Original Article

Evaluation of Biochemical and Hematological Dynamics as Markers for Severe Dengue Forms

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Abstract

Dengue is a viral infection that has become a serious problem in recent years. It is a major cause of mortality and morbidity. The present study is a prospective, hospital-based, observational study done from 2015 to October 2022. The objective of our study was to consider whether dengue infection can be suspected based on hematological and biochemical findings.

The study included 100 patients positive for dengue infection. Complete haemograms, transaminases for liver injury, blood urea, and serum creatinine levels for renal assessment were performed for these patients. The most common hematological findings were thrombocytopenia, leucopenia, an increase in the mixed cell fraction of the leucocytes, and the presence of reactive lymphocytes.

Biochemical parameters like aminotransferases, blood urea, and serum creatinine levels were significantly raised. Hence, a platelet count of <100,000 cells/µl, leucopenia of < 4000 cells/µl, and aspartate aminotransferase levels of >82.2 U/L can be considered predictors of dengue infection.

Keywords: Dengue fever, hematological parameters, biochemical parameters

Introduction

Dengue viruses have spread rapidly within countries and across regions in the past few decades, resulting in an increased frequency of epidemics and severe dengue diseases[1]. Dengue infection affects a large number of people, mainly in tropical and subtropical regions of the world[2]. There are four serotypes (i.e., DENV-1, DENV-2, DENV-3, and DENV-4) which are closely related to each other antigenically and belong to enveloped, single-stranded positive- sense RNA virus family known as the Flaviviridae, genus Flavivirus which causes Dengue[3,4]. The Flavivirus genus comprises more than 70 viruses, many of which are arthropod-borne human pathogens that cause a wide variety of clinical diseases, ranging from moderate fever to severe conditions, including encephalitis and hemorrhagic fever[5,6]. The majority of flaviviruses are spread by the bite of infected arthropod vectors, primarily mosquitoes of the genus Aedes (Aedes aegypti and, to a lesser extent, Aedes albopictus) and Cluex. However, a number of flaviviruses, like dengue, yellow fever, and zika, are spread through a mosquito bite, human-to- human transmission by blood transfusion, or transplantation of infected tissue[7].

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Over 390 million DENV infections are thought to occur annually, of whom 96 million show clinical symptoms of various severity, and 3.9 billion people in 128 countries are thought to be at risk of infection[8,9] Dengue fever is one of the most common sorts of infection. Mostly semi-tropical and hot areas have high rates of dengue fever[10]. Both genders, male and female suffer from dengue. The ratio of adults infected with dengue fever is significantly higher than children[11,12]. DF is a mild fever which is less lethal, and the patient has body pain , fever and joint pains. While Dengue Haemorrhagic Fever is severe type in which organs functions are also affected. In critical dengue cases, the respiratory system, muscular system, heart, nervous and renal system are highly affected, so the medical assistance is urgently needed[10]. Yearly reported Dengue Haemorrhagic Fever and Dengue Shock Syndrome cases are 500,000, among which 22,000 people die.

Fatalities are reported mostly in children and old age people. Reported by WHO, mostly the patients have no symptoms[13]. The severity of Dengue Haemorrhagic Fever is high and it can be fatal due to various other health factors such as hypertension, thrombocytopenia, cardiac diseases, diabetes, asthma[14,15]. These comorbidities make the dengue more hazardous and lethal. Dengue fever (DF) is characterized by fever, headache, vomiting, pain, myalgia, and arthralgia.

These symptoms worsen and become life threatening for most human beings. This leads to hemorrhagic fever, which was first recognized in Philippines in 1954, characterized by thrombocytopenia, hemorrhage, and plasma leak, furthermore, fatigue, irritability, persistent vomiting, and severe belly pain[16,17]. Comorbid patients are reported to be at substantial risk of developing severe dengue[18]. It is hypothesized that comorbidities like diabetes, hypertension, asthma led to higher risk of developing Dengue Haemorrhagic Fever/Dengue Haemorrhagic Shock Syndrome. Although the data available on the relationship between comorbidities and the severity of dengue is very less, we have managed to collect the data of 102 comorbid patients with dengue[12]. Multiple tests have been applied to confirm the relation between comorbidities and dengue.

LITERATURE REVIEW

Dengue fever is an ancient disease. The earliest record discovered to date is in a Chinese encyclopedia of disease, symptoms, and remedies, edited in 610 A.D. and again in 992 A.D. (Nobuchi 1979). With the rapid growth of shipping and the Port city development in the 18th and 19th centuries, the mosquito vector, Aedes aegypti, and dengue viruses have spread to new geographic areas, causing major problems and epidemics. Southeast Asia and the Pacific experienced ecological disruption.

During and after WWII, the theatres created ideal conditions for viral transmission. It was in the setting where there was transmission and an increase in mosquito-borne disease that a global dengue pandemic began In Japan, the dengue virus was discovered in 1943, through patient serum inoculation Kimura and Hotia's suckling mice 1944). The virus was isolated from the sera of US soldiers in many parts of the world in 1944.

The entire world, including Calcutta (Sabin and Schlesinger, 1945). The most severe form of Dengue fever, also known as DHF, was first detected in Manila, the Philippines in 1953, 1954 Rigau-Perez and colleagues (1998)

All four serotypes have caused disease in both East and West Africa (Gubler).

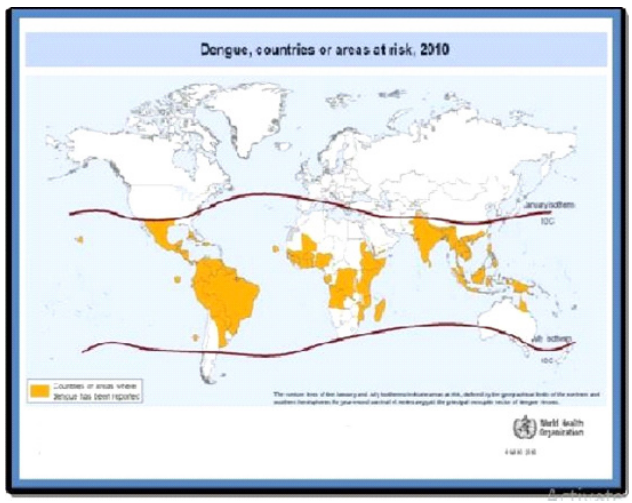

Figure 1

Trent, 1994). Dengue viruses and Aedes aegypti mosquitoes had a global distribution in tropical and subtropical countries in 1997. Fig 1

Methodology

Materials and Methods

STUDY DESIGN

It is a retrospective study.

ETHICAL APPROVAL

Ethical approval was obtained during January 2022 from the committee of Yusra Institute of Pharmaceutical Sciences and ethical approval from respective hospitals from where data was collected and consent was obtained from the relevant Patients.

STUDY POPULATION AND RESPONDENTS

The sample size was 1500 patients.

STUDY SITE

Benazir Bhutto Hospital, Holy family Hospital (RWP)

SAMPLING TECHNIQUES

Data was collected through a convenient sampling technique by using a questionnaire.

INCLUSION CRITERIA

Patients of age ranging from 18 to 65 years. All patients of both the private sector as well as government sectors including Hypertension patients, Diabetics patients Pneumonia patients, and Shock Patients.

EXCLUSION CRITERIA

Exclusion criteria include all those patients having NS1 test -ve.

DATA COLLECTION TOOLS

A structured questionnaire has been developed through an extensive review of the literature as none of the available tools was seen to be effective for our study.

DATA COLLECTION METHOD AND ANALYSIS

Data is collected by the principal investigator who has been trained by the supervisor. The questionnaire will be hand – delivered but the data collector to be the respondent. The respondents were identified and after obtaining written/verbal consent from them, the questionnaire was hand-delivered to them. The questionnaire was collected back on the same day to avoid study business. Data were analyzed using SPSS version 16.

GANTT CHART:

Activities	May2019	June-Aug 2019	Sep-Oct 2019	Nov-Dec 2020	Jan-March 2020
Literature Review					
Tool development					
Synopsis Development					
Proposal defence					
Data collection					

SAMPLE SIZE

The samples were taken from hospitals which include Benazir Bhutto Hospital, Holy family Hospital (RWP) were more than 1000 but the patients with Ns1+ were 786 patients.

Results

The following data was extracted from the information obtained from the hospitals and is displayed in the form of graphs and tables.

Each Table represents Hematological Parameters including WBCs, Hemoglobin, and Platelet counts of patients having different Co-morbidities which include Diabetes, Hypertension and asthma.

Blood report: WBC+ Hemoglobin+ Platelet counts

Diabetes

Total Comorbidity patients (diabetes) =43

Total healthy patients (non-comorbid) =667

(Those with mention DHF, DF, and DSS=39)

(Those with mention DHF,DF, and DSS= 636) DSS=01,DHF=331,

DHF=25, DF=12, DF=302, DSS=03

Table 1 Comparison of WBC count, Hemoglobin, and platelet counts between DHF, DF and DSS of diabetic and non-diabetic patients

WBC Count (10^9/L) (Diabetic)							WBC Counts (10^9/L) (Non-Diabetic)						P-value	
Days	DHF group (n=25)		DF group (n=12)		DSS group (n=01)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		DH F	DF
	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D- 01	5.31	2.15	5.57	4.27	10.6	N/A (single value)	D- 01	4.93	4.80	4.36	2.13	8.46	7.66	0.099	0.232
D- 02	5.61	2.85	0.85	3.30	--	--	D- 02	4.89	2.45	4.34	2.14	6.76	6.23	0.321	0.156
D- 03	8.06	3.0	5.7	3.40	--	--	D- 03	5.14	2.49	4.84	3.16	4.96	2.89	0.004	0.472
D- 04	7.86	1.02	--	--	--	--	D- 04	5.12	2.32	5.32	4.95	7.36	6.07	0.001	--

Table 1 shows the comparison of WBC count among Diabetic and Non Diabetic Patients having DHF, DF and DSS on days (D-01, D-02, D-03 and D-04). The WBC Count in Diabetic Patients having DHF were (5.31), (5.61), (8.06),(7.86). In DF were (5.57), (0.85), (5.7) and in DSS were (10.6). While the

WBC Count in non-diabetic Patients having DHF were (4.93), (4.89), (5.14), (5.12). In DF were (4.36), (4.34), (4.84), (5.32) and in DSS were (8.46), 6.76), (4.96), and (7.36).

The P-value between diabetic and non-diabetic patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; DHF (0.099), (0.321), (0.004), and (0.001) which shows that on d-01 and d-02 the p- value is higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis while on d-03 and d-04 the p-value is less than 0.05 which shows that result is statistically significant and rejects null hypothesis. For DF (0.232), (0.156), and (0.472) shows that the p-values are higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis.

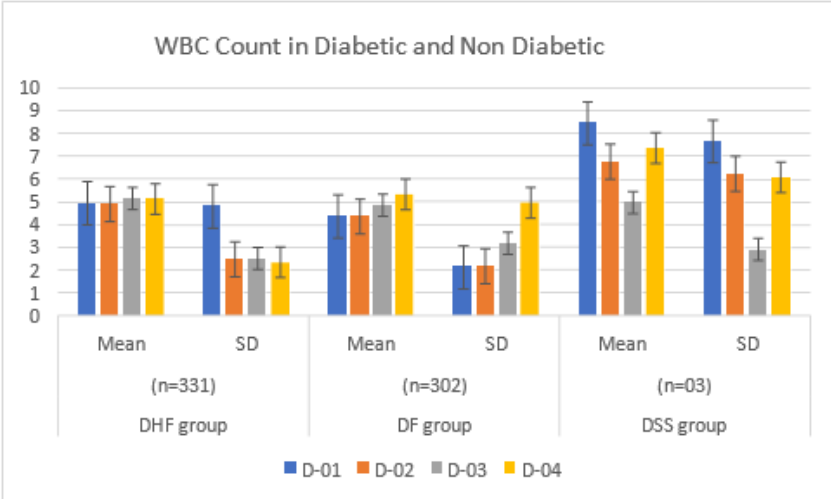

Figure 2

Hemoglobin (g/dL) (Diabetic)							Hemoglobin (g/dL) Non-Diabetic)							
Days	DHF group (n=25)		DF group (n=12)		DSS (n=01)		Da ys	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		
	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	
D- 01	14.13	3.43	13.99	1.19	18.3	N/A (single value)	D- 01	14.93	6.91	14.49	9.06	15.2	2.94	0.947	0.899
D- 02	13.87	3.14	13.06	2.89	---	--	D- 02	14.34	3.34	14.05	3.08	13.3	0.79	0.391	0.845
D- 03	13.91	3.38	15.46	0.64	--	--	D- 03	13.88	2.28	13.36	2.63	13.23	1.05	0.304	0.121
D- 04	15.06	1.87	--	--	--	--	D- 04	14.05	2.45	12.73	2.59	13.16	0.45	0.331	--

Table 2 shows the comparison of Hemoglobin levels among Diabetic and Non Diabetic Patients having DHF, DF and DSS on days (D-01, D-02, D-03 and D-04). The Hemoglobin levels in Diabetic Patients having DHF were (14.13), (13.87), (13.91), (15.06). In DF were (13.99), (13.06), (15.46) and in DSS were (18.3). While Hemoglobin levels in Non –Diabetic Patients having DHF were (14.34), (13.88),(13.88), (14.05).In DF were (14.49), (14.05), (13.36), (12.73) and in DSS were (15.2), (13.3), (13.23), (13.16).

The P-value between hypertension and non-hypertension patients having DHF, DF and DSS on (d-01, d- 02, d-03 and d-04) were; for DHF (0.947), (0.391), (0.304), and (0.331) which shows that the p-value is higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis. For DF (0.121), (0.845), and (0.899) shows that the p-values are higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis.

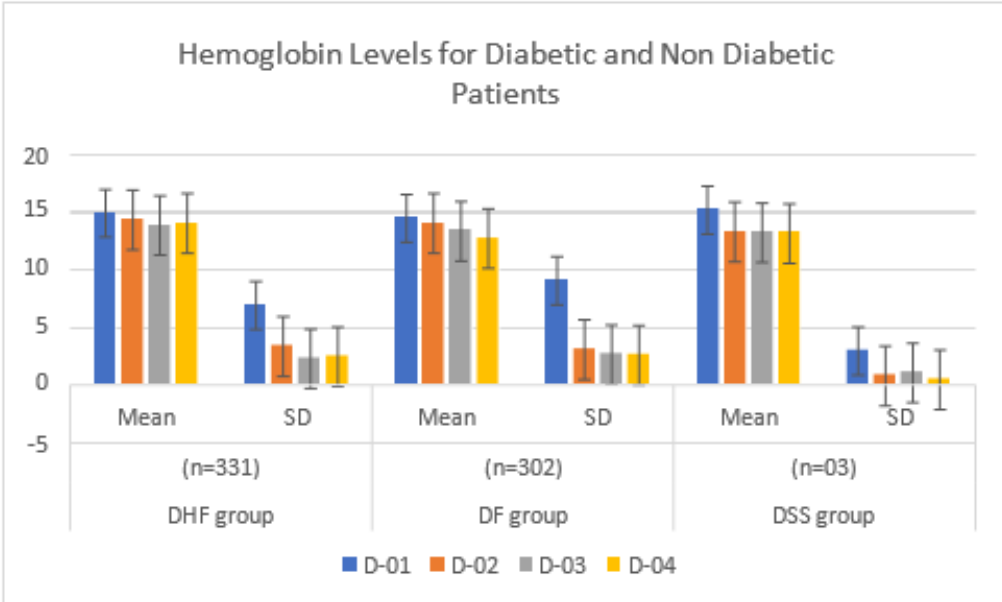

Figure 3

	Platelets Counts (10^9/L)		(Diabetic)					Platelets Counts (10^9/L)		Non-Diabetic)					
Days	DHF group (n=25)		DF group (n=12)		DSS (n=01)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)			
	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D-01	50.28	21.97	65.03	27.80	69	N/A (single value)	D-01	69.19	55.79	80.79	46.53	47.33	16.16	0.064	0.424
D-02	69.52	45.49	61	21.73	--	--	D-02	63.74	46.18	87.42	50.31	54.33	18.58	0.606	0.096
D-03	43.16	19.70	48.33	19.08	--	--	D-03	63.40	39.53	89.80	64.04	57.33	35.38	0.120	0.209
D-04	42.4	17.61	--	--	--	--	D-04	74.10	48.35	81.78	47.13	166	122.74	0.170	--

Table 3 shows the comparison of Platelets Counts among Diabetic and Non Diabetic Patients having DHF, DF and DSS on days (D-01, D-02, D-03 and D-04). The Platelets Counts in Diabetic Patients having DHF were (50.28), (69.52), (43.16),(42.4). In DF were (65.03), (61), (48.33) and in WBC Count DSS were (67). While Platelet Counts in Non-diabetic patients having DHF were (69.19), (63.74), (63.40), (74.10). In DF were (80.79), (87.42), (89.80),(81.78) and in DSS were (47.33), (54.33), (57.33), (166).

The P-value between Diabetic and non-diabetic patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.064), (0.606), (0.120), and (0.170) which shows that on d-01 and d-02 the p- value is higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis while on d-03 and d-04 the p-value is less than 0.05 which shows that result is statistically significant and rejects null hypothesis. For DF (0.424), (0.096), (0.209) shows that the p-values are higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis.

Hypertension:

Total Comorbidity patients (Hypertension) =53

Total healthy patients (non-comorbid)=667

Table 2 Comparison of WBC count, Hemoglobin, and platelet counts between DHF, DF and DSS of hypertension and non-hypertension patients.

Table 3

WBC Counts (10^9/L) (Hypertension)						WBC Count (10^9/L) (Non- Hypertension)						P-Value	
Days	DHF group (n=27)		Days	DF group (n=22)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		DH F	DF
	Mean	SD		Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D-01 (27)	5.162963	2.277169	D-01 (21)	4.734762	3.231822	D-01	4.93	4.80	4.36	2.13	8.46	7.66	0.192	0.631
D-02 (19)	4.847368	1.297591	D-02 (14)	3.558571	1.115698	D-02	4.89	2.45	4.34	2.14	6.76	6.23	0.660	0.237

Continue.....

D-03 (11)	7.145455	2.330392	D-03 (5)	4.666	2.824142	D-03	5.14	2.49	4.84	3.16	4.96	2.89	0.003	0.849
D-04 (5)	7.68	1.164903	D-04 (2)	3.03	0.890955	D-04	5.12	2.32	5.32	4.95	7.36	6.07	0.003	--

Table 4 shows comparison of WBC count among hypertension and non-hypertension patients having DHF, DF, and DSS on days (d-01, d-02, d-03 and d-04). The WBC count in hypertension patients having DHF were (5.162963), (4.847368), (7.145455), (7.68); and DF were (4.734762), (3.558571), (4.666), (3.03). While WBC count in non-hypertension patients having DHF were (4.93), (4.89), (5.14), (5.12); having DF were (4.36), (4.34), (4.84), (5.32); and having DSS were (8.46), (6.76), (4.96), (7.36).

The P-value between hypertension and non-hypertension patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.192), (0.660), (0.003), (0.003) shows that on d-01 and d-02 the p-value is higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis while on d-03 and d-04 the p-value is less than 0.05 which shows that result is statistically significant and rejects null hypothesis. For DF (0.631), (0.237), (0.849) shows that the p-value is higher than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis.

Graph below shows comparison of WBC count for hypertension and non-hypertension patients.

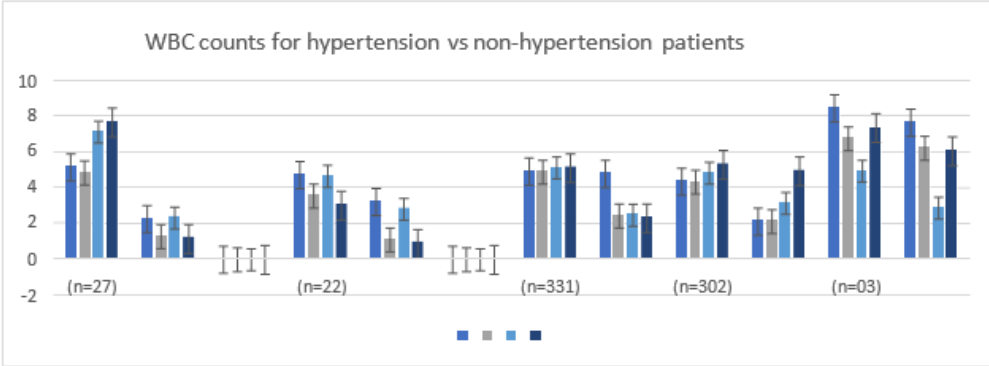

Figure 4

Table 4

Hemoglobin (g/dL) (Hypertension)						Hemoglobin (g/dL) (Non-Hypertension)							P-Valu E	
Days	DHF group (n=27)		Days	DF group (n=22)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		DHF	DF
	Mean	SD		Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D-01 (27)	14.95185	2.535346	D-01 (21)	15.65714	7.022291	D-01	14.93	6.91	14.49	9.06	15.2	2.94	0.396	0.440
D-02 (19)	14.93158	3.277711	D-02 (14)	13.65	1.867845	D-02	14.34	3.34	14.05	3.08	13.3	0.79	0.245	0.669
D-03 (11)	14.51818	2.17063	D-03 (5)	13.96	2.003247	D-03	13.88	2.28	13.36	2.63	13.23	1.05	0.792	0.949
D-04 (5)	14.04	2.751	D-04 (2)	11.4	0.424264	D-04	14.05	2.45	12.73	2.59	13.16	0.45	0.799	--

Table 4 shows comparison of hemoglobin levels among hypertension and non-hypertension patients having DHF, DF and DSS on days (d-01, d-02, d-03, d-04). The hemoglobin level in hypertension patients having DHF were (14.95185), (14.93158), (14.51818), (14.04); having DF were (15.65714), (13.65), (13.96), (11.4). While hemoglobin level in non-hypertension patients having DHF were (14.93), (14.34), (13.88), (14.05); having DF were (14.49), (14.05), (13.36), (12.73); and having DSS were (15.2), (13.3), (13.23), (13.16).

The P-value between hypertension and non-hypertension patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.396), (0.245), (0.792), (0.799) and for DF (0.440), (0.669), (0.949) shows that the p-value is higher than 0.05 from d-01 to d-04 which shows that result is not statistically significant and do not rejects null hypothesis.

Graph below shows comparison of hemoglobin levels between hypertension and non- hypertension patients.

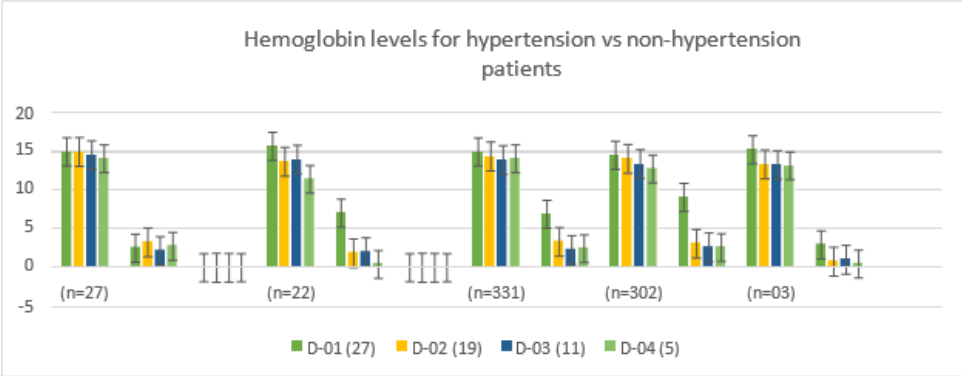

Figure 5

Table 5.

Platelets Counts (109/L) (Hypertension)						Platelets Counts (109/L) (Non-Hypertension)							P-VALUE	
Days	DHF group (n=27)		Days	DF group (n=22)		Day s	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		DH F	DF
	Mean	SD		Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D- 01 (27)	60.8148 1	70.9360 7	D- 01 (20)	85.55	60.0232 2	D- 01	69.1 9	55.7 9	80.7 9	46.5 3	47.3 3	16.16	0.00 8	0.83 5
D- 02 (19)	81.3684 2	68.3513 9	D- 02 (14)	57.8142 9	24.6587 1	D- 02	63.7 4	46.1 8	87.4 2	50.3 1	54.3 3	18.58	0.65 1	0.00 8
D- 03 (11)	50.0909 1	22.9715 2	D- 03 (5)	94.8	91.3110 1	D- 03	63.4 0	39.5 3	89.8 0	64.0 4	57.3 3	35.38	0.42 2	0.28 1
D- 04 (5)	39.6	15.5016 1	D- 04 (2)	133.5	60.1040 8	D- 04	74.1 0	48.3 5	81.7 8	47.1 3	166	122.7 4	0.09 5	--

Table 5 shows comparison of platelets count among hypertension and non-hypertension patients having DHF, DF and DSS on days (d-01, d-02, d-03, d-04). The platelets count in hypertension patients having DHF were (60.81481), (81.36842), (50.09091), (39.6); having DF were (85.55), (57.81429), (94.8), (133.5). While platelets count in non-hypertension patients having DHF were (69.19), (63.74), (63.40), (74.10); having DF were (80.79), (87.42), (89.80), (81.78); and having DSS were (47.33), (54.33), (57.33), (166).

The P-value between hypertension and non-hypertension patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.008), (0.651), (0.422), (0.095) shows on d-01 the p-value is less than 0.05 which shows result is statistically significant

while on the other 3 days the p-value is greater than 0.05 which shows that result is not statistically significant and do not rejects null hypothesis; and for DF (0.835), (0.008), (0.281) shows on d-02 the p-value is less than 0.05 while it is greater than 0.05 on the other 2 days (i.e. d-01, d-03).

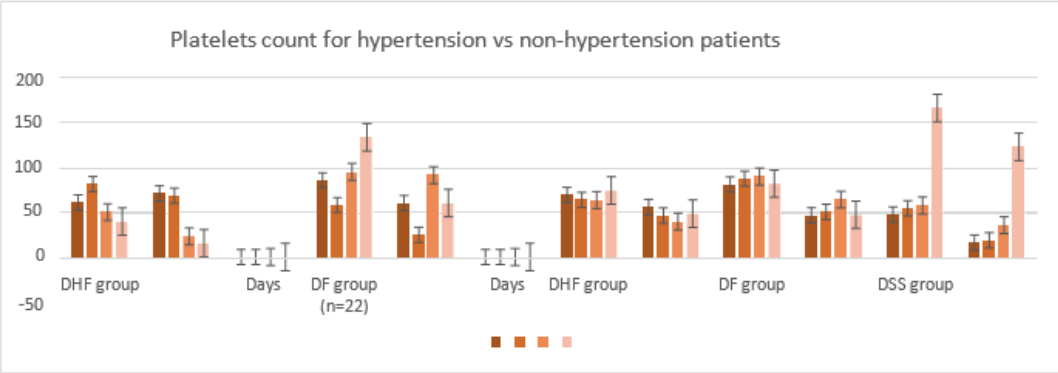

Figure 6

Asthma:

Total asthma patients=15

Total healthy patients (non-comorbid) =667

(Those with mention DHF, DF, and DSS =14)

Those with DHF,DF, and DSS= 636)

DHF=10, DF=04

DHF=331, DF=302, DSS=03

Table 3 Comparison of WBC count, Hemoglobin, and platelet counts between DHF, DF and DSS of asthma and non-asthmatic patients.

Table 6

	WBC Count (10^9/L) (ASTHMA)					WBC Counts (10^9/L) (Non-Asthmatic)						P-Value	
Days	DHF group (n=10)		DF group (n=04)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		DHF	DF
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D- 01	4.72	1.784377	4.325	1.381726	D- 01	4.93	4.80	4.36	2.13	8.46	7.66	0.722	0.138
D- 02	5.321	3.148116	3.4	0.989949	D- 02	4.89	2.45	4.34	2.14	6.76	6.23	0.915	0.219
D- 03	7.575	4.380544	3.5	0.282843	D- 03	5.14	2.49	4.84	3.16	4.96	2.89	0.29	0.33
D- 04	8.2	5.23259	3.3	#DIV/0! (because of one value)	D- 04	5.12	2.32	5.32	4.95	7.36	6.07	--	0.475

Table 6 shows comparison of WBC count among asthmatic and non-asthmatic patients having DHF, DF, and DSS on days (d-01, d-02, d-03 and d-04). The WBC count in asthmatic patients having DHF were (4.72), (5.321), (7.575), (8.2); having DF were (4.325), (3.4), (3.5), (3.3).

While WBC count in non-asthmatic patients having DHF were (4.93), (4.89), (5.14), (5.12); having DF were (4.36), (4.34), (4.84), (5.32); and having DSS were (8.46), (6.76), (4.96), (7.36).

The P-value between asthmatic and non-asthmatic patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.722), (0.915), (0.29) and for DF (0.138), (0.219), (0.33), (0.475) shows that the p-value is greater than 0.05 on all respective days which proves that the result is statistically non-significant and do not rejects null hypothesis but rejects alternative hypothesis.

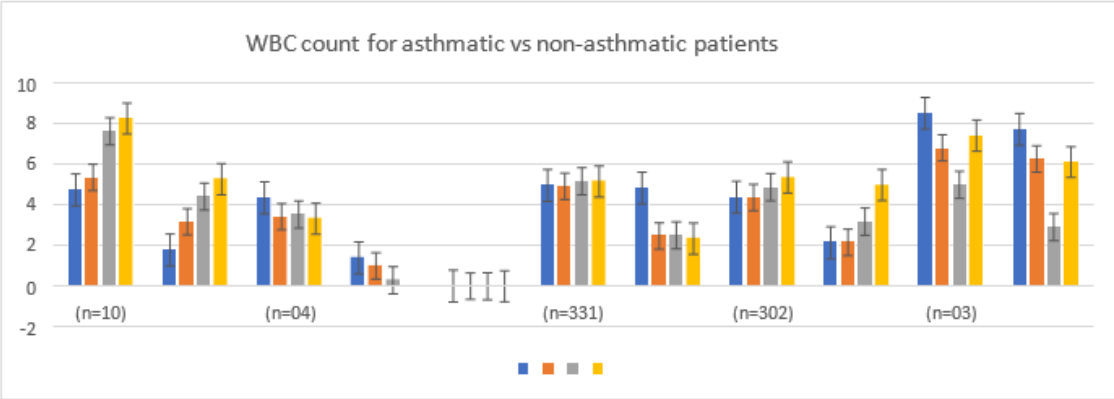

Figure 7

Table 7

Hemoglobin (g/dL) (ASTHMATIC)					Hemoglobin (g/dL) (NON-ASTHMATIC)						P-VALUE	
Days	DHF group (n=10)		DF group (n=04)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	DHF	DF
D- 01	14.23	2.275498	14.3	1.652271	D- 01	14.93	6.91	14.49	9.06	15.2	2.94	0.79	0.868
D- 02	14.18	2.61483	13.66667	1.625833	D- 02	14.34	3.34	14.05	3.08	13.3	0.79	0.95	0.851
D- 03	13.55	1.594783	15	#DIV/0! (bcz of one value)	D- 03	13.88	2.28	13.36	2.63	13.23	1.05	0.594	--
D- 04	13.95	1.343503	-	-	D-04	14.05	2.45	12.73	2.59	13.16		0.693	

Table 7 shows comparison of hemoglobin levels among asthmatic and non-asthmatic patients having DHF, DF, and DSS on days (d-01, d-02, d-03 and d-04). The hemoglobin level in asthmatic patients having DHF were (14.23), (14.18), (13.55), (13.95); and having DF were (14.3), (13.66667), (15). While hemoglobin level in non-asthmatic patients having DHF were (14.93), (14.34), (13.88), (14.05); having DF were (14.49), (14.05), (13.36), (12.73); and having DSS were (15.2), (13.3), (13.23), (13.16).

The P-value between asthmatic and non-asthmatic patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.79), (0.95), (0.594), (0.693) and for DF (0.868), (0.851) shows that the p-value is greater than 0.05 on all respective days which proves that the result is statistically non-significant and do not rejects null hypothesis but rejects alternative hypothesis.

Figure 7

Table 8

Platelets Counts (10^9/L) ASTHMATIC					Platelets Counts (10^9/L) NON-ASTHMATIC							P-VALUE	
Days	DHF group (n=10)		DF group (n=04)		Days	DHF group (n=331)		DF group (n=302)		DSS group (n=03)		DHF	DF
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD		
D-01	93.25	109.8259	92	33.09582	D- 01	69.19	55.79	80.79	46.53	47.33	16.16	0.97	0.30
D-02	85.8	78.1662	89.5	38.12698	D- 02	63.74	46.18	87.42	50.31	54.33	18.58	0.50	0.57
D-03	38.75	17.91415	70	#DIV/0! (because of one value)	D- 03	63.40	39.53	89.80	64.04	57.33	35.38	0.22	0.97
D-04	46.5	31.81981	-	-	D-04	74.10	48.35	81.78	47.13	166	122.74	0.44	--

Table 3.3 shows comparison of platelets count among asthmatic and non-asthmatic patients having DHF, DF, and DSS on days (d-01, d-02, d-03 and d-04). The platelets count in asthmatic patients having DHF were (93.25), (85.8), (38.75), (46.5); and having DF were (92), (89.5), (70). While platelets count in non-asthmatic patients having DHF were (69.19), (63.74), (63.40), (74.10); having DF were (80.79), (87.42), (89.80), (81.78); and having DSS were (47.33), (54.33), (57.33), (166).

The P-value between asthmatic and non-asthmatic patients having DHF, DF and DSS on (d-01, d-02, d-03 and d-04) were; for DHF (0.97), (0.50), (0.22), (0.44) and for DF (0.30), (0.57), (0.97) shows that the p-value is greater than 0.05 on all respective days which proves that the result is statistically non-significant and do not rejects null hypothesis but rejects alternative hypothesis.

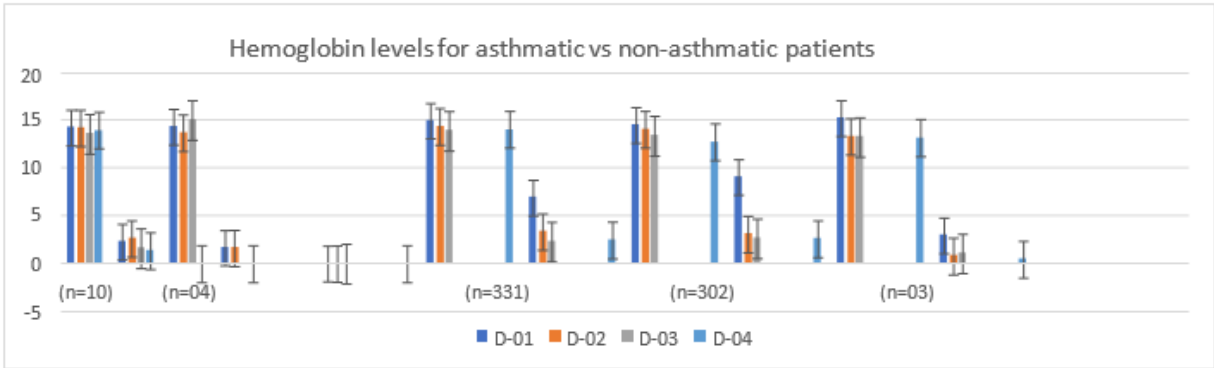

Figure 8 shows comparison of platelets count between asthmatic and non-asthmatic patients.

Interpretation

Table 1 Characteristics of patients with dengue hemorrhagic fever, dengue shock syndrome, dengue fever and severe dengue[a].

	DHF (A)	DF (B)	DSS (C)
Median Age (05-90), Yrs.	**N=58**	**N=34**	**N=01**
Gender			
Male	40 (68.96%)	26 (76.47)	01 (100)
Female	18 (31.03)	8 (23.52)	00
Comorbidity conditions [b]			
Diabetes	25 (43.10)	12 (35.29)	01 (100)
Hypertension	27 (47.55)	22 (64.70)	00
Asthma	10 (17.24)	04 (11.76)	00
Smoker	05 (8.62)	03 (8.82)	01 (100)
Symptoms/signs at hospital [c]			
Fever	57 (98.27)	34 (100)	01 (100)
Cough	10 (17.24)	01 (2.94)	00
Fatigue	01(1.72)	02 (5.88)	00
Nausea	23 (39.65)	06 (17.64)	01 (100)
Headache	17 (29.31)	10 (29.41)	00
Myalgia Muscle pain	27 (46.55)	15 (44.11)	00
Diarrhea	09 (15.51)	04 (11.76)	00
Abdominal-Pain	14 (24.13)	04 (11.76)	01 (100)
Vomiting	29 (50)	20 (58.82)	01(100)
Bleeding	10 (17.24)	04 (11.76)	00
Chill	08 (13.79)	06 (17.64)	00
Arthralgia	11 (18.96)	03 (8.82)	00
Body ache	12 (20.68)	06 (17.64)	00
Epigastric pain	08 (13.79)	03 (8.82)	00
Sore throat	03 (5.17)	01 (2.94)	00
Retro Orbital pain	06 (10.34)	04 (11.76)	00

Future Prospects of Study

For the past three decades it is reported that Dengue is the most prevalent human vector-borne viral infection, with approximately 2 billion people at risk and up to 100 million cases reported annually. Given that there are currently no clear prevention strategies for dengue, the current study's findings may direct public health practitioners and clinicians to evaluate infection severity based on the presence of comorbidity. This is an important public health measure that may prevent severe disease outcome. Our study shows that age group of 60 years or older, diabetes, cardiac disorders, asthma, and two or more pre-existing comorbidities were independent risk factors of severe organ involvement. In the past ten years, there has been a significant improvement in the laboratory diagnosis of dengue virus infection. Early diagnosis can be predicted based on thrombocytopenia, leucopenia and an increase in AST levels which may direct public health practitioners and clinicians to evaluate early diagnosis of infection.

Conflict of Interest: Nil

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