

Cumulative Alcohol Consumption Burden and the Recovery of Stroke in Young Adults

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Received: 01-07-2025 / Revised: 15-08-2025 / Accepted: 21-09-2025

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Conflict of interest: Nil

Abstract

Background: The modifiable risk factor for stroke in young individuals is alcohol use. The relationship between cumulative burden of alcohol, stroke severity, and recovery has not been clarified. This investigation examines the relation between cumulative alcohol use and functional recovery in young adults after acute stroke.

Methods: A cross-sectional analytical study was carried out among 117 alcoholic stroke patients aged 20–45 years at the Neurology Department of TVMCH from August 2023 to December 2024. Stroke severity was measured by NIHSS at admission, and functional recovery was measured by Modified Rankin Scale (MRS) at discharge. Alcohol intake was classified as mild (<105g/week), moderate (105–210g/week), or heavy (>210g/week), and cumulative alcohol burden was estimated for four years. Multivariate logistic regression analysis was used to identify the association between alcohol burden and recovery from stroke.

Results: Those with greater cumulative alcohol burden presented with more severe strokes on admission (NIHSS: mild = 7, moderate = 12, heavy = 19) and poorer functional recovery on discharge (MRS: mild = 2, moderate = 3, heavy = 5). Heavy drinkers had the worst recovery, which suggests a dose-dependent association between alcohol burden and post-stroke disability.

Conclusion: Increased cumulative alcohol use is linked with greater stroke severity and worse recovery in young adults. Lower alcohol consumption may enhance stroke outcomes and prevent long-term neurological deficits. More research is necessary to examine the advantages of alcohol reduction in preventing stroke and recovery.

Keywords: Alcohol Consumption, Stroke Recovery, Young Adults, Cumulative Alcohol Burden, Neurological Outcomes, Stroke Severity.

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Introduction

Stroke is a major cause of disability and death globally, and although it is well recognized as being prevalent in older persons, its frequency in young adults has been increasingly rising. Out of the multiple risk factors involved for stroke in young adults, alcohol use is an important and modifiable risk factor. Heavy drinking has been associated with an increased stroke risk because alcohol affects blood pressure, coagulation, and heart function. Nonetheless, whereas acute alcohol consumption has been established to be causative of stroke, the role of cumulative alcohol burden in stroke recovery is not well understood. Elucidation of this association is crucial for directing clinical management and lifestyle interventions to enhance post-stroke outcome in young adults [1-2]. Stroke-stricken young adults have their own set of

challenges because they are usually in the peak periods of their productive and active years. They are different from older patients, who are likely to be preoccupied with daily work, education, and family obligations, and functional recovery is thus an important component of stroke rehabilitation [3]. Recovery following a stroke depends on a variety of factors such as the intensity of the stroke, availability of rehabilitation facilities, comorbid conditions, and lifestyle factors like alcohol intake. Although there have been studies analyzing the impact of alcohol intake on stroke occurrence, long-term implications of cumulative alcohol burden on recovery following a stroke are not well understood [4-5]. Cumulative alcohol burden is the overall exposure to alcohol over a long period, taking into account both the frequency and amount

of alcohol intake. Chronic alcohol use has been shown to have negative impacts on the central nervous system, which may compromise neuroplasticity and recovery processes after a stroke. Moreover, alcohol-related complications like liver impairment, cardiovascular disease, and immune dysfunction may add to recovery inhibition by heightened systemic inflammation and healing delays. Considering these pathways, it is important to establish whether cumulative alcohol exposure adversely impacts stroke recovery in young adults [6-7].

This research **explores** the correlation between cumulative alcohol burden and recovery from stroke among young adults, filling an essential knowledge gap. Through an analysis of the long-term effects of alcohol use on post-stroke recovery, the results can potentially inform the development of focused interventions for young survivors of stroke. Discovering a possible correlation between alcohol burden and stroke recovery would alert healthcare providers and policymakers to the value of alcohol moderation in stroke rehabilitation planning. Eventually, knowing this relationship may lead to enhanced clinical practice guidelines and lifestyle advice that will help produce better long-term functional outcomes among young adults with a stroke [8].

Methods

Study Design and Population: This study was a cross-sectional analytical study among young adult patients of acute stroke who visited the Neurology Department at TVMCH. The study population included persons between 20 and 45 years of age clinically diagnosed with ischemic stroke or hemorrhagic stroke, and confirmed by CT or MRI imaging. The study specifically included individuals with a history of alcohol consumption, as the primary objective was to assess the association between cumulative alcohol burden and stroke recovery. Patients who were non-alcoholic, as well as those diagnosed with terminal illnesses such as cancer, chronic kidney disease (CKD), chronic liver disease (CLD), chronic obstructive pulmonary disease (COPD) or coronary artery disease (CAD) were excluded from the study.

Study Period and Sampling Method: The study was carried out over a duration from August 2023 to December 2024, collecting data from all the eligible stroke patients who visited the Neurology Department over that period. The study included 117 patients, and the sample size was calculated using statistical formulas. Consecutive sampling was used, and all the eligible patients who satisfied the inclusion criteria were included sequentially as they reported to the hospital over the study period.

Data Collection and Evaluation: All the participants on enrollment went through a detailed clinical evaluation, namely neurological evaluation, and imaging proof by means of CT or MRI. Severity at admission was quantified through clinical scoring instruments and the use of National Institutes of Health Stroke Scale (NIHSS) as well as the Glasgow Coma Scale (GCS). The baseline demographics, clinical parameters, comorbidities like diabetes mellitus as well as hypertension, along with other risk determinants like cigarette smoking were documented.

A standardized alcohol drinking questionnaire was completed by each subject, determining their total alcohol consumption over the previous four years. Patients were divided into three groups according to their mean weekly alcohol intake: mild drinkers (<105 g/week), moderate drinkers (105–210 g/week), and heavy drinkers (>210 g/week). The cumulative alcohol burden score were evaluated by assigning a score of 1, 2 and 3 for mild, moderate and heavy alcohol drinking respectively and by adding the individual scores over the four-year period(4-12). This score was utilized as the main independent variable in analyzing its effect on stroke recovery outcomes.

Outcome Measures and Statistical Analysis: The main outcome of the study was the functional recovery of the study patients at the time of hospital discharge. Neurological recovery was measured using the Modified Rankin Scale (MRS), which gave a standardized assessment of disability and functional independence after a stroke. The relationship between cumulative alcohol burden and stroke outcomes was examined using statistical analyses, such as multivariate logistic regression analysis, to assess whether increased levels of drinking were associated with less favorable outcomes.

Descriptive statistical values like mean, standard deviation, and percentages were utilized to describe patient demographics. Comparative testing using t-tests and likelihood ratio tests was performed to ascertain statistical significance.

Results

Baseline Characteristics: A total of 117 young adults aged 20–45 years with stroke and a history of alcohol consumption were enrolled. The mean age of participants was 36.8 ± 5.4 years, with a male predominance (92 males, 78.6%). Ischemic stroke accounted for 74 cases (63.2%), while hemorrhagic stroke occurred in 43 patients (36.8%). The most frequent neurological deficits at presentation included hemiparesis (47.9%), facial deviation (31.6%), dysarthria (20.5%), and sensory impairment (18.8%). Among comorbidities,

hypertension was most common (42.7%), followed by diabetes mellitus (31.6%) and smoking (29.9%).

Alcohol Consumption Patterns: Based on weekly alcohol intake over the preceding four years, participants were categorized as mild drinkers (<105 g/week; n=40, 34.2%), moderate drinkers (105–210 g/week; n=47, 40.2%), and heavy drinkers (>210 g/week; n=30, 25.6%). The cumulative alcohol burden score, derived from longitudinal exposure, ranged from 4 to 12, with a mean of 7.3 ± 2.1 . Notably, heavy drinkers had disproportionately higher cumulative scores, reflecting sustained and intense alcohol exposure.

Stroke Type and Alcohol Burden: The distribution of stroke types across drinking categories is detailed in Table 1. Ischemic stroke predominated among mild (67.5%) and moderate (65.9%) drinkers, whereas hemorrhagic stroke was more frequent among heavy drinkers (46.7%).

This trend suggests that higher alcohol burden may predispose to hemorrhagic pathology, consistent with alcohol's hypertensive and coagulopathic effects.

Stroke Severity at Admission: Stroke severity, measured by NIHSS, showed clear stratification by alcohol category. Mild drinkers had predominantly mild-to-moderate deficits (80% NIHSS <15), whereas 56.7% of heavy drinkers presented with NIHSS ≥ 16 . A statistically significant linear association was observed between cumulative alcohol burden and NIHSS ($p < 0.01$). Mean admission NIHSS scores were 7.2 for mild drinkers, 12.1 for moderate drinkers, and 18.9 for

heavy drinkers, indicating progressively greater severity with increased alcohol exposure.

Functional Outcomes at Discharge: Functional recovery, evaluated by the modified Rankin Scale (mRS) at discharge, also differed across groups (Table 2). Good recovery (mRS 0–2) was achieved by 55% of mild drinkers, but only 20% of heavy drinkers. Conversely, severe disability (mRS 4–5) was present in 64.3% of heavy drinkers, compared with 27.5% of mild drinkers. Multivariate logistic regression analysis confirmed cumulative alcohol burden as an independent predictor of poor outcome ($\beta = 0.42$, $p < 0.01$) after adjustment for age, sex, and comorbidities.

Correlation Analysis

Pearson's correlation demonstrated a strong positive relationship between cumulative alcohol burden and admission NIHSS ($r = 0.46$, $p < 0.001$) as well as discharge mRS ($r = 0.44$, $p = 0.002$). Graphical analysis further illustrated these trends:

- **Figure 3:** NIHSS scores increased proportionally with cumulative alcohol burden.
- **Figure 4:** The proportion of patients with severe disability (mRS ≥ 4) rose sharply among heavy drinkers.

Hospital Stay and Recovery Trajectory: Heavy drinker's also experienced longer hospital stays (mean 12.3 ± 3.7 days) compared to mild drinkers (8.1 ± 2.5 days). These findings underscore the impact of cumulative alcohol exposure not only on neurological deficits but also on healthcare utilization and rehabilitation trajectory.

Table 1: Distribution of Study Participants Based on Alcohol Consumption and Stroke Type

Stroke Type	Mild Drinker(n=40)	Moderate Drinker(n=47)	Heavy Drinker(n=30)	Total (n=117)
Ischemic Stroke	27 (67.5%)	31 (65.9%)	16 (53.3%)	74 (63.2%)
Hemorrhagic Stroke	13 (32.5%)	16 (34.1%)	14 (46.7%)	43 (36.8%)

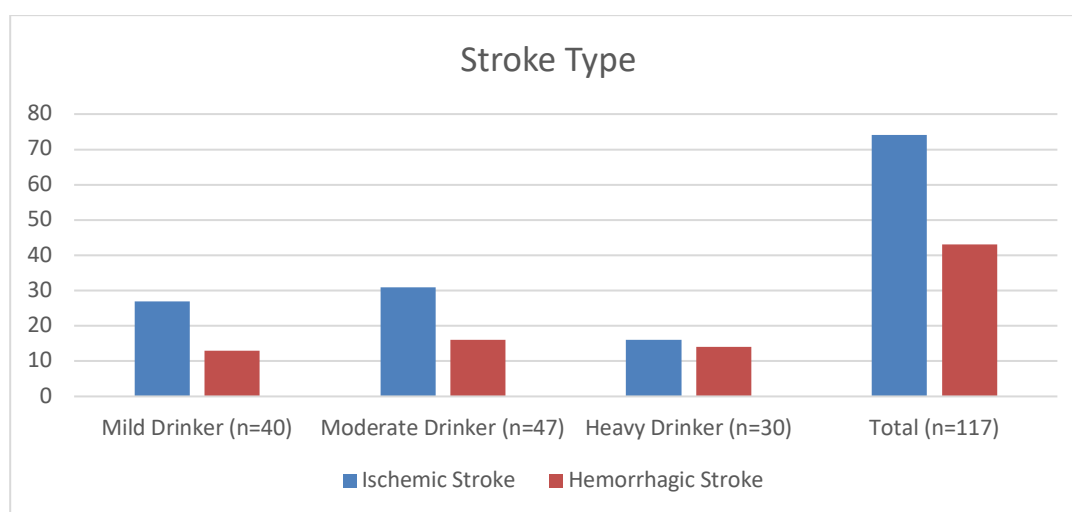


Figure 1: Stroke Type

Table 2: NIHSS Score at Admission and MRS Score at Discharge According to Alcohol Consumption

Alcohol Consumption	NIHSS <5	NIHSS 5-15	NIHSS 16-25	NIHSS >25	MRS 1-2	MRS 3	MRS 4-5
Mild Drinker	14 (35.0%)	18 (45.0%)	7 (17.5%)	1 (2.5%)	22 (55.0%)	7 (17.5%)	11 (27.5%)
Moderate Drinker	9 (19.1%)	22 (46.8%)	12 (25.5%)	4 (8.5%)	14 (29.8%)	13 (27.7%)	20 (42.6%)
Heavy Drinker	3 (10.0%)	10 (33.3%)	12 (40.0%)	5 (16.7%)	6 (20.0%)	5 (16.7%)	19 (64.3%)

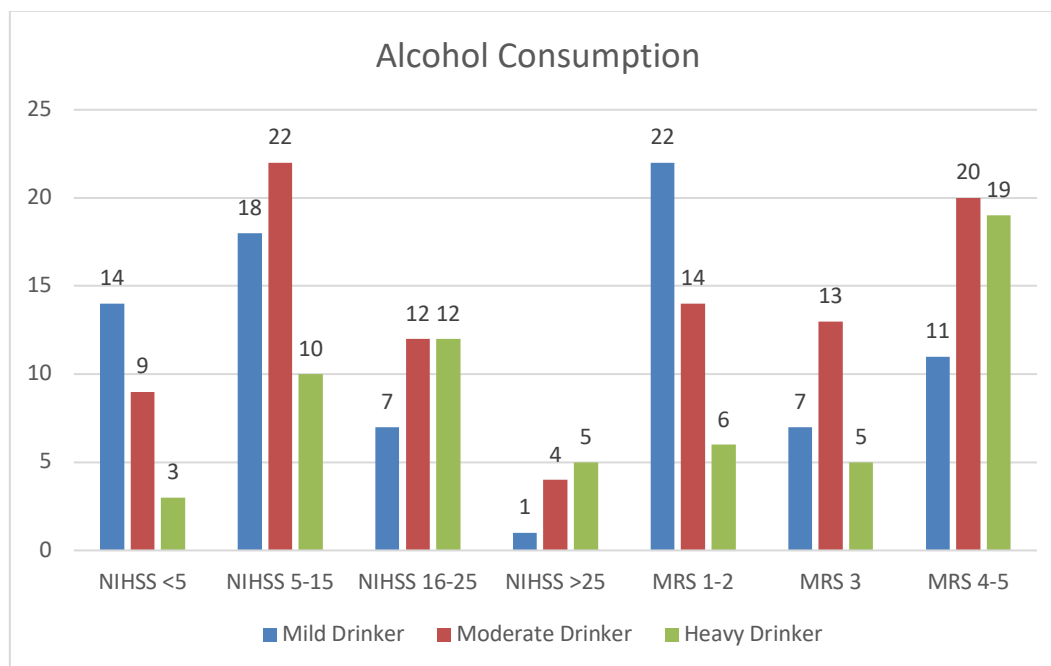
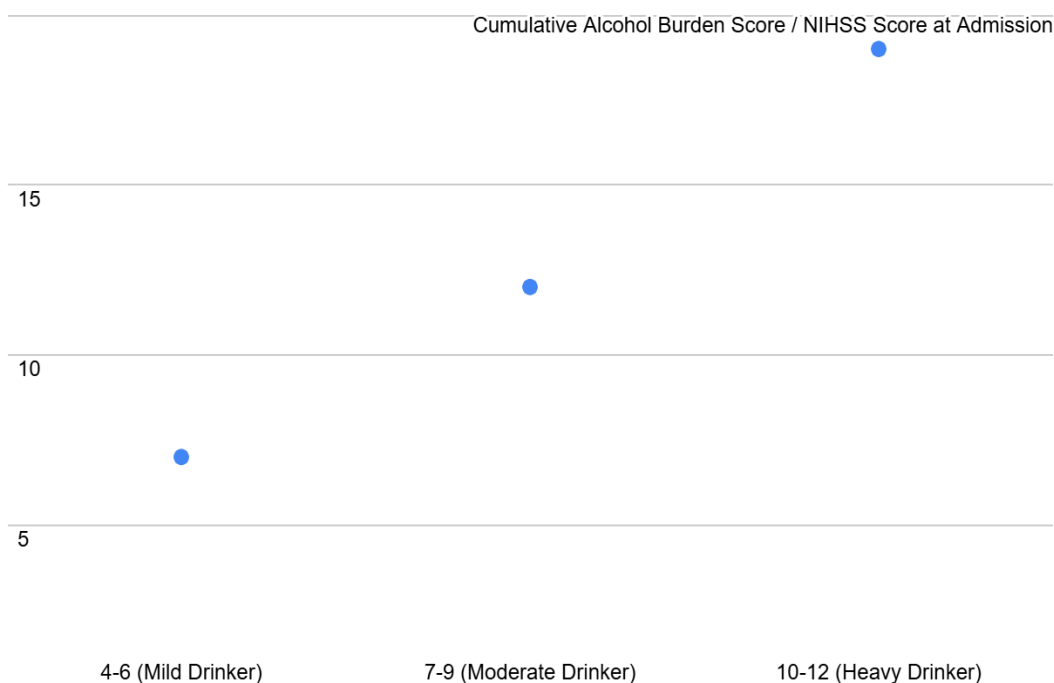
**Figure 2: Alcohol Consumption****Figure 3: Correlation between Cumulative Alcohol Burden and NIHSS Score on Admission**

Figure 3 shows the positive correlation between the cumulative alcohol burden score and NIHSS on admission, showing greater stroke severity in heavy drinkers.

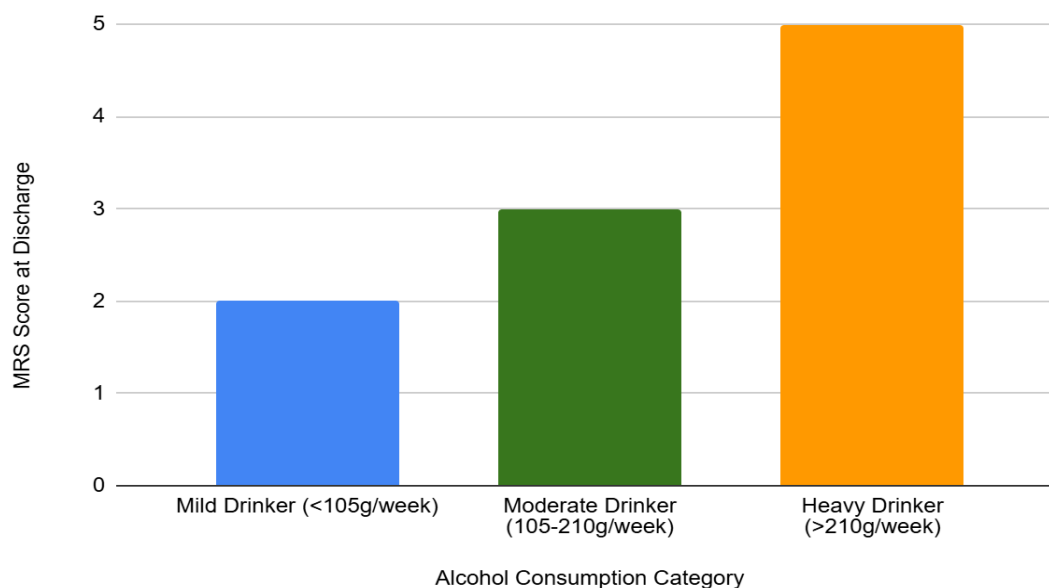


Figure 4: Distribution of MRS Scores at Discharge According to Alcohol Consumption

Figure 4 shows the percentage of patients in each alcohol use category with mild, moderate, and severe disability at discharge, emphasizing the worse recovery outcomes for heavy drinkers.

The results from the study implied that young adults with a high cumulative burden of alcohol had higher severity strokes upon admission and more impaired functional improvement upon discharge. Heavy drinkers most likely experienced meaningful disability after a stroke, focusing on the ill effects of heavy alcohol intake in stroke recovery. The findings underline the necessity to implement targeted measures to curtail alcohol use in young adults susceptible to stroke so as to advance recovery outcomes.

Discussion

The current study examined the relation between cumulative alcohol burden and recovery from stroke among young adults. Our results indicate that patients with a greater cumulative alcohol burden have more severe strokes on admission and have poorer functional recovery on discharge. Our findings are consistent with earlier research showing harmful effects of chronic alcohol use on stroke risk and stroke outcomes.

Chung et al. (2023) had a population-based large-scale study to investigate the association of cumulative alcohol use and stroke risk in young adults. In their findings, they revealed that heavy drinking had a significant raising of ischemic and hemorrhagic stroke risk, which was dose-dependent. Likewise, our research identified that those with a greater cumulative alcohol burden were at greater risk of having severe stroke, reflected by their greater NIHSS scores upon admission. These results highlight the significance

of chronic alcohol use patterns over acute consumption in predicting stroke risk and recovery prognosis (Chung et al., 2023) [9].

The effects of alcohol on cardiovascular and cerebrovascular well-being have been extensively discussed. While others, like Song et al. (2023) [12], have put forth the contention that moderate consumption can be a protective factor with regard to stroke, our experience supports the latter authors' assertion. Jeong et al. (2022) [13], for instance, showed how altered alcohol drinking habits, or rather an elevation of consumption level over time, are linked with ischemic stroke. Our research extends this evidence further by demonstrating that cumulative alcohol burden not only affects stroke severity but also adversely affects post-stroke recovery, supporting the necessity for long-term behavioral changes.

Consumption of alcohol is recognized to affect stroke pathophysiology via several mechanisms such as elevated blood pressure, atrial fibrillation, and endothelial dysfunction. Han et al. (2022) [10] showed that regular alcohol consumption was an independent risk factor for atrial fibrillation among young adults, which is further an independent predictor of cardioembolic stroke. In our study, heavier drinkers had poorer functional outcomes, with the presumed compounded effect of alcohol on stroke severity as well as on attendant cardiovascular comorbidities. Also, a study conducted by Liu et al. (2023) [15] in China illustrated a strong positive correlation between alcohol use and stroke incidence, again validating our results. Interventions aimed at lowering alcohol consumption have been found to be associated with favorable cardiovascular outcomes. Kang et al. (2024) [11] reported that patients whose previously

high alcohol consumption was lowered had significantly less likelihood of major adverse cardiovascular events. This suggests that early intervention is crucial in the alteration of alcohol drinking patterns to enhance stroke prognosis.

Our findings lend support to this argument by illustrating that cumulative alcohol burden is related to poor recovery from stroke, indicating that interventions aimed at limiting alcohol intake may be pivotal in enhancing outcomes after stroke among young adults.

Yang et al. (2021) [14] investigated if there are favorable drinking habits and concluded that moderate drinking has the potential to risk ischemic stroke. This concurs with our study, wherein moderate drinkers have poorer recovery profiles compared to mild drinkers, although better than that of heavy drinkers. Although some research has pointed towards possible cardiovascular protective effects of low-to-moderate alcohol use, our findings show that cumulative exposure is associated with worse neurological recovery, and thus caution must be exercised in the interpretation of such benefits.

Our study overall points towards the significant relationship between cumulative alcohol burden and stroke severity and recovery among young adults. It corroborates existing literature showing that chronic alcohol use elevates stroke risk and results in worse outcomes. Notably, it also highlights the necessity for intervention specifically aimed at lowering alcohol consumption, especially among young adults who may not be fully aware of the long-term cerebrovascular impact of their patterns of alcohol use. Longitudinal interventions should be studied in the future to determine if decreasing cumulative alcohol burden can prominently enhance post-stroke recovery as well as overall neurological outcomes.

Conclusion

This research illustrates a robust positive correlation between cumulative burden of alcohol use and stroke severity and recovery in young adults. Increased cumulative alcohol consumption was associated with greater stroke severity upon admission and worse functional outcomes at discharge, consistent with alcohol's long-term effects on cerebrovascular disease. These results concur with prior studies, further supporting the theory that chronic alcohol use increases stroke severity and inhibits recovery. With the rising trend of alcohol use among young adults, specific interventions to curtail alcohol consumption may hold great promise in limiting stroke severity and enhancing post-stroke recovery. More longitudinal research would be encouraged to examine the value

of measures to lower alcohol use in improving neurological outcomes among this group.

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