Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2022 Jun 12; 10(E):1024-1028.
https://doi.org/10.3889/oamjms.2022.9943
eISSN: 1857-9655
Category: *E - Public Health*
Section: *Public Health Epidemiology*

Predictive Estimations for Patients Who Have Suffered From Acute Cerebrovascular Accident and Have Undergone Rehabilitation

Guljakhan Abilova*, Vitaly Kamkhen, Zhanna Kalmatayeva

Department of Epidemiology, Biostatistics and Evidence-based Medicine, Faculty of Medicine and Health Care, Al–Farabi Kazakh National University, Almaty, Kazakhstan

Edited by: Sasho Stoleski
Citation: Abilova G, Kamkhen V, Kalmatayeva Z. Predictive Estimations for Patients Who Have Suffered From Acute Cerebrovascular Accident and Have Undergone Rehabilitation. Open Access Maced J Med Sci. 2022 Jun 12; 10(E):1024-1028. https://doi.org/10.3889/oamjms.2022.9943
Keywords: Survival; Stroke; Medical rehabilitation; Almaty; Kazakhstan
***Correspondence:** Guljakhan Abilova, Al–Farabi Kazakh National University, Almaty, Kazakhstan. E-mail: dr.abilova@mail.ru
Received: 24-Apr-2022
Revised: 12-May-2022
Accepted: 02-Jun-2022

Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Acute cerebral circulation disorder is known to be one of the main causes of morbidity, mortality, long-term disability, and the overall so-called disability in society. Prevention of acute cerebral circulation disorder, mortality after acute cerebral circulation disorder, methods of rehabilitation after acute cerebral circulation disorder are studied all over the world, but there are so few studies in the literature on the relationship between rehabilitation and survival of patients after acute cerebral circulation disorder.

AIM: The aim is to study the features of survival among patients who have suffered from acute cerebral circulation disorder (hereinafter referred to as ACCD) and have undergone rehabilitation.

METHODS: Based on the register statistics on cases of acute cerebral circulation disorder among Almaty residents, the association of the fact of rehabilitation with a fatal outcome was studied and a survival analysis was performed using the Kaplan-Meyer method.

RESULTS: In patients with acute cerebral circulation disorder who have not undergone rehabilitation, the chances of a fatal outcome increase by 3.830 times, in comparison with patients who have received an appropriate course of recovery. With the postponement of rehabilitation, the probability of death in patients with acute cerebral circulation disorder increased by 6−10%. The average survival rates in patients who did not receive a rehabilitation course are significantly lower compared to those who underwent rehabilitation: the average survival was 87 years (CI95% 87.0−87.0) and 82 years (CI95% 80.3 ÷ 83.7), respectively, (Log-rank test: test statistics χ^2 = 7.916, for DF = 1, p = 0.005).

CONCLUSIONS: The main conclusion that can be drawn is that the early rehabilitation care increases the probability of survival among patients who have undergone ACCD. At the same time, the predictive parameters of an unfavorable outcome are the sexual characteristic and the type of acute cerebral circulation disorder.

Introduction

It is known that life expectancy is one of the main parameters of the state's level of development, which depends on a large number of social, economic, biological, natural, and environmental causes [1], [2]. The survival rate (by constructing survival tables and/or by the Kaplan-Mayer method) used in medical research to assess the life expectancy of patients after treatment (including restorative treatment) is an indicator of the quality of the public health system [3], [4]. It should be noted that the survival rate varies significantly depending on the nosological forms and some aspects, mainly of an organizational nature [5], [6].

An important task of public health is to monitor (to find optimal management) the survival rates of the main causes leading to high mortality, among which acute cerebral circulatory disorders occupy one of the leading positions [7].

The prevalence of stroke worldwide is growing annually, both in economically developed and developing countries, and according to the "Heart Disease and Stroke Statistics-2016 Update" from the American Heart Association, 33 million people, with 16.9 million. These are the first established cases ACCD, which of them 5.2 million are under the age of 65 [8].

Along with this, ACCD is one of the most common causes of disability and mortality worldwide [9]. According to the results of recent studies ("Global Burden of Diseases, injuries and risk factors (GBD 2015)"), a "shift" in mortality from infectious diseases, maternal, and nutritional causes to non-communicable diseases, such as cancer, has been revealed. This effect is probably caused by the increase and aging of the world's population in recent decades [10].

For no other reason do so many people die every year as from cardiovascular diseases (hereinafter referred to as CVD) and currently ACCD is the second leading cause of death worldwide [11]. By estimation 17.9 million people died from CVD in 2016, it is 31% of all deaths worldwide. About 85% of these deaths occurred as a result of a heart attack and ACCD [12].

According to the official statistics of the Ministry of Health of the Republic of Kazakhstan, more than 40 thousand cases of ACCD are registered annually in the country, among them only 5 thousand die in the first 10 days and another 5 thousand within 1 month after discharge at home [13]. The incidence of ACCD in various regions of the country ranges from 2.5 to 3.7 cases per 1000 people per year, and mortality from 100 to 180 cases per 100,000 people. ACCD is the main cause of disability in Kazakhstan and made up 104.6 per 100,000 population [14].

Hence, according to the official data with the Republican center for health development (RCHD) for the period from January 1, 2014, to December 31, 2021, in Almaty there were 37616 cases of acute disorders of cerebral circulation, including in children that have been classified by the International classification of diseases 10th revision (hereinafter, ICD 10).

According to the percentage of occurrence of ischemic (I63), hemorrhagic (I60, I61, and I62) and unspecified stroke (I64), the difference was 81.2%, 18.1%, and 0.7%, respectively. At the same time, 9% of repeated cases of stroke were detected. There is also an increase in brain infarction caused by cerebral artery thrombosis (I63.3) and a decrease in the number of other brain infarctions (I63.8) [15].

There are a sufficient number of scientific works in the modern literature on estimations of the population survival in different countries [16], including the estimation of the survival of patients with ACCD [17], [18], but at the same time, there is a shortage of scientific works on the study of survival among the cohort of patients with ACCD who have undergone rehabilitation. The above has determined the relevance of this study, the purpose of which was to study the features of survival among patients who underwent ACCD and underwent rehabilitation.

Materials and Methods

A retrospective study with descriptive and analytical statistics was used as a basic method.

The main source of information was the official data of the GCP at the Municipal Clinical Hospital No.7 of the Department of Public Health of the City of Almaty about the cured cases of ACCD for the 1st half of 2020. In general, 928 cases were analyzed during the study period. According to the accumulated statistical data (register data), it was possible to include the following features (variables) in the analysis: By gender, taking into account the diagnosis of ACCD and the fact of rehabilitation.

The associative relationship of the fact of rehabilitation with the studied outcome was evaluated using Pearson's Chi-square criterion and the odds ratio indicator.

The main subject of the survival analysis was indicators: Average survival time, median survival time, survival function, etc. The Kaplan-Meyer method was used to perform the analysis. Time variables are age (age survival) and the time between discharge from the stroke department and rehabilitation. The studied outcome is mortality cases. The Log Rank statistical criterion was used for a comparative assessment of survival in the groups. The null hypothesis (about the absence of differences) was accepted at $p > 0.05$.

For average indicators (including relative ones), the standard error of the mean and/or confidence interval was calculated.

Microsoft Excel and the IBM SPSS Statistics package served as a tool for statistical processing of the data obtained.

Results

The incidence of ischemic stroke in the study sample was 824 cases (or 88.8 ± 1.04%), and hemorrhagic stroke was 104 cases (or 11.2 ± 1.04%). Primary ACCD was observed in 593 cases (or 63.9 ± 1.58%), and recurrences were in 335 cases (or 36.1 ± 1.58%). 312 cases (or 33.6 ± 1.55%) after the rehabilitation stage and 616 cases (or 66.4 ± 1.55%) of non-rehabilitation were registered. At the same time, the frequency of rehabilitation among patients with hemorrhagic stroke is slightly higher compared to patients with ischemic stroke (47.1 ± 4.89% and 31.9 ± 1.62%, respectively). Out of the total number of observations, 135 cases with a fatal outcome (or 14.5 ± 1.16%) were noted: 122 cases from ischemic stroke and 13 cases from hemorrhagic stroke.

The association of the fact of rehabilitation with the studied outcome is analyzed (Table 1). It was found that patients with ACCD who have not undergone rehabilitation have 3.830 times (in some cases 6.421 times) increased the chances of death, compared with patients who received the appropriate course of recovery. The proportion of deaths among

Table 1: Initial data of patients, taking into account gender and type of stroke, who underwent and did not undergo rehabilitation

	Status		RS	Pearson's Chi-square
	"Died"	"Alive"		
Total (n = 928)				
Rehabilitation "-"	117	499	3.830 (2.284÷6.421)	$\chi^2 = 29.135$,
Rehabilitation "+"	18	294		$p \le 0.001$
Males (n = 483)				
Rehabilitation "-"	65	240	3.173 (1.723÷5.843)	$\chi^2 = 14.855$,
Rehabilitation "+"	14	164		$p \le 0.001$
Females (n = 445)				
Rehabilitation "-"	52	259	3.830 (2.284÷6.421)	$\chi^2 = 16.060$,
Rehabilitation "+"	4	130		$p \le 0.001$
Ischemic stroke (n = 824)				
Rehabilitation "-"	108	453	4.240 (2.379÷7.557)	$\chi^2 = 27.538$,
Rehabilitation "+"	14	249		$p \le 0.001$
Hemorrhagic stroke (n = 104)				
Rehabilitation "-"	9	46	2.201 (0.632÷7.663)	$\chi^2 = 1.593$,
Rehabilitation "+"	4	45		$p = 0.207$

patients who underwent and did not have rehabilitation was 5.8 ± 1.32% and 19.0 ± 1.58%, respectively.

In the male and female totality, the fact of undergoing rehabilitation (rehabilitation "+" or "-") is associated with the outcome (the status of "dead" or the status of "alive"). Chi-square criterion statistics: in the male group, χ^2 = 29.135, p ≤ 0.001, in the female group, χ^2 = 16.060, p ≤ 0.001.

In patients with ischemic stroke, the studied outcome is also associated with the fact of rehabilitation (22 = 27.538, p ≤ 0.001), and in the group of patients with hemorrhagic stroke, there was no statistically significant relationship between the outcome and the fact of rehabilitation (χ^2 = 1.593, p = 0.207). 7.538, p ≤ 0.001), and in the group of patients with hemorrhagic stroke, there was no statistically significant relationship between the outcome and the fact of rehabilitation (χ^2 = 1.593, p = 0.207).

The analysis of age survival was performed. The average survival rates were determined. It was found that the average survival time among patients who did not receive a rehabilitation course is significantly less in comparison with those who underwent rehabilitation: 80 years (CI95% 79.3−81.5) versus 84 years (CI95% 82.2−85.3), respectively. Median survival was 82 years (CI95% 80.3÷83.7) in patients who have not undergone rehabilitation and are 87 years old (CI95% 87.0÷87.0) in patients who have undergone rehabilitation. Differences in survival are visualized on the graph (Figure 1) and confirmed by the results of the Log Rank test: test statistics χ^2 = 7.916, df = 1, p = 0.005.

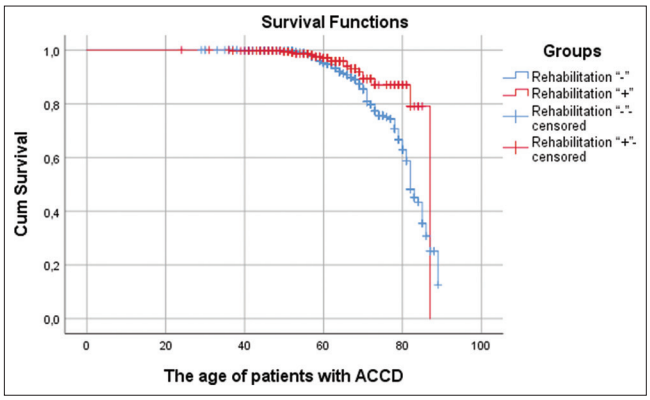

Figure 1: The age of patients with ACCD

The average survival rates in stratified populations were also determined: by gender, taking into account the diagnosis and type of ACCD.

The median survival time for men who did not undergo rehabilitation was at the age of 82 (CI95% 79.7−84.3), for women who did not undergo rehabilitation at the age of 85 [CI95% 82.2−87.8]. Differences in survival are statistically significant: test Log Rank χ^2 = 9.875, df = 1, p = 0.002.

In the cohort of patients who did not undergo rehabilitation for hemorrhagic stroke, the median survival time was at the age of 82 [CI95% 80.8 ÷ 83.2], in the cohort of non–rehabilitated patients with ischemic stroke at the age of 82 [CI95% 80.1÷83.9], without significant differences (test Log Rank χ^2 = 0.000, df = 1, p = 0.995).

In patients who did not undergo rehabilitation with primary ACCD, the median survival time was at the age of 83 [CI95% 81.3÷84.7], in patients who did not undergo rehabilitation for repeated ACCD, the median survival time was at the age of 80 [CI95% 78.0 ÷ 82.0]. The differences in survival are significant: The test Logarithmic rank χ^2 = 6.336, df = 1, p = 0.012.

Along with the analysis of age-related survival, the probabilities of the onset of the outcome under study were assessed, taking into account the time spent by patients with ACCD on rehabilitation (the time between discharge from the stroke department and rehabilitation). It was found that with the prolongation of rehabilitation, the probability not to have a fatal outcome (cumulative survival) decreased (Figure 2). Thus, with a delay in rehabilitation for 1 month, the probability of a fatal outcome in patients with ACCD increased by 6%; postponing rehabilitation for 2 months increased the probability of death by 8%, and postponing rehabilitation for 3 months or more increased the probability of getting a fatal outcome by 10%.

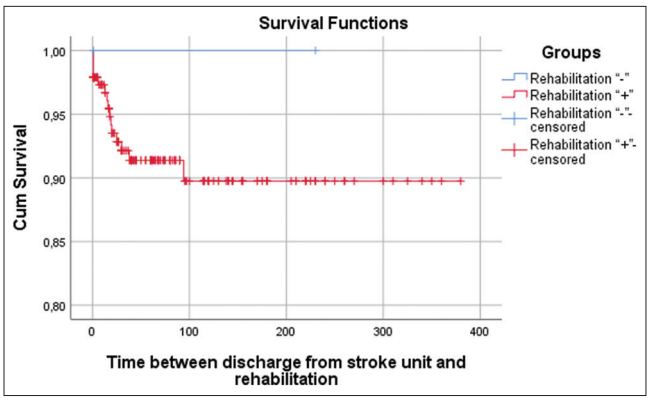

Figure 2: Time betwee discharge from stroke unit and rehabilitation

Discussion

In modern conditions, a significant transformation of "established" trends in the population is possible. First of all, it may affect the survival processes that are associated with the full course of rehabilitation treatment.

It is known that the share of ischemic stroke accounts for a greater percentage of prevalence in the population compared to hemorrhagic stroke, and according to the study, we can observe such a pattern. In our study, we found that ischemic stroke is about 8 times more common than hemorrhagic stroke. There

is fairly high level of not only primary stroke, but also recurrent, which is about 1/3 of all analyzed cases.

Attention is drawn to the results obtained during the study to assess the associative relationship of the fact of rehabilitation (rehabilitation "+" or "-") with the outcome (status "dead" or status "alive"). It was found that an unfavorable outcome is more characteristic for patients who have not undergone a course of rehabilitation treatment. At the same time, in this group of patients, the chances of having a fatal outcome are 3.830 times (in some cases, 6.421 times) higher than in patients who have undergone medical rehabilitation. It should be noted that this phenomenon is typical for both male and female cohorts, as well as for patients diagnosed with ischemic stroke. In patients with hemorrhagic stroke, the association of the fact of medical rehabilitation and death was not revealed.

There is a significant difference in the average (4 years) and median (5 years) survival time between patients who have undergone rehabilitation and those who have not, which, in our opinion, is the main prognostic factor of an unfavorable outcome.

There were significant differences in the survival rate of patients who did not undergo rehabilitation in groups by gender and type of ACCD. At the same time, survival is slightly lower among men and patients with primary ACCD, which is also a predictor of the outcome being studied.

Furthermore, we can trace the link between the fatal outcome after ACCD and the time of rehabilitation, which makes us think not only about the importance of receiving rehabilitation assistance, but also about its timeliness, about early post-stroke rehabilitation.

Summing up the above, it is necessary to note the possibilities of applying the results of this study and some of its weaknesses. We hope that the original research results we have obtained will serve as a starting point for further scientific research in this direction and will be able to have a certain impact on the formation of regional health policy on improving medical rehabilitation. The "weak" aspect in this study, in our opinion, is a certain limitation in the materials presented in the statistical register, which makes it difficult to conduct a larger study with the inclusion of more predictors in the analysis.

Conclusion

Thus, based on the data obtained in the course of our study, it can be concluded that the passage of timely early rehabilitation care increases the probability of survival among patients who have undergone ACCD. At the same time, the predictive parameters of an unfavorable outcome are the sexual characteristic and the type of ACCD (primary, recurrent).

References

1. Novoselova EN. Main factors of megalopolis citizens' life expectancy (example of Moscow). Moscow State University Bulletin. Series 18. Sociol Political Sci. 2016;22(2):176-200. https://doi.org/10.24290/1029-3736-2016-22-2-176-200
2. Zvezdina N, Ivanova L. Life expectancy in Russia and its underlying factors. Voprosy Statistiki. 2015;7:10-20. https://doi.org/10.34023/2313-6383-2015-0-7-10-20
3. Rumyantsev PO, Saenko VA, Rumyantseva UV, Chekin SY. Statistical methods for the analyses in clinical practice. Part 2. Survival analysis and multivariate statistics. Probl Endocrinol (Mosk). 2009;55(6):48-56. https://doi.org/10.14341/probl200955648-56

   PMid:31569892
4. Sharashova EE, Kholmatova KK, Gorbatova MA, Grjibovski AM. Survival analysis in health sciences using SPSS software. Nauka I Zdravookhranenie. Sci Healthc. 2017;5:5-28.
5. Bernhardt J, Dewey H, Collier J, Thrift A, Donnan G. Very early rehabilitation trial (AVERT): Phase II safety and feasibility. Stroke. 2008;39(2):390-6. https://doi.org/10.1161/STROKEAHA.107.492363

   PMid:18174489
6. Kovalchuk VV, Gusev AO, Minnullin, KV. Nesterin. Post-Stroke Rehabilitation. Efficacy Criteria and Success Factors: A role of physical, neuropsychological and drug therapy. Effect Pharmacother. 2017;19:62-72.
7. Denisova EV, Topical issues in epidemiology of brain vascular diseases in the world. Denisova EV, Bulletin of Public Health and Health care of the Russian Far East. 2011;3S:8-15.
8. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, *et al*. Heart disease and stroke statistics-2016 update: A report from the American heart association. Circulation. 2016;133(4):e38-360. https://doi.org/10.1161/CIR.0000000000000350

   PMid:26673558
9. Donnan G, Fisher M, Macleod M, Davis S. Stroke. Lancet. 2008;371(9624):1612-23. https://doi.org/10.1016/S0140-6736(08)60694-7

   PMid:18468545
10. Mortality GBD; GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: A systematic analysis for the global burden of disease study 2015. Lancet. 2016;388(10053):1459-544. https://doi.org/10.1016/S0140-6736(16)31012-1

    PMid:27733282
11. Group GBDNDC; GBD 2015 Neurological Disorders Collaborator Group. Global, regional, and national burden of neurological disorders during 1990-2015: A systematic analysis for the global burden of disease study 2015. Lancet Neurol. 2017;16(11):877-97. https://doi.org/10.1016/S1474-4422(17)30299-5
12. World Health Organization. Newsletters Cardiovascular Diseases. Geneva: World Health Organization; 2017. Available from: https://www.who.int/ru/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)# [Last accessed on 201 Oct

25].

13. Akshulakov SK, Adilbekov YB, Akhmetzhanova ZB, Medukhanova ZG. Organization and current condition of the stroke service of the Republic of Kazakhstan in 2016. J Neurosurg Neurol Kazakhsta. 2018;1(50):31-5.
14. Zhusupova AS. Stroke is a global problem of domestic neurology. Human Med. 2011;3:6-9.
15. Abilova GT, Mlik SH, Mukhitova MR, Kapanova G, Kalmatayeva ZH. Epidemiological data of acute infringement of brain blood circulation in the city of Almaty. J Life Health Sci. 2020;1:70-5. https://doi.org/10.24411/1995-5871-2020-10068
16. GBD 2019 Stroke Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990-2019: A systematic analysis for the global burden of disease study 2019. Lancent Neurol. 2021;20(10):795-820. https://doi.org/10.1016/S1474-4422(21)00252-0

    PMid:34487721
17. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, *et al* Heart disease and stroke statistics-2020 update: A report from the American heart association. Circulation. 2020;141(9):e139-596. https://doi.org/10.1161/CIR.0000000000000757

    PMid:31992061
18. Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, *et al.* Guidelines for adult stroke rehabilitation and recovery: A guideline for healthcare professionals from the American heart association/American Stroke association. Stroke. 2016;47(6):e98-169. https://doi.org/10.1161/STR.0000000000000098

    PMid:27145936