Central Asian Journal of Medical Sciences
CAJMS
Original Article
Cent Asian J Med Sci. 2020 September;6(3):151-158. https://doi.org/10.24079/CAJMS.2020.09.006

The Effectiveness of Long-Term Rehabilitation Treatment After Stroke

Batchimeg Shirmen[1], Batgerel Oidov[3], Narantsetseg Tsegmid[1], Batzorig Bayartsogt[4], Tsagaankhuu Guntev[2], Baljinnyam Avirmed[1]

[1]Department of Rehabilitation, School of Medicine, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; [2]Department of Neurology, School of Medicine, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; [3]Department of Administration, Third State Central Hospital, Ulaanbaatar, Mongolia; [4]Department of Epidemiology and Biostatistics, School of Public Health, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia

Submitted: May 27, 2020
Revised: Aprel 06, 2020
Accepted: September 16, 2020

Corresponding Author
Baljinnyam Avirmed MD, PhD
Associate Professor
Department of Rehabilitation Medicine, School of Medicine, Mongolian National University of Medical Sciences
Ulaanbaatar, 13270, Mongolia

Tel: +976-99128860
E-mail: baljinnyam.a@mnums.edu.mn

Objectives: Stroke is the leading cause of long-term disability. Therefore, we studied the effects of comprehensive long-term rehabilitation after stroke in improving the quality of life. **Methods:** Participants were compared in an experimental intervention model, with 120 control subjects, which received conventional short-stay inpatient hospitalization rehab, with 105 study subjects who received comprehensive rehabilitation program using the Guidelines for Adult Stroke Rehabilitation and Recovery from the American Heart Association/American Stroke Association starting in the hospital and extending for 6 months. The effects of rehabilitation were assessed Modified Rankin Scale (mRS), Functional Independence Measure (FIM), Barthel Index (BI) methods at admission, discharge, and 3 and 6 months after discharge. **Results:** There was no significant difference in the NIHSS, mRS, BI, and FIM scores between study and control patients at admission ($p > 0.05$). For the mRS, BI, and FIM scores, there was a significant interaction between treatment and time, indicating that the scores improved more rapidly for patients in the study group than the control group over the six-month study period ($p < 0.001$). A significant improvement in the scores with time was observed in the study and control groups at each time interval ($p < 0.001$). However, by 3 months after discharge the mRS, BI, and FIM scores of the study group were significantly better than the control group and the gap widened at 6 months, indicating further improvement. **Conclusions:** We found that providing prolonged by a multidisciplinary rehabilitation team results in higher functional independence and improvements in daily living activities.

Keywords: Stroke Rehabilitation, Activities of Daily Living, Patient Care, Mongolia.

Introduction

Stroke is a leading cause of severe and long-term disability and one of the most common causes of prolonged detrimental effects on the patients' physical, mental, social and financial performance deterioration and often on their family and friends [1]. Despite significant advances in detecting stroke causes, risk factors and stroke prevention strategies, many unanswered questions remain concerning the treatment issues. Worldwide 17 million people suffer a stroke each year. Of these, 10% of stroke survivors recover entirely, 15% die, 25% are partially disabled, 40% suffer mild to moderate disability, and 10% are left permanently disabled and should be provided institutional nursing care [2].

In England, there are 1.2 million people who suffer a stroke annually, of whom at least 300,000 survivors live with moderate to severe disability [3]. Stroke is the leading cause of disability in the United States and throughout the world [4]. Although stroke increases exponentially with age, a stroke occurs in 13 per 100,000 children, making 26% of stroke survivors under 65 [3, 5]. The latest WHO data revealed that the age-adjusted death rate from stroke reached 16,606 per 100,000 populations in Mongolia, giving Mongolia the third-highest rate globally. Moreover, yearly statistical reports on morbidity and mortality in Mongolia show that young adults account for approximately 20-26% of all stroke patients than 10-13% in Western countries [6]. The main reasons for the high incidence of stroke in Mongolia are animal-based diet, alcohol, and cigarettes. It has been reported that 14.0-18.4% of Mongolians over 18 years of age are obese, which is relatively high than other Asian populations [6].

Stroke is generally classified into hemorrhagic and ischemic. It has been shown that the international incidence ratio of these two types of stroke is 1:4, while the domestic rate is 1.5:1 in Mongolia. Hemorrhagic stroke is the most lethal form of stroke and typically requires a long rehabilitation with permanent care [6]. According to many randomized controlled trials conducted in many countries, hospitalization of stroke patients in specialized stroke centers is critical in reducing mortality and the risk of dependence on caregivers in the short and long term [7]. Numerous randomized controlled trials emphasize the effectiveness of early discharge and long-term continuous rehabilitation as it contributes greatly to increased levels of motor function and activities of daily living and self-care [8]. Lee et al. demonstrated that rehabilitation during the first four weeks after a stroke resulted in the most rapid recovery, especially of lower motor function (n = 20). This functional recovery decelerated in the following 3 and 6 months. Studying the effects of stroke rehabilitation on different ethnic groups also revealed higher FIM ratings at 3-month follow-up, while there were few improvements between 3 and 12 months. This study also concluded that both Hispanic and black patients showed lower FIM ratings than white patients.

On the other hand, a stroke rehabilitation study performed in a geriatric day hospital in Hong Kong demonstrated an increase of the total FIM score at three months. This score did not decrease significantly even after six months post-discharge. Further, the authors indicated no significant difference in total FIM scores after 3- and 6-months' rehabilitation between cognitively impaired and cognitively normal patients.

Even though stroke remains one of the leading causes of disability [9] and rehabilitation should be ensured for longer periods to reduce the aftermath of functional impairments and dependency, little is known about the impact of stroke rehabilitation on Mongolians. A new stroke rehabilitation program was introduced in Mongolia in 2013. We aimed to investigate the long-term effects of this new rehabilitation program after stroke as a crucial factor in improving the post-stroke victims' quality of life in Mongolia.

Materials and Methods

Subjects

Two hundred twenty-five stroke patients similar in age, gender and ability to perform basic functional activities at hospitalization were compared using an experimental intervention model. The study group (n = 105) was hospitalized at the Stroke Center at the Third State Central Hospital in Ulaanbaatar, Mongolia, from March 10 – May10, 2018. The control group (n = 120) was hospitalized in the Department of Neurology at the Songinkhairkhan District Hospital in the same city during the same period.

The study group was admitted and received early post-stroke rehabilitation treatment according to the Guidelines for Adult Stroke Rehabilitation and Recovery from the American Heart Association/American Stroke Association [22] provided by a multidisciplinary rehabilitation team for six consecutive months. The team consisted of rehabilitation doctors, nurses and physical, occupational and speech therapists. In contrast, the controls received the rehabilitation treatment practiced using hospital protocols and was limited to the hospitalization duration. The team consisted of The National Institutes of Health Stroke Scale (NIHSS), Modified Rankin Scale (mRS), Functional Independence Measure (FIM) and Barthel Index (BI) methods were used to assess the effects of the rehabilitation treatment at four-time intervals: admission, discharge, and 3 and 6 months after hospital discharge

Inclusion criteria

The admission criteria to the rehabilitation unit were 1) age 15 years or older, 2) the presence of impairments or disabilities after a stroke that might benefit from a comprehensive inpatient rehabilitation program regardless of diagnosis, 3) patient has the potential to participate in a goal-oriented rehabilitation program and 4) stabile medical condition sufficient to participate in a rehabilitation program. Rehabilitation Medicine specialists selected patients for rehabilitation during consultation rounds and coordinated the transfer of appropriate candidates from the acute referring units.

Instrument

The NIHSS evaluates physical and cognitive functioning. It is a 15-item instrument assessing the level of consciousness, understanding and following simple commands, pupillary response, deviation of gaze, visual field loss, facial palsy, dysarthria, aphasia, sensory loss and motor weakness. Items are graded on a 3- or 4-point ordinal scale. Scores range from 0 to 42, with higher scores indicating greater impairment.

The Modified Rankin Scale (mRS) is a commonly used scale for measuring the degree of disability or dependence in the daily activities of people who have suffered a stroke. Its scores range from 0 (no residual symptoms) to 5 (severe disability, bedridden, incontinent, requiring continuous care) for stroke survivors.

The Barthel Index (BI) is the most widely used method for assessing the post-stroke functional status and ability to perform activities of daily living (ADL). The Barthel includes ten personal activities: feeding, personal toileting, bathing, dressing and undressing, getting on and off a toilet, bladder control, moving from wheelchair to bed and returning, walking on a level surface (or propelling a wheelchair if unable to walk) and ascending and descending stairs. Items are graded 2 – 3-point ordinal scale and multiplied by five and summed. The score ranges from 0 to 100, with higher scores indicating better function.

The functional independence measure (FIM) was the primary functional outcome measure used in our facility and is a widely-used validated functional outcome measure in medical rehabilitation [14}. It has13 motor and five cognitive items that measure independent performance in self-care, sphincter control, transfers, locomotion, communication, and social cognition on an ordinal scale. FIM scores range from 1 to 7 on an ordinal scale (1 = total assist and 7 = complete independence). The possible total score ranges from 18 to 126, higher scores indicating higher levels of independence. The FIM gain is the difference between the admission and discharge scores and measures functional improvement. All physicians, nurses and therapists who performed FIM assessments were trained and accredited in FIM scoring.

Measurement

A multidisciplinary team led by a rehabilitation physician assessed and scored the NIHSS, mRS, BI, and FIM within 72 hours of admission and discharge for study and control groups. All patients went through a comprehensive rehabilitation program, including medical and nursing care, physical therapy and occupational therapy. Speech or language therapies and medical social work interventions were arranged where appropriate. Patients received approximately 2 to 3 hours of therapy per day. Weekly multidisciplinary staff meetings were conducted to assess progress, review functional goals, plan further therapies and formulate discharge plans.

Statistical analysis

Chi-square tests were used to compare demographic characteristics for the control and study groups. The ages of the patients in the control and study groups were compared using independent t-tests. Likewise, functional scores in the control and study groups at each time period were compared using independent t-tests. The NIHSS, mRS, BI and FIM scores for each group at each time were checked for outliers and missing data. Patients with missing scores for a given clinical scale were removed from that scale's analysis. The main effects of time, treatment type and their interaction were determined using a mixed two-way ANOVA with a Greenhouse-Geiser adjustment for lack of sphericity. A critical p-value of < 0.05 was used. The repeated measurements within subjects were then compared the previous time interval using paired t-tests. The study and control groups' differences at each time interval were tested using the independent t-tests. A Bonferroni-type correction was applied to all t-test results resulting in a significance level set at p < 0.017 (= 0.05/3). SPSS version 24 software (SPSS Inc., Chicago, IL, USA) was used for statistical analyses.

Ethical statement

The Research Ethics Committee of the Mongolian National University of Medical Sciences) was approved by the study (No13-03/1A). All patients provided written informed consent before participating in the study.

Results

The demographic characteristics of the study participants are shown in Table 1. There were no differences except for age, and while this difference was statistically significant, it was clinically irrelevant. The participants were divided into two groups, 120 of them were controls, and 105 participants were in the study group. Regarding the study group, 58 (60%) were males, 47 (40%) were females. The average age of the participants was 56.9 ± 11.6 years.

Table 1. The stroke patient's demographic characteristics

Variables	Control (n = 120)	Study (n = 105)	Total (n = 225)	p-value
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	
Age (years)	55.1 ± 11.7	56.3 ± 13.2	56.6 ± 12.5	0.000[a]
	N (%)	**N (%)**	**N (%)**	
Males	68 (30.2)	58 (25.8)	126 (56.0)	0.938[b]
Tobacco use	50 (22.3)	46 (20.4)	96 (42.7)	0.852[b]
Alcohol use	49 (21.8)	44 (19.5)	93 (41.3)	0.640[b]
Ischemic stroke	43 (19.1)	42 (18.6)	85 (37.7)	0.566[b]
Hemorrhagic stroke	77 (34.2)	63 (28.1)	140 (62.3)	0.748[b]

[a]unpaired t-test, [b]chi-square test

Table 1 shows that the NIHSS scores were the same for both groups at admission (p > 0.05). There was also no difference between the study and control groups at discharge (p > 0.05). As expected, the scores for both groups improved significantly by the time of hospital discharge (p < 0.001). The type of treatment received had no measurable impact on NIHSS during the brief period of hospitalization (p = 0.246). A similar lack of measurable effect of treatment type during the hospitalization was seen for two of the other three scales.

Table 2. National Institutes of Health Stroke Scale (NIHSS) values at baseline and discharge

Variable	Control (n = 88)	Study (n = 90)	Total (n = 178)
NIHSS	Mean ± SD	Mean ± SD	Mean ± SD
Admission	10.2 ± 5.7	10.7 ± 5.0	10.5 ± 5.4
Discharge	6.6 ± 3.8	6.5 ± 3.7	6.5 ± 3.7

Two-way mixed ANOVA results: Interaction of time and treatment F (1,176) = 1.352, p = 0.246; Main effect of time F(1,176) = 273.02, p < 0.001; Main effect of treatment F(1,176) = 0.101, p = 0.752

The mixed ANOVA results are shown in Tables 3-5 for mRS, BI, and FIM, respectively. The pattern of results was the same for each scale. There was no significant difference in the scores between study and control patients at admission ($p > 0.05$). There was a significant interaction between treatment and time, indicating that the scores improved more rapidly for patients in the study group compared to the control group over the six months of our study ($p < 0.001$). A significant improvement in the scores over time was observed in the pooled scores of the study and control groups ($p < 0.001$).

Table 3. Change in Modified Rankin Scale (mRS) values at baseline, discharge, three and six months after stroke.

Variable	Control (n = 89)	Study (n = 80)	Total (n = 178)	ᵃp-value
mRS	Mean ± SD	Mean ± SD	Mean ± SD	
Admission	3.6 ± 1.1^{a}	3.8 ± 0.8^{d}	3.7 ± 0.9	0.162
Discharge	3.1 ± 1.1^{ab}	3.3 ± 0.9^{de}	3.2 ± 1.0	0.193
3 months	2.6 ± 1.0^{bc}	2.2 ± 1.0^{ef}	2.4 ± 0.9	0.016
6 months	2.4 ± 1.0^{c}	1.9 ± 1.0^{f}	2.2 ± 1.1	0.002

Two-way mixed ANOVA results: Interaction of time and treatment $F(1.918, 337.59) = 23.195$, $p < 0.001$; Main effect of time $F(1.918, 337.59) = 335.31$, $p < 0.001$; Main effect of treatment $F(1,176) = 0.666$, $p = 0.416$; *Independent t-test, control vs. study; ^{abcdef}Paired t-test $p < 0.001$

There was also a consistent trend in the estimated means of the control and study groups over the six months the patients were studied. The mean scores suggested slightly poorer function for study group patients compared to controls at hospital discharge that was statistically significant for FIM and insignificant for mRS and BI. However, three months after discharge, the situation reversed, with the study group patients' function statistically significantly higher than controls for the mRS, BI, and FIM.

Table 4. Change in Barthel Index (BI) values at baseline, discharge, three and six months after stroke.

Variable	Control (n = 88)	Study (n = 90)	Total (n = 178)	ᵃp-value
BI	Mean ± SD	Mean ± SD	Mean ± SD	
Admission	24.6 ± 21.6a	24.5 ± 19.8d	24.5 ± 20.6	0.980
Discharge	52.1 ± 26.2ab	48.5 ± 22.9de	50.3 ± 24.6	0.391
3 months	66.4 ± 20.9bc	76.7 ± 15.6ef	71.6 ± 19.1	0.001
6 months	69.5 ± 21.1c	82.8 ± 15.4f	76.3 ± 19.5	0.001

Two-way mixed ANOVA results: Interaction of time and treatment $F(2.131, 372.88) = 20.623$, $p < 0.001$; Main effect of time $F(2.131, 372.88) = 703.652$, $p < 0.001$; Main effect of treatment $F(1,175) = 3.299$, $p = 0.071$; *Independent t-test, control vs. study; ^{abcdef}Paired t-test $p < 0.001$

We contrasted the study and control group's mRS, BI, and FIM scores at each time interval using independent t-tests. By three months after discharge, the study group's functional scores were significantly better than the control group and the gap widened at six months, indicating further improvement.

Table 5. Change in Functional Independence Measure (FIM) values at baseline, discharge, three and six months after stroke.

Variable	Control (n = 88)	Study (n = 90)	Total (n = 178)	ᵃp-value
FIM	Mean ± SD	Mean ± SD	Mean ± SD	
Admission	48.4 ± 21.8^{a}	42.9 ± 20.6^{e}	45.6 ± 21.3	0.086
Discharge	67.8 ± 26.1^{bc}	62.6 ± 25.2^{ef}	65.2 ± 25.7	0.001
3 months	80.6 ± 23.5^{cd}	93.5 ± 20.9^{fg}	87.1 ± 23.1	0.001
6 months	86.0 ± 22.2^{d}	99.8 ± 19.4^{g}	93.0 ± 21.9	0.001

Two-way mixed ANOVA results: Interaction of time and treatment $F(2.116, 372.42) = 36.260$, $p < 0.001$; Main effect of time $F(2.116, 372.42) = 528.38$, $p < 0.001$; Main effect of treatment $F(1,176) = 1.802$, $p = 0.181$; *Independent t-test, control vs. study; ^{abcdef}Paired t-test $p < 0.001$

Using paired t-tests, we also contrasted the scores with the adjacent time interval's scores to detect changes between visits. At each time, the mRS, BI, and FIM score improved significantly compared to the measurement at the previous visit ($p < 0.001$). The largest improvements occurred during the first three months after hospital discharge. This happened for all scales regardless of treatment.

Discussion

Our study evaluated the recovery during long-term rehabilitation therapy. We utilized the widely-used validated scoring methods of NIHSS, mRC, BI, and FIM. There was a significant improvement in NIHSS scores for both the study and control patients during the brief hospitalization ($p < 0.001$). The absence of a significant interaction between the type of treatment and time ($p = 0.246$), and the lack of a main effect of treatment type ($p = 0.752$,) indicates there was no measurable improvement in NIHSS for patients receiving the study rehab protocol compared to the hospital protocol during the short period of hospitalization.

However, the trends were very different for scales used for the six-month study period. Here, the study group's intensive rehabilitation protocol's effect was evident in the highly significant time-treatment interaction for mRC, BI and FIM scales ($p < 0.001$). This interaction was apparent by three months after discharge when the functional scores of the study group were significantly better than the control group and continued to improve at six months. This effect was observed regardless of the scale used. These findings indicate brain plasticity that is responsive to aggressive rehabilitation resulting in higher functioning outcomes during the first six months after a stroke. Notably, this effect was seen in all three of these scales. Of the instruments used, the functional gain was most significant for the BI, and it was nearly large enough over the six month study period for the treatment type to become a significant main effect ($p = 0.071$).

Musicco and colleagues [12] confirmed that the time interval between the stroke and when rehabilitation starts plays a central role in determining patients' long-term outcomes in either residual disability or QOL. Our study results show similar results. Dam et al. [13] concluded that a consistent percentage of patients with severe disability three months after stroke might attain functional independence in response to long-term rehabilitation therapy. Gains in independence in gait and ADL activities should be expected up to 1 year, and some cases up to two years after stroke. Similarly, our study shows that after 3- and 6-months of multidisciplinary rehabilitation, the outcome scores are better than the control group. It means that long-term rehabilitation services must be available after stroke to gain independence and improve QOL.

Our study shows that the short-term treatment outcomes in both groups were no different, and this might be due to shorter hospital stays in Mongolia compared with other countries. The average stroke hospital stay in Mongolia is approximately nine days, shorter than some developed countries [20], including Japan's 20 days [18]. Also, most hospitals do not provide different types of post-stroke multidisciplinary rehabilitation treatment. For example, breathing exercises, in combination with cardiovascular endurance exercises regularly, are recommended to restore the arms' function, whereas physical exercises are recommended to improve walking ability [10]. Similar to the above study, cardiovascular endurance-like walking exercises using international stroke guidelines in our study group was more effective than traditional physical therapy in our controls.

The U.S. Practice Guidelines recommend that stroke survivors do moderate-intensity exercises with sufficient load, sweating, and increased heart rate at least for 30 minutes 1-3 times a week [14]. In Norway, the clinical guidelines emphasize that exercises should be performed 2 - 5 times a week for 10 - 60 minutes with a maximum heart rate of 60 - 80% during the acute post-stroke rehabilitation phase. Yet the intensity of exercise training is below that encountered in ordinary day-to-day life [15]. In our study, patients in the study groups had 30 - 40 minutes of therapy three times per week, under physical and occupational therapists' supervision. Unfortunately, most hospitals in Mongolia lack the organizational structures and financial resources to form multidisciplinary teams and provide long-term rehabilitation. Impaired and reduced mobility are the most common causes of resuming active life for post-stroke survivors [16]. This has been proven by a plethora of randomized controlled trials conducted to explore various ways to strengthen and stabilize post-stroke motor function activities [17, 18].

The researchers highlight the importance of regular consultation with a rehabilitation specialist every 3, 6, and 12 months after a stroke to successfully implement exercise training programs [19]. However, stroke survivors are advised not to do physical activity training only; instead, they are encouraged to adopt healthier lifestyles to enhance their outcome [20].

There is no evidence-based strategy regarding the duration and intensity of physical activity to stabilize functional activity after a stroke [10]. Concerning the increasing number of patients presenting with stroke, improving functional abilities, stabilizing gains, and long-term rehabilitation remain an urgent need of the healthcare system [21]. Stabilization of functional activities should be maintained throughout life and fit the needs of the patient. Therefore, a randomized controlled trial should be used to assess the effectiveness of long-term post-stroke rehabilitation treatment.

According to Askim and Langhammer, repeated exercise training in all phases of post-stroke rehabilitation is essential to restore functional abilities [1]. They point out that the patients who practiced intensive physical activity training five times per week were able to stabilize their functional activities and reduce the risk of recurrent strokes. Rehabilitation therapy reduces the incidence of readmission and reduces the cost of care because the main reason for readmission is complications related to deconditioning. Thus, even a moderate amount of physical exercise activity has a great benefit.

There are very few studies in Mongolia that estimate the effectiveness of post-stroke rehabilitation. Our study differs from previous studies in that it follows the long-term outcome of stroke rehabilitation care. Since the incidence of stroke in Mongolia and the number of people with disabilities are increasing, it is important to accept the effectiveness of stroke rehabilitation treatment and to develop and implement clinical guidelines appropriate to Mongolia's conditions.

Our study has some limitations, most notably inclusion bias. Only patients who were admitted to inpatient rehabilitation in Third Central Hospital received the study protocol. Patients admitted to the other facility received their hospital's protocol. There may have been selection bias in hospital choice or other confounding facility-related factors that improved patient outcomes of those admitted to Third Central Hospital. Thus, this study's findings may not reflect the wide range of patients with disabilities who preferred rehabilitation at other facilities such as inpatient rehabilitation units at different hospitals and community rehabilitation hospitals [8]. However, the significant strength of our study was a large enough sample size to identify multiple similar statistically significant effects using different functional assessment tools. In future research, we need to include several study populations from other rehabilitation facilities and hospitals [9]. Moreover, future studies should have a larger sample size and adequate duration to confirm our present findings.

Conclusions

Our findings have shown the effectiveness of the continuous, long term rehabilitation treatment delivered by a multidisciplinary rehabilitation team rather than traditional standard therapy. The study group patients have demonstrated a higher level of ADL and motor function than controls.

Conflict of Interest

The authors state no conflict of interest.

Acknowledgements

We thank those who helped in any way with our study at Third and Second Central Hospitals, Songinkhairkhan, Khan-Uul, Sukhbaatar, Bayanzurkh, Baganuur, Chingeltei and Nalaikh District Hospitals.

We also thank Denis Egget Ph.D., professor of statistics at Brigham Young University, in Provo, Utah, U.S.A., for help with statistical analyses.

References

1. Askim T, Langhammer B, Ihle-Hansen H, Magnussen J, Engstad T, Indredavik B. A long-term follow-up program for maintenance of motor function after stroke: protocol of the life after stroke—the LAST study. Stroke Res Treat 2012; doi: 10.1155/2012/392101.
2. Feigin VL, Forouzanfar MH, Krishnamurthi R, Mensah GA, Connor M, Bennett DA, et al. Global and regional burden of stroke during 1990–2010: findings from the global burden of disease study 2010. Lancet 2014; 383(9913): 245-55.
3. Powers WJ, Derdeyn CP, Biller J, Coffey CS, Hoh B, Jauch EC, et al. 2015 American Heart Association/American Stroke Association focused update of the 2013 guidelines for the early management of patients with acute ischemic stroke regarding endovascular treatment: a guideline

for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2015; 46(10): 3020-35.
4. Tavares M, Calabi KAL, San ML. Systemic diseases and oral health. Dent Clin North Am 2014; 58(4): 797-814.
5. Mallick AA, O'Callaghan FJ. The epidemiology of childhood stroke. Eur J Paediatr Neurol 2010; 14(3): 197-205.
6. Delgermaa TS, Tsagaankhuu G, Tuvshinjargal D, Baigalmaa G, Tovuudorj A. Comparative study of ischemic stroke in patients aged above and below 50 years admitted to a tertiary care hospital in Ulaanbaatar. Cent Asian J Med Sci 2016; 2(2): 143-52.
7. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. Cochrane Database Syst Rev 2013; doi:10.1002/14651858.CD000197.
8. Langhorne P, Taylor G, Murray G, Murray G, Dennis M, Anderson C, et al. Early supported discharge services for stroke patients: a meta-analysis of individual patients' data. Lancet 2005; 365(9458): 501-6.
9. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet 2006; 367(9524): 1747-57.
10. Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. Lancet 2011; 377(9778): 1693-702.
11. Granger CV, Dewis LS, Peters NC, Sherwood CC, Barrett JE. Stroke rehabilitation: analysis of repeated Barthel index measures. Arch Phys Med Rehabil 1979; 60(1): 14-7.
12. Musicco M, Emberti L, Nappi G, Caltagirone C. Early and long-term outcome of rehabilitation in stroke patients: the role of patient characteristics, time of initiation, and duration of interventions. Arch Phys Med Rehabil 2003; 84(4): 551-8.
13. Dam M, Tonin P, Casson S, Ermani M, Pizzolato G, Laia V, et al. The effects of long-term rehabilitation therapy on poststroke hemiplegic patients. Stroke 1993; 24(8): 1186-91.
14. Furie KL, Kasner SE, Adams RJ. Guidelines for the prevention of stroke in patients with stroke or transient ischemic attack: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2011; 42(1): 227-76.
15. Rand D, Eng JJ, Tang P-F, Jeng JS, Hung C. How active are people with stroke? Use of accelerometers to assess physical activity. Stroke 2009; 40(1): 163-8.
16. Zalewski KR, Dvorak L. Barriers to physical activity between adults with stroke and their care partners. Top Stroke Rehabil 2011; 18(sup1): 666-75.
17. Langhammer B, Lindmark B, Stanghelle JK. Stroke patients and long-term training: is it worthwhile? A randomized comparison of two different training strategies after rehabilitation. Clin Rehabil 2007; 21(6): 495-510.
18. Askim T, Mørkved S, Engen A, Roos K, Aas T, Indredavik B. Effects of a community-based intensive motor training program combined with early supported discharge after treatment in a comprehensive stroke unit: a randomized, controlled trial. Stroke 2010; 41(8): 1697-703.
19. Langhammer B, Stanghelle JK, Lindmark B. Exercise and health-related quality of life during the first year following acute stroke: a randomized controlled trial. Brain Injury 2008; 22(2): 135-45.
20. Lund A, Michelet M, Sandvik L, Wyller T, Sveen U. A lifestyle intervention as supplement to a physical activity programme in rehabilitation after stroke: a randomized controlled trial. Clin Rehabil 2012; 26(6): 502-12.
21. Waaler H, Scenario 2030: Sykdomsutvikling for eldre fram til 2030. Oslo, Norway: 1999. p 6-99.
22. 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: e98-e169.
doi: 10.1161/STR.0000000000000098.