Original Article

Overview Of Dengue Hemorrhagic Fever Among Pediatric Cases Of Twin Cities: A Cross-Sectional Analytical Study

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Abstract

Objective: The present study aimed to determine sex-based variations in haematological and serological parameters. The association between NS1 and haematological biomarkers should also be explored.

Methods: A cross-sectional analytical study was conducted among 31 children with confirmed DHF who visited the Dengue Outpatient Department (OPD) of Holy Family Hospital, Rawalpindi, between October and November 2024. Patients were enrolled in the study through consecutive non-probability sampling. Data were analysed using SPSS version 27.0. Descriptive statistics were used. Gender-wise differences in haematological and serological markers were determined by applying an independent sample t-test. The linkage of NS1 with haematocrit and platelets was determined by applying an independent sample t-test, while the relationship of NS1 with leucocytes was explored using the Mann-Whitney U test. Statistical significance was set at $P < 0.05$.

Results: Of the 31 children with DHF in our study, 20 were male. The mean age of the children was 8.5 ± 2.5 years. Eighteen cases belonged to Rawalpindi, while 13 were residents of Islamabad. The mean length of hospital stay was 2.94 ± 1.12 days. Only sex-based variation in leucocyte count in DHF cases was statistically significant ($P<0.03$). The association of NS1 with all haematological markers of DHF cases was also statistically insignificant.

Conclusion: Sex differences were statistically significant only for the leucocyte count in children with DHF. Gender-stratified variations in serological biomarkers were not statistically significant.

Keywords: Dengue Hemorrhagic Fever (DHF), pediatric cases, serological biomarkers, hematological parameters, leucocyte count.

Introduction

The tropical and subtropical regions of the globe are subjected to accelerated dengue virus infection, with increased vulnerability among children. Approximately 25,000 subsequent paediatric mortalities have been reported.[1] The remarkably severe forms of this infection are dengue haemorrhagic fever (DHF) and Dengue Shock Syndrome (DSS), which are linked to increased mortality and morbidity among children.[2] Hence, prompt diagnosis and timely management of this condition in children is of utmost importance because of its clinical severity and poor prognosis.[3]

On reviewing the global burden of dengue infection, approximately 63.4% upsurge in dengue cases among children and adolescents was reported in 2021 relative to the incidence stated in 1990. This crucial scenario has been observed specifically in Southeast Asian regions across the world.[4] Dengue is considered a significant public health threat due to the escalated economic burden, which is primarily attributed to the lack of implementation of effective vaccination strategies in low- and middle-income countries.[5] Periodic outbreaks of dengue, specifically among children, have frequently been reported in some of the major cities of Pakistan, including Lahore and Karachi. The clinical spectrum of this disease among children ranges from common presenting complaints to severe critical illness that ultimately ends in mortality.[6] A retrospective study carried out on 2016-2019 pediatric dengue data from a tertiary care hospital in

Karachi elucidated bleeding manifestations among 31% of the children, although there was no mortality.[7] Although dengue affects people of all age groups, children below 18 years of age are highly vulnerable.[8] The risk of mortality among dengue-infected children is also determined to be 15 times greater than that among adults.[9]
Despite the documented dengue burden in Rawalpindi district,[10] there is an evident gap in understanding the precise laboratory findings of DHF among children. Studying the serological and haematological biomarkers among children with dengue haemorrhagic fever (DHF) is crucial to rationalise paediatric case management guidelines and streamline resource allocation in our context. Therefore, this study was planned to bring evidence-based improvement in prognosis and to mitigate the likelihood of unfortunate consequences.

Materials And Methods

A cross-sectional analytical study was done among 31 confirmed DHF cases who visited Paediatrics OPD of Holy Family Hospital, Rawalpindi, during October and November 2024. Data was gathered from the Paediatrics department with informed consent of Hospital administrators (Letter No. MS/HFH/1049). This study was conducted as an exploratory hospital-based observational study, and all eligible patients diagnosed with dengue haemorrhagic fever (DHF) who presented during the study period and met the inclusion criteria were enrolled using consecutive non-probability sampling. Therefore, the final sample size of 31 participants reflects the total number of eligible cases available within the predefined enrolment period rather than a sample derived from an a priori power calculation. Data was entered and analysed by using SPSS version 27.0. Descriptive statistics were applied. Mean length of hospital stay was also measured. Independent sample t-test was applied to determine gender-wise difference in serological and haematological biomarkers of the cases. Association of NS1 with haematocrit and platelets was determined by applying independent sample t-test while the relationship of NS1 with leucocytes was explored by using the Mann-Whitney U test. $P < 0.05$ was considered significant.

Results

Of the 31 paediatric DHF cases in our study, 20 (64.5%) were male and 11 (35.5%) were female. The mean age of paediatric patients diagnosed with Dengue Hemorrhagic Fever (DHF) was 8.5 ± 2.5 years. Approximately 18 and 13 cases belonged to Rawalpindi and Islamabad, respectively. The mean length of hospital stay was 2.94 ± 1.12 days. There was a statistically insignificant difference in serological biomarkers of the children diagnosed with DHF according to sex, as illustrated in Table 1.

Table 1: Serological biomarkers among pediatric DHF cases

Serological biomarkers	Average	Males (n = 20)	Females (n = 11)	P-value
NS1 antigen positivity	64.5%	15 (75%)	5 (45.4%)	0.09
IgM positivity	71%	13 (65%)	9 (82%)	0.05
IgG positivity	61.3%	12 (60%)	7 (63.6%)	0.10

Only sex-based variation in White Blood Cell (WBC) count in paediatric cases was statistically significant, as shown in Table 2.

Table 2: Gender-wise difference in Hematological parameters of pediatric DHF cases

Hematological parameters	Overall Mean ± SD	Males (n= 20) Mean ± SD	Females (n = 11) Mean ± SD	P-value
Hematocrit	34.6 ± 5.9	34.4 ± 5.3	34.9 ± 7.15	0.82
WBC count	4551.61 ± 2263.16	3915 ± 1900.8	5709.1 ± 2493.4	0.03*
Platelet count	71516.13 ± 31100.8	75600 ± 33612.9	64091 ± 25711.7	0.33

statistically significant difference

The association between NS1 and haematological biomarkers was statistically insignificant, as shown in Table 3.

Table 3: Association of NS1 with hematological biomarkers

Hematological biomarkers	NS1 Positive Mean	NS1 Negative Mean	Test of Significance	P-value
Hematocrit	34.45	34.91	Independent t-test	0.850
WBC count	4115	5345	Mann-Whitney U test	0.154
Platelet count	78550	58727	Independent t-test	0.073

Discussion

The mean age of children diagnosed with Dengue Hemorrhagic Fever (DHF) in the present study was 8.5 ± 2.5 years, and 64.5% of them were males. A similar study on hospital-based data of DHF revealed a mean age of 6.5 ± 4.3 years among DHF-confirmed children; however, 61% of them were females.[11] Another study conducted among Sri Lankan dengue-infected children during the dengue epidemic in 2017 illustrated that 60% of the affected children were males and the mean age was approximately 8.6 years. However, only 17% of the cases were diagnosed with DHF.[12] Contrary to our findings, most of the DHF hospitalised children in Vietnam were 10-16 years old, with a male-to-female ratio of 1.18:1.[13.] Consistent with our findings, a study of 4522 South East Asian children revealed that the mean age of the confirmed dengue-infected children admitted to the hospital was 9.8 ± 3.4 years.[14] Analysis of 54 DHF cases from a healthcare facility in Bandung elucidated the age of 6-12 years as the most afflicted age group; however, gender-based discrimination in DHF occurrence was insignificant.[15] Further research is needed to explore the age- and sex-linked patterns in the occurrence of DHF. An in-depth analysis and cross-tabulation of the variables would enable us to perceive the concealed relationship between age, sex, and disease presentation among children.

Gender-wise difference in serological biomarkers of DHF cases in the present study was found to be statistically insignificant, as evident from Table 1. An analytical study carried out among dengue cases visiting a tertiary care hospital of Lahore, varying from less than 20 years old to above 60 years of age, during the dengue epidemic of 2011 also reflected statistically insignificant gender-based variation in serological markers.[16] There was more NS1 positivity (75%) among males, while more IgM positivity (82%) among females in the current study, though statistically insignificant (Table 1). Contrary to our findings, a study by Chakarvarti A et al. explicated a statistically significant association of NS1 antigen and IgM antibody with females and males, respectively.[17] A cross-sectional analytical study done among paediatric dengue cases from a tertiary care hospital of Thoothukudi illustrated that elevated IgG antibodies to dengue virus among children were indicative of secondary infections that can contribute to higher morbidity.[18] A study among hospitalised paediatric dengue cases elucidated that antibody titre was comparatively higher among dengue fever cases without warning signs than those presenting with warning signs and complexities.[19] Consistent with our findings, gender-wise differences in NS1 and IgM positivity in a study carried out by Soomar SM et al. among children less than 18 years old with dengue fever were statistically insignificant ($P > 0.63$). Assessing Serological markers of paediatric dengue cases is highly valuable for timely intervention and to save lives.[20] The present study showed IgG positivity a little bit more among females, although gender-wise difference was statistically insignificant ($P>0.10$), as evident from Table 1. This biomarker is suggestive of past dengue infection.[21] Contrary to our findings, a study among paediatric dengue cases from a non-endemic zone of Bangladesh revealed comparatively greater NS1 antigen positivity than that of IgM positivity.[22] There is limited data availability about gender-based variation in serological markers among children diagnosed with DHF and its significance. Although children mostly present with a milder form of dengue, they are vulnerable to having a severe form of dengue that can be life-threatening.[23] Rigorous studies should specifically be carried out among children to determine the dengue severity and resultant outcomes.

Gender-based differences in haematological parameters of DHF cases in our study were statistically insignificant, specifically pertaining to haematocrit and platelets, as evident from Table 2. However, the White Blood Cell (WBC) count in males was comparatively lower than that in females ($P< 0.03$). The occurrence of thrombocytopenia is also evident from Table 2 in the current study. A study by Zeb et al. was illustrative of severe thrombocytopenia among adults compared to teens and children. Moreover, children with dengue do not manifest any clinical abnormalities.[24] Consistent with our findings in Table 3, a study of dengue cases reporting to a tertiary care hospital in Gujrat elucidated little to no significant correlation between serological and haematologic biomarkers of dengue cases that included not only patients below 15 years of age but also those above 60 years of age.[25] Studies are scarce regarding the correlation between serological and haematological parameters among children with DHF. The number of diagnosed cases of DHF in our study was also minimal, which might be the reason for the insignificant correlation between the serological and haematological markers of the cases. A retrospective cross-sectional study conducted by Vidhi et al. on 393 dengue-positive cases over a period of 6 months elucidated that thrombocytopenia was categorically diagnosed among cases found positive for both NS1 antigen and IgM antibodies.[26] As our study was based only on 31 paediatric DHF cases, the insignificant correlation between platelets and NS1 antigen/IgM antibodies might be due to the limited sample size. We may obtain significant findings by studying a large number of DHF cases.

Conclusions

Sex-wise differences in serological markers of DHF cases were statistically insignificant. About haematological parameters, only the white blood cell count showed a significant sex-related variation, with female DHF patients revealing higher mean WBC counts than those of males. Large multicentre studies, along with longitudinal monitoring of haematological parameters of children diagnosed with Dengue Hemorrhagic Fever (DHF) in future studies, may prove beneficial in delineating temporal changes in serological biomarkers. Prospective studies with large sample sizes and the inclusion of other laboratory parameters, such as liver enzymes and serum ferritin, may also facilitate the optimal management of cases.

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