

HEAL-Dengue: Hospital- based Exploration, Analysis and Learning about Dengue Outcomes (HEAL-D-ALDO)

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Abstract

Background: Dengue Fever, also known as break-bone fever, is a viral illness and transmitted to humans by bites of infected *Aedes aegypti* and *Aedes albopictus* mosquitoes.

Objective: To determine the outcomes of patients presenting with dengue infection and describe the risk factors for mortality.

Study type, settings & duration: This prospective observational study was conducted in Intensive Care Units (ICUs) and Medical Wards, Department of Medicine, Fatima Memorial Hospital, Lahore from October 2021 to October 2023.

Methodology: A total of 215 patients presenting with characteristic symptoms and NS1 antigen and IgM. Anti Dengue antibodies positivity were included in current study. The hematological variables were recorded on day 1, 3 and 5 after admission. Clinical and biochemical parameters were recorded on the day of admission. Clinical course of the patient was monitored and outcomes were recorded.

Results: Out of 215 patients, 11 (5.1%) expired. A significant association between female gender and the necessity for packed cell volume and fresh frozen plasma transfusion was observed (OR (95% CI: 10.26 (2.23 – 96.24), $p = 0.0005$). The significant risk factors for mortality were: presence of ascites, pleural effusion, organ dysfunction, need for PCV, FFP and platelet megaunit transfusion. Higher hemoglobin on day 1 and 5 ($P = 0.05$), higher WBCs on day 3 and 5 ($p = 0.0$), platelets on day 5 ($p = 0.009$), O₂ saturations ($p = 0.0$) and mean BP on presentation ($p = 0.008$) (day 1) were significant predictors of death.

Conclusion: In patients with dengue infection, trend of hematological parameters should be monitored closely on daily basis. Specially attention should be paid to WBC count as results revealed that leucocytosis is an independent marker/ predictor of the mortality in patients with dengue.

Key words: Aedes, dengue, dengue fever, viral hemorrhagic fever.

Introduction

Dengue Fever, also known as break-bone fever, is a viral illness and transmitted to

humans by bites of infected *Aedes aegypti* and *Aedes albopictus* mosquitoes. Dengue virus (DENV) is a single-stranded ribonucleic acid (RNA) virus belonging to the family, Flaviviridae and genus Flavivirus.¹ DENV has four different serotypes (DENV to -4), with one serotype confers life-long immunity against that particular type but not to other serotypes. However temporary cross-immunity against rest of three serotypes persists for few months.² According to World Health Organization (WHO) March 2023, about half of the world's population is now at risk of dengue with an estimated 100-400 million infections occurring each year worldwide. Dengue is prevalent in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas.³ The non structural protein (NS1) antigen may be detectable on day one of infection

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Authors Contribution

AZK conceptualized the project. AHS did the data collection. OS did the literature search. SAFS performed the statistical analysis. Drafting, revision & writing of manuscript were done by MBB & QS.

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and has a sensitivity of around 80% and specificity of 99%.⁴

The first confirmed case of dengue virus occurred in Pakistan in 1994 but in mid 2000s it was an eye opener for the health authorities when the huge number of cases were reported from Karachi.⁵ Larger cities are affected the most as Pakistan's expanding urban and agricultural economies place it at a higher risk for acquiring vector-borne diseases.⁶ Pakistan is currently in the top 10 countries affected by climate change, and many research papers have concluded that there is a strong association between climate change and dengue fever.^{7,8} Dengue fever in Pakistan seems to have changed in terms of survivability, and the recent data hints towards the change in its intensity.⁹ As per recent reports published in 2023, Lahore has a population of 13.9 million people,¹⁰ making it more vulnerable for emergence of humongous dengue cases. Climate directly influences the vector borne diseases and changes in temperatures and humidity as well as natural disasters such as heavy flooding makes it more suitable and convenient for escalation in mosquito-borne diseases, such as dengue fever.⁴

Bed rest and hydration are the major modalities in management of dengue fever but Acetaminophen remains the major pharmacological strategy to combat severe pain. Non-steroidal anti-inflammatory drugs (NSAIDs) ibuprofen and aspirin are best avoided as they make the patient more vulnerable to bleed. In Endemic areas, Dengvaxia, is a vaccine approved in many European countries, suitable for only those persons who have had dengue infection in the past at least once. The results of the vaccines are promising.³ While many DENV infections are asymptomatic or produce only mild illness, DENV-2 can cause more severe cases, and even death. Prevention and control of dengue mainly relies on vector control by using effective methods. Fatality rates among patients with Dengue shock syndrome (DSS) can be 10% or higher but, with early recognition and treatment, can be less than 1%.¹¹ There is no anti-viral or any specific treatment for dengue/severe dengue. The key modality should be emphasizing on its early detection and timely assessment of cases. In addition ensuring proper medical care facilities especially in the periphery and training of the doctors time and again would lower the chances of mortality.³

Since dengue fever is a common condition in Pakistan, it is important to conduct a patient analysis to recognize severity of disease and its outcomes and predictors of mortality to prevent disease progression. This study was conducted to understand the profile of patients presenting with

dengue infection and determine the outcomes of patients presenting with dengue infection and describe the risk factors for mortality.

Methodology

A prospective, observational study was conducted in Intensive Care Units (ICUs) and Medical Wards, Department of Medicine, Fatima Memorial Hospital, Lahore from October 2021 to October 2023. A total of 215 patients, both genders, presenting with characteristic symptoms and NS1 antigen and IgM Anti Dengue antibodies positivity were included in the study by non-probability consecutive sampling. The sample size was calculated by Fisher's formula by keeping 5% margin of error, 95% confidence interval and 50% population proportion as in Bolarinwa et al.¹² Informed consent to use anonymized data for research was taken.

After obtaining Institutional review board (IRB) approval, all patients were admitted to ICU and wards with diagnosis of Dengue infection. As per usual practice/local guidelines about dengue fever management, routine labs were carried out daily. The clinical findings, hematological and biochemical parameters were recorded on a specially designed proforma. The hematological variables Haemoglobin (Hb), White blood cell counts (WBC) and Platelet count were recorded on days 1, 3 and 5 and clinical and biochemical parameters were recorded on the day of admission. Clinical course of the patient was monitored and outcomes were recorded.

Utilizing R Statistical Software, comprehensive analysis of our dataset was conducted, employing key packages such as Tidyverse, Stats, Table One, and Survival. Categorical variables (nominal and ordinal variables) were analyzed using frequencies and percentages and for numerical variables we used means and standard deviation (SDs). Tests of significance were applied wherever appropriate. We used Cox proportional Hazards model to predict the outcomes and created Kaplan Meier's survival plots for significant predictors of death. To assess data normality, the Shapiro-Wilk test was employed, revealing *p*-values below the 0.05 threshold, indicative of non-normality. Consequently, non-parametric tests were selected for subsequent analyses.

The ethical approval was obtained from the Ethical Committee of Fatima Memorial Hospital, Lahore vide letter no. 15/102.

Results

A detailed overview of demographics and group characteristics is presented in Table-1, while histograms illustrating hematological parameters can be found in Figure-1.

The results indicated a significant disparity between the two genders concerning hemoglobin values on days 1, 3, and 5 (Table-2). A significant association between female gender and the necessity for PCV transfusion (Odds Ratio [OR]: 10.26, 95% Confidence Interval [CI]: 2.23 – 96.24, p -value: 0.0005). Similarly, a significant association was observed between female gender and the requirement for FFPs transfusion (OR: 10.31, 95% CI: 1.28 – 472.01, p -value: 0.01). However, no significant association was found between female gender and the requirement for Platelet Megaunit transfusion. Figure-2 encapsulates these findings with boxplots.

A significant differences between the three age groups in terms of WBCs on day 5, Platelet count on days 1, 3, and 5, AST, Systolic and

Diastolic blood pressures, and O2 saturations on presentation (Table-3 and Figure-3).

Significant differences between age groups regarding categorical variables were noted. The presence of organ dysfunction and Dengue syndrome designation (Dengue Fever, Dengue Hemorrhagic Syndrome, and Dengue Shock Syndrome) exhibited significant variation across the three age groups (Table-4).

The presence of ascites, pleural effusion, organ dysfunction, need for PCV, FFP and platelet megaunit transfusion were all related to worse outcomes with high ORs and significant p values. The logistic regression revealed that lower hemoglobin on day1 and 5, higher WBCs on day 3 and 5, platelets on day 5, O2 saturations and mean BP on presentation (day 1) were significant predictors of death.

Cox Proportional Hazards (215 observations, 11 events) was done to create a prediction model for study population. The survival data, representing time until expiry, was modeled using various sets of covariates on days 1,3 and 5 (Figure-4).

Table 1: Patients' characteristics.

Group Characteristic	Result
Demographics	
N	215
Gender (n, %)	Males: 124 (57.7), Females: 91 (42.3)
Age (mean, SD) (years)	34.59 (18.05)
Dengue Syndrome	
Dengue Fever (n, %)	107(49.8)
Dengue Hemorrhagic Fever (n, %)	100 (46.5)
Dengue Shock	8 (3.7)
Serology	NS-1 positive: 109 (50.7) IgM Anti-Dengue Ab positive: 106 (49.3)
Hematological Parameters	
Hb. on day 1, 3, 5 (mean (SD))	13.63 (2.26), 13.52 (2.06), 13.14 (1.91)
HCT on day 1, 3, 5 (mean (SD))	40.62 (6.16), 40.29 (5.65), 39.31 (5.35)
WBCs on day 1, 3, 5 (mean (SD))	5.43 (3.63), 5.64 (3.85), 6.10 (4.20)
Platelets on day 1, 3, 5 (mean (SD))	100.68 (88.98), 82.59 (71.85), 96.08 (67.18)
Clinical Events	
Bleeding (n, %)	74 (34.4)
Bleeding Site	
Occult (n, %)	67 (31.2)
GIT (n, %)	4 (1.9)
Gum Bleeding	2 (0.9)
Cannula (n, %)	1 (0.5)
Organ dysfunction(n, %)	13 (6.1)
Ascites(n, %)	47 (21.9)
Pleural effusion (n, %)	55 (25.6)
Platelet Megaunit required (n, %)	63 (29.3)
Platelet Concentrate required (n, %)	7 (3.3)
PCV transfusions given (%)	18 (8.4)
FFP transfusion given (%)	9 (4.2)
Outcome	
Survived (%)	204 (94.9)
Expired (%)	11 (5.1)

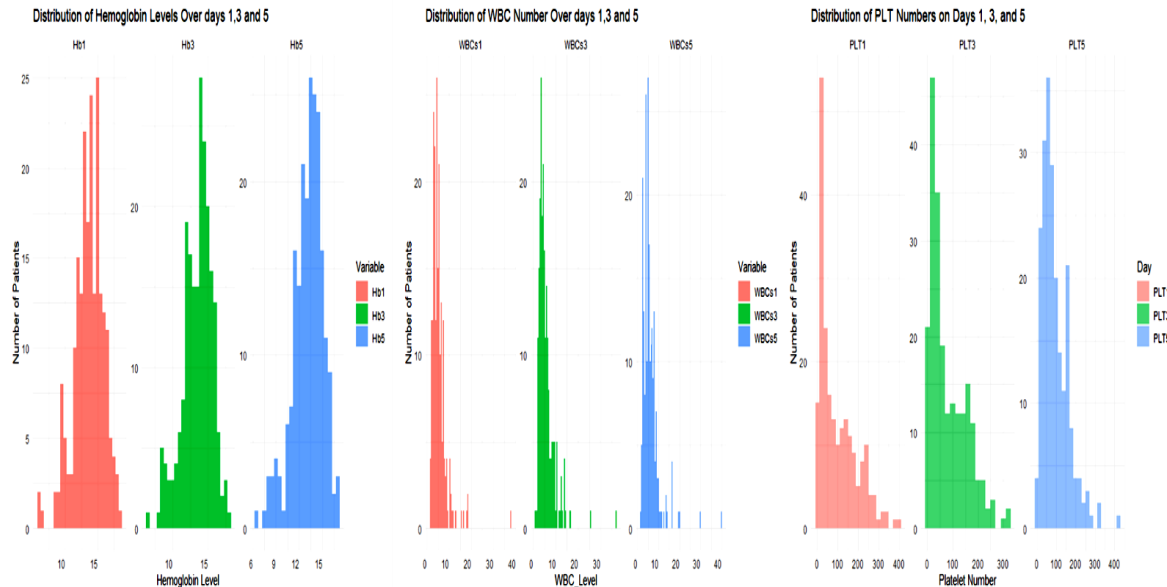


Figure 1: Histograms representing the progression of changes in hematological parameters (Hemoglobin, WBC count and Platelet count on days 1, 3 and 5).

Table 2: Gender differences in hematological parameters.

Hematological Parameters	Male	Female	Kruskal Wallis Rank Sum Test (df = 1)
Hb on day 1 (mean(SD)) (g/dl)	14.42 (1.87)	12.48 (2.3)	Chi2 = 37.593, <i>p</i> -value = 0.000
Hb on day 3 (mean(SD)) (g/dl)	14.31(1.66)	12.34 (1.9)	Chi2 = 54.493, <i>p</i> -value = 0.000
Hb on day 5 (mean(SD)) (g/dl)	13.91 (1.53)	12.07 (1.82)	Chi2 = 55.066, <i>p</i> -value = 0.000

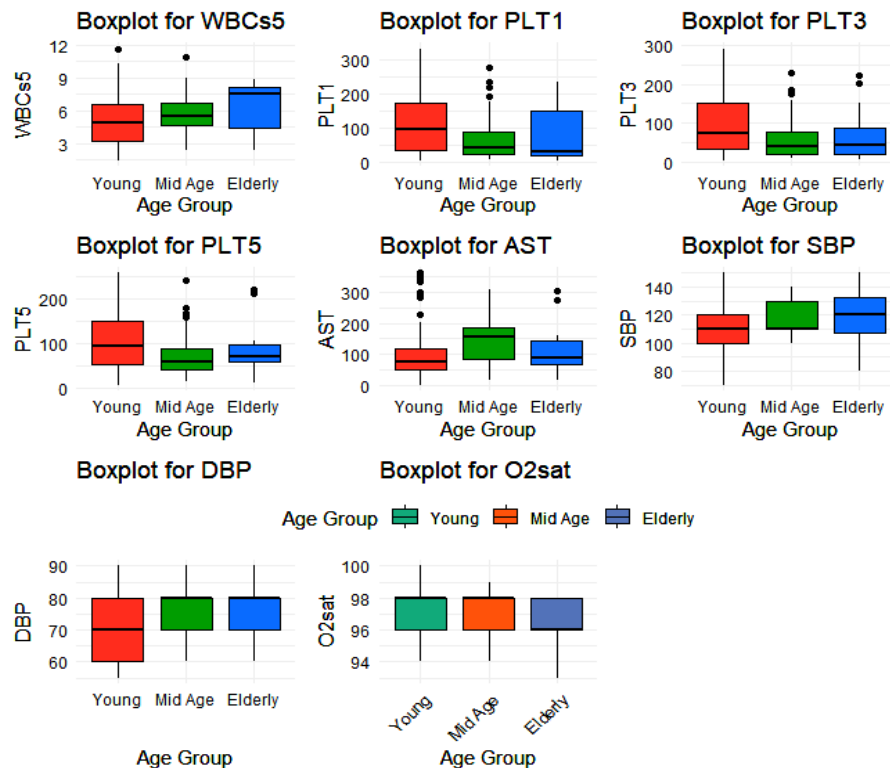
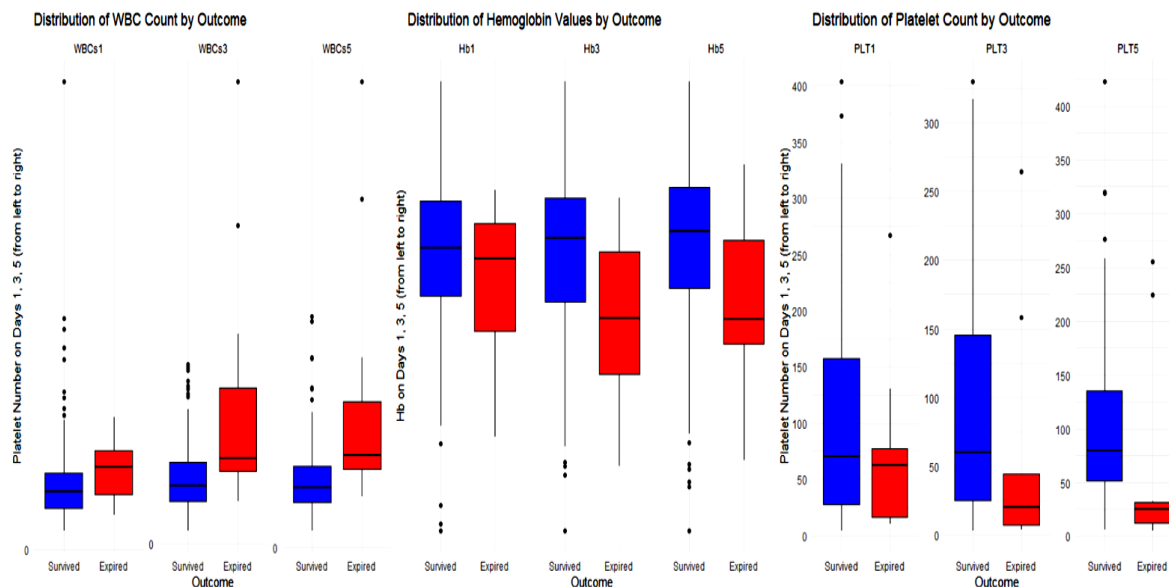


Figure 2: Boxplots of age group differences.

Table 3: Significant age group differences for numerical variables

	Young	Middle Aged	Elderly	Kruskal Wallis Rank Sum Test (df = 2)
WBCs on day 5 (–/mm ³) (mean(SD))	5.3 (2.68)	6.4 (3.46)	7.2 (3.64)	Chi2 = 9.889, <i>p</i> -value = 0.007
Platelets on day 1 (–/mm ³) (mean(SD))	118.6 (93.9)	67.6 (65.2)	76.6 (77)	Chi2 = 13.73, <i>p</i> -value = 0.001
Platelets on day 3 (–/mm ³) (mean(SD))	96.2 (75.7)	55.7 (52)	67 (68)	Chi2 = 12.76, <i>p</i> -value = 0.001
Platelets on day 5 (–/mm ³) (mean(SD))	107.8 (70.6)	75.3 (51.6)	80.8 (57.4)	Chi2 = 11.17, <i>p</i> -value = 0.003
AST (IU/L) (median (IQR))	91 (105)	171 (113)	92 (87)	Chi2 = 12.06, <i>p</i> -value = 0.0002
SBP (mmHg) (mean (SD))	109 (13.6)	116.1 (15.5)	112.4 (33.4)	Chi2 = 10.57, <i>p</i> -value = 0.005
DBP (mmHg) (mean (SD))	70.5 (10.3)	75.9 (15.4)	75.3 (11.2)	Chi2 = 13.31, <i>p</i> -value = 0.0001
O2 sats (%) (mean (SD))	96.9 (2.3)	96.7 (2.9)	94.5 (4.5)	Chi2 = 10.42, <i>p</i> -value = 0.005

**Figure 3: Distribution of hematological parameters with regards to outcomes****Table 4: Age group differences in categorical variables.**

	Young		Middle Aged		Elderly		<i>p</i>
	Present	Absent	Present	Absent	Present	Absent	
Organ Dysfunction	5	134	1	50	3	14	0.039
Dengue Syndrome							0.042
Dengue Fever	79		19		9		
Dengue Hemorrhagic Syndrome	59		32		9		
Dengue Shock Syndrome	4		1		3		

The day 1 analysis revealed that higher levels of hemoglobin were associated with a decreased hazard of death (HR: 0.6883, 95% CI: 0.4741 – 0.9993, *p*-value: 0.04958), while elevated O2 saturation (HR: 0.7192, 95% CI: 0.6038 – 0.8566, *p*-value: 0.000) was also protective. Normal SBP was associated with a decreased hazard (HR: 0.9674, 95% CI: 0.9437 – 0.9917, *p*-value: 0.00887). The model demonstrated good discriminatory power (Concordance = 0.887) and was statistically significant (Likelihood ratio test *p*-value: 0.00002).

On day 3 Elevated WBCs (HR: 1.1415, 95% CI: 1.056 – 1.23, *p*-value: 0.000) were associated with an increased hazard, while no significant

associations were found for other variables. This model exhibited a Concordance of 0.729 and statistical significance in both the Likelihood ratio test (*p*-value: 0.00002) and Wald test (*p*-value: 0.000002).

The Day 5 model showed increased WBCs (HR: 1.17, 95% CI: 1.09 – 1.26, *p*-value: 0.000) and decreased Platelets (HR: 0.9801, 95% CI: 0.9662 – 0.9953, *p*-value: 0.00974) were associated with higher hazards of death. The model demonstrated good discriminatory power (Concordance = 0.786) and was statistically significant in all tests (Likelihood ratio test *p*-value: 0.00004, Wald test *p*-value: 0.00008, Score test *p*-value: 0.00000002).

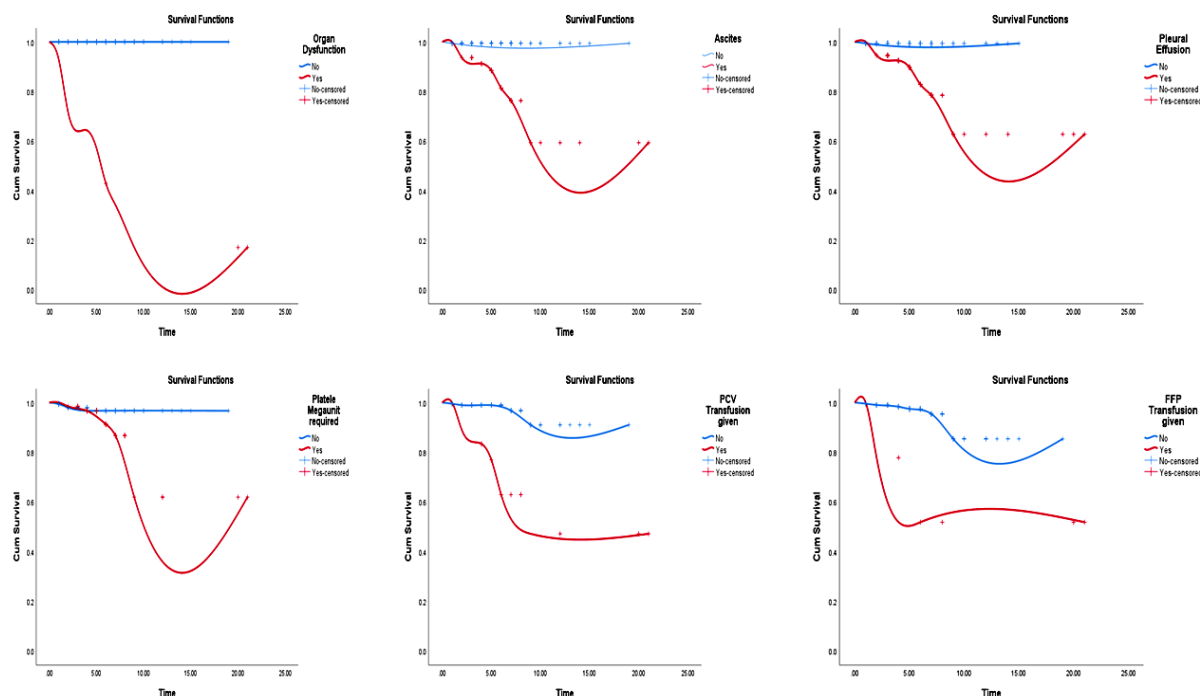


Figure 4: Kaplan Meier survival plots for important predictor variables.

A model incorporating Gender and Serology as predictors showed no significant associations. Male gender exhibited a Hazard Ratio of 0.5507 (95% CI: 0.1586 – 1.912, p -value: 0.348), and SerologyNS1 had a Hazard Ratio of 1.8891 (95% CI: 0.5495 – 6.495, p -value: 0.313). The model did not achieve statistical significance in any of the tests.

Discussion

A prospective observational study was conducted enrolling 215 dengue fever patients with confirmed positive NS1 antigen and anti Dengue IgM antibodies. There was a clear predominance of male patients (57.7%). This difference between men and women can also be observed in a study conducted by Mahmood R et al. in Dhaka city, Bangladesh where they faced worst outbreak in 2019 (64.11% men vs 35.89% women).¹³ This difference can be attributed to the fact that males are more prone to the infection as they are mostly out for work in both these countries. The same study also reflected that young patients were more affected (49.8%) which is highly comparable with current study (46.3%).

In present study, majority of population was young patients (66.04%) and most of the cases (44.3%) had severe form of dengue that is either DHF and DSS. A study recently published in December 2023 from Bangladesh conducted by

Sami CA et al. also had (47.7%) young patients with severe form of dengue which is highly comparable with current study.¹⁴

A meta-analysis done by Toledo J et al.¹⁵ revealed that severe dengue was affecting more older individuals whereas present study showed that young people were affected more with severe dengue, this contrast of population who are affected can be explained on the basis that more young patients were enrolled in this study.

A study conducted in South India, in department of medicine, Yashoda hospital, Hyderabad by Agrawal VK, et al.¹⁶ revealed that NS1 antigen was positive in 140 (41.9%) and Dengue IgM antibodies was detected in 203 (60.7%) whereas in present study NS1 antigen and Dengue IgM antibodies were detected in 109 (50.7%) and 106 (49.3%), so results of present study are pretty much consistent with this study and the minor difference can be explained on the basis of larger sample size.

A retrospective study conducted by John KJ et al.¹⁷ in South India and published in 2019 revealed dengue fever in (12.6%), DHF in (44%) and DSS in (43.4%) and current study also had (46.5%) patients who had DHF which is highly comparable with our study, because Pakistan and India have commonalities in culture and genetics along with rapid urbanization. In the same study, Platelet transfusion was done in (27%), Fresh frozen plasmas (FFPs) was transfused in (19.5%)

and (1.2%) patients received Packed cell volume (PCV). Whereas in present study (29%) patients had received platelet transfusion which is similar and highly comparable. Same study also revealed that patients who had higher White blood cells (WBCs) were falling in severe category of Dengue and they have had mortality.

Another landmark study conducted at Hayatabad Medical Complex, Peshawar and published in March, 2023 by Mahmood A et al¹⁸ concluded that patients having increased white cell counts as the disease progressed along with acute kidney injury remained major predictor of the severity and mortality, these results are consistent with current study as leukocytosis sets in, severity and mortality escalates.

John KJ and colleagues¹⁷ found out that median Haemoglobin(Hb) with Interquartile range(IQR) level as 14.4 (12.9-15.8) for both genders, Platelet counts were 31 (15-85), WBCs 4.9 (3.2-8.2) whereas in present study Mean Hb with SD was 14.4 (1.87) in males and 12.48 (2.3) and mean WBCs as 5.43 (3.63), similar to reported results.

A study conducted in 2019 in Rawalpindi at Pak-Emirates Military Hospital by Shabir M and colleagues¹⁹ concluded that (43%) patients had occult bleeding followed by Gum bleed in (28%) and Haematemesis in (3%) and in contrast, present study had 74 (34.4%) patients who had occult bleeding and Haematemesis in 4(1.9%) patients, so results are in line and consistent with the study conducted by Shabir, et al.

A study conducted at Agha Khan University Hospital Karachi by Ali N et al²⁰ revealed dengue mortality rate as 3.3% (n=7) and all of these patients had DSS, while 196 (93.3%) recovered completely and were discharged safely. In contrast, current study had mortality rate of (5.1%) (n=11) and 204 (94.9%) patients recovered completely and sent home, this minor difference in mortality rate can be attributed to the fact that study was conducted for five years where present study was conducted for two years and recovered patients percentage is almost same so standards of care are comparable too.

In a study conducted by John KJ et al.¹⁷ 4 (2.5%) patient expired out of 159 patients whereas in current study 11 (5.1%) expired out of 215 patients, this minor difference between mortality rate can be explained that current study was conducted from October 2021 to October 2023 and sample size was larger than the study by John KJ et al.¹⁶

This present study had some limitations. The study was single center and done in a single city, hence results cannot be generalized on whole

population of the country. There is a need to conduct multicenter studies from all mega cities of Pakistan for better understanding of the regional variation. A collaborative effort is the need of the day to combat this preventable disease. Awareness campaigns through symposia and conferences should be regularly conducted by the federal and provincial governments well before the monsoon season and public health department should be made alert before monsoon season by the policy makers for developing a comprehensive plan of action.

Haematological parameters should be monitored closely on daily basis, special emphasis should be given to changes in WBC counts as study revealed that leucocytosis is an independent marker/ predictor of the mortality in patients with dengue.

Conflict of interest: None declared.

References

- Schaefer TJ, Panda PK, Wolford RW. Dengue Fever. National Library of Medicine. StatPearl Publishing 2022; 26: 2022.
- Seixas G, Salgueiro P, Bronzato-Badial A, Gonçalves Y, Reyes-Lugo M, et al. Origin and expansion of the mosquito *Aedes aegypti* in Madeira Island (Portugal). Sci Rep 2019; 9(1): 2241.
- World Health Organisation. Dengue and severe dengue. Accessed on 12th December 2024) Available from URL: [https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue\(2024\)](https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue(2024))
- Hermann LL, Thaisomboonsuk B, Poolpanichupatam Y, Jarman RG, Kalayanarooj S, Nisalak A, et al. Evaluation of a dengue NS1 antigen detection assay sensitivity and specificity for the diagnosis of acute dengue virus infection. PLoS Negl Trop Dis 2014; 8(10): e3193.
- Jahan F. Dengue fever (DF) in Pakistan. Asia Pacific Family Med 2011; 10: 1-4.
- Shaikh OA, Baig MT, Tahir S, Parekh AD, Nashwan AJ. Dengue outbreak following unprecedented flooding in Pakistan. Hyg Environ Health Adv 2023; 7: 100076.
- IPCC. The Intergovernmental Panel on Climate Change, Working Group II Impacts, Adaptation and Vulnerability; (2018). Accessed on 12th December 2024) Available from URL: <https://www.ipcc.ch/working-group/wg2/>.
- Lee H, Kim JE, Lee S, Lee CH. Potential effects of climate change on dengue transmission dynamics in Korea. PLoS One 2018; 13(6): e0199205.
- Haider Z, Ahmad FZ, Mahmood A, Waseem T, Shafiq I, Raza T, et al. Dengue fever in Pakistan: a paradigm shift; changing epidemiology and clinical patterns. Perspect Public Health 2015; 135(6): 294-8.
- World Population Review. Lahore, Pakistan Population 2024. Accessed on 12th December 2024)

- Available from URL: <https://worldpopulationreview.com/world-cities/lahore-population>
11. CDC. Dengue. Accessed on 12th December 2024) Available from URL: <http://www.cdc.gov/dengue/resources/healthcarepract.pdf>
 12. Bolarinwa OA. Sample size estimation for health and social science researchers: The principles and considerations for different study designs. *Niger Postgrad Med J* 2020; 27(2): 67-75.
 13. Mahmood R, Benzadid MS, Weston S, Hossain A, Ahmed T, Mitra DK, et al. Dengue outbreak 2019: clinical and laboratory profiles of dengue virus infection in Dhaka city. *Heliyon* 2021; 7(6): e07183.
 14. Sami CA, Tasnim R, Hassan SS, Khan AH, Yasmin R, Monir-uz-Zaman M, et al. Clinical profile and early severity predictors of dengue fever: Current trends for the deadliest dengue infection in Bangladesh in 2022. *IJID Reg* 2023; 9: 42-8.
 15. Toledo J, George L, Martinez E, Lazaro A, Han WW, Coelho GE, et al. Relevance of non-communicable comorbidities for the development of the severe forms of dengue: a systematic literature review. *PLoS Negl Trop Dis* 2016; 10(1): e0004284.
 16. Agrawal VK, Prusty BS, Reddy CS, Reddy GK, Agrawal RK, Bandaru VC. Clinical profile and predictors of Severe Dengue disease: A study from South India. *Caspian J Int Med* 2018; 9(4): 334.
 17. John KJ, Gunasekaran K, Prasad JD, Mathew D, Das S, Sultan N, et al. Predictors of major bleeding and mortality in dengue infection: a retrospective observational study in a tertiary care centre in South India. *Interdiscip Perspect Infect Dis* 2019; 2019: 1-7.
 18. Mahmood A, ul Haq A, Amin S, Rahim F, Noor M, Gul H, et al. Predictors of Mortality in Patients With Dengue Fever: Insights From a Comparative Analysis. *Cureus* 2023; 15(3): e36040.
 19. Shabir M, Nisar S, Urooj Z, Sohail M, Khan MS, Khan DH. Thrombocytopenia and its Relationship with Bleeding Manifestations in Dengue Patients-A Tertiary Care Hospital Experience. *Pak Armed Forces Med J* 2022; 72(6): 2021-4.
 20. Ali N, Usman M, Syed N, Khurshid M. Haemorrhagic manifestations and utility of haematological parameters in dengue fever: a tertiary care centre experience at Karachi. *Scandinavian J Infect Dis* 2007; 39(11-12): 1025-8.
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