### **ORIGINAL ARTICLE**

# The Effectiveness of Feldenkrais Exercise on Dynamic Balance and Risk of Fall among Older People in Indonesia

Nikmatur Rosidah<sup>1</sup>, Selvia Wahyu Nur'Aini<sup>1</sup>, Anita Faradilla Rahim<sup>1</sup>

<sup>1</sup> Department of Physiotherapy, Faculty of Health Science, University of Muhammadiyah Malang, Indonesia

### ABSTRACT

Background: Older people refers to those who have experienced physiological changes due to the aging process. The overall physiological changes associated with aging lead to changes in body system. These changes lead to an increased problem in the older people, such as balance problems that leads to the risk of falls. Prevalence of the older people suffering from diseases that lead to the risk of falls has increased from 25% to 35% overtime. Unaddressed risk factors for falls lead to recurrent falls and poor quality of life. Effective multifactorial fall prevention programs in the primary care setting may be a promising approach to reduce incidence rate of falls. One of the interventions to address falls for the older people is Feldenkrais Exercise. The objective of this study was to investigate the effect of Feldenkrais Exercise on the dynamic balance and the risk of falling among the population. Methods: This research was a one group, pre-post-test study. A convenience sample of 25 community dwelling older adults was recruited in this study. The participants attended 5-week Feldenkrais Programs, consisting 60 minutes of Feldenkrais Exercise for three times per week. Time Up and Go Test (TUG) was used to measure the Dynamic Balance and Morse Falls Scale (MFS) was used to measure the Risk of Falls of the participants. Paired T-test were used to analyze the data. Results: After completion of the programs, dynamic balance (p = 0,001) and risk of falls (p=0,001) decreased, indicating that Feldenkrais Exercise is effective to be used to prevent falls among the older people. Conclusion: The results of this study support the hypothesis that Feldenkrais Exercise positively influence dynamic balance and the risk of falling among the older people. Feldenkrais Exercise can make up part of the rehabilitation program to prevent the decline of dynamic balance and reduce the incidence rate of falls among this population.

**Keywords:** Older people; Dynamic balance; Falls risk; Feldenkrais exercise; Time Up and Go Test; Morse Falls Scale

### **Corresponding Author:**

Selvia Wahyu Nur'Aini Email: <u>selviawahyuna@gmail.com</u>

### INTRODUCTION

An older people can be described as someone who has entered the age of 60 years and over (Yuliadarwati 2020). The populations experience a decrease in muscle strength and coordination that leads to decrease in balance. More than 30% of older people aged 65 years and over experience falls at least once a year (Thomas et al. 2019). In 2018, incidence of falls among this population in Indonesia is 67.1% in the age group of 65-74 years old and increase to 78.2% at the age 75 years (Riskesdas 2018). In 2020, the percentage of falls among the older people has increased by 25% to 35% followed by the decline in function among this population, which eventually can lead to the balance disorders and further increased risk of falls (Dewi et al. 2021; Rohima et al. 2020).

to movement, and react to changes in body position so that the body remains stable (Osoba et al. 2019). Balance occurs when the vestibular, visual, and proprioceptive are stimulated (Agrawal et al. 2020). The input from sensory systems is integrated by the cerebellum, cerebral cortex, and brainstem (Picard-Deland et al. 2022). Then the input that has been processed is realized by the output motor which consists of vestibulo-ocular reflexes and motor impulses ((Ellithy et al. 2020).

In general, older people experience a decrease in three sensory systems which results in the misinformation being passed on to the brain, resulting in balance disorders (Kiik 2018). The decreasing proprioception among the older people causes coordination and balance problems that result in a higher risk of falling (Ferlinc et al. 2019). They also experience a decrease in muscle strength, muscle flexibility, muscle elasticity, decreased reaction time and relaxation and decreased functional performance (Kurnia 2019).

There are several comprehensive rehabilitation options

Balance is required to maintain body position, respond

to improve balance and reduce risk of falling in older people. Sweeting (2020), suggested several exercises for balance, which are Feldenkrais Exercise, Tango Dance Exercise, Tai Chi, and Alexander Technique Exercise. Wijayanti (2017) stated that Feldenkrais exercise produced good result in dynamic balance and decrease the risk of falling in older people with Osteoarthritis. Feldenkrais exercise provide the learning and stimulation to sensing and thinking that can improve the body function.

Research conducted by Teixeira-Machado (2017) showed that, Feldenkrais exercise improves static and dynamic balance and reduce the duration of Time Up and Go test in patients with Parkinson's disease. Feldenkrais Exercise is reported to be able to improve balance in Cerebral Palsy patients too, by relaxing the lower leg muscles, controlling abnormal reflexes, correcting posture and gait (Panova et al. 2017). Increase body awareness and able to move comfortably was also reported as an effect of Feldenkrais Exercise in patients with mobility problems (Palmer 2017). There are a few studies related to Feldenkrais Exercise on balance and the risk of falling among the older people. This study was aimed to determine the effectiveness of a 5-week Feldenkrais Exercise on dynamic balance and the risk of falling among the Indonesian older people.

### METHODS

This study was approved by the Human Research Ethics Committees at the Medical Faculty, University of Muhammadiyah Malang, Protocol Number E.5.a/ 045/ KPEK-UMM/ III/ 2023.

The participants in this study were a sample of convenience drawn from community dwelling older adults, who had enrolled to this research at the Tresna Werdha Jombang Social Services. The inclusion criteria are patients aged over 65 years old, positive sign of balance disorder confirming by Time Up and Go Test (TUG), did not have impaired cognitive function confirming by the Montreal Cognitive Assessment (MoCA), and shown willingness to participate in the study. All participants provided informed consent. Those currently experiencing fractures and severe injuries, using assistive devices (walkers, wheelchairs and crutches), are attached to an IV-line, are in a bedrest condition, and having depression or anxiety were excluded from the study.

The selected participants were assessed on dynamic balance using Time up and Go test (TUG) and risk of falls using Morse Falls Scale (MFS) measures prior to starting the intervention and at the completion of the program.

The Feldenkrais exercise were carried out 3 times a week for 5 weeks with a duration of 35-45 minutes. Movements in Feldenkrais training included: (1) Ankle and foot flexion; (2) Crossing leg and arm; (3)

Standing balance; (4) Weight bearing; (5) One Leg Standing; (6) Stand from Chair; (7) Tandem Walking; (8) Sitting and lean forward; (9) Sitting with lateral trunk rotation; (10) Sitting with lateral cervical flexion; (11), Sitting with lean to the side; (12) Supine with knee flexion.

There were three physical therapists who were called for assist in this study, namely: (1) an examiner, in charge of overall assessments for the participants; (2) the assessor in charge to measure all the outcome measures at the pre and post intervention phases; and (3) a physical therapist who was trained for the Feldenkrais Exercise, in charge to conduct the intervention on the participants.

Descriptive statistics were used to analyse all outcome measure scores. The normality test used was the Shapiro Wilk test for both TUG and MFS. Parametric tests were used for dynamic balance by TUG, while non-parametric test was used for MFS as the data were not normally distributed. To evaluate the effect of Feldenkrais exercise for the normally distributed data of dynamic balance by TUG, the Paired T test was used to compare the pre and post intervention values. Meanwhile, Wilcoxon sign rank test was used to evaluate the effect of the Feldenkrais exercise on Risk of Falls by MFS as the data is not-normally distributed. The statistics level was set at p-value < 0,05.

### RESULTS

A total of 25 participants were screened for eligibility at the Tresna Werdha Elderly Community Social Service Jombang. There were two participants who excluded due to not fulfilling the inclusion criteria. Eventually, a total of 23 participants who were eligible participated in the research and signed letter of informed consent. All participants were measured at baseline and postintervention.

The demographic data and baseline are shown in Table 1: the mean age of the participants is 70.9 years old; BMI =  $23,35 \text{ kg/m}^2$ ; TUG = 28,34 second; and MFS = 44,34 points.

#### Table 1: Demography of the participants

Characteristics (N=23)	Mean	(SD)
Gender (female/male)	18/5	-
Age (years)	70.9	(8.16)
BMI (kg/m <sup>2</sup> )	23.3	(2.75)
TUG (second)	28.34	(3.05)
MFS	44.34	(9.45)

## Table 2: Comparisons of the dynamic balance by TUG within group

Measurement	Time Up and Go Test (N=23)		p-value	
Period	Mean	(SD)		
Pre-Test	28.34	(3.05)	0.001	
Post Test	23.22	(3.24)	0.001	

Table 3: Comparisons of the risk of falls by MFS within group

Measurement Period	Morse (N=23)	Falls Scale	p-value
	Mean	(SD)	
Pre-Test	44.34	(9.45)	0.001
Post Test	33.69	(10.57)	0.001

Table 2 shows the TUG results. The paired T-Test was used to analyze data for TUG to test the difference between pre and post-test scores. It was found statistically significant (p=0.001). That proves the effectiveness of Feldenkrais Exercise on dynamic balance on the older people.

The Wilcoxon signed rank test was used to analysed data for Morse Falls Scale to test the difference between pre and post-test scores. It was found statistically significant (p=0.001) (Table 3), which proves the effectiveness of Feldenkrais Exercise on the risk of falling among the older people.

### DISCUSSION

As mentioned, this study was aimed to determine the effectiveness of Feldenkrais Exercise on dynamic balance and the risk of falling among the older people.

A total of 23 participants with average age of 65 - 70 years old in the study experience balance disorders indicated by TUG score above 15 seconds. Literature reported that at the age of 65, older people was found to experience a reduction of functional ability, both physically and psychologically (Rahman et al. 2022). Due to aging process, older persons commonly experience physiological changes that affect their daily activity, such as changes in body organs, skin and facial appearance, changes in neurological, sensory system and musculoskeletal system changes, instability and increase risk of fall (Mustafa et al. 2022). The results of this study are in line with findings of the research which reported that there are 28 - 35% of older people having balance problem at the age of 60 and this increased to 32 - 42% at the age of 70 years old (Pramadita et al. 2019). Another study reported that many older people experience falls due to loss of balance which accounted to 49.4% at the age over 55 years old, and 67.1% at the age over 65 years old and these increased by 25% to 35% at the age of 70 - 75years old (Rohima et al. 2020).

Balance is a complex process of the 3 integrated sensory systems are: visual, vestibular, and proprioceptive as well as musculoskeletal which linked by the brain as the body's response to maintaining balance (Mekayanti et al. 2015). Balance is also a process in which the body tried to maintain their position whether the circumstance is changing, from static to dynamic to the standing or ambulation (Yuliadarwati et al. 2020).

Feldenkrais Exercise is reported able to increase body

awareness by providing stimulation to the senses, movements, feelings, and thought to reach the goal of maintaining the body position (Kang et al. 2022). The sequence of movement provide by the Feldenkrais exercise can improve balance by changing habits or correct the posture and the movement as to provide the body positions while doing daily activity (Jones et al. 2022). The Feldenkrais exercise is normally executed in a various of position and movement such as sitting, standing position as well as moving around and shifting weigh while sitting and standing. The movement in Feldenkrais Exercise is able to control body posture by controlling the pelvis which supports the body in various position, controlling movements in the torso and ankle, and increasing body awareness. Foot contact with the floor or the surface and the attention of the person to which body parts are involved in a movement can build confidence in improving the balance (Galea, Connors & Said 2011).

Further, Feldenkrais exercise also improves dynamic control related to gait and locomotion. This is obtained by activating the muscle when stepping which includes the muscle around hip, knee, ankle, and postural muscles (erector spinae muscle and rectus abdominis muscles) (Faidah et al 2020). Feldenkrais exercise provides benefits in the form of adaptation to increase stride length and decreasing stride width, increase walking speed and increase muscle strength (Frederic & AI Haris 2022). This current study found positive changes of TUG score indicating improved dynamic balance following the exercise intervention further support these benefits of Feldenkrais for older people.

Feldenkrais Exercise is also reported to improve motor control, speed and visual scanning speed in the older people (Ullmann & Williams 2016). Besides, there is an increase in proprioception by emphasizing sensory information during the movement. Remarkably, this can increase the sensitivity of perception and perceptual motor skills, hence, it will be easier for the body to adjust to any movements (Mattes, 2016). A dynamic postural response will be achieved when doing Feldenkrais exercises, the linear acceleration of the body will be detected by the macula utriculus sensory organ which plays an important role in determining the orientation of the head when in an upright position. In the macula utriculus there are many like a hair cell that heir synapse connected with the sensory endings of the vestibular nerve. Next, appropriate signals are sent via the vestibular nerve to the vestibular nuclei to the brainstem for processing the signals. The brainstem transmits strong excitation signals to the antigravity muscles via the medial and lateral vestibulospinal tracts in the anterior columns of the spinal cords (Gyuton & Hall 2013). The body will respond by activating the antigravity muscles by providing movement feedback in the form of correction or protection the body due to a disturbance or change in the surface or base of support in maintaining body balance (Mujiadi & Mawaddah 2019). These mechanisms explain the reduction of falls risk (MFS

scores lowered by 10 units) among the older people following Feldenkrais exercise in this study.

Older people will experience degeneration that may lead to changes in the body, one of them is the changes musculoskeletal systems (Pringgadani et al. 2022). These changes result in weakness of the muscles, short steps, and unsteady standing (Nisa et al. 2019). Feldenkrais Exercise can increase body awareness in order to improve the sequence of movements by providing feedback in the form of balance, optimizing perception, improving coordination, and increase muscle strength (Kampe 2010). Previous study believed Feldenkrais Exercise can improve physical fitness and muscle strength, as well as reduce the risk of falling as to increase the independence of the elderly in doing their daily activities (Shalahuddin (2022).

In addition, Feldenkrais Exercise is able to increase awareness and comfort in moving. This was revealed in research by Palmer (2017). In a study conducted by Kalron (2017), there was an increase in balance and a reduction in duration when measured by the Time Up and Go Test. Hillier & Worley (2015) also concluded that Feldenkrais Exercise is good for the older people. In research conducted by Yuliadarwati (2021) it was shown that Feldenkrais Exercise is able to reduce the level of risk of falling on the elderly. In Sangam's study (2015) Feldenkrais Exercise was reported to be able to maintain body stability so that it could reduce the risk of falling on the elderly. Research conducted by Berland (2022) shows that there is an effect of Feldenkrais Exercise on the risk of falling.

Feldenkrais Exercise is highly recommended for older people because it is an exercise to increase awareness of body movements to the fullest but with minimal effort (Mohan et al. 2016). Minimal power produces resistance where the body's metabolism needs to work less so as to produce optimal energy to perform a movement efficiently by optimizing coordination, muscle strength, balance, and efficient time (Henry et al. 2016). Movement in Feldenkrais Exercise improves balance by changing habits or movement postures to stay balanced so as to provide ease in. daily activities (Wallman-Jones et al. 2022). This mechanism is much needed in the older people.

### CONCLUSION

Based on this study findings, it can be concluded that a 5-weeks intervention of Feldenkrais Exercise, significantly improves dynamic balance as measured by TUG and Risk of Falls as measured by MFS among older people.

### ACKNOWLEDGEMENT

The researchers sincerely thank all participants for taking part in this study and thank the staffs from Tresna Werdha Elderly Community Social Service Jombang for

the study approval. Appreciation is also extended to the physicians who assisted in the data collection.

### CONFLICT OF INTEREST

No conflict of interest.

### FUNDING

This research used personal funds and was not sponsored by any party.

### REFERENCES

- Agrawal, Y., Merfeld, D. M., Horak, F. B., Redfern, M. S., Manor, B., Westlake, K. P., Holstein, G. R., Smith, P. F., Bhatt, T., Bohnen, N. I., & Lipsitz, L. A. (2020). Aging, Vestibular Function, and Balance: Proceedings of a National Institute on Aging/National Institute on Deafness and Other Communication Disorders Workshop. *Journals* of Gerontology - Series A Biological Sciences and Medical Sciences, 75(12), 2471–2480. https://doi.org/10.1093/gerona/glaa097
- Anggraeni, D. N., Amalia, M., & Asmiyati, N. N. (2023). Implementasi Peningkatan Kekuatan Otot Lansia Melalui Latihan Aktif. *Jurnal Abdimas Madani*, 5(1), 41–47.
- Berland, R., Marques-Sule, E., Marín-Mateo, J. L., Moreno-Segura, N., López-Ridaura, A., & Sentandreu-Mañó, T. (2022). Effects of the Feldenkrais Method as a Physiotherapy Tool: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *International Journal of Environmental Research and Public Health*, 19(21). https://doi.org/10.3390/ijerph192113734
- Desnita, R., Dahlia, D., & Sukmarini, L. (2020). Bentuk Kaki Berhubungan dengan Keseimbangan Fungsional pada Pasien Neuropati Diabetik. *Jurnal Keperawatan Muhammadiyah*, 5(1), 195–201. https://doi.org/10.30651/jkm.v5i1.3967
- Dewi, E. R., Falentina Tarigan, E., Azizah, N., Tambun, M., Septriyana, T., & Nancy Sinaga, W. (2021). Pelaksanaan Senam Lansia Untuk Peningkatan Kualitas Hidup Lansia. Prosiding Konferensi Nasional Pengabdian Kepada Masyarakat Dan Corporate Social Responsibility (PKM-CSR), 4, 440–444. https://doi.org/10.37695/pkmcsr.v4i0.1208
- Dunggio, A. S. P. (2022). Efektivitas Square Stepping Exercise Dan Balance Exercise Terhadap Peningkatan Keseimbangan Dinamis Pada Lansia Narrative Review Efektivitas Square Stepping Exercise Dan Balance Exercise Terhadap Peningkatan. 1–14.
- Ellithy, A. A., Salem, E. E., Abd, E. R., & Rauof, E. (2020). Role of Mechanical Vestibular Stimulation on Balance in Children With Down Syndrome. *Egyptian Journal of Applied Science*, 35(9), 100–107. https://doi.org/10.21608/ejas.2020.128890
- Faidah, N., Kuswardhani, T., & Artawan E.P, I. W. G. (2020). Pengaruh Latihan Keseimbangan Terhadap Keseimbangan Tubuh Dan Risiko Jatuh Lansia. *Jurnal Kesehatan*, *11*(2), 100. https://doi.org/10.35730/jk.v11i2.428
- Ferlinc, A., Fabiani, E., Velnar, T., & Gradisnik, L. (2019). The Importance and Role of Proprioception in the Elderly: a Short Review. *Materia Socio Medica*, 31(3), 219. https://doi.org/10.5455/msm.2019.31.219-221
- Frederic, L., & Al Haris, M. (2022). Pengaruh Latihan Keseimbangan Terhadap Penurunan Risiko Jatuh Pada Lansia Di Desa Penen Kec. Sibiru-Biru. 901–906.

 $\label{eq:https://journals.stimsukmamedan.ac.id/index.php/senashtek$ 

- Galea, M. P., Connors, K. A., & Said, C. M. (2011). Feldenkrais method balance classes improve balance in older adults: A controlled trial. *Evidence-Based Complementary and Alternative Medicine*, 2011(page 1642). https://doi.org/10.1093/ecam/nep055
- Grote, C., Reinhardt, D., Zhang, M., & Wang, J. (2019). Regulatory mechanisms and clinical manifestations of musculoskeletal aging. *Journal of Orthopaedic Research*, 37(7), 1475–1488. https://doi.org/10.1002/jor.24292
- 13. Gyuton, & Hall. (2013). Fisiologi Kedokteran.
- 14. Hillier, S., & Worley, A. (2015). The effectiveness of the Feldenkrais method: A systematic review of the evidence. *Evidence-Based Complementary and Alternative Medicine*, 2015. https://doi.org/10.1155/2015/752160
- Kalron, A., Rosenblum, U., Frid, L., & Achiron, A. (2017). Pilates exercise training vs. physical therapy for improving walking and balance in people with multiple sclerosis: A randomized controlled trial. *Clinical Rehabilitation*, 31(3), 319–328. https://doi.org/10.1177/0269215516637202
- Kampe, T. (2010). 'Weave': The Feldenkrais Method as Choreographic Process. *Perfformio*, 1(2), 34–52. http://www.smu.ac.uk/perfformio/images/stories/vol1no2 /weave.pdf
- Kang, S. H., Kim, J., Kim, I., Moon, Y. A., Park, S., & Koh, S. B. (2022). Dance Intervention Using the Feldenkrais Method Improves Motor, and Non-Motor Symptoms and Gait in Parkinson's Disease: A 12-Month Study. *Journal* of *Movement Disorders*, 15(1), 53–57. https://doi.org/10.14802/jmd.21086
- Kemenkes RI. (2018). Hasil Riset Kesehatan Dasar Tahun 2018. Kementrian Kesehatan RI, 53(9), 1689– 1699.
- 19. Kiik, S. M. (2018). Pengaruh latihan keseimbangan terhadap kualitas hidup lansia di Kota Depok. *Jurnal Keperawatan Indonesia*, *21*(2), 109–116.
- Kurnia, R. (2019). Pengaruh Senam Terhadap Keluhan Muskuloskeletal Pada Lansia. *Interest: Jurnal Ilmu Kesehatan*, 8(2), 137–140. https://doi.org/10.37341/interest.v8i2.158
- 21. Mattes, J. (2016). Attentional focus in motor learning, the feldenkrais method, and mindful movement. *Perceptual and Motor Skills*, 123(1), 258–276. https://doi.org/10.1177/0031512516661275
- Mekayanti, A., Indrayani, & Dewi, K. (2015). Optimalisasi Kelenturan (Flexibelity), Keseimbangan (Balance), dan Kekuatan (Strength) Tubuh Manusia secara Instan dengan Menggunakan "Secret Method." *Jurnal Virgin*, 1(1), 40–49.
- Mohan, V., Paungmali, A., Sitilertpisan, P., Henry, L. J., Mohamad, N. B., & Kharami, N. N. B. (2016). Feldenkrais method on neck and low back pain to the type of exercises and outcome measurement tools: A systematic review. *Polish Annals of Medicine*, *24*(1), 77– 83. https://doi.org/10.1016/j.poamed.2016.10.003
- Mujiadi, & Mawaddah, N. (2019). Pengaruh Latihan Keseimbangan Terhadap Risiko Jatuh Pada Lansia Di Upt Pesanggrahan Pmks Mojopahit Mojokerto. *Prosiding Seminar Nasional. Hasil Penelitian Dan Pengabdian Masyarakat Seri Ke-3 Tahun 2019*, *3*, 233–238.
- Muladi, A. (2022). Pengaruh Balance Exercise Terhadap Tingkat Keseimbangan Postural Dalam Menurunkan Resiko Jatuh Pada Lansia. *Intan Husada: Jurnal Ilmiah Keperawatan*, 10(02), 145–154. https://doi.org/10.52236/ih.v10i2.248

- Mustafa, D. G., Thanaya, S. A. P., Adiputra, L. M. S. H., & Saraswati, N. L. P. G. K. (2022). Hubungan Antara Kekuatan Otot Tungkai Bawah Dengan Risiko Jatuh Pada Lanjut Usia Di Desa Dauh Puri Klod, Denpasar Barat. *Majalah Ilmiah Fisioterapi Indonesia*, 10(1), 22. https://doi.org/10.24843/mifi.2022.v10.i01.p05
- Ni Putu Riantini, Indah Pramita, I. M. A. Y. (2022). Pengaruh Latihan Body-Weight Squat The Effect Of Body-Weight Squat Exercise Can Increase The Strength Of The Lower Limb Muscle Of Elderly Women in Banjar Bangah, Tabanan District. *Jurnal Fisioterapi Dan Rehabilitasi*, 6(1), 1–8.
- Nisa, L. F., Aini, L., & Rosyidi, K. (2019). The Relationship Between The Ability To Perform Activities Of Daily Living With Risk For Falls Among Older Adults In Tresna Werdha Social Service Banyuwangi. *Journal Of Nursing Science*, 7(2), 1–11.
- 29. Orendorz-Frączkowska, K., & Temporale, H. (2020). Organ of hearing and balance in peri- And postmenopausal women. Effects of hormone replacement therapy on hearing and balance in peri- And postmenopausal women- And current state of knowledge. *Advances in Clinical and Experimental Medicine*, 29(6), 751–755. https://doi.org/10.17219/acem/121935
- Osoba, M. Y., Rao, A. K., Agrawal, S. K., & Lalwani, A. K. (2019). Balance and gait in the elderly: A contemporary review. *Laryngoscope Investigative Otolaryngology*, *4*(1), 143–153. https://doi.org/10.1002/lio2.252
- 31. Palmer, C. F. (2017). Feldenkrais Movement Lessons Improve Older Adults' Awareness, Comfort, and Function. *Gerontology and Geriatric Medicine*, 3, 233372141772401.
  - https://doi.org/10.1177/2333721417724014
- Panova, T., Nikolova, D., & Hachmeriyan, A. (2017). Feldenkrais Method for Cerebral Palsy - A Case Report. 203–207.
- Picard-Deland, C., Allaire, M.-A., & Nielsen, T. (2022). Postural balance in frequent lucid dreamers: a replication attempt. *Sleep*, 45(7), zsac105. https://doi.org/10.1093/sleep/zsac105
- Pramadita, A. P., Wati, A. P., Muhartomo, H., Kognitif, F., & Romberg, T. (2019). Hubungan Fungsi Kognitif Dengan Gangguan Keseimbangan Postural Pada Lansia. Diponegoro Medical Journal (Jurnal Kedokteran Diponegoro), 8(2), 626–641.
- Prasetya, L. Y., Wibawa, A., & Putra, I. N. A. (2015). Hubungan Antara Postur Tubuh Terhadap Keseimbangan Statik Pada Lansia. *FK Unud Denpasar*, *3*(2). https://ojs.unud.ac.id/index.php/mifi/article/view/13106
- 36. Pwri, D. I., & Denpasar, K. (2022). Keseimbangan Dinamis Pada Lansia. 6, 1662–1668.
- Rachmat, N., Syaifudin, M., & Hanifah, H. (2017). Indeks Massa Tubuh dengan Keseimbangan Statis Pengguna Transtibial Prosthesis. *Jurnal Kesehatan*, 8(3), 425. https://doi.org/10.26630/jk.v8i3.630
- Rahman, I., Zane, F. L., Lena, B. Y. S., & Amelia, E. R. (2022). Edukasi Pemberian Tes Fukuda Untuk Mengetahui Gangguan Keseimbangan pada Lansia di Komplek BTN Ciereng Subang. *Jurnal Pengabdian Kepada Masyarakat Digital (JUPED)*, 1(2004), 1–5. https://ejournal.insightpower.org/index.php/JUPED/article /view/108
- Ramadhani, B. (2020). Analisis Hubungan Indeks Masa Tubuh (Imt) Dengan Keseimbangan Lansia. Fakultas Ilmu Kesehatan Universitas 'Aisyiyah Yogyakarta
- Rohima, V., Rusdi, I., & Karota, E. (2020). Faktor Resiko Jatuh pada Lansia di Unit Pelayanan Primer Puskesmas Medan Johor. *Jurnal Persatuan Perawat Nasional Indonesia (JPPNI)*, 4(2), 108. https://doi.org/10.32419/jppni.v4i2.184

- Sadeghi, H., Ashraf, A., Zeynali, N., Ebrahimi, B., & A Jehu, D. (2021). Balance and functional mobility predict low bone mineral density among postmenopausal women undergoing recent menopause with osteoporosis, osteopenia, and normal bone mineral density: A cross-sectional study. *Geriatric Nursing*, 42(1), 33–36. https://doi.org/10.1016/j.gerinurse.2020.10.020
- Salsabilla, D., Yuliadarwati, N. M., & Lubis, Z. I. (2023). Hubungan antara Aktivitas Fisik dengan Keseimbangan pada Lansia di Komunitas Malang. 14(1).
- Sangam, S., Naveed, A., Athar, M., Prathyusha, P., Moulika, S., & Lakshmi, S. (2015). Comparative Effect of Pilates and Feldenkrais Intervention on Functional Balance and Quality of Life in Ambulatory Geriatric Population: A Randomized Controlled Study. *International Journal of Health Sciences and Research*, 5(1), 156–164.
- Shalahuddin, I., Maulana, I., Eriyani, T., & Nurrahmawati, D. (2022). Latihan Fisik Untuk Menurunkan Risiko Jatuh pada Lansia: Literatur Review. *Jurnal Keperawatan Jiwa* (*JKJ*), 10(4), 739–754.
- Sihombing, F., & Athuhema, T. K. (2017). Hubungan Antara Usia Dan Jenis Kelamin Lansia Dengan Risiko Jatuhdi Pstw Unit Abiyoso Yogyakarta. STIKes Santo Borromeus, 82–86. http://ejournal.stikesborromeus.ac.id/file/10-10.pdf
- Sweeting, J., Merom, D., Astuti, P. A. S., Antoun, M., Edwards, K., & Ding, D. (2020). Physical activity interventions for adults who are visually impaired: A systematic review and meta-analysis. *BMJ Open*, *10*(2). https://doi.org/10.1136/bmjopen-2019-034036
- Teixeira-Machado, L., De Araújo, F. M., Menezes, M. A., Cunha, F. A., Menezes, T., Ferreira, C. D. S., & DeSantana, J. M. (2017). Feldenkrais method and functionality in Parkinson's disease: A randomized controlled clinical trial. *International Journal on Disability* and Human Development, 16(1), 59–66. https://doi.org/10.1515/ijdhd-2016-0006
- Tomasoa, V. Y., & Herwawan, J. H. (2021). Faktor-Faktor yang Berhubungan dengan Keseimbangan Lansia di Panti Tresna Werdha Inakaka, Kota Ambon. *Moluccas Health Journal*, 3(1), 90–96.
- 49. Ullmann, G., & Williams, H. G. (2016). The Feldenkrais Method® can enhance cognitive function in independent living older adults: A case-series. *Journal of Bodywork and Movement Therapies*, 20(3), 512–517. https://doi.org/10.1016/j.jbmt.2015.11.017
- Wallman-Jones, A., Mölders, C., Schmidt, M., & Schärli, A. (2022). Feldenkrais to Improve Interoceptive Processes and Psychological Well-being in Female Adolescent Ballet Dancers: A Feasibility Study. *Journal* of Dance Education, 00(00), 1–13. https://doi.org/10.1080/15290824.2021.2009121
- Wijayanti, I. A. S. (2017). Metode Feldenkrais Sebagai Menejemen Nyeri Pada Penderita Osteoartritis. *Ekp*, *13*(3), 1576–1580.
- 52. Yuliadarwati, N. M. (2020). Optimization of Feldenkrais Training as a Prevention of Falling Risk in Elderly. Hsic 2019, 220–222. https://doi.org/10.5220/0009127702200222
- Yuliadarwati, N. M., Agustina, M., Rahmanto, S., & Septyorini, S. (2020). Gambaran Aktivitas Fisik Berkorelasi Dengan Keseimbangan Dinamis Lansia. *Jurnal Sport Science*, 10(2), 107. https://doi.org/10.17977/um057v10i2p107-112
- Yuliadarwati, N. M., Susanti, S., & Rini, S. (2021). Terapi Latihan Dengan Metode Feldenkrais Berpengaruh Terhadap Risiko Jatuh Pada Lansia. *Jurnal Ilmiah Keperawatan Indonesia*, 5(1), 1–8.
- 55. Zahid, S., & Khan, Y. (2020). Feldenkrais method:

utilisation and evidence base. *Journal of Geriatric Care and Research*, 7(2), 93–95.