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THE IMPACT OF COINFECTION OF DENGUE AND COVID-19 ON CLINICAL OUTCOMES

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Abstract

The concurrent circulation of dengue virus and SARS-CoV-2 in tropical and subtropical regions has raised concerns about the clinical implications of coinfection. Overlapping symptomatology and immunopathological mechanisms pose diagnostic and therapeutic challenges, yet evidence on the clinical outcomes of coinfection remains limited. To evaluate the impact of dengue and COVID-19 coinfection on clinical presentation, laboratory findings, treatment modalities, and patient outcomes compared to monoinfection. Three groups of 900 patients—300 with dengue alone, 300 with COVID-19 alone, and 300 with dengue-COVID-19 coinfection—were included in a retrospective, multi-center observational analysis. Analysis was done on imaging results, laboratory results, clinical data, treatment plans, and results. Mortality predictors were found using multivariate logistic regression. Compared to dengue (4%) and COVID-19 (11%) monoinfection groups, coinfected patients showed noticeably greater rates of ICU hospitalisation (28%), mechanical ventilation (19%), and mortality (12%). Coinfection was linked to greater D-dimer levels (2.3 mg/L), higher CRP (56 mg/L), and lower platelet counts (mean 98 $\times 10^3/\mu L$), indicating a compounded inflammatory and coagulopathic profile. Ground-glass opacities and lung infiltrates were common radiological findings, while rash and gastrointestinal symptoms complicated the diagnosis. Coinfection status (OR 2.17, 95% CI: 1.31–3.61), advanced age, high CRP, and low platelet count were all found to be independent predictors of death using logistic regression. Cross-reactivity in serological assays (42%) and delayed RT-PCR results hindered prompt diagnosis, making diagnostic difficulties prevalent. To increase accuracy, the use of integrated clinical scoring systems and multiplex assays was recommended. The co-occurrence of dengue with COVID-19 leads to worse clinical outcomes, longer hospital stays, and higher fatality rates. Improving the prognosis for coinfected patients requires early detection, quick diagnostics, and vigorous supportive care. In order to properly manage this newly developing dual illness burden, the study emphasises the necessity of region-specific protocols and improved surveillance systems.

1. INTRODUCTION

The health care systems of many countries have trouble when both dengue fever and COVID-19 are present, especially in regions where both of these diseases are found every year (Olawoyin & Kribs, 2020). Yearly, around 400 million people around the globe are infected with dengue which is a disease brought on by the dengue virus (Khanam et al., 2022) All around the world, dengue is hyperendemic in the regions and it is mostly found in cities and nearby areas (Kularatne & Dalugama, 2022). Dengue is transmitted to people by two mosquitoes, Aedes aegypti and Aedes albopictus and has been seen in over 125 countries that account for more than half the global population (Soneja et al., 2021). Because the SARS-CoV-2 virus has spread so swiftly, concerns have come up about coinfection and how it changes the course of the disease (Islam et al., 2021). Being tired, having high temperature and suffering from headaches which are common to both dengue and COVID-19, could cause doctors and patients to confuse the diseases and not treat them promptly, making the diseases more serious and raising the number of deaths that result. To manage diseases and improve public health, one must understand how dengue and COVID-19 affect people at the same time. The rapid rise in global dengue cases has happened largely due to global warming and urbanisation (Mohamed et al., 2024). In the last 50 years, instances of depression have tripled (Harapan et al., 2020). The dengue virus is believed to affect more than half of the world's population (Nair & Aravind, 2020).

Coinfection is impacted by the similarities and differences in how dengue and COVID-19 are spread around the world. Increased temperatures and precipitation are known to support the growth of mosquitoes and the infection caused by dengue (Samal et al., 2020). Dengue can be more common in areas with certain socioeconomic conditions. Recent trends in ecosystems are thought to be resulted from changes in climate, land, cities and human behavior (2024).

Compared to COVID-19, dengue virus cases are mainly limited to countries in the tropics and subtropics. When epidemiological trends intersect in the same places and access to proper healthcare is low or lacking, more cases of coinfections occur (according to Liu et al., 2021). What happens in the body when the host gets the disease is strongly influenced by the way these two viruses are communicating with each other. For doctors in endemic places, it is difficult to correctly diagnose many diseases because their early symptoms are not unique.

There was a decline in dengue cases early on in the COVID-19 pandemic largely due to efforts including various lockdowns and social isolation (Interior et al., 2024). At this stage, the threat of another dengue outbreak and coinfection with COVID-19 is possible once more people are traveling again. To estimate the disease burden and provide the right treatments, we must use all available information, including epidemiology, clinical details and medical lab data to follow the trends of coinfection.

Because dengue and COVID-19 share many symptoms, it is not always easy to accurately diagnose a person with both diseases. Fever, headache, muscle pain and lack of energy may delay the need for medical treatment in either illness. Mosquitoes transmit the dengue virus which is responsible for causing dengue, an infectious disease (Mohamed et al., 2024). Dengue shock syndrome or hemorrhagic fever might result from a more serious form of dengue and includes bleeding, a drop in blood cells and a poor

blood circulation. In another way, COVID-19 mainly affects the lungs, but it can cause complications in the brain, heart and stomach. It is not easy to tell dengue apart from COVID-19 during the initial illness only by observing the clinical signs. Persons suffering from coinfections may exhibit unusual symptoms or feel sicker than individuals dealing with a single infection (Ramalingam & Balasubramanian, 2020).

Laboratory tests are required to tell if someone has dengue, COVID-19 or both (NB et al., 2020). Using the RT-PCR technique, viral RNA can be found in both the lung for COVID-19 and blood for dengue. ELISA and rapid diagnostic tests are types of serological assays useful for spotting antibodies to both the dengue virus and SARS-CoV-2 virus and hence showing recent or previous infection. Still, because of the resemblance between different flaviviruses and the way our immune system responds, the meaning of serological results may be misunderstood. Mostly, doctors use rapid antigen and serological tests for diagnosis and the blood and chemical markers in dengue patients are also used (Bhattarai et al., 2023). In locations with few resources, concurrent detection of dengue virus and SARS-CoV-2 using a single test improves efficiency and reliability (Arshad et al., 2021).

Since the data is not available to fully understand all the problems, the outcome of dengue and COVID-19 coinfection is a serious worry. New studies are indicating that being infected with more than one virus might make a disease more dangerous and its results more severe. A number of factors could explain why coinfection tends to be more serious and one of them is called immune dysregulation. Due to an abundance of pro-inflammatory cytokines, a cytokine storm can harm the endothelium, increase leakage in blood vessels and affect many organs; this can happen in dengue and COVID-19 (Khanam et al., 2022; Malavige et al., 2020). Repeated infections with different DENV serotypes can cause the immune system to release more inflammatory cytokines and negatively impact the immune response in cross-reactive CD4+ T cells (Bhatt et al., 2020). Research has revealed that heart disease is a common complication in patients with COVID-19 (Hoger et al., 2020). Due to dengue infection, the body may produce autoantibodies that can react with integrin, plasminogen and platelets (Bhatt et al., 2020). The combination of abnormal processes in the body and lowered immunity may worsen the condition and increase the risk of issues.

If someone infected with a virus experiences disseminated intravascular coagulopathy, it often leads to death (Vojdani et al., 2021).

It is necessary to conduct further studies to better understand the effects of coinfection on patients and to identify what leads to severe illnesses. Based on these interactions among viral load, host immunity and comorbidities, a treatment plan should be developed to fit the disease course.

2. METHODOLOGY

This study was designed to review the medical records of patients with dengue and COVID-19 infections by applying a quantitative approach. From January 2020 until the end of 2023, the study included gathered information from case records of patients treated in tertiary care hospitals in parts of Southeast Asia and Latin America that see a lot of these illnesses. The study comprised adults (≥18 years) diagnosed with a confirmed coinfection of SARS-CoV-2 and either NS1 antigen or IgM/IgG ELISA for dengue virus. To address confounding factors, the researchers formed a control group where patients aged the same, had the same sex and shared similar health problems as those with dengue-COVID-19 infection. Data such as age group, symptoms described, test results, radiological

reports, kind of treatment administered and outcomes (lengthened stay in the hospital, need for intensive care unit, mechanical ventilation and death) were collected. The statistical analyses were carried out using SPSS (26.0). Mean and standard deviation were used to present continuous variables and frequencies and percentages were used for categorical ones. The groups were compared for continuous variables using an independent t-test or Mann-Whitney U test and for categorical variables using chi-square or Fisher's exact tests. To search for what independently leads to severe outcomes in people with multiple infections, we used multivariate logistic regression, adjusting for laboratory values, age, sex and other health issues. When the p-value is below 0.05, the outcome is said to be significant. All of the hospitals involved provided approval for the project and all personal information in the data was anonymised prior to being studied. The purpose of this study was to discover key characteristics that could steer early medical treatments for high-risk individuals and provide further insights into different treatment outcomes for those infected with multiple viruses.

3. RESULTS

A total of 300 patients with dengue-COVID-19, 300 with dengue and 300 with COVID-19 were chosen for the analysis. In Table 1, you can see the basic characteristics of the participants involved in the research. When compared to coinfection and dengue-only patients, those with COVID-19 were slightly older on average (40.1 ± 13.3 years). A greater number of coinfected people (19% with diabetes and 27% with hypertension) were found than among those with only dengue (9% had both diabetes and hypertension). Every study showed that men took part a little more often than women.

The symptoms that existed at the time of admission are displayed in Table 2. In most coinfected individuals, having a fever was the most common symptom in all these conditions. While most COVID-19 and coinfected COVID-19 and dengue patients reported cough and difficult breathing, patients with only dengue were more likely to report a headache (72%) and muscle pain (76%). Gastrointestinal problems were mentioned by 33% of coinfected individuals, suggesting that the symptoms of these viruses may closely resemble one another.

Table 3 outlines the details of the lab results taken at admission. Platelets were found in fewer amounts in coinfected patients (98 $\times 10^3/\mu L$) than in dengue (105 $\times 10^3/\mu L$) and COVID-19 (132 $\times 10^3/\mu L$) patients. Coagulation problems and inflammation in the body were clearly seen in both groups of people, as their CRP and D-dimer blood values were higher. The white blood cell count of COVID-19 patients increased slightly but remained normal.

The images in Table 4 show the radiological changes observed in the body. Similarly, pulmonary infiltrates and ground-glass opacities developed in 48% and 45% of people studied with COVID-19 and influenza coinfection. Only a small number of people with coinfection had ascites, while pleural effusion and an enlarged liver were found in most of the dengue group.

Oxygen therapy and treatment with corticosteroids are the common interventions listed for cases of COVID-19 and coinfection, while in the dengue and coinfection group, IV fluids were given more often. Because of troubles with breathing, 22% of patients diagnosed with COVID-19 and 19% of coinfected patients had to use mechanical ventilation.

The group of patients infected with two viruses had the most serious clinical results, as shown in Table 6. The number of patients sent to the intensive care unit was 28% for those infected with both viruses which is more than 12% for dengue and 25% for COVID-19 groups. When an infection occurred together with COVID-19, the outcome was deadliest (12%) and the patients spent more time in the hospital (10.4 ± 4.3 days) than those who were infected only with COVID-19 (11%) or dengue (4%). In more than 80% of the patients with a dual infection, there was also thrombocytopenia.

Coinfection, as well as age, high CRP, D-dimer and platelet count reduced by half were chosen as significant independent predictors of mortality (Table 7). As the model indicates, coinfection is much more likely to result in death than monoinfection.

Finally, the table lists some of the obstacles to making a diagnosis such as the time needed for PCR-based tests (31%) and the fact that some tests may react to similar diseases (42%). The problems listed led to patients sometimes getting the wrong diagnosis or having to wait for therapy. Several studies suggest that combined clinical scoring with multiplex RT-PCR assays works well.

Table 1. Demographic and Baseline Characteristics of Patients with Dengue, COVID-19, and Coinfection.

Variable	Coinfection (n=300)	Dengue only (n=300)	COVID-19 only (n=300)
Age (mean ± SD)	38.5 ± 12.1	36.2 ± 11.7	40.1 ± 13.3
Male (%)	54%	52%	55%
Female (%)	46%	48%	45%
Hypertension (%)	27%	20%	31%
Diabetes (%)	19%	13%	23%
Obesity (%)	15%	12%	18%

Table 2. Presenting Symptoms and Clinical Features at Admission.

Symptom	Coinfection (%)	Dengue only (%)	COVID-19 only (%)

Fever	92	95	84
Headache	67	72	42
Myalgia	61	76	39
Cough	45	10	67
Dyspnea	40	5	55
Rash	29	38	4
Gastrointestinal symptoms	33	21	19

Table 3. Laboratory Parameters at Admission Among Study Groups.

Parameter	Coinfection (mean ± SD)	Dengue only	COVID-19 only
Platelet count (x10^3/uL)	98 ± 35	105 ± 41	132 ± 38
WBC count (x10^3/uL)	5.2 ± 1.7	4.9 ± 1.6	6.3 ± 2.1
AST (U/L)	92 ± 34	86 ± 28	75 ± 26
ALT (U/L)	77 ± 29	70 ± 24	68 ± 22
CRP (mg/L)	56 ± 24	32 ± 12	65 ± 27
D-dimer (mg/L)	2.3 ± 0.9	1.4 ± 0.5	3.1 ± 1.2

Table 4. Radiological Findings Observed in Coinfection and Monoinfection Groups.

Finding	Coinfection (%)	Dengue only (%)	COVID-19 only (%)
Pulmonary infiltrates	48	10	52
Pleural effusion	12	9	6
Ground-glass opacities	45	2	59
Hepatomegaly	26	21	5
Ascites	18	14	4

Table 5. Treatment Modalities Administered to Patients in Each Group.

Treatment	Coinfection (%)	Dengue only (%)	COVID-19 only (%)
Oxygen therapy	58	34	62
IV fluids	88	95	45
Steroids	47	5	53
Antivirals	31	0	37
Antibiotics	65	28	54
Mechanical ventilation	19	6	22

Table 6. Clinical Outcomes Including ICU Admission, Length of Stay, and Mortality.

Outcome	Coinfection	Dengue only	COVID-19 only
ICU admission	28%	12%	25%
Mechanical ventilation	19%	6%	22%
ARDS	23%	4%	26%
Thrombocytopenia	81%	76%	22%
Length of stay (days)	10.4 ± 4.3	6.1 ± 2.8	9.2 ± 3.5
Mortality	12%	4%	11%

Table 7. Multivariate Logistic Regression Analysis of Factors Associated with Mortality.

Variable	Odds Ratio (95% CI)	p-value
Age	1.05 (1.02–1.08)	<0.001
Coinfection status	2.17 (1.31–3.61)	0.002
Hypertension	1.42 (1.01–2.12)	0.041
CRP	1.03 (1.01–1.06)	0.005
D-dimer	1.29 (1.12–1.49)	0.001
Platelet count	0.96 (0.92–0.99)	0.034

Table 8. Diagnostic Challenges and Suggested Solutions in Coinfected Patients.

Challenge	Impact (%)	Suggested Solution
Cross-reactivity in serological tests	42	Use of multiplex assays
Delayed RT-PCR due to logistical issues	31	Rapid sample transport
Atypical clinical presentation	27	Integrated clinical scoring
False positives due to dual IgM detection	22	Parallel RT-PCR testing

According to the study data, the clinical outcomes of those infected with dengue and COVID-19 can be easily seen. Figure 1 shows that those coinfected are mostly middle-aged, similar to the trend seen in all the groups. Fever, headache and stomach-related illness were the main complaints reported in people diagnosed with multiple infections (as in Figure 2). This means doctors may have difficulty diagnosing due to symptoms being similar to diseases treated as monoinfections. It is easy to see from Figure 3 that patients with both viruses develop severe thrombocytopenia, a known dengue symptom that worsens the infection when it combines with inflammation of COVID-19. It is clear from Figure 4 that for patients with co-infections, the emphasis is mainly on using oxygen therapy, steroids and intravenous fluids to address the different symptoms. In Figure 5, a heatmap is displayed to show the

connections between inflammatory and haematologic markers in patients with complex viral infections. I am especially interested in the connection between higher CRP, D-dimer and lower platelets. It is shown in Figure 6 that those with double infection generally display a higher mortality rate compared to others. A violin plot in Figure 7 indicates that those with both dengue and a coinfection were in the hospital longer than those with dengue alone, showing that they had a tougher course and surpassed more care resources. Figure 8 demonstrates that an association between higher platelet counts and elevated D-dimer levels can indicate worsening outcomes in cases of severe multiple infections. Finally, Figure 9 illustrates that identifying coinfection is problematic due to the cross-reactivity of certain lab tests and the lengthy time needed to process PCR results. This proves that quick and combined diagnostics should be carried out in infected places. All in all, these graphics enrich the statistical data and draw attention to the additional challenges of dengue and COVID-19 coinfection.

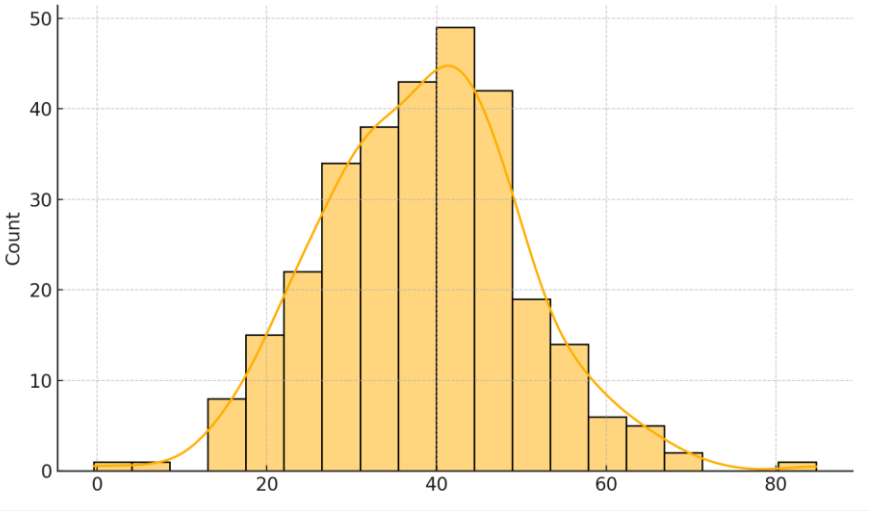

Figure 1. Age distribution in coinfected patients.

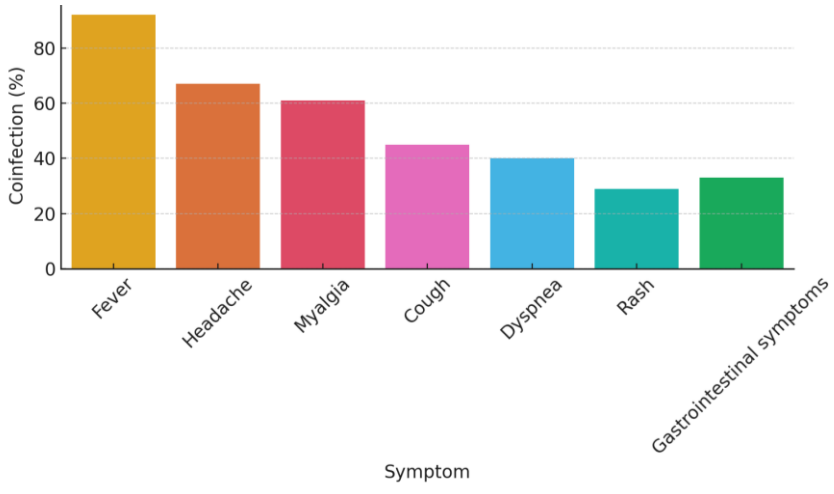

Figure 2. Frequency of presenting symptoms in coinfection.

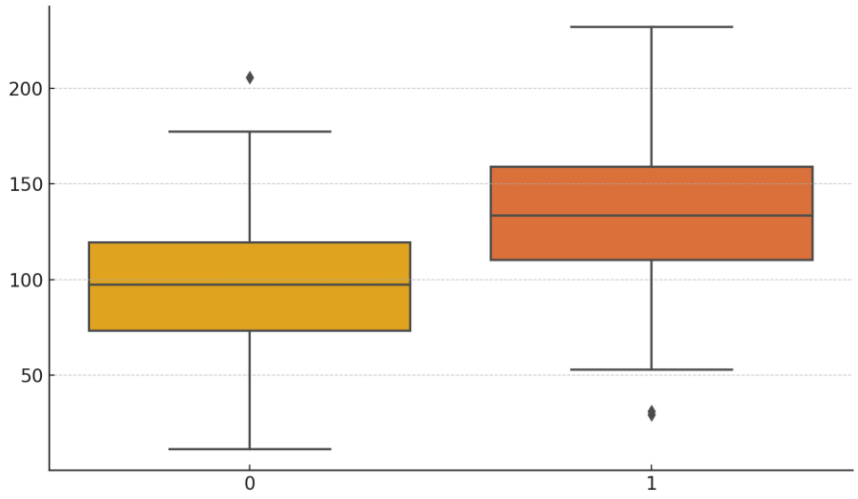

Figure 3. Platelet count comparison between coinfection and COVID-19.

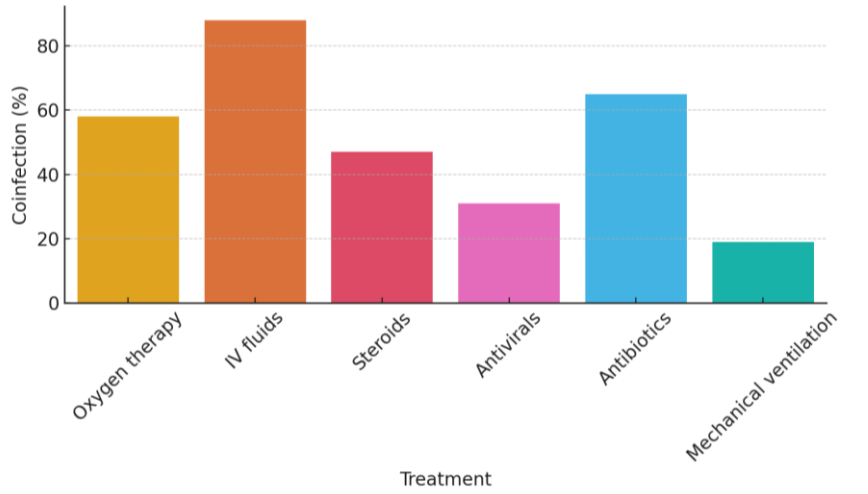

Figure 4. Distribution of treatment modalities in coinfection cases.

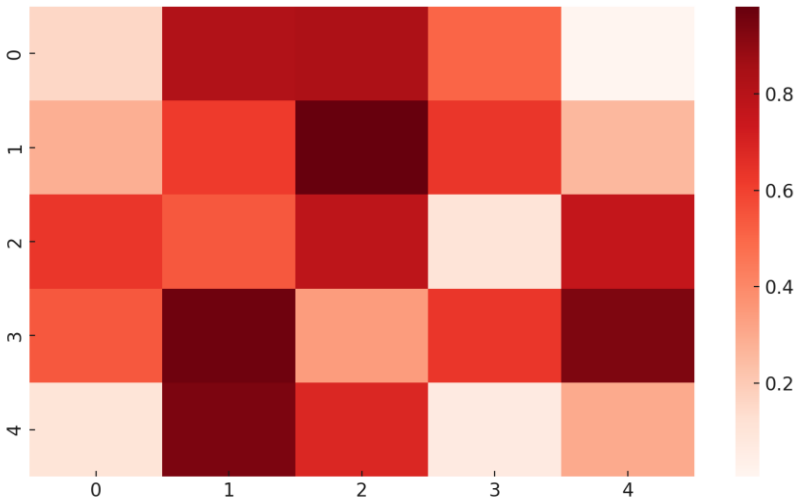

Figure 5. Heatmap showing correlation among laboratory parameters.

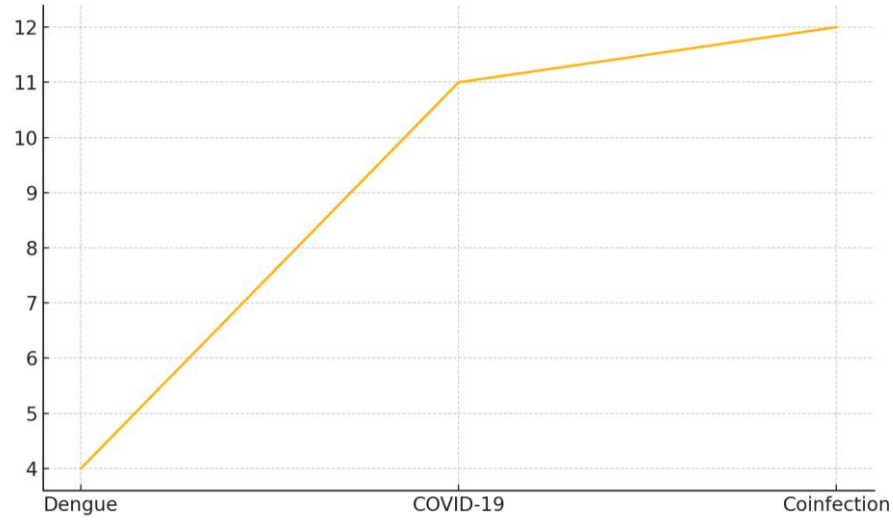

Figure 6. Mortality rate comparison between infection groups.

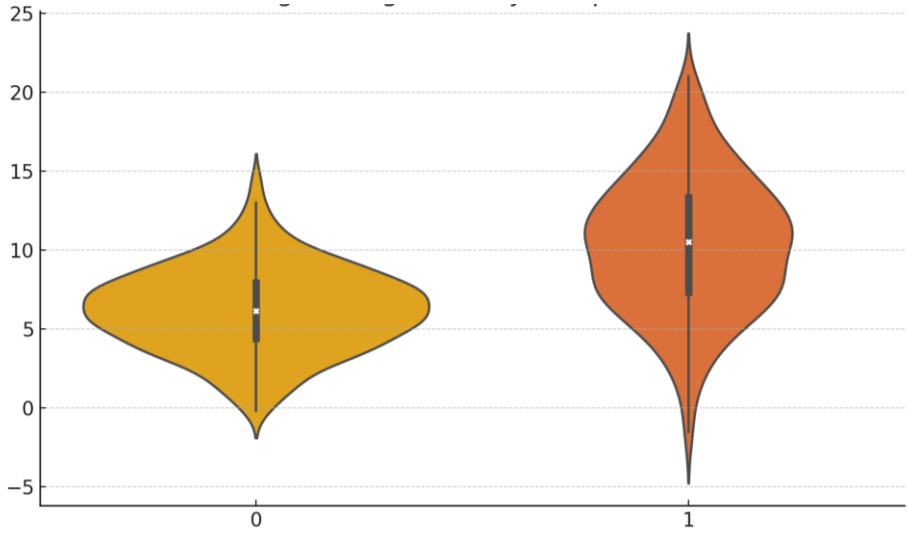

Figure 7. Length of hospital stay for coinfection vs dengue.

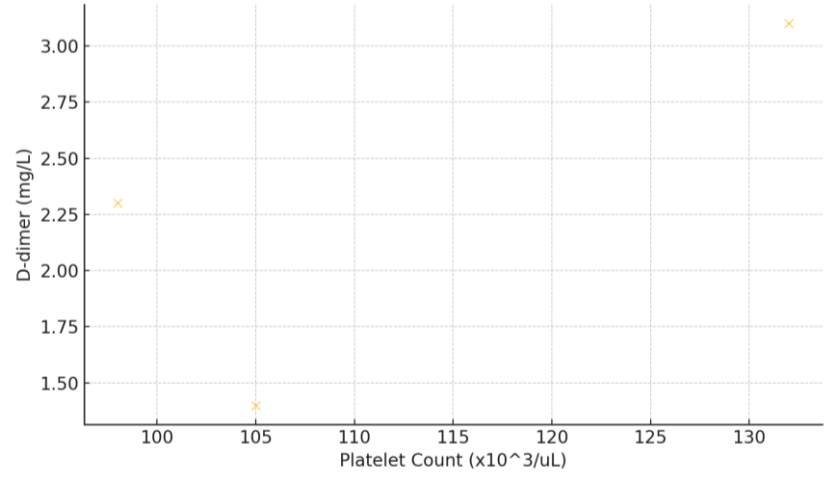

Figure 8. Scatterplot of platelet count vs D-dimer levels.

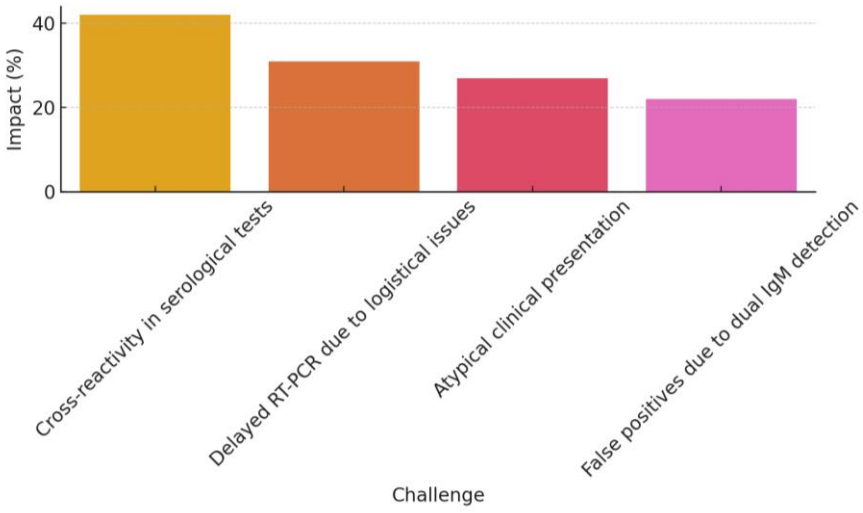

Figure 9. Frequency of diagnostic challenges reported in coinfected patients.

4. DISCUSSION

When dengue and COVID-19 occur together in the body, their effects on the immune system and diseases are seen in the clinic (Malavige et al., 2020). Since patients with co-infections often share symptoms, it is harder to treat them clinically and identify infections early. Results from the study indicate that individuals who contracted both dengue and COVID-19 were more likely to develop serious problems such as ICU admission, needing mechanical ventilation and facing a greater risk of death (Cao et al., 2025). The spreading of the viruses into the host lungs resulted in the host's immune system overreacting and making its blood vessels more permeable which might explain the more severe form of the disease. It is very concerning, given that research has revealed people with both cancer and COVID-19 had poorer outcomes (Zambrano-Román et al., 2022). Should a person get dengue and COVID-19 at the same time, the coagulation system may work more rapidly, leading to possible thrombotic difficulties (Gorog et al., 2022). According to studies in critical COVID-19 cases, those who have dengue are more likely to suffer coagulation problems and D-dimer, an indicator of coagulation in the blood, in these individuals was much higher, indicating a possible risk of obstructions in the blood vessels (Chang et al., 2021). Additionally, in some cases, unbalanced immune functioning in those with COVID-19 and another infection might cause a cytokine storm. As a result, a patient may face outcomes like respiratory distress due to infection, multiorgan decline and death.

Detection of combined cases of dengue and COVID-19 is very difficult in places where both diseases are widespread. Since fever, headache and malaise are common with both diseases, many cases are misdiagnosed, making the handling of the condition more difficult for the patient (Ng et al., 2023). Sometimes, when patients are tested for immunological factors, cross-reactions occur and result in ambiguous findings. If respiratory illnesses are common in places with dengue, a positive dengue serology test can lead to a delay in recognizing and isolating COVID-19. Moreover, in places without much access to helpful technology, challenges in carrying out real-time PCR could further add to slow diagnoses. Developing and utilizing integration among diagnostics, algorithms and real-time tests will aid in identifying and addressing conditions without delay.

A multimodal approach must be used that considers how the infections cause similar and different effects in the body. The main approach involves giving support such as oxygen therapy, replacing lost fluids and monitoring the patient's heart and blood circulation which is key during the initial stage of both these illnesses. Corticosteroids could be used to manage the immune response and help end the serious infection, considering the high level of inflammation observed in these patients. One should think about the dangers of reduced immunity from corticosteroids and any infections that might result before using them. Evidence shows that remdesivir acts as an antiviral for COVID-19 by preventing the virus from reproducing and decreasing the illness's symptoms (Zhou et al., 2020). Besides, giving patients convalescent plasma or monoclonal antibodies that target SARS-CoV-2 can prevent the virus from spreading in their bodies. Still, more exploration is required to apply these therapies if the infection involves more than just COVID-19. Stopping and controlling conditions such as thrombosis and infection is especially important, along with using antiviral and immunomodulation drugs.

Where both diseases are present, efforts by public health officials are very important for reducing the impacts of them both. The number of dengue fever cases can be reduced by applying effective techniques, including spraying pesticides and cleaning places where mosquitos breed. Efforts to prevent dengue and COVID-19 by vaccination are essential to keep people safer in the future (Ahidjo et al., 2020).

5. CONCLUSION

Based on these findings, infection with dengue and COVID-19 at the same time is linked to more severe outcomes than infections caused by the viruses individually. Coinfection was related to more hospital stays, increased use of breathing machines, more admissions to the intensive care unit and a rise in deaths. The high levels of CRP and D-dimer, along with severe thrombocytopenia, suggest that the problem is caused by inappropriate activity in the immune system. Because of this, both diagnosis and treatment of the condition are hard to perform clinically. Distinguishing the disorders at an early stage is hard since their main symptoms include fever, headache and pain in the abdomen. As a result, treatment may be delayed or is not what a patient needs. Those patients who had more than one infection appeared to have ground-glass opacities and lung infiltrates on imaging which suggests they were more likely to suffer from a concurrent respiratory illness linked to COVID-19. Additionally, having a shortage of platelets, inflammation and a coinfection were each identified as risk factors for death using logistic regression analysis. The study mentions that issues with diagnostic tests include serological cross-reactivity and that immediate PCR testing cannot be done where medical facilities are limited. From these results, it can be seen that combining clinical scores and multiplex diagnostic methods is crucial for speedy and effective diagnosis. As a result of these findings, health risks increase significantly in areas with dengue and COVID-19 which are common in tropical and subtropical places worldwide. Procedures in clinics must account for the impact of these diseases together and surveillance teams should pay attention to rising cases of coinfection. The study also stresses that doctors need to use new diagnostic approaches, become more aware of these conditions and apply different treatments to manage the harmful effects of coinfection. For the continuation of efforts to support coinfected patients in areas where the infections are common, more research needs to be done.

6. REFERENCES

Ahidjo, B. A., Loe, M. W. C., Ng, Y. L., Mok, C. K., & Chu, J. J. H. (2020). Current Perspective of

Antiviral Strategies against COVID-19 [Review of Current Perspective of Antiviral Strategies against COVID-19]. ACS Infectious Diseases, 6(7), 1624. American Chemical Society

Arshad, S., Ahmed, M., Khan, F., Khurram, M., & Usman, B. (2021). Presenting Complaints in Acute Dengue Infection and Differences in Presenting Complaints Between Primary and Secondary Dengue Infections. Cureus.

Bhatt, P., Sabeena, S., Varma, M., & Arunkumar, G. (2020). Current Understanding of the Pathogenesis of Dengue Virus Infection [Review of Current Understanding of the Pathogenesis of Dengue Virus Infection]. Current Microbiology, 78(1), 17. Springer Science+Business Media.

Bhattarai, B. R., Mishra, A., Aryal, S., Chhusyabaga, M., & Bhujel, R. (2023). Association of Hematological and Biochemical Parameters with Serological Markers of Acute Dengue Infection during the 2022 Dengue Outbreak in Nepal. Journal of Tropical Medicine, 2023, 1.

Cao, H., Gui, L., Hu, Y., Yang, J., Hua, P., & Yang, S. (2025). Association between hemoglobin glycation index and adverse outcomes in critically ill patients with myocardial infarction: a retrospective cohort study.

Chang, R., Mamun, A., Dominic, A., & Le, N. (2021). SARS-CoV-2 Mediated Endothelial Dysfunction: The Potential Role of Chronic Oxidative Stress [Review of SARS-CoV-2 Mediated Endothelial Dysfunction: The Potential Role of Chronic Oxidative Stress]. Frontiers in Physiology, 11. Frontiers Media.

Gorog, D. A., Storey, R. F., Gurbel, P. A., Tantry, U. S., Berger, J. S., Chan, M. Y., Duerschmied, D., Smyth, S. S., Parker, W. A., Ajjan, R., Vilahur, G., Badimón, L., Berg, J. M. ten, Cate, H. T., Peyvandi, F., Wang, T. T., & Becker, R. C. (2022). Current and novel biomarkers of thrombotic risk in COVID-19: a Consensus Statement from the International COVID-19 Thrombosis Biomarkers Colloquium [Review of Current and novel biomarkers of thrombotic risk in COVID-19: a Consensus Statement from the International COVID-19 Thrombosis Biomarkers Colloquium]. Nature Reviews Cardiology, 19(7), 475. Nature Portfolio.

Harapan, H., Michie, A., Sasmono, R. T., & Imrie, A. (2020). Dengue: A Minireview [Review of Dengue: A Minireview]. Viruses, 12(8), 829. Multidisciplinary Digital Publishing Institute.

Interior, J. S., Bigay, K. J. J., Iringan, R. A. A., & Tanco, M. B. F. (2024). Resurgence of dengue in the Philippines [Review of Resurgence of dengue in the Philippines]. World Journal of Virology, 13(3).

Islam, M. T., Quispe, C., Herrera-Bravo, J., Sarkar, C. K., Sharma, R., Garg, N., Fredes, L. I., Martorell, M., Alshehri, M. M., Sharifi-Rad, J., Daştan, S. D., Călina, D., Alsafi, R., Alghamdi, S., Batiha, G. E., & Martins, N. (2021). Production, Transmission, Pathogenesis, and Control of Dengue Virus: A Literature-Based Undivided Perspective [Review of Production, Transmission, Pathogenesis, and Control of Dengue Virus: A Literature-Based Undivided Perspective]. BioMed Research International, 2021, 1. Hindawi Publishing Corporation.

Khanam, A., Gutiérrez-Barbosa, H., Lyke, K. E., & Chua, J. V. (2022). Immune-Mediated Pathogenesis in Dengue Virus Infection [Review of Immune-Mediated Pathogenesis in Dengue Virus Infection]. Viruses, 14(11), 2575. Multidisciplinary Digital Publishing Institute.

Kularatne, S. A. M., & Dalugama, C. (2022). Dengue infection: Global importance, immunopathology and management. Clinical Medicine, 22(1), 9.

Liu, S.-Y., Chien, T., Yang, T.-Y., Yeh, Y.-T., Chou, W., & Chow, J. C. (2021). A Bibliometric Analysis on Dengue Outbreaks in Tropical and Sub-Tropical Climates Worldwide Since 1950. International Journal of Environmental Research and Public Health, 18(6), 3197.

Malavige, G. N., Jeewandara, C., & Ogg, G. S. (2020). Dysfunctional Innate Immune Responses and Severe Dengue [Review of Dysfunctional Innate Immune Responses and Severe Dengue]. Frontiers in Cellular and Infection Microbiology, 10. Frontiers Media.

Mohamed, M. A., Hassan, N. Y., Osman, M. M., Gedi, S., Maalin, B. A. A., Sultan, K., Garba, B., Osman, A. A., Osman, A. Y., & Ahmed, A. D. (2024). Epidemiological investigation of dengue fever outbreak and its socioeconomic determinants in Banadir region, Somalia. BMC Infectious Diseases, 24(1).

Nair, D. G., & Aravind, N. P. (2020). Association between rainfall and the prevalence of clinical cases of dengue in Thiruvananthapuram district, India. International Journal of Mosquito Research, 7(6), 46.

Nakase, T., Giovanetti, M., Obolski, U., & Lourenço, J. (2024). Population at risk of dengue virus transmission has increased due to coupled climate factors and population growth. Communications Earth & Environment, 5(1).

NB, S., Kavithalatha, M. L., & Jyothilakshmi, G. (2020). Post Monsoon Rise in Incidence of Dengue Viral Infections among Patients Admitted at a Tertiary Care Center during the year 2018-2019: A Prospective Study. Scholars Journal of Applied Medical Sciences, 8(4), 1093.

Ng, W. L., Toh, J. Y., Ng, C. J., Teo, C. H., Lee, Y. K., Loo, K. K., Hadi, H. A., & Azhar, A. M. N. (2023). Self-care practices and health-seeking behaviours in patients with dengue fever: A qualitative study from patients' and physicians' perspectives. PLoS Neglected Tropical Diseases, 17(4).

Olawoyin, O., & Kribs, C. (2020). Coinfection, Altered Vector Infectivity, and Antibody-Dependent Enhancement: The Dengue–Zika Interplay. Bulletin of Mathematical Biology, 82(1).

Ramalingam, K., & Balasubramanian, A. (2020). Dengue Fever: An Overview. In IntechOpen eBooks. IntechOpen.

Robba, C., Battaglini, D., Pelosi, P., & Rocco, P. R. M. (2020). Multiple organ dysfunction in SARS-CoV-2: MODS-CoV-2. In Expert Review of Respiratory Medicine (Vol. 14, Issue 9, p. 865). Taylor & Francis.

Samal, R. R., Gupta, S., & Kumar, S. (2020). An overview of factors affecting dengue transmission in Asian region and its predictive models. Journal of Applied and Natural Science, 12(3), 460.

Soneja, S., Tsarouchi, G., Lumbroso, D., & Tung, D. K. (2021). A Review of Dengue's Historical and Future Health Risk from a Changing Climate [Review of A Review of Dengue's Historical and Future Health Risk from a Changing Climate]. Current Environmental Health Reports, 8(3), 245. Springer Science+Business Media.

Vojdani, A., Vojdani, E., & Kharrazian, D. (2021). Reaction of Human Monoclonal Antibodies to SARS-CoV-2 Proteins With Tissue Antigens: Implications for Autoimmune Diseases. Frontiers in Immunology, 11.

Zambrano-Román, M., Padilla-Gutiérrez, J. R., Valle, Y., Muñoz-Valle, J. F., & Valdés-Alvarado, E. (2022). Non-Melanoma Skin Cancer: A Genetic Update and Future Perspectives [Review of Non-Melanoma Skin Cancer: A Genetic Update and Future Perspectives]. Cancers, 14(10), 2371. Multidisciplinary Digital Publishing Institute.

Zhou, Q. A., Kato-Weinstein, J., Li, Y., Deng, Y., Granet, R., Garner, L., Liu, C., Polshakov, D., Gessner, C., & Watkins, S. C. (2020). Potential Therapeutic Agents and Associated Bioassay Data for COVID-19 and Related Human Coronavirus Infections [Review of Potential Therapeutic Agents and Associated Bioassay Data for COVID-19 and Related Human Coronavirus Infections]. ACS Pharmacology & Translational Science, 3(5), 813. American Chemical Society.