

Original Research

Examining the Pre-Hospital Workflow of Stroke Patients Referred with Code SAMA (724) and their Outcome in the Emergency Department of Imam Reza Hospital (AS)

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Abstract

The "Sama Code" is a protocol implemented in Iranian pre-hospital emergency services to manage time and treat patients with suspected stroke symptoms based on the FAST criteria. This study aims to analyze the workflow of patients with stroke symptoms transferred under the Sama Code. All patients with neurological symptoms who were brought to Imam Reza Hospital by pre-hospital emergency services after activating the Sama Code during the years 2021 and 2022 were included in the study. Data were collected from pre-hospital emergency records and registries, including patient age and gender, time of emergency contact, code activation, arrival of personnel at the patient's side, clinical findings recorded in pre-hospital files, time to emergency department arrival, CT scan (Computed tomography scan), thrombolytic therapy initiation, reasons for treatment cancellation, and patient outcomes. A total of 880 patients were included in the study, with a mean age of 69.24 years (CI 95%: 68.30-70.17). The median age was 71 years, with most patients aged 61-80 years. Among the



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patients, 505 (57.4%) were male, and 375 (42.6%) were female. The number of patients transferred by pre-hospital emergency services under the Sama Code was roughly equal over the two years studied. The median time from emergency notification to mission start was 1 minute, while the median time from care plan initiation to patient arrival was 10 minutes. The median time from the patient's side to transfer was 18 minutes, and from transfer initiation to hospital arrival was 10 minutes. The median time from hospital arrival to CT scan was 17 minutes. Of 880 patients, 750 were admitted to the hospital, and 13 Sama Codes were canceled during triage due to other diagnoses. Of the remaining 737 patients, only 20 received thrombolytic treatment, with a median time from CT scan to treatment of 20 minutes. According to this study's findings, a small percentage of patients receive thrombolytic treatment; however, patient transfers in accordance with the Sama Code guidelines are well implemented, ensuring rapid CT scanning and timely decision-making.

Keywords

Stroke; pre-hospital emergency services; thrombolytics

1. Introduction

Stroke is a leading cause of mortality and disability worldwide. The consequences of acute strokes impose significant healthcare costs and loss of productive workforce on families and national health systems [1]. Approximately 75% of acute strokes are ischemic, while 25% are hemorrhagic. Most ischemic strokes result from occlusion due to thrombosis or atherosclerosis [2]. In acute ischemic stroke, thrombolysis with tissue plasminogen activator (tPA) is the recommended treatment following the exclusion of hemorrhagic stroke via imaging. Early treatment correlates with better outcomes, particularly when administered within 4.5 hours of symptom onset [3]. Delays in initiating thrombolytic therapy may stem from deficits in public awareness, inefficiencies in pre-hospital emergency response, or both.

The Sama Code is a protocol in Iranian pre-hospital emergency services designed to manage time and treat patients exhibiting positive Face-Arms-Speech (FAST) stroke symptoms. The 724 code allows for the acceptance of patients with acute stroke symptoms 24/7 at designated hospitals equipped with stroke teams and facilities for thrombolytic therapy [4-6]. Upon activation of the Sama Code, emergency supervisors must notify security to prepare for ambulance arrival and ensure that the stroke unit is ready for immediate patient assessment and treatment.

Objective: This study aims to analyze the workflow of patients with stroke symptoms transferred under the Sama Code.

The study highlights the importance of timely diagnosis and treatment in improving patient outcomes and emphasizes the need for streamlined processes in emergency medical services to enhance stroke care delivery [6-8].

2. Materials and Methods

This study employed a cross-sectional, descriptive-analytical design.

2.1 Study Duration, Sample Size, and Sampling Method

The pilot study included 35 patients, which was calculated to require a sample size of 67 based on a 95% confidence level and a 5% margin of error. To enhance the study's power, the final sample size was set at 70 patients. Patients who arrived at the hospital without SAMA code activation from the start and with incomplete medical records were excluded.

2.1.1 Study Location

Imam Reza (AS) Educational, Treatment, and Research Center in Tabriz.

2.1.2 Sampling Method

All patients with neurological symptoms who were brought to Imam Reza (AS) Hospital via activation of the SAMA code by pre-hospital emergency services during 2021 and 2022 were included in the study via a census until the required sample size was reached. All Emergency Medical Services (EMS) personnel involved in SAMA code activation are licensed professionals. In accordance with national regulations, they must complete annual refresher courses covering stroke recognition, including the use of the FAST screening tool, and pre-hospital management protocols to maintain eligibility for active fieldwork.

When a patient or a companion contacts the EMS dispatch center to report acute neurological symptoms, the dispatcher evaluates the information provided. If stroke is suspected, the dispatcher activates the SAMA (code 724) protocol and deploys an EMS team trained in stroke assessment and pre-hospital management. All patients presenting to Imam Reza (AS) Hospital with neurological symptoms who had activated the SAMA code in 2021 or 2022 were eligible for inclusion. Exclusion criteria were: patients with a positive urine toxicology test, patients whose symptoms completely resolved, including those diagnosed with transient ischemic attack (TIA), and patients with stroke mimics, such as electrolyte disturbances, hypoglycemia, and other non-cerebrovascular causes of neurological deficits. Data extracted from pre-hospital emergency records included age, gender, time of contact with emergency services, time of SAMA code activation, time personnel arrived at the patient's side, clinical findings recorded in pre-hospital files, time of arrival at the emergency department and CT scan, time of thrombolytic therapy administration, reasons for cancellation or delay in treatment, and patient outcomes in the emergency department. All these data were extracted from the stroke registry of the Neurosciences Research Center of Tabriz University of Medical Sciences.

2.2 Statistical Analysis

Statistical analyses were performed using SPSS software, version 24 (IBM Corp., Armonk, NY, USA). Descriptive statistics were applied to summarize patient characteristics and workflow parameters. Continuous variables are presented as medians with interquartile ranges (IQRs), and categorical variables are expressed as frequencies and percentages.

3. Results

In this study, 880 patients were enrolled, and the data did not follow a normal distribution according to the Kolmogorov-Smirnov statistical method ($p < 0.001$). The mean age of the patients was 69.24 years (95% CI: 68.30-70.17), with a median age of 71 years and an interquartile range of 61 to 80 years.

Regarding gender distribution, 505 patients (57.4%) were male, and 375 patients (42.6%) were female. The number of patients referred by pre-hospital emergency services via the activation of the SAMA code was approximately equal over the two years studied.

The median time from notification to the start of the mission was 1 minute (interquartile range, 0-1 minute; Figure 1). The median time from mission start to arrival at the patient's side was 10 minutes (interquartile range, 7-15 minutes; Figure 2).

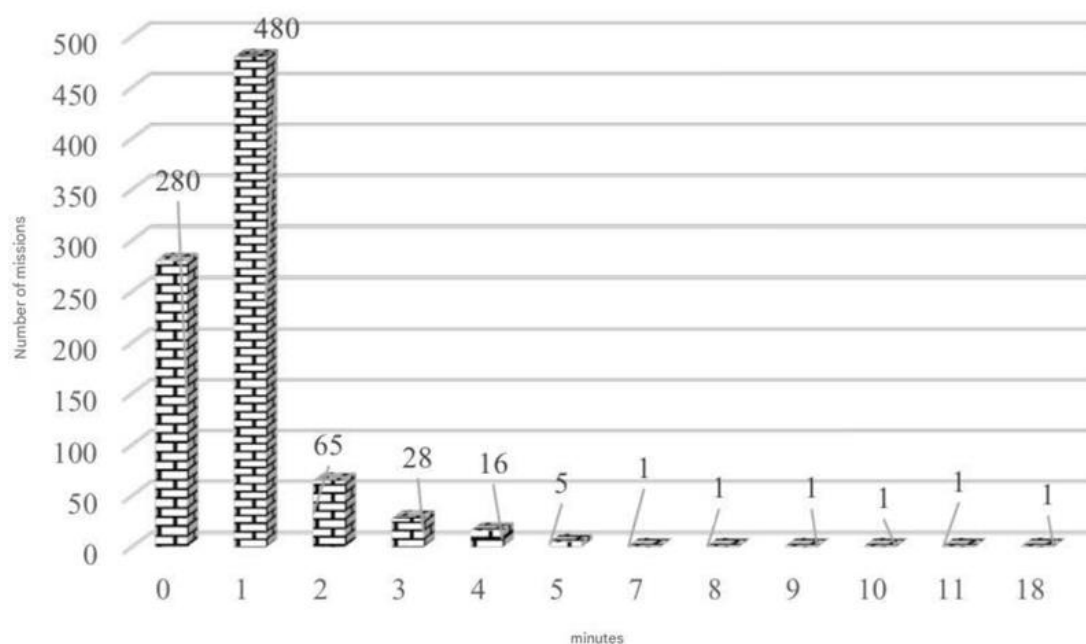


Figure 1 Time interval between the notification of the mission and the start of the mission.

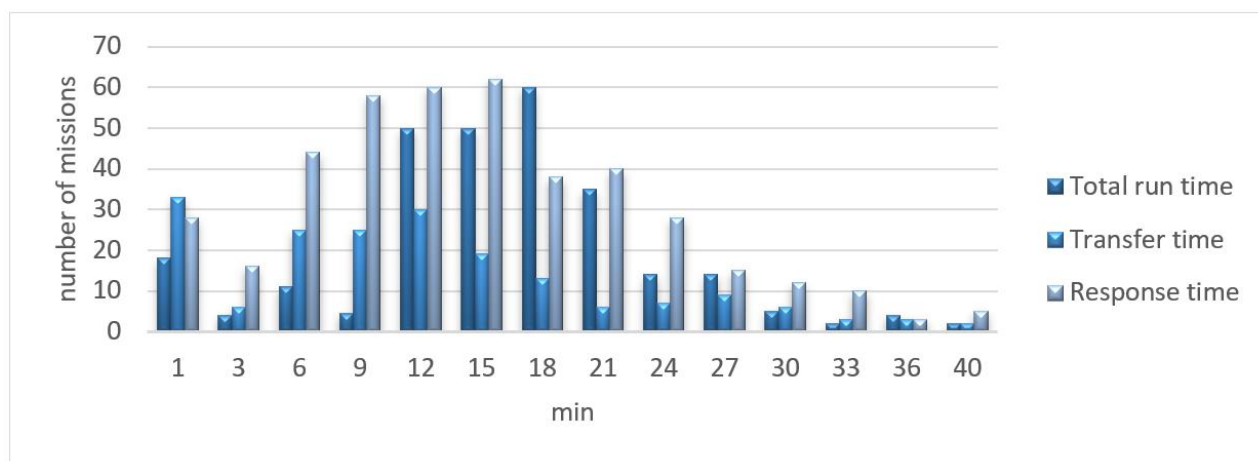


Figure 2 Summary of the missions' time.

The median time from the arrival of the pre-hospital emergency service at the patient's side to patient transfer was 18 minutes, with an interquartile range of 12 to 21 minutes. The median time from the start of patient transfer by pre-hospital emergency services to arrival at the hospital was also 10 minutes, with an interquartile range of 11 to 26 minutes.

The median time from patient arrival at the hospital to CT scan completion was 17 minutes (interquartile range, 17-38 minutes; Figure 3). Of the 880 patients, 750 were admitted to the hospital, and SAMA codes were canceled for 13 patients during triage due to alternative diagnoses, and 737 patients underwent CT scans.

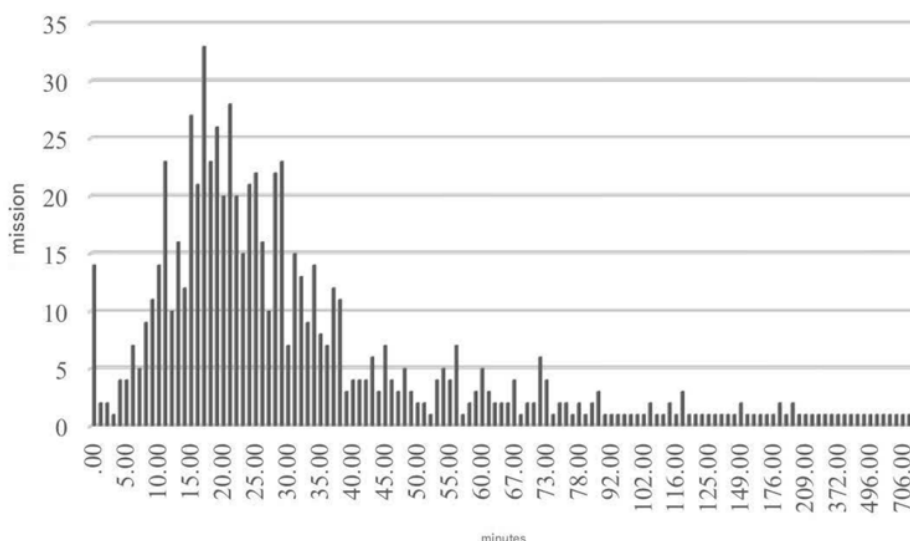


Figure 3 The time interval between the patient's arrival at the hospital and the CT scan.

From the 737 patients studied, only 20 patients (2.7%) received thrombolytic treatment. Among these patients, 377 (42.8%) were admitted to neurology wards, and 12.3% (108 patients) died within the first 24 hours.

For patients who were candidates for thrombolytic therapy, the median time from CT scan to treatment was 20 minutes, with an interquartile range of 13 to 34 minutes. In 30 patients, the level of consciousness was not recorded by pre-hospital emergency services.

The median recorded systolic blood pressure was 140 mmHg (interquartile range: 125 to 170 mmHg), while the median diastolic blood pressure was 85 mmHg (interquartile range: 80 to 95 mmHg). The median arterial oxygen saturation was recorded at 95% (interquartile range: 93 to 96%), and the median heart rate was 85 beats per minute (interquartile range: 75 to 90 bpm). The median respiratory rate was 16 breaths per minute (interquartile range: 14-17 bpm).

4. Discussion

Stroke is a leading cause of mortality and disability among working-age populations [9]. Approximately 80% of stroke patients experience ischemic strokes due to arterial blockage. In such cases, the blockage can potentially be resolved through thrombolytic therapy or thrombectomy within a few hours of symptom onset [9, 10]. Only a small number of patients receive these treatments, primarily due to delays in reaching the hospital [11, 12].

EMS plays a crucial role in this context by rapidly identifying patients who remain within the critical time window for reperfusion therapies and transferring them to hospitals equipped with

adequate diagnostic and treatment capabilities [13]. EMS personnel are typically the first healthcare professionals to encounter patients with acute ischemic strokes. Improving the performance of EMS personnel can significantly reduce delays in patient transfer to hospitals.

In this study, 880 patients were enrolled, with a mean age of 69.24 years (95% CI: 68.30-70.17) and a median age of 71 years. The gender distribution showed that 57.4% were male and 42.6% were female. The number of patients referred by pre-hospital emergency services via SAMA code activation was nearly equal over the two years studied.

The screening tools used by EMS are critical for enhancing performance. The pre-hospital diagnosis of stroke has improved significantly with the introduction of specific pre-hospital scales, such as the FAST scale. Systematic reviews have not identified a superior diagnostic tool, but FAST remains one of the best tools for pre-hospital screening of suspected acute stroke patients [14, 15].

Since July 2016, Iran has implemented the "724" system (providing 24/7 specialized services for acute ischemic stroke patients) in some hospitals, utilizing FAST screening for SAMA code activation. This system aims to facilitate rapid identification and screening of suspected acute stroke patients and to enhance coordination between pre-hospital systems and acute myocardial infarction centers for quicker transfers of stroke patients to facilities capable of providing thrombolytic therapy.

The use of FAST by emergency medical technicians (EMTs) demonstrates acceptable sensitivity and specificity for diagnosing acute stroke. It can be effectively used as a screening tool in pre-hospital emergencies [16]. However, high sensitivity and low specificity observed in EMTs when using this tool may lead to excessive triage, potentially reducing EMT sensitivity to SAMA alerts from dispatch centers [17].

The phrase "door-to-needle time" underscores the urgency of stroke treatment; thus, healthcare systems strive to plan and implement interventions to reduce delays in thrombolytic treatment. One of these activities to reduce treatment delays is the establishment of pre-hospital notifications. The pre-hospital notification for stroke in Iran, coded as SAMA, facilitates the rapid identification of suspected stroke patients who exhibit positive FAST tests and ensures their quick transfer to comprehensive stroke centers, thereby reducing treatment delays. Additionally, it raises awareness and readiness among stroke centers for immediate treatment [18].

In this study, the median time interval between notification to the pre-hospital emergency services and mission initiation was 1 minute (interquartile range, 0-1 minute). The median time from mission start to arrival at the patient's bedside was 10 minutes (interquartile range, 7-15 minutes). The median time from the arrival of pre-hospital emergency services at the patient's bedside to patient transfer was 18 minutes, with an interquartile range of 12 to 21 minutes. The median time from the start of patient transfer by pre-hospital emergency services to hospital arrival was 10 minutes (interquartile range, 11-26 minutes). The median time from patient arrival at the hospital to CT scan was 17 minutes (interquartile range, 17-38 minutes).

The main goal in treating stroke patients is to improve neurological deficits [19]. Therefore, the success of any intervention and treatment in stroke management, such as pre-hospital notification through SAMA, is primarily measured by its impact on neurological improvement. Given the importance of reducing delays in thrombolytic treatment and the primacy of neurological improvement in stroke management, this study aimed to investigate whether SAMA pre-hospital notification effectively reduces treatment delays and, if so, by how much. Reducing time can significantly affect neurological outcomes. Stroke remains one of the leading causes of long-term disability and mortality and is one of the main challenges in healthcare systems worldwide [8].

Today, the recognized treatment for acute ischemic stroke is intravenous thrombolysis. However, this treatment is time-dependent, considering the importance of early administration of thrombolysis and neurological recovery as the ultimate goal of stroke treatment. According to research, time delays—including door-to-needle, door-to-CT, and door-to-needle—were shorter for patients transferred via SAMA than for those who self-transferred [18, 20]. These findings are consistent with a study by Sadeghi Hokm-Abadi and colleagues, which showed that pre-hospital notification could significantly reduce treatment delays, including door-to-CT and door-to-needle times in patients with acute ischemic stroke. Several studies in different countries have shown comparable results [21-26]. Overall, it has been demonstrated that pre-hospital notification in various regions performs well in reducing time delays in thrombolytic treatment for patients with acute ischemic stroke. Therefore, establishing the SAMA code as a successful pre-hospital notification system has achieved the goal of early transfer for patients with ischemic stroke.

Although reducing delay time is a notable aspect of establishing pre-hospital notifications for stroke management, the ultimate goal of implementing any new intervention, such as pre-hospital notification, is to improve neurological deficits. According to one study, there was no significant difference in neurological outcomes as assessed by the NIHSS (National Institutes of Health Stroke Scale) and mRS (Modified Rankin Scale) at discharge between patients transferred via SAMA and those who self-transferred. The lack of a significant difference in neurological improvement between the two groups, despite shorter delays, was an unexpected finding [27, 28]. However, similar to current results, some studies did not show a significant effect of reduced delay times on neurological outcomes in patients with acute ischemic stroke [22-31]. For instance, a study by Kim et al. in Korea indicated that pre-hospital notification, despite reducing processing times in the hospital, did not significantly improve neurological outcomes in patients with acute ischemic stroke undergoing thrombolysis. This study utilized NIHSS and mRS scales to measure neurological deficits [29]. Additionally, there are similar studies that indicated that reduced time intervals do not lead to better outcomes in mRS or NIHSS in patients with acute ischemic strokes [32].

In the study by Soon et al., significant differences were observed between MRI (Magnetic Resonance Imaging) and CT groups with respect to thrombolysis. Among patients receiving thrombolytic treatment based on MRI, shorter time intervals were associated with a notable improvement in favorable outcomes. In contrast, while delays were reduced in the CT-based thrombolysis group, no significant increase in favorable outcomes was observed.

Out of 880 patients, 750 were admitted to the hospital. Among them, the SAMA code was canceled for 13 patients during triage, who were then triaged for other potential diagnoses. Ultimately, 737 patients underwent CT scans, and only 20 received thrombolytic treatment.

For patients eligible for thrombolytic therapy, the average time between CT scan and treatment initiation was 20 minutes (range, 13-34 minutes). This underscores the importance of time in the diagnosis and treatment process for stroke patients and highlights the need for improved referral and triage systems to increase the percentage of patients receiving thrombolytic treatment.

Some explanations for the lack of improvement despite reduced delay times may relate to the scales used for assessing neurological improvement. Certain scales may not be sufficiently sensitive to detect minor improvements in neurological deficits [33]. Additionally, the timing of evaluations could contribute to variability in performance outcomes [34]. For instance, studies have shown that evaluating neurological function with the mRS at later time points (e.g., 90 days post-stroke) may

yield more robust findings. In contrast, assessments conducted shortly after the stroke may not detect between-group differences [31].

Although one study indicated that pre-hospital transfer times via SAMA reduced the time to treatment by 32 minutes, this did not correlate with better neurological outcomes. The authors suggest that a more significant reduction in delays is necessary to achieve statistically meaningful differences in neurological performance. Another factor contributing to variability in results may be that the actual onset of stroke differs from that documented. Some patients might ignore mild symptoms for a while and only seek help when symptoms worsen, potentially missing the critical window for thrombolysis before hospital transfer.

Findings from another study indicated that the pre-hospital notification system (SAMA) was somewhat effective in reducing treatment delays in acute ischemic stroke; however, this reduction did not translate into significant improvements in neurological deficits. Given that time is a crucial determinant of the effectiveness of thrombolytic treatment in acute ischemic strokes, stabilizing pre-hospital notification programs like SAMA may help reduce delays and improve outcomes. However, a more substantial reduction in delay times is likely necessary to effectively ameliorate neurological impairments [35]. We reported real-world data collected from the pre-hospital and emergency department workflow of stroke patients referred under code SAMA (724) at Imam Reza Hospital. The low proportion of patients receiving thrombolytic therapy (2.7%) accurately reflected the operational realities observed during the study period. Although we identified cancellations and delays as primary contributors, our design did not permit a systematic investigation of all potential barriers. Other potential contributing factors may include pre-hospital triage inefficiencies, late patient arrival beyond the therapeutic window, diagnostic uncertainties, patient-related contraindications, and infrastructural or resource limitations. Understanding the relative impact of these factors requires further targeted research, which was beyond the scope of the current work but is crucial for optimizing stroke care pathways in similar real-world contexts.

An additional limitation of this study is the presence of missing or incomplete data for certain variables, notably the level of consciousness, which was not recorded in 30 patients. These gaps may have introduced bias or reduced the precision of descriptive and outcome analyses. Such missing data largely reflect the constraints of real-world emergency department documentation and the variability in pre-hospital information transfer. Although we attempted to validate and cross-check available records, the potential impact of these omissions should be considered when interpreting our results, particularly with respect to workflow timelines and patient outcomes.

Another limitation of our study is that 130 out of 880 patients with an activated SAMA (code 724) were not admitted to Imam Reza Hospital. These patients were transferred to or presented to other hospitals based on their own or their families' preferences at the time of EMS evaluation. Consequently, their clinical data and outcomes were not available for inclusion in the present analysis, which may have introduced a selection bias and limited the generalizability of our findings to the broader SAMA population.

Finally, our study did not collect longer-term functional outcomes, such as the modified Rankin Scale at 90 days, which are recognized as important indicators of clinical impact in stroke research. This omission reflects the predefined objectives of our study, which focused on the pre-hospital workflow and immediate emergency department outcomes for patients with SAMA (724). As the data were obtained from real-world emergency and hospital records without longitudinal follow-up, extended functional measures could not be systematically captured. Future studies

incorporating standardized post-discharge follow-up would be valuable for addressing this gap and providing a more comprehensive assessment of patient recovery.

5. Conclusion

The present study found that most stroke patients are aged above 70 years. Pre-hospital emergency services consistently transfer stroke cases, and contacting the pre-hospital emergency service to initiate the mission usually takes about one minute. Most emergency services arrive at the patient within 7 to 15 minutes of departure from the base. The pre-hospital emergency service normally transfers patients within 12 to 21 minutes of arriving at the patient's side. Most patients arrive at the hospital within 11 to 26 minutes of transfer. Most patients undergo CT scans within 17-38 minutes of arrival at the hospital. The average time from CT scan to thrombolytic treatment for qualified applicants is 20 minutes, but most start within 13 to 34 minutes.

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Author Contributions

Alireza Ala and Samad Shams Vahdati conceptualized and designed the study. Eliyar Sadeghi-Hokmabadi and Sadaf Jalilzadeh were responsible for data collection and registry data extraction. Mahsa Kashtkar performed the statistical analysis and contributed to data interpretation. Asghar Jafari Rouhi participated in the interpretation of results and critical revision of the manuscript. Samad Shams Vahdati supervised the study. All authors reviewed and approved the final version of the manuscript.

Competing Interests

The authors have declared that no competing interests exist.

AI-Assisted Technologies Statement

Artificial intelligence (AI) tools were used solely for basic grammar correction and language refinement in the preparation of this manuscript. Specifically, OpenAI's ChatGPT was employed to improve the readability and linguistic clarity of the English text. All scientific content, data interpretation, and conclusions were developed independently by the author. The authors have thoroughly reviewed and edited the AI-assisted text to ensure its accuracy and accept full responsibility for the content of the manuscript.

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