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ORIGINAL RESEARCH

# Factors Influencing Early Hospital Arrival of Patients with Acute Ischemic Stroke, Cross-Sectional Study at Teaching Hospital in Mogadishu Somalia

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**Background and Purpose:** The low rates of thrombolysis for ischemic stroke in our country and other developing countries can be attributed to delays in arrival at the hospital. This study aims to investigate the factors that influence the early hospital arrival of patients with acute ischemic stroke to the hospital in Mogadishu, Somalia.

**Methods:** This is a cross-sectional study conducted at a teaching hospital in Mogadishu, Somalia. Adult patients with acute ischemic stroke admitted to the emergency department (ED) between June 2021 and May 2022 were included in the study. A questionnaire-based interview was administered to adult patients or their relatives to assess the factors contributing to hospital delay.

**Results:** Of the 212 patients in the study, 113 (53.3%) were male, while 99 (46.7%) were female. The mean age of the patients was 62 ±10. Hypertension was the most common risk factor among patients 121 (57%), followed by diabetes and hyperlipidemia. One hundred and forty (66%) patients lived in the city, while 72 (34%) lived outside of the city. About 53 (25%) of the patients were brought to the ED by ambulance, and only 32 (15%) reached the hospital in less than 4 hours. The majority of patients had no idea about stroke symptoms and thrombolytic treatment. In univariate and binary logistic regression analysis, delays in hospital arrivals were associated with a travel distance of more than 10 km, transportation via non-ambulance means, living alone, lack of recognition of stroke symptoms, night-time stroke onset, lack of knowledge about thrombolytic treatment, and non-hemiplegic presentation.

**Conclusion:** This study demonstrates factors delaying early hospital arrivals of patients with ischemic stroke. Improving the modifiable factors through public education will prevent delays in the early hospital arrival of stroke patients and will improve early thrombolytic intervention and the overall outcome of these patients.

**Keywords:** thrombolytic treatment, acute ischemic stroke, hospital arrival, delaying factors

## Introduction

Stroke is one of the leading causes of death and disability worldwide, especially in the elderly. Eighty-five percent of strokes are ischemic strokes due to occlusion of major intracranial vessels or their branches.[1] Administration of intravenous thrombolytics is a very effective treatment for acute ischemic stroke, as is mechanical thrombectomy for selected patients with acute ischemic stroke (AIS) who are eligible for thrombolysis if they come to the hospital within the therapeutic window.[2] The earlier patients arrive at the hospital, the more likely they are to benefit from thrombolysis. However, fewer patients with acute ischemic stroke arrive at the hospital within the therapeutic window.[3] The longer it takes for a patient to get to the hospital after a stroke, the less likely they are to be treated with thrombolytic and/or mechanical thrombectomy.[4] There are a variety of factors that have been researched in the literature that lead to patients' arriving to the hospital after the therapeutic window has passed. Among these factors are referral pattern, living alone, nocturnal onset, history of stroke or cardiovascular disease, transportation method to the hospital, knowledge of thrombolysis, and clinical status.[5,8]

Somali's healthcare system is not well developed; there are limited hospitals which provide thrombolytic treatment for patients with acute ischemic stroke. Mechanical thrombectomy is not available in the country. There are no dedicated stroke units in the country. Only these few hospitals could provide this thrombolytic treatment and majority of hospitals/clinics refer AIS patients to these centers. The emergency ambulance service is not well organized and patients must rely on other transportation options to get to the hospital. The EMS is not readily available; this may be a contributing factor to the prehospital delay. In our setting, very few patients with acute ischemic stroke arrive at the hospital within the therapeutic window, and therefore the majority of patients miss the benefit of the thrombolytic treatment.

There are no previous studies performed in our country that investigate the factors contributing to this delay. We conducted this study at the largest hospital in Mogadishu, which provides 24/7 stroke care, including thrombolytic treatment. Our study aims to determine the factors affecting the arrival time to the hospital of patients with acute ischemic stroke.

## Materials and Methods

This was a cross-sectional study conducted in a tertiary teaching hospital (Mogadishu Somali Turkish training and research hospital), which is the only hospital in Mogadishu providing IV thrombolytic treatment for patients with acute ischemic stroke). Patients diagnosed with acute ischemic stroke who arrived at the emergency department between June 2021 and May 2022 were included in the study. A questionnaire-based interview was administered to the patients or patients' relatives by attending neurologists to determine the factors that delay the early arrival of patients with acute ischemic stroke to the hospital. All patients of age >18 years (willing to participate) with symptoms of stroke and neuro-imaging (cerebral computed tomography/magnetic resonance imaging) evidence consistent with acute ischemic stroke were included. Patients who developed ischemic stroke while in the hospital and patients with intracerebral hemorrhages were excluded from the study. The time when stroke symptoms first appeared was recorded as the stroke onset time. The time when the patient was last seen as healthy was used to determine the stroke onset time in wake-up strokes. Other studies have preferred the same definition of stroke onset for patients whose symptoms were detected on awakening.[6,7]

Patients' demographic characteristics, stroke risk factors, NIHSS Score, time to hospital arrival, factors influencing early hospital arrival including travel distance, ambulance availability, time of stroke onset, knowledge of thrombolytic treatment, and also the rate of thrombolytics application among study participants were evaluated.

The stroke onset time was divided into day (6 am–6 pm) and night (6 pm–6 am) based on the local time. The patients were divided into two groups based on the time of their emergency visit after the onset of stroke symptoms: those who arrived early (4 hours) and those who arrived late (>4 hours). Consciousness was assessed by using the Glasgow Coma Scale (GCS) and was further categorized into less than or equal to 8/15 and greater than 8 to determine patients who were conscious and those that were unconscious. The stroke severity was measured using the National Institute of Health Stroke Scale (NIHSS). First-stroke symptom presentation was recorded as hemiplegia/hemisensory loss, aphasia/dysarthria, or altered mental status. The distance travelled by the patients to hospital was categorized as 10 km or less and more than 10 km. This distance was reasonably considered because people living within a 10-km away from the hospital, are able to reach the emergency within the 4-hour therapeutic window period.

## Statistical Analysis

The variables were analyzed by using the statistical package for social sciences (SPSS) version 26. Descriptive statistics, frequencies, and percentages were calculated for variables such as stroke risk factors, time of stroke onset, travel distance, transportation availability, time of arrival to hospital, and rate of thrombolytic administration. To assess the univariate relationship between early presentation to the hospital and the variables of interest, the Persons' Chi-square test was used for qualitative data such as educational status, living conditions, time of onset, travel distance, and transportation availability. Binary logistic regression analysis was applied to variables that were statistically significant (p < 0.05) in univariate analysis. OR and 95% confidence intervals were assessed for all the values in the final model.

## Ethical Approval

This study was performed in line with the principles of the Declaration of Helsinki. The study was reviewed and accepted by the ethics committee of Mogadishu Somali Turkish Training and Research Hospital (Ethics Protocol No: MSTH/ 6746). All patients or caregivers were informed as to the purpose of this study. Written informed consent was obtained from the patient or relatives during the data collection and they signed the consent form. We declare that we have followed the protocols of our work center. Patients' data confidentiality was respected.

## Findings

The study included 212 patients admitted to the emergency department due to acute ischemic stroke. The male patients in this study were 113(53.3%) of the subjects, while 99(46.7%) were female. The mean age of the patients was 62±10. The majority of the patients 153(72%) were above 60 years of age. Hypertension was the most common risk factor among patients 121(57%), followed by diabetes mellitus and hyperlipidemia (see Table 1).

A total of 111(52.4%) had NIHSS score of less than 12, while 101(47.6%) had NIHSS score of more than 12. The NIHSS score was not a significant factor influencing the early hospital arrival of patients. On admission, 100 (47.2%) of the patients had elevated blood pressure, 67(31.6%) of the patients had an elevated blood glucose level, while 20(9.4%) had associated metabolic derangement. At admission, 82 (39%) had a GCS of less than 10, while 130 (61%) had a GCS greater than 10. MCA infarct was the most common arterial territory of infarction 117(55%), followed by ACA infarct 52 (24.5%), vertebrobasilar territory infarct 35(16.5%), while 8(4%) had internal carotid occlusion. Regarding place of living, 140(66%) of the patients lived in the city, while 72(34%) lived outside of the city, 72(34%) of the patients lived

**Table 1** Demographic Characteristics of Patients

|  | N% |
|---|---|
| **Age, Years** |  |
| >60 years | 153(72%) |
| < 60 years | 59(28%) |
| **Gender** |  |
| Male | 113(53.3%) |
| Female | 99(46.7%) |
| **Place of Living** |  |
| Urban | 140(66%) |
| Rural | 72(34%) |
| **Living Condition** |  |
| Alone | 62(29%) |
| Live with family/friend | 150(71%) |
| **Education Level** |  |
| Primary education | 97(46%) |
| Secondary education | 83(39%) |
| University level or above | 32(15%) |
| **Income Level** |  |
| Low level of income | 107(50.5%) |
| Middle level of income | 78(36.8%) |
| High income level | 27(12.7%) |
| **Stroke Risk Factors** |  |
| HTN | 91(43%) |
| DM | 65(31%) |
| Hyperlipidemia | 73(34%) |
| Heart disease | 9(4.2%) |
| Previous stroke/TIA | 16(7.5%) |

**Abbreviations**: HTN, hypertension; DM, diabetes mellitus; TIA, transient ischemic stroke.

alone, while 140(66%) lived with their families or friends. Rural residency and living alone were associated with delays in hospital arrival (p < 0.005 and p < 0.038 respectively).

Considering stroke onset, 22(68.8%) of the patients with daytime stroke onset reached the hospital in less than 4 hours, compared to 10(31.3%) of the patients with night time stroke onset. This was statistically significant (p= 0.016). Regarding travel distance, 127(60%) travelled less than 10km to the hospital, while 85(40%) travelled more than 10km to the hospital. About 53(25%) of the patients were brought to the ED by ambulance, while the remaining 159(75%) were brought via other means of transportation. The analysis shows that only 32(15%) of patients reached the hospital in less than 4 hours, while the rest of patients were delayed (see Figure 1). The mean time to hospital arrival for the patients was 16 hours. Twenty-three percent of the patients were referred from other hospitals or clinics. Referral pattern was not a significant factor delaying early hospital arrival (p > 0.275). Decision to visit the emergency was made by family member in 167(79%), while 56(21%) of the decision was made by the patient.

As shown in Table 2, hemiplegia was the major stroke presentation in the majority of the patients 111(52.5%), aphasia/dysarthria in 52(24.5%), while 49(23%) presented as altered mental status for their stroke. Thrombolytic treatment was applied in 1.4% of the patients. Forty-three percent of the patients/relatives had known about stroke symptoms, while 121(57%) had no idea about stroke symptoms. Only 34(16%) of the patients/relatives had known about thrombolytic treatment for acute stroke.

In univariate and binary logistic regression analysis, delay in hospital arrivals were associated with female gender (OR 0.39, 95% CI 0.17–0.89, p<0.022), having lower education background (OR 4.22, 95% CI 1.59–12.49, p<0.001), living in outside of the city (OR 4.25, 95% CI 1.42–13.64, p<0.005), GCS score of more than 8 (OR 0.42, 95% CI 1.08–4.99, p < 0.027), travel distance of more than 10km (OR 2.73, 95% CI 1.12–6.64, p<0.022), living alone (OR 2.21, 95% CI 1.03–4.74, p < 0.038), lack of recognition of stroke symptoms (OR 4.20, 95% CI 1.84–9.62, p<0.001), night time stroke onset (OR 2628, 95% CI 1.17–5.86. p<0.016), lack of knowledge about thrombolytic treatment for acute stroke (OR 3.57, 95% CI 1.52–8.37, p<0.002), and non-hemiplegic presentation (OR 3.89, 95% CI 1.79–8.46. p<0.001). The following factors were not associated with hospital arrival delay: referral from local hospital/clinic, transportation means, income level, emergency visit decision maker, past history of stroke/TIA, and NIHSS score of the patient (see Table 3).

## Discussion

Ischemic stroke is a neurologic emergency and remains a major global health problem and a leading cause of mortality and morbidity. Ischemic stroke represents 85% of acute strokes. Due to ongoing demographic shifts, such as population aging and health transformations seen in developing countries, its importance is expected to increase in the future.[9,10] Currently, intravenous thrombolytic treatment (IVT) is considered the most effective intervention treatment for patients
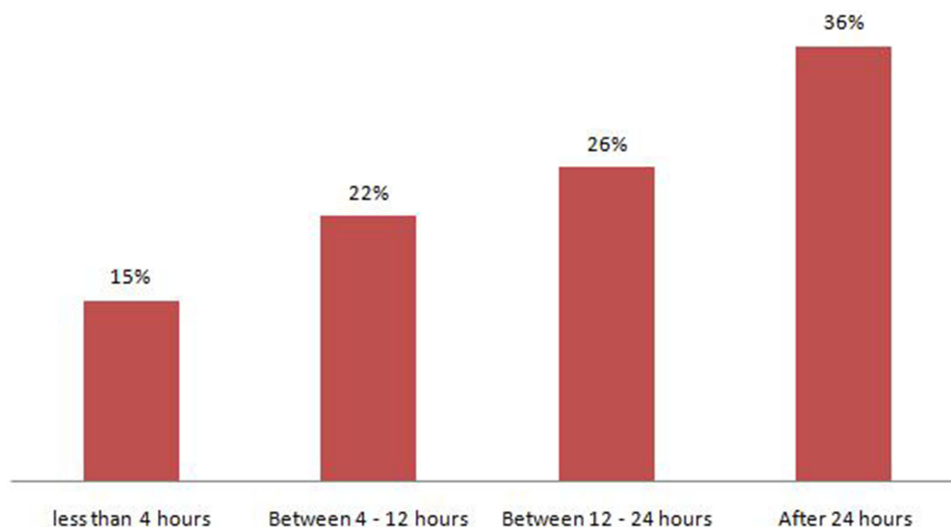


**Figure 1** Shows time to the emergency department presentation per stroke onset.

**Table 2** Patients' Stroke Related Features

|  | N/% |
|---|---|
| **NIHSS Score** |  |
| <12 | 111(52.4%) |
| >12 | 101(47.6%) |
| **BP on Admission** |  |
| Elevated | 100(47.2%) |
| Normal | 112(52.8%) |
| **Glucose Level on Admission** |  |
| Elevated | 67(31.6%) |
| Normal | 145(68.4%) |
| **Metabolic Derangement** |  |
| Present | 20(9.4%) |
| Absent | 192(90.6%) |
| **GCS of Patients** |  |
| <8 | 80(39%) |
| >8 | 132(61%) |
| **Arterial Territory Of Infarction** |  |
| MCA | 117(55%) |
| ACA | 52(24.5%) |
| Vertebrobasilar system | 35(16.5%) |
| Internal carotid | 8(4%) |
| **Stroke Presentation** |  |
| Hemiplegia | 111(52.5%) |
| Aphasia/dysarthria | 52(24.5%) |
| Coma | 49(23%) |
| **Administration of Thrombolytic Treatment** | 9(4.2%) |
| Applied | 3(1.4%) |
| Not applied | 209(98.6%) |

**Abbreviations**: NIHSS, National Institutes of Health Stroke Scale; GCS, Glasgow Coma Scale; MCA, middle cerebral artery; ACA, anterior cerebral artery.

**Table 3** Analysis of Factors Contributing to Delay of Hospital Arrival Among Patients

|  | <4 hr% | >4 hr% | *P* value |
|---|---|---|---|
| **Age** |  |  |  |
| <60 years | 6(18.8%) | 53(29.4%) | 0.214 |
| >60 years | 26(81.3%) | 127(70.6%) |  |
| **Gender** |  |  |  |
| Male | 23(71.9%) | 90(50%) | 0.022 |
| Female | 9(28.1%) | 90(50%) |  |
| **Education Level** |  |  | 0.001 |
| Primary level | 14(43.8%) | 83(46.1%) |  |
| Secondary level | 11(34.4%) | 72(40.0%) |  |
| University level or above | 7(21.9%) | 25(13.9%) |  |
| **Income Level** |  |  |  |
| Low income | 14(43.8%) | 93(51.7%) | 0.493 |
| Middle income | 12(37.5%) | 66(36.7%) |  |
| High income | 6(18.8%) | 21(11.7%) |  |

*(Continued)*

**Table 3** (Continued).

| | <4 hr% | >4 hr% | P value |
|---|---|---|---|
| **Place of Living** | | | |
| Rural | 4(12.5%) | 68(37.8%) | 0.005 |
| Urban | 28(87.5%) | 112(62.2%) | |
| **Travel Distance** | | | |
| <10km | 25(78.1%) | 102(56.7%) | 0.022 |
| >10km | 7(21.9%) | 78(43.3%) | |
| **Stroke Presentation** | | | |
| Hemiplegia | 28(87.5%) | 83(46.1%) | 0.001 |
| Aphasia/dysarthria | 2(6.3%) | 50(27.8%) | |
| Coma | 2(6.3%) | 47(26.1%) | |
| **Knowledge About Thrombolytic Treatment** | | | |
| Yes | 11(34.4%) | 23(12.8%) | 0.002 |
| No | 21(65.6%) | 157(87.2%) | |
| **NIHSS Score** | | | |
| <12 | 13(40.6%) | 98(54.4%) | 0.149 |
| >12 | 19(59.4%) | 82(45.6%) | |
| **Stroke Recognition** | | | |
| Yes | 23(71.9%) | 68(37.8%) | 0.001 |
| No | 9(28.1%) | 112(62.2%) | |
| **GCS** | | | |
| <8 | 18(56.3%) | 64(35.6%) | 0.027 |
| >8 | 14(43.8%) | 116(64.4%) | |
| **Time of Stroke Onset** | | | |
| Day | 22(68.8%) | 82(45.6%) | 0.016 |
| Night | 10(31.3%) | 98(54.4%) | |
| **Living Alone** | | | |
| Yes | 16(50.0%) | 56(31.1%) | 0.038 |
| No | 16(50.0%) | 124(68.9%) | |
| **Referral from Other Hospital** | | | |
| Yes | 5(15.6%) | 44(24.4%) | 0.275 |
| No | 27(84.4%) | 136(75.6%) | |
| **Key Decision Maker** | | | |
| Patient | 8(25%) | 37(20.7%) | |
| Family member | 24(75%) | 142(79.3%) | 0.582 |
| **Transportation Method** | | | |
| Ambulance | 11(34.4%) | 41(22.8%) | 0.160 |
| Other means | 21(65.6%) | 139(77.2%) | |

**Abbreviations**: NIHSS, National Institute of Health Stroke Scale; GCS, Glasgow Coma Scale; AMS, altered mental status.

presenting with acute ischemic stroke (AIS). However, majority of patients come to the hospital late and miss this golden opportunity.[11,12]

In this study, we investigated the various factors influencing the early arrival of AIS patients to the emergency department in Mogadishu. Compared to other Western and developed countries, where prehospital delays typically range from 3 to 6 hours.[13,14] The median prehospital delay in this study is 14 hours, which is much longer. Of the patients, only 32 (15%) arrived at the hospital within the therapeutic window of 4.5 hours. This has a negative impact on the management and outcomes of patients with acute ischemic stroke. This should be a public health concern and therefore should become a top priority for healthcare professionals. In univariate and multivariate analysis of this study, factors associated with early hospital arrival were: male gender, having higher education, living in the city, low GCS score, travel distance of less than 10 km, living with family or friends, knowledge of stroke symptoms at daytime stroke onset,

knowledge of thrombolytic treatment for acute stroke, and hemiplegic presentation. There was not any previous study evaluating the factors contributing to the prehospital delay of acute ischemic stroke patients.

The cutoff point for classifying patients into delayed and early arrival groups varied from study to study. Some studies kept 2 hours as the cutoff point, considering the hospital delay.[17,18] Two studies from India used 3 hours as the cutoff for categorizing early and late arrivals.[19,20] In our study, the cutoff point for early arrival for ischemic stroke thrombolysis was 4 hours. The proportion of patients' who arrive in the therapeutic window varies from one study to the other. Study by Guveli et al[15] 30.7% of patients arrived at the hospital within 3 hours after the onset of stroke symptoms. In another study by Kocak et al,[16] 29.5% of patients came to the hospital in <4 hours. As per a study by Caroline Mithi et al, only 23.9% of patients with acute ischemic strokes arrived early to the hospital within the therapeutic window.[21] In this study, only 15% of the patients came to the hospital within the therapeutic window, and therefore, the majority of the patients missed the golden opportunity.

Male patients had shorter prehospital delays than female patients. Male patients were more likely to arrive early than female patients. Age was a significant factor in terms of prehospital delay. According to a study by Jin et al, people over the age of 65 and female patients were just more likely to arrive early than younger patients and men.[22] According to univariate analysis, higher educational level and residence in the city were associated with fewer prehospital delays. However, in our analysis, age and income status had no impact on prehospital delay. Some studies showed that educational status and income level of patients had no effect on hospital arrival delays.[23,24]

According to certain prior studies (mainly from western countries), living alone is a significant factor in the delay in getting medical treatment among stroke patients.[25,26] In our study, the majority of patients were living with their families (80%). According to the univariate analysis, those living with family or friends had fewer hospital delays than those living alone. In this study, past history of stroke, TIA, and other comorbidities such as hypertension, diabetes, and hyperlipidemia were not significant factors influencing early hospital arrival.

In univariate analysis, recognition of symptoms of stroke by patients or relatives was significantly associated with early hospital arrival. Patients or relatives without knowledge of stroke symptoms were more likely to arrive late. Fifty-seven percent of the subjects did not know about stroke symptoms. Likewise, only 16% of patients or relatives knew about the availability of thrombolytic treatment for acute ischemic stroke. These findings emphasize the urgent need to educate the public about stroke, especially the patients in the risk group. In contrast, some studies revealed that recognition of stroke symptoms had no appreciable impact on timely presentation at the emergency room.[27,29] However, some other previous studies showed that knowledge and awareness of stroke symptoms has substantial impact on early hospital arrival.[2,28] In the literature, there are a number of studies showing that use of ambulances can reduce prehospital delays in acute stroke patients.[28,30] The patients who arrived at the hospital via ambulance were 25% in this study. This rate is very low compared to that of the developed countries, which is 60%.[6] In Somalia, since there are not many emergency ambulance services, patients must rely on other transportation options to get to the hospital. However, 25% of patients arriving via ambulance is still a good number, but was not significant enough to reduce the prehospital delay of the patients. This indicates that readily availability, quick access, and organization of emergency ambulance services are not developed in the country.

In our study, the average hospital arrival time for the patients was 16 hours. This delay is almost similar in other African countries, for example, in the neighboring Kenya where patients present to the emergency between 1 and 3 days from the onset.[21] Patients were significantly more likely to arrive at the hospital early if they lived in Mogadishu or its vicinity. This was similar to what has been found by Ashraf et al, where early emergency arrival was substantially related to living within 15 km of the hospital.[2] In this study, patients with daytime stroke onset were more likely to arrive early at the hospital than those who had night time stroke onset. This is in contrast to research by Haki et al, which revealed no association between the time of arrival at the hospital and the onset of symptoms as day or night.[1]

The factors delaying early hospital arrival of patients with acute ischemic stroke should be addressed both at a patient level and community level; these include providing public education of stroke symptom recognition and strategies to improve public health seeking behavior and attitude towards stroke. At national level, a functional emergency response system should be implemented, and the health infrastructure should be improved by equipping different regional medical

facilities with diagnostic/imaging CT scanners and the provision of thrombolytic agents, along with the education and training of hospital personnel.

## Strengths and Limitations

This research is the first to be published that addresses the major challenges and barriers towards receiving acute care for acute ischemic stroke patients in Somalia. The study specifically focused on the factors influencing the early hospital arrival of patients with acute ischemic stroke. Our findings have implications for reducing stroke patients' prehospital delays, and therefore addressing these factors will improve stroke care in the country.

The study is a single-centered study using a modest sample size. However, this study provides a useful, representative picture of the current issues surrounding prehospital delay in the presentation of acute stroke in this part of the world. Further studies with a larger sample size involving various stroke centers are required to verify these conclusions. Another limitation in our study is the utilization of information from the parapatients when the patient cannot communicate properly, which may become less representative.

## Conclusion

The study showed greater hospital delays after stroke onset. The study found that lack of recognition of stroke symptoms, living in a rural area, travelling more than 10 km to hospital, low education level, and night time stroke onset were the independent factors contributing to prehospital delay in patients with acute ischemic stroke. Public education and health promotion measures to improve public awareness of early recognition of stroke symptoms, early transfer of patients to hospitals with thrombolysis treatments, and improving ambulance services are practical and reasonable methods to speed up early presentation to hospitals by stroke patients.

## Ethical Approval

This study was performed in line with the principles of the Declaration of Helsinki. The study was reviewed and accepted by the ethics committee of Mogadishu Somali Turkish Training and Research Hospital (Ethics Protocol No: MSTH/ 7418).

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To note, we previously posted this manuscript as a preprint on the Research Square site.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Disclosure

The authors declare no conflicts of interest.

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