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Vibrant Insights in Medicine and Healthcare

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Editorial

From Publication to Recognition: Establishing Identity and Legitimacy in Scholarly Publishing

Muhammad Junaid Khan✉

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The publication of the inaugural issue of *MedPulse Spectrum* marked a significant milestone, yet it soon became clear that publication itself was only the beginning. For any scholarly journal, credibility depends not solely on content but on formal recognition, regulatory compliance, and institutional accreditation.[1] The subsequent pursuit of an International Standard Serial Number (ISSN) and submission for recognition by the Higher Education Commission (HEC) of Pakistan represented critical steps in transforming a new publication into a legitimate scholarly entity.

The ISSN is a globally recognised identifier that distinguishes serial publications and ensures their traceability within international bibliographic systems.[2] Although the application process through the international ISSN Centre initially appeared administrative, it required detailed documentation, including proof of publication, editorial policies, and declarations of frequency, etc. The verification procedures are intentionally rigorous to safeguard the integrity of the global serials registry.[2]

During this phase, unsolicited offers promising expedited ISSN allocation for a fee highlighted a significant risk for emerging journals. Legitimate ISSN assignment is conducted exclusively through national centres affiliated with the ISSN International Centre and is not a commercial service. Adhering to formal procedures, despite delays, is essential for preserving institutional credibility and protecting against predatory practices.

The formal allotment of ISSNs for print and online formats established the journal's bibliographic identity. With this recognition, *MedPulse Spectrum* acquired a unique and internationally traceable identity (**p-ISSN:** 3105-4226, **e-ISSN:** 3105-4234) within the global scholarly ecosystem.[3]

In Pakistan, recognition by the HEC is a functional necessity for journals seeking academic credibility, particularly for attracting high-quality faculty submissions linked to promotion and career progression. The revised HEC Journal Recognition System (2024) introduced more stringent, structured evaluation criteria, emphasising editorial governance, peer-review integrity, digital infrastructure, publication ethics, and transparency.[4] The technical requirements proved equally demanding. HEC required evidence that the journal used a recognised manuscript management system, with OJS as the preferred platform. This we had, but the evaluators also required that specific metadata—publication dates, volume and issue numbers—be prominently displayed on the journal's homepage. The cascading style sheets I had painstakingly adjusted during the launch phase required further modification. I revisited PHP files I had naively considered finished, tweaking the code to ensure the newly assigned ISSN appeared in the sidebar and that the publication frequency was clearly stated. The email configuration, still temperamental despite previous troubleshooting, demanded another round of attention when automated correspondence failed to arrive. A solution involving Gmail's SMTP settings in the core HTML file, which temporarily worked during the launch, malfunctioned again. I spent an entire weekend migrating the journal's email infrastructure to a domain-based system, testing each configuration until confirmation messages finally landed in my inbox rather than the spam folder. I thought this was important for HEC submission, but was surprised to find it was not.

Anyhow, the submission, when finally completed, represented hundreds of hours of cumulative effort compressed into uploaded files and form fields. And now, the waiting. Each morning begins with a login to the HEC portal, a steadying breath, and the same message: under review. The subject line I am waiting for—"Decision Regarding Journal Recognition Application"—has not yet arrived. I tell myself that no news is not necessarily bad news, that the volume of applications is high, and that due process takes time. Still, the inbox is checked hourly, and the spam folder is checked twice daily. ISSN confirmed our identity; HEC recognition would confer legitimacy, and until that notification arrives,

the journal exists in a suspended state—fully operational yet awaiting formal acknowledgment. I spend my evenings on contingency planning, identifying every possible weakness in our application and preparing revisions should they be requested. The wait, I have come to understand, is not merely administrative. It is the final threshold, and I am standing at it, waiting every day for good news.

The accreditation process reinforced a fundamental principle: scholarly publishing is inherently collaborative. Advisory board members contributed to policy refinement and application reviews. The social network of editors and their mentorship provided clarity and direction, transforming procedural compliance into timely task completion. This experience affirmed that academic publishing is sustained not by individual effort alone but by collective intellectual and institutional engagement.

Recognition is not guaranteed, and HEC categorisation, when granted, will require continued compliance with publication schedules, strengthened peer-review processes, and measurable progress toward wider indexing visibility. Journal development is evolutionary rather than episodic; milestones such as ISSN allocation and regulatory accreditation establish foundations, but sustained credibility depends upon consistent quality assurance, ethical vigilance, and editorial discipline.

The transition from launch to recognition will not signal completion; it will only signal progression—from establishment toward consolidation and measured growth. Much of this work remains administrative and procedural, yet it is within these details that scholarly integrity is secured. Once the notification arrives, it will define the responsibility ahead. Until then, the journal remains fully operational, the applications remain submitted, and I stay at my desk, checking the portal each morning, waiting every day for good news.

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Commentary

UNDERSTANDING THE CONCEPT OF LEADERSHIP & MANAGEMENT IN HEALTHCARE INDUSTRY: ARE THESE TWO SIDES OF THE SAME COIN?

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ABSTRACT: Leadership and management are distinct yet complementary forces essential for an effective healthcare system. While leadership involves setting a visionary path, inspiring teams, and motivating change through intuition and interpersonal influence, management focuses on the systematic organisation, coordination, and execution required to achieve specific goals. This article explores the differences between these two attributes, highlighting that a competent manager may not inherently be a strong leader, and vice versa. Effective healthcare delivery demands a blend of both skill sets: communication, delegation, and conflict resolution are integral to management, whereas vision and inspiration are the hallmarks of leadership. The article argues that for a healthcare system to function smoothly, leadership must initiate the process and define the direction, while management must facilitate the journey, ensuring targets are met through organised planning and evaluation. Ultimately, both are two sides of the same coin, interlinked and necessary for translating vision into tangible patient outcomes.

KEYWORD: Leadership; Management; Healthsector

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INTRODUCTION

Leadership is a crucial component in the healthcare industry, ensuring that medical services are delivered effectively, patient outcomes are improved, and a positive working environment is maintained.[1] In contrast to leadership in other sectors, healthcare leadership requires a thorough understanding of clinical procedures and a genuine compassion for both patients and employees. To effectively balance the demands of patients, staff, and the organisation, healthcare leaders must possess strong strategic planning, decision-making, and communication skills. [2]

On the other hand, management in the healthcare industry involves effective resource organisation, coordination, and oversight to provide high-quality patient care. Planning, resource allocation, and funding are all essential to maintaining the efficient operation of healthcare facilities. Healthcare managers play a crucial role in enhancing operational effectiveness, leading healthcare teams, and implementing policies and procedures, thereby contributing to patient safety and quality improvement.[3]

Although leadership and management are closely interrelated, they remain two distinct attributes. Collectively, both form a framework of vital skills and abilities required for an individual to carry a team successfully towards a target. [4] However, on the other hand, a good manager may not be a good leader, and vice versa. Leadership enables a person to define a path and motivates others to pursue that path. Whereas management is different, it enables the team to follow that path to achieve the ultimate goal.

Leadership vis-à-vis Management

There may be occasions when leadership is responsible for various aspects of management. Stelnicki *et al.* mentioned that effective nursing leadership plays a vital role in the management of nurses' mental health. [5] According to Turk W, most people agree that leadership and management are different from each other, but when they are asked to identify the key differences, they struggle to enumerate any. The reason is probably that they have an image in their mind but cannot express it in words. However, he notes a key distinction between a manager and a leader: a manager adheres to established policies and procedures, following textbook knowledge and techniques, whereas a leader follows their own intuition. In other words, leadership is responsible for setting the path, while management is responsible for driving it forward. [6] Ellis P and Abbott J consider a leader as someone- followed by choice, but on the other hand,

people have to obey the manager.[7] In crux, both are distant aspects but of the same coin.[8]

What is integral for effective management?

There are quite many things that are important and integral for effective team management. Communication skills play a key and vital role in management. If a person communicates effectively with their team members, they can manage the team more effectively.[8] Sometimes, it becomes challenging to manage a team remotely, particularly when outsourcing projects and managing global virtual teams (GVTs), which can result in a virtual communication gap. To overcome this, I suggest that in-person management meetings should be scheduled mandatorily to interact with the team.

Delegation of tasks is another key component of effective management. Not everything can be done by a single person. A good manager is one who can utilise the strengths and weaknesses of their team members and delegates the right tasks to the right person. Problem-solving and troubleshooting are other key skills essential Leadership inspires the team to initiate the process, while management facilitates it, ensuring the team meets their expected targets by evaluating their performance against pre-defined key performance indicators. Turk W quotes an interesting proverb in his article that "Managers do things right, while leaders do the right thing."[6] Algahtani states that to ensure effective management, a person requires an aptitude for directing, building, and planning. However, to exercise effective leadership, a person requires an aptitude for motivating and inspiring others.[10]

for managing a team. If one struggles with problem-solving or troubleshooting, it may be challenging to manage the team effectively. Similarly, conflict management is another crucial skill necessary for effective team management [8]

Are the two sides of the same coin?

Now, this is a tricky question to answer, because there are many key ingredients common to both leadership and management, such as communication and interpersonal skills, mentoring, and delegation of assignments. However, as discussed earlier, there is a fine line between leadership and management. One person can be a good leader and a good manager simultaneously, but it is not always the case. A good leader may not possess good management skills, and similarly, a good manager may not prove to be a good leader. Leadership requires a visionary mindset, while management requires a systematic, well-organised approach to turn that vision into reality. [9]

What can help in the smooth delivery of an effective healthcare system?

CONCLUSION

Collectively, leadership and management are two distinct skill sets that share a few common traits. For effective team management in the healthcare industry, both are essential for delivering the targeted patient-centred services successfully. In other words, they are interlinked and collectively lead towards a goal by two or more individuals, as it is tough to find a perfect leadership and management skill set in a single individual.

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Original Article

THE EFFECT OF LOW-MOLECULAR-WEIGHT HEPARIN ON THE BIRTH WEIGHT IN 28 TO 34-WEEK PREGNANCIES COMPLICATED BY INTRAUTERINE GROWTH RESTRICTION

Qurat-ul-Ain✉, Komal Imtiaz, Maria Nawaz
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Background: The use of low-molecular-weight Heparin (LMWH) in intra-uterine growth reduction (IUGR) is very common. However, its effect on the neonatal birth weight has not been studied in our context. This study aims to compare the mean birth weight of neonates receiving IUGR versus controls in females presenting with IUGR. **Methods:** This comparative cross-sectional study enrolled 100 women aged 18–40 years with parity <6, presenting at 28–34 weeks of gestation with IUGR, from the Department of Obstetrics and Gynaecology, Pakistan Institute of Medical Sciences, Islamabad. After applying the selection criteria and obtaining approval, group 1 females were given LMWH (0.2–0.4 mL by subcutaneous injection) along with parenteral nutrition, while in group 2, females received only parenteral nutrition (control group). Then, females were followed up every 15 days until delivery. At the time of delivery, the baby's birth weight was recorded. **Results:** The mean age of women in group 1 was 30.10±5.48 years, and in group 2 was 29.06±4.48 years. Mean gestational age was 30.49±1.87 weeks. The mean birth weight of infants in group 1 was 2957.20±177.76 grams, and in group 2 was 2663.7±176.32 grams, with a p<0.0001. **Conclusion:** The mean birth weight of neonates receiving LMWH is higher compared to controls in females presenting with intrauterine growth retardation.

Keywords: Intrauterine growth restriction, heparin, LMWH, birth weight.

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INTRODUCTION

A reduction in foetal growth rate that prevents an infant from reaching its full potential is known as intrauterine growth restriction (IUGR).[1] Additionally, it continues to be a major global cause of perinatal morbidity and mortality. With a reported incidence of 25%, IUGR is notably prevalent in Pakistan.[2] The main cause of IUGR is utero-placental insufficiency, although the aetiology is complex.[3] Major complications for the new-borns are linked to this condition, such as intrapartum asphyxia, hypoglycaemia, and meconium aspiration syndrome.

Management of IUGR often includes bed rest, but this increases the risk of thrombosis. Heparin, with its anticoagulant properties and its ability to inhibit complement activation on trophoblasts, has been considered an effective therapeutic agent for preventing pregnancy complications such as IUGR.[4] Theoretical advantages of LMWH over unfractionated heparin include superior bioavailability and a lower risk of complications.

Several emerging studies have begun investigating the specific efficacy of LMWH in improving outcomes in pregnancies with IUGR.[5,6] The most important study to date, that of Yu *et al,* from China, demonstrated that among females with IUGR between 28 and 34 weeks of gestation, the mean birth weight was significantly higher in those treated with LMWH compared with controls (3080±225 grams vs. 2580±304 grams).[7] This suggests further exploration; due to the lack of effective intervention for IUGR pregnancies, further research is needed to establish how effective LMWH can be as a regular treatment modality in the Pakistani context.

This study is based on the aforementioned research gap. It aimed to compare the mean birth weight of new-borns to mothers presenting with IUGR who were administered LMWH versus those who received standard care alone. The main benefit of this study is to provide concrete evidence on the role of LMWH as a therapeutic intervention to improve foetal growth and, consequently, perinatal outcomes in cases of IUGR.

MATERIALS AND METHODS

This comparative cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, Pakistan Institute of Medical Sciences, Islamabad, from February 15, 2023, to April 15, 2024. With non-probability, consecutive sampling, a sample size of 100, (50) in each group was calculated with a 95% confidence interval and 5% level of significance, 80% power of the test, with a mean birth weight of 3080±225 g in the LMWH group and 2580±304 g in the control group in females presenting with intrauterine growth retardation. [7] Females of age 18–40 years of parity <6 presenting during gestational age 28-34weeks (on USG and antenatal record) presenting with IUGR (as per operational definition) were included whereas, pregnancies complicated by gestational diabetics (BSR >185mg/dL), hypertensive (BP>140/90), eclamptic, underweight (BMI <18 Kg/m^2) were excluded.

After obtaining approval from the hospital's ethics committee and informed consent, 100 females meeting the selection criteria were enrolled in the study from the OPD. Demographic information (name, age, weight, height, gestational age, parity, and contact information) was obtained. Then, the females were randomly divided into two groups by using the lottery method. Both groups were given parenteral nutrition. In group 1, females received LMWH (0.2-0.4 mL by subcutaneous injection) along with parenteral nutrition, while in group 2, females received only parenteral nutrition (control group). Then, females were followed up every 15 days until delivery. At the time of delivery, the baby's birth weight was recorded. All this information was collected through a pre-designed proforma.

Considering the data to be normally distributed, descriptive statistics and the sample *t*-test were used to analyse the data in SPSS IBM software. $p \leq 0.05$ was taken as significant

RESULTS

A total of 100 participants with an age range of 18 to 40 had a mean age of 29.78±5.0 years (group 1 was 30.10±5.48 years, and group 2 was 29.06±4.48 years). The age in years and gestational age in weeks, and parity of both groups are shown in Table-1. The Mean birth weight of group 1, i.e., 2957.2±177.76, with a $p = 0.0001$, is shown in Figure-1.

The stratification of age, gestational age, and parity is shown in Table-2 with a significant *p*-value.

Table-1: Age distribution for both groups (n=100)

		Group I (n=50)		Group II (n=50)		Total (n=100)	
		n	%	n	%	n	%
Age (years)	18–30	26	52.0	33	66.0	59	59.0
	31–40	24	48.0	17	34.0	41	41.0
	Mean±SD	30.10±5.48		29.06±4.48		29.78±5.07	
GA (weeks)	28–30	27	54.0	27	54.0	54	54.0
	31–34	23	46.0	23	46.0	46	46.0
	Mean±SD	30.56±1.94		30.46±1.86		30.49±1.87	
Parity	0–2	11	22.0	15	30.0	26	26.0
	3–5	39	78.0	35	70.0	74	74.0

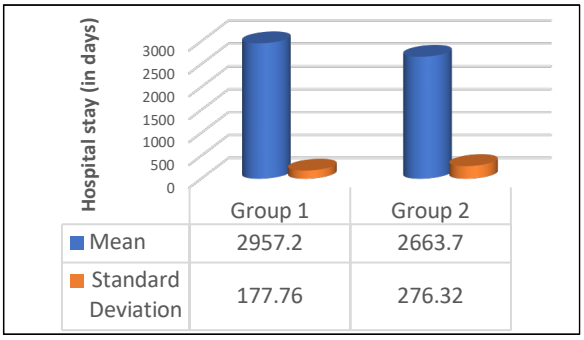

Figure-1: Mean birth weight of neonates in both groups

Table-2: Stratification of birth weight of neonates with respect to different variables

Dichotomous variables		Group 1 (n=50) Birth weight of neonates Mean±SD	Group 2 (n=50) Birth weight of neonates Mean±SD	*P*
Age of patients (years)	18–30	2985.70±164.70	2681.20±284.35	0.0001
	31–40	2926.33±189.54	2629.80±265.07	0.0001
GA (weeks)	28–30	2959.10±173.17	2767.33±262.17	0.0001
	31–34	2955.03±186.90	2542.13±245.33	0.0001
Parity	0–2	3008.55±161.80	2597.12±293.98	0.0001
	3–5	2942.74±181.33	2692.39±267.69	0.0001

$p = 0.0001$, which is statistically significant

DISCUSSION

The main aim of this study was to compare the mean birth weight of neonates born to mothers with IUGR who were given LMWH against those who received only standard care. Our results indicate a statistically significant increase in mean birth weight in the LMWH group (2957.20±177.76 g) compared with the control group (2663.7±176.32 g; $p=0.0001$). This finding strongly supports that administration of LMWH enhances fetal growth parameters in pregnancies complicated by IUGR.

The demographics of the study population mirror those of a general obstetric population typically seen in tertiary care. The mean age of participants was 29.78±5.07 years. As in the general obstetric population, most women (59.0%, n=59) were younger, aged 18–30 years. Our population also had very high maternal parity, with 74.0% (n=74) of women having a parity of 3–5. The anticipated benefits of LMWH observed in our population align with its pleiotropic effects, which are thought to complement its anticoagulant properties with anti-inflammatory and pro-angiogenic effects, thereby mitigating placental dysfunction.[4]

The observed statistically significant increases in birth weight observed in this study further contribute to the ongoing discussion surrounding the clinical utility of LMWH, as evidenced by substantial variations in global guideline recommendations regarding postpartum venous Thromboembolism prophylaxis.[8] Finally, and in consideration of the clinical application of our results, it

must be emphasised that, in terms of weighing benefit to risk, we need to acknowledge and recognise that bleeding events have been shown to occur in this population even though they are infrequent.[9]

The positive impact was consistent across all gestational ages. Neonates in the LMWH group had higher birth weights, whether the treatment began at 28–30 weeks (2959.10 vs. 2767.33 g) or 31–34 weeks (2955.03 vs. 2542.13 g). The larger difference in the latter group is noteworthy, suggesting that while LMWH is effective after diagnosis, foetal issues may be more severe in later-presenting cases, and the treatment helps mitigate this. A 2024 study supports this, noting that placental issues are often more severe in late-onset IUGR, and treatments that improve placental blood flow could be very helpful.[10] Lastly, the study showed that LMWH was beneficial for both low-parity (0–2) and high-parity (3–5) women (p=0.0001). This demonstrates the positive effects of LMWH in IUGR cases, regardless of the mother's disease history, including parity.

Our result, though not directly, is supported by the literature. Cruz-Lemini M *et al,* in their systematic review, concluded that the use of LMWH in high-risk pregnancies has significantly (OR= 0.61) reduced the prevalence of small-for-gestational-age new-borns.[11] This supports our study, indicating a more protective role in IUGR, as observed in our non-interventional group. Another meta-analysis by Chen J *et al*, studying the synergistic effect of LMWH with low-dose aspirin on high-risk pregnancies without thrombophilia, resulted in the prevention of foetal growth restriction.[12] Although the current study only included LMWH, it reinforces the potential therapeutic effect of LMWH in IUGR. This appears to improve the placental insufficiency, and hence the IUGR.

Studies suggest that, in addition to its role in anticoagulation, LMWH enhances placental function through various mechanisms. Through binding to cytokines like IL-6 and IFN-γ, it inhibits inflammatory pathways and reduces inflammation, playing a key role in IUGR placental issues.[13] Moreover, by inhibiting heparinise and boosting nitric oxide, it also protects the endothelial cells, resulting in improved blood flow in the placenta. Newer studies even suggest a promising role for LMWH in placental repair by enhancing the function of mesenchymal stem cells. Collectively, these factors, reducing inflammation, repairing cellular structure, and protecting vessels, seem favourable for increasing foetal weight gain, thus reducing IUGR incidence. [14]

Despite the beneficial effects of LMWH in IUGR pregnancies, conflicting studies also exist. For example, in a larger trial, TIPPS mentioned that LMWH use in high-risk pregnancies is not beneficial in reducing IUGR.[11] Such a difference can arise from variation in the study participants and the study setup. Our study included LMWH as a treatment modality for IUGR in pregnancies between 28 and 34 weeks. On the other hand, larger trials used LMWH as a preventive measure in high-risk pregnancies.[12] This appears to be a key difference because the use of LMWH in a struggling placenta might be beneficial than preventing other health issues in an already healthy placenta. Furthermore, the gestational age also matters. As in Cruz-Lemini *et al,* LMWH has a beneficial effect in preeclampsia when used before the 16th gestational week.[11,15] However, our study indicated a promising effect when treatment was initiated at the 28th gestational age, suggesting that late treatment in pregnancies with IUGR may be more effective. LMWH is generally safe during pregnancy, as shown in a 2024 review.[4] Bleeding is a known risk, but its predictable behaviour makes it the preferred option. It can be beneficial in difficult situations, such as IUGR, because the benefits to the baby's growth likely outweigh the risks.

LIMITATIONS AND FUTURE DIRECTIONS

The study's small size and single-centre design limit the generalizability of the results. The gestational range, i.e., 28–34 weeks, and limited to one condition of placental insufficiency, i.e., IUGR, is too specific and can show variable results in other placental conditions and gestational age. Future studies

CONCLUSION

The LMWH use in otherwise healthy pregnant women between gestational ages of 28-34 weeks increases the average birthweight of IUGR infants. This further supports the notion that LMWH improves placental sufficiency through various mechanisms, thereby enhancing blood flow and increasing nutrient availability to the fetus, making it a suitable treatment option for IUGR pregnancies.

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Original Article

LIFESTYLE HABITS OF MEDICAL AND NON-MEDICAL TEACHERS: A COMPARATIVE CROSS-SECTIONAL STUDY

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Background: Teachers, both medical and non-medical, are important community professionals. Their lifestyle habits, such as diet, exercise, and stress management, are influenced by their profession. This study aimed to identify the similarities and differences in lifestyle habits between medical and non-medical teachers in two populous provinces of Pakistan. **Method:** This cross-sectional study was conducted in different cities of Punjab and Khyber-Pakhtunkhwa (KPK) province from April 2024 to January 2025. By convenient sampling, 208 medical and non-medical teachers completed an electronic questionnaire. Data was analysed using SPSS-22. The Independent *t*-test and Chi-square test were used to compare lifestyle habits between the groups. A $p<0.05$ was considered significant. **Results:** A Total of 208 medical and non-medical teachers with a mean age of 33.36±10.165 years, 131 (63.0%) males and 77 (37.0%) females participated in the study. Overall, 178 (85.6%) of the respondents had healthy lifestyle habits, with a mean value of **5**1.44±8.6301. A chi-square test across lifestyle domains, including exercise, diet, stress management, and demographic variables, resulted in an insignificant. Additionally, no significant difference was found between lifestyle domains and overall scores versus those of medical and non-medical teachers ($p>0.05$, respectively). **Conclusion:** The study confirmed that teachers, as a whole, exhibit healthy lifestyle habits, including exercise, stress management, and a balanced diet, irrespective of their profession across various academic institutions in Punjab and KPK. This suggests that occupational context and socioeconomic factors are more significant determinants of lifestyle than specialised health knowledge.

Keywords: Lifestyle Habits; Medical Teachers; Non-Medical Teachers; Comparison.

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INTRODUCTION

Health is a state of physical, mental, and social well-being in which disease and infirmity are absent.1,2 The term 'lifestyle' is a relatively familiar concept often used to describe people's lives. It is the full range of reflections of social values, attitudes, and activities.[3] Lifestyle includes behaviours such as food habits, sleeping, resting, physical activity, exercising, weight controlling, and immunisation against disease.[4] A healthy lifestyle (HLS) helps keep and improve peoples' health and well-being.

Every profession and occupation has its risks and hazards.[5] Medical teachers, in general, are more committed to their profession and experience late working hours and stress management, which negatively impact their health. On the other hand, non-medical teachers tend to be relatively more relaxed and live healthier lives.[6]

Studies on the lifestyle of non-medical teachers have been conducted. The results of Charkzai *et al*, showed that the lifestyle of 84% of teachers in Gorgan city was semi-desirable, and other studies indicate that the lifestyle status of teachers is not favourable.[7] However, in Asian countries, a comparative analysis of HLS habits, particularly diet, exercise, and stress management among medical and non-medical professionals, is rarely studied. Medical teachers, as healthcare providers, are more knowledgeable about healthy living and health hazards compared to non-medical teachers. Therefore, it is necessary to determine whether they apply their knowledge in practice.

This study aims to identify and compare the lifestyle behaviours, including eating habits, exercise practices, and stress management, or coping capabilities, among medical and non-medical teachers in Punjab and KPK provinces of Pakistan.

MATERIALS AND METHODS

This cross-sectional study was conducted in various cities of Punjab and Khyber Pakhtunkhwa from April 2024 to January 2025. After obtaining ethical approval and using a convenience sampling technique, data were collected via an electronic (freely available on Google) form at various medical and non-medical undergraduate institutions. The e-form comprised six sections: a brief introduction including the objective and exclusion criteria, a consent and confidentiality statement, a socio-demographic profile, and questions related to three domains of HLS: exercise, stress management, and diet. The first two domains consisted of 7 questions each, with a 5-point Likert scale. The minimum score was 7, and the maximum was 35. A cut-off value of ≤21 was considered an HLS. The third domain consisted of six questions, each with five levels (ranging from 6 to 30). A cut-off value of ≤18 was considered a healthy diet habit. Each question had a cut-off value of 3, with responses 1-3 indicating a healthier lifestyle (strongly agree, agree, neutral) and 4–5 indicating a poorer lifestyle (disagree, strongly disagree). For the total score (20 questions, minimum 20 and maximum 100), a cut-off of 60 or less was considered HLS. However, the greater the score, the poorer the lifestyle was assumed.

The study included participants from undergraduate medical and non-medical teaching professions with at least 5 years of experience and a minimum age of 25. Designation was categorised according to the basic pay scale or its equivalent. All teachers of primary and secondary schools or diploma-awarding institutes, as well as those with any chronic disease(s), were excluded. In SPSS 22, the Shapiro-Wilk test was used to assess data normality. In addition to descriptive statistics and the chi-square test, the independent *t*-test was used to compare lifestyle domain scores across the two professions. When the *p*-value of the Levens test was >0.05, equal variance was assumed for each domain. $p<0.05$ was considered significant.

RESULTS

A total of 284 responses reached the e-form, among which 76 were excluded due to either non-consent or incomplete form completion. The remaining 208 respondents' data, with a mean age of 33.36±10.165 years, are included in the current study. Table-1.

Table-1: Demographic characteristics of participants

Attributes of participants		n (%)
Gender	**Male**	131 (63.0)
	Female	77 (37.0)
Profession	**Medical teachers**	89 (42.8)
	Non-medical teachers	119 (57.2)
Marital Status	**Single**	98 (47.1)
	Married	106 (51.0)
	Divorced	4(1.9)
Profession scale	**BPS-16 or below**	74 (35.6)
	BPS-17	65 (31.3)
	BPS-18	25 (12.0)
	BPS-19	18 (8.7)
	BPS-20 or above	26 (12.5)
Total		208(100.0)

Overall, 178 (85.6%) of the respondents had healthy lifestyle habits, with a mean value of **5**1.44±8.6301 (Table-2).

Table-2: Descriptive statistics of lifestyle domains and categorization of health vs poorer lifestyle

Domain	Standard cut-off value	Mean+SD	Min-Max	Healthier Lifestyle	Poorer Lifestyle
Exercise	≤21	18.86±4.0673	7–28	145(69.7)	63(30.3)
Stress management	≤21	18.13±4.0346	7–35	176(84.6)	32(15.4)
Diet	≤18	14.46±3.9168	6–27	174(83.7)	34(16.3)
Overall	≤60	51.44±8.6301	20–77	178(85.6)	30(14.4)

When the chi-square test was run across lifestyle and demographic variables, none of the results was significant. However, 114 (87%) males, 77 (86.5%) medical teachers, 92 (86.8%) married, and 63 (85.1%) with a BPS-16 or lower ranking had higher frequencies of healthier lifestyles compared to those with poorer lifestyles. This confirms that medical teachers are not significantly more or less likely to have a healthy lifestyle than non-medical teachers, Table-3.

Table-3 Comparison of participants' characteristics with lifestyle status, Chi-Square test (n=208)

Participants attributes	Lifestyle status		Total n (%)	*p*
	Healthy lifestyle Habits	Poor lifestyle Habits		
Gender				
Male	114 (87)	17 (13)	131 (100)	0.439
Female	64 (83.1)	13 (16.9)	77 (100)	
Profession				
Medical teachers	77 (86.5)	12 (13.5	89 (100)	0.739
Non-medical teachers	101 (84.9)	18 (15.1)	119 (100)	
Marital Status				
Single	82 (83.7)	16 (16.3)	98 (100)	0.580
Married	92 (86.8)	14 (13.2)	106 (100)	
Divorced	4 (100)	0 (0.0)	4 (100)	
Pay scale				
BPS-16 or below	63 (85.1)	11 (14.9)	74 (100)	0.865
BPS-17	55 (84.6)	10 (15.4)	65 (100)	
BPS-18	21 (84)	4 (16)	25 (100)	
BPS-19	17 (94.4)	1 (5.6)	18 (100)	
BPS-20 or above	22 (84.6)	4 (15.5)	26 (100)	
Total	178 (85.6)	30 (14.4)	208 (100)	

$p<0.05$=significant

When each question was checked for lifestyle categorisation with a cut-off value of <3, 14/20 question mean values were with a positive response (Table-4).

Table-4: Mean±deviation of each question, indicating a positive response with a cut-off value of <3

Questions	Mean	SD

Exercise is a part of my daily routine	2.35	1.006
I start an exercise program but then find myself unable to stick to that	2.21	0.948
I feel fresh after exercise	1.66	0.830
I feel exhausted after exercise	3.29	1.302
I cannot do exercise because of busy schedule	2.77	1.391
I cannot do exercise because of laziness	3.06	1.364
I visit doctor for regular check-up	3.50	1.270
I eat a balanced diet and healthy diet	2.25	1.005
I drink at least eight glasses of water in a day	2.41	1.334
I eat homemade food	1.91	0.966
Fruits and vegetables are included in my daily diet	1.94	0.981
I avoid soft drinks and junk food	2.61	1.318
I often order food from restaurant	3.33	1.297
I'm able to cope with stress in my life	2.34	1.114
I relax and enjoy leisure time	2.11	0.911
I feel stressed during work hours	3.06	1.336
I drink tea/ coffee to relieve stress	2.77	1.418
I smoke or take relaxants to relieve stress	3.71	1.217
I sleep 8 hours daily	2.10	1.040
I enjoy my work	2.04	1.028

An independent *t*-test was conducted to compare the mean score of lifestyle domains between medical and non-medical teachers. No significant difference was found between lifestyle domains, such as exercise, diet, stress management, and overall score, versus medical and non-medical teachers (p>0.05, respectively), as shown in Table-5. For all tests, degrees of freedom were assumed to be equal, as Levene's test was not significant for any variable (p>0.05).

Table-5: Comparison of lifestyle domains with professions by independent *t*-test (n-208)

	Teaching status					
Lifestyle Domain	**Medical Teacher Mean±SD**	**Non-Medical Teacher Mean±SD**	***t***	**df**	**Cohen's d**	***p***
Exercise	19.0000±4.13412	18.7395±4.03052	0.532	206	0.06	0.649
Diet	14.4719±4.07623	4.07623± 3.81055	0.048		0.01	0.962
stress management	17.5843±4.04185	18.5378±3.99744	-1.694		-0.24	0.092
Overall	51.0562±8.52451	51.7227±8.73326	-0.550		-0.08	0.583

p<0.05=significant

DISCUSSION

The current study aimed to identify and compare lifestyle habits, including dietary patterns, physical activity, and stress management, between medical and non-medical teachers. Contrary to the assertion that medical teachers would exhibit better health practices, the study revealed no significant differences in the lifestyle habits of medical and non-medical teachers.

Based on the overall score, this study identified a high percentage (85.5%) of healthy lifestyle habits in the whole cohort. This is quite high compared to other studies, which report moderate levels of health-promoting behaviours.[8] From a broader spectrum, Pakistan's national data suggested that most of the population lives with insufficient physical activity and consumes a low-healthy diet.[9] This discrepancy indicates that the teaching cohort of the population, irrespective of their field of speciality, is observing healthy lifestyle habits because of their structured working hours and greater job stability and satisfaction.

The primary question of the current study yielded unequivocal null results. The chi-square test revealed no significant association between professional category and lifestyle classification (X^2=0.112, p=0.739), with nearly identical proportions of medical (86.5%) and non-medical teachers (84.9%). Maintaining a healthy lifestyle. This finding was further substantiated by independent-samples t-tests, which showed no statistically significant differences in mean domain scores for exercise (t=0.532, p=0.649), diet (t=0.532, p=0.649), stress management (t=-1.694, p=0.092), or the overall lifestyle score (t=-0.550, p=0.962). These results align with recent work by F Alves R (2023), who found that health knowledge alone was a poor predictor of lifestyle habits among educated professionals and more closely support the hypothesis that occupational context overrides disciplinary background.[10,11]

The paradoxical finding that medical knowledge does not translate into personal health practices can be explained through the theoretical framework of the "know-do-gap", a well-documented phenomenon in health behaviour research by Pakenham-Walsh N.[12] This gap is particularly evident in high-stress professions where time constraints become a predominant barrier. The mean values of our questionnaire support this, revealing that the "busy schedule" (Q5, mean=2.77) was a commonly endorsed barrier to exercise across both groups. This suggests that the structural constraints of the teaching profession - including heavy workloads and time pressures - create a universal barrier that impedes the translation of knowledge into action regardless of disciplinary background.[13] Moreover, a uniform distribution of participants across Basic Pay Scale 16 to 20 shares a similar socioeconomic status, indicating a uniform access to resources, similar mindsets that lead them to adaptation of healthy lifestyle behaviours [14]

Despite valuable insights, this study bears certain limitations. Due to the study's cross-sectional design, causal relationships could not be established. A potential participant bias arises from the nature of self-reported measures, in which participants may over- or under-report their lifestyle habits. A limited cross-analysis of sub-groups, such as divorced individuals, and a relatively small sample size of females, may affect its generalizability. Future studies should focus on

minimising the limitations by employing a longitudinal study design or independent behavioural analysis through phenomenological approaches.

CONCLUSION

Overall, teachers exhibit commendably healthy lifestyle habits, with medical teachers engaging in no more healthy behaviours than their non-medical colleagues. This establishes that socioeconomic factors and occupational context are powerful determinants of lifestyle behaviours than specialised health knowledge. Institute-level wellness initiatives within educational premises are warranted to address pervasive constraints, such as work-related stress management and busy schedules, thereby supporting all educators and maintaining their health despite the demands of their profession.

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Original Article

INPATIENT DECOMPENSATED CHRONIC LIVER DISEASE: EPIDEMIOLOGY AND HOSPITAL OUTCOMES IN TERTIARY CARE

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Background: decompensated chronic liver disease (DCLD) is the leading cause of global mortality and morbidity with varied aetiological factors and inconsistent outcomes. Extensive literature exists on its clinical and management aspects, but little on epidemiological outcomes; therefore, this study aims to characterise the epidemiology and hospital outcomes of patients admitted with DCLD in a tertiary care hospital. **Methods:** This analytical cross-sectional study was conducted at Khyber Teaching Hospital & Hayat Medical Complex from March 2019 to April 2021 among adult inpatients with confirmed cirrhosis. Data on demographic and disease characteristics were recorded and analysed using SPSS-26. The primary outcome, i.e., discharge status (improved vs. died), was tested using independent t-tests and chi-square/Fisher's exact tests with $p<0.05$. **Results:** A total of 61 diagnosed cases of DCLD, male 36 (59%), with an overall mean age of 49.61±14.028 years, a mean duration of disease of 3.94±3.649 years, and 4.02±1.576 days of LOS were included. The mortality rate of in-patient DCLD patients was 12 (19.7%). Only aetiology was significantly associated with patient outcomes. Patients who improved had a longer hospital stay. **Conclusion:** Outcomes in DCLD are strongly influenced by non-clinical forces. Social class was more important in predicting death than clinical factors, while gender and disease duration mattered less than expected. The high death rate from Hepatitis C needs immediate action to improve access to care. Also, staying longer in the hospital may help save lives by allowing better management of complications.

Keywords: Decompensated chronic liver diseases; DCLD; epidemiology; disease outcome

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INTRODUCTION

Chronic liver disease (CLD) represents a leading cause of global morbidity and mortality, with over two million deaths annually, with cirrhosis alone responsible for about one million deaths.[1,2] Progression to decompensated chronic liver diseases (DCLD)-characterised by the development of ascites, hepatic encephalopathy, visceral haemorrhage, or jaundice- marks a critical inflection point.[3] The DCLD signifies advanced liver dysfunction and occurs in more than 50% of cirrhotic patients within 10 years.[4] It is associated with a 1-year mortality exceeding 20% after initial decompensation, rising to 43.8% with >2 complications.[5] In Bhopal, India, 46.4%, Nepal 18.9%, Nothingin, UK, 38.8% and Philadelphia, USA, 10.9% mortality is documented.[6–9]

The literature on different aspects of DCLD is extensive. Regarding aetiology and management, the literature suggests that the distribution of aetiologies and approaches to managing them varies globally. A recent review article reported that liver cirrhosis is caused mostly by Hepatitis C (24%), and alcohol-related (27.9%), whereas in Pakistan, it is Hepatitis C, i.e., 86%.[10,11] The management burden is increased by the complication of DCLD. The complications, e.g., variceal bleeding, hepatorenal syndrome, are well-studied; however, a comprehensive analysis of non-clinical determinants of outcome in general DCLD admissions remains limited.[12] Existing research prioritises aetiology-specific studies or interventions over non-clinical determinants. Key determinants such as socioeconomic status (SES), disease duration, length of stay (LOS), and aetiology distribution are underreported despite their profound impact.[13]

Evidence suggests that the non-clinical determinants matter significantly in DCLD.[13] Lower SES correlates with 34–43% higher hospitalisation rates for alcohol-related DCLD in high-income countries and has a 7.4-fold higher mortality in deprived populations.[14] Moreover, the time from chronic liver disease diagnosis to decompensation predicts outcomes and determines LOS at the hospital. A DCLD patient with more complications stays for a prolonged time in a hospital with higher mortality rates. No doubt, these factors play a crucial role

in shaping disease patterns, healthcare utilization, and overall population health, yet they are overlooked in epidemiological studies.[13]

Despite these trends, integrated analysis linking demographics, SES, disease duration, LOS, and aetiology to dichotomous inpatient outcomes (improved vs dead) in a tertiary-care DCLD cohort is scarce. This gap hinders risk stratification, particularly in resource-limited settings where DCLD mortality rates vary. Therefore, this study aims to characterise the epidemiology (including demographic profile, disease duration, LOS, and aetiology) and hospital outcomes (discharge status) of patients admitted to a tertiary care hospital with decompensated chronic liver disease. By defining these characteristics and their relationships to survival, this study seeks to provide valuable insights for risk stratification, resource allocation, prognostication, and the development of targeted management strategies for hospitalised DCLD patients in a tertiary care setting.

METHODOLOGY

This analytical cross-sectional study was conducted at a tertiary care hospital from March 2019 to April 2021. Using the WHO sample size calculator (version 2.0), with absolute precision (d=0.10), an inpatient mortality rate of 18.9% for DCLD patients, and ±10% absolute precision (95% CI), a minimum of 62 samples was calculated. The precision balances feasibility and validity, and subgroup analyses are exploratory due to reduced power for effects with an absolute difference <25%. A total of 61 adult in-patients (≥18 years) with clinically, radiologically, or histologically confirmed cirrhosis were consecutively enrolled. Patients unable to consent due to encephalopathy or cognitive impairment, those with prior liver transplantation or co-existing malignancies (other than hepatocellular carcinoma), and individuals with significant comorbidities (e.g., advanced cardiac, renal, or pulmonary disease) were excluded.

After obtaining ethical approval from the institute's IRB and patient consent, data were collected and recorded on a structured pro forma. The independent variables included age, gender, duration of cirrhosis (years since diagnosis), LOS in days, disease aetiology (e.g., Hepatitis B, C, alcohol, others), and SES based on Collis D's social grade classification.[15] Whereas the dependent or outcome variable included discharge status, which was dichotomised as "improved" or "died". Data entry and analysis were performed using SPSS-26.

The normality of continuous variables (such as age, disease duration, and LOS) was confirmed by the Kolmogorov-Smirnov test (p>0.005). Inferential analysis included an independent *t*-test to assess the significance of the difference between the continuous and outcome variables. Chi-square or Fisher's exact tests to assess associations between categorical variables (gender, aetiology, and SES) and outcome. Two-tailed p<0.05 were considered statistically significant. Statistical methods were chosen to align with participants' normal variable distributions and small cell counts, in accordance with the STROBE guidelines for observational research reporting.

RESULT

A total of 61 diagnosed cases of DCLD with a mean age of 49.61±14.028 years, a mean duration of disease of 3.94±3.649 years, and 4.02±1.576 days of LOS. Among the 61 patients, males were more prevalent, i.e., 36 (59%). The social class grade was E in 28 (45.9%) patients. Hepatitis C was the most common cause of DCLD, affecting 47 (77.0%) patients. The mortality of in-patient DCLD patients appeared 12 (19.7%), as in Table-1.

The Chi-square and/or Fisher's exact test revealed that only aetiology had a significant p-value, whereas gender and SES showed no association with DCLD, Table-2. The independent *t*-test revealed a significant difference in hospital stay and patient outcomes, with discharged patients staying longer than those who died, t (59) = 2.96, p=0.036, with a mean difference of 1.06 days (95% CI [0.07, 2.04]), indicating length of hospitalisation may be associated with discharge status. Whereas no significant difference in age, t (59) = -1.84, p=0.070, 95% CI [-17.03, 0.70], nor in disease duration, t (12.72) = -1/37, p=0.196, 95% CI [-17.03, 0.70], between improved and died patients was observed, Table-3.

Table-1: Demographic and clinical characteristics of patients (n=61)

Variable	Mean±SD OR n (%)
Age	49.61±14.028
Duration of disease?	3.94±3.649
LOS (in days)	4.02±1.576
Gender	
Male	36 (59%)
Female	25 (41%)
Socio economic status	
Middle class (B)	5 (8.2 %)
Lower middle class (C1)	9 (14.8 %)
Skilled working class (C2)	7 (11.5%)
Working class (D)	12 (19.7 %)
Lowest level (E)	28 (45.9%)
Cause of DCLD	
Hepatitis B	5 (8.2 %)
Hepatitis C	47 (77.0 %)
NAFLD/ ALD	2 (3.3%)
Wilson's disease	3 (4.9%)
Others	4 (6.6%)
Status at discharge	
Improved	49 (80.3%)
Died	12(19.7%)
Total:	61(100%)

Table-2: Association between gender and aetiology with discharge status, Chi-square/Fisher's exact test

Category	Improved (n=49)	Died (n=12)	*p*
Gender			
Male	29 (80.6%)	7 (19.5%)	0.957[1]
Female	20 (80%)	5 (20%)	

Aetiology			
Hepatitis C	36 (73.5%)	11 (91.7%)	0.032[2]
Hepatitis B	4 (8.2%)	1 (8.3%)	
NAFLD/ ALD	2 (4.1%)	0 (0.0%)	
Wilson's disease	3 (6.1%)	0 (0.0%)	
Others	4 (8.2%)	0 (0.0%)	
Socio economic status			
Middle class (B)	4 (8.2%)	1 (8.3%)	0.474
Lower middle class (C1)	8 (16.3%)	1 (8.3%)	
Skilled working class (C2)	4 (8.2%)	3 (25.0%)	
Working class (D)	9 (18.4%)	3 (25.0%)	
Lowest level (E)	24 (49.0%)	4 (33.3%)	
Total	49	12	61

[1] Chi-square test | [2] Fisher's exact test (for small, expected counts)

Table-3: Comparison of age, disease duration, and stay at hospital by discharge status (independent *t*-test)

	Variance	df	*t*	Two-tailed *p*	Mean Difference	95% CI [Min-Max]
Age	Equal	59	-1.84	.070	-8.166	[-17.03–0.70]
Duration of disease	Unequal	12.72	-1.37	.195	-2.205	[-5.70–1.29]
LOS	Equal	59	2.96	.036	1.058	[0.071–2.04]

DISCUSSION

DCLD remains a leading cause of global mortality, with studies reporting 1-year mortality rates of 20–57%.[16] Despite extensive research on pathophysiological mechanisms and clinical management, non-clinical determinants of outcome, such as SES, LOS, and disease aetiology in our province, remain underexplored. This study addresses this gap by analysing 61 DCLD inpatients, revealing an overall mortality rate of 19.7%, which is very close to 20.91% reported by Shah AS *et al*, from India, and 19.8% reported by Bhattarai S from Nepal.[7,17] However, our findings showed higher mortality compared to another study done in the same-study place, i,e.8% among cirrhotic inpatients.[18] our findings align with global burdens highlighted by Asrani *et al*, where cirrhosis accounts for 1.32 million annual deaths.[19] This underscores an urgent need for holistic patient profiling beyond traditional clinical metrics.

Contrary to the literature suggesting gender-based survival differences, this study found near-identical mortality rates between males (19.5%) and females (20%), which is supported by Mazumder NR, who found no association between females and cirrhosis-related mortality.[20] This contrasts with Devarbhavi H *et al,* and Mellinger JS *et al*, who noted higher male mortality in alcohol-related liver disease and global data where men constitute two-thirds of cirrhosis deaths.[1,21] Moreover, Bhattarai S also found 78.2% of total 754 DCLD inpatients were males.[7] However, Volk *et al,* similarly reported no gender-based outcome differences in decompensated cirrhosis re-admissions.[22] Our results may reflect evolving etiology patterns or equitable healthcare access in the setting, or more care and attention provided to the male counterpart. This parity underscores that gender alone is not a definitive prognostic marker in DCLD

Hepatitis C Virus-associated DCLD exhibited the highest mortality (91%) in our cohort, which is quite high compared to Samonakis DN *et al*, who reported 41%. [23] This discrepancy may arise from regional factors: late diagnosis, limited access to direct-acting antivirals (DAA), or advanced disease at presentation. For instance, Verna EC *et al* demonstrated that DAA-treated HCS patients with decompensated cirrhosis still face high mortality if baseline MELD scores exceed 20.[24]. Conversely, alcohol-related DCLD showed lower mortality (27.3%) here versus 48% by Shah AS *et al,* possibly due to practising more religious values here. [17] These findings highlight etiology-specific risks necessitating tailored management.

Patients in the lower SES stratum (Level E) had a mortality rate 3.3 times that of higher SES groups. This corroborates Qazi AFA *et al*, who linked low SES to poorer outcomes and mortality in CLD due to medication non-adherence, nutritional deficits, and delayed care seeking.[18] Kardashian A *et al*, further identified SES as a structural driver of health inequalities, where deprivation exacerbates comorbidities and limits treatment access.[19] Our data reinforces that SES interventions, e.g., subsidised care, community support, are as critical as medical management in improving DCLD outcomes.

Unlike Al-Smadi K *et al*, we found no association between disease chronicity and outcomes.[20] However, LOS significantly differed by outcome: discharged patients stayed 1.06 days longer than those who died (p=0.036), with overall LOS as 4.02±1.576 days, which is very close to 6.3 days reported by Bhattarai S.[7] Khan HA *et al*, among liver cirrhotic patients, having total LOS as 7±4.12 days, concluded that the inpatients' mortality increases with increased LOS.[21] But may reflect our cohort's therapeutic responsiveness. Extended stays could enable the management of complications, such as infection control and electrolyte correction, and turn high-risk admissions into survivable events.

This study is limited by a modest sample size (n=61) and a single-centre design, which restricts generalizability and may introduce potential seasonal biases due to consecutive sampling. Future research should validate findings in multi-centre cohorts, integrate molecular and socioeconomic factors, develop targeted community interventions, and apply results in prospective cohorts, such as PREDICT, to improve outcome prediction.

CONCLUSION

Outcomes in DCLD are strongly influenced by non-clinical forces. SES was more important in predicting

death than clinical factors, while gender and disease duration mattered less than expected. The high death rate from Hepatitis C needs immediate action to improve access to care. Also, staying longer in the hospital may help save lives by allowing better management of complications. To improve survival, we need to focus on fair and accessible care, not just medical treatments.

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Original Article

DIAGNOSTIC ACCURACY OF C-REACTIVE PROTEIN IN NEONATAL SEPSIS USING BLOOD CULTURE AS GOLD STANDARD: A CROSS-SECTIONAL STUDY

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Background: Neonatal sepsis is a life-threatening but treatable condition if diagnosed early, though its nonspecific signs can delay detection. C-reactive protein (CRP) is a helpful marker, but its diagnostic accuracy varies. This study evaluates CRP's accuracy in diagnosing neonatal sepsis, using blood culture as the gold standard. **Methods:** This cross-sectional study was conducted at the Paediatric department of Ittifaq Hospital, Lahore, over a six-month period. A total of 150 patients were included. After fulfilling the study criteria, Informed consent from either parent, as well as a detailed history and a blood sample, were taken for CRP and blood culture tests. All data were analysed using SPSS-24. The data were stratified by age and gender to address the issue, and a chi-square test was applied with a $p \leq 0.05$ considered significant. **Result:** Among the total 150 patients, the mean age was 14.46±7.61 days, with 64 (42.7%) females, and the mean CRP was 10.97±13.23. CRP was found positive in 47 (31.33%) patients, whereas Blood culture was positive in 45 (30.00%). The sensitivity and specificity of CRP were 93.33% and 95.24% respectively, with an overall diagnostic accuracy of 94.67%. A significant association was also found between blood culture and CRP, $p<0.001$. **Conclusion:** CRP is a good diagnostic tool for diagnosing neonatal sepsis. Using this simple test, an accurate and timely diagnosis can be made, and it can help initiate early medical treatment for these high-risk cases. These findings support CRP's utility for ruling out sepsis and guiding early antibiotic discontinuation.
Kyewords: Neonatal sepsis; C-reactive protein; blood culture; diagnostic accuracy

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INTRODUCTION

Neonatal sepsis is a bloodstream infection among neonates, i.e., aged <28 days, and remains a major cause of mortality and morbidity in low- and middle-income countries.[1,2] Neonates are predisposed to infections during the perinatal period due to a relatively compromised immune system. The burden of neonatal sepsis is attributed to neonatal infections, which vary by geographic region and maternal and neonatal risk factors. Worldwide, it is estimated that more than 1.3 million neonatal deaths annually are the consequence of neonatal sepsis.[3] Its incidence varies worldwide but remains between 1 and 5 in 1000 live births.[4]

There are mainly two types of neonatal sepsis: early-onset sepsis (EOS) and late-onset sepsis (LOS). EOS remains a common and serious problem for neonates, especially preterm infants. Group B streptococcus (GBS) is the most common etiologic agent, while *Escherichia coli* is the most common cause of mortality. LOS attributable to Gram-positive organisms, including coagulase-negative *Staphylococci* and *Staphylococcus aureus*, is also associated with increased morbidity and mortality among premature infants.[1,5]

Early diagnosis of neonatal sepsis is often difficult because of the nonspecific symptoms and signs.[6] Traditional methods, such as blood culture, though it's a gold standard but its accuracy is being questioned because of spurious positive results due to contamination, negative blood cultures even sometimes in fatal cases, and the time it takes to get a result.[7] Thus, in addition to blood culture, different laboratory tests are evaluated in the diagnosis of EOS, of which complete blood count with different neutrophil parameters and C-reactive protein (CRP) are most frequently used.[8]

The diagnostic accuracy of CRP for neonatal sepsis shows significant variability across studies, influenced by cutoff values, the timing of sepsis onset,

and testing. A recent Pakistani study highlights this heterogeneity: Irshad *et al*, reported a sensitivity of 77.6% and a specificity of 73.8%, while Aslam *et al*, documented 94% sensitivity and 74% specificity at a cutoff of >10 mg/L.[9,10] Earlier work by Hisamuddin *et al,* showed lower sensitivity, i.e., 76.92% and specificity 53.8%.[11] Conversely, some studies report higher accuracy, such as Younis S *et al*, with sensitivity and specificity both 95%, though these findings are less consistent with recent literature.[12] Overall, CRP's negative predictive value (NPV) tends to be robust (81.2%-93.7%), supporting its role in ruling out sepsis, while variables' positive predictive value (PPV) limits its confirmatory utility.

It is now evident that CRP is a potential diagnostic tool for neonatal sepsis, as supported by a meta-analysis by Liu Y *et al*. However, the literature shows wide variation in reported diagnostic accuracy, creating uncertainty about CRP's true reliability in clinical practice.[13] While blood culture remains the gold standard for diagnosing neonatal sepsis, it is time-consuming, often taking 48 hours to 6 days til result, during which critical delays in treatment may worsen neonatal outcomes. Timely and accurate diagnosis remains a challenge, and given the limitations of blood culture and the variability in CRP's reported for accuracy, this study was conducted to determine the diagnostic accuracy of CRP for diagnosing neonatal sepsis, using blood culture as the gold standard.

METHODOLOGY

This cross-sectional study was conducted at the Department of Paediatrics, Ittifaq Hospital, Lahore, over a six-month period from January 1, 2023, to June 30, 2023.

After obtaining ethical approval from the institute ethical board, and through purposive sampling, a total of 150 patients were taken in this study using WHO sample size calculator, which determined that a minimum of 147 participants was required based on an expected sensitivity of 77.6%, specificity of 95%, a predicted prevalence of 50%, a desired precision of 10% and a 95% confidence interval.[9,12]

All patients of either gender, aged 0 to 28 days, who presented with suspected neonatal sepsis were included. Neonates with major congenital anomalies, e.g., heart defects, neural tube defects, Down syndrome, very low birth weight (<1000 g), or underlying surgical conditions, like intussusception, imperforate anus, were excluded based on clinical presentation and radiographic investigation.

After fulfilling the criteria, Informed consent was obtained from either parent, and a detailed history was taken, including their age, gender, and address, in a standardised form. CRP and blood cultures were obtained from all patients at admission and sent to the laboratory free of charge. After all aseptic measures, 2 cc of blood was taken and inoculated into a blood culture bottle containing brain heart infusion (BHI). For CRP estimation, blood was taken using a 3 cc syringe. CRP was performed by latex agglutination assay in Ittefaq hospital laboratory, and a value more than 6 mg/L was considered as raised or positive. Diagnosis of neonatal sepsis on culture was based on the presence of bacteria or fungi; cultures with>105 colonies/HPF were labelled positive for neonatal sepsis. Blood culture (positive/negative) and CRP (raised/not raised) were also noted in the same form by the researcher herself.

All the data collected were entered and analysed using SPSS-24. For qualitative variables, such as patient gender, neonatal sepsis on blood culture, and CRP levels greater than 6, results were presented as frequencies and percentages. For quantitative variables such as age and CRP levels, the mean ± SD was calculated. A 2×2 table was made for CRP (>6) and blood culture (positive, negative). Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were calculated manually for CRP using blood culture as the gold standard. The data were stratified by age and gender to address potential effect modifiers, and a post-stratified chi-square test was applied to determine significance ($p \leq 0.05$).

RESULTS

Among total 150 patients, with mean age of the patients was 14.46±7.61 days(min 1 and max 28 days), females 64 (42.7%) and males 86 (57.3%) participated, with a mean value of CRP 10.97±13.23 (min 1 and Max 70) it was found positive in 47 (31.33%) patients, whereas Blood culture was positive in 45 (30.00%), Table-1. Among the 47 (31.3%) positive CRP cases, blood culture was found to be positive in 42 (89.4%), as shown in Table-2**.** The sensitivity and specificity of CRP were 93.33% and 95.24% respectively. The positive and negative predictive values were 89.36% and 97.09%, respectively, with an overall diagnostic accuracy of 94.67% Table-3. When data was stratified for age group and Gender significant association between blood culture and CRP was found, $p<0.001$, Table-4.

Table-1: Descriptive statistics of sample n=150

Variable		n (%)
Age	**14.46±7.613 (1–28)**	
CRP Value	**10.97±13.259 (1–70)**	
Gender	**Female**	64 (42.7)
	Male	86 (57.3)
Age group	**0–14 days**	86 (57.33%)
	15–28 days	64 (42.67%)
Blood culture	**Negative**	105 (70%)
	Positive	45 (30%)
CRP value	**Negative**	103 (68.7%)
	Positive	47 (31.3)

Table-2: Comparison between CRP and blood culture

Variable	Blood culture	Total

		Positive	Negative	
CRP	**Positive**	42 (93.3%)	5 (4.8%)	47(31.3%)
	Negative	3 (6.7%)	100 (95.2%)	103 (68.7%)
Total		45 (100%)	105 (100%)	150 (100%)

Table-3: Diagnostic metrics of CRP and blood culture

Matrics	Point Estimate	95% CI
Sensitivity	93.33%	(82.14, 97.71)
Specificity	95.24%	(89.33, 97.95)
Positive Predictive Value	89.36%	(77.41, 95.37)
Negative Predictive Value	97.09%	(91.78, 99)
Diagnostic Accuracy	94.67%	(89.83, 97.27)

Table-4: Comparison between CRP and age group with respect to blood culture, n=150

Variable	Blood culture		Total	*p*
	Negative	Positive		
Age-group				
1–14 days	59 (56.2%)	27 (60%)	86 (57.3%)	0.666
15–28 days	46 (43.8%)	18 (40%)	64 (42.7%)	
CRP				
Negative	100 (95.2%)	3 (6.7%)	103 (68.7%)	0.000
Positive	5 (4.8%)	42 (93.3%)	47 (31.3%)	

DISCUSSION

This cross-sectional study demonstrates exceptionally high sensitivity (93.33%) and specificity (95.24%) of CRP for diagnosing neonatal sepsis, using blood culture as the gold standard. While these results suggest CRP's utility as a diagnostic tool, they must be contextualised within existing literature and evaluated for methodological influences. Below, we analyse each key finding through comparative literary analysis.

The observed sensitivity (93.33%), specificity (95.24%), and diagnostic accuracy (94.67%) are notably high and comparable to a similar study conducted nearby, which reported a sensitivity of 97.3%, specificity of 95.2%, and a diagnostic accuracy of 96.6% for CRP. Twelve other studies reported lower values, including 77.6% sensitivity, 76.92% sensitivity, 73.8% specificity, and 53.99% specificity, as well as 75% and 70.07% diagnostic accuracy of CRP, by Irshad *et al*, and Al-Atwi SS *et al*, respectively.[9,14] Our findings exceed these benchmarks, aligning with only a few single-centre studies that reported similarly high CRP sampling (14-day mean age, likely at peak infection phase) or variability in CRP thresholds and assay methods, which meta-regression suggests may significantly influence accuracy.[15] Still, the strong diagnostic metrics support CPR's potential utility, albeit requiring validation in larger, more representative cohorts.

Our high NPV (97.09%%) suggests CRP effectively rules out sepsis, supporting antibiotic discontinuation in negative cases. This aligns with recent evidence that serial CRP measurements reduce antibiotic exposure by 7 (17%).[16] However, the PPV (89.36%%) may be inflated by variability in CPR cut-offs and assay methods, which can yield false positives in the presence of non-infectious inflammation, such as birth trauma, intraventricular hemorrhage.[17] Crucially, blood culture's limitations as a gold standard-false negative occurs in 30-70% of sepsis cases due to low bacteremia volumes—may misclassify the true sepsis cases as false negatives, artificially elevating PPV.[18]

The strong association between CRP and blood culture positivity ($p<0.005$) reinforces CRP's diagnostic relevance. Yet, the imperfect sensitivity of blood cultures necessitates cautious interpretation. Studies indicate that maternal antibiotics reduce culture sensitivity, which may explain why only 4.8% of our CRP-positive cases had blood culture-negative infants with clinical symptoms.[19] Thus, while CRP correlates with culture results, its true value may lie in identifying culture-negative sepsis.

The absence of an association between CRP accuracy and gender/age group suggests consistent performance across neonatal subgroups. This contrasts with the literature, which shows that gestational age significantly affects CRP kinetics, with preterm infants exhibiting delayed and attenuated CRP responses.[20] Our findings may reflect homogeneous sampling (mean age 14 days; term infants), missing EOS where age effects are pronounced. Future studies should stratify by onset type to clarify demographic interactions.

Although enrolling 150 neonates yields moderate precision (95% CI ±10–15%), relying on a single CPR measurement at a mean age of 14 days likely misses the early inflammatory peak, which occurs around 36–48 hours post-infection.[21] As is clearly evident, the difference in values of diagnostic accuracy of CPR measured at the time of admission and after 72 hours, reporting higher values at 72nd hours.[22] Moreover, neonatal blood cultures often fail to detect low-grade bacteremia (<4CFU/mL), leading to false negatives that inflate CPR's apparent accuracy.[23] Nevertheless, the high NPV supports CRP's use to rule out sepsis and reduce antibiotic duration—serial CRP protocol has cut treatment courses by up to 48–54% in similar cohorts.[24] To enhance confiramatroty power, future strategies should integrate CRP with early-phase markers (e.g., IL-6, procalcitonin) and standardise serial sampling at symptom onset and 24 hours later.

CONCLUSION

CRP provens high diagnostic accuracy and excellent NPV for neonatal sepsis compared to the blood culture. These findings support the utility of CRP in ruling out sepsis to guide early antibiotic discontinuation. However, the variability in CPR thresholds and assay methods, as well as a single CRP measurement, limits generalizability. Future prospective studies with serial measurements and multi-marker approaches are warranted to validate these findings. CPR remains a valuable- though not a standalone—adjunct in neonatal sepsis diagnosis.

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Original Article

ANATOMICAL STUDY OF CORNEA IN DEVELOPING CHICK EMBRYOS: A LABORATORY-BASED EXPERIMENTAL STUDY

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Background: The resemblance of the developmental anatomy of the chicken to that of mammals makes it a suitable animal model for understanding the human biological systems. The histological structure of the chick embryo cornea was observed at four developmental stages, with a particular focus on its application to the study of eye development. **Methods:** This laboratory-based experimental study was conducted at the Anatomy Department, Regional Centre, College of Physicians and Surgeons, Islamabad, Pakistan. After obtaining ethical approval, a total of 70 fertilised eggs of *Gallus* domesticus were obtained from the Poultry Research Institute in Punjab, Rawalpindi. The eggs were incubated under standard laboratory conditions. The histological development of the chick cornea was studied at four distinct post-incubation stages: 10th day (n=30), 15th day (n=30) post-incubation, newly hatched chicks (n=5), and adult chickens (n=5). **Results:** at day 10 of incubation, the thickness of the cornea was 171 µm, and the stroma was 160 µm. At day 15 of development, this thickness was 145 µm, with a stroma thickness of 130 µm. The thickness of the cornea of a newly hatched chick was about 170- 200 µ, with a thickness of stroma 135 µ. In adults, the cornea is approximately 250-300 µm thick, with the stroma accounting for about 200 µm. **Conclusion:** This laboratory research presents the differentiation of the chick cornea at various developmental stages, which may contribute to the anatomical understanding of corneal embryology and provide a comparative background for pathological deviations.

Keywords: Chick embryo; cornea; model; histology

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INTRODUCTION

Animal models play a crucial role in vision research for ocular diseases and conditions, including corneal injuries. The chick embryo has a long and eminent history as a major model system in developmental biology, with benefits in cost, size, and ease of handling compared to other models. Like most avian species, the chick relies on vision for foraging and escaping predators. The chick eye is relatively large, accounting for 50% of its cranial volume, compared to approximately 5% in humans.[1]

The chick cornea is composed of five distinct layers: An epithelium, Bowman's layer, corneal stroma, Descemet's membrane, and an endothelium on the posterior aspect.[2] histologically, epithelial cells, keratocytes, and endothelial cells form the cellular components, and collagen and glycosaminoglycans constitute the acellular components. The epithelium is stratified squamous, non-keratinised, with 5–7 cell layers. Bowman's membrane lies just anterior to the stroma. The corneal stroma forms the greater part of the cornea and includes approximately 80%–85% of its thickness. It is transparent due to the precise organisation of stromal fibres and extracellular matrix. The endothelium is a layer of hexagonal cells with an endothelial pump that regulates the water content and maintains corneal transparency.[3] The epithelial cells are derived from epidermal ectoderm. The keratocyte and endothelial cells are derived from the neural crest.

The development of the chick eye is a complex process that starts when a region of the anterior neural plate becomes specified as the 'eye field'. The eye field is then divided into two separate lateral domains. The first sign of eye development is the evagination of the optic vesicles from the lateral domains. Each optic vesicle expands and comes in contact with the surface ectoderm. The ectoderm thickens to form the lens placode, which later invaginates, giving rise to the lens vesicle, whereas the surface ectoderm progresses towards the formation of the cornea.[4]

The epithelial cells start forming an acellular primary corneal stroma by 3rd day of development. This embryonic chick corneal epithelium secretes extracellular matrix that contributes to the formation of the primary corneal stroma. Periocular cells originate

from neural crest cells. These periocular cells migrate to form the corneal endothelium and keratocytes. The primary corneal stroma is invaded by mesenchymal cells on day 6 and begins to produce the collagen that will constitute the adult stroma.[5–7]

The chick cornea has been widely used as a research model due to its histological and anatomical similarities to the human cornea.[4] In some Ocular diseases, it is used for studying corneal wound healing, opacification, transplantation, to understand pathophysiology and pharmacological intervention.[8–10] Chick cornea endothelial cells, with improved techniques for transferring cultured cells to the host, serve as a significant model for Garnier transplant.[11] Moreover, in training procedures like intra-stromal corneal ring segment, the chick cornea is the best model for a beginner surgeon.[12]

Although the literature suggests a variety of applications of the chick cornea as a research model, it is essential to understand its histological development at various stages to validate its effectiveness as a research and training model.[13–15] Therefore, this study aims to investigate the sequential histological development of the chick cornea at different stages, providing a clearer assessment of its suitability and relevance for future experimental and educational purposes, such as a research model or training model.

METHODOLOGY

This laboratory-based experimental study was conducted at the Anatomy Department, Regional Centre, College of Physicians and Surgeons, Pakistan, Islamabad. Ethical approval was obtained from the institutional animal care and use committee. A total of 70 fertilised eggs of *Gallus* domesticus were procured from the Poultry Research Institute, Punjab, Rawalpindi. Eggs with visible cracks or those stored in refrigerators were excluded to ensure viability and optimal development.

Under typical conditions, the chosen eggs were kept incubated at 38±0.5 °C with relative humidity levels of 60% and 70%. At 4 separate post-incubation stages, developmental histology of the chick cornea was considered: at 10^{th} (n=30), 15^{th} (n=30) post-incubation day, newly hatched chicks (n=5), and adult chickens (n=5). Each developmental stage was represented in the same histomorphological studies, with the same sample size, at the same time, to reduce animal use. To ensure reliable, reproducible histological observations, the selected sample sizes were used to minimise loss of potential embryonic tissue during processing.

For every developmental phase, each egg was opened cautiously to dissect the embryos. After that, the dissected embryos were immediately placed in 10% neutral buffered formalin for 48 hours. In the sagittal plane, the embryos' heads were bisected while keeping the right balls solitary. The anterior half of each eyeball was dissected using a sharp blade, further bisected at the meridian plane, and one portion was processed for paraffin embedding. The samples from freshly hatched and adult chicks underwent a similar tissue-processing procedure.

The selected sample tissue was paraffin-embedded, sectioned at 7 µm, and H&E-stained. A light microscope and calibrated ocular micrometre was used for measurement. The total corneal thickness from the apical stroma surface to the basal endothelium was measured. The other measurement was the epithelial thickness, from the epithelial surface to the basement membrane. The number of epithelial cell layers was also measured. Stromal thickness was calculated as the distance from the epithelial basement membrane to the anterior margin of the endothelium. Finally, endothelial thickness was measured from the anterior surface of the endothelial cells to their posterior basement membrane. All were measured in micrometres.

RESULTS

The recorded measurements were summarised as minimum and maximum values for each developmental stage. Given the descriptive nature of this histo-morphological study, no inferential statistical tests were applied. The analysis was based on direct histological comparisons and descriptive measurement ranges, which are presented in Table-1 to illustrate the variations in corneal thickness across developmental stages.

Three distinct layers of cornea can be identified at this stage of development. The epithelium, stroma, and endothelium. The stratified squamous non-keratinised epithelium contained three nuclear layers with a layer of flattened cells at the top that is oriented in the long axis of the cornea. A narrow, eosinophilic acellular band was observed just below the basement membrane of the anterior epithelium, which is the Bowman's layer of the cornea. The stroma exhibited a lamellar appearance, characterised by parallel collagen bundles. The flattened corneal cells called keratocytes are more concentrated in its anterior region. (Figure-1)

The endothelium had a single layer of low cuboidal cells. The thickness of the cornea at this stage was about 171 µm, with the thickness of the stroma 160 µm, and the anterior epithelium and endothelium were about 7- 8 µm and 2 µm, respectively. (Table-1)

Table-1: Shows thickness of different layers of the cornea at different stages of development

Developmental stages	Epithelium µm	Stroma µm	Endothelium µm	Total thickness µm
Day 10 of incubation	7– 8	160	2–3	171
Day 15 of incubation	10–12	130	3–4	145
At hatch	25–30	350	5	170–200
Adults	30–40	200	5–6	250–300

The cornea showed an anterior epithelium with three to four nuclear layers. The stroma had a uniform distribution of corneal corpuscles; however, the thickness of the stroma decreased at this stage of development. The endothelium had the same structure as in day 10 embryos. The corneal thickness at this stage was about 145 µm, with the stroma at 130 µm. The thickness of the anterior epithelium and endothelium was about 10–12 µm and 2 µm, respectively. (Figure-2)

The junction of the cornea with the sclera is the site where the regular arrangement of the corneal lamellae adjoins the irregularly distributed stroma of the sclera. The trabecular meshwork at the sclerocorneal junction, with large open intertrabecular spaces, was present. The intra-scleral vessel is visible as a small vacuole at the posterior limit of the cornea (Figure-3B, arrow). The corneal thickness at this stage was about 350 µm, with the stroma measuring 170–200 µm. The anterior epithelium is approximately 25–30 µm in thickness and consists of 5–6 nuclear layers. The superficial layer had flattened nuclei, while the deep layers had more rounded and oval nuclei. (Figure-3A)

In adult checks, the superficial zone contained about 2 to 3 layers of flat nuclei, and the deep zone contained about 4 layers of round or oval nuclei. The presence of goblet cells in the epithelium, Figure-4 B (arrow), indicates the start of the conjunctival epithelium at the sclerocorneal junction. Furthermore, no Bowman's layer is seen at this junction. The scleral venous sinuses with red blood cells are visible (Figure-5, arrow). The stroma contained relatively fewer nuclei than did the cornea in the newly hatched chick. The thickness of the cornea in adults is approximately 250-300 µm, with the stroma measuring about 200 µm. The anterior epithelium is about 30 µm in thickness and comprises two zones of cells.

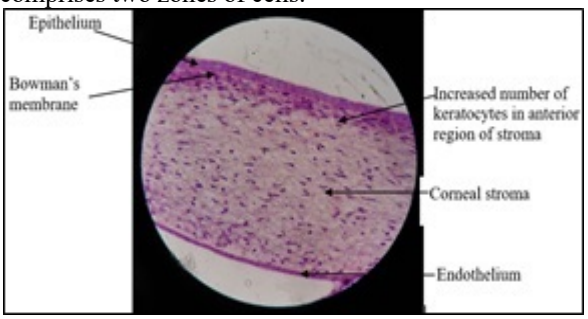

Figure-1: Cornea of chick at day 10 of incubation
Scale bar=200 µm

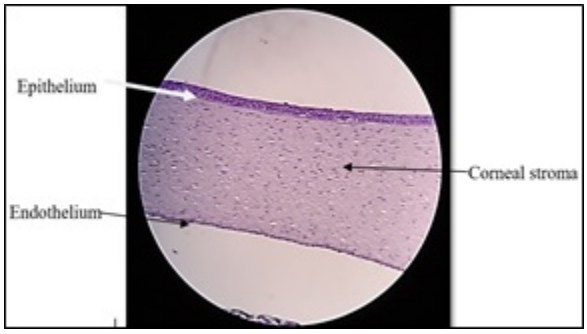

Figure-2: Cornea of chick at day 15 of incubation
Scale bar=20µm

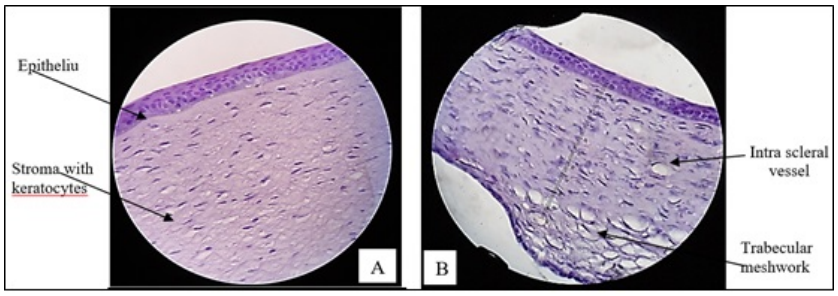

Figure-3: Cornea (A) and sclerocorneal junction (B) of newly hatched chicks
Scale bar=250µm

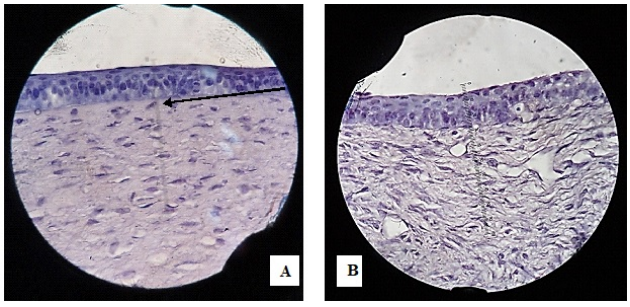

Figure-4: Cornea (A) and sclerocorneal junction (B) of newly hatched chicks
Scale bar=20µm

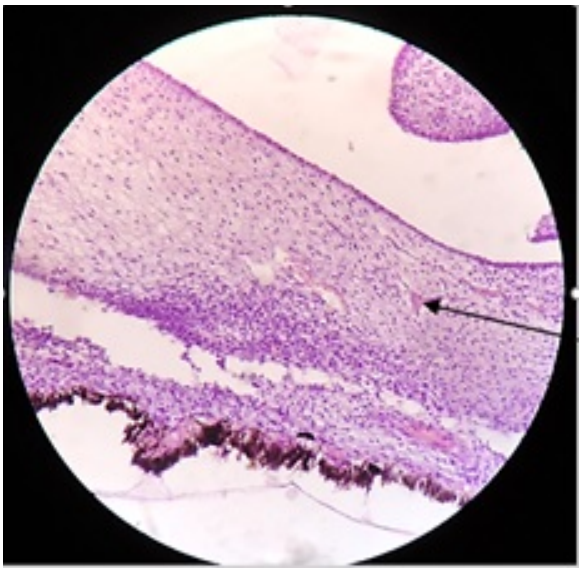

Figure-5: Sclerocorneal junction of adult chicks with red blood cells in venous sinuses (arrow).
Scale bar=250µm

DISCUSSION

The present study provides a systematic histopathological analysis of chick corneal development, delineating the structural maturation from the embryonic stage to adulthood. Our findings confirm that the chick cornea is composed of five distinct layers: the epithelium, the Bowman's layer, the stroma, the Descemet's membrane, and the endothelium, like the human cornea. The main goal of the study was to investigate changes in the corneal layers. In our study, we observed two opposing trends: as the epithelium thickens, the stroma becomes thinner and reorganises.

There was a noticeable alteration in the corneal epithelium: it increased in adulthood from ~7–8 µm (three nuclear layers at day 10) to ~30–40 µm with five to seven layers. In the early development of the two-layered epithelium in humans, it appears around 10–20 weeks, and around 22 weeks, it progresses to three to four layers. Finally, it reaches six layers by the end of the term. This maturation, from a simple bilayer to a stratified squamous epithelium, reflects a conserved process of building a resilient ocular surface.[17,18]

Then again, the stroma undergoes a more complex conversion. Before growing to roughly 200 µm in adulthood, its thickness decreased from approximately 160 µm at day 10 to 130 µm by day 15. This is supported by the work of Quantock and Young.[19–20] Rather than tissue loss, this mid-development thinning represents a crucial stage of matrix compaction. This process, necessary to achieve optical transparency, involves a tighter packing of collagen fibres and a decrease in tissue water content. A clear morphological sign of this condensation is the observed change in keratocytes shape from rounded to flattened. The latter stages of stromal thickening are probably the result of ongoing collagen deposition to satisfy the structural requirements of adulthood.

The anatomical significance of the cheek model is further supported by observations at the sclerocorneal junction. Human ocular anatomy is closely reflected in the distant shift from ordered corneal lamina to irregular scleral collagen, as well as the identification of related vascular and cellular processes.[21] A crucial landmark for study on limbal function, i.e., the corneal conjunctival border, is described by the occurrence of goblet cells at this junction in adults.[21]

The findings further aid the concept that chick as a strong model for corneal research. This further emphasises the histological similarity to humans in terms of epithelial layering and stromal compaction.[22–23] This model is more favourable for studying developmental biology, modelling for human corneal disease, and evaluating new treatments.[24]

This analysis provides a basic histological description, but it's the two-dimensional, illustrative reference that leaves room for improvement. With that said, 3D imaging (e.g., micro-CT or advanced microscopy), molecular profiling to classify the genes underlying these modifications, and functional assays (such as hydration measurements) to link structure to physiology.

CONCLUSION:

This study establishes a corneal development timeline for a chick and identifies histological benchmarks. It demonstrates epithelial stratification to build a protective barrier, indicating maturation, and enabling stromal compaction and transparency. There is a strong similarity between the human cornea and the chick, which supports the chick as a biologically relevant model for ophthalmic research and therapeutic development.

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