEO-FFI-3, Criminal behaviour, South India, Convicts

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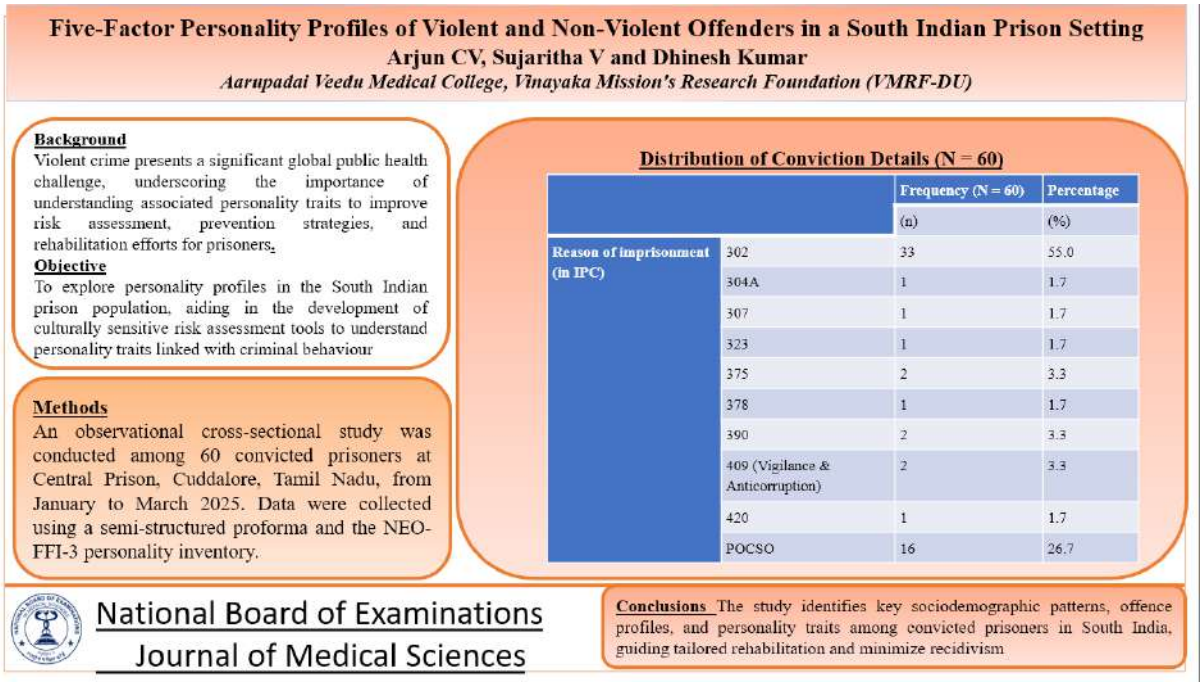
Graphical Abstract



Introduction

Violent crime continues to be a major public health issue globally. Comprehending the personality characteristics linked to violent behaviour might enhance risk evaluation, preventive measures, and rehabilitation initiatives for jailed individuals [1]. Nevertheless, current studies in this domain have predominantly concentrated on Western populations, while research from India indicates a correlation between personality problems and violence in males referred for medico-legal assessment [2]. Nevertheless, these research derive from particular sample populations. Personality traits may exhibit variation between countries, and cultural influences might affect their expression and interpretation [3].

This study examines personality profiles among the general prison population in South India, seeking to offer culturally pertinent insights. It elucidates the disparity in personality traits between violent and non-violent offenders, aiding in the creation of culturally relevant risk assessment instruments for violent behaviour. Many current research emphasize sociodemographic tendencies while overlooking psychological aspects in criminal profiling. The aim is to analyze the sociodemographic attributes, categories of offences, and personality profiles of incarcerated individuals in South India.

Materials and Methods

The observational, cross-sectional study was performed at the Central Prison, Caper Hills, Cuddalore, Tamil Nadu, India, between January and March 2025. The study commenced following the acquisition of authorization from the IRC and the Administrative Officer at the Office of the Additional Director General of Police/Inspector General of Prisons, Whannels Road, Egmore, Chennai, as well as ethical clearance from the Institutional Human Ethics Committee (IHEC) under reference number AV/IHEC/02/2024/008 dated 18/12/2024. Each participant

received a Participant Information Sheet (PIS) in their native language to guarantee understanding. Informed consent in writing was acquired before participation. The study population consisted of male offenders aged 18 to 60 who were convicted in the year prior to the study. Individuals convicted of either violent or non-violent offences qualified for inclusion. Violent crime is on the basis of definition given by National Crime Records Bureau i.e., Violent crime means violation of criminal law that involve the intentional use of violence by one person against another including intentionally threaten, attempt, or inflict physical harm on others such as homicide, assault, robbery, rape, etc. Non-violent crime is on the basis of definition given by National Crime Records Bureau ie Non-violent crimes are called when a crime with no injury or force is used on another person such as bribery, prostitution, theft, cheque bounce, and gambling.' Individuals presently undergoing trial or possessing a recorded history of current or prior psychiatric disorders were excluded.

A comprehensive enumeration sampling method was utilized, enrolling all eligible subjects who satisfied the inclusion and exclusion criteria during the study period.

$$n \geq \frac{(Z1-\alpha/2 + Z1-\beta)^2 (\sigma12+\sigma22/r)}{(\mu1-\mu2)^2}$$

The sample size of 60 (30 in each group) was calculated based on comparison of two mean based on Singh et al in 2022 [4]. The disparity in the number of violent and non-violent participants reflects the actual inmate composition of the prison during the study period, with fewer non-violent offenders available for inclusion. Sociodemographic information, encompassing age, education, marital status, was gathered by a semi-structured proforma. Personality traits were evaluated by the NEO-FFI-3, a validated 60-item psychometric instrument based on the NEO-PI-3. It assesses five fundamental domains: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C). Each question is evaluated using a 5-point Likert scale ranging from 'Strongly Disagree' to 'Strongly Agree'. The NEO-FFI-3 demonstrates robust psychometric qualities, with Cronbach's alpha values between 0.68 and 0.86 and test-retest reliability ranging from 0.75 to 0.83 over a six-month period. The scale was administered in the participants' primary language.

All gathered data were collected, coded, and analyzed utilizing the Statistical Package for the Social Sciences (SPSS) v26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were represented as frequencies and percentages, whereas continuous variables were provided as means accompanied by standard deviations.

Results

This analysis of 60 incarcerated individuals, comprising 7 non-violent and 53 violent offenders, uncovers significant disparities in sociodemographic and criminal histories. Among violent offenders, 9.4% possessed a primary or middle school education, 50.9% had a secondary or upper secondary education, and 34.0% attained a bachelor's or master's degree. In contrast, 57.1% of non-violent offenders have an primary or middle school education, and 28.6% held a bachelor's or master's degree. Concerning occupation, 49.1% of violent offenders were unskilled,

3.8% were skilled, and 1.9% were jobless. Among non-violent criminals, 57.1% were semi-skilled, and none were unemployed. The majority of violent offenders identified as Hindu (96.2%), whilst non-violent offenders were Hindus (71.4%), Christians (14.3%), and Muslims (14.3%). Socioeconomically, 54.7% of violent offenders originated from a low status, while 41.5% came from a middle class. Non-violent offenders exhibited a more even distribution, with 42.9% originating from low status and 57.1% from middle status (Table 1).

The majority of offenders were incarcerated for murder (55%) under IPC 302, with 26.7% imprisoned under the POCSO Act (Table 2). Concerning criminal records, 92.5% of violent offenders and 85.7% of non-violent offenders had no previous incarceration. Criminal history within families was nonexistent in 94.3% of violent offenders and 85.3% of non-violent offenders. Although no non-violent offenders indicated a familial history of psychiatric disorders, 9.4% of violent criminals did (Table 3).

The personality evaluation of 60 incarcerated individuals with the NEO-FFI-3 yielded some significant findings. Neuroticism scores were high, with 58.3% of participants showing elevated levels and 23.3% falling in the extremely high range. Extraversion was predominantly low, with 60% classified as very low and 28.3% as low. Openness to Experience showed a mixed distribution, with most participants scoring in the low to normal range. Agreeableness was markedly low, with 83.3% classified as extremely low and 13.3% as low. Conscientiousness was the lowest-scoring trait, with 91.7% of individuals falling into the extremely low category (Table 4). Of the 60 inmates, 88.3% were sentenced for violent crimes. Neuroticism was elevated or markedly elevated in 83.3% of violent offenders and 71.5% of non-violent offenders. Extremely low levels of agreeableness and conscientiousness were noted in over 80% and 90% of both groups, respectively, whereas extraversion scores were primarily very low, particularly among violent offenders (58.5%) (Table 5).

Table 1. Sociodemographic Characteristics of convicted prisoners (N=60)

		Type of conviction	
		Non-violent N = 7	**Violent N = 53**
		n (%)	**n (%)**
Age (in years), Mean (SD)		50.4 (22.1)	41.3 (11.3)
Age (in years)	≤40	2 (28.6)	27 (50.9)
	40 to 60	3 (42.9)	23 (43.4)
	>60	2 (28.6)	3 (5.7)

Religion	Christian	1 (14.3)	1 (1.9)
	Hindu	5 (71.4)	51 (96.2)
	Islam	1 (14.3)	1 (1.9)
Education	Uneducated	0 (0.0)	3 (5.7)
	Primary/Middle	4 (57.1)	5 (9.4)
	Secondary/Higher secondary	1 (14.3)	27 (50.9)
	Bachelor/Masters	2 (28.6)	18 (34.0)
Occupation	Unemployed	0 (0.0)	1 (1.9)
	Unskilled	2 (28.6)	26 (49.1)
	Semiskilled	4 (57.1)	24 (45.3)
	Skilled	1 (14.3)	2 (3.8)
Socioeconomic status	Low	3 (42.9)	29 (54.7)
	Middle	4 (57.1)	22 (41.5)
	High	0 (0.0)	2 (3.8)
Marital status	No	1 (14.3)	14 (26.4)
	Yes	6 (85.7)	39 (73.6)
SD, Standard deviation			

Table 2. Distribution of Conviction Details (N = 60)

		Frequency (N = 60)	**Percentage**
		(n)	**(%)**
Reason of imprisonment (in IPC)	302	33	55.0
	304A	1	1.7
	307	1	1.7
	323	1	1.7
	375	2	3.3
	378	1	1.7

	390	2	3.3
	409 (Vigilance & Anticorruption)	2	3.3
	420	1	1.7
	POCSO	16	26.7

Table 3. Distribution of Prior Criminal History, and Family Background (N = 60)

		Type of conviction	
		Non-violent N = 7	**Violent N = 53**
		n (%)	**n (%)**
History of previous imprisonment	No	6 (85.7)	49 (92.5)
	Yes	1 (14.3)	4 (7.5)
Criminal history in the family	No	6 (85.7)	50 (94.3)
	Yes	1 (14.3)	3 (5.7)
Family history of psychiatric illness	No	7 (100)	48 (90.6)
	Yes	0 (0.0)	5 (9.4)

Table 4. Personality Trait Distribution Among Convicted Prisoners Based on NEO-FFI-3 Scores (N = 60)

		Frequency (N = 60)	**Percentage**
		(n)	**(%)**
Neuroticism, Mean (SD)		60.6 (6.7)	
Neuroticism	Average	11	18.3
	High	35	58.3
	Very high	14	23.3
Extraversion, Mean (SD)		34.9 (8.6)	
Extraversion	Very low	36	60.0
	Low	17	28.3

	Average	6	10.0
	High	1	1.7
Openness to Experience, Mean (SD)		41.5 (8.7)	
Openness to Experience	Very low	18	30.0
	Low	18	30.0
	Average	20	33.3
	High	4	6.7
Agreeableness, Mean (SD)		28.9 (6.1)	
Agreeableness	Very low	50	83.3
	Low	8	13.3
	Average	2	3.3
Conscientiousness, Mean (SD)		26.4 (3.8)	
Conscientiousness	Very low	55	91.7
	Low	5	8.3
SD, Standard deviation			

Table 5: Personality Trait Distribution Based on NEO-FFI-3 Scores, by non-violent and violent conviction (N = 60)

		Type of conviction	
		Non-violent N = 7	**Violent N = 53**
		n (%)	**n (%)**
Neuroticism, Mean (SD)		62.6 (8.5)	60.3 (6.5)
Neuroticism	Average	2 (28.6)	9 (17.0)
	High	3 (42.9)	32 (60.4)
	Very high	2 (28.6)	12 (22.6)
Extraversion, Mean (SD)		36.3 (10.6)	34.7 (8.4)
Extraversion	Very low	5 (71.4)	31 (58.5)

	Low	0 (0.0)	17 (32.1)
	Average	2 (28.6)	4 (7.5)
	High	0 (0.0)	1 (1.9)
Openness to Experience, Mean (SD)		44.0 (9.6)	41.1 (8.6)
Openness to Experience	Very low	1 (14.3)	17 (32.1)
	Low	2 (28.6)	16 (30.2)
	Average	3 (42.9)	17 (32.1)
	High	1 (14.3)	3 (5.7)
Agreeableness, Mean (SD)		29.4 (6.0)	28.8 (6.2)
Agreeableness	Very low	6 (85.7)	44 (83.0)
	Low	1 (14.3)	7 (13.2)
	Average	0 (0.0)	2 (3.8)
Conscientiousness, Mean (SD)		25.7 (1.9)	26.4 (4.0)
Conscientiousness	Very low	7 (100)	48 (90.6)
	Low	0 (0.0)	5 (9.4)
SD, Standard deviation			

Discussion

This study examines the sociodemographic characteristics, conviction trends, and personality evaluations of incarcerated male offenders in a central jail in South India. The average age of the participants was 42.4 years. This age distribution is noteworthy, as it underscores the cultural and economic ramifications of criminal behaviour within a demographic that represents the principal workforce. A predominant 93.3% of participants in this survey identified as Hindu, mirroring the religious demographic pattern in Tamil Nadu according to the national census [5]. The educational levels of detainees varied, with the majority having completed at least secondary education; significantly, 33.3% possessed bachelor's or master's degrees. This conclusion diverges from previous work that frequently indicated elevated illiteracy rates among convicts, implying a transformation in the educational demographics of criminals, potentially attributable to increased access to education in recent decades [6].

Occupational statistics indicated that 93.4% of participants were employed in unskilled or semiskilled labor, with a minimal number engaged in skilled employment. These findings align with research demonstrating a significant link between poor socioeconomic position and criminal behaviour. The prevalence of inmates from low (53.3%) and middle

(43.3%) socioeconomic backgrounds reinforces this correlation, highlighting that economic marginalization may contribute to criminal behaviour, likely due to restricted access to legitimate income opportunities and social services.[7] Findings regarding marital status indicated that 75% of inmates were married. Although marital status is frequently seen as a protective factor against criminal behaviour due to heightened social duties and emotional support, its influence within this demographic is more intricate. Prior research indicates that although marriage may provide certain protective benefits, these may be eclipsed by several detrimental socioeconomic and psychological variables common among jailed individuals [8]. Concerning the nature of offences, more than half of the detainees (55%) were convicted under IPC Section 302 (murder), while a notable percentage (26.7%) were sentenced under the POCSO Act for sexual offences against children. The prevalence of violent crimes in this group indicates the seriousness of offences resulting in imprisonment in central penitentiaries.

Similarly, research conducted throughout India has indicated that murder is the predominant offence among inmates in high-security facilities [9]. The residual offences, such as robbery, rape, and fraud, occurred with diminished frequency. Significantly, 91.7% of participants indicated no previous incarceration, suggesting that a substantial majority may be first-time offenders. This finding diverges from Western data, which indicates significantly elevated recidivism rates, implying variations in crime patterns or criminal justice procedures [10]. A mere 8.3% had prior incarceration, attributed to a spectrum of violent and non-violent offences, as well as unspecified reasons. Family criminal history was documented in 6.7% of the participants, a figure that, although modest, carries significant consequences. Criminological theories, including the intergenerational transmission of criminal behaviour, propose that persons with criminal relatives may experience heightened exposure to antisocial conduct and diminished deterrents to offending [11]. 8.3% of the group indicated a family history of psychiatric disorder. This self-reported finding is pertinent due to the established correlation between mental health vulnerability and criminal behaviour. The lack of psychiatric history in most cases may indicate under diagnosis or the social stigma surrounding mental disease, especially within the Indian context.

The high scores in Neuroticism indicate a notable incidence of emotional instability, anxiety, and susceptibility to stress. Prior work indicates that elevated neuroticism is a substantial predictor of maladaptive coping strategies and impulsivity, characteristics often associated with criminal behaviour [12].

Heightened neuroticism in incarcerated individuals is correlated with inadequate adaptation to imprisonment and a greater likelihood of violent outbursts. Conversely, Extraversion was significantly diminished among the study participants. Low extraversion, indicative of introversion, social retreat, and decreased assertiveness, may correlate with inadequate social skills and a lessened capacity for pro-social behaviour [13]. The introverted temperament, though not intrinsically maladaptive, may combine with qualities like high neuroticism, heightening vulnerability to interpersonal conflicts and isolation. Openness to

Experience, characterised by intellectual curiosity, imagination, and adaptability, exhibited limited expression, as 60% of inmates scored in the very low or low category. A mean score of 41.5 indicates restricted cognitive flexibility and creativity. Individuals with low openness may demonstrate rigidity in their cognition and exhibit a diminished propensity for reflective decision-making. This may lead to impulsive and risk-seeking behaviour, thus elucidating the vulnerability to criminal activity in a certain group of offenders. The domain of Agreeableness, characterized by qualities such as empathy, trust, and cooperation, was significantly lacking in this community. Low agreeableness is a prominent personality correlate of antisocial and criminal behaviour, particularly in relation to violent offences [14]. Individuals with poor scores in this domain frequently display distrust, manipulativeness, and a disregard for others—characteristics integral to numerous criminogenic profiles, such as psychopathy and antisocial personality disorder. The outcome in Conscientiousness is maybe the most notable. It is correlated with self-discipline, organization, and goal-oriented behaviour, and its deficiency has been significantly associated with externalizing behaviour and criminality [15]. Minimal conscientiousness may present as irresponsibility, impulsivity, and a deficiency in future orientation, obstructing compliance with social standards and legal regulations. The findings collectively depict a profile of inmates characterized by increased emotional reactivity, social disengagement, cognitive rigidity, diminished empathy, and inadequate self-regulation—traits that not only predispose individuals to criminal behaviour but may also hinder rehabilitation attempts. This study underscores the correlation between personality traits and criminal behaviour, revealing that the majority of convicts (88.3%) are guilty of violent offences. Both violent (83%) and non-violent offenders (71.4%) exhibited elevated levels of neuroticism, indicating emotional instability as a shared characteristic. A significant number of offenders exhibited low levels of agreeableness and conscientiousness, suggesting qualities such as violence and irresponsibility that may facilitate criminal behaviour. Among violent criminals, the low extraversion rate (58.5%) indicates a propensity for social isolation. These findings highlight the impact of emotional and social obstacles on criminal behaviour, underlining the necessity for rehabilitation programs that target these personality qualities.

The current study was constrained by its modest sample size and single-centre methodology, which impede generalizability. The utilization of self-reported data about mental and criminal background may have introduced reporting bias. The cross-sectional approach prohibits causal inferences between personality variables and criminal behaviour.

Conclusion

The research highlights significant sociodemographic trends, offence characteristics, and personality attributes among incarcerated male offenders in South India. High neuroticism and low levels of extraversion, agreeableness, and conscientiousness signify psychological vulnerabilities that affect criminal behaviour. These findings can assist prison officials in customizing rehabilitation programs, aid mental health experts in

formulating culturally sensitive interventions for offenders, and empower legislators to devise evidence-based solutions that diminish recidivism and improve community safety.

Conflict of interest

The authors declare no conflicts of interest.

Ethics Approval

The study was approved by the Institutional Human Ethics Committee, Aarupadai Veedu Medical College, Vinayaka Mission's Research Foundation (VMRF-DU), Puducherry, India. The approval number was IHECNo: AV/IHEC/02/2024/008.

Author contribution

All three contributors (ACV, SV, DK) were equally involved in the development and execution of the study. They collaboratively contributed to the conceptualization, design, and definition of intellectual content. Each contributor actively participated in the literature search, data acquisition, statistical analysis, and manuscript preparation, editing, and review. All three contributors also served as guarantors for the integrity of the work.

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ORIGINAL ARTICLE

Clinico Etiological Profile of Patients with Acute Lower Motor Neuron Facial Palsy and Treatment Outcome of Bell's Palsy: A Prospective Study in a Tertiary Care Centre

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Abstract

Introduction: Acute lower motor neuron (LMN) facial palsy is a debilitating condition with diverse etiologies. Bell's palsy stands as the single most common cause, distinguishing it from other secondary aetiologies viz trauma, infection etc. **Methods**: This was a prospective observational study conducted in the Department of otorhinolaryngology at a tertiary care teaching government medical college, Thrissur. A total of fifty patients who presented with symptoms of acute LMN facial palsy were evaluated. Detailed examination of the Clinical features, comorbidities, and the radiological findings were evaluated. Patients who were diagnosed to have Bell's palsy were treated with corticosteroids/antivirals and they were followed up for a period of 12 weeks using validated House–Brackmann (HB) grading system. **Results**: The mean age of the study cohort was 48.0 ± 13.9 years. Bell's palsy was found to be the predominant etiology (62%), which was followed by temporal bone fracture (18%) and then chronic otitis media (10%). Otalgia was observed as a significant associated symptom (46%). Among the diagnosed Bell's palsy patients (n=31), tow thirds (67.7%) achieved good recovery (HB Grade I–II) at the end of 12 weeks. **Conclusion**: A high index of suspicion about secondary causes is necessary in tertiary settings, wherein trauma and otological disease constitutes a considerable portion of facial palsy cases. Early Medical intervention yields a favourable functional outcome among idiopathic cases.

Keywords: Acute facial palsy, Bell's palsy, Lower motor neuron facial nerve paralysis, House–Brackmann grading

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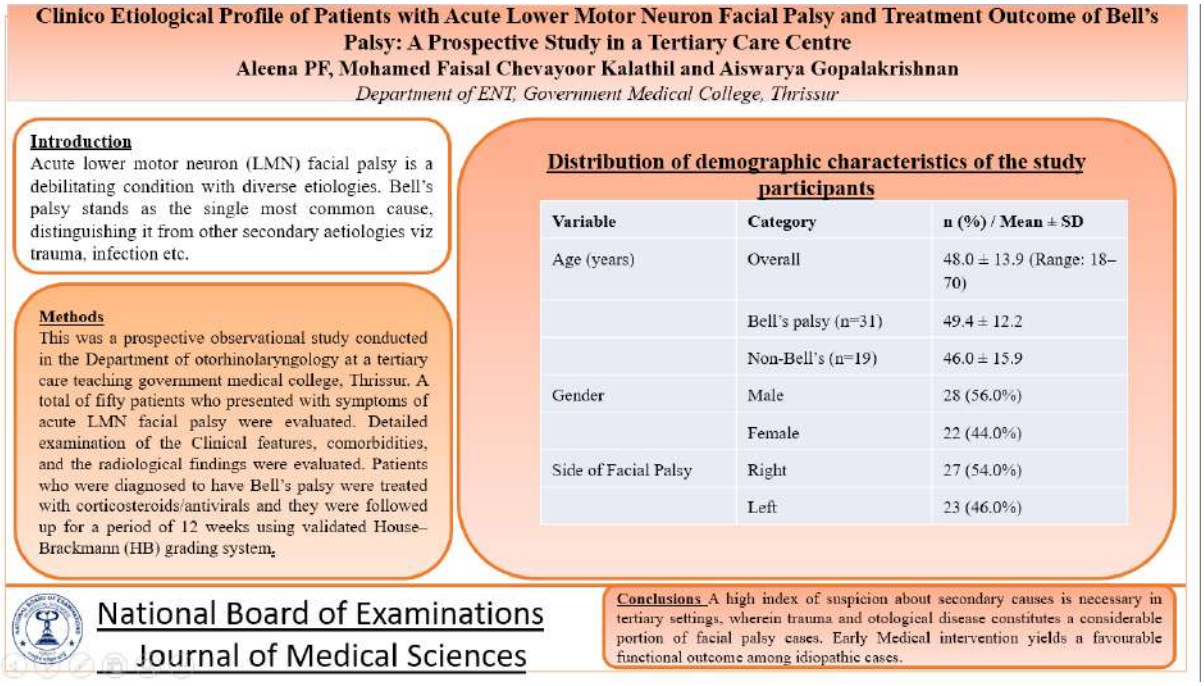
Graphical Abstract



Introduction

Facial nerve is the most commonly paralyzed cranial nerve because its complex anatomical course through the temporal bone. Acute lower motor neuron (LMN) facial palsy is one among the condition that results in significant functional morbidity along with corneal exposure and oral incompetence which caused profound psychological distress [1].

Facial nerve is one of the commonly paralyzed cranial nerves. Bell's palsy (also known as idiopathic facial paralysis) is considered as the most cited cause of LMN facial palsy, which accounts for a total of 60–75% of cases in the global literature [2] However, "Bell's palsy" remains as a diagnosis of exclusion. In a tertiary care setting, a significant proportion of these cases may arise from secondary causes such as the temporal bone trauma, chronic otitis media (COM), herpes zoster oticus (Ramsay Hunt syndrome), and other neoplasms [3] Differentiating these secondary causes is essential, since the management often requires surgical intervention (e.g., facial nerve decompression or mastoidectomy) rather than medical treatment.

The prognosis is also variable. While Bell's palsy has a generally favorable natural history, evidence suggests that outcomes are optimized with the early administration of systemic corticosteroids and antivirals [4,5]. This study aims to delineate the clinicoetiological profile of LMN facial palsy in a South Indian tertiary care center and evaluate the functional recovery of Bell's palsy patients over a 12-week period.

Methods

Study Design and Ethical Considerations

This prospective observational study was conducted in the Department of ENT at Government Medical College, Thrissur. The study protocol was reviewed and approved by the Institutional Ethics

Committee (Reg. No. EC/NEW/INST/2022/KL/0176) on June 21, 2023. The approved protocol number was IEC/GMCTSR/2023/084. The study was conducted in accordance with the submitted research proposal and we followed all the ethical principles as per Helsinki's declaration.

A total of 50 participants presenting with acute onset LMN facial palsy were recruited. Patients of all ages and genders presenting within 2 weeks of symptom onset were included in the study. Patients with congenital facial palsy, upper motor neuron lesions (sparing the forehead), or recurrent facial palsy were excluded from the study.

A structured study proforma was designed with sociodemographic details, clinical details, comorbidities and clinical examination. Clinical details focussed on onset of the symptoms, progression, associated features like otalgia, vesicles and disturbance in taste. Pure tone audiometry (PTA) and Impedance audiometry was done to assess hearing status and stapedial reflex. Schirmer's Test was conducted to evaluate the greater superficial petrosal nerve function. All study participants with history of trauma, discharge from ear or non recovery underwent High-Resolution Computed Tomography (HRCT) of the temporal bone. MRI was done selectively.

Treatment and Outcome Measures

Patients with Bell's palsy were treated with oral prednisolone (1 mg/kg/day tapered over 10 days) and antivirals (acyclovir/valacyclovir) for 7 days. Eye care (lubricating drops and taping) was instituted for all patients with lagophthalmos. Secondary causes were managed surgically or medically as indicated.

Functional recovery was assessed using the House–Brackmann (HB) grading system [6]. Assessment was conducted at presentation, 6 weeks, and 12 weeks.

Results

Demographic Profile

A total of 50 patients presenting with acute lower motor neuron (LMN) facial palsy were included in the study. The cohort consisted of 31 cases (62%) of Bell's palsy and 19 cases (38%) of secondary facial palsy. The mean age of the overall study population was 48.0 ± 13.9 years (range: 18–70 years). Patients with Bell's palsy were slightly older (mean 49.4 ± 12.2 years) compared to those with secondary facial palsy (mean 46.0 ± 15.9 years). There was a male predominance (56%) and a slight predilection for right-sided involvement (54%). Detailed demographic characteristics are summarized in Table 1.

Clinical Characteristics

Motor asymmetry with deviation of the angle of the mouth was present in all patients. Lagophthalmos was present in 88% of the study participants(n=44), followed by otalgia (46%) and dysgeusia (40%). Epiphora was noted in 34% of the study population and 26% had dry eye. Viral Prodrome was noted in 14% of the study population (Table 2).

Table 3 details the Otological and neurological assessment. Otological manifestations were predominantly associated with the secondary etiologies. 26% of the study participants had hearing loss, 18% had tinnitus and 16% had active ear discharge. In 4% of the study participants Vesicular eruptions which is characteristic of the herpes zoster oticus was observed.

Comorbidities and Risk Factors observed are detailed in Table 4. Twenty eight percent of the study population has systemic comorbidities. Diabetes mellitus (14%) and hypertension (12%) were the most common metabolic risk factors. Trauma was a significant specific risk factor, present in 18% of cases (n=9).

Diagnostic Evaluation

Diagnostic findings are summarized in Table 5. Otoscopy was normal in 60% of patients; however, pathological findings such as tympanic membrane perforation, attic erosion, and cholesteatoma were observed exclusively in the secondary facial palsy group. Pure-tone audiometry revealed conductive or mixed hearing loss in 36% of patients. Schirmer's test indicated reduced lacrimation in 32% of the cohort. High-resolution computed tomography (HRCT) of the temporal bone, performed in 21 indicated cases, confirmed temporal bone fractures in nine patients and squamous chronic otitis media in five.

Etiology

Idiopathic (Bell's) palsy was the most common diagnosis (62%). Among secondary causes, temporal bone fractures due to trauma were the leading etiology (18%), followed by chronic otitis media with squamous disease (10%) and herpes zoster oticus (4%). The complete etiological distribution is provided in Table 6.

Treatment and Management

All patients (n=50) received systemic corticosteroids. Antiviral therapy was administered to 60% of patients, primarily those with Bell's palsy and herpes zoster oticus. Physiotherapy was incorporated into the management plan for 38% of patients. Surgical intervention was required in two cases (4%) to manage underlying temporal bone pathology in the non-Bell's group (Table 7).

Recovery of the facial nerve was assessed using the House Brackmann grading system. In the Bells Palsy group, more than 90% had Grade 3 and above during presentation with symptoms to our hospital. After 12 weeks around 32% only had grade 3 and above. The above observation was statistically significant (Table 8).

Exposure keratitis was observed among 6% of the study participants. Hemifacial spasm or synkinesis was not observed in any of the study participants during the study.

Table 1. Distribution of demographic characteristics of the study participants.

Variable	**Category**	**n (%) / Mean ± SD**
Age (years)	Overall	48.0 ± 13.9 (Range: 18–70)
	Bell's palsy (n=31)	49.4 ± 12.2

	Non-Bell's (n=19)	46.0 ± 15.9
Gender	Male	28 (56.0%)
	Female	22 (44.0%)
Side of Facial Palsy	Right	27 (54.0%)
	Left	23 (46.0%)

Table 2. Clinical Features at Presentation (N = 50)

Symptom	**Present (n, %)**	**Absent (n, %)**
Difficulty in eye closure	44 (88%)	6 (12%)
Ear ache (Otalgia)	23 (46%)	27 (54%)
Taste abnormality	20 (40%)	30 (60%)
Watering of eye (Epiphora)	17 (34%)	33 (66%)
Dry eye	13 (26%)	37 (74%)
Paraesthesia	7 (14%)	43 (86%)
Viral prodrome	7 (14%)	43 (86%)
Dizziness	2 (4%)	48 (96%)
Diplopia	1 (2%)	49 (98%)

Table 3. Otological and Neurological Findings (N = 50)

Finding	Yes (n, %)	No (n, %)
Hearing loss	13 (26%)	37 (74%)
Tinnitus	9 (18%)	41 (82%)
Ear discharge (Otorrhea)	8 (16%)	42 (84%)
Vesicles (Herpes Zoster Oticus)	2 (4%)	48 (96%)

Table 4. Comorbidities and Risk Factors (N = 50)

Condition	Frequency (n)	Percentage (%)
None	23	46%
Trauma	9	18%
Diabetes mellitus	7	14%
Hypertension	6	12%
Combined (DM/HTN/CAD)	2	4%
Prior ear surgery	2	4%
Pregnancy / Postpartum	1	2%

Table 5. Diagnostic Evaluation Results

Test	**Finding**	**n (%)**
Otoscopy	Normal	30 (60%)
	Attic erosion / Cholesteatoma	5 (10%)
	Tympanic Membrane (TM) perforation	2 (4%)
	TM retraction	3 (6%)
	Congestion / Acute Otitis Media	2 (4%)
	Other	3 (6%)
Schirmer Test	Normal Lacrimation	34 (68%)
	Reduced Lacrimation	16 (32%)
Pure Tone Audiometry	Normal	32 (64%)
	Conductive / Mixed Hearing Loss	18 (36%)
Tympanometry	Normal (Type A)	10 (20%)
	Type B	13 (26%)
	Type C	4 (8%)

	Other	2 (4%)
Imaging (HRCT/MRI)	Normal HRCT	5 (10%)
	Temporal bone fracture	9 (18%)
	COM – Squamous disease	5 (10%)
	Other abnormalities	2 (4%)
	MRI Normal (All performed cases)	100%

Table 6. Etiological Distribution of LMN Facial Palsy (N = 50)

Etiology	**n**	**%**
Bell's palsy (Idiopathic)	**31**	**62%**
Temporal bone fracture	9	18%
COM – Squamous disease	5	10%
Herpes zoster oticus	2	4%
Other causes*	3	6%

- *Includes Acute Otitis Media, Mucosal COM, and Glomus Tympanicum.*

Table 7. Treatment Modalities Administered (N = 50)

Treatment Modality	**n (%)**	**Note**
Systemic Corticosteroids	50 (100%)	Administered to all patients
Antivirals	30 (60%)	Primarily for Bell's palsy & HZO
Physiotherapy	19 (38%)	Facial nerve exercises
Surgical Management	2 (4%)	Indicated for non-Bell's cases only

Table 8. House–Brackmann (HB) Facial Nerve Grading Over Time (Bell's Palsy Group, n = 31)

HB Grade	**Baseline (n, %)**	**At 6 Weeks (n, %)**	**At 12 Weeks (n, %)**
Grade I (Normal)	1 (3.2%)	2 (6.5%)	8 (25.8%)
Grade II (Mild)	2 (6.7%)	12 (38.7%)	13 (41.9%)
Grade III (Moderate)	8 (26.7%)	7 (22.6%)	9 (29.0%)
Grade IV (Mod. Severe)	15 (50.0%)	10 (32.3%)	1 (3.2%)
Grade V (Severe)	5 (16.7%)	0 (0.0%)	0 (0.0%)

Discussion

The mean age of the study population was 48 years. This aligns with other studies done. Peitersen's "landmark study" on 2,500 patients reported a peak incidence among the 40–49 age group [7]. The slight male predominance in the study (56%) is observed with Asian studies but some western studies shows female preponderance [1]. Fourteen percent of our study population had Diabetes mellitus and another 12% of the study population had Hypertension. In a study done by Riga et al. the author observed that microangiopathy in diabetes predisposes the facial nerve to ischemic injury, thereby leading to more severe presentations [9].

Bell's palsy constituted to be the predominant etiology in our study (62%); however, there was a relatively high proportion of secondary facial nerve palsy (38%) observed in comparison to the population-based studies. Also, among other secondary causes, the temporal bone trauma accounted for about 18% of study population. This increased incidence in our study can be attributed to the tertiary level care status of our institution, and also that our Institute caters to a large proportion of road traffic accidents and also complex trauma cases. Our study findings also reinforces the importance of performing a high-resolution computed tomography (HRCT) of the temporal bone to all patients with a history of head injury, even when the trauma appears trivial, as identification of a fracture line that directly influences management decisions such as conservative therapy versus surgical decompression [3]. Additionally, squamous chronic otitis media (COM) accounted for 10% of study participants which emphasizes that facial nerve palsy can be an initial manifestation of an unsafe ear mainly due to cholesteatoma, necessitating an early surgical intervention in the form of mastoidectomy.

Otalgia, a common presenting symptom, was observed in 46% of participants, and was observed in both the conditions - Bell's palsy and secondary facial palsy. In Bell's palsy, otalgia is considered to result from the involvement of sensory fibres in the facial nerve [8]. However, persistent intolerable ear ache should be subjected for prompt evaluation to rule out other serious etiologies such as Herpes Zoster Oticus and malignant otitis externa, which was observed among few cases in our study [10]. Audiological evaluation among the study participants played a crucial diagnostic role, with 36% of the participants demonstrating hearing loss on pure tone audiometry (Table 5). Our observation highlights the fact that facial nerve palsy is often not truly an "isolated," entity and subclinical cochlear involvement may also be present even when the patients do not subjectively perceive the hearing impairment.

The therapeutic approach towards Bell's palsy has evolved over time, with systemic corticosteroid therapy forming the cornerstone of management. In our present study, two thirds of the participants with Bell's palsy achieved House–Brackmann Grade I or II recovery within 12 weeks of initiation of treatment. This aligns with evidence from a Cochrane review, which indicated that corticosteroid therapy significantly reduces the risk of incomplete recovery [4] Antiviral therapy was administered to 60% of participants, particularly to those who presented with severe facial nerve dysfunction (House–Brackmann Grades IV–V) or a suspected viral prodrome. Although the additional benefit of antivirals when combined with

steroid therapy remains controversial, the current guidelines recommend their use in severe conditions to minimize the risk of synkinesis and extensive nerve degeneration [5,11].

Limitations

Relatively small sample of fifty patients limits the generalisability. Furthermore, the follow-up duration of 12-weeks was inadequate to understand the process of early recovery, to understand the late neurological involvement, the follow period could be continued till one year in future studies [12].

Conclusion

This study confirms that while Bell's palsy is the most common cause of LMN facial palsy, secondary causes—particularly temporal bone trauma and chronic otitis media—constitute a significant proportion of cases in a tertiary care setting. A systematic clinical approach involving otoscopy, audiometry, and selective imaging is indispensable. Standardized treatment with corticosteroids yields favorable functional recovery in the majority of Bell's palsy patients, with nearly 70% achieving near-normal facial function by 12 weeks.

Statements and Declarations

Conflicts of interest

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

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ORIGINAL ARTICLE

Rural Realities: Assessing Menstrual Hygiene Knowledge and Practices among Women of Reproductive Age in Kanchipuram, Tamil Nadu

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Abstract
Background: Menstruation is a key physiological milestone in a woman's life, yet it remains surrounded by taboos and cultural misconceptions, particularly in rural India. Poor menstrual hygiene can lead to various health complications and negatively impact psychological and social well-being. This study aimed to assess the knowledge and practices related to menstrual hygiene among women of reproductive age in a rural area of Kanchipuram District, Tamil Nadu, and to explore the influence of socio-demographic factors on these practices. **Methods:** A community-based analytical cross-sectional study was conducted among 330 women aged 15–49 years in the rural field practice area of Chettinad Hospital and Research Institute. Participants were selected using multistage random sampling. Data were collected through a structured, validated questionnaire. Statistical analysis was performed using SPSS version 21.0. Associations between variables were analyzed using the Chi-square test, with a p-value of <0.05 considered statistically significant. **Results:** While 90.9% of participants demonstrated good knowledge about menstrual hygiene, a substantial proportion still practiced less hygienic methods—23.6% used cloth and 3.1% used locally prepared napkins, compared to 73.3% who used sanitary napkins. Burning was the most common disposal method (54.5%). Lower educational status and socioeconomic class were significantly associated with both the type of absorbent used and disposal practices. Community health workers (47%) and healthcare professionals (41%) were the primary sources of information, while mass media played a minimal role (3%). **Conclusion:** Despite high awareness, gaps in hygienic practices persist. Addressing these requires culturally appropriate, affordable and accessible interventions that consider the socio-economic and educational context of rural women.

Keywords: Menstrual hygiene, Reproductive-age women, Rural health, Socio-demographic factors, Sanitary practices

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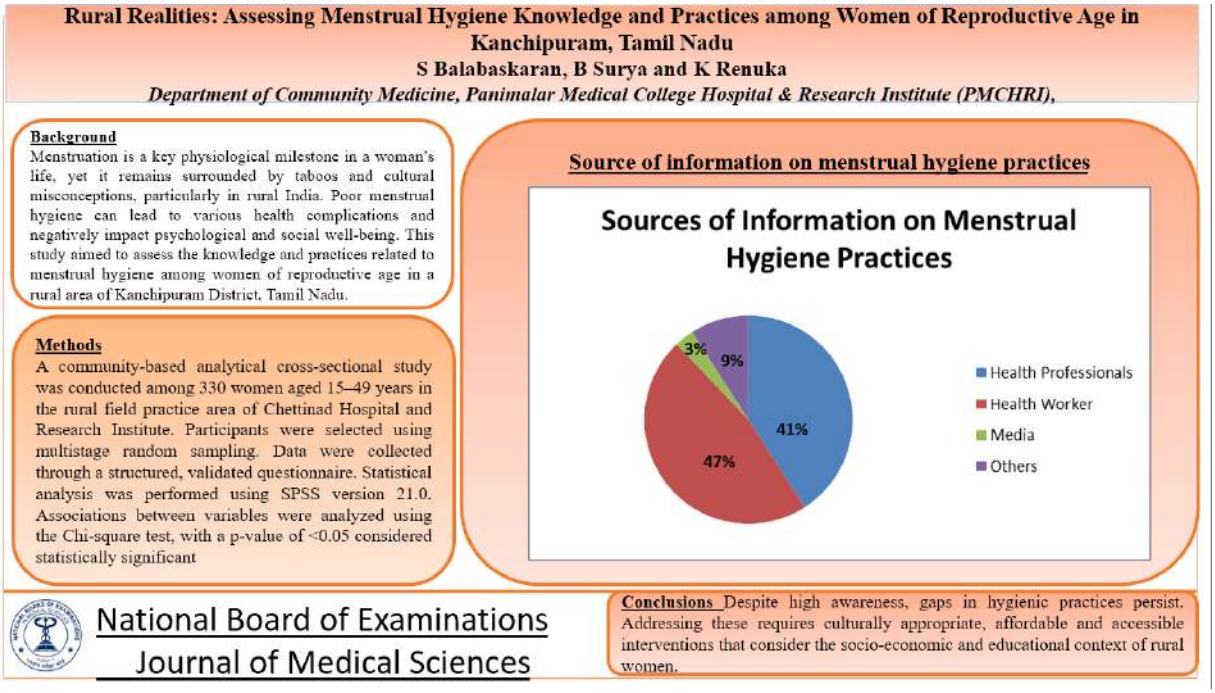
Graphical Abstract



Introduction

One of the key indicators of puberty is menstruation, which is the recurring vaginal bleeding brought on by the loss of the uterine mucosa. Menstruation usually starts one or two years after the emergence of secondary sexual features [1]. For women in the reproductive age group, the menstrual cycle is a crucial indicator of reproductive health and a typical physiological function. Menstruation is frequently associated with a number of customs and myths. In Indian society, menstruation is still seen as filthy or disgusting. A negative perception of this condition has been fostered by the family's isolation of menstruating girls and women and the restrictions placed on them [2]. Menstrual hygiene is basically the idea of keeping the body clean while a woman is having her menstruation. Inadequate menstrual hygiene can cause serious complications like toxic shock syndrome and pelvic inflammatory disease, as well as minor issues like rashes or itching in the perineal area and poor odor [3]. It also has negative psychological and social effects [4]. Social prohibitions prevent women in India, particularly in rural cultures, from knowing about menstrual hygiene practices and from discussing the issue [5].

Menstrual hygiene is becoming increasingly important, as seen in recent times in India. Ministries understand that MHM can enhance the health, nutritional status, and overall well-being of young women while also increasing their school enrollment and retention, which may have long-term positive effects on their social, economic, and health outcomes. The educational, economical, and cultural standing of a household influences menstrual hygiene [6]. Reducing levels of awareness among communities, practitioners, and policymakers are correlated with a cyclical causal relationship between menstrual hygiene neglect and inadequate awareness. This disregard has numerous detrimental repercussions on women's lives as well as

the accomplishment of larger development objectives [7]. There is an urgent need to start policy-making and awareness campaigns because of the alarmingly high rate of menstrual hygiene among rural populations [8]. With this context in mind, the current study was carried out among reproductive-age women residing in rural Kanchipuram District, Tamil Nadu with the aim of learning about their knowledge of menstrual hygiene, as well as their practices related to maintaining it and the impact of socio-demographic factors on these practices.

Aims and Objectives

To assess the knowledge about Menstrual Hygiene and its Practices among women in Reproductive age group in Rural area of Kanchipuram District, Tamil Nadu.

Materials and Methods

A cross-sectional study was conducted in the rural field practice area of Chettinad hospital and research institute for a period of 6 months. The total population of rural field practice area was 39,545 among which 19,065 were females. About 5,062 women were in the reproductive age category, and samples were selected by line listing. Antenatal, postnatal, and postmenopausal women were excluded from the study. After reviewing several articles, the sample size was estimated to 292 based on the formula $n=4pq/l^2$ and to account for nonresponse rate (among 15%) due to non-cooperation and non-availability of the participants, a total of 330 subjects were enrolled. Where n is the sample size, p is the prevalence of the previous study, q is 100 – prevalence, l is the allowable error. Multistage random sampling was followed in sample selection and samples were selected on the basis of population proportion to size. A structured validated questionnaire (cronach alpha – 0.85) on menstrual hygiene referred from other studies (9) was used. The data collected was entered in Microsoft Excel and coding done for further statistical analysis. The statistical analysis was done using the SPSS software version 21.0. Chi-square test was applied for significance. *P* value < 0.05 was considered significant. Institutional Ethical Approval was obtained with the approval number 23/ IHEC/ 3-16.

Results

Out of 330 female participants in the reproductive age group , majority of the study population were in the age group 28-37 years of age with 47.3%(156), 90.6% (299) were married and living with their spouse, 233(70.6%) belongs to the Hindu community, 23.9% (79) were completed their high school level of education and 40.6% (134) were from the lower socio economic class according to B.G.Prasad's classification and 58.8% (194) were living in a nuclear family.Majority of the study participants, i.e., 186 (56.4%) had the history of age of menarche >13 years while 144 participants (43.6%) had menarchial age <=13 years of age.

Table 1 describes the percentage and frequency distribution of the study participants based on the socio-demographic characteristics.

Table 1. Frequency distribution of the study participants based on the socio- demographic characteristics

S.NO	VARIABLES	FREQUENCY (n=330)	PERCENTAGE (%)
1.	**Age group**		
	18-27	75	22.7
	28-37	156	47.3
	38-49	99	30.0
2.	**Marital status**		
	Living with husband	299	90.6
	Widow	18	5.5
	Divorce	13	3.9
3.	**Religion**		
	Hindu	233	70.6
	Christian	66	20.0
	Muslim	31	9.4
4.	**Educational status**		
	Primary	56	16.9
	Middle school	32	9.7
	High school	79	23.9
	Higher secondary	54	16.4
	Graduate	58	17.6
	Illiterate	51	15.5
5.	**Socio economic class**		
	Upper	9	2.7
	Upper middle	49	14.8
	Lower middle	134	40.6
	Upper lower	103	31.3
	Lower	35	10.6
6.	**Type of family**		
	Nuclear	194	58.8
	Joint	81	24.5
	Three generation	55	16.7

Menstrual hygiene practice was assessed from the use of material of napkins and the methods used for the disposal of used napkins. Out of the study participants, as a majority, 73.3 % (242) used sanitary napkins followed by the use of clothes with 23.6 % (78) and the locally prepared napkins with 3.1 % (10) as the least usage.

Table 2 describes the distribution of study participants based on the usage of type of napkin according to the demographic characteristics of the study population. The statistical association was found be significant with the type of napkin used and the educational status of the study population with p- value of 0.043, and the association was also found to be significant with the socio economic status with the p- value of 0.010.

Table 2. Distribution of study participants based on the usage of type of napkin and Association between the demographic characteristics

S.NO	VARIABLES	MENSTRUAL HYGIENE PRACTICES TYPE OF NAPKIN USED			STATISTICAL SIGNIFICANCE
		SANITARY NAPKINS	CLOTHES	LOCALLY PREPARED NAPKINS	Chi-square P-value
1.	**Age group**				
	18-27	58	14	03	6.389
	28-37	120	32	04	0.172
	38-49	64	32	03	
2.	**Religion**				
	Hindu	167	58	08	0.231
	Christian	50	14	02	0.891
	Muslim	25	06	0	
3.	**Educational status**				
	Primary	43	11	02	
	Middle school	25	06	01	
	High school	55	21	03	18.773
	Higher secondary	46	08	0	**0.043**
	Graduate	45	10	03	
	Illiterate	28	22	01	
4.	**Socio economic class**	06	01	02	
	Upper	41	08	0	20.179
	Upper middle	96	37	01	**0.010**
	Lower middle	74	24	05	
	Upper lower	25	08	02	
	Lower				
5.	**Type of family**				
	Nuclear	147	42	05	2.815
	Joint	57	20	04	0.589
	Three generation	38	16	01	
6.	**Marital Status**				
	Living with	217	72	10	1.749
	husband	14	04	0	0.782
	Widow	11	02	0	
	Divorce				
7.	**Age of Menarche**				
	<=13 years	108	35	01	4.748
	>13 years	134	43	09	0.093

Burying, burning, washing and reusing the napkin and wash and throw away are the different methods considered for the disposal of used napkins. Most of the study participants, 180 participants (54.5 %) used the burning technique to dispose the used napkin while 72 participants (21.8%) used burying method, 41 study participants (14.2%) reused the napkins by washing and 31 study subjects 9.3 % wash and throw away the used napkins.

Table 3 describes the distribution of the study population based on the method used for disposal of the used napkins according to the demographic characteristics and the association between the two. Significant statistical association was noted between the educational status and the disposal method with p- value of 0.05. The association between the type of family was also found to be significant with p-value of 0.006.

Table 3. Distribution of the study population based on the method used for disposal and Association between the demographic characteristics

S.NO	VARIABLES	MENSTRUAL HYGIENE PRACTICES DISPOSAL OF USED NAPKINS				STATISTICAL SIGNIFICANCE
		BURRY	BURN	WASH & THROW	WASH & REUSE	Chi-square P-value
1.	**Age group**					
	18-27	16	41	05	13	6.199
	28-37	33	86	20	17	0.401
	38-49	23	53	06	17	
2.	**Religion**					
	Hindu	53	125	22	33	9.026
	Christian	12	43	03	08	0.172
	Muslim	07	12	06	06	
3.	**Educational status**					
	Primary	16	29	01	10	
	Middle school	06	20	05	01	24.379
	High school	16	46	08	09	**0.050**
	Higher secondary	10	32	01	11	
	Graduate	11	33	06	08	
	Illiterate	13	20	10	08	
4.	**Socio economic class**	02	06	01	0	
	Upper	08	31	03	07	7.655
	Upper middle	33	76	14	18	0.811
	Lower middle	24	50	11	18	
	Upper lower	06	23	02	04	
	Lower					

5.	**Type of family**					
	Nuclear	46	114	16	24	18.310
	Joint	27	38	06	10	**0.006**
	Three generation	05	28	09	13	
6.	**Marital Status**					
	Living with husband	65	160	30	44	2.923
	Widow	04	11	01	02	0.818
	Divorce	03	09	0	01	
7.	**Age of Menarche**					
	<=13 years	24	82	13	25	5.158
	>13 years	48	98	18	22	0.161

Knowledge about the menstrual hygiene was assessed using a using a series of 10 Likert scale questions adopted from different studies. The responses of each 10 item questions had a range of scores from 0 to 3 (0 = strongly disagree, 1 = disagree, 2 = agree, 3 = strongly agree). The questions had both positively and negatively worded items regarding menstruation, and negatively worded statements were scored reversely. Individuals with a total sum score of 15 (mean score) and above were considered as having a good knowledge regarding menstrual hygiene. Out of 330 study participants, 300 (90.9%) had a good knowledge about the menstrual hygiene practices.

Table 4 shows the distribution of study participants based on the knowledge about the menstrual hygiene according to the socio demographic characteristics. Chi square test was done to assess the statistical significance and it was noted that there was a statistically significant association between the good knowledge and the age of the study subjects with p-value 0.028, educational status with p-value 0.050, and socio-economic status with p- value 0.016.

Table 4. Distribution of study participants based on the knowledge about the menstrual hygiene and Association between the demographic characteristics

S.NO	**VARIABLES**	**KNOWLEDGE REGARDING MENSTRUAL HYGIENE**		**Chi-square**	**P-value**
		GOOD	**POOR**		
1.	**Age group**				
	18-27	74	03	7.141	**0.028**
	28-37	142	12		
	38-49	84	15		

2.	**Religion**				
	Hindu	211	22	0.231	0.891
	Christian	61	05		
	Muslim	28	03		
3.	**Educational status**				
	Primary	51	05		
	Middle school	30	02	10.679	**0.050**
	High school	69	10		
	Higher secondary	51	03		
	Graduate	57	01		
	Illiterate	42	09		
4.	**Socio economic class**				
	Upper	09	0		
	Upper middle	45	04	12.216	**0.016**
	Lower middle	125	09		
	Upper lower	86	17		
	Lower	35	0		
5.	**Type of family**				
	Nuclear	180	14	2.105	0.349
	Joint	72	09		
	Three generation	48	07		
6.	**Marital Status**				
	Living with husband	272	27	0.897	0.639
	Widow	17	01		
	Divorce	11	02		
7.	**Age of Menarche**				
	<=13 years	132	12	0.177	0.674
	>13 years	168	18		

Figure 1 shows the source of information on menstrual hygiene practices among the study participants. Majority of the study subjects conveyed that their source of information about the menstrual hygiene practices is mainly through the community health worker with 47%, followed by health care professionals with 41 %, other sources like family members, friend and relatives with 9% and the least 3 % of the participants conveyed that their knowledge about the menstrual hygiene was through the mass media communications.

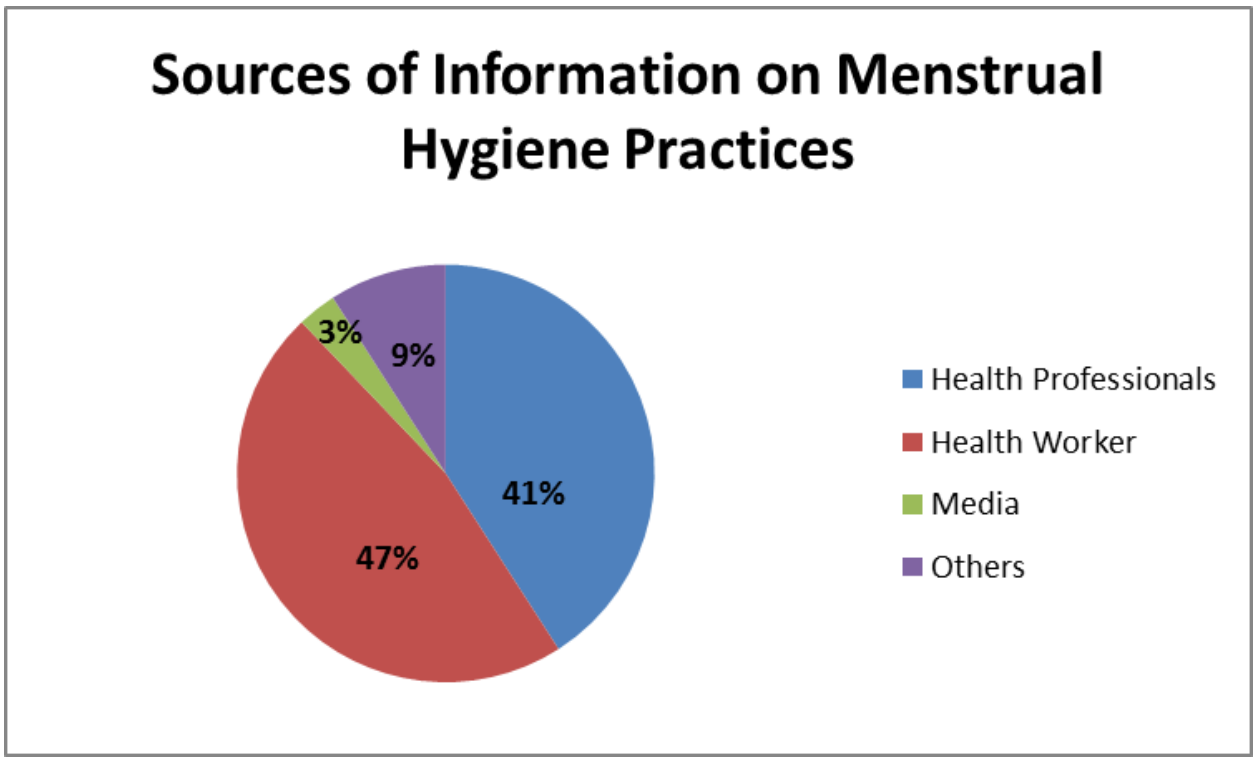


Figure 1. Source of information on menstrual hygiene practices among the study participants

Discussion

This community-based cross-sectional study in rural Kanchipuram District, Tamil Nadu, provides valuable insights into the knowledge and practices related to menstrual hygiene among women of reproductive age. The finding of this study reported knowledge (90.9%) which is contrast with the observations from the study focusing on adolescent girls in other South Asian contexts. The study conducted by Sapkota et al.'s study (2013) in rural Nepal highlighted significant gaps in knowledge among school-going adolescents. Similarly, Dhingra et al.'s (2009) study among tribal adolescent girls in India revealed limited awareness regarding menstruation.

However, the study conducted by Dasgupta and Sarkar's (2008) revealed high self-reported knowledge, the persistence of less hygienic practices such as the use of cloth (23.6%) and locally prepared napkins (3.1%) raised concerns about the hygiene practices among adolescent girls in India. The significant association found between the type of absorbent used and both educational and socioeconomic status aligns with the moderate knowledge that socioeconomic factors play a major role in health behaviors according to the study conducted by Kasper et al., 2012, for the general influence of socioeconomic status on health. Women with higher education and better socioeconomic standing are more likely to adopt sanitary napkins, indicating that access to information and resources are critical determinants of menstrual hygiene practices. This is further supported by the significant association between disposal methods and education and family type. The prevalence of burning as a disposal method (54.5%)

raises environmental and potential health concerns and underscores the need for education on safe and sustainable disposal practices.

The study's finding that community health workers and healthcare professionals are the primary sources of information suggests the effectiveness of these category workers in disseminating good knowledge. This supports with the importance of school-based educational interventions highlighted by Haque et al.'s (2014) study in Bangladesh, although the current study focused on adult women in the community rather than schoolgirls. The limited role of mass media (3%) as a source of information suggests that targeted community-based approaches might be more effective in this rural setting.

Balamurugan et al.'s (2014) community-based study in rural Tamil Nadu, revealed a similar finding like our study with high degree of self-reported knowledge (90.9%), mostly from healthcare professionals and community health workers. Despite this awareness, a significant minority continued to use cloth (23.6%) or locally made napkins (3.1%), while 73.3% of people used sanitary napkins

Summary

In this study, 330 women of reproductive age in Tamil Nadu's rural Kanchipuram District had their knowledge and habits on menstrual hygiene evaluated. The results showed a high degree of self-reported knowledge (90.9%), mostly from healthcare professionals and community health workers. Despite this awareness, a significant minority continued to use cloth (23.6%) or locally made napkins (3.1%), while 73.3% of people used sanitary napkins. The most popular form of disposal (54.5%) was burning. Women who are better educated and have greater socioeconomic position are more likely to use sanitary napkins, according to the study, which also revealed strong correlations between the type of absorbent used and these factors. Likewise, there was a substantial correlation between disposal techniques and family type and educational position. Additionally, age, education, and socioeconomic level were all substantially correlated with good knowledge. In order to improve menstrual hygiene practices in this rural community, the study draws attention to a possible knowledge gap and emphasizes the necessity of interventions that address accessibility, affordability, and cultural issues. It also highlights how important healthcare professionals and community health workers are to the spread of knowledge.

Conclusion

In conclusion, women of reproductive age who participated in this study in the rural Kanchipuram District self-reported having a good degree of knowledge on menstrual hygiene. However, as seen by the persistence of less hygienic options and the widespread use of burning as a disposal method, this knowledge did not always translate into good behaviors. Menstrual absorbent type and disposal practices were strongly influenced by socio-demographic characteristics, especially socioeconomic position and education. The need of enhancing these channels for efficient health education is highlighted by the important role that healthcare professionals and community health workers play as primary information

sources. Multifaceted interventions are essential to bridge the knowledge-practice gap and improve menstrual health in this rural area. These should include culturally sensitive education by ASHA workers and healthcare professionals, affordable/ subsidized hygienic absorbents, promotion of safe disposal methods (e.g., incinerators or burial pits), and integration into existing community health programs to address socio-economic and cultural barriers effectively.

Limitations of the study

The study was carried out in a particular rural region of Tamil Nadu's Kanchipuram District. Because cultural norms, resource availability, and knowledge levels can differ greatly, the results may not apply to other rural areas in Tamil Nadu or other Indian states.

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

Ethical approval was obtained with the approval number 23/ IHEC/ 3-16

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ORIGINAL ARTICLE

Comparative Study of Dexmedetomidine vs Fentanyl as Adjuvant to Intrathecal Bupivacaine in Infraumblical Surgeries

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Abstract

Background: Spinal anaesthesia is widely used for infraumbilical and gynaecological surgeries, further the addition of intrathecal adjuvants improve the quality, duration of anaesthesia and analgesia. This prospective randomised controlled study was conducted to compare the efficacy and adverse effects of intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine. **Aim:** To compare the efficacy and adverse effects of intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine in patients undergoing infraumbilical surgeries. **Materials and Methods:** This prospective randomized controlled study included 60 patients scheduled for elective infraumbilical surgeries under spinal anaesthesia. Patients were randomly allocated into two groups. Group BD received 0.5% hyperbaric bupivacaine (13 mg) with dexmedetomidine 5 µg, while Group BF received 0.5% hyperbaric bupivacaine (13 mg) with fentanyl 25 µg intrathecally. The onset and duration of sensory and motor block, duration of postoperative analgesia, haemodynamic parameters, and adverse effects were evaluated. **Results:** The onset of sensory and motor block was comparable between the two groups. The duration of sensory block, motor block, and postoperative analgesia was significantly prolonged in the dexmedetomidine group compared to the fentanyl group ($p < 0.05$). Haemodynamic parameters remained stable in both groups. A higher incidence of hypotension and bradycardia was observed in the dexmedetomidine group, whereas pruritus and nausea were more common in the fentanyl group. No serious adverse effects were noted. **Conclusion:** Intrathecal dexmedetomidine is a safe and effective adjuvant to hyperbaric bupivacaine and provides significantly prolonged anaesthesia and postoperative analgesia compared to fentanyl. It may serve as a suitable alternative to intrathecal opioids for infraumbilical surgeries.

Keywords: Spinal anaesthesia, Infraumbilical surgeries, Intrathecal adjuvant, Dexmedetomidine, Fentanyl, Hyperbaric bupivacaine

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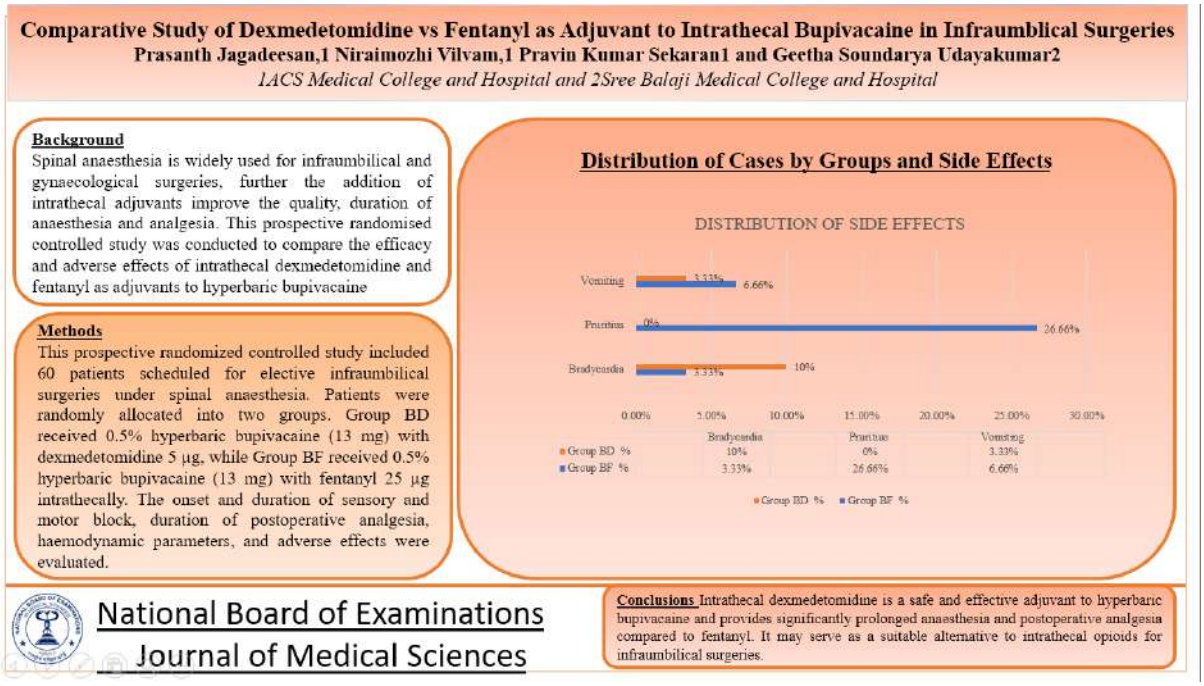
Graphical Abstract



Introduction

Spinal anaesthesia is widely employed for lower abdominal and lower extremity surgical procedures owing to its well-established advantages over general anaesthesia, including rapid onset, reliable sensory and motor blockade, reduced perioperative morbidity, and enhanced postoperative recovery. Commonly used local anaesthetic agents for spinal anaesthesia include lignocaine, bupivacaine, and ropivacaine [1]. To improve the quality and duration of neuraxial blockade, various adjuvants such as opioids and alpha-2 adrenergic agonists are frequently combined with local anaesthetics [2]. The rationale for using adjuvants is to achieve synergistic analgesic effects, thereby allowing dose reduction of individual agents while maintaining analgesic efficacy and minimise the adverse effects [3]. Surgical procedures involving the uterus and other pelvic organs performed under spinal or epidural anaesthesia are often associated with visceral pain, intraoperative discomfort, nausea, and vomiting [4]. Previous studies have demonstrated that the addition of intrathecal fentanyl to bupivacaine prolongs the duration of analgesia and reduces the incidence of intraoperative nausea and vomiting [5]. Dexmedetomidine, a highly selective alpha-2 adrenergic receptor agonist, is approved for intravenous use as a sedative and co-analgesic agent and has recently gained interest for intrathecal administration [6]. While most clinical studies on intrathecal alpha-2 adrenergic agonists have focused on clonidine, dexmedetomidine, due to its greater receptor selectivity, may provide enhanced analgesia with a favourable side-effect profile [7]. The present study aimed to evaluate and compare the efficacy and side-effect profile of intrathecal dexmedetomidine (5 µg) and intrathecal fentanyl (25 µg) when used as adjuvants to

bupivacaine in spinal anaesthesia for lower abdominal and gynaecological procedures.

Materials and Methods

This prospective, randomised controlled study was conducted following approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants. A total of sixty patients classified as American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective infraumbilical surgery under subarachnoid block, were included in the study. The participants were randomly allocated into two equal groups of 30 patients each. Group BD received intrathecal 0.5% hyperbaric bupivacaine (2.8 ml) combined with dexmedetomidine 5 µg (0.5 ml), while Group BF received intrathecal 0.5% hyperbaric bupivacaine (2.8 ml) with fentanyl 25 µg (0.5 ml). The total intrathecal volume was standardised to 3.3 ml in both groups.

Inclusion Criteria

Patients aged 18 years and above scheduled for elective infraumbilical surgery under spinal anaesthesia

Patients belonging to American Society of Anesthesiologists (ASA) physical status I and II

Exclusion Criteria

History of hypersensitivity or allergy to any of the study drugs

Presence of renal or hepatic dysfunction
Coagulation disorders or bleeding diathesis

Statistical analysis

Study variables were summarised using descriptive statistical methods and displayed in two-way tables. Categorical data were presented as counts and percentages, whereas continuous data were expressed using measures of central tendency (mean and median) along with measures of variability (standard deviation and range). Associations between categorical variables were assessed using the chi-square test. For comparison of two independent groups, non-parametric tests such as the Mann–Whitney U test (Wilcoxon rank-sum test) were employed, and the Kruskal–Wallis H test was used for comparisons involving more than two groups where applicable. One-way analysis of variance (ANOVA) was applied for comparisons of continuous variables. Statistical significance was defined as a p-value less than 0.05.

Result

This prospective study included sixty (60) patients. The patients were randomly allocated into two groups. Group BF received 2.8 mL (13 mg) of 0.5% hyperbaric bupivacaine combined with 25 µg (0.5 mL) of fentanyl. Group BD received 2.8 mL (13 mg) of 0.5% hyperbaric bupivacaine combined with 5 µg (0.5 mL) of preservative-free dexmedetomidine. In both groups, the total intrathecal drug volume administered was 3.3 mL.

Onset of Sensory Block T10 Level

The onset time to achieve a sensory block up to the T10 dermatome after subarachnoid block, evaluated by loss of cold sensation using an alcohol swab, was 2.83 ± 0.53 minutes in Group BF and 2.67 ± 0.47 minutes in Group BD. The difference between the two groups was not statistically significant ($p = 0.207$) (Table 1).

Table 1. Distribution of Mean Onset of Sensory Block [T10] in Minutes by Groups

Parameters	Group BF	Group BD	'P' Value
No. of Cases	30	30	0.207
Mean	2.83	2.67	
S.D	0.531	0.479	

To reach sensory block T6 level

The time required to attain the maximum sensory block at the T6 dermatome after subarachnoid block, assessed by loss of cold sensation using an alcohol swab, was 4.80 ± 0.76 minutes in Group BF and 4.77 ± 0.68 minutes in Group BD. No statistically significant difference was observed between the two groups (p = 0.207) (Table 2).

Table 2. Distribution of Mean Sensory Block [T6] in Minutes by Groups

Parameters	Group BF	Group BD	'P' Value
No. of Cases	30	30	0.207
Mean	4.80	4.77	
S.D	0.761	0.679	

Time to reach Bromage Grade 3 motor block

Onset of motor block following subarachnoid block was evaluated using the Modified Bromage Scale. The mean time to achieve motor block was 6.63 ± 0.69 minutes in Group BF and 6.53 ± 0.62 minutes in Group BD, with no statistically significant difference between the groups (p = 0.623) (Figure 1)

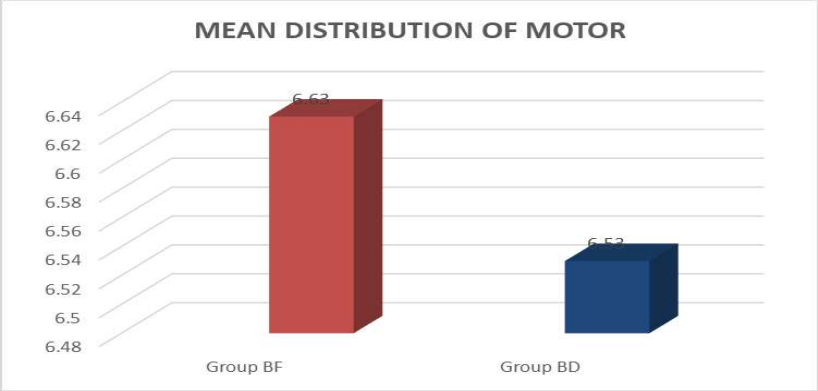


Figure 1. Distribution of Mean Time to Reach Motor Block [Bromage Grade 3] Minutes By Groups

Duration of sensory block

The mean time for regression of sensory block to the S1 dermatome was 358.97 ± 46.73 minutes in Group BF and 459.03 ± 56.9 minutes in Group BD. The difference in sensory block duration between the two groups was statistically significant ($p < 0.001$) (Figure 2).

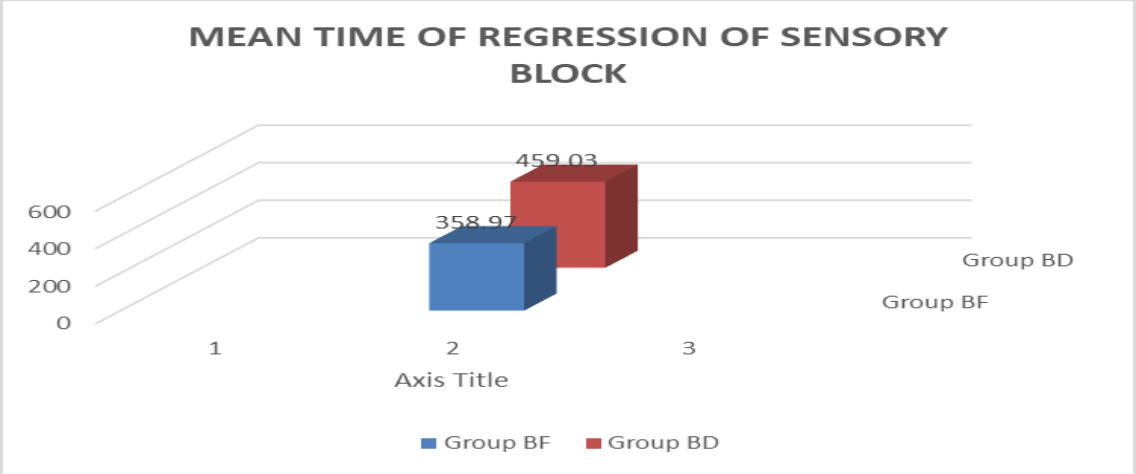


Figure 2. Distribution of Mean Time for Regression of Sensory Block [S1] In Minutes by Groups

Duration of motor block

The mean time for complete regression of motor block to a Modified Bromage score of 0 was 231.83 ± 39.96 minutes in Group BF and 288.63 ± 31.13 minutes in Group BD. This difference in motor block duration between the groups was statistically significant ($p < 0.001$) (Figure 3)

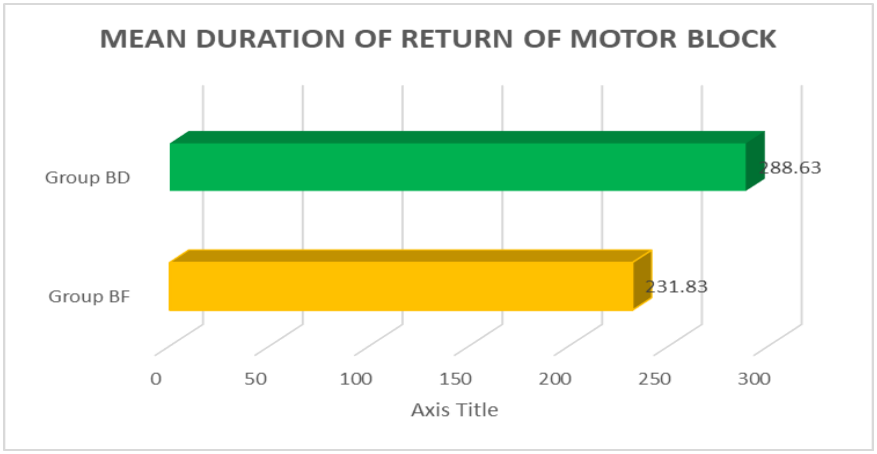


Figure 3. Distribution of Mean Time for Regression of Motor Blockade [Bromage 0] In Minutes by Groups

Duration of time for Rescue analgesia

The mean time to first request for analgesia (defined as the point at which the patient requested pain relief) was 212.67 ± 38.97 minutes in Group BF and 276.73 ± 49.32 minutes in Group BD. The difference between the groups was statistically significant ($p < 0.001$) (Figure 4).

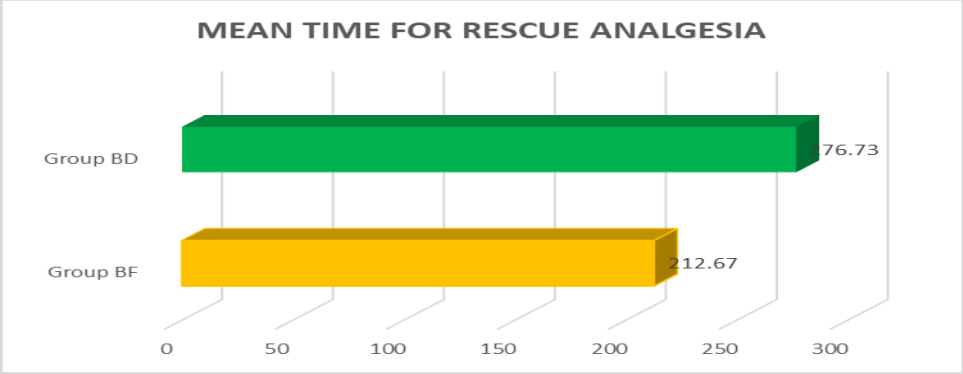


Figure 4. Distribution of Mean Time for Rescue Analgesia in Minutes by Groups

Maximum grade of motor block

Both groups achieved a maximum motor block of Grade 3. There was no statistically significant difference between the groups with respect to the highest grade of motor block achieved (p = 1.000) (Table 3).

Table 3. Maximum Grade of Motor Block by Groups

Parameters	Group BF		Group BD		'P' Value
	No	%	No	%	
No. of Cases	30		30		1
Grade 3	30	100	30	100	
Grade 2	0	0	0	0	

Maximum level of Sensory Block [T4-T6]

The maximum level of sensory block ranged from T4 to T6 in both groups, with a median sensory level of T6. In Group BF, 13.3% of patients achieved a maximum block at T4 and 86.6% at T6, whereas in Group BD, 10% reached T4 and 90% attained T6. The distribution of maximum sensory block levels between the two groups was not statistically significant (p = 1.000) (Table 4)

Table 4. Maximum Level of Sensory Block By [T4 - T6] Groups

Parameters	**Group BF**		**Group BD**		**'P' Value**
	No	%	No	%	
No. of Cases	30		30		0.086
T4	4	13.3	3	10	
T6	26	86.6	27	90	

Quality of surgical Anaesthesia

Quality of surgical anaesthesia was excellent in all patients. There was no statistically significant difference among two groups p < 1 (Table 5).

Table 5. Distribution of Cases by Groups and Quality of Surgical Anaesthesia

Parameters	**Group BF**		**Group BD**		**'P' Value**
	No	%	No	%	
No. of Cases	30		30		1
Excellet	30	100	30	100	
Good	0	0	0	0	

Bradycardia occurred in 3.33% of Group BF and 10% of Group BD, with no statistically significant difference in either group (p < 0.30). The incidence of pruritus in Group BF was 26.66%, while there were no cases of pruritus in Group BD (p 0.002). The incidence of vomiting was 6.66% in Group BF and 3.33% in Group BD, which was statistically insignificant (p 0.55). (Figure 5).

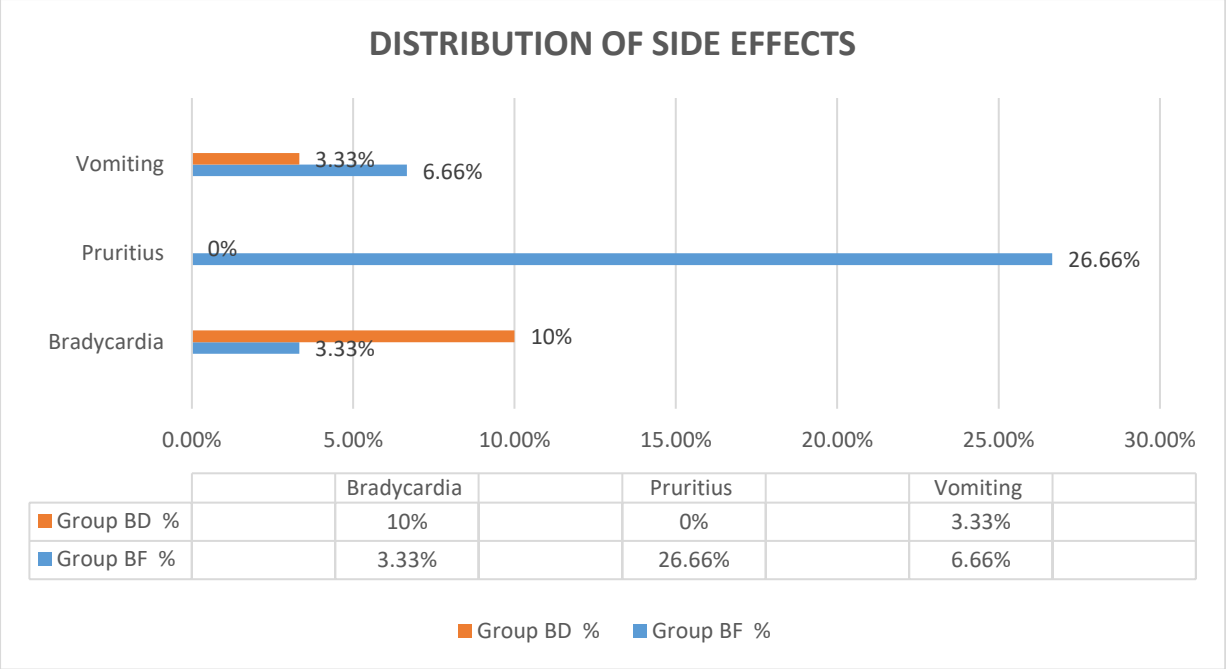


Figure 5: Distribution of Cases by Groups and Side Effects

Discussion

Spinal anesthesia is a widely used technique for infra-umbilical procedures. There is growing interest in the use of adjuvant analgesics to enhance the effects of spinal local anesthetics [8]. The purpose of this study is to compare the onset and duration of sensory and motor blockade, quality of intraoperative analgesia, and incidence of adverse effects between fentanyl and dexmedetomidine when used as intrathecal adjuvants to hyperbaric 0.5% bupivacaine for subarachnoid block in patients undergoing infra-umbilical surgeries. In the present study, 60 patients who underwent infra-umbilical surgery received either 5 µg of dexmedetomidine or 25 µg of fentanyl, in combination with 13 mg (2.8 ml) of 0.5% hyperbaric bupivacaine. Patients received 25 µg of fentanyl (0.5 ml) combined with 2.8 ml of hyperbaric bupivacaine constituted the control group, while those receiving 5 µg of dexmedetomidine (0.5 ml) with 2.8 ml of hyperbaric bupivacaine formed the intervention group. The mean time to onset of sensory block at the T10 level was 2.83 ± 0.53 minutes in the BF group and 2.67 ± 0.48 minutes in the BD group. In the present study, the addition of 5 µg dexmedetomidine to hyperbaric bupivacaine did not significantly shorten the onset of sensory block compared to 25 µg fentanyl. The onset of sensory block at the T10 level was comparable between the two groups. These findings are consistent with those of Subhi M. Al-Ghanem et al. who compared the effects of 5 µg dexmedetomidine versus 25 µg fentanyl added to 10 mg intrathecal plain bupivacaine and found no statistically significant difference between the groups in terms of the duration of sensory and motor block [9]. Similarly, Ibrahim F. A. Khalifa et al. reported no significant difference in the onset of sensory block at T10, with Group BD = 5.5 ± 3.7 minutes and Group BF = 6.2 ± 1.3 minutes ($p = 0.69$) in a comparative study evaluating 5 µg dexmedetomidine versus 5 µg sufentanil

added to 10 mg hyperbaric bupivacaine [10].

In the present study both the BD and BF groups, the median upper limit of sensory block was T6. There was no statistically significant difference in the maximal sensory block between the two groups. The addition of 5 µg dexmedetomidine to hyperbaric bupivacaine did not alter the onset of sensory block compared to 25 µg fentanyl. These findings are in agreement with Kanazi et al., who reported no significant difference in the maximal sensory block when 12 mg of 0.5% bupivacaine was administered alone or in combination with 3 µg dexmedetomidine or 30 µg clonidine ($p = 0.3$) [11]. In contrast, Mahmoud M. Al-Mustafa et al. demonstrated that higher doses of dexmedetomidine (5 µg and 10 µg) combined with 12.5 mg intrathecal bupivacaine increased the level of sensory block in a dose-dependent manner [12]. In the present study the mean time to achieve T6 sensory block was 4.80 ± 0.76 minutes in Group BF and 4.77 ± 0.68 minutes in Group BD, with no significant difference. This aligns with Subhi M. Al-Ghanem et al., who reported comparable times to peak sensory level with 5 µg dexmedetomidine or 25 µg fentanyl added to 10 mg intrathecal bupivacaine (19.34 ± 2.87 vs. 18.39 ± 2.46 min, $p = 0.12$).[9] The onset of motor block was also similar between groups. The time to reach Modified Bromage Score 3 was 6.53 ± 0.68 min in BD and 6.63 ± 0.56 minutes in BF. Ibrahim F. A. Khalifa et al similarly reported no significant difference in motor block onset between 5 µg dexmedetomidine and 5 µg sufentanil with 10 mg intrathecal bupivacaine. The duration of sensory block was significantly prolonged with dexmedetomidine: 459.03 ± 56.93 minutes in BD versus 358.97 ± 46.74 minutes in BF [10].

The mean duration of motor block was significantly longer in Group BD (288.63 ± 31.13 minutes) compared with Group BF (231.83 ± 39.96 minutes). The addition of 5 µg dexmedetomidine to 0.5% hyperbaric bupivacaine markedly prolonged motor blockade. These findings are consistent with Subhi M. Al-Ghanem et al., who demonstrated prolonged motor block with intrathecal dexmedetomidine compared to fentanyl when added to hyperbaric bupivacaine [9]. Kanazi et al. similarly reported prolonged motor block with dexmedetomidine or clonidine combined with bupivacaine, attributed to α_2-agonist action on spinal motor neurons [11]. Dexmedetomidine, an α_2-adrenergic agonist, has been shown to prolong both sensory and motor blockade and to provide extended postoperative analgesia.

Dexmedetomidine, when administered intrathecally as an adjuvant to hyperbaric bupivacaine, produced a significant prolongation of both sensory and motor blockade compared to fentanyl. Patients receiving dexmedetomidine demonstrated a markedly longer duration of sensory block as well as delayed regression of motor block, indicating superior neuraxial blockade. In addition, the duration of postoperative analgesia, as assessed by the time to first request for rescue (demand) analgesia, was significantly prolonged in the dexmedetomidine group. This reflects enhanced and sustained analgesic efficacy of dexmedetomidine when used intrathecally. However, no statistically significant difference was observed in the onset time of either sensory or motor blockade between the fentanyl and dexmedetomidine groups, suggested that

both adjuvants have a comparable effect on the initiation of spinal anaesthesia. With regard to adverse effects, patients receiving intrathecal dexmedetomidine experienced side effects primarily in the form of hypotension, bradycardia, and occasional vomiting. These effects were manageable and consistent with the known pharmacological profile of dexmedetomidine. Conversely, the incidence of pruritus was significantly higher in patients who received intrathecal fentanyl, which is a well-recognized opioid-related side effect, and was comparatively uncommon in the dexmedetomidine group.

Conclusion

Dexmedetomidine given intrathecally augments the subarachnoid block than intrathecal fentanyl because dexmedetomidine provides sustained sensory & motor block. This form of block is clearly more appropriate for lower abdomen and lower extremity procedures. The increased duration of motor block caused by Dexmedetomidine enhanced spinal block features may not be preferred for short duration surgeries or ambulatory surgery.

Ethical clearance

The Institutional Human Ethics Committee has reviewed our proposal on 23.02.2020, and it was approved (SBMC/IHEC/2020/1455)

Statements and Declarations

Conflicts of interest

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

Funding

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ORIGINAL ARTICLE

Diagnostic Accuracy of Extended Focused Assessment with Sonography in Trauma (eFAST) for Detection of Blunt Chest Injuries: A Prospective Study Comparing EFAST with CT Chest

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Abstract

Background: Blunt chest trauma is a major cause of illness and death in trauma patients. Early detection of injuries such as pneumothorax and haemothorax is important for timely treatment. Computed tomography (CT) of the chest is the diagnostic gold standard. However, CT may not be easily available in emergency settings due to time and logistical constraints. Extended focused assessment with sonography in trauma (eFAST) provides a rapid bedside imaging option for early diagnosis. **Objectives:** To evaluate the diagnostic accuracy of eFAST in detecting blunt chest injuries in trauma patients, using CT chest as the reference standard. **Methods:** This prospective diagnostic accuracy study was conducted in the Department of Emergency Medicine at a tertiary care teaching hospital in Tamil Nadu over one year. Ninety-nine hemodynamically stable patients with suspected blunt chest trauma underwent bedside eFAST followed by CT chest. The diagnostic performance of eFAST was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV). **Results:** Among the 99 patients studied, eFAST showed high specificity (100%) for all thoracic injuries. The sensitivity of eFAST was 75.0% for pneumothorax, 76.9% for haemothorax, 78.9% for rib fractures, and 50.0% for lung contusions. For detection of any chest injury, eFAST showed a sensitivity of 78.1% and a specificity of 100%. The PPV was 100% and the NPV was 90.5%. **Conclusion:** eFAST is a highly specific and reliable bedside tool for the early detection of blunt chest injuries, especially pneumothorax, haemothorax, and rib fractures. Although CT chest remains the definitive imaging modality, eFAST is an effective screening and triage tool in emergency and resource-limited settings.

Keywords: Blunt chest trauma, eFAST, Point-of-care ultrasound, Pneumothorax, Haemothorax, Computed tomography

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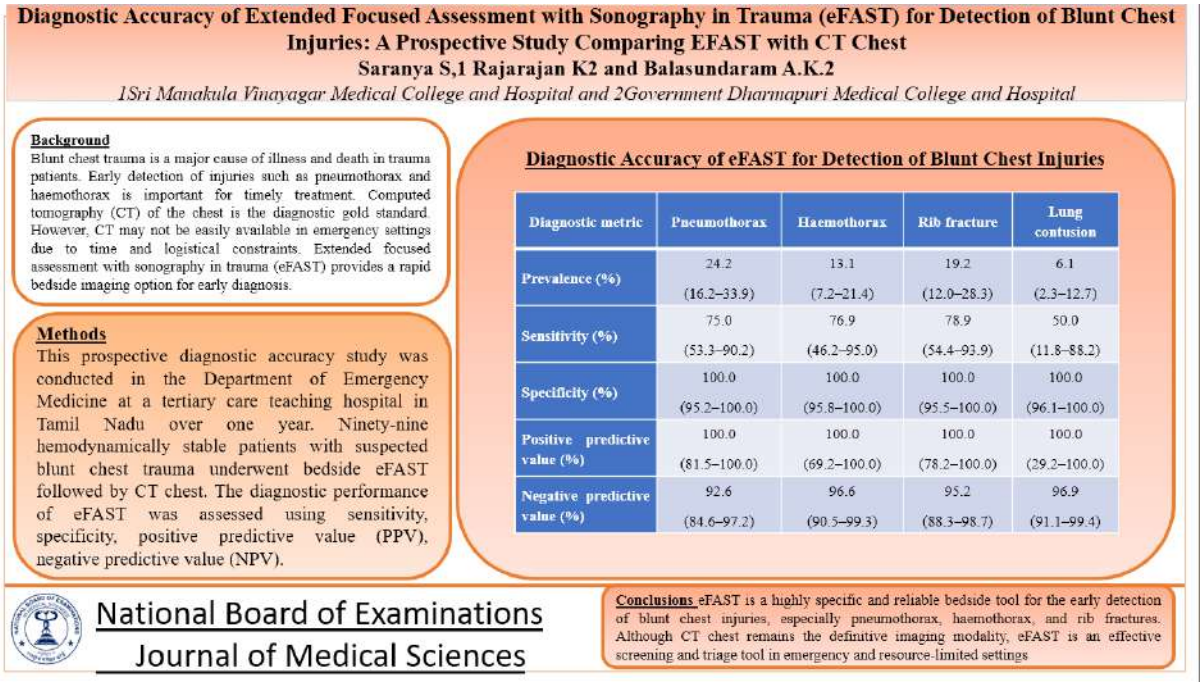
Graphical Abstract



Introduction

Trauma is a leading cause of death worldwide and is the most common cause of mortality among individuals aged 5–29 years, accounting for nearly 10% of all global deaths [1]. Chest trauma, particularly blunt thoracic injury, contributes significantly to trauma-related illness and death and is responsible for approximately 25% of trauma fatalities [2].In India, the burden of blunt chest trauma has increased markedly, mainly due to road traffic accidents, with more than 150,000 trauma-related deaths reported each year [3].Blunt thoracic injuries include a wide range of conditions such as pneumothorax, haemothorax, pulmonary contusion, rib fractures, and injuries to the heart or mediastinum. These injuries commonly present with mild signs or sometimes with some non-specific clinical signs. Early diagnosis is particularly difficult in unconscious or intubated patients [4]. Delay in identifying these injuries can result in hypoxia, shock, cardiac tamponade, and multi-organ dysfunction, leading to increased preventable mortality [5].

Computed tomography (CT) of the chest is considered the gold standard for diagnosing thoracic injuries because of its high sensitivity and ability to detect occult injuries not seen on plain chest radiographs [6].CT imaging has been shown to change clinical management in up to one-third of trauma patients by identifying important injuries missed during initial assessment [7]. However, CT requires patient transfer, exposes patients to ionizing radiation, and may not be readily available in emergency settings, especially in low- and middle-income countries [8].

Extended focused assessment with sonography in trauma (eFAST) builds upon the traditional FAST examination by adding thoracic views to detect pneumothorax, haemothorax, and pericardial effusion. eFAST is a rapid, portable, repeatable, and radiation-free imaging tool. These features make it suitable for bedside use during

trauma resuscitation [9]. Several studies have shown that eFAST has high specificity and moderate to high sensitivity for detecting pneumothorax and haemothorax. In many cases, it performs better than supine chest radiography [10–12].

Despite increasing international evidence supporting its use, data on the diagnostic accuracy of eFAST in Indian emergency departments remain limited. Differences in patient characteristics, availability of resources, and operator experience highlight the need for region-specific evaluation. Therefore, this study was conducted to assess the diagnostic accuracy of eFAST compared with CT chest in detecting blunt chest injuries in a tertiary care emergency setting in India.

Materials and Methods

Study Design and Setting

This was a prospective diagnostic accuracy study conducted in the Department of Emergency Medicine at Government Dharmapuri Medical College and Hospital, Tamil Nadu, India. The study was carried out over a one-year period from August 2023 to July 2024.

Study Population

Consecutive trauma patients presenting with suspected blunt chest injury and requiring CT chest evaluation were screened for inclusion in the study.

Inclusion Criteria

- Patients with blunt chest trauma
- Hemodynamically stable at the time of presentation
- Patients who underwent both eFAST and CT chest imaging
- Patients who provided informed consent

Exclusion Criteria

- Patients with penetrating chest trauma
- Hemodynamically unstable patients requiring immediate intervention
- Patients with prior intercostal drain insertion
- Pregnant women
- Patients with contraindications to CT imaging

Study Procedure

All eligible patients underwent a detailed clinical examination. This was followed by a bedside eFAST examination performed by trained emergency physicians. The eFAST assessment was used to identify pneumothorax, haemothorax, rib fractures, and lung contusions. All findings were recorded immediately using a standardized proforma. After the eFAST examination, all patients underwent CT chest imaging. CT chest served as the reference standard. The CT images were interpreted by a radiologist who was blinded to the eFAST findings.

Outcome Measures

The primary outcome measure was the diagnostic accuracy of eFAST compared with CT chest for detecting individual thoracic injuries and for identifying any chest injury.

Statistical Analysis

Data were entered and analyzed using STATA version 14. Diagnostic performance was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), with 95% confidence intervals.

Ethical Considerations

The study was approved by the Institutional Human Ethics Committee. Written informed consent was obtained from all participants or from their legally authorized representatives.

Results

The baseline characteristics of the study participants are shown in Table 1. The average age of the patients was 43.5 years, showing that blunt chest trauma was common in middle-aged adults. Most patients were male. Road traffic accidents were the most frequent cause of injury. Clinical signs of chest injury were present in only one-third of patients, indicating that many chest injuries may not be obvious on initial examination.

Table 1. Baseline Characteristics and Injury Profile of Study Participants (n = 99)

Variable	**Category**	**n (%)**
Age (years)	**Mean ± SD**	43.5 ± 15.1
Sex	**Male**	79 (79.8)
	Female	20 (20.2)
Mode of injury	**Road traffic accident**	71 (71.7)
	Accidental self-fall	17 (17.2)
	Assault	11 (11.1)
Clinical signs of chest injury	**Present**	33 (33.3)
	Absent	66 (66.7)

Table 2 shows the imaging findings detected by eFAST and CT chest. CT chest identified chest injuries in about one-third of patients, while eFAST detected positive findings in about one-quarter of cases. This shows that eFAST may miss some injuries detected by CT, especially minor or subtle injuries. However, eFAST was able to detect most clinically important chest injuries at the bedside.

Table 2. Distribution of Imaging Findings on eFAST and CT Chest (n = 99)

Imaging modality	**Finding**	**n (%)**
eFAST findings	**Positive**	25 (25.3)
	Negative	74 (74.7)
CT chest	**Positive**	32 (32.3)
	Negative	67 (67.7)

The diagnostic accuracy of eFAST for specific thoracic injuries is shown in Table 3. Pneumothorax was the most common injury, followed by rib fractures and haemothorax, while lung contusion was less common. eFAST showed good sensitivity for pneumothorax, haemothorax, and rib fractures. However, its sensitivity was lower for lung contusion, as lung contusions are difficult to detect with ultrasound. eFAST showed very high specificity for all injuries, meaning that no false-positive cases were identified. This indicates that when eFAST was positive, the injury was truly present.

Table 3. Diagnostic Accuracy of eFAST for Detection of Blunt Chest Injuries Compared with CT Chest (n = 99)

Diagnostic metric	**Pneumothorax**	**Haemothorax**	**Rib fracture**	**Lung contusion**
Prevalence (%)	24.2 (16.2–33.9)	13.1 (7.2–21.4)	19.2 (12.0–28.3)	6.1 (2.3–12.7)
Sensitivity (%)	75.0 (53.3–90.2)	76.9 (46.2–95.0)	78.9 (54.4–93.9)	50.0 (11.8–88.2)

Specificity (%)	100.0 (95.2–100.0)	100.0 (95.8–100.0)	100.0 (95.5–100.0)	100.0 (96.1–100.0)
Positive predictive value (%)	100.0 (81.5–100.0)	100.0 (69.2–100.0)	100.0 (78.2–100.0)	100.0 (29.2–100.0)
Negative predictive value (%)	92.6 (84.6–97.2)	96.6 (90.5–99.3)	95.2 (88.3–98.7)	96.9 (91.1–99.4)

Table 4 presents the overall performance of eFAST in detecting any chest injury. eFAST correctly identified most chest injuries and did not falsely label any patient as having an injury. The high positive predictive value shows that all patients with positive eFAST findings truly had chest injuries. The negative predictive value was also high, showing that eFAST was reliable in ruling out injury in most patients. Overall, eFAST showed excellent diagnostic accuracy as a screening tool.

Table 4: Diagnostic Accuracy of eFAST In Detecting Any Chest Injury Compared to CT Chest (Reference Standard) (n=99)

Diagnostic Metric	**Value**	**95% CI**
Prevalence	32.3%	23.3% - 42.5%
Sensitivity	78.1%	60.0% - 90.7%
Specificity	100.0%	94.6% - 100.0%
Positive Predictive Value	100.0%	86.3% - 100.0%
Negative Predictive Value	90.5%	81.5% - 96.1%

Table 5 shows the diagnostic accuracy of clinical examination alone. Clinical findings were sensitive in detecting chest injuries, meaning many injured patients had some clinical signs. However, clinical examination had lower specificity compared to eFAST, indicating that some patients without injury were wrongly

suspected to have chest injuries. This highlights that clinical examination alone is not sufficient and should be supported by imaging.

Table 5. Diagnostic Accuracy Of Clinical Findings In Detecting Chest Injury Compared To CT Chest (Reference Standard) (n=99)

Diagnostic Metric	**Value**	**95% CI**
Prevalence	32.3%	23.3% - 42.5%
Sensitivity	87.5%	71.0% - 96.5%
Specificity	92.5%	83.4% - 97.5%
Positive Predictive Value	84.8%	68.1% - 94.9%
Negative Predictive Value	93.9%	85.2% - 98.3%

Overall, these findings show that eFAST is a reliable and highly specific bedside imaging tool for the evaluation of blunt chest trauma. While it may miss some minor injuries, especially lung contusions, it is very useful for early detection and decision-making in emergency settings, particularly where CT facilities are limited.

Discussion

This prospective diagnostic accuracy study assessed how well eFAST detects blunt chest injuries, using CT chest as the reference standard. Road traffic accidents were the most common cause of injury in this study. This finding is similar to national trauma patterns reported in India and other low- and middle-income countries [3,13].

In the present study, eFAST showed a sensitivity of 75.0% and a specificity of 100% for detecting pneumothorax. These results are comparable to earlier systematic reviews and meta-analyses, which reported sensitivities between 69% and 92% and specificities close to 99–100% [10,14,15]. The high specificity indicates that when eFAST detected pneumothorax, the diagnosis was accurate. This allowed early treatment without waiting for CT confirmation. The cases missed by eFAST were mostly small or occult pneumothoraces, which are known limitations of ultrasound-based imaging [11].

For haemothorax, eFAST demonstrated a sensitivity of 76.9% and a specificity of 100%. These values are similar to previously reported sensitivities of 64–80% and specificities above 97% [14,16]. The false-negative cases were likely due to very small amounts of pleural fluid or technical limitations during scanning, especially in patients examined in the supine position.

eFAST showed good sensitivity and excellent specificity for detecting rib fractures. Previous studies have shown that ultrasound can identify rib fractures better than chest radiography, particularly for

fractures located anteriorly, while posterior fractures are more difficult to detect [17]. The findings of this study support the use of eFAST as an additional tool for identifying clinically important rib fractures during the initial assessment of trauma patients.

Detection of lung contusions was the main limitation of eFAST, with a sensitivity of only 50%. This finding is consistent with existing literature, which shows that ultrasound has limited ability to detect deep lung injuries that do not involve the pleural surface [18]. CT chest therefore remains essential for accurate diagnosis and assessment of pulmonary contusions.

When compared with clinical examination alone, eFAST showed lower sensitivity but higher specificity. This reduced the number of false-positive diagnoses. Although clinical examination is an important part of trauma assessment, it is not reliable when used alone for diagnosing thoracic injuries, especially in patients with multiple injuries [19].

Overall, the findings of this study support current Advanced Trauma Life Support (ATLS) recommendations, which advocate the use of eFAST as an adjunct to the primary survey in trauma patients [20]. In settings with limited resources, eFAST is particularly valuable as a triage tool. It helps in the early detection of life-threatening injuries and guides timely management while awaiting definitive imaging.

Strengths and Limitations

The strengths of this study include its prospective design and the use of CT chest as the reference standard. Imaging findings were interpreted independently, which reduced bias. Data were collected in a uniform manner using a standardized format, which improved reliability. The study also has some limitations. It was conducted at a single center with a relatively small sample size. Ultrasound findings depend on the skill and experience of the operator. Hemodynamically unstable patients were not included in the study, which may limit the applicability of the results to all trauma patients. Also the eFAST operators weren't blinded about the clinical examination findings which could possible influence the outcome.

Conclusion

eFAST is a useful bedside imaging tool for detecting blunt chest injuries. It has high specificity and good overall accuracy. Although it cannot replace CT chest, it is helpful as an initial screening and triage method, especially in emergency and resource-limited settings. Regular use of eFAST in trauma protocols can help in early diagnosis and lead to better patient outcomes.

Author Contributions

Author 1 has contributed to the conceptualization and definition of the intellectual content of the manuscript, design of the study, data acquisition, Author 2 contributed to the literature search, manuscript editing, and manuscript review. Author 3 contributed towards Statistical analysis, Manuscript review and editing. Author 2 will serve as the corresponding author / guarantor of the manuscript

Data availability statement

The datasets generated and analysed in this study are available from the corresponding author on reasonable request. They are not publicly shared because they contain sensitive information that could indirectly identify participants.

Ethical approval

This study has been approved by the Institution Ethics Committee – Government Dharmapuri Medical College Dharmapuri, carrying approval number IHEC-07/2023 dated 10.08.2023.

Informed Consent

Written informed consent was obtained from all participants after explaining the study procedures, potential risks and benefits. Consent covered both participation and publication of anonymised findings, with assurance of confidentiality and data privacy.

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Usage of AI Tools: Authors declare to have used Chat-GPT 5.0 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 AI tool usage is for content moderation alone.

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ORIGINAL ARTICLE

Evaluation of Correlation between Plasma Glucose, Lipid Profile and Serum Amylase Among Obese Type 2 Diabetes Mellitus Patients

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is characterized by chronic hyperglycaemia, insulin resistance, and progressive β-cell dysfunction. The pancreas functions as an integrated endocrine–exocrine organ, and increasing evidence suggests that metabolic derangements in T2DM may also affect exocrine pancreatic function. Obesity further amplifies insulin resistance, promotes diabetic dyslipidaemia, and contributes to pancreatic fat deposition, potentially influencing pancreatic enzyme secretion. Serum amylase has emerged as a simple biochemical surrogate of exocrine pancreatic activity in metabolic states. **Objectives**: To assess the correlation between fasting plasma glucose and serum amylase among obese patients with type 2 diabetes mellitus; To assess the correlation between lipid profile parameters and serum amylase among obese patients with type 2 diabetes mellitus. **Methods**: This descriptive cross-sectional study was conducted in a tertiary care teaching hospital in Salem during March – June 2024. 50 obese patients (BMI >30 kg/m²) with T2DM attending the outpatient department were included by purposive sampling. Fasting plasma glucose, lipid profile (total cholesterol, triglycerides, HDL, LDL, VLDL, TC/HDL ratio), and serum amylase were estimated using standard biochemical methods. Pearson's correlation was applied to assess associations. **Results**: The mean age of participants was 54.2 ± 6.2 years, with male predominance (68%). Mean fasting plasma glucose was 146.82 ± 23.02 mg/dl. The lipid profile demonstrated an atherogenic pattern, and mean serum amylase levels were relatively low (28.30 ± 7.64 IU/L). Serum amylase showed a strong inverse correlation with fasting plasma glucose ($r = -0.831$, $p < 0.01$), triglycerides, VLDL, total cholesterol, LDL, and TC/HDL ratio, and a strong positive correlation with HDL cholesterol ($p < 0.01$). **Conclusion**: Serum amylase is inversely associated with hyperglycaemia, atherogenic dyslipidaemia, and duration of diabetes in obese T2DM patients, supporting a close endocrine–exocrine–metabolic linkage.

Keywords: Type 2 diabetes mellitus, Obesity, Serum amylase, Diabetic dyslipidaemia, Fasting plasma glucose

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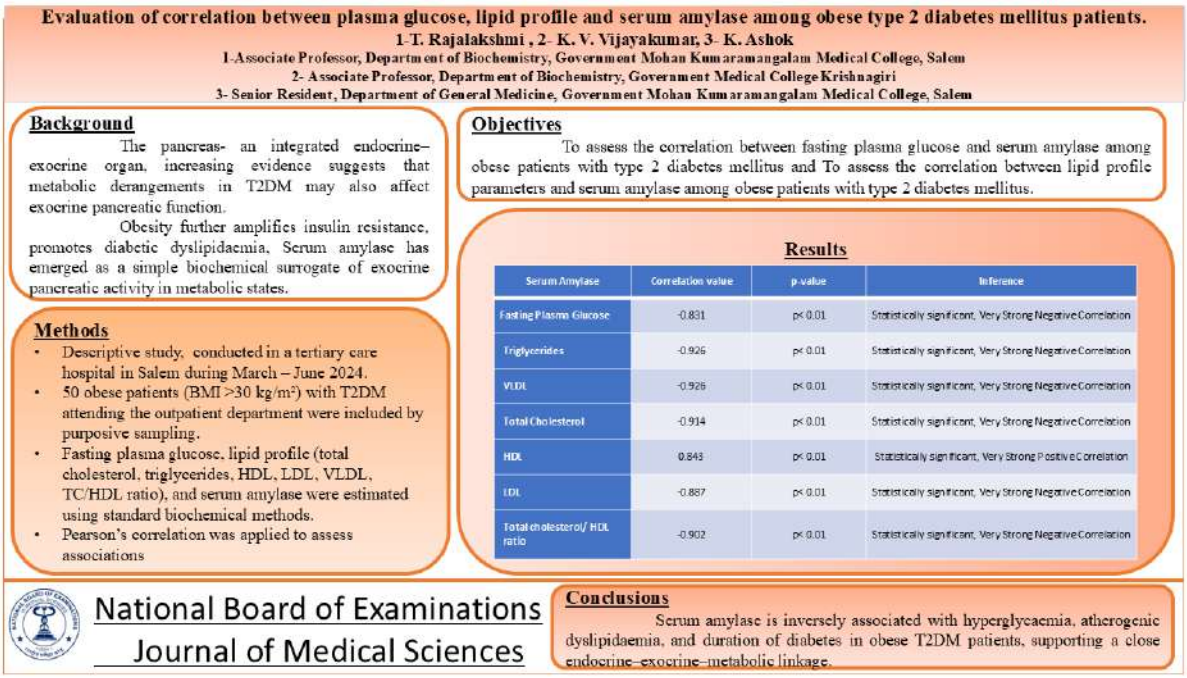
Graphical Abstract



Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycaemia due to impaired insulin secretion, impaired insulin action, or both. In type 2 diabetes mellitus (T2DM), progressive β-cell dysfunction occurs on a background of insulin resistance, and fasting plasma glucose (FPG) is widely used as a pragmatic biochemical index of basal glycaemic status and hepatic glucose output [1,2].

The pancreas is a mixed exocrine–endocrine gland with a strong anatomical and functional interdependence between compartments. The exocrine pancreas constitutes approximately 85% of pancreatic mass, while endocrine islet tissue accounts for about 2%, with the remainder comprising ducts, vasculature and extracellular matrix [3]. Beyond simple co-localisation, contemporary evidence supports bidirectional endocrine–exocrine "crosstalk" mediated by shared developmental origins, vascular–paracrine signalling, neural inputs and gut–pancreas hormonal pathways, such that perturbations in one compartment can influence the other [4]. This biological linkage provides a clear biochemical rationale for examining endocrine markers (plasma glucose) alongside exocrine markers (serum pancreatic enzymes) within the same patient.

Serum amylase, produced predominantly by pancreatic acinar cells (with contribution from salivary isoenzymes), is an accessible, low-cost biochemical surrogate that may reflect aspects of exocrine pancreatic function in population studies. Importantly, "low" serum amylase has gained attention as a metabolic signal rather than only a pancreatitis marker; recent clinical reviews highlight that reduced serum amylase can be seen in metabolic states and may carry diagnostic or prognostic implications depending on context [5].

Obesity is a key modifier in this relationship and is central to the present

study focus. Obesity amplifies insulin resistance, increases inflammatory adipokines, and promotes ectopic fat deposition, including in the pancreas. Non-alcoholic fatty pancreatic disease (NAFPD)/pancreatic steatosis is increasingly described as a metabolic phenotype associated with obesity, insulin resistance and metabolic syndrome, with potential progression to pancreatic inflammation and fibrosis [6]. Pancreatic fat and low-grade inflammation may plausibly impair both β-cell function (worsening hyperglycaemia) and acinar/ductal function (altering enzyme output), thereby strengthening the biological rationale to examine glucose–amylase correlations specifically among obese T2DM patients [7].

In addition to abnormalities in glucose metabolism, T2DM is characteristically associated with diabetic dyslipidaemia, primarily due to insulin resistance–mediated alterations in hepatic lipid synthesis, impaired lipoprotein lipase activity [8].

Against this background, the present study evaluates the correlation between fasting plasma glucose and serum amylase as representative biochemical indices of endocrine and exocrine pancreatic function, respectively, in obese patients with T2DM and additionally their correlation with Lipid profile.

Objectives

- To assess the correlation between Fasting Plasma Glucose and serum amylase among Obese Type 2 Diabetes Mellitus.
- To assess the correlation between lipid profile and serum amylase among Obese Type 2 Diabetes Mellitus.

Methodology

This descriptive cross-sectional study was conducted in a tertiary care teaching hospital in Salem during March – June 2024. Sample size for this study was calculated to estimate the mean serum amylase with 95% confidence using $n=(Z\alpha*\sigma/d)^2$. The SD of serum amylase among T2DM patients was taken as 29.56 U/L from a published open-access study [9]. With Z=1.96 and allowable error (d) as 8 U/L, the required sample size arrived as 50. Hence, 50 patients of type 2 Diabetes mellitus with BMI > 30 (Obese as per WHO BMI categories) attending OPD, were included in this study by purposive sampling technique. After obtaining informed consent from the study recruits, Fasting Plasma Glucose, Lipid profile and serum Amylase were estimated. Patients with acute illness, those who were not on fasting and those who denied consent were excluded. Fasting Plasma Glucose was estimated by GOD-POD method. The serum Triglycerides and Total Cholesterol was measured by enzymatic GPO-PAP method. Serum HDL was measured by Phosphotungstic acid method and Serum VLDL & LDL were calculated by Friedwalds formula. Serum Amylase was estimated using a chromogenic substrate CNPG3(2-Chloro 4-NitroPhenyl linked with Galactomaltoside) which acts upon amylase to release more than 95% of 2-chloro 4-Nitrophenyl and forms 2- chloro, 4-Nitrophenyl D-Maltoside, Malotriose & Glucose. Amylase activity was measured at 405nm using Semi Auto Analyzer.

Results

Demographic and Clinical characteristics

This study included 50 participants, the mean age of them was 54.2 $\pm$ 6.2 years, ranging from 44 to 65 years, with a Male

predominance (68%)., indicating that the cohort predominantly represented middle-aged to elderly male individuals. The Mean BMI of the study participants was 31.92 ± 1.29 kg/m^2, ranging from 30.1 to 35.5 kg/m^2. Of the 50 study participants, 16 (32%) were with DM for < 5 years, 16 (32%) were with DM for 5-10 years and the rest 18 (36%) had DM for >10 years. Table 1 shows the demographic and clinical characteristics of the study population.

Table 1. Demographic and Clinical characteristics of study participants

Variable		**Descriptive Statistics**			
		Mean	**S.D.**	**Min.**	**Max.**
Age in yrs		54.2	6.15	44	65
BMI (kg/m^2)		31.92	1.29	30.07	35.55
		Frequency		**Percentage**	
Gender	**Male**	34		68	
	Female	16		32	
Duration of DM	**<5 years**	16		32	
	5-10 years	16		32	
	>10 years	18		36	

Fasting Plasma Glucose, Lipid Profile and Serum Amylase levels

With respect to glycaemic status, fasting plasma glucose levels demonstrated poor glycaemic control, with a mean value of 146.82 ± 23.02 mg/dl and a wide range from 114 to 192 mg/dl. Lipid profile analysis revealed dyslipidaemia typical of type 2 diabetes mellitus. Mean serum triglyceride (TGL) levels were 155.32 ± 29.83 mg/dl (range: 110–213 mg/dl), while very-low-density lipoprotein (VLDL) levels averaged 31.06 ± 5.96 mg/dl. Total cholesterol (TCHO) showed a mean of 167.54 ± 24.34 mg/dl, with values ranging from 131 to 212 mg/dl.

High-density lipoprotein (HDL) cholesterol levels were relatively low, with a mean of 33.98 ± 4.33 mg/dl, whereas low-density lipoprotein (LDL) cholesterol demonstrated a mean value of 102.49 ± 22.97 mg/dl. The total cholesterol to HDL ratio (TC/HDL), an established atherogenic index, was elevated with a mean of 5.08 ± 1.32, indicating increased cardiovascular risk within the study population.

Serum amylase levels, representing exocrine pancreatic function, were notably

on the lower side, with a mean value of 28.30 ± 7.64 IU/L and a range of 17.43 to 43.03 IU/L. Overall, the descriptive analysis highlights a cohort of obese T2DM patients with suboptimal glycaemic control, characteristic diabetic dyslipidaemia, and relatively reduced serum amylase levels, providing the basis for subsequent correlation analysis between fasting plasma glucose and serum amylase.

Table 2 shows the descriptive details of the Fasting plasma glucose, Lipid profile and Serum Amylase levels among the study participants.

Table 2. Descriptive data of Fasting Plasma Glucose, Lipid Profile and Serum Amylase

Variables	**Descriptive Data**			
	Mean	**S.D.**	**Min.**	**Max.**
Fasting Plasma Glucose (mg/dl)	146.82	23.02	114	192
TGL (mg/dl)	155.32	29.83	110	213
VLDL (mg/dl)	31.06	5.96	22	42.6
T.CHO (mg/dl)	167.54	24.34	131	212
HDL (mg/dl)	33.98	4.33	28	43
LDL (mg/dl)	102.49	22.97	68.8	148.2
TC/HDL ratio	5.08	1.32	3.3	7.32
Serum Amylase (IU/L)	28.3	7.64	17.43	43.03

Correlation of serum amylase with glycaemic and lipid parameters

Pearson's correlation analysis demonstrated a very strong and statistically significant association between serum amylase levels and multiple metabolic parameters in the study population (Table 3). Serum amylase showed a very strong negative correlation with fasting plasma glucose ($r = -0.831$, $p < 0.01$), indicating that higher glycaemic levels were associated with progressively lower serum amylase concentrations.

Table 3. Correlation of serum amylase with glycaemic and lipid parameters

Serum Amylase	Correlation value	p-value	Inference
Fasting Plasma Glucose (mg/dl)	-0.831	p< 0.01	Statistically significant, Very Strong Negative Correlation
Triglycerides (mg/dl)	-0.926	p< 0.01	Statistically significant, Very Strong Negative Correlation
VLDL (mg/dl)	-0.926	p< 0.01	Statistically significant, Very Strong Negative Correlation
Total Cholesterol (mg/dl)	-0.914	p< 0.01	Statistically significant, Very Strong Negative Correlation
HDL(mg/dl)	0.843	p< 0.01	Statistically significant, Very Strong Positive Correlation
LDL (mg/dl)	-0.887	p< 0.01	Statistically significant, Very Strong Negative Correlation
Total cholesterol/ HDL ratio	-0.902	p< 0.01	Statistically significant, Very Strong Negative Correlation

Similarly, serum amylase exhibited a very strong inverse correlation with serum triglycerides ($r = -0.926$, $p < 0.01$) and very-low-density lipoprotein (VLDL) levels ($r = -0.926$, $p < 0.01$), suggesting a close relationship between exocrine pancreatic enzyme levels and atherogenic lipid fractions. A significant negative correlation was also observed between serum amylase and total cholesterol ($r = -0.914$, $p < 0.01$) as well as low-density lipoprotein (LDL) cholesterol ($r = -0.887$, $p < 0.01$).

In contrast, high-density lipoprotein (HDL) cholesterol demonstrated a very strong positive correlation with serum amylase ($r = 0.843$, $p < 0.01$), indicating that higher protective lipid levels were associated with higher serum amylase concentrations. Furthermore, the total cholesterol to HDL ratio, an established marker of cardiovascular risk, showed a

strong inverse relationship with serum amylase ($r = -0.902$, $p < 0.01$).

Overall, these findings indicate that lower serum amylase levels are consistently associated with poorer glycaemic control and an adverse lipid profile among obese patients with type 2 diabetes mellitus, supporting a close functional relationship between exocrine pancreatic activity, glucose metabolism, and lipid abnormalities.

Discussion

The present study comprised predominantly middle-aged type 2 diabetes mellitus, with a mean age of 54.2 ± 6.15 years, and a mean BMI of 31.92 ± 1.29 kg/m^2. This is consistent with epidemiological studies indicating that T2DM commonly manifests in the fifth and sixth decades of life, where cumulative insulin resistance and β-cell dysfunction increase with age and obesity [7,10].

In this cohort of obese T2DM patients, had a suboptimal fasting glycaemic control. The lipid profile showed an atherogenic pattern suggesting increased cardiometabolic risk. Serum amylase levels were relatively low in this cohort supporting the rationale to evaluate exocrine–metabolic correlations in obese T2DM. This biochemical pattern is consistent with the Indian description of diabetic (atherogenic) dyslipidaemia, where high triglycerides and low HDL-C are emphasized as typical and clinically important in T2DM; this is explicitly highlighted in the RSSDI consensus recommendations for dyslipidaemia management in diabetes [11].

In Indian clinical cohorts, dyslipidaemia is reported to be highly prevalent among patients with T2DM and contributes substantially to atherosclerotic risk, aligning with the elevated TG and low HDL observed in the present study [11].

Regarding exocrine markers, Indian studies such as Patel et al. have also reported altered serum amylase in T2DM and described an inverse relationship with glycaemic measures, supporting the clinical relevance of including serum amylase in metabolic profiling [9].

The present study demonstrated a very strong and statistically significant inverse correlation between serum amylase and fasting plasma glucose indicating that worsening glycaemic status was associated with progressively lower serum amylase levels in obese patients with T2DM. This finding suggests a close functional link between endocrine pancreatic dysfunction and exocrine pancreatic activity in the diabetic state. Comparable findings have been reported by many Indian literatures as they observed significantly lower serum amylase levels in patients with type 2 diabetes mellitus and reported a negative association between serum amylase and glycaemic parameters, supporting the present observation that hyperglycaemia is associated with reduced exocrine enzyme levels [9,12-14].

In addition to glycaemia, serum amylase showed a very strong negative correlation with triglycerides, VLDL, total cholesterol, LDL cholesterol and TC/HDL ratio while demonstrating a strong positive correlation with HDL cholesterol all of which were statistically significant ($p < 0.01$). These findings indicate that lower serum amylase levels are closely associated with a more atherogenic lipid profile in obese T2DM patients, as emphasized in the RSSDI consensus recommendations (2022) [11].

Although Indian studies directly correlating serum amylase with lipid

fractions are limited, the observed associations are biologically plausible and align with reports suggesting that pancreatic fat accumulation, insulin resistance, and altered lipid metabolism may collectively impair exocrine pancreatic function.

A plausible interpretation is that obesity-driven insulin resistance may simultaneously worsen fasting glycaemia and promote atherogenic dyslipidaemia, while chronic metabolic stress and pancreatic fat/inflammation may contribute to lower exocrine enzyme output, reflected as reduced serum amylase in susceptible T2DM phenotypes. Concurrently, the same metabolic milieu promotes diabetic dyslipidaemia, thereby explaining the strong associations between serum amylase and adverse lipid parameters observed in this study [11,15].

Conclusion

Thus, Our study demonstrates an evident relationship between glycaemic status, lipid abnormalities, and exocrine pancreatic function among obese patients with type 2 diabetes mellitus. These findings support the concept of an integrated endocrine–exocrine–metabolic dysfunction in obesity-associated T2DM, wherein chronic hyperglycaemia, insulin resistance, and dyslipidaemia collectively contribute to pancreatic functional alterations. However, larger prospective studies incorporating direct measures of exocrine pancreatic function and pancreatic imaging are warranted to validate these observations and to clarify their clinical implications.

Limitations

The cross-sectional study design limits causal inference. Purposive sampling may introduce selection bias and restrict generalizability. Potential confounders including age, sex, duration of diabetes, glycaemic control, alcohol intake, and concurrent medications (insulin and lipid-lowering agents) may have influenced serum amylase and lipid parameters and could not be fully adjusted for. BMI categorization was based on WHO criteria; the use of Asian/Indian–specific cut-offs may have been more appropriate and could limit generalizability to the Indian population. These factors should be considered when interpreting the findings.

Clinical Implications

Serum amylase, a simple and easily available test, may serve as an adjunct marker of metabolic burden and possible exocrine pancreatic involvement in obese patients with type 2 diabetes mellitus, particularly in resource-limited settings. The observed associations warrant larger longitudinal studies incorporating direct exocrine function tests and pancreatic imaging to determine its predictive value and clinical utility.

Statements and Declarations

Conflicts of interest

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

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REVIEW ARTICLE

Strengthening Community Healthcare Delivery: Framework of Value-Added Educational Courses for Community Health Guides in India: A Scoping Review

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Abstract

Introduction: India's health progress struggles to overcome unequal access despite advances in biomedical initiatives, especially in rural and tribal areas. Despite staff like ASHAs and ANMs, community healthcare efforts continue to prioritise the health of mothers and children over more common requirements. To bridge this workforce deficit, the Indian Council of Medical Research (ICMR) conducted an initiative in which local volunteers got informal training to record health data and deliver preventive aspects of treatment. **Methods:** By assessing the framework of certification courses to sanctify exercise for Health Guides (HGs), this study builds on that. Through administrations like NIOS, IGNOU, and NSDC, the study identified over 25 government-approved programs in AYUSH, geriatric care, yoga therapy, home-based care, and community health. **Results:** Scalability is ensured by these low-priced, hybrid courses with supple eligibility. **Discussion:** The study suggests engaging trained HGs to promote universal health coverage, with a focus on health recording, screening, behaviour change communication, referral linkage, and environmental assessment. HGs might become culturally rooted promoters through standardised training, which would increase accountability. **Conclusion:** Locals enrolled in accredited short-term courses could develop a community-based, sustainable workforce to tackle India's healthcare issues.

Keywords: Community, Healthcare, Courses, AYUSH, Health guide

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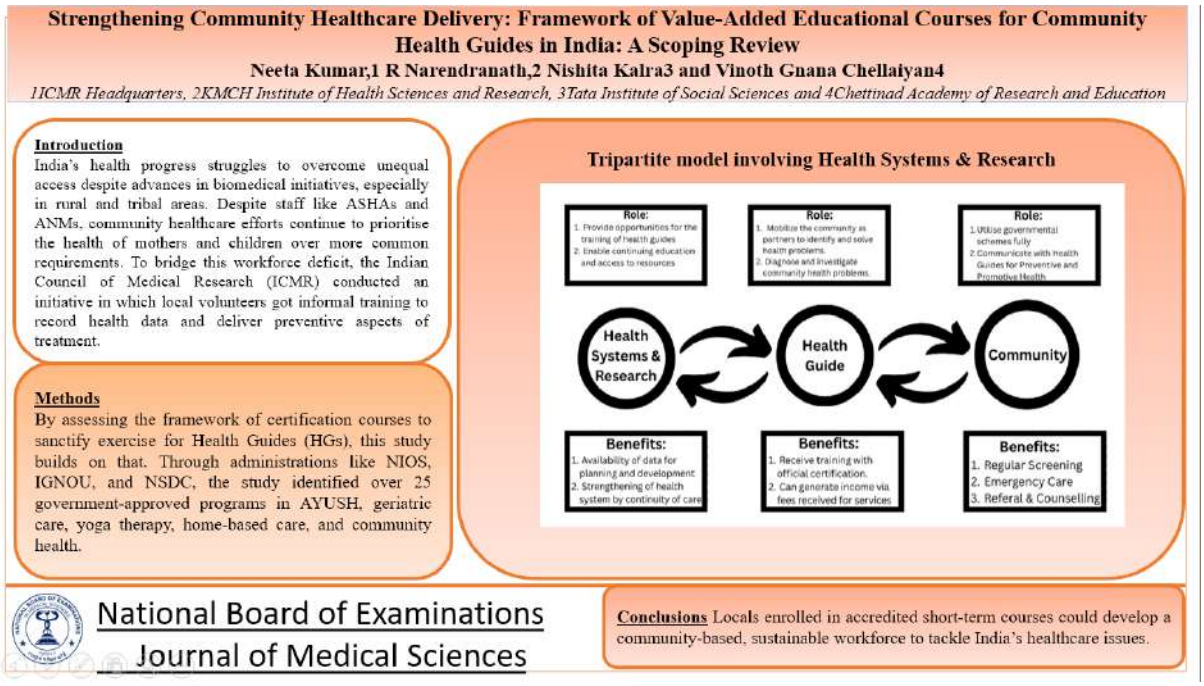
Graphical Abstract



Back ground

India's public health has improved in this field over the past 7 decades, but despite the advancements in the field of biotechnology and pharmaceutical sciences, the country still struggles to provide proper treatment, especially in rural areas. Given that the present density is just 34.6 per 10,000 people, an extra 1.8 million health professionals are needed to reach the WHO-recommended level of 44.5 health professionals per 10,000 people to provide equitable healthcare access for all Indians [1]. Finding, keeping, and inspiring healthcare workers is still a major difficulty that is essential to enhancing the efficiency of current health systems [2].

The primary focus of the community health workers, including ASHAs, ANMs, and Anganwadi workers, is maternal and child health, which limits their capacity to address the community health issues. Burnout and low morale result from this limited-service scope, which is impaired by poor infrastructure, limited training, and the demanding workload [3]. To manage these limitations, the Indian Council of Medical Research (ICMR) launched a community-based pilot program that collects community-generated data and better understands public health needs using tools like Health Account Number (Unique Health ID), Health Diaries, and other mobile applications [4].

Building this initiative, local people were trained informally using the modified educational system to provide the preventive aspects of healthcare through house visits. This concept raised community participation from 0% to 74% when it was appraised through the medical colleges [5]. Regional homemakers and students who have served as participating health guides were able to spend two to four hours per week on these programs [4].

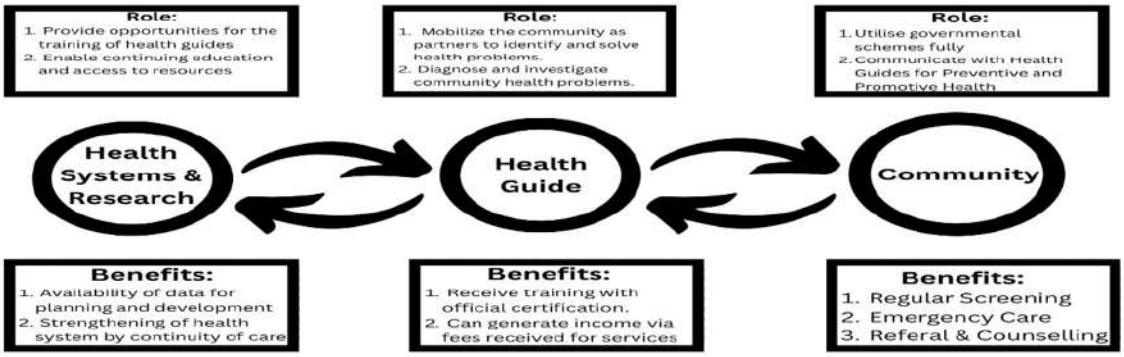


Figure 1. Tripartite model involving Health Systems & Research, Health Guides, and the Community [6]

Methodology

The Health Guide (HG) concept was created to support the community-based workforce and to improve the effectiveness of the Ayushman Bharat Digital Mission (ABDM). A local HG who lived within 100 meters of radius might complete a single house visit in roughly an hour, according to the ICMR pilot studies. On a single day, each HG usually served five houses. Depending on their availability, an HG may reach 15–30 homes per month, or 75–150 people (assuming five people per household). The actual household participation may differ according to the local availability, comfort, and time of the HG visit [7].

The envisioned responsibilities of HGs include:

- Recording the community-level health data.
- Conducting a regular screening programme for common illnesses.
- Delivering preventive and curative health education.
- Facilitating referrals for early diagnosis and treatment in the community.
- Promoting awareness and use of government health schemes and their benefits [8].

HGs are supposed to work as front - line workers, keeping an eye on the health of the community, spotting environmental risk factors (such as contaminated water and inadequate sanitation), and sending the proper alerts and referrals. They also function as promoting the community participation, encourage behavioural change communication, and support disease surveillance. They would also assist in the development and implementation of national health initiatives in collaboration with the regional health officials [9].

Formal certificates were suggested to standardise the training and maintain involvement once it was realised that informal volunteering has its own limitations. Certified HGs have the potential to become competent, independent caregivers who can provide comprehensive, culturally relevant health care at the household level [10]. A total number of 40 certificate courses were chosen based on the training of health guides at the community, among which 22 courses which provide hands-on training as a part of the curriculum are being included for comparison.

To operationalize the ICMR convened expert panels for designing the short-term certification courses tailored to

Indian health priorities. The curriculum includes emergency and rehabilitative care, first aid, yoga, dietetics, and de-addiction. Minimum eligibility was completed 10th standard education, with a course duration of under one year, hybrid delivery (online + offline), pan-India access, and a fee cap under ₹10,000. Placement support and skill applicability of the courses were prioritised for long-term utility [11].

Based on these, the ongoing courses shortlisted are shown in Table 1.

Table 1: List of currently existing courses in India for comprehensive skilling of persons as frontline health workers [12-17]

Program name	Institution	Entry level	Minimum age	Fees (Rs.)	duration	Mode of teaching	Remarks
1. Yoga	NIOS	8th pass	14 yrs	1000	6 months	Online + offline	Provides foundational knowledge about YOGA, both in theory and practice.
2. Yoga Assistant	NIOS	10th pass	14 yrs	3000	6 months	Online + offline	Trains to assist yoga students and guarantee a secure and productive yoga practice.
3. Ayurveda Assistant	NIOS	10th pass	14 yrs	3000	6 months	Online + offline	Help Ayurvedic practitioners, mostly in clinics, hospitals, and wellness centres. Basics of ayurvedha are taught.
4. Panchakarma assistant	NIOS	10th pass	14 yrs	3000	6 months	Online + offline	Provides both theoretical understanding and practical skills in the Ayurvedic detoxification treatment known as Panchakarma. Prepares students to work as Ayurvedic Panchakarma helpers.
5. Care of the Elderly	NIOS	10th pass	14 yrs	6000	1 year	Online + offline	Gives the skills ty need to care for senior citizens. Care includes general care, ageing, and the requirements of the elderly, including senior yoga.
6. Community Health workers	NIOS	10th pass	14 yrs	5000	1 year	Online + offline	Prepares competent health workers for underprivileged communities by giving them the fundamental information and real-world skills in emergency response, primary healthcare, community

							health, and health awareness.
7. Certificate in Home-Based Health Care (CHBHC)	IGNOU	10th pass	No bar	2000	6 months	Online + offline	Provides the knowledge and abilities needed to care for the elderly and those with long-term, progressive illnesses. Teaches Kriyas, Yogic Kriyas, Asanas, Pranayama, Mantra Japa, etc.
8. Certificate Program in YOGA (CPY)	IGNOU	12th pass	18 years	5000	Self-paced	Online + offline	Orients knowledge of yoga's advantages for mental, emotional, and physical health.
9. Certificate in Home Health Assistance (CHHA)	IGNOU	12th pass	18 years	6000	6 months	Online + offline	Creates skilled workers who may be hired to support patients and help other healthcare professionals in their homes.
10. Home Health Aide	IGNOU and NSDC	18yrs	10th pass	6-10 000	6 months	Offline	Trains home-based health aid, which emphasises patient care, personal cleanliness, and basic medical support in a home environment. Also trains to assist the elderly and those with chronic illnesses in their homes.
11. Basic care support for the COVID-19 frontline worker and home care support for the COVID-19 frontlin	PMKVY (NSDC)	10TH CLASS	18 years	No fee	195 hours	Offline	-

e worker							
12. Advanced care support COVID frontline worker	PMKVY (NSDC)	10TH PASS	18 years	No fee	210 hours	Offline	-
13. Sample collection support COVID frontline workers	PMKVY (NSDC)	12TH PASS science stream	18 years	No fee	211 Hours	Offline	-
14. Emergency care support COVID frontline workers	PMKVY (NSDC)	12TH PASS	18 years	No fee	144 Hours	Offline	-
15. Medical equipment support For COVID frontline worker	PMKVY (NSDC)	10th class + I.T.I with 3- 5 years of experience or diploma (technical subjects like electronic/ mechanical/ electrical/ computers/ any other related field	18 years	No fee	312 Hours	Offline	-
16. Yoga instructor,	NSDC, NOS Sub Sector:	8th pass	18 years	Ranges from	226 hours	Offline	-

NOS Category: Beauty & Wellness Sector Skill Council	Alternate Therapy NOS QP Category: Retired Occupational Standards QP Code: BWS/Q2201 Occupations: Yoga Services			500 to 5000			
17. PMKVY Yoga instructor-available to join an accredited yoga training center.	PMKVY - course for one health concept	8th pass	18 years	500	3 days	Offline	-
18. ASHA manuals Training Module for Multipurpose Workers	Directorate of National Vector Borne Diseases Control Program, DGHS, MOHFW	10th pass	18 years	No fee	3 days	Offline	Creates a strong multipurpose worker (MPWs), the ASHA (Accredited Social Health Activist), to do reporting, community involvement, and healthcare. Provides the abilities they need to handle health concerns at the local level.
19. Diploma in Multipurpose Health Worker	Private Colleges, Universities	12th pass	18 years	As per college norms -Rs. 12 to 48000	6 months to 2 years	Offline	Trains the staff who worked as COVID-19 frontline workers and who meet the requirements for the PMI-RMP®

20. Youth Leadership Training course - Karm yoga	NGO- Vyakti Vikas Kendra, affiliated to the Ministry of AYUSH	18 years	Fees Rs.1500/- (residential- includes boarding lodging, feed tuition fees study material, etc.)	Duration- 7 days, mode- offline	Self-paced	A package for holistic all-round development of self and surroundings	Produces trained manpower with entrepreneurship skills, communication, counseling skills, skills for identifying problems, making locally / culturally appropriate solutions, implementing solutions, skills to use local resources, taking care of the mental and physical needs of sick persons using Yoga as well as Ayurveda, and skills of environment management.
21. 256 preventive health courses are listed at SAKSHAM site of NIHFW.	NIHFW For existing skill enhancements	18 years	Entry-level 10th pass	Minimum age 18 years	Self-paced	Courses/module: 256 modules available online to enhance existing skills and improve skills through self-learning	Trains in common preventative health conditions and management in the community.
22. General Duty Assistant Program	MOHFW. Government	18 years	Duration 6 months, fees 7500/-	offline	Self-paced	In hospital settings, rehabilitation services in a home setting	Provides an opportunity to enhance basic nursing and community health worker skills.

In addition to the schemes, Pradhan Mantri Kaushal Vikas Yojana (PMKVY), SAKSHAM, the National Institute of Public Health Training and Research (NIPHTR), the Healthcare Sector Skill Council, and the Basic Healthcare Provider program (which includes training in patient hygiene, infection control, clinical skills, safety promotion, and biomedical waste management) are generating the skilled public health workforce in our country [18–21]. These initiatives operate under the aegis of the National Skill Development Corporation (NSDC) [22]. The Symbiosis of Centre for Health Skills (SCHS) also contributes to the workforce generation through its simulated learning-based clinical training modules [23].

Training these programs, such as Skills in Obstetrics and Gynecology,

offered by the Indian Institute of Skill Development Training, and academic public health training institutions such as the National Institute of Epidemiology (NIE-ICMR), Indian Institutes of Public Health (IIPH), and Indian Institute of Health Management Research (IIHMR), are also playing a role [24–26]. However, their focus is largely on the administrative, epidemiological, and hospital-based care provider cadres, rather than front-line community health workers [27].

As per the inclusion criteria of all India representativeness of course centres, available in all regional languages, financially affordable (within Rs. ten thousand costs of training), covering all the topics of holistic comprehensive preventive promotive health care knowledge, 31 above curricula were shortlisted. Out of these 31 selected/shortlisted courses are fulfilling the inclusion criteria. The IGNOU course of health guide and Karma yoga develop communication and counselling skills - a combination of these two was selected after consulting with subject experts in a series of meetings and deliberations over the issue in ICMR.

Discussion

With India aspiring to attain the high middle-income status by 2047 — marking a century of independence — the economy is projected to remain one of the fastest-growing globally [28]. Between 2011 and 2019, the proportion of people living in extreme poverty (under $2.15/day, 2017 PPP) was more than halved — from about 22.5 % to 10.2 % [29]. Yet, despite these economic gains, India cannot emerge as a global leader without parallel progress in health, development, and social equity [30].

Criteria of comparison

Cost, all-India presence/ representativeness, logistics, and feasibility all over India. After comparing logistics available all over India, syllabus covering all required components, fees and eligibility criteria – the IGNOU program of health guide home health care) 6 months course on correspondence mode, and 7 days Karma yoga workshop to add entrepreneurship communication counselling, preventive health, may be considered as suitable to generate a skilled workforce for multitasking as frontline health workers. Online courses of NIHFW for the supplement/upgradation of skills to make the skilled workforce more versatile are suggested. Unlike ongoing ASHA workers, this certified trained workforce can become self-employed as their utility is much more for the community and little handholding with kits (diagnostic and therapy kits contains essential equipment for BP, sugar, temperature height weight measurement and common use medicines) from IEC budget of district make them complete preventive and supportive health care providers, available at door step of community.

Comparison of cost and training duration found that the cost of courses by Private Institutions was higher than the available courses of the Government of India's NIOS, IGNOU and PMKVY. Skills @ of INR.2000 to 6000 as fees for training material found feasible and affordable, as most part of the courses is through correspondence with short contact class room sessions, hence may be used for remotely situated and working population. It was noted that these courses have many centres across the country for contact sessions - infrastructure is adequate. Duration: The average duration is 6 months

for NIOS, IGNOU, and PMKVY, which is shorter than other courses of 2-3 years. If the cost of training is nominal, screening and emergency treatment kits imparted from the ongoing IEC budget (Information Education Communication) for the district, funnelling of the budget makes the best use. In this way, no extra budget is required to generate huge numbers of trained HG in a short span of time, within 6 months to one year.

Training duration: to develop doctors, nurses, and technical staff is more costly and time-consuming, while the need of door step delivery of basic services and health data flow may be covered by empowering 10th to 12th pass using available courses within 6 months of time. Hence, 6 months correspondence course of NIOS or IGNOU, and 7 days of training of Karmyog - YLTP, yoga instructor under PMKVY, is considered to bridge the gap of certified caregivers for preventive health education, screening, emergency care, counselling and referral for testing and treatments in the early stage of all identified ailments. Identified curricula include technical, physical and mental, soft skills and communication skills to identify risk sign symptoms, impart preventive, rehabilitation care, and palliative care. Syllabus content is such that it increases the acceptability of such workers in the families they serve.

However, the WHO document's prediction of INR 3000 billion for doctors and INR 1100 –1500 billion for nurses, totalling INR 8000 billion by 2030, may not be as high. If AYUSH qualifications are added to the active health workforce, the necessary investment to close the gap would be in the range of INR 200 billion 49. However, this investment will not be required in the proposed model to generate a skilled workforce, as meager-easily manageable course fees may be managed by self-funding from individuals opting for courses or by using the existing IEC budget. The only thing the government can do is to advertise these courses at large scale, so many get attracted 50. ICMR study demonstrated that 51 Medical colleges may be optimally used in skilling manpower for public health. Each medical college with a preventive and social medicine department may be hand holder accountable for strengthening of grass root workers. A strong and equitably distributed health workforce is foundational to achieving universal health coverage. Against the WHO's recommended threshold of 44.5 doctors, nurses, and midwives per 10 000 population, India reports a significantly lower density—approximately 5.0 doctors and 6.0 nurses/midwives per 10 000 people—serving a population exceeding 1.3 billion [31]. This shortfall is further exacerbated by urban–rural disparities, public–private divides, and interstate imbalances [32].

India has introduced program-specific health workers under vertical initiatives like *TB Mukt Bharat* and *Anaemia Mukt Bharat*. However, these cadres often lack cost-effectiveness, long-term sustainability, and do not adequately align with the comprehensive 12-point service delivery mandates of Health and Wellness Centres (HWCs) [33,34]. Moreover, health worker availability, recruitment, roles, and education are frequently constrained by financial limitations, affecting both supply and demand [35].

This article explores scalable and context-sensitive solutions to India's healthcare workforce challenges. Given that existing personnel are overburdened

and narrowly trained, achieving comprehensive care requires a reimagined workforce strategy. Community-based individuals—familiar with local cultural norms and needs—represent promising candidates. Employing local members fosters trust, enhances service uptake, and may lead to improved health outcomes [36].

However, informal training pathways—lacking standardized metrics and evaluation systems—risk becoming obsolete. Further, community participation may remain limited without incentives or recognition. To mitigate these concerns, we propose structured certification programs with formal assessments, enabling volunteers to acquire comprehensive caregiving competencies and engage in periodic skill refreshers. Accordingly, we undertook a review of existing community health certification programs to inform curriculum design [37].

Conclusion

As seen by current initiatives from organisations like NIOS, IGNOU, and NSDC, formalising the training of community-based health guides through organised certification programs can help address India's healthcare manpower shortages. Enhancing primary healthcare delivery and reducing urban-rural inequities can be achieved by providing local volunteers with standardized training in preventative care, health education, and referral coordination. By combining these initiatives with national health initiatives like Ayushman Bharat, scalability and sustainability are guaranteed, and community involvement and trust are encouraged. By utilizing human resources at the grassroots level, this strategy supports India's objectives of attaining universal health coverage and equitable health outcomes.

Relevance to preventive medicine

- **Strengthening Primary Prevention at the Community Level** – By formalizing training for Ayushman Health Guides (HGs) in health recording, screening, behaviour change communication, and environmental health assessment, the model targets early disease detection and health promotion, which are core elements of preventive medicine.
- **Addressing Social Determinants of Health** – The deployment of trained, culturally embedded community health workers improves access in underserved areas, tackling inequities in healthcare delivery and enabling preventive interventions before diseases progress

Implications for clinical practice

1. **Enhanced Early Detection and Referral** – Trained Ayushman Health Guides (HGs) can identify at-risk individuals through screening and health recording, enabling timely referrals to clinical facilities and reducing the burden of late-stage disease management.
2. **Improved Continuity of Care** – By linking communities with formal healthcare systems, HGs can support follow-up, treatment adherence, and patient education, complementing clinicians' work.
3. **Reduction in Preventable Morbidity** – Preventive and promotional care delivered at the community level can lower the incidence of conditions requiring intensive clinical interventions.

4. **Culturally Sensitive Health Promotion** – HGs' local knowledge can enhance patient trust and compliance, making clinician-recommended lifestyle modifications more effective.

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Statements and Declarations

Conflicts of interest

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

Consent to participate

Written informed consent was obtained from all participants before their inclusion in the study.

Consent for publication

Written informed consent was obtained from all participants for the publication of anonymized data and any images, where applicable.

Author contributions

NK conceptualized and designed the study, supervised data collection, and contributed to manuscript preparation. VGC and NR was responsible for data acquisition, statistical analysis, and drafting of the initial manuscript, while Ms Nishita Kalra assisted in data interpretation, critical manuscript revision, and overall study supervision. All authors reviewed and approved the final manuscript. NR will act as guarantor of the manuscript.

Data Availability

The corresponding author can provide the data supporting the study's conclusions upon request. Because they contain information that could jeopardize research participants' privacy, the data are not publicly accessible.

Ethical clearance

The Institutional Human Ethics Committee (CARE IHEC II) has reviewed our proposal on 27.01.2022, and it was approved (IHEC-II/0147/22)

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Annexure – 1

Other courses

1. Ayurveda Dietician	HHSSC (NSDC)	Certificate	BAMS	23 YRS	No fee	6 months	Online + offline	1. HSS/N3904: Creates an ayurvedic food plan based on the health and medical requirements of the customer. 2. HSS/N3905: Trains to prepare personalized food plan based on Ayurvedic principles 3. HSS/N3906: Assess the diet plan's efficacy 4. HSS/N3907: Keep dietary data up to date for follow-up activities
2. Yoga Therapy Assistant	HHSSC (NSDC)	Certificate	12^{TH} PASS	18 YRS	No fee	6 months	Online + offline	Trains the unit as per the yoga therapy needs, carrying out initial interaction with individuals for proposed yoga therapy as per directions, conducting yoga therapy sessions as per prescribed advice, conducting post yoga therapy session review, etc.
3. Assistant Yoga Instructor	HHSSC (NSDC)	Certificate	8^{th} Class OR 8^{th} Class (ASHA and Anganwadi worker) with 2 Years of experience	18 YRS	No fee	6 months	Online + offline	Trains via yoga sessions (CYP) as per the instructions, follow sanitization and infection control guidelines, maintain a safe and secure working environment, interpersonal relationships and professional conduct
4. Yoga Wellness Trainer	HHSSC (NSDC)	Certificate	18 yrs	With 2 Years of experience	5-6000	6 months	Offline	Trains via yoga sessions for participants to promote wellness, regular in-house training for subordinates, and

(Assistant Yoga Instructor)				OR I.T.I (Certificate in				ensures sanitisation and infection control guidelines are followed at the workplace
5. COVID Frontline Worker (Basic Care Support)	NSDC	Certificate	18 yrs	10th pass	free	195 hours	Online + offline	The course is for the last office (death care), transferring patients and their samples, drugs, documents within the hospital, provide support in the routine activities of in-patient.
6. COVID Frontline Worker (Home Care Support)	HHSSC (NSDC)	Certificate	10th pass	18yrs	free	195 hours	Offline	The course is for multiple works like emergency health care services at lower levels in various places, sanitization and infection control guidelines, assist patient in bathing, dressing, and grooming.
7. Home Health Aide Occupational Standards (NOS)	HHSSC (NSDC)	Certificate	10 th pass	18 yrs	Varying center to center	6 months	Hybrid mode	Competencies include training on Personal care, reporting patient conditions to medical specialists, and helping patients with everyday living tasks, which are important duties.
8. Diet Assistant	HHSSC (NSDC)	Certificate	10th pass	18 yrs	Varying center to center	6 months	Hybrid mode	Trains on food safety and cleanliness, including how to store food properly, prepare food safely to preserve its nutritional content and prevent contamination, educate patients about dietary limitations in accordance with instructions, and choose a therapeutic Nutrition plan.
9. Ayurveda Ahara & Poshana Sahayak	HHSSC (NSDC)	Certificate	10th pass	18 YRS	No fee	6 months	Online + offline	Trains to carry out routine activities – provide support to Ayurveda Dietician, maintain interpersonal relationships with patients, colleagues and others, maintain a safe, healthy and secure working environment, complying with Infection Control and Bio Medical Waste Disposal norms.

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CASE REPORT

Extra-nasopharyngeal Angiofibroma: A Rare Case Report

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Abstract

An extra-nasopharyngeal angiofibroma (ENA) is a rare, atypical tumour that arises from sites other than the sphenopalatine foramen. It has a very variable clinical presentation depending on the site of origin, can occur at any age, and does not have a male predominance. This can create difficulties and challenges for doctors tasked with diagnosing the tumour. A rare case of angiofibroma in the left parapharyngeal space is reported as Nasopharyngeal Angiofibroma (NA), which is the most common benign neoplasm of the nasopharynx, but an extremely rare vascular tumor, and represents only 0.05 % of all head and neck tumors. ENAs are even more uncommon. As there are not many cases of this pathology reported in the literature, it becomes extremely difficult to accept this diagnosis except by having a high level of clinical acumen and suspicion.

Keywords: Parapharyngeal Space, Angiofibroma, Extra-nasopharyngeal Angiofibroma, Nasopharyngeal Neoplasms

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Introduction

Nasopharyngeal Angiofibroma (NA) is a rare benign, but locally aggressive vascular tumor that occurs almost exclusively in young teenage boys. However, sometimes angiofibroma can occur in sites other than the sphenopalatine foramen. This is called extra-nasopharyngeal angiofibroma. This is an even rarer tumor with an incidence of 0.05% of all head and neck tumor [1,2], which does not conform to the typical characteristics of torrential epistaxis of NA, and the clinical picture depends on the site of origin. It usually does not recur as its extra-nasopharyngeal origin often facilitates total resection. Histopathology is necessary for accurate diagnosis.

Case Report

A 40-year-old lady presented to the ENT outpatient department of a tertiary care medical college hospital with chief complaints of difficulty in swallowing and a foreign body sensation in the throat for the past 2 months. Odynophagia was of a gradual onset, with a 2-month duration, and was progressive in nature. It was characterized by difficulty swallowing solids more than liquids, accompanied by a foreign body sensation in the throat. There were complaints of voice change and snoring with no other positive findings**.**

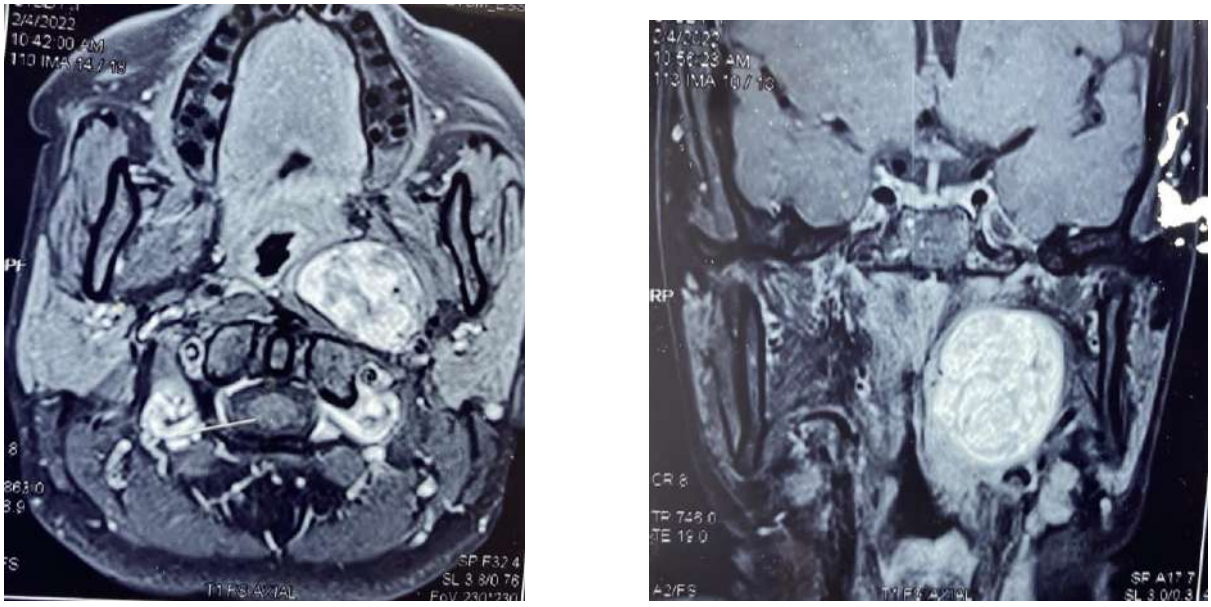
General examination of the patient did not reveal anything significant.

Local examination revealed a diffuse bulge in the left lateral wall of the oropharynx, which extended to the midline; upper and lower limits could not be visualized (Figure 1). No other abnormal findings. A provisional diagnosis of a left parapharyngeal mass was made with the differential diagnosis of paraganglioma, minor salivary gland tumor, or a nerve sheath tumor.

Figure 1. Mass presenting as a bulge in the lateral pharyngeal wall

Diagnostic nasal endoscopy and video laryngeal stroboscopy were both normal. CT angiography revealed a well-defined isodense enhancing lesion in the left parapharyngeal space supplied by the left ascending pharyngeal artery. The left external and internal carotid arteries were pushed laterally along with compression of the left internal jugular vein. A Carotid Doppler showed a tumor with minimal internal vascularity. MRI and CT scans of the neck revealed an oval-shaped mass measuring 4.5X3.8X2.8 cm in the left side of the neck-parapharyngeal space from the base of the skull to C3 (Figures 2 and 3).

Figure 2. CT showing an isodense parapharyngeal mass



Figures 3a and 3b. MRI picture of the tumour

A surgical decision for excision biopsy under general anaesthesia was made through a transcervical approach. Preoperative embolization was not tried due to the proximity of the tumour to the carotid sheath and due to the small length of the feeding vessel. Under endotracheal intubation, a transcervical submandibular incision was made 2 cm below the mandible on the left side of the neck, extending from the hyoid to the tip of the mastoid. The submandibular gland was gently retracted, and the carotid sheath identified. Branches of Ansa cervicalis and the hypoglossal nerve and the common carotid bifurcation were identified and retracted. On tracing the external carotid artery, a parapharyngeal mass was visualized in the oropharynx with the help of a tongue depressor (Figure 4). The tumor was found to be ballotable with the capsule just posterior to the carotid. With absolute precaution, the common carotid, internal, and external carotid arteries were retracted and the mass delineated and dissected from surrounding structures and removed in toto with the capsule. The excised tumour specimen was sent to Histopathology and Immunohistochemistry**.** Histopathology confirmed the diagnosis as Angiofibroma with immunohistochemistry positive for IHC-CD34.

Follow-up was done at 1 year and showed that her symptoms resolved with no recurrence (Figure 5).

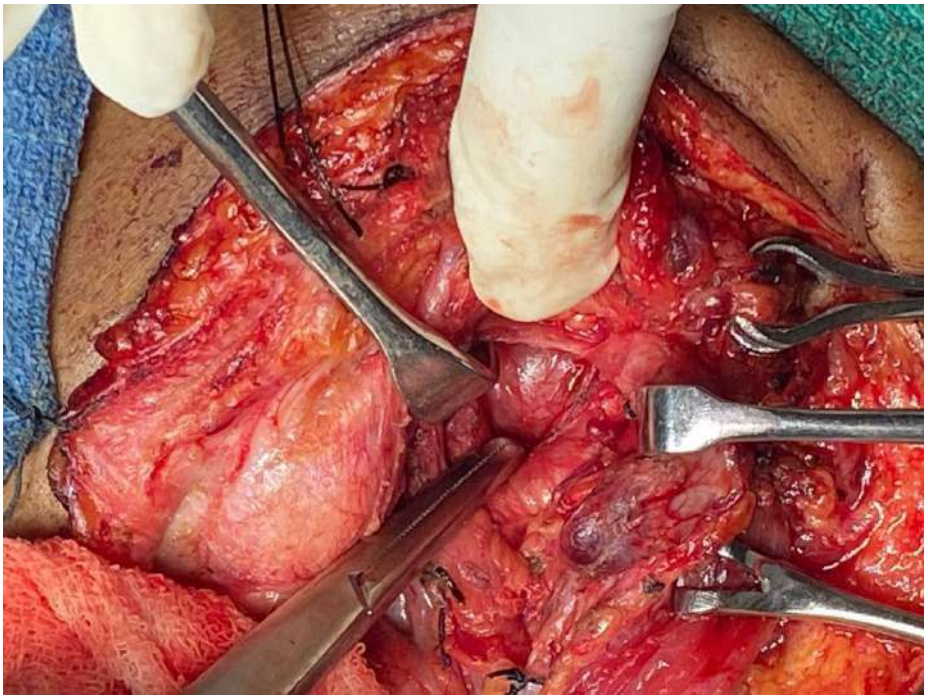


Figure 4. Intra-operative picture of tumour and major vessels

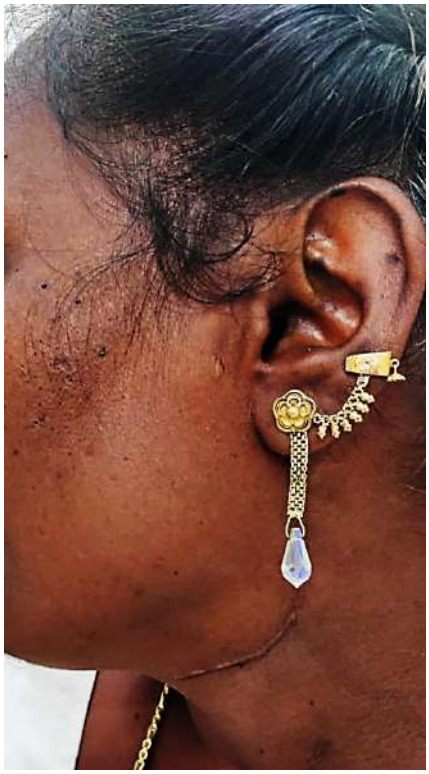


Figure 5. One-year post-op picture showing no recurrence

Discussion

Nasopharyngeal Angiofibroma (NA) is a rare, benign but locally aggressive vascular lesion that occurs almost exclusively in young teenage boys. These lesions typically originate from the sphenopalatine foramen and are present within the nasopharynx. Even though it's benign histologically, it may be locally aggressive with invasion into the bony nasal turbinate, nasal septum, and medial pterygoid lamina. It commonly extends into the nasal cavity, nasopharynx, and pterygopalatine fossa, and can extend into the sphenoid, maxillary, and ethmoid sinuses, and can cause bony destruction. Rarely it spread through the inferior orbital fissure and into the masticator space through the infratemporal fossa. Orbital and intracranial involvement are present in 10 to 37% of cases [3]. The recurrence rate after surgery of nasopharyngeal angiofibroma is around 34% [4].

Extra-Nasopharyngeal angiofibroma (ENA) is a still rare entity with very few reported cases in the literature [5]. These tumors present with different clinical features, with maximum incidence in females, with a mean age of presentation of 22 years, with a few cases have been reported in children too. The most common site of origin is the maxillary sinus (24.6 %). However, the nasal septum, with invasion of the ethmoid sinus, nasal cavity, larynx, sphenoid sinus, cheek, conjunctiva, oropharynx, retromolar area, middle turbinate, tonsil and inferior turbinate, external nose, hard palate, external ear, lacrimal sac, carotid bifurcation, oesophagus, trachea, facial nerve, middle cranial fossa and infratemporal fossa have been reported in the literature. Devoid of typical clinical and radiological features in all age groups and in females, these lesions arise from various sites, may be less vascularised, and produce

a variety of symptoms depending on the point of origin. Unlike NAs, symptoms of extra-nasopharyngeal angiofibromas are non-specific, like pain, fever, rhinorrhoea, swelling of the cheek, proptosis, headache, progressive nasal obstruction, and occasional epistaxis in a few cases. The main clinical manifestations of ENA were nasal obstruction (80%) and spontaneous rhinorrhagia (60%) [6].

Conclusion

In conclusion, this case gains importance due to the rarity of its presentation and performing the desired surgery in a situation where the plane of dissection involved major anatomical vessels in the neck, it becomes a surgical challenge for every surgeon, as not many are doing such operations on a regular basis to get the desired surgical experience. Though being benign histopathologically, NA and ENA present a challenge to a surgeon due to aggressive growth, intensive intraoperative bleeding, and a high recurrence rate. The clinical manifestations are variable according to their location & harder to diagnose radiologically. HPE is needed for confirmation (acellular connective tissue stroma, matrix of dilated vessels without a muscle layer & lower number of vascular elements). The recurrence rate of ENA is rare because its extra-nasopharyngeal location facilitates total resection. The major hurdles doctors may face are in the accurate diagnosis of this tumour as it is a rare case; each new case may teach us something new about the tumour and its diagnosis and management.

Author's Contribution

Conception and design of the study: KB and NB; Acquisition of data: ASB, NB; Drafting of the article: ASB, NB, KB; Critical revising: ASB, NB, KB; Final approval: ASB, NB, KB

Conflicts of interest

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

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Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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