

Original Research

## The Effect of Buerger Allen Exercise on Muscle Cramps in Preventing Intradialysis Emergency



Danny Putri Sulistyaningrum<sup>1\*</sup>, Maya Cobalt Angio Septianingtyas<sup>1</sup>, & Mianti Nurriszky Sutejo<sup>1</sup>

<sup>1</sup>STIKES Telogorejo, Semarang, Indonesia

Article Info	Abstract
Article history: Received: 22 May 2024 Accepted: 20 October 2024	<p><i>Introduction:</i> Hemodialysis is a kidney replacement therapy for patients with stage V chronic kidney disease. During hemodialysis, patients often complain of muscle cramps. More than <math>\frac{3}{4}</math> of hemodialysis patients have experienced muscle cramps. This condition causes discomfort and anxiety, which can reduce their quality of life. If the patient shortens the duration of hemodialysis, the process of removing toxins and excess fluid will not be optimal. This study aimed to investigate the effect of Buerger Allen exercises on muscle cramps in intradialysis patients.</p> <p><i>Methods:</i> This study used a quasi-experimental design with a two-group pretest-posttest control group structure. The sample consisted of 64 hemodialysis patients at Klinik Ginjal dan Hipertensi Lestari, selected using a consecutive sampling technique. The sample was divided into two groups: 32 in the treatment group and 32 in the control group. The inclusion criteria were ages 25 to 70, compos mentis, able to read and write, willing to participate, and undergoing routine hemodialysis twice a week for at least 4 hours. Statistical analysis was performed using the Mann-Whitney test.</p> <p><i>Results:</i> The results showed that the mean rank in the treatment group was higher than in the control group (44.97 vs. 20.03). Statistical analysis showed a p-value of 0.000 (&lt;0.05).</p> <p><i>Conclusion:</i> Buerger Allen exercises have a significant effect on reducing muscle cramps in intradialysis patients.</p>
Keywords: Buerger Allen exercise, hemodialysis, muscle cramps	

\*Corresponding Author:

e-mail: [danny\\_putri@stikestelogorejo.ac.id](mailto:danny_putri@stikestelogorejo.ac.id)



This work is licensed under a Creative Commons Attribution 4.0 International License.

## **INTRODUCTION**

Hemodialysis is a process of filtering blood using a machine that functions as a substitute for the kidneys in removing the body's metabolic waste [1]. This procedure is performed 2 to 3 times per week, with each session lasting 4 to 5 hours, for patients diagnosed with stage 5 chronic kidney disease (CKD) [2]. In recent years, the incidence of stage 5 CKD has increased and has become a global health issue.

Between 2000 and 2019, the number of new patients with stage 5 CKD increased by 40,392 people [3]. Meanwhile, the IRR recorded that 35,602 people in Indonesia were registered as new stage 5 CKD patients from 2017 to 2018 [4]. In Central Java alone, there were 7,906 new patients with stage 5 CKD [4]. Additionally, the number of hemodialysis patients at Klinik Ginjal dan Hipertensi "Lestari" in 2023 was 167.

Klinik Ginjal dan Hipertensi "Lestari" is a clinic that provides hemodialysis services. According to interviews with room nurses, patients often complained of muscle cramps during intradialysis. In interviews with patients, they expressed that muscle cramps caused unbearable pain and interfered with the hemodialysis process. They also reported feeling anxious about starting hemodialysis therapy again.

Muscle cramps affect around 25% to 50% of patients undergoing hemodialysis [5]. Punj et al. also found that 79% of patients had experienced muscle cramps at least once during dialysis [6]. The exact cause of muscle cramps in hemodialysis patients is not yet known, but several triggers, such as electrolyte imbalances, hypovolemia,

hypotension, high blood flow, ultrafiltration rates, and improper dialysate composition, have been identified [5]. Muscle cramps generally occur about halfway through or near the end of the hemodialysis session [7]. These cramps start with severe pain, which has been reported to negatively affect sleep quality and quality of life, often leading to depression and anxiety [5],[8].

Treatment for muscle cramps includes intravenous fluids, oral medications, adjusting dialysis settings, warm compresses, and stretching [5]. The Buerger Allen exercise is a stretching technique involving active plantar movements, intended to perform regular motions with the aid of gravitational force [9]. This exercise is expected to increase arterial and venous blood flow by opening capillaries and improving blood supply to the tissues [10]. A new aspect of this research is the introduction of the Buerger Allen exercise, which has not been previously used in this context. Additionally, previous studies required three training sessions per week, each lasting 20 minutes [5]. Therefore, the study aimed to investigate the effect of Buerger Allen exercises on muscle cramps in intradialysis patients.

## **METHOD**

### ***Study Design***

This study employed a quasi-experimental design, using a two-group pretest-posttest control group structure. The design was chosen to evaluate the effect of Buerger Allen exercises on muscle cramps in patients undergoing hemodialysis. A control group receiving standard care was compared to a

treatment group performing Buerger Allen exercises during dialysis sessions.

***Subject (Population, Sample, Technique Sampling, Subject Criteria)***

The study was conducted at Klinik Ginjal dan Hipertensi “Lestari”, a specialized clinic providing hemodialysis services. The study population consisted of all patients undergoing hemodialysis at the clinic. In 2023, the clinic had a total of 167 registered patients receiving routine hemodialysis treatment. The inclusion of patients from this clinic allowed the researchers to access a relevant and homogenous population for the study.

The sample size was determined using the Slovin formula, which produced a total sample size of 64 respondents. The sampling technique used was non-probability sampling, specifically consecutive sampling, where every eligible patient who met the inclusion criteria was recruited until the desired sample size was achieved. The sample was equally divided into two groups: 32 participants in the treatment group and 32 participants in the control group.

The inclusion criteria included patients aged 25–70 years who were *compos mentis*, were able to read and write, were willing to be a respondent, and were undergoing routine hemodialysis twice a week for at least 4 hours. Meanwhile, exclusion criteria were patients with hemodynamic instability, defined by blood pressure  $\leq 110/70$  mmHg or  $\geq 150/90$  mmHg, pulse rate  $\leq 60$  or  $\geq 100$  times per minute, respiratory rate  $\leq 16$  or  $\geq 20$  times

per minute, and body temperature  $\leq 36^{\circ}\text{C}$  or  $\geq 37^{\circ}\text{C}$ , and patients unable to complete the required sessions of the intervention due to illness or other factors.

***Intervention***

The intervention involved administering Buerger Allen exercises during hemodialysis sessions. The treatment group performed the exercise during their intradialysis period, consisting of active plantar flexion and dorsiflexion movements designed to promote blood circulation. The exercises were conducted over a period of four consecutive hemodialysis procedures, with each session lasting 20 minutes.

The treatment group engaged in the exercise during their regular hemodialysis sessions scheduled on Mondays and Thursdays or Tuesdays and Fridays. The control group, whose hemodialysis sessions were scheduled on Wednesdays and Saturdays, received standard care as outlined in the clinic’s Standard Operating Procedures (SOP).

Before the intervention, the severity and frequency of muscle cramps were measured using the Cramp Questionnaire Chart as a pretest. The same chart was administered again after the four hemodialysis sessions, during which the treatment group performed the exercises, to assess any changes in muscle cramps (posttest).

***Outcome Measurement***

The primary outcome measure was the change in the occurrence and intensity of muscle cramps in both groups. Muscle cramps were assessed using the Cramp Questionnaire

Chart, a validated instrument for evaluating muscle cramp severity and frequency. Respondents were asked to report the frequency and intensity of muscle cramps experienced during each hemodialysis session. Scores were collected before the intervention (pretest) and after the intervention (posttest) to determine the impact of the exercise.

### Statistical Analysis

Data analysis was conducted using SPSS version 25. Descriptive statistics (mean, standard deviation, and frequency distribution) were used to summarize the demographic data and baseline characteristics of the participants. The Kolmogorov-Smirnov test was applied to test the normality of the data distribution.

For inferential analysis, the Mann-Whitney U test was employed to compare the mean differences between the treatment and control groups, given that the data were not normally distributed. A p-value of <0.05 was considered statistically significant, indicating that the Buerger Allen exercise had a meaningful impact on reducing muscle

cramps in the treatment group compared to the control group.

### Ethical Considerations

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the STIKES Telogorejo Semarang Ethics Committee, under approval number 111/XI/KE/STIKES/2023. All participants were informed about the study's purpose, procedures, potential risks, and benefits, and written informed consent was obtained from each participant prior to their inclusion in the study.

### RESULTS

Table 1 shows that the mean age of respondents was 54.78 years (standard deviation 10.34), with a range from 27 to 70 years. The 95% confidence interval suggests that the mean age is likely between 52.19 and 57.36 years. The mean Qb (Quick of Blood) of respondents was 189.45 mL/min (standard deviation 33.65), with a range of 150 to 300 mL/min, and a 95% confidence interval indicating that the mean Qb is between 181.05 and 197.86 mL/min.

**Table 1.** Distribution of respondent characteristics based on age and Qb at Klinik Ginjal dan Hipertensi Lestari November – December 2023 (n=64)

Variable	N	Mean ± SD	Median	Min – Max	95% CI	
					(Min)	(Max)
<b>Age</b>						
Treatment dan Control	64	54.78 ± 10.34	57.00	27 – 70	52,19	57.36
Treatment	32	55.63 ± 8.56	57.00	33 – 70	52.54	58.71
Control	32	53.94 ± 11.94	57.00	27 – 70	49.63	58.24
<b>Quick of blood (Qb)</b>						
Treatment dan Control	64	189.45 ± 33.65	180.00	150 – 300	181.05	197.86
Treatment	32	189.38 ± 29.34	192.50	150 – 300	178.80	199.95
Control	32	189.53 ± 37.96	180.00	150 – 300	175.85	203.22

Table 2 shows that the highest proportion of respondents was male (51.6%, 33 respondents). Additionally, 50% (32

respondents) had been undergoing hemodialysis for more than 24 months.

**Table 2.** Distribution of respondent characteristics based on gender and length of time undergoing hemodialysis at Klinik Ginjal dan Hipertensi Lestari November – December 2023 (n=64)

Variable	Category	Treatment		Control		Total	
		N	%	n	%	n	%
Gender	Male	18	28.1	15	23.4	33	51.6
	Female	14	21.9	17	26.6	31	48.4
Length of time undergoing hemodialysis	<12 months	8	12.5	8	12.5	16	25
	12 – 24 months	9	14.1	7	10.9	16	25
	>24 months	15	23.4	17	26.6	32	50

Table 3 indicates that the data for muscle cramps before (p = 0.003) and after (p =

0.000) the intervention were not normally distributed (p < 0.05).

**Table 3.** Normality Test

Variable	df	Sig.
Muscle Cramps Pre	64	0.003
Muscle Cramps Post	64	0.000

Table 4 demonstrates a significant difference in muscle cramp severity between the treatment and control groups after the

Buerger Allen exercise (p < 0.05), with the treatment group showing significantly fewer muscle cramps.

**Table 4.** Differences in muscle cramps after Buerger Allen exercise in the control group and treatment group at Klinik Ginjal dan Hipertensi November – December 2023 (n=64)

Variable	Group	n	Mean Rank	Z	P value
Muscle Cramps	Treatment	32	44.97	-5.981	0.000
	Control	32	20.03		

## DISCUSSION

The research results show that the average age of respondents is 54.78 years. These findings align with IRR data, which indicate that the majority of hemodialysis patients are aged between 45–54 years (29.36%) and 55–64 years (31.19%) [4]. The kidneys are among the organs that age most rapidly, which is reflected in their declining structure and function as people grow older [11]. The loss of

kidney function is characterized by a decrease in the glomerular filtration rate (GFR) and the number of nephrons. This decline can be due to physiological conditions, such as the natural aging process, or pathological conditions, such as prolonged exposure to diseases [12]. The Baltimore Longitudinal Study of Aging (BLSA) reports that healthy individuals aged 30 years experience an average decrease in creatinine clearance of

0.75 mL/min/year [12]. This is also supported by studies from Denic et al. and Noronha et al., which state that the decline in GFR after the age of 30–40 years is considered physiological and becomes more significant after the age of 70 [12],[13]. This condition can eventually progress to stage V chronic kidney disease.

The research results show that the majority of respondents were men (51.6%). Kidney function decreases in both men and women with age, but research suggests that more men initiate kidney replacement therapy than women. This disparity may be due to men's unhealthy lifestyles, which lead to quicker declines in kidney function [14]. Several factors contribute to the development of stage V chronic kidney disease. Research by Ricardo et al. found a significant difference in the decrease in GFR between men ( $-1.43 \text{ mL/min/1.73 m}^2$ ) and women ( $-1.09 \text{ mL/min/1.73 m}^2$ ) [13]. Smoking habits and the consumption of protein-rich foods in men increase the risk of kidney damage [12]. In contrast, women benefit from the protective effects of estrogen, which helps preserve blood vessel and kidney function, reducing the risk of chronic kidney disease [15]. Additionally, women tend to seek conservative treatments, such as using healthcare services and controlling risk factors, which lower their risk of chronic kidney disease [13].

The study found that the average Qb (Quick of Blood) of respondents was 189.45 mL/min. This result is consistent with research by Ahmad et al., whose study recorded a Qb of 186.6 mL/min [16]. However, this finding differs from IRR data,

which suggest that the Qb proportion typically falls between 200–249 mL/min [4]. Qb, also known as blood flow velocity, is the amount of blood (in mL) that flows per minute to the dialyzer. A higher blood flow rate allows more waste and fluid to be removed from the body. According to Nurbadriyah et al., patients beginning hemodialysis are initially given a Qb of 100 mL/min, which is gradually increased to the optimal speed [17]. Qb is typically adjusted for patient comfort or based on needle size [18]. A Qb lower than 200 mL/min is often used in specific cases, such as for new patients, pediatric patients, elderly patients, and those with heart conditions [17].

The study also revealed that 50% of respondents (32 patients) had been undergoing hemodialysis for more than 24 months. These results are in line with Irawan & Suhartini's research, where 52.4% of respondents had undergone hemodialysis for over 24 months [19]. The findings also agree with research by Syara et al., which reported that the majority of patients had been undergoing hemodialysis for more than 24 months [20]. Hemodialysis is a lifelong kidney replacement therapy for patients with stage V chronic kidney disease [2]. It is the most popular alternative to peritoneal dialysis, offering a higher survival rate for stage V chronic renal disease patients. Hemodialysis effectively removes toxins from the body, alleviating symptoms such as nausea, vomiting, edema, and poor appetite [21]. Patients undergoing hemodialysis for a longer period tend to reach an acceptance stage, becoming more compliant and receptive to

health education from healthcare providers [22].

The results of this study demonstrate that Buerger Allen exercise can significantly reduce muscle cramps in hemodialysis patients ( $p < 0.05$ ). Hemodialysis remains the most common form of kidney replacement therapy worldwide. Despite technological advances, the morbidity rate remains high. Muscle cramps are a common complaint among hemodialysis patients [23], often described as sudden, painful muscle contractions that interfere with daily activities [24]. As many as 97% of hemodialysis patients report experiencing muscle cramps at least once during dialysis [6]. Causes of muscle cramps include hypovolemia due to high ultrafiltration, changes in electrolyte balance, hypotension, and reduced muscle blood flow during dialysis [5],[6].

Leg cramps typically occur due to the release of calcium ions from the sarcoplasmic reticulum, causing muscle spasms. Muscle cramps can also result from excessive water loss during ultrafiltration, leading to changes in extracellular fluid volume and increased bicarbonate ( $\text{HCO}_3^-$ ) concentration. When the amount of water removed is greater than the body's mass, hypotension and decreased blood flow can occur [7].

Buerger Allen exercise is a form of physical therapy designed to improve vascularization in muscles affected by arterial insufficiency in the lower limbs [25]. The exercise involves alternating dorsiflexion and plantar flexion in the ankle, which pumps the muscles and promotes capillary vasodilation. This process increases arterial blood flow and

stimulates vascular angiogenesis [10]. Buerger Allen exercise during intradialysis also enhances nutrient delivery to cells and increases the capillary surface area, facilitating the movement of urea and toxins from tissues to the vasculature, thereby reducing muscle cramps [26].

### **NURSING IMPLICATIONS**

The findings of this study present important nursing implications, particularly the potential for Buerger Allen exercises to reduce muscle cramps in hemodialysis patients. Integrating this exercise into standard nursing practice can enhance patient comfort and improve treatment adherence. Nurses can empower patients to perform these exercises independently, promoting self-management and engagement in their care. Furthermore, implementing these exercises as an early intervention during dialysis could prevent cramps, ensuring smoother sessions. However, personalized care is essential, as patients vary in their health status and ability to perform exercises. This holistic approach, combining exercise with monitoring fluid balance, blood pressure, and electrolyte levels, could improve patient outcomes.

### **STUDY LIMITATION**

The study, however, has several limitations. The small sample size and limited focus on factors like electrolyte imbalances and comorbidities restrict the generalizability of the findings. Additionally, the lack of long-term follow-up and exclusion of other forms of exercise leave room for further exploration. Future research should include larger, more

diverse populations, examine the long-term benefits of the Buerger Allen exercise, and explore other interventions for managing muscle cramps. Addressing these limitations would provide a more comprehensive understanding of effective interventions for improving the quality of life for hemodialysis patients.

## CONCLUSION

The results of this study show a significant effect of Buerger Allen exercise in reducing muscle cramps in intradialysis patients ( $p < 0.05$ ). Patients can independently perform this exercise during the first hour of intradialysis, for a duration of 20 minutes. Healthcare providers should consider incorporating Buerger Allen exercise into standard operating procedures in hemodialysis units.

## ACKNOWLEDGEMENT

Thank you to all parties who have supported this research by providing information and collaborating with the Klinik Ginjal dan Hipertensi Lestari, especially hemodialysis patients involved in this research.

## REFERENCES

[1] S. Vadakedath and V. Kandi, "Dialysis: A Review of the Mechanisms Underlying Complications in the Management of Chronic Renal Failure," *Cureus*, Aug. 2017, doi: 10.7759/cureus.1603.

[2] F. Murdeshwar, H.N. and Anjum, *Hemodialysis*. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2022. [Online]. Available: <https://www.ncbi.nlm.nih.gov/books/>

NBK563296/

- [3] United States Renal Data System, "2022 USRDS Annual Data Report: Epidemiology of kidney disease in the United States," 2022. [Online]. Available: <https://usrds-adr.niddk.nih.gov/2022>
- [4] PERNEFRI, "11th report Of Indonesian renal registry 2018," *Indones. Ren. Regist.*, pp. 14–15, 2018.
- [5] D. Mastnardo *et al.*, "Intradialytic massage for leg cramps among hemodialysis patients: A pilot randomized controlled trial," *Int. J. Ther. Massage Bodyw. Res. Educ. Pract.*, vol. 9, no. 2, pp. 3–8, 2016, doi: 10.3822/ijtmb.v9i2.305.
- [6] S. Punj, A. Enaam, A. Marquez, A. J. Atkinson, and D. Batlle, "A Survey on Dialysis-Related Muscle Cramping and a Hypothesis of Angiotensin II on Its Pathophysiology," *Kidney Int. Reports*, vol. 5, no. 6, pp. 924–926, Jun. 2020, doi: 10.1016/j.ekir.2020.03.003.
- [7] A. Takahashi, "The pathophysiology of leg cramping during dialysis and the use of carnitine in its treatment," *Physiological Reports*, vol. 9, no. 21. American Physiological Society, Nov. 01, 2021. doi: 10.14814/phy2.15114.
- [8] L. Juwita and I. R. Kartika, "Pengalaman Menjalani Hemodialisa Pada Pasien Gagal Ginjal Kronis," *J. Endur.*, vol. 4, no. 1, p. 97, Mar. 2019, doi: 10.22216/jen.v4i1.3707.
- [9] C. F. Chang, C. C. Chang, S. L. Hwang, and M. Y. Chen, "Effects of Buerger Exercise Combined Health-Promoting Program on Peripheral Neurovasculopathy Among Community Residents at High

- Risk for Diabetic Foot Ulceration,” *Worldviews Evidence-Based Nurs.*, vol. 12, no. 3, pp. 145–153, Jun. 2015, doi: 10.1111/wvn.12091.
- [10] A. Salindeho *et al.*, “Pengaruh Senam Diabetes Melitus Terhadap Kadar Gula Darah Penderita Diabetes Melitus Tipe 2 Di Sanggar Senam Persadia Kabupaten Gorontalo,” 2016.
- [11] J. Dybiec, M. Szlagor, E. Młynarska, J. Rysz, and B. Franczyk, “Structural and Functional Changes in Aging Kidneys,” *International Journal of Molecular Sciences*, vol. 23, no. 23. MDPI, Dec. 01, 2022. doi: 10.3390/ijms232315435.
- [12] “4239-9203-1-PB”.
- [13] A. C. Ricardo *et al.*, “Sex-related disparities in CKD progression,” *J. Am. Soc. Nephrol.*, vol. 30, no. 1, pp. 137–146, Jan. 2019, doi: 10.1681/ASN.2018030296.
- [14] J. J. Carrero, M. Hecking, N. C. Chesnaye, and K. J. Jager, “Sex and gender disparities in the epidemiology and outcomes of chronic kidney disease,” *Nat. Rev. Nephrol.*, vol. 14, no. 3, pp. 151–164, 2018, doi: 10.1038/nrneph.2017.181.
- [15] H. Y. Kao, C. C. Chang, C. F. Chang, Y. C. Chen, C. Cheewakriangkrai, and Y. L. Tu, “Associations between Sex and Risk Factors for Predicting Chronic Kidney Disease,” *Int. J. Environ. Res. Public Health*, vol. 19, no. 3, Feb. 2022, doi: 10.3390/ijerph19031219.
- [16] N. N. A. Nanda, Danny Putri Sulistyaningrum, and Riris Risca Megawati, “The Relationship between Quick Of Blood and Fatigue in Stage V Chronic Renal Failure Patients Undergoing Hemodialysis,” *Healthc. Nurs. J.*, vol. 5, no. 2, pp. 790–799, Jul. 2023, doi: 10.35568/healthcare.v5i2.3637.
- [17] W. Dwi Nurbadriyah, N. Nursalam, I. Yuni Widyawati, . H., A. Wahyu Kurniawan, and D. Santi Fatmawati, “Correlation Between the Quick of Blood and Quality of Life of Chronic Kidney Disease Patients in Dialysis Therapy in the Hemodialysis Unit at Wava Husada Hospital,” *KnE Med.*, Mar. 2023, doi: 10.18502/kme.v3i2.13067.
- [18] S. Fadlilah, A. Sucipto, and N. H. Rahil, “The relationship between blood flow rate and changes in blood pressure of patients during hemodialysis in Central Java, Indonesia,” *World J. Adv. Res. Rev.*, vol. 2020, no. 02, pp. 2581–9615, 2020, doi: 10.30574/wjarr.
- [19] A. Website, D. Irawan, and T. Suhartini, “Jurnal Keperawatan Muhammadiyah Hubungan Lama Menjalani Terapi Hemodialisis Dengan Tingkat Stress Pasien Gagal Ginjal Kronis.”
- [20] A. M. Syara, S. Suhaimi, A. S. G. Purba, J. M. Simarmata, and C. Y. Saragih, “Hubungan Lama Hemodialisis Dengan Nafsu Makan Pada Pasien Gagal Ginjal Kronik Di Unit Hemodialisis Rumah Sakit Grandmed Lubuk Pakam Tahun 2019,” *J. Keperawatan Dan Fisioter.*, vol. 3, no. 1, pp. 79–86, Oct. 2020, doi: 10.35451/jkf.v3i1.537.
- [21] S. M. Kim *et al.*, “Comparison of hemodialysis and peritoneal dialysis patients’ dietary behaviors,” *BMC Nephrol.*, vol. 21, no. 1, Mar. 2020, doi:

- 10.1186/s12882-020-01744-6.
- [22] A. Saputra and O. A. Wiryansyah, "Babul Ilmi\_Jurnal Ilmiah Multi Science Kesehatan Hubungan Lama Masa Hemodialisis Dengan Kualitas Hidup Pasien Gagal Ginjal Kronik," vol. 15, no. 1, p. 126, [Online]. Available: <https://jurnal.stikes-aisyiyah-palembang.ac.id/index.php/Kep/article/view/>
- [23] C. D. Y. Nekada and M. Judha, "Dampak Frekuensi Pernapasan Predialisis Terhadap Kram Otot Intradialisis Di Rsud Panembahan Senopati Bantul," *J. Keperawatan Indones.*, vol. 22, no. 1, pp. 11-22, May 2019, doi: 10.7454/jki.v22i1.604.
- [24] N. Luh Putu Ekarini, R. Siti Maryam, J. Keperawatan, and P. Kesehatan Kemenkes, "Pengaruh Terapi Relaksasi Otot Progresif terhadap Respon Fisiologis Pasien Hipertensi," Online, 2019. [Online]. Available: <http://ejurnal.poltekkes-tjk.ac.id/index.php/JK>
- [25] A. Sari, A. W. W, and Y. Sofiani, "Efektifitas Perbandingan Buerger Allen Exercise dan Senam Kaki terhadap Nilai ABI pada Penderita DM Tipe II," *J. Telenursing*, vol. 1, no. 1, pp. 1-16, Apr. 2019, doi: 10.31539/joting.v1i1.492.
- [26] M. L. J, D. E. J. Abraham, and D. G. Malarvizhi, "Effectiveness of Intradialytic Stretching Exercises on Prevention and Reduction of Muscle Cramps among Patients undergoing Haemodialysis at PSG Hospitals Coimbatore," *IOSR J. Nurs. Heal. Sci.*, vol. 06, no. 02, pp. 47-53, Mar. 2017, doi: 10.9790/1959-0602044753.