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RESEARCH ARTICLE

D-DIMER LEVELS AND THEIR IMPACT ON PREDICTING COVID-19 DISEASE PROGRESSION: A RETROSPECTIVE STUDY AT DIAGNOSTIC LABORATORY, ZIMBABWE

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Abstract

Background: Coronavirus disease 2019 (COVID-19) is frequently complicated by coagulation abnormalities, with elevated D-dimer levels consistently associated with severe disease and poor clinical outcomes. Evidence from sub-Saharan Africa, particularly Zimbabwe, remains limited despite the clinical relevance of this biomarker in resource-limited settings.
Objective: To evaluate the impact of D-dimer levels on predicting COVID-19 disease progression among patients tested at a diagnostic laboratory in Zimbabwe between December 2019 and December 2020.
Methods: This retrospective observational study reviewed records of 99 patients with laboratory-confirmed COVID-19 who had documented D-dimer results. Demographic data, D-dimer levels, patient ward location, and indicators of disease severity were analyzed. Severe COVID-19 was defined as admission to a high-dependency unit (HDU) or intensive care unit (ICU). Statistical analyses included descriptive statistics, comparison across age groups and wards, receiver operating characteristic (ROC) curve analysis, and logistic regression to assess the predictive value of D-dimer.
Results: The mean age of patients was 68.04±20.37 years, with a slight female predominance (53.54%). The overall mean D-dimer level was 1.48±2.76 µg/mL. Higher D-dimer concentrations were observed in older age groups and in patients admitted to HDU and ICU. ROC curve analysis demonstrated good discriminatory performance of D-dimer in predicting severe COVID-19. Logistic regression showed a positive association between increasing D-dimer levels and the probability of severe disease.
Conclusion: Elevated D-dimer levels are strongly associated with COVID-19 disease severity and progression in this Zimbabwean cohort. D-dimer is a valuable and accessible prognostic biomarker that can support early risk stratification and clinical decision-making in resource-constrained healthcare settings.
Keywords: COVID-19, coagulation, D-dimer, disease severity, Zimbabwe.

INTRODUCTION

The coronavirus disease 2019 (COVID-19), triggered by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), swiftly transformed from a localized incident into a worldwide public health crisis after its appearance in late 2019[1,2]. Although the disease first appeared mainly as an acute respiratory condition, growing clinical and laboratory evidence has confirmed COVID-19 as a complex multisystem illness with notable hematological and vascular engagement[3]. Coagulation abnormalities, which are among the most clinically significant complications noted, have been closely linked to the severity of the disease, thromboembolic occurrences, and mortality[4,5]. A key laboratory marker of COVID-19–related coagulopathy is D-dimer, a byproduct of fibrin breakdown that occurs during the degradation of cross-linked fibrin. Increased D-dimer levels indicate the activation of coagulation and fibrinolytic pathways and are commonly utilized in clinical settings to evaluate thrombotic risk. During COVID-19, significantly elevated D-dimer levels have been observed even without visible thrombosis, indicating a possible underlying hypercoagulable and pro-inflammatory condition caused by endothelial damage, cytokine storm, and mismanaged immune reactions[6-8].

Numerous research efforts from Asia, Europe, and North America have consistently shown that high or increasingly rising D-dimer levels correlate with severe illness, necessity for hospitalization, ICU admission, and heightened mortality risk[9-11]. These results have established D-dimer as both a diagnostic supplementary tool and a prognostic biomarker that can identify patients at elevated risk of clinical deterioration. As a result, global clinical guidelines have advised regular monitoring of D-dimer in hospitalized patients with COVID-19 to inform risk assessment and treatment choices, including anticoagulation approaches[12,13]. Even with the increasing amount of worldwide evidence, information from sub-Saharan Africa is still scarce. This discrepancy is especially significant due to the distinctive demographic, epidemiological, and health system traits of the area. In Zimbabwe, similar to numerous low- and middle-income nations, diagnostic laboratories are crucial for patient assessment because of limited availability of advanced imaging technologies and critical care services. Affordable, accessible, and informative laboratory-based biomarkers are thus crucial for the early identification of patients who are likely to undergo disease progression[14-17].

Additionally, the prevalence of communicable and non-communicable diseases in Zimbabwe, such as HIV, tuberculosis, cardiovascular issues, and diabetes, may affect coagulation profiles and the results of COVID-19. Comprehending the behavior of D-dimer within the local population amid SARS-CoV-2 infection is essential for framing its clinical relevance and preventing both overestimation and underestimation of risk[18-21]. In light of this context, the current retrospective analysis sought to assess D-dimer levels in confirmed COVID-19 patients who were tested at a diagnostic laboratory in Zimbabwe from December 2019 to December 2020. The study aimed to identify the relationship between D-dimer levels and the progression, severity, and clinical outcomes of COVID-19. This study provides locally relevant evidence that aids in the informed integration of laboratory and clinical practices, while promoting the rational use of D-dimer testing in managing COVID-19 in resource-constrained environments.

METHODS

Research design

This study was a retrospective observational cohort study. Data was collected from existing medical records of patients was tested at Diagnostic Laboratory Mater Dei during December 2019 to December 2020 and met the inclusion criteria.

Study setting

The study was conducted using clinical and laboratory data records originating from Diagnostic Laboratory Services (DLS) at Mater Dei Hospital in Bulawayo, Zimbabwe. This is a private full service laboratory that serves a broad clintele, processing samples from clinics and hospitals. The data reviewed was collected from patients who were tested at DLS laboratory.

Study population

The study population consisted of adult patients (18 years and older) who were tested at Diagnostics Laboratory between December 2019 and 2020 with a confirmed diagnosis of COVID-19. Patients were included regardless of their symptoms, severity of illness, or treatment received.

Exclusion criteria

Patients below the age of 18 were excluded. Patients with a history of severe liver or kidney disease, known coagulopathy, or those on anticoagulant therapy prior to COVID-19 diagnosis were excluded. Patients with insufficient medical records or missing data were also excluded. A total of 96 patient records that met the inclusion criteria were reviewed and analyzed.

Inclusion criteria

The study included all adult patients (18 years and older) who had a confirmed diagnosis of COVID-19 based on RT-PCR testing. Only records from patients tested at Diagnostics Laboratory between December 2019 and 2020 that had available D-dimer measurements during their disease course were included.

Sampling methods

The sampling method used was consecutive sampling to include all eligible patients who were tested at the Diagnostics Laboratory during December 2019 to December 2020.

Data analysis

Data was collected from patient medical records, including demographic information, clinical characteristics, D-dimer values, and COVID-19 disease progression. Statistical analysis was performed using DLS software. Descriptive statistics were used to summarize the characteristics of the study population. Correlation analysis was conducted to examine the relationship between D-dimer values and COVID-19 disease progression.

Ethical considerations

Ethical approval to conduct the study was requested and received from the Africa University Research Ethics Committee (AUREC 3424/25). Approval to access clinical records was granted by the Laboratory Manager at Diagnostic Laboratory Services Bulawayo. Confidentiality of results was preserved since all information was kept in software secured by a password provided by the manager. Confidentiality was rigorously upheld, and no participant names were recorded throughout this research. Data was gathered in accordance with the stipulations of the Ethics Committee (AUREC).

RESULTS

A total of 99 confirmed COVID-19 patients were part of the analysis. Females made up a marginally larger percentage of the study group (53.54%, n=53) than males (46.46%, n=46). The majority of patients were older adults, with an average age of 68.04±20.37 years and a median age of 67 years, spanning from 21 to 97 years. The average D-dimer concentration was 1.48±2.76 µg/mL, with a median of 0.86 µg/mL and a broad range (0.11–14.57 µg/mL), reflecting significant variability among individuals. Concerning the clinical

setting during sampling, almost half of the patients were treated in the casualty ward (47.47%), followed by the high-dependency unit (HDU) (22.22%), isolation wards (19.19%), and intensive care unit (ICU) (11.11%), indicating a range of disease severity within the group (Table 1).

Table 1: Demographic and clinical characteristics.

Characteristic	Statistic
Total Sample Size	99
Gender	
Male, n (%)	46 (46.46%)
Female, n (%)	53 (53.54%)
Age (Years)	
Mean±SD	68.04±20.37
Median (Range)	67 (21-97)
D-dimer Value (µg/mL)	
Mean±SD	1.48±2.76
Median (Range)	0.86 (0.11-14.57)
Patient Location (Ward)	
Casualty, n (%)	47 (47.47%)
HDU, n (%)	22 (22.22%)
Isolation, n (%)	19 (19.19%)
ICU, n (%)	11 (11.11%)

Patients were categorized into three age groups to assess age-dependent trends in D-dimer levels. The age group of 21–49 years (n=28) exhibited a comparatively low average D-dimer value of 0.63 µg/mL, which aligns with less severe disease manifestations. The 50–79-year age group made up the largest share of patients (n=48) and showed the highest average D-dimer level (2.72 µg/mL), indicating heightened thrombotic and inflammatory activity within this age range. Patients aged 80–99 years (n=23) exhibited a mean D-dimer value of 1.46 µg/mL, which, while higher than that of younger patients, was still lower than the levels found in the 50–79-year group. In general, advancing age correlated with elevated average D-dimer levels (Table 2). The box plot representing D-dimer values by ward location revealed a distinct gradient in D-dimer levels across care levels. Patients treated in emergency and isolation units showed lower median D-dimer levels with tighter interquartile ranges. Conversely, individuals admitted to the HDU and ICU exhibited significantly higher median D-dimer levels and increased variability, suggesting a robust link between raised D-dimer values and more severe clinical conditions (Figure 1). ROC curve analysis was conducted to evaluate the effectiveness of D-dimer levels in predicting severe COVID-19, characterized by hospitalization in HDU or ICU.

Table 2: Average age and average D dimer value.

Age group	Average Age	Average D-Dimer (µg/mL)	Number of patients
21-49	35.6	0.63	28
50-79	67.0	2.72	48
80-99	87.5	1.46	23

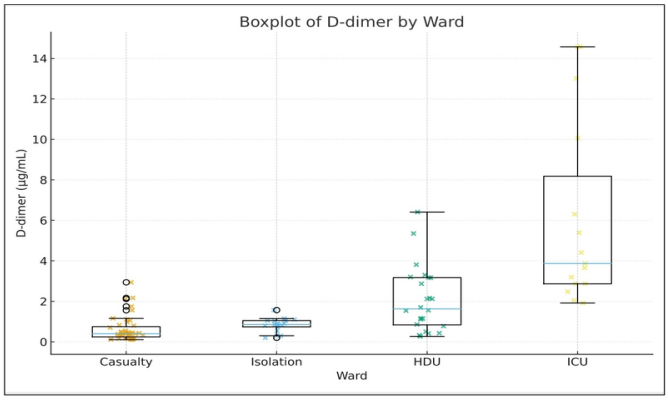


Figure 1: D dimer value and ward Box plot.

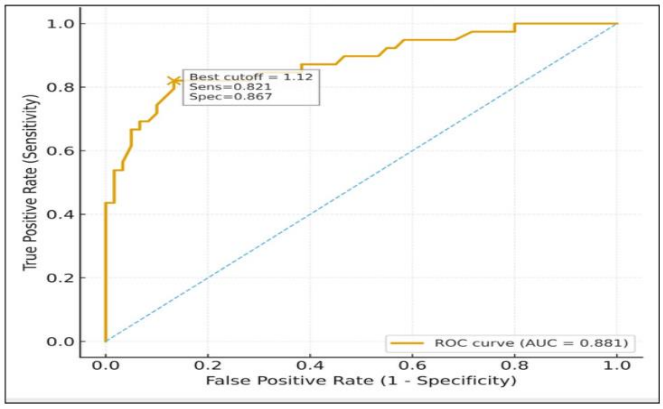


Figure 2: ROC Curve -D-dimer predicting severe (HDU/ICU).

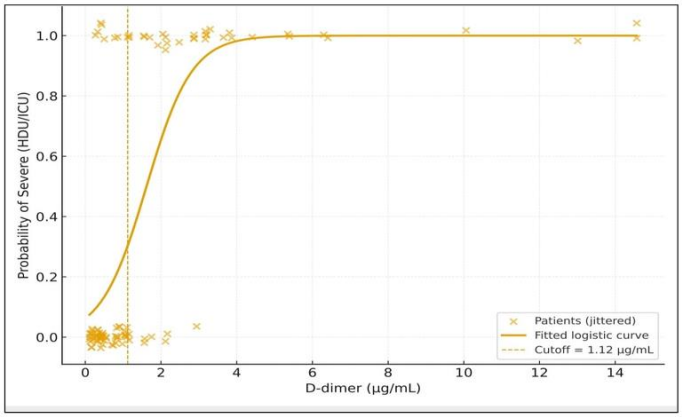


Figure 3: Logistic regression: Probability of severe COVID-19 vs D-dimer.

The ROC curve exhibited strong discriminatory ability, with D-dimer indicating a significant balance between sensitivity and specificity in detecting patients at risk for severe illness. This result reinforces the value of D-dimer as a prognostic indicator for disease severity (Figure 2). Logistic regression analysis showed a positive relationship between increasing D-dimer levels and the likelihood of severe COVID-19. With rising D-dimer levels, the likelihood of admission to HDU or ICU increased gradually. This association suggests that higher D-dimer levels notably heighten the chances of severe illness, confirming its status as an independent indicator of COVID-19 progression (Figure 3).

DISCUSSION

This retrospective analysis assessed the association between D-dimer levels and the severity of COVID-19 among patients treated in a diagnostic laboratory-connected clinical environment in Zimbabwe during the initial year of the pandemic. The results indicate that high D-dimer levels were prevalent among hospitalized COVID-19 patients and were significantly linked to older age, greater intensity of care, and the advancement to severe illness necessitating admission to high-dependency units (HDU) or the intensive care unit (ICU). The study group mainly consisted of older individuals, with an average age exceeding 68 years, aligning with worldwide data indicating that older age is a significant risk factor for severe COVID-19 and negative outcomes. In this cohort, older patients showed elevated D-dimer levels, indicating age-associated alterations in coagulation, endothelial activity, and inflammatory reactions. The patients aged 50–79 years exhibited the highest average D-dimer levels, and this group also represented the greatest percentage of severe cases. This aligns with earlier findings that the relationship between age and COVID-19–related coagulopathy greatly impacts disease advancement[22-24].

D-dimer levels displayed significant differences between clinical wards, with the lowest amounts found in patients treated in casualty and isolation wards, while the highest values were noted in HDU and ICU patients. This gradient among care levels strongly indicates that an increase in D-dimer correlates with clinical decline. Comparable patterns have been observed in global research, indicating that high D-dimer levels were associated with respiratory failure, thromboembolic issues, and higher mortality rates. The current results strengthen the significance of D-dimer as a proxy indicator of thrombo-inflammatory load in COVID-19[25-27]. The ROC curve analysis indicated that D-dimer had strong discriminatory power for forecasting severe COVID-19, characterized by the requirement for HDU or ICU admission. This suggests that D-dimer measurement may aid in early risk assessment, especially in resource-poor environments where advanced imaging and extensive monitoring are limited. The logistic regression analysis further validated that elevated D-dimer levels correlated with a higher likelihood of severe disease, emphasizing its significance as an independent predictor of COVID-19 progression[28-30].

The pathophysiological reason for increased D-dimer in COVID-19 is well defined and involves endothelial damage, cytokine-driven activation of coagulation pathways, platelet activation, and reduced fibrinolysis. These processes together create a hypercoagulable condition, heightening the likelihood of both microvascular and macrovascular thrombosis. The significant variation of D-dimer values noted in this study indicates the diversity of disease manifestation and development, even among a relatively limited group[31-33]. From both clinical and public health viewpoints, the results of this study hold significant importance for the healthcare landscape in Zimbabwe. Routine D-dimer testing is more readily available than complex imaging studies and can offer essential prognostic insights to assist with patient triage, monitoring levels, and treatment choices, including prompt initiation or escalation of anticoagulation therapy when clinically warranted[34,35].

CONCLUSIONS AND DECLARATIONS

This retrospective study shows that high D-dimer levels are strongly linked to the severity and progression of COVID-19 in patients treated at a clinical setting connected to a diagnostic laboratory in Zimbabwe. Elevated D-dimer levels were noted in elderly patients and those needing advanced care, especially admission to intensive care units and high-dependency units. The results indicate that D-dimer is a

trustworthy prognostic marker for detecting patients with a higher risk of severe COVID-19. Its capacity to distinguish between mild and severe conditions, demonstrated by ROC and logistic regression evaluations, highlights its clinical importance in initial risk assessment and patient care. In settings with limited resources like Zimbabwe, where access to advanced diagnostic and critical care is restricted, regular D-dimer testing provides a practical and affordable means to enhance prompt clinical decision-making. Integrating D-dimer testing into routine COVID-19 assessment procedures could enhance patient sorting, refine monitoring techniques, and possibly diminish negative results by facilitating prompt intervention.

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AUTHOR'S CONTRIBUTIONS

Shumba L: conceptualization, methodology, data collection and analysis, visualization, validation, writing the draft, editing, review, data collection, data interpretation. **Obeagu EI:** supervision, conceptualization, methodology, data collection, visualization, validation, writing the draft, editing, review. Final manuscript was checked and approved by the both authors.

DATA AVAILABILITY

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request, subject to applicable ethical and institutional restrictions.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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