

# Long-Term Prognosis of Ischemic Stroke in Young Adults

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**Abstract:** In recent years, the prevalence of ischemic stroke in young adults has been rising, which is of great significance to public health. In young stroke patients, the long-term effects on neurological, psychological, and social functioning are incalculable. This article reviews the latest knowledge on the prognosis of young ischemic stroke, with a particular focus on the long-term prognosis and socio-economic issues of young individuals who have experienced an ischemic stroke. The review revealed that young patients with ischemic stroke have a significantly higher long-term mortality rate compared to the general population of the same age and gender. The majority of these deaths are caused by cardiovascular issues. The overall occurrence rate of subsequent stroke can reach up to 9.4%~11.5% over 5 years and up to 19.4%~21.6% within 10 years. Among young stroke patients with atherosclerosis, cardioembolism, and multiple vascular risk factors, the risk of mortality and recurrent vascular events increased, whereas cryptogenic stroke was associated with the lowest risk of recurrent cerebrovascular events. During extended periods of observation, young individuals who have experienced a stroke frequently encounter additional negative long-term effects, such as epilepsy, cognitive decline, depression, and difficulties in returning to work. Overall, the outlook for young individuals with ischemic stroke in the long term is generally unfavorable, with the specific outcome depending on the cause and risk factors of the stroke. Early detection and proactive management of risk factors, together with the improvement of primary and secondary prevention and treatment, are essential in minimizing the impact of stroke on young individuals in the future.

**Keywords:** Ischemic stroke; Young adults; Prognosis; Long-term.

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## INTRODUCTION

Stroke is a prominent contributor to mortality and impairment on a global scale, with ischemic stroke being responsible for as much as 80% of instances (1). The incidence of ischemic stroke among young adults is on the rise, raising concerns regarding its impact on public health (2,3,4). As young adults bear significant social and familial responsibilities, the occurrence of stroke in this population places significant hardship on both individuals and society. Although young stroke patients generally exhibit better overall physical health and short-term outcomes compared to their older counterparts, they are more likely to experience repeated stroke incidents and have a greater chance of death after extended monitoring. The long-term effects of stroke on the neurological, psychological, and social functions of young people

are incalculable. This article seeks to evaluate the existing studies on the long-term outlook for young individuals who have experienced an ischemic stroke. It specifically focuses on the factors that influence the prognosis, as well as the impact on their quality of life and ability to return to work.

## METHODS

For our review, we conducted a comprehensive search of PubMed, Wanfangdata, and CNKI.gov databases, as well as pertinent references in works published between 1993 and 2024. The search terms “stroke”, “ischemic stroke”, “epidemiology”, “young adults”, “diagnosis”, “etiology”, “risk factors”, “treatment”, “prognosis,” and “outcome” are used. The author conducted a comprehensive analysis of existing research on the occurrence, causes, treatment, outlook, and long-term monitoring of ischemic stroke in individuals between the ages of 18 and 50.

## SUMMARY IN DEFINITION, EPIDEMIOLOGY AND ETIOLOGY OF YOUNG ISCHEMIC STROKE

Young stroke, is often known as strokes that occur in individuals between the ages of 18 and 50, while some research may define the maximum age limit as 45 or 55 years old (1,5-10). Young stroke refers to a group of cerebrovascular events that includes ischemic stroke, transient ischemic attack (TIA), and hemorrhagic stroke. Ischemic stroke is the most prevalent type among them. This review will focus on describing young ischemic stroke.

Increasing incidences of young ischemic stroke have been observed in epidemiological studies published since the 1980s (11,12), with a remarkable variation in the geographic incidence. Recent data from the Global Burden of Disease (GBD) 2019 survey reveals that the prevalence of ischemic stroke among young adults is steadily rising in regions with poor sociodemographic indices, such as North Africa, the Middle East, and Southeast Asia (13). Possible factors contributing to the rising occurrence of stroke in young individuals include heightened stroke awareness, enhanced diagnostic precision through increased utilization of brain magnetic resonance imaging (MRI), a surge in conventional risk factors like hypertension, diabetes, and tobacco use, as well as the use of illicit substances among young stroke patients (14).

Young individuals who have ischemic stroke have a variety of etiologies that differ based on factors like age, sex, and geography. Early-onset ischemic strokes are caused by more than 150 different factors, including cerebral artery dissection, antiphospholipid antibody syndrome, central nervous system vasculitis, rare monogenic disorders, etc (15,16). Therefore, the etiological diagnosis of young ischemic stroke is more challenging. A recent meta-analysis conducted by the GOAL initiative analyzed data from 16864 young stroke cases worldwide. The findings revealed that the most frequent cause of ischemic stroke in young adults is unknown (26.9%), followed by other identified causes (22.7%), cardiac embolism (CE) (19.0%), large arteriolar atherosclerosis (LAA) (16.6%), and small-arteriole occlusion (SAO) (14.8%) (17). These proportions vary across research depending on region, ethnicity, the completeness of the diagnostic workup, classification, and age restrictions employed.

Young people experiencing ischemic stroke have a significantly broader spectrum of risk factors compared to older patients. These risk variables encompass standard vascular risk factors, characteristics particular to their age group, as well as other infrequent factors. Research has indicated that the classic risk factors for stroke, such as high blood pressure, abnormal levels of lipids in the blood, diabetes, smoking, and obesity, are also prevalent among young individuals who have experienced an acute stroke (18). Other risk factors and conditions include patent foramen ovale (PFO), pregnancy, oral contraceptive use, migraine, and recent infections (19). Young patients with ischemic stroke can benefit greatly from early prevention and intervention targeting traditional vascular risk factors.

## SHORT-TERM OUTCOME OF YOUNG ISCHEMIC STROKE

Young people who have an ischemic stroke have a generally favorable short-term prognosis. Younger patients with ischemic stroke have a lower short-term death rate than older ones (20). The 30-day mortality rate for young ischemic stroke varies between 2.3% and 4.5% (1,4,21-24). The 30-day death rate is significantly linked to stroke severity, with a National Institute of Health Stroke Scale (NIHSS) score greater than 15, as well as post-stroke infection (23). Typically, younger patients have superior

functional recovery compared to older groups. Young patients achieved a higher frequency of good functional results (modified Rankin Scale (mRS) 0-2) at 3 months (25).

## LONG-TERM PROGNOSIS AND RELATED FACTORS OF YOUNG ISCHEMIC STROKE

Ischemic strokes can cause long-lasting disability and an increased mortality risk for young individuals, which is a serious concern. Hence, the potential enduring consequences of strokes that occur during the early stages of life are substantial. Long-term prognosis for young ischemic stroke requires attention to various factors such as mortality, disability, recurrence of stroke and vascular events, chronic complications, cognitive function, quality of life, and return-to-work status. It is essential to monitor mortality and recurrence, as well as consider the multifaceted burdens imposed on society and psychology in young ischemic stroke. Disturbingly, recent long-term follow-up studies specifically examining young individuals who have experienced ischemic stroke have revealed a pessimistic long-term outlook for these patients. In young people, ischemic stroke has a more pronounced and lasting effect compared to older patients, since it heightens the likelihood of impairment and the occurrence of further episodes. Furthermore, these patients exhibit a greater death rate that is adjusted for age when compared to the overall population (26).

### 1. LONG-TERM MORTALITY AND FUNCTIONAL OUTCOME

In general, young people who experience acute ischemic stroke have a relatively low risk of long-term mortality. Their long-term prognosis is better compared to older patients. Nevertheless, the fatality rate for young individuals suffering from ischemic stroke is considerably greater than that of the overall population within the same age group. While there may be variations in the age ranges examined in different research, it is generally observed that the greatest risks of mortality occur within the initial month and year following a young ischemic stroke and subsequently decrease dramatically (21). For young ischemic stroke patients, the first-year mortality rate ranges from 4.5% to 6.3%, and the average mortality rate in the following years is

between 0.8% and 1.8% (21,27-29). Findings from a cohort study based on the Dutch registry revealed a 15-year mortality rate of 17.0% (95% CI, 16.2%-17.9%) among 30-day survivors of 15,527 young ischemic stroke patients aged 18 to 49. Standardized mortality rates for ischemic stroke in comparison to the general population are 5.1 (95% CI, 4.7-5.4) (30).

The prognostic value of age in predicting outcomes for young stroke patients is still a topic of discussion. Among ischemic stroke patients aged 15 to 45, it has been observed that individuals over the age of 35 had a higher risk of mortality (21,28). A study conducted in Helsinki revealed that patients aged 45 to 49 years had an approximately 2-fold higher risk of death than those aged <45 years (cumulative 5-year risk 14.7% [95%CI, 13.1% to 16.3%] vs 7.0% [6.4% to 7.6%]) (31). The higher mortality rate of patients  $\geq 45$  years old may reflect the higher prevalence of their traditional vascular risk factors. Nonetheless, a Norwegian study with patients ranging in age from 15 to 49 did not discover a correlation between fatality rates and age (29). The increased mortality rate observed in younger stroke patients who are older may be attributed to a higher incidence of atherosclerotic causes and vascular risk factors in this particular age cohort (5).

The primary cause of death in young patients who died during long-term follow-up after stroke was cardiovascular disease (CVD) (26,31). A study conducted on individuals who survived for 30 days after experiencing a stroke at a young age found that more than 20% of fatalities were a result of repeated strokes, close to 30% were caused by cardiac or aortic disorders, and over half (54.6-58%) were linked to vascular diseases (23,31). Research suggests that individuals with large artery atherosclerosis and cardioembolic causes have notably elevated long-term mortality rates in comparison to other subtypes of causes (6,31). Large-artery atherosclerosis is recognized as an independent factor that can predict the risk of death over a lengthy period of time (31).

This indicates that vascular risk factors that cause stroke in individuals at a relatively early age may elevate their long-term risk of developing cardiovascular and cerebrovascular disorders. This highlights the significance of managing cardiovascular risk factors in the community of young individuals who have experienced ischemic stroke.

**2. RECURRENCE OF STROKE AND VASCULAR EVENTS**

Young ischemic stroke patients have a considerable cumulative risk of experiencing a recurrence, which poses a high long-term risk of stroke and vascular event recurrence for them. During the early years after ischemic stroke, there is a 1-3% chance of experiencing another stroke each year and a 0.5-1% chance of experiencing other cardiovascular

events each year (1,6,32-34). Over time, ischemic stroke recurrence can increase from 9.4% at 5 years to 19.4% at 20 years (32,34). The recurrence of vascular events occurs at rates of 11.5% at 5 years (32), 21.6% at 10 years (35(p1)), and 32.8% at 20 years (34). We have compiled the findings from several cohort studies regarding the long-term likelihood of recurrent stroke and vascular events in young patients with ischemic stroke. These results are presented in Table 1.

Country or Region	Average follow-up time	Follow-up number	Age range	Statistical results
Netherlands	9.1 years	724	18-50	A total of 142 patients, accounting for 19.6% of the study population, had at least one recurrent vascular event. The cumulative risk of experiencing a recurrent stroke after an initial ischemic stroke over 20 years was found to be 19.4% (95% CI = 14.6-24.3%). After experiencing an ischemic stroke, the overall risk of any vascular incident during a period of 20 years was 32.8% (95% CI = 26.7-38.9%).(34)
Europe	11.8 years	396	18-55	Out of the total number of patients, 89 individuals (22.5%) encountered a recurring vascular event, 62 patients (15.7%) experienced a cerebrovascular event, 34 individuals (8.6%) had different types of vascular events, and 27 patients (6.8%) passed away. The overall 10-year occurrence rate per 1000 person-years was 21.6 (95% CI 17.1-26.9) for any repeated vascular incident and 14.9 (95% CI 11.3-19.3) for any cerebrovascular event.(36)
Finland	5 years	807	15-49	The 5-year recurrence rate for nonfatal or fatal ischemic stroke was 9.4% (95% CI, 7.3-11.5%). The recurrence rate for nonfatal or fatal myocardial infarction or other arterial endpoints was 2.4% (95% CI, 1.3-3.5%). The overall recurrence rate, including all endpoints, was 11.5% (95% CI, 9.2-13.7%).(32)
Italy	68.8 months	135	16-45	Fifteen patients (11.1%) experienced recurrent ischemic stroke within 3 to 76 months (average 27.4 months) following the initial stroke, with an annual incidence rate of 2.26%.(33)
Iowa (state in the United States)	6 years	296	15-45	Out of the total number of patients, 14% (equivalent to forty individuals) passed away over 6.0 years on average. Out of the total number of patients, 23 individuals (9%) had recurring strokes, and among them, 9 patients passed away. (6)
Netherlands	4.3 years	1216	18-49	A total of 170 instances of recurring vascular events were seen in 137 individuals, accounting for 11.3% of the study population during the follow-up period. The 5-year probability of experiencing any recurring vascular event was 12.2%. This probability was shown to be higher among individuals who had experienced recurrent ischemic stroke and TIA, compared to other types of vascular events. Patients with atherothrombotic stroke had the highest long-term cumulative risk (22.7%), while patients with cryptogenic stroke had the lowest risk (5.8%).(37)

**Table 1.** Summary of multiple cohort studies on long-term risk of recurrent stroke and vascular event in young adults with ischemic stroke.

The cohort studies on young adults with ischemic stroke reveal that there is a significant and varying long-term risk of recurrent stroke and vascular events based on the origin of the stroke. Patients with atherosclerosis and cardioembolism had the highest probability of experiencing another stroke, whereas patients with cryptogenic stroke had the lowest risk after a period of 5 years (36,37). Long-term antithrombotic treatment is needed for young strokes caused by atherosclerosis and cardiogenic etiology for secondary prevention. Nevertheless, cryptogenic stroke consistently remains a significant factor in the cause of stroke among young adults. Various investigations have consistently demonstrated that young patients exhibit a diminished risk of vascular events following a cryptogenic stroke, with this risk reducing every year. Hence, it is imperative to deliberate upon a crucial matter: whether these patients should be administered long-term antithrombotic therapy. This is prompted by a recent study which posits that the likelihood of bleeding in young patients is nearly equivalent to the likelihood of ischemic events (38). For young individuals who have a very low likelihood of experiencing recurring ischemia, it may not be advantageous to use antithrombotic medication due to the potential danger of bleeding outweighing the potential benefits. Nevertheless, the uncertainty surrounding the cessation of antithrombotic medication following a cryptogenic stroke persists. This complex issue necessitates additional investigation.

Several studies have discovered that various risk factors can accurately forecast the occurrence of repeated vascular episodes in young individuals who have experienced a stroke. Studies primarily focus on the long-term recurrence of stroke and the impact of established vascular risk factors rather than unusual or temporary risk factors. The SIFAP study revealed a progressive rise in the occurrence of vascular risk factors among young patients with ischemic stroke. Furthermore, it was shown that the presence of atrial fibrillation at the beginning of the study was substantially linked to subsequent recurrent vascular events (39). A recent study found that the probability of any recurring occurrence after 5 years was linked to typical vascular variables such as hypertension, diabetes, and alcohol misuse at the beginning of the study (37). Similarly, research conducted in China validated that individuals aged 45 years or older and those with atrial fibrillation are independent factors that can predict the likelihood of experiencing a stroke again (40). It is

important to identify and modify these risk factors to prevent young individuals from experiencing recurrent strokes.

### 3. OTHER CHRONIC COMPLICATIONS AND COMORBIDITIES

Young stroke patients will face various physical, psychological, cognitive, and other issues after the onset of stroke, which will significantly impact their life quality and work status. Hence, it is imperative to provide comprehensive counseling and assistance to young patients with ischemic stroke regarding their prognosis and the impact of the stroke during their hospitalization, rehabilitation, and subsequent monitoring.

### 4. POST-STROKE SEIZURES

Previous research indicates that 5.5% of patients experience post-stroke seizures within 3 years and 11.5% within 10 years (41). A prospective study conducted in the Netherlands (42) revealed that the cumulative risk of post-stroke seizures, following an average follow-up period of 9.8 years, is 12.7%. Logistic regression analysis revealed that patients with post-stroke seizures have lower mRS scores and functional results in instrumental activities of daily living (iADL) compared to people without seizures (42). Multiple regression analysis showed that epilepsy was an independent predictor (mRS score >2: odds ratio 3.38, 95% confidence interval 1.33-8.60) (42). One theory for the poor functional results seen in epilepsy patients following an ischemic stroke is that seizures may directly hinder recovery through as-yet-unidentified mechanisms. In previously ischemic brain parenchyma, seizures may exacerbate the condition of inadequate oxygen and energy delivery, which would increase the extent of the infarct and hinder motor recovery (43).

#### Cognitive impairment

When compared to people who have not had a stroke, individuals who experience a young ischemic stroke often have poorer cognitive outcomes in the majority of cognitive areas over a long period. Approximately 50% of patients exhibit below-average performance or cognitive impairment, with the most prominent abnormalities reported in processing speed, working memory, and attention (44). Even 11 years after the stroke occurred, a

significant portion of young stroke patients (>50%) still exhibit poor performance in various cognitive domains (44). Although young adults have a better cognitive prognosis than older adults, given their longer life expectancy and the impact on daily life, it is essential to monitor the cognitive function of young patients in clinical practice.

### Post-Stroke Depression

Studies have indicated that individuals who have experienced a stroke are at a significantly higher risk of developing anxiety and depression compared to those who are in good health. The risk is found to be 2 to 3 times greater in stroke patients, with a particularly higher occurrence of depression in individuals whose left cerebral hemisphere was affected (45,46). A study conducted in the Netherlands found that the occurrence of depressive symptoms in young stroke patients was almost three times higher compared to a healthy control group of the same age (16.8% vs. 6.1%). Approximately twice as many young stroke patients (23.0% > 12.2%) reported anxiety as the control group. Anxiety is quite prevalent and has been linked to poor physical function recovery following a stroke. It can also cause avoidance of regular activities. Stroke survivors are more than twice as likely to experience suicidal thoughts and are three to six times more likely to attempt suicide as compared to the healthy control group (47,48). In comparison to older patients, younger patients report more severe depressive symptoms and fewer functional impairments (49).

## 5. RETURNING TO WORK AFTER STROKE

Resuming employment after experiencing a stroke is a vital factor in determining one's overall contentment with life(50,51) and may even be an essential requirement for many people to financially sustain themselves. In addition to its personal impact on patients, the inability to return to work after a stroke imposes an economic burden on society as a whole. Presently, numerous studies conducted in industrialized nations suggest that between 50% and 80% of individuals who have experienced a stroke are able to resume employment within a minimum of four years following the stroke (52-54). A recent cross-sectional survey conducted in China revealed that the proportion of young individuals who had experienced a stroke and subsequently returned to work was 46.6%.

Among different age groups, males, those with higher monthly income, and those without residual functional impairments had the highest rates of returning to work, with the 30-39 age group having the highest rate of return to work. In the future, it is necessary to strengthen stroke knowledge education, emphasize early rehabilitation training, pay attention to the professional roles and expectations of female patients, and improve their readiness to return to work.

## STRATEGIES FOR IMPROVING THE PROGNOSIS OF YOUNG ISCHEMIC STROKE

The long-term outlook for ischemic stroke in young individuals is unfavorable, and it varies depending on the cause and risk factors of the stroke. Swiftly identifying the cause and risk factors and implementing targeted treatment and initiatives to change risk variables are crucial for improving the prognosis of young stroke patients. The main objectives of treatment for young individuals with ischemic stroke are to lower the risk of death and stroke recurrence, lessen the incidence of long-term sequelae, enhance quality of life, and enable return to employment. Therefore, it is crucial to optimize the targeted strategies of early identification, acute treatment, secondary prevention, and rehabilitation of ischemic stroke in young adults.

Identifying the causes and risk factors for ischemic stroke in young individuals is difficult due to the unusual ways in which strokes present themselves, as well as the wide range of possible causes and risk factors. A comprehensive evaluation, which includes imaging of the brain and blood vessels, testing for abnormal blood clotting, and echocardiography, may frequently pinpoint or limit the possible causes. For patients without a clear etiology, further investigations, such as detection of PFO, screening for monogenic disorders, illicit drugs, acquired and genetic thrombophilia, vasculitis, and cancer, might be necessary to reveal potentially rare causes and risk factors. However, there is a lack of specialized, proven diagnostic methods for young patients.

In addition, the etiologic categorization system schemes, such as the TOAST classification, that are currently in place for stroke patients, particularly those over the age of 65, appear to be inadequate in identifying the underlying causes of stroke in younger individuals. According to the TOAST

classification, a significant proportion of young individuals with ischemic stroke, approximately one-third, are identified as having cryptogenic stroke following a comprehensive clinical evaluation. Furthermore, the existing classification system fails to account for the diverse etiologies and probable pathophysiological mechanisms underlying stroke in patients with several uncommon causes. Consequently, it overlooks the potential variations in long-term outcomes that may arise from different stroke causes. The IPSS study (international pediatric stroke study) developed a special risk factor classification for stroke in children and adolescents (55). According to the IPSS definition of pediatric stroke, risk factors mainly include nine categories: arteriopathy, cardiac disorders, chronic systemic conditions, prothrombotic states, acute systemic disorders, chronic head and neck disorders, acute head and neck disorders, pregnancy-related, and risk factors of atherosclerosis in adulthood. Recent studies have modified and assessed the IPSS classification system schemes to determine the risk factors and potential pathophysiological mechanisms of young ischemic stroke. These studies found that traditional risk factors for stroke are highly prevalent among young adults with a cryptogenic stroke. Of 226 cryptogenic patients, 193 (92.3%) had at least one risk factor for early atherosclerosis (56,57). The IPSS permits the inclusion of many risk factor categories that can overlap with each other. It also acknowledges age-specific putative risk factors and causes that are not accounted for in the TOAST categorization. While a risk factor does not always directly cause a condition, promptly identifying risk factors is a crucial first step in starting treatment and implementing measures to prevent further complications. Additional research should investigate the precise causality of these factors and their prevalence among the general population within the same age group. In the future, we need to establish new classification system schemes and diagnostic algorithms for the etiology and risk factors of young ischemic stroke that are more in line with clinical practice and further validate and optimize them in clinical research.

Intravenous thrombolysis has been shown to enhance adult ischemic stroke patients' prognosis; however, data on its effects on young individuals with ischemic stroke are scarce. Through the analysis of data from the Get with the Guidelines (GWTG) registration, researchers discovered that young patients between the ages of 18 and 40 who suffered

from acute ischemic stroke had a higher likelihood of receiving intravenous tPA treatment compared to older patients. Additionally, these young patients had lower rates of symptomatic intracranial hemorrhage, longer time intervals from arrival to treatment initiation, improved functional outcomes, and lower mortality rates during their hospital stay (58). The findings align with data from other nations, providing evidence of the efficacy and safety of intravenous thrombolysis in young individuals with acute ischemic stroke (25,59,60). Given the rising incidence of ischemic stroke in young individuals, our findings have great significance as they provide evidence for the efficacy and safety of vascular recanalization in young patients in real-world settings. Endovascular thrombectomy (EVT) is the standard of care for anterior circulation acute ischemic stroke (AIS) with large vessel occlusion (LVO). The safety and effectiveness of EVT in young patients with acute ischemic stroke due to LVO remain uncertain, as these patients exhibit unique stroke processes and causes. Recent studies have consistently shown that young patients with acute ischemic stroke due to LVO who receive EVT have higher rates of effective blood flow restoration and typically experience better results compared to older patients (25,25,60,61). Reducing the time it takes to treat young adults with acute stroke is a crucial goal for improving their short-term and long-term outlook. Therefore, future research may need to establish precise recommendations for implementing reperfusion treatment in younger individuals.

Anticipating and averting recurring vascular incidents is of utmost importance for young individuals who have experienced ischemic stroke, given their extended lifespan. However, the secondary prevention of stroke can be difficult due to the diverse underlying causes of the condition. General recommendations should be followed for secondary prevention following strokes brought on by small vessel disease, large artery atherosclerosis, and cardioembolism. Individualized treatment approaches should be considered to prevent recurrent stroke in other rare causes that have been discovered. Significant progress has been achieved in the secondary prevention of stroke in young individuals with various causes, such as the use of transcatheter closure of PFO. Strong evidence for PFO closure in high-risk individuals with cryptogenic ischemic stroke is provided by randomized controlled trials (62). However, there are still some unanswered questions in real-world practice, and the most important

one is how to determine the correlation between stroke and PFO in terms of etiology or mechanism. A recent study revealed notable disparities in the approaches of neurologists and cardiologists regarding the closure of PFO following a stroke, notably in their interpretation of the underlying cause of the stroke. According to a nationwide poll, cardiologists are more inclined than neurologists to endorse the closure of PFO in various scenarios. This highlights the significance of working together and making decisions together, while also presenting a chance for educational outreach by professional societies (63).

Significant advancements have been achieved in the last twenty years in the secondary prevention of ischemic stroke. These include the use of anti-thrombotic medication, statin therapy, and the management of risk factors. Nevertheless, the practical implications of these advancements on therapeutic results, particularly about young patients, have not been extensively investigated in recent years. There have been worries that young patients with ischemic stroke would not get the best care possible. Young patients are more prone to be uninformed about risk factors prior to experiencing an ischemic stroke, receive thrombolytic therapy at a later stage after the stroke, and are less likely to obtain appropriate treatment for the underlying cause and preventive measures. Furthermore, young patients face a dearth of precise guidelines, despite their distinct risk factors and causes, in contrast to older patients (64). Consistent and prolonged use of secondary prevention medicines is essential for attaining treatment objectives. Observational studies suggest that stopping antiplatelet and antihypertensive drugs, as well as not following the prescribed regimen for antihypertensive medications, are linked to higher risks of experiencing another stroke, other vascular events, and mortality (65,66). Roughly 33% of young stroke patients exhibit inconsistent adherence to antihypertensive medicines. Users have decreased death rates and a diminished likelihood of stroke recurrence in comparison to non-users (66). Less than 50% of young individuals with ischemic stroke utilize statins. Statins have been found to be independently linked to a decrease in both overall mortality and the likelihood of stroke recurrence in young individuals (67). Regular multidisciplinary consultations are necessary for young stroke patients to address secondary prevention, prognosis, and the long-term impacts of stroke throughout follow-up.

## CONCLUSION

In recent years, there has been a significant and unbalanced rise in the occurrence of stroke among young adults. Young individuals, being the primary contributors to society and familial obligations, experience the full force of stroke. This not only affects their physical health but also has repercussions on their psychological well-being, economic situation, and relationships within their family. While the short-term prognosis for young stroke patients is relatively favorable, longitudinal outcomes over time are not as optimistic when compared to the general young population and may not be better than those of older stroke patients. Young stroke patients with atherosclerosis, cardioembolism, and other vascular risk factors face a growing threat of death and recurring vascular episodes. During extended periods of observation, it is common for young individuals who have experienced a stroke to face additional negative long-term effects such as epilepsy, cognitive decline, depression, and difficulties in returning to work. Overall, the outlook for young individuals with ischemic stroke in the long term is generally unfavorable, with the specific outcome depending on the cause and risk factors associated with the stroke. Currently, there is a lack of sufficient understanding of young stroke, and there is a need for diagnostic, therapeutic, and rehabilitation management guidelines specifically tailored for young stroke patients. Ongoing large-scale investigations like FUTURE, GOAL, SECRETO, and others are expected to uncover novel risk factors and causes that can explain a substantial fraction of cryptogenic stroke. These studies also aim to enhance our understanding of the factors that impact long-term prognosis, with the ultimate goal of improving patient care.

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## Conflict of Interest Disclosures

The authors declare that the research was conducted in the absence of any potential conflict of interest.

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List of Abbreviations

TIA: transient ischemic attack  
 GBD: Global Burden of Disease  
 MRI: magnetic resonance image  
 CE: cardiac embolism  
 LAA: large arteriolar atherosclerosis  
 SAO: small-arteriole occlusion  
 PFO: patent foramen ovale  
 NIHSS: National Institute of Health Stroke scale  
 mRS: modified Rankin Scale  
 CVD: cardiovascular disease  
 iADL: instrumental activities of daily living  
 IPSS: International Pediatric Stroke Study  
 GWTG: Get with the guidelines  
 EVT: endovascular thrombectomy  
 AIS: acute ischemic stroke  
 LVO: large vessel occlusion  
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