INSIGHTS-JOURNAL OF
LIFE AND SOCIAL SCIENCES

INSIGHTS-JLSS
Insights-Journal of Life and Social Sciences

EVALUATION OF INTERLEUKIN-6 IN HEPATOCELLULAR CARCINOMA PATIENTS WITH CHRONIC HEPATITIS B

Original Article

Hira Zulfiqar[1], Muhammad Akram Khan[2]*

[1]Department of Biological Sciences, The Superior University, Lahore, Pakistan.

[2]School of Allied Health Sciences, PU Lahore and Shaikh Zayd Hospital, Lahore, Pakistan.

Corresponding Author: Muhammad Akram Khan, School of Allied Health Sciences, PU Lahore and Shaikh Zayd Hospital, Lahore, Pakistan, aakramszmdcc@gmail.com

Conflict of Interest: None

Grant Support & Financial Support: None

Acknowledgment: We acknowledge the support of the clinical and laboratory teams involved in patient care and ELISA testing for this study.

ABSTRACT

Background: Another significant risk factor of hepatocellular carcinoma (HCC) is chronic hepatitis B (CHB), particularly in places where genetic testing is not widely available. The pathogenesis of HCC has been associated with inflammatory cytokines such as Interleukin-6 (IL-6), which enhances hepatocyte proliferation and decreases apoptosis. This research aimed to reveal the significance of serum IL-6 levels concerning the presence of HCC in CHB patients and prove the effectiveness of IL-6 as a non-invasive diagnostic marker in HCC.

Methods: A comparative study was carried out on a sample size of 70 in a tertiary care hospital. They were subdivided into two groups, including CHB patients with HCC (n = 50) and those without HCC (n = 20). Serum IL-6 was measured in fasting blood samples of the patients by enzyme-linked immunosorbent assay (ELISA), and in routine liver tests, including alpha fetoprotein (AFP). A structured proforma was used to record demographic and clinical information. Statistical analyses, including t-tests and Pearson correlation, were conducted with $p < 0.05$ as a significance criterion.

Results: The average levels of IL-6 were significantly lower in the control group than in patients with HCC (74.5 ± 18.3 vs 28.6 ± 9.4 pg/mL, p = <0.0001). A positive relationship of IL-6 was strongly correlated with a tumor ($r = 0.61$, $p < 0.001$) and AFP ($r = 0.58$, $p = 0.002$), but there was a lack of significant correlations with age or sex. Also, a moderate positive correlation was found with the alanine aminotransferase (ALT) levels ($r = 0.45$, $p = 0.01$).

Conclusion: This study indicates that IL-6 can be used as a complementary biomarker to AFP for early screening and surveillance of HCC among CHB patients. Future surveillance strategies may be enhanced by the correction of IL-6 measurement in low-resource settings.

Keywords: Interleukin-6, Hepatocellular carcinoma, Chronic hepatitis B, Biomarkers.

INTRODUCTION

Hepatocellular carcinoma (HCC) is the most widespread primary liver cancer and the third leading cause of cancer mortality (1). Chronic hepatitis B (CHB) infection is one of the most significant risk factors of HCC, especially in low- and middle-income countries where the prevalence of chronic hepatitis B and hepatitis C is high and the vaccine coverage is inconsistent (2). Even with improved surveillance and antiviral therapy, several patients with CHB develop cirrhosis. However, recent studies highlighted the importance of Interleukin-6 (IL-6), gaining more popularity due to its versatile contribution to inflammation, fibrosis, and carcinogenesis development in the liver (3).

Chronic inflammation and persistent metabolic stress can contribute to the rise in cytokine levels (e.g., IL-6), which trigger hepatocyte survival and proliferation pathways and increase the possibility of malignant transformation (4). Systematic reviews have highlighted the importance of histopathological and molecular biomarkers that are used to detect malignancies at an early stage, possibly acting as an adjunct or complement to traditional biomarkers such as alpha-fetoprotein (AFP) (5). With hepatokines in non-alcoholic fatty liver disease, the similarities in pathways mediated have been demonstrated, including those involved in viral hepatitis, again echoing the idea of IL-6 as such a common factor (6). Similarly, metabolic as well as genetic disorders, including GBA and HEXA mutations, further describe the relations between chronic metabolic stress, cytokine dysregulation, and disease progression (7).

The reported effects of Berberine in beta-cell physiology suggest the therapeutic potential of targeting inflammatory and metabolic pathways in chronic conditions, such as liver disorders (8). Similarly, the incorporation of newer imaging modalities such as CT and MRI highlights the fact that there is still a need to improve the accuracy of the diagnosis of small or early liver HCC lesions (9). Nevertheless, imaging can be insufficient, especially in resource-limited contexts, and the potential search for reliable serum biomarkers is necessary to achieve more objective measurements (10). The use of PROM2 and other molecular markers helps explain the possibility of risk-stratifying patients and intervening at the right time through the use of biomarkers (11). Remarkably, the implication of HLA haplotype in immune-mediated conditions, such as in celiac cohorts, shows the importance of genetic host susceptibility in terms of immune modulation (12).

Although there is increasing evidence regarding the clinical applications of IL-6 as a prognostic biomarker used in early detection of HCC in CHB subjects, it is underutilized in regional contexts in clinical settings. This knowledge gap constrains clinicians to adhere to individualized surveillance approaches (13). Measuring the regulators of iron metabolism, such as hepcidin, can additionally change the biomarker profile, shedding light on the disruption of iron homeostasis in cases of chronic inflammation, paving the way to direct liver disease development (14). Population-based research in Pakistan has confirmed the relevance of biomarker research related to the local context, particularly at a time when chronic viral hepatitis burdens are high (15).

Nonetheless, the lack of local evidence to support the use of IL-6 as a non-invasive biomarker that is simple and effective in detecting early HCC in chronic hepatitis B patients remains evident. The justification of this study is to address this gap and provide the regional data that may be used by policymakers in establishing better screening strategies. The potential utility of IL-6 monitoring may contribute to the early detection of HCC, which increases patient survival.

The goal of the study was to compare serum IL-6 concentrations in patients with CHB with or without HCC. It also evaluated the correlation between IL-6 and tumor size, AFP, and liver functional tests. The aim was to determine IL-6 as a potential marker to detect the illness at its early stages and monitor the disease.

METHODOLOGY

The study was conducted using a cross-sectional comparative design at a tertiary care facility, collaboratively at SAHS Lahore and Punjab University Lahore where serum IL-6 concentrations with and without HCC in patients with CHB were assessed from 2023 July to December 2023 (ref#112/SZH/Admin).

Non-probability purposive sampling was employed to recruit. The sample size was calculated using OpenEpi version 3.0.0 (released 2013, Atlanta, GA, USA) based on previous literature, which presented a mean difference in IL-6 levels between groups, and the calculated sample size was 70 patients (fifty with confirmed HCC and twenty with CHB without HCC).

Inclusion criteria included adults aged between 18 and 70 years who had confirmed chronic HBV infection, with the case group also having radiologically or histologically documented HCC. Patients who were co-infected with hepatitis C or HIV, had other autoimmune liver diseases, other active malignancies, or were under continued immunosuppressive therapy were excluded.

The sample was stratified into two comparative groups: CHB with HCC (cases) and CHB without HCC (controls). All the participants were subjected to routine clinical examination and laboratory tests. Structured proforma was used to record relevant clinical and demographic data such as age, gender, liver functional test, and AFP level. The concentration of serum IL-6 was determined by a commercially available enzyme-linked immunosorbent assay (ELISA) kit according to the instructions of the manufacturer. Liver routine function tests, AFP, and imaging reports were also reviewed to ensure the status of the disease and match the tumor features.

The protocol was followed by the participants who provided fasting blood samples and required follow-ups. SPSS version 26.0 (released 2019, IBM Corp., Armonk, NY) was used in the analysis of the data. The mean level of IL-6 between groups was compared using an independent t-test. Pearson correlation coefficient was used to determine the association between IL-6, tumor size, AFP, and liver enzymes. Statistically significant changes were determined at $p < 0.05$.

RESULTS

The study population consisted of 70 patients, of whom 50 had HCC and CHB (patients), and 20 were without it (controls). The HCC group had significantly elevated serum IL-6 levels compared with the controls. There was a strong positive correlation between IL-6 and tumor size and AFP. There was also a moderate positive relationship between IL-6 and ALT. There was no notable correlation with either age or gender. Table 1 summarizes the clinical and demographic characteristics of study participants.

Table 1: Clinical and demographic characteristics of the study population

Characteristic	HCC Patients (n = 50)	Controls (n = 20)	Test Used	Test Value	Significance (p-value)
Age (years) Mean ± SD	55.8 ± 8.4	54.3 ± 7.9	Independent t-test	t = 0.72	p = 0.47 (NS)
Gender (Male: Female)	38:12	16: 4	Chi-square test	$\chi^2 = 0.01$	p = 0.92
ALT (U/L)	78.5 ± 15.6	45.2 ± 10.3	Independent t-test	t = 9.5	p < 0.001
AFP (ng/mL)	320 ± 105	12 ± 4	Independent t-test	t = 18.2	p < 0.001
HBV DNA Positive (%)	80% (40/50)	75% (15/20)	Chi-square test	$\chi^2 = 0.17$	p = 0.68
Serum IL-6 (pg/mL)	74.5 ± 18.3	28.6 ± 9.4	Independent t-test	t = 13.2	p < 0.001
Tumor Size (cm)	4.5 ± 1.2	N/A	N/A	N/A	N/A

*HCC = Hepatocellular Carcinoma, HBV = Hepatitis B virus, ALT = Alanine amino transferase, AFP = Alpha fetoprotein, IL-6 = Interleukin-6, n = Number of participants, SD = Standard Deviation, * = Significance at p<0.05*

There was no statistically significant difference between the mean ages of CHB patients with HCC (55.86 ± 8.4 years) and controls (54.3 ± 7.9 years, p = 0.47). The distribution of gender was also similar (HCC: 38 males/12 females, controls: 16 males/4 females, p=0.92). HCC patients had significantly elevated ALT levels (78.5 ± 15.6 U/L) compared to controls (45.2 ± 10.3 U/L; p = 0.001), and average AFP levels were significantly higher in the HCC group (320 ± 105 ng/mL) than controls (12 4 ng/mL; p -0.001). As observed, mean serum IL-6 was 74.5 ±18.3 pg/mL in the HCC group compared with 28.6 ± 9.4 pg/mL in controls (p < 0.001). These results suggest that IL-6, similarly to AFP, can be used to differentiate between CHB patients with and without HCC. Correlation of IL-6 with clinical parameters of the study participants is presented in Table 2.

Table 2: Correlation of IL-6 with clinical parameters

Parameter	Test Used	Test Value	Significance (p-value)
Correlation with Tumor Size	Pearson correlation	r = 0.61	p < 0.001
Correlation with AFP	Pearson correlation	r = 0.58	p = 0.002
Correlation with ALT	Pearson correlation	r = 0.45	p = 0.01
Association with Age	Pearson correlation	r = 0.05	p = 0.65
Association with Gender	Pearson correlation	r = 0.06	p = 0.39

*ALT = Alanine amino transferase, ALT = Alpha fetoprotein, * = Significance at p<0.05*

Tumor size and AFP were both positively correlated with IL-6 (r=0.61, p<0.001 and r=0.58, p=0.002, respectively). These results showed that higher levels of IL-6 correlate with a larger size of the tumor and increased tumor markers. A weak positive correlation was found with ALT (r = 0.45, p = 0.01), suggesting that IL-6 could represent continued liver inflammation. It showed no significant correlation with age (r = 0.05, p = 0.65) or with gender (p = 0.39). These findings indicate that IL-6 may become a disease-specific biomarker, regardless of demographic factors, and be used to track tumor progression in patients with CHB.

DISCUSSION

The aim of the study was to determine whether the serum level of IL-6 was significantly related to HCC in patients with CHB and evaluate whether it has a possible use in early detection as a simple biomarker. These results demonstrated that serum IL-6 levels were significantly elevated in patients with CHB and HCC compared to those without HCC and emphasized that chronic inflammation is a central mechanism in liver carcinogenesis. The findings also revealed that IL-6 was strongly correlated with tumor size and AFP levels, and showed no significant correlation with age or gender, implying specificity to the disease. This aligns with global literature, which has demonstrated that IL-6 inflammatory cytokines can stimulate hepatocyte growth and tumorigenesis in chronic viral hepatitis (16, 17). Furthermore, a study highlighted the growing clinical interest in inflammatory pathways and the opportunities they introduce to early cancer diagnosis and treatment (18).

Absence of IL-6 correlation with gender and age also aligns with other studies. Similarly, a study demonstrated that choosing targeted treatments based on a precise diagnosis enhances patient outcomes, highlighting prompt clinical decisions (19). The same phenomenon has been reported in trauma-induced coagulopathy with an excess inflammatory reaction, further increasing its complications (20). As part of health-care administration, implementation of WHO-recommended regimens has been proven to enhance patient outcomes, a factor that resonates with the necessity of resilient biomarker-based screening approaches (21). The incorporation of technology, e.g., the Internet of Things (IoT), can also improve biomarker monitoring and patient care (22). Uterine tract infection studies demonstrated how unresolved inflammation in another system can result in chronic conditions, a similar effect of unresolved inflammation in hepatitis B (23).

A study on intrauterine insemination emphasized the value of biological markers in forecasting reproductive survival, which has justified that molecular signals could be used to inform clinical outcomes (24). Similarly, research on ABO blood groups and obesity demonstrated how hereditary influences may influence the inflammatory phenotype and predisposition towards a disease (25). Immune response in autoimmune diseases was also associated with hematological indices like red blood cell parameters and further stressed the general applicability of laboratory parameters (26). The study of the antimicrobial and antioxidant activity of spice extracts reveals the way inflammation regulation is a cross-disciplinary area of interest (27). Animal experiments on antiviral agents such as Sofosbuvir confirm that treatment may affect the biochemical parameters of the liver (28).

The high incidence of hepatotoxicity in the context of HIV-tuberculosis co-infection reinforces the importance of the idea that liver health can be readily affected by various factors (29). Stress-induced hypertension predictors indicate that physiological indicators can

be used to detect patients likely to develop a chronic illness (30). Self-assessment and feedback have already proven useful in medical education (31), where patient empowerment may similarly be helpful in HCC surveillance. The correlation between the level of vitamin D3 and left ventricular hypertrophy demonstrates the importance of nutritional factors and inflammation and their relation across the pathologies (32). Associations among insomnia, melatonin, and stress demonstrate how the factors of physiological burden multiply the impact on inflammation (33).

The correlation of vitamin D deficiency and obesity in premenstrual syndrome provides another piece of evidence that metabolic imbalance is the driver of the chronic inflammatory process (34). Biomarkers such as IL-6 are essential in cases like liver disease because the inflammation is chronic, and environmental pollutants have been proven to elevate them (35).

The use of mean platelet volume has been effective in measuring the severity of chronic kidney disease, which provides a parallel to the application of IL-6 in liver disease (36). The functional importance of olive oil in dermatitis highlights the overall importance of inflammatory modulation (37). Studies on vitamin D3 and parathyroid hormone in the treatment of hypertension also confirm the interconnection of metabolic control and inflammation (38).

The introduction of multiple indicators to improve the management of hypertensive patients in comparative risk assessment has found synergy in combining IL-6 and AFP in the detection of HCC (39). The impact that nerve growth factor has on airway inflammation demonstrates how, similarly, local mediators can contribute to the systemic response, as IL-6 does with tumor microenvironments (40). Another example of inflammatory and molecular pathways intersecting in the carcinogenesis process is the notch signaling pathways in oral cancer (41). Studies of adipokines in polycystic ovary syndrome indicate that metabolism regulators have a connection with inflammatory pathways, similar to that of IL-6 (42). Recently, salivary diagnostics highlight the potential of non-invasive parameters to check inflammatory diseases (43). The case of dual-mechanism thrombocytopenia is a rare example of how immune-related pathways can complicate the disease and make its progression problematic without early identification (44).

Taken together, the findings carry significant meaning in enhancing the early diagnosis of HCC among CHB patients in low-resource facilities where easily accessible and less invasive biomarkers are valuable tools (45).

This study has limitations in terms of a cross-sectional nature, a single-center environment, and a rather limited sample size, thus decreasing the possibility of results generalizability. Potential confounders, including nutritional status, co-comorbid metabolic problems, and use of drugs, were not properly addressed. Longitudinal, multi-centric research design with larger cohorts needs to be conducted to establish valid IL-6 cut-offs, predictive accuracy, and biomarker screening incorporated with standard imaging would improve early HCC diagnosis.

CONCLUSION

The results of this investigation indicated that there were significant relationships with elevated serum IL-6, which was associated with CHB patients with HCC compared to serum IL-6 in CHB patients without HCC, and that it was closely correlated with tumor size as well as the AFP level. The results indicated that IL-6 can be an effective non-invasive biomarker for the early detection and monitoring of HCC in high-risk CHB patients. There is no strong correlation with age or sex, implying that IL-6 measures disease-specific processes and not demographic characteristics.

These results suggest that the inclusion of IL-6 measurement in regular surveillance might help in improving early-stage diagnosis in cases where imaging or conventional markers are not enough.

AUTHOR CONTRIBUTION

Author	Contribution
Hira Zulfiqar	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published

Muhammad Akram Khan*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published

REFERENCES

1. Konyn P, Ahmed A, Kim D. Current epidemiology in hepatocellular carcinoma. Expert Rev Gastroenterol Hepatol. 2021 Nov;15(11):1295-1307. doi: 10.1080/17474124.2021.1991792.
2. Al-Busafi SA, Alwassief A. Global Perspectives on the Hepatitis B Vaccination: Challenges, Achievements, and the Road to Elimination by 2030. Vaccines (Basel). 2024 Mar 9;12(3):288. doi: 10.3390/vaccines12030288.
3. Giraldez MD, Carneros D, Garbers C, Rose-John S, Bustos M. New insights into IL-6 family cytokines in metabolism, hepatology and gastroenterology. Nat Rev Gastroenterol Hepatol. 2021 Nov;18(11):787-803. doi: 10.1038/s41575-021-00473-x.
4. Shah T, Uqaili AA, Shaikh SN, Madni SU, Channa R, Khan HS. Serum FGF-23 and Vitamin D Deficiency as Predictors of Metabolic Syndrome in Chronic Kidney Disease. Pakistan Journal of Medicine and Dentistry. 2025;14(2):334-341.
5. Ahmed MA, Minhas M, Tariq U, Kumar D, Mazhar M, Faisal M, Ahmed E. *A Systematic Review on Histopathological and Molecular Biomarkers in Oral Pathology: Advancing Early Diagnosis of Precancerous and Cancerous Lesions.* Pakistan Journal of Medicine and Dentistry. 2025 Apr 13;14(2):452-62. DOI: 10.36283/ziun-pjmd14-2/064
6. Ahmed S, Ahmed M, Abbas F, Wahab A, Pathan S, Singla B, Ismail S, Khaliq M, Shah MH. *Evaluating Hepatokines in the Progression of Non-alcoholic Fatty Acid Liver Disease.* Cureus. 2025 May 16;17(5): e84258. DOI: 10.7759/cureus.84258
7. Kalhoro R, Pathan S, Shaikh AR, Shakeel M, Roheen T, Ali SA. *Genetics of Metabolic Disorders: GBA and HEXA Mutations in Gaucher and Tay-Sachs Disease.* Rawal Medical Journal. 2025 Apr 29;50(2)
8. Khoharo HK, Shaikh DM, Nizamani GS, Shaikh TZ, Ujjan I, Uqaili AA. Effects of Berberine on Blood Glucose, Glycated Hemoglobin A1, Serum Insulin, C–Peptide, Insulin Resistance and β–Cell Physiology. J Pharma Res Intl. 2020;32(36):36-41.
9. Rafiq T, Fatima H, Niaz M, Khan SA, Minhas M, Khaliq H. *Comparative accuracy of CT and MRI in diagnosis of pituitary microadenoma.* Rawal Medical Journal. 2025 May 12;50(2):329-.
10. Li J, Shaikh SN, Uqaili AA, Nasir H, Zia R, Akram MA, Jawad FA, Sohail S, AbdelGawwad MR, Almutairi SM, Elshikh MS. Pan-cancer analysis of pituitary tumor-transforming 3 pseudogene. Am J Transl Res. 2023;15(8):5408
11. Uqaili AA, Usman G, Bhatti U, Nasir H, Zia R, Akram MA, Jawad FA, Farid A, AbdelGawwad MR, Almutairi SM, Elshikh MS. PROM2 as Diagnostic and Prognostic Biomarker. Am J Transl Res. 2023;15(8):5389.
12. Siddiqui K, Uqaili AA, Rafiq M, Bhutto MA. Human leukocyte antigen (HLA)-DQ2 and-DQ8 haplotypes in celiac, celiac with type 1 diabetic, and celiac suspected pediatric cases. Medicine. 2021;100(11):e24954.
13. Ahmad S, Alavi AF, Minhas DM, Javid A, Hafiz Aamir Ali Kharl. *Antimicrobial Resistance Trends in Wound Pathogens: A Study at a Tertiary Care Hospital in Peshawar, Pakistan.* J Popul Ther Clin Pharmacol. 2024 Jun;31(6):528-537. DOI: 10.53555/jptcp.v31i6.6529
14. Uqaili AA, Chang AH, Kalhoro MA, Ahmed O, Samejo MA, Memon MS, Ahmed E. Hepcidin as a Therapeutic Target in Liver Cirrhosis: A Cohort Study on Iron Dysregulation. Pakistan Journal of Medicine and Dentistry. 2025;14(2):16-21.
15. Ali S, Channar HB, Emran A, Hina H, Laghari ZA, Malik A, Nazir A, Qureshi HS, Saleem A, Samo AA, Uqaili AA. Contextuality of Healthcare Choices in Pakistan. Rowman & Littlefield; 2024.
16. Xu J, Lin H, Wu G, Zhu M, Li M. IL-6/STAT3 Is a Promising Therapeutic Target for Hepatocellular Carcinoma. Front Oncol. 2021 Dec 15;11:760971. doi: 10.3389/fonc.2021.760971.

17. Srivastava A, Sharma H, Khanna S, Sadhu Balasundaram T, Chowdhury S, Chowdhury R, Mukherjee S. Interleukin-6 Induced Proliferation Is Attenuated by Transforming Growth Factor-β-Induced Signaling in Human Hepatocellular Carcinoma Cells. Front Oncol. 2022 Jan 20;11:811941. doi: 10.3389/fonc.2021.811941.

18. Zhao H, Wu L, Yan G, Chen Y, Zhou M, Wu Y, Li Y. Inflammation and tumor progression: signaling pathways and targeted intervention. Signal Transduct Target Ther. 2021 Jul 12;6(1):263. doi: 10.1038/s41392-021-00658-5.

19. Ujjan RA, Shaikh GS, Pathan S, Niamat M, Shaikh F, Ali K. *The Effectiveness of Azithromycin versus Cefixime in the Treatment of Typhoid Fever in Children.* Pakistan Journal of Health Sciences. 2024 Oct 31:179-83. DOI: 10.54393/pjhs.v5i10.2105

20. Rashid NU, Nasir AA, Fattani B, Minhas M, Tanvir S, Pathan S, Barkha FN, Nangdev P, Khalid A, Rasheed NU. *Evaluation of Trauma-Induced Coagulopathy by Systematic Insights Into Pathophysiology and Advances in Emergency Resuscitation.* Cureus. 2025 May 10;17(5): e83839. DOI: 10.7759/cureus.83839

21. Hussain Z, Ambareen A, Rashid NU, Raza A, Anwar S, Minhas M, Qureshi S, Sana M, Zara K, Rasheed NU. *Insights Into the Assessment of WHO-Recommended Practices Based on Surgical Operations in Tertiary Healthcare Settings.* Cureus. 2025 Apr 29;17(4): e83181. DOI: 10.7759/cureus.83181

22. Shukla D, Lashari UG, Rafique T, Gupta A, Ririe AK, Minhas M. *IoT in Healthcare: Exploring the Integration of Internet of Things Devices in Enhancing Patient Care. A Bibliometric Review.* Cuestiones de Fisioterapia. 2024 Nov 2;53(03):4363-420.

23. Rehman NU, Pathan S, Naz T, Niamat M, Sattar E, Shakeel M. *Urinary Tract Infections as a Gateway to Chronic Kidney Disease: A Cross-Sectional Study.* Rawal Medical Journal. 2025 May 12;50(2):267-269.

24. Bibi F, Ghaffar S, Aziz T, Pathan S, Memon M, Gul E, Kulsoom O, Khalid A, Shah MH. *Intrauterine Insemination in DHEA-Treated Women: Oocyte Quality and Pregnancy Rates.* Cureus. 2025 Apr 26;17(4): e83045. DOI: 10.7759/cureus.83045.

25. Shaikh SA, Yousfani NA, Mangi MM, Memon SF, Laghari KR, Uqaili AA. Exploring the Link between ABO Blood Groups and Obesity among Young Adults. Journal of University College of Medicine and Dentistry. 2025;4(1):32-36.

26. Siddiqui K, Rafiq M, Bhutto MA, Uqaili AA. Red Blood Indices, Platelet Count and Transferrin Levels in Celiac Patients with and without Type 1 Diabetes Mellitus. KMUJ. 2021;13(1):25-9.

27. Siddique K, Sahar S, Saba N, Uquaili AA. Effect of Spice Extracts as Antimicrobial and Anti-Oxidative Agent Against Common Bacterial and Fungal Infection Strains. Indo Am J P Sci. 2019;6(2):4757-62.

28. Wagan G, Uqaili AA. Effects of Sofosbuvir on Serum Lipid Profile and Serum Uric Acid in Albino Rats. Annals of PIMS. 2018;14(3):212-7.

29. Uqaili AA, Gurbakhshani M, Shaikh ZA, Ansari IA, Gurbakhshani K. Prevalence of Hepatotoxicity in HIV-positive, Tuberculosis and HIV+TB Co-infected Patients. IJMSCI. 2020;7:4900-7.

30. Shaikh SN, Uqaili AA, Shah T, Memon A, Shaikh F, Dars S. Biochemical and Physiological Predictors of Stress-Induced Hypertension Among Medical Students: Cross-Sectional Study. JPUMHS. 2024;14(2):92-100.

31. Allah Buksh DH, Kishwar DM, Shah DT, Uqaili DAA, Abbas DU. Role of Self-Assessment and Facilitator Feedback in Healthcare Education. J Popul Ther Clin Pharmacol. 2024;31(6):2441-8.

32. Siddiqui S, Roshan S, Buriro M, Uqaili AA, Meghji KA. Vitamin D3 levels in Left Ventricular Hypertrophy in Essential Hypertension: Case Control Study. Annals of PIMS. 2019;15(4):143-147.

33. Dars JJ, Memon SF, Uqaili AA, Shaikh S, Tagar M, Javed S. Prevalence of Insomnia among Emergency Doctors and Serum Melatonin Link. PJMHS. 2022;16(9):664.

34. Naeem A, Bhatti U, Batool S, Shaikh K, Uqaili A, Rani K. Association of Vitamin D with Obesity in Premenstrual Syndrome: Hyderabad Population. PJMHS. 2023;16(11):656.

35. Uqaili AA, Shah T, Naz S, Abbas U, Shabbir S. Environmental Pollutants and Chronic Respiratory Disease Exacerbations in Jamshoro. PJMD. 2024;13(4):108-117.

36. Memon S, Soomro KQ, Nizamani YM, Memon AM, Aqaili A, Shaikh S. Mean Platelet Volume and Chronic Kidney Disease Stages. JPUMHS. 2018;8(3):273–278.

37. Rajar UD, Kazi N, Solangi S, Uqaili AA, Ram A. Olive Oil Efficacy in Treatment of Penile Lichen Planus: Placebo-Controlled Study. Indo Am J Pharm Sci. 2018;5(9):9079-9083.

38. Uqaili AA, Sapna DA, Kumar O, Das G, Kumar V. Vitamin D3, Parathyroid Hormone and Serum Calcium in Essential Hypertension. ejpmr. 2017;4(2):112-117.

39. Khan M, Pathan S, Ansari K, et al. (June 08, 2025) Comparative Risk Assessment in Hypertensive Patients With Metabolic Syndrome by Exploring Angiotensin-Converting Enzyme Inhibitors and Angiotensin II Receptor Blockers. Cureus 17(6): e85564. doi:10.7759/cureus.85564

40. Bukhari AAS, Shaikh ARK, Salman W, Bhatti FA, Malik W, Minhas M, Muddasser A, Khaliq H. Pathophysiological role of nerve growth factor (NGF) in asthma: insights into airway inflammation, remodeling, and neural regulation in intensive care settings. Anaesth. pain intensive care 2025;29(3):681-689. DOI: 10.35975/apic.v29i3.2778

41. Abdellah Ahmed M, Rafiq T, Rashid N, et al. (June 16, 2025) Evaluating the Role of Neurogenic Locus Notch Homolog Protein 1 in Oral Cancer Progression and Therapeutic Opportunities. Cureus 17(6): e86149. doi:10.7759/cureus.86149

42. Danish S, Gul E, Chaudhry S, et al. (June 28, 2025) Exploring Adipokines in Assessing the Role of Dehydroepiandrosterone in Polycystic Ovary Syndrome-Linked Infertility. Cureus 17(6): e86921. doi:10.7759/cureus.86921

43. Kausar R, Batool A, Bukhari AAS, Shaikh ARK, Aleem A, Minhas M, et al. Crosslinking Salivary Diagnosis with Non-Invasive Insights to Oral Pathology: Novel Systematic Insights to Personalized Medicine in Disease Management. Pak Armed Forces Med J. 2025 Jun. 30;75(3):611-6.

44. Pathan S, Khan M J, Khaliq M. A Rare Case of a Dual-Mechanism-Based Thrombocytopenia Secondary to Carbamazepine in an Epileptic Patient. Cureus. 2025 June 24;17(6). e86674. doi:10.7759/cureus.86674

45. Pan A, Truong TN, Su YH, Dao DY. Circulating Biomarkers for the Early Diagnosis and Management of Hepatocellular Carcinoma with Potential Application in Resource-Limited Settings. Diagnostics (Basel). 2023 Feb 11;13(4):676. doi: 10.3390/diagnostics13040676.

