

Hand exercise using a rubber ball increases grip strength in patients with non-haemorrhagic stroke

By Ira Rahmawati

Hand exercise using a rubber ball increases grip strength in patients with non-haemorrhagic stroke

Ira Rahmawati¹, Ratna Dewi², Sumirah Budi Pertami³, Budiono⁴, Ester Pasaribu⁵

^{1,3,4}Department of Nursing, Poltekkes Kemenkes Malang, Indonesia

^{2,5}Department of Nursing, Faculty of Health, Esa Unggul University

ABSTRACT

10

Stroke can cause various degrees of disturbance, such as decreased muscle tone, loss of sensibility in some parts of the body, limits the ability to move the affected limbs and incapacity in certain activities. This study aimed to identify the effect of hand exercises using a rubber ball on muscle strength in patients with non-haemorrhagic stroke. We measure handgrip strengths of the respondents as it reflects the muscle strength and integrity functions of the upper limbs. The sample in this study were 40 patients with one-sided upper extremity paresis causing by ischaemic stroke. A pre-experimental method with one group pre-post-test design was used in this study. The respondents were given hand exercise using a ragged rubber ball for seven days twice a day. Handgrip strength of were measured by a handgrip dynamometer before and after the interventions. The Wilcoxon signed-rank test was performed with p-value of 0.000 ($\alpha < 0,05$) which means that hand exercises using a rubber ball does increase the muscle strengths of the upper extremity. We suggest that hand therapy using a ragged rubber ball can be used as an alternative for motor exercise in post-stroke patients.

Keywords: Stroke, hemiparesis, hand exercises, handgrip strength, handgrip dynamometer.

31

Introduction

Stroke is one of the leading causes of mortality and disability with enormous economic costs globally. Stroke accounted for 5.5 million of deaths in 2016, with 2.7 million of the deaths were due to ischaemic stroke. Globally, Stroke is also the second leading cause of Disability-adjusted Life Years (DALYs) in 2016 (Feigin et al. 2019; Randolph 2016).

The prevalence of ischaemic stroke is higher than haemorrhagic stroke.

In Indonesia, stroke exerts a great economic burden on Indonesian Households, costing a total of Int\$ 0, 29 billion in 2010 and is predicted to increase to Int\$ 1, 27 billion

in 2020 (Finkelstein, Chay & Bajpai 2014). According to the Ministry of Health of Indonesia (2019), there are 500.000 cases of stroke Indonesia each year, causing 12.500 deaths and leaving the rest disabled. 80% of the stroke are ischaemic and the rest 20% are haemorrhagic stroke (Ministry of Health Indonesia 2018).

Stroke is defined as ³⁵ sudden onset of focal or global neurological deficits, lasting for ²³ more than 24 hours, or leading to death with no apparent cause other than a vascular origin. When ⁴⁸ the disruption of blood supply to the brain is caused by occlusion of ³⁴ the cerebral blood vessels, it is called ischaemic stroke. Meanwhile, hemorrhagic stroke is caused by a rupture of the cerebral blood vessels preventing blood flow to the brain (Catangui & Slark 2012; Hickey 2013). Stroke may cause a various degree of disruption of the patients' psychological and physical functions. These include decrease in muscle tones, loss of sensibility and muscle strength of the affected body's parts and decrease ⁴⁷ of the ability to perform certain activities.

One of ^{the} most devastated sequelae of stroke is a loss of mobility. In Indonesia about 70% of the stroke case is non hemorrhagic stroke (Azmi 2012; Yudianto et al. 2014) and more than 70% of these patients were having weakness on one side of the body (Heriyanto & Anna 2015; Oktraningsih 2017; Yazid 2017). Paresis of the upper extremity is the most frequent motor problem experienced by individual with stroke (Winstein Carolee et al. 2016). Rehabilitation after stroke is indeed an important part of the stroke management and should be started early. However, the initiation of stroke rehabilitation within 24 hours may be not beneficial for the long term outcomes or even harmful. Growing evidence suggests that constraint-induced movement therapy for the upper extremities may be significantly beneficial to be initiated within 2 weeks of stroke (Belagaje 2017; Coleman et al. 2017).

Hand strength may be improved by resistance trainings, such as weight-bearing training, medicine balls, and elastic balls. Grasping a rubber ball can be used as an alternative for hand exercise, especially for patients with paresis of the upper extremities. Squeezing the ball will stimulate the upper extremity's muscles including fingers, hands, and wrists. It also stimulate the brain to coordinate the movement. In addition, grasping a rubber ball may help the muscles relax: gripping and releasing patterns lessen tension and stress. Several studies have used different means for the hand training resulted in varied results of muscles strength improvement (Mardati, Setyawan & Kusuma 2014; Prok, Gessal & Angliadi 2016).

⁴⁶ This study aimed to evaluate the effect of hand training using a rubber ball on the muscles strengths of the patients with hemiparesis after stroke. The exercise was conducted in the patients' home in an urban area of West Jakarta in March to June 2019. The muscle strengths of the affected hand was measured before and after the intervention using a handgrip dynamometer.

Methods

This study employed a pre experimental one-group pre-posttest design. Forty stroke-survival individuals with weaknesses in one sided of the hands were recruited using purposive sampling method. ⁴⁵ The inclusion criteria were patients with non-haemorrhagic stroke with hemiparesis. All respondents were given hand exercise twice a day for fourteen days. We asked the individuals to squiz a ragged rubber ball for five seconds then relaxed for five seconds. These procedures were repeated seven times for ten minutes. The hand strength were measured before and after interventions using *handgrip dynamometer*. Data analysis was conducted using *Wilcoxon test*, specifically to identify ³⁸ the difference of the patients' muscle strength before and after the intervention.

⁴⁴ Results

Table 1. Distribution of respondent by gender and age group

43

Age group (in years)	36-45	46-55	56-65	>65
Male	2	15	4	2
Female	1	10	5	1
N (%)	3 (7.5%)	25 (62.5%)	9 (22.5%)	3 (7.5%)

The majority of our respondent were 45 – 55 years old, that is 62, 5% of the total sample. Meanwhile, respondent who were more than 65 years old were only three individuals. Table 1 also shows that more than a half of our respondent were male. Numerous studies have found that male are at high risk for stroke compared to pre menopause female (Förster et al. 2009; Haast, Gustafson & Kiliaan 2012; Watila et al. 2011)

Table 2. Mean grip strength of the affected hand pre and post interventions based on age and gender

Age-group (years)	36-45		46-55		56-65		> 65	
	pre	post	pre	post	pre	post	pre	post
Male	27,4	28,6	26	28,1	26,1	27,3	21,1	22,7
Female	13,6	14,2	12,2	13,5	10,8	12,7	8,6	10,6

Note: Handgrip strength is measured in mmHg using handgrip dynamometer

Table 2 shows that the highest increase in grip strength was found in men at the age of 46-55 years old. The handgrip strength increases by 2.1 mmHg.

Table 3. Mean handgrip strength of the affected hand pre and post intervention

Mean grip strength	Pre	Post
	19,6	21,4

Statistical analysis using Wilcoxon signed ranks test was carried out to evaluate the effect of hand exercise using a rubber ball on hand grip strength:

Table. 5 Comparison of handgrip strength before and after intervention

	N	Mean	Std. Deviation	Z	Asymp. Sig.(2 tailed)
Grip strength before intervention	40	19, 625	7,4777	-5,513b	0,000
Grip strength after intervention	40	21, 423	7, 6045		

($\alpha = 0, 05$)

Table 5 shows the 2 tailed value is $0,000 < 0,05$ meaning that ⁵ there is a significant difference of the hand grip strength before and after intervention given.

Discussion

Risk factors for stroke includes older age, smoking, high blood pressure, family history of stroke, ischaemic heart diseases, and consumption of birth control pills (Kelly-Hayes 2010). Furthermore, as the incidence of metabolic disorders and cardiovascular diseases increase with age, the incidences of stroke will also increase after the age of 55 years old, and the risk is double every ten years after that ages. However, stroke may also occur in all age groups (Michael & Shaughnessy 2006; Sairaoka 2012). Indeed the majority of our respondents were 45 – 55 years old and most of them have history of hypertension and smoking.

Studies have reported that handgrip strengths correlates with gender, dominant hands, age and also height and weight of the individuals (Agnew & Maas 1982; Kamarul, Ahmad & Loh 2006; Petersen et al. 1989). Measuring handgrip strengths using handgrip dynamometer can be used to predict the muscle strength. Handgrip strength test need only a simple handgrip dynamometer and minimal effort from individuals, such as post-stroke patients who might be unable to carry out the other heavy and complex test (Trosclair et al. 2011).

The value of handgrip strength as an indicator for arm recovery in post stroke patients have been studied and found that handgrip strength ⁸ can be used to reflect the functional

integrity of the upper extremity (McAniff & Bohannon 2002; Sunderland et al. 1989). Our study found that simple hand exercise at home could increase grip strength on the affected hand in post stroke patients. Decreased handgrip strength may reduce the ability to perform activity daily living (ADL) and therefore, affect the individuals' quality of life. A study also found that handgrip strength is associated with social and psychological functions (Taekema et al. 2010).

Hand strength may be improved by resistance training, such as grasping elastic ball weight-bearing training, medicine balls, and many others. In our study, we asked the individuals to squiz a ragged rubber ball for five seconds then relaxed for five seconds. This procedure was repeated for seven time in 10 minutes twice a day for fourteen days. Grasping and releasing a ragged rubber ball for a certain period may stimulate acupressure points at the palm, which then activate the sensory neurons to send the impulse to the sensory areas of the affected hemisphere. Furthermore, squizzing a rubber ball with varied grip strength will train the muscles as well as the brain. Repeated hand exercise using a rubber ball or other tools such as cylindrical grips may help to increase muscles tones in several studies (Chaidir & Zuardi 2014; Irfan 2012; Lindberg et al. 2004; Mardati, Setyawan & Kusuma 2014).

Physical training for stroke patients is to be initiated within 2 weeks because hand exercise very early within 24 hour of stroke attack may be harmful for the patients. All of the respondents in our study were in the rehabilitation phase, which was more than four week after stroke. Our study found that an increase of handgrips strange is higher in men than in women. The highest increase was found in men at the age group of 46 to 55 years old. Family support is one of the contributing factors to the training outcomes. Therefore, every step of the treatment given for patients with stroke should involve their next of kin or

close family members. The family involvement is mostly crucial in the rehabilitation phase as well as the stroke prevention programs (Rahmawaty et al. 2019).

Conclusion

Physical rehabilitation after stroke is an integral part of the stroke management and should be initiated early. Hand exercise using a rubber ball can be utilized as an alternative physical rehabilitation as it is cheap, simple, and easy to perform at home. The success of this exercise might be affected by several factors including the age of the respondent and support from the family members.

References

Agnew, PJ & Maas, F 1982, 'Hand function related to age and sex', *Arch Phys Med Rehabil*, vol. 63, no. 6, Jun, pp. 269-271.

Azmi, E 2012, 'Gambaran Kadar Kolesterol HDL dan Tekanan Darah Pasien Stroke yang Dirawat Di Bagian Saraf RSUD Arifin Achmad Provinsi Riau', *Jurnal Publikasi. Pekanbaru: Fakultas Kedokteran Universitas Riau*.

Belagaje, SR 2017, 'Stroke Rehabilitation', *Continuum (Minneapolis)*, vol. 23, no. 1, Cerebrovascular Disease, Feb, pp. 238-253.

Catangui, EJ & Slark, J 2012, 'A thrombolysis pathway for patients following acute ischaemic stroke', *Nurs Stand*, vol. 26, no. 31, Apr 4-10, pp. 35-42.

Chaidir, R & Zuardi, IM 2014, 'Pengaruh Latihan Range Of Motion Pada Ekstremitas Atas Dengan Bola Karet Terhadap Kekuatan Otot Pasien Stroke Non Hemoragi Di Ruang Rawat Stroke RSSN Bukittinggi tahun 2012', *AFIYAH*, vol. 1, no. 1.

Coleman, ER, Moudgal, R, Lang, K, Hyacinth, HI, Awosika, OO, Kissela, BM & Feng, W 2017, 'Early Rehabilitation After Stroke: a Narrative Review', *Curr Atheroscler Rep*, vol. 19, no. 12, Nov 7, p. 59.

Feigin, V, Nichols, E, Alam T, Bannick, M, Beghi, E & Blake, N 2019, 'Global, regional, and national burden of neurological disorders, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016', *Lancet Neurol*, vol. 18, no. 5, May, pp. 459-480.

1

Finkelstein, EA, Chay, J & Bajpai, S 2014, 'The Economic Burden of Self-Reported and Undiagnosed Cardiovascular Diseases and Diabetes on Indonesian Households', *PLOS ONE*, vol. 9, no. 6, p. e99572.

17

Förster, A, Gass, A, Kern, R, Wolf Marc, E, Ottomeyer, C, Zohsel, K, Herici, M & Szabo, K 2009, 'Gender Differences in Acute Ischemic Stroke', *Stroke*, vol. 40, no. 7, 2009/07/01, pp. 2428-2432.

16

Haast, RAM, Gustafson, DR & Kiliaan, AJ 2012, 'Sex Differences in Stroke', *Journal of Cerebral Blood Flow & Metabolism*, vol. 32, no. 12, 2012/12/01, pp. 2100-2107.

3

Heriyanto, H & Anna, A 2015, 'Perbedaan Kekuatan Otot Sebelum dan Sesudah Dilakukan Latihan (Mirror Therapy) Pada Pasien Stroke Iskemik dengan Hemiparesis di RSUP Dr. Hasan Sadikin Bandung', *Hasan Sadikin Bandung, Bandung*.

27

Hickey, JV 2013, *The Clinical Practice of Neurological and Neurosurgical Nursing*, 7th edn, Lippincott Williams & Wilkins, Philadelphia.

3

Irfan, M 2012, *Fisioterapi Bagi Insan Stroke*, Graha Ilmu, Yogyakarta.

22

Kamarul, T, Ahmad, TS & Loh, WYC 2006, 'Hand Grip Strength in the Adult Malaysian Population', *Journal of Orthopaedic Surgery*, vol. 14, no. 2, 2006/08/01, pp. 172-177.

18

Kelly-Hayes, M 2010, 'Influence of Age and Health Behaviors on Stroke Risk: Lessons from Longitudinal Studies', *Journal of the American Geriatrics Society*, vol. 58, no. s2, 2010/10/01, pp. S325-S328.

4

Lindberg, P, Schmitz, C, Forsberg, H, Engardt, M & Borg, J 2004, 'Effects of passive-active movement training on upper limb motor function and cortical activation in chronic patients with stroke: a pilot study', *Journal of rehabilitation medicine*, vol. 36, no. 3, pp. 117-123.

13

Mardati, L, Setyawan, D & Kusuma, MAB 2014, 'Perbedaan Range of motion spherical grip dan cylindrical grip terhadap kekuatan otot ekstremitas atas pada pasien stroke di RSUD Tugurejo Semarang', *Karya Ilmiah*.

30

McAniff, CM & Bohannon, RW 2002, 'Validity of grip strength dynamometry in acute rehabilitation', *Journal of physical therapy science*, vol. 14, no. 1, pp. 41-46.

21

Michael, KM & Shaughnessy, M 2006, 'Stroke prevention and management in older adults', *J Cardiovasc Nurs*, vol. 21, no. 5 Suppl 1, Sep-Oct, pp. S21-26.

36

Ministry of Health Indonesia 2018, *Pusat Data dan Informasi Kesehatan Kementerian Kesehatan RI*, Indonesia.

3
Oktraningsih, I 2017, 'Gambaran Kekuatan Otot Pasien Stroke yang Immobilisasi di RSUP H. Adam Malik Medan'.

5
Petersen, P, Petrick, M, Connor, H & Conklin, D 1989, 'Grip strength and hand dominance: challenging the 10% rule', *Am J Occup Ther*, vol. 43, no. 7, Jul, pp. 444-447.

8
Prok, W, Gessal, J & Angliadi, L 2016, 'Pengaruh latihan gerak aktif menggenggam bola pada pasien stroke diukur dengan handgrip dynamometer', *e-CliniC*, vol. 4, no. 1.

19
Rahmawaty, E, Handayani, S, Sari, MHN & Rahmawati, I 2019, 'SOSIALISASI DAN HARMONISASI GERAKAN MASYARAKAT HIDUP SEHAT (GERMAS) DAN PROGRAM INDONESIA SEHAT DENGAN PENDEKATAN KELUARGA (PIS-PK) DI KOTA SUKABUMI', *LINK*, vol. 15, no. 1, pp. 27-31.

39
Randolph, SA 2016, 'Ischemic Stroke', *Workplace Health Saf*, vol. 64, no. 9, Sep, p. 444.

Suiraoaka 2012, *Penyakit degenerative*, Nuha Medika Yogyakarta, Indonesia.

9
Sunderland, A, Tinson, D, Bradley, L & Hewer, RL 1989, 'Arm function after stroke. An evaluation of grip strength as a measure of recovery and a prognostic indicator', *J Neurol Neurosurg Psychiatry*, vol. 52, no. 11, Nov, pp. 1267-1272.

1
Taekema, DG, Gussekloo, J, Maier, AB, Westendorp, RG & de Craen, AJ 2010, 'Handgrip strength as a predictor of functional, psychological and social health. A prospective population-based study among the oldest old', *Age Ageing*, vol. 39, no. 3, May, pp. 331-337.

11
Trosclair, D, Bellar, D, Judge, LW, Smith, J, Mazerat, N & Brignac, A 2011, 'Hand-Grip Strength as a Predictor of Muscular Strength and Endurance', *The Journal of Strength & Conditioning Research*, vol. 25, p. S99.

12
Watila, M, Nyandaiti, Y, Bwala, S & Ibrahim, A 2011, 'Gender variation in risk factors and clinical presentation of acute stroke, Northeastern Nigeria', *Journal of Neuroscience and Behavioural Health*, vol. 3, no. 3, pp. 38-43.

2
Winstein Carolee, J, Stein, J, Arena, R, Bates, B, Cherney Leora, R, Cramer Steven, C, Deruyter, F, Eng Janice, J, Fisher, B, Harvey Richard, L, Lang Catherine, E, MacKay-Lyons, M, Ottenbacher Kenneth, J, Pugh, S, Reeves Mathew, J, Richards Lorie, G, Stiers, W & Zorowitz Richard, D 2016, 'Guidelines for Adult Stroke Rehabilitation and Recovery', *Stroke*, vol. 47, no. 6, 2016/06/01, pp. e98-e169.

25
Yazid, B 2017, 'GAMBARAN KEKUATAN OTOT PASIEN STROKE YANG IMOBILISASI DI RSUP. H. ADAM MALIK MEDAN', *JURNAL KEPERAWATAN FLORA*, vol. 10, no. 1.

Yudiarto, F, Machfoed, M, Darwin, A, Ong, A & Karyana, M 2014, 'Indonesia Stroke Registry (S12.003)', AAN Enterprises.

Hand exercise using a rubber ball increases grip strength in patients with non-haemorrhagic stroke

ORIGINALITY REPORT

34%

SIMILARITY INDEX

PRIMARY SOURCES

1	journals.plos.org Internet	58 words — 2%
2	www.cambridge.org Internet	51 words — 2%
3	www.scribd.com Internet	51 words — 2%
4	Jong Hyun Kim, Jae Soo Hong, Keyoung Jin Chun. "Kinematic analysis based on changes in arm support length and central axis location through rotational motion of the upper limb", International Journal of Precision Engineering and Manufacturing, 2014 Crossref	43 words — 1%
5	studentsrepo.um.edu.my Internet	40 words — 1%
6	eprints.ums.ac.id Internet	35 words — 1%
7	www.researchsquare.com Internet	32 words — 1%
8	es.scribd.com Internet	32 words — 1%
9	boris.unibe.ch Internet	31 words — 1%

10	scitepress.org Internet	30 words — 1%
11	publicacoes.cardiol.br Internet	29 words — 1%
12	Andreas Rantepadang, Angelia Tendean. "PENGARUH MUSIC MOVEMENT THERAPY TERHADAP KEMAMPUAN AKTIVITAS HARIAN PADA PASIEN STROKE DI RSUP. PROF. DR. R.D. KANDOU MANADO", Jurnal Skolastik Keperawatan, 2019 Crossref	27 words — 1%
13	digilib.unisayogya.ac.id Internet	27 words — 1%
14	nrronline.org Internet	25 words — 1%
15	ojs.unimal.ac.id Internet	25 words — 1%
16	cris.maastrichtuniversity.nl Internet	24 words — 1%
17	hdl.handle.net Internet	24 words — 1%
18	onlinelibrary.wiley.com Internet	23 words — 1%
19	ejournal.poltekkes-smg.ac.id Internet	21 words — 1%
20	www.mdpi.com Internet	19 words — 1%
21	www.son.jhmi.edu Internet	18 words — 1%

22	Internet	18 words — 1%
23	www.panafrican-med-journal.com Internet	18 words — 1%
24	yeniir.blogspot.com Internet	18 words — 1%
25	nursing-inspirations.com Internet	17 words — 1%
26	docplayer.net Internet	17 words — 1%
27	www.adelaide.edu.au Internet	16 words — 1%
28	www.magonlinelibrary.com Internet	16 words — 1%
29	edoc.pub Internet	15 words — 1%
30	dsc.duq.edu Internet	14 words — < 1%
31	Ana Railka de Souza Oliveira-Kumakura, Cássia Milena Freitas Machado Sousa, Jessica Aparecida Biscaro, Kelly Cristina Rodrigues da Silva et al. "Clinical Validation of Nursing Diagnoses Related to Self-Care Deficits in Patients with Stroke", Clinical Nursing Research, 2019 Crossref	12 words — < 1%
32	journals.lww.com Internet	11 words — < 1%
33	www.iata.org Internet	10 words — < 1%
34	"Neuroprotective Therapy for Stroke and Ischemic Disease",	

Springer Science and Business Media LLC, 2017

Crossref

10 words — < 1 %

35 lup.lub.lu.se

Internet

10 words — < 1 %

36 myjurnal.poltekkes-kdi.ac.id

Internet

9 words — < 1 %

37 U. M. Nordenskiöld, G. Grimby. "Grip Force in Patients with Rheumatoid Arthritis and Fibromyalgia and in Healthy Subjects. A Study with the Grippit Instrument", Scandinavian Journal of Rheumatology, 2009

Crossref

9 words — < 1 %

38 Setiyawan Setiyawan, Pipit Siti Nurlely, Agnes Sri Harti. "PENGARUH MIRROR THERAPY TERHADAP KEKUATAN OTOT EKSTREMITAS PADA PASIEN STROKE DI RSUD dr. MOEWARDI", JKM (Jurnal Kesehatan Masyarakat) Cendekia Utama, 2019

Crossref

9 words — < 1 %

39 Ying-Ying Lin, Tong-ya Yu, Hui Quan, Yu-Juan Chen, Xue-Yuan Liu, Dong-Ya Huang. "Association Between PSD95 Gene 3'UTR Single Nucleotide Polymorphism and Risk of Acute Ischemic Stroke in Chinese Han Population", Journal of Molecular Neuroscience, 2020

Crossref

8 words — < 1 %

40 Adrià Arboix, Joan Massons, Luís García-Eroles, Cecilia Targa, Montserrat Oliveres, Emili Comes. "Clinical Predictors of Prolonged Hospital Stay after Acute Stroke: Relevance of Medical Complications", International Journal of Clinical Medicine, 2012

Crossref

8 words — < 1 %

41 Jing-Quan Zheng, Hui-Ju Lai, Cai-Mei Zheng, Yu-Chun Yen, Kuo-Cheng Lu, Chaur-Jong Hu, Hsun-Hua Lee, Yuan-Hung Wang. "Association of stroke subtypes with risk of hip fracture: a population-based study in Taiwan", Archives

8 words — < 1 %

42	epdf.tips Internet	8 words — < 1%
43	id.scribd.com Internet	8 words — < 1%
44	Muriyati, Safruddin, Andi Nurwahyuni Asmur. "The Effect of Range Of Motion (ROM) Exercise on the Level of Stroke Patient Mobility", Comprehensive Health Care, 1970 Crossref	8 words — < 1%
45	www.gssrr.org Internet	8 words — < 1%
46	worldwidescience.org Internet	8 words — < 1%
47	www.science.gov Internet	8 words — < 1%
48	journals.rcni.com Internet	8 words — < 1%
49	Carlo Francescutti, Sergio Mariotti, Giorgio Simon, Paola D'errigo, Rossella Di Bidino. "The impact of stroke in Italy: First step for a National Burden of Disease Study", Disability and Rehabilitation, 2009 Crossref	7 words — < 1%

EXCLUDE QUOTES OFF
EXCLUDE OFF
BIBLIOGRAPHY

EXCLUDE MATCHES OFF