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Implementation of Ankle Pump Exercise for Edema Reduction in Chronic Kidney Disease Patients

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Abstract

Chronic Kidney Disease (CKD) is a global public health problem characterized by a gradual loss of kidney function over time. Edema is a common clinical manifestation in patients with Chronic Kidney Disease (CKD), particularly in the advanced stages, resulting from impaired fluid and sodium regulation due to declining kidney function, often accompanied by hypoalbuminemia and increased capillary hydrostatic pressure. The objectives of this study was to describe the the implementation of ankle pump exercise to reduce the degree of edema in patients with CKD. The study used a descriptive case study method based on Evidence-Based Nursing Practice (EBNP), using a nursing care process approach consisting of assessment, nursing diagnosis, intervention, implementation, and evaluation. The subjects in this study were 3 respondents who are case-managed patients within the nursing care approach. The ankle pump exercise was implemented over 3 days, with a total of 6 sessions conducted twice a day, each lasting 8 minutes per session. The results of the analysis before and after therapy with ankle pump exercises showed that ankle pump exercises have an effect on the degree of edema in the lower extremities of patients with CKD. Ankle pump exercise therapy has been proven to help reduce the degree of edema in CKD patients. This intervention is highly relevant to nursing practice because it is simple, can be performed independently by patients, and contributes to an improved quality of life.

Keywords: *Ankle pump exercise, Chronic Kidney Disease, Edema.*

Introduction

Chronic Kidney Disease (CKD) is global health concern with increasing prevalence worldwide. CKD is a progressive and irreversible impairment of kidney function, leading to physiological alterations in which the body can no longer maintain metabolic processes and fluid-electrolyte balance, ultimately resulting in uremia[1]. Kidney damage disrupts renal function,

rendering the kidneys unable to excrete metabolic waste products through urine. The kidney dysfunction further affects of hormonal regulation, electrolyte balance, fluid homeostasis, metabolic processes, and acid-base equilibrium[2].

According to the Global Burden of Disease report, Chronic Kidney Disease (CKD) ranks among the leading causes of death worldwide, with over one million deaths annually attributed to complications of the disease [3]. Data World Health Organization (WHO) indicate that the number of CKD cases in Indonesia is projected to increase significantly by 41.4% between 1995 and 2025[4]. In Indonesia, the data of Riskesdas survey in 2018 reported a CKD prevalence of 3.8 per thousand population, with this figure expected to rise in parallel with increasing age and the presence of comorbidities such as hypertension and diabetes mellitus[5]. In Central Java specifically, the prevalence of CKD has reached 0.42%, with an estimated 96,794 individuals affected[6].

One of the most common clinical manifestations observed in patients with Chronic Kidney Disease (CKD) is peripheral edema, particularly in the lower extremities. This condition is primarily caused by fluid retention due to the kidneys' diminished ability to excrete sodium and water. If left unmanaged, edema can lead to discomfort, reduced mobility, and an increased risk of pressure ulcers and infection[7]. Edema is also recognized as a characteristic symptom in CKD patients experiencing the nursing problem of hypervolemia. Clinical data from Seruni Ward at Level II Hospital Dr. Soedjono Magelang show that, during the one-month period from November to December 2024, 9 out of 15 patients diagnosed with CKD presented with lower extremity edema.

The management of edema in patients with Chronic Kidney Disease (CKD) involves pharmacological therapy, such as the administration of diuretics, fluid restriction, and passive physical therapy. However, pharmacological treatment alone is often insufficient to resolve edema without the support of non-pharmacological nursing interventions that focus on enhancing peripheral circulation. One simple yet effective intervention proven to improve venous return and prevent venous stasis is the Ankle Pump Exercise (APE). APE consists of active dorsiflexion and plantarflexion movements of the ankle joint[7].

Based on findings from Evidence-Based Nursing Practice (EBNP), the implementation of ankle pump exercise has been shown to be effective in reducing edema in patients with chronic kidney disease (CKD). Previous studies have demonstrated that APE is widely used as a preventive measure for deep vein thrombosis (DVT), particularly in postoperative patients and those

undergoing prolonged immobilization[8]. The other research also confirmed that APE significantly increases venous blood flow in the lower extremity[9]. Other studies have shown a significant effect of ankle pump exercise interventions in reducing the diameter of edema in patients with lower limb edema. Additionally, flexion and extension exercises of the affected limb have also been found to contribute to the reduction of edema diameter[10]. Other studies have also demonstrated a significant effect of ankle pump exercise interventions in reducing the level of lower limb edema in patients with chronic kidney disease (CKD)[11]. However, the specific application of APE in patients with CKD related edema remains limited, particularly in the context of nursing care for CKD patients in the Seruni Ward at Rumkit Tk.2 dr. Soedjono, Magelang.

Based on the background, it is essential to conduct a case study to describe the effectiveness of ankle pump exercise (APE) in reducing edema among patients with Chronic Kidney Disease (CKD). The implementation of APE may serve as a simple, low-cost, and non-pharmacological intervention that can be performed independently by patients under the guidance of nurses to address the nursing problem of hypervolemia, as indicated by the presence of lower extremity edema. This study is expected to contribute to the body of scientific evidence in nursing care practices for CKD patients with edema and support efforts to improve their overall quality of life.

Methods

The study used a descriptive case study method based on Evidence-Based Nursing Practice (EBNP), using a nursing care process approach consisting of assessment, nursing diagnosis, intervention, implementation, and evaluation. The descriptive case study method based on EBNP approach is used to provide an in-depth description of real events, situations, or phenomena experienced by individuals or groups within a specific context. The EBNP approach integrates the best available scientific evidence, clinical expertise, and patient values or preferences in making nursing care decisions[10,11].

The population in this study consisted of CKD patients hospitalized in the Seruni Ward of Level II Hospital Dr. Soedjono, Magelang. The case study subjects were three CKD patients in the Seruni Ward who met the predetermined inclusion and exclusion criteria. The inclusion criteria included CKD patients who were hospitalized, experiencing lower extremity edema, and willing to receive the intervention. The exclusion criteria included patients with impaired consciousness (GCS < 15), patients with ulcers, and patients with fractures.

The instruments used in this study included the nursing care format, a pitting edema observation sheet, a ruler, a wristwatch, a weighing scale, and the Standard Operating Procedure (SOP) for the ankle pump exercise. The case study was conducted in the Seruni Ward of Level II Hospital Dr. Soedjono, Magelang, through a three-day nursing care process during the period from November 26 to 28 2024. The intervention was administered for 8 minutes per session, twice daily, with a 7-hour interval between sessions, in accordance with the Ankle Pump Exercise SOP. Data were collected through literature review, interviews, and observation. The collected data were presented in the form of narrative descriptions and an implementation table of the ankle pump exercise.

Results

The case study based on Evidence-Based Nursing Practice (EBNP) using the nursing care process approach was conducted in the Seruni Ward of Level II Hospital Dr. Soedjono, Magelang, over a three-day period from November 26 to 28, 2024. The case study subjects consisted of three patients diagnosed with Chronic Kidney Disease (CKD) who met the established inclusion and exclusion criteria: Mrs. T, Mrs. S, and Mrs. D. The outcomes of the nursing care implementation include assessment, formulation of nursing diagnoses, intervention planning, implementation, and evaluation. The assessment findings revealed the following characteristics in the three case study subjects:

Table 1

Assessment Results

No.	Data	Patient 1	Patient 2	Patient 3
1.	Name	Ny.T	Ny.S	Ny.D
2.	Age	60 years old	62 years old	37 years old
3.	Sex	Female	Female	Female
4.	Religion	Islam	Islam	Islam
5.	Occupation	Housewife	Housewife	Housewife
6.	Marital Status	Married	Married	Married
7.	Educational	Junior High School	Senior High School	Senior High School
8.	Duration of CKD Diagnosis	8 months	2 years	1 years
9.	Hemodialysis Frequency	2 times/week	2 times/week	2 times/week
10.	Past Medical History	Hypertension	-	-
11.	Chief Complaints	Dizziness, difficulty breathing, and swollen leg	Difficulty breathing, nausea, and swollen leg	Difficulty breathing and swollen leg
12.	Vital Sign	BP : 180/95 mmHg HR: 102x/menit RR:22x/menit	BP: 170/95 mmHg HR:100x/menit RR: 24x/menit	BP: 150/90 mmHg HR: 98x/menit RR: 22x/menit

		T: 37,2ºC	T: 36,5 ºC	T: 36,8ºC
13.	Depth of Edema	6 mm	6 mm	4 mm
14.	Degree of Edema	3	3	2
15.	Body Weight	65 kg	55 kg	50 kg
16.	CRT	50 seconds	60 seconds	15 seconds

Based on Table 1, all of three patients on this case study subjects were female, married, Muslim, and worked as housewives. The first subject, Mrs. T, had been diagnosed with CKD for 8 months and had a history of hypertension. During the assessment conducted on November 24, 2025, patients complained of dizziness, difficulty breathing, and swollen leg. Physical assessment showed that blood pressure of 180/95 mmHg, lower extremity edema with a depth of 6 mm and grade 3, body weight of 65 kg, and a capillary refill time (CRT) of 50 seconds. The second subject, Mrs. S, had been diagnosed with CKD since 2023 and had no prior history of chronic illness. During the assessment on November 25, 2025, patients complained of difficulty breathing, nausea, and swollen leg. Physical assessment showed that blood pressure of 170/95 mmHg, lower extremity edema with a depth of 6 mm and grade 3, body weight of 55 kg, and CRT of 60 seconds. The third subject, Mrs. D, had been living with CKD for approximately one year and also had no known history of chronic illness. During the assessment on November 25, 2025, patients complained of difficulty breathing and swollen leg. Physical assessment showed that blood pressure of 150/90 mmHg, lower extremity edema with a depth of 4 mm and grade 2, body weight of 50 kg, and CRT of 15 seconds.

The nursing diagnosis for the three case study subjects was hypervolemia related to impaired regulatory mechanisms proven by complaints of difficulty breathing and swollen leg, the lower extremity edema, edema depth ranging from 4 to 6 mm, edema grade between 2 until 3, CRT > 2 seconds, and elevated blood pressure (D.0022)[12].

The intervention in this case study was Hypervolemia Management (I.03114), which was carried out over a period of three days. The expected outcome was Improved Fluid Balance (L.03020), with outcome criteria including reduced peripheral edema, improved blood pressure, improved body weight, and improved capillary refill time (CRT)[13,14]. The fluid volume excess management intervention consisted of observation, therapeutic, educational, and evaluative actions, which included monitoring signs and symptoms of hypervolemia (edema, CRT, blood pressure, body weight), daily weight monitoring, elevating the head of the bed to 30–40°, performing ankle pump exercise therapy, advising the patient to restrict fluid intake, collaborating

in the administration of diuretics, and, if necessary, collaborating on continuous renal replacement therapy (hemodialysis).

The implementation was carried out in accordance with the planned interventions, focusing on therapeutic actions through the administration of ankle pump exercise therapy to the three case study subjects over a period of three days. Each session was conducted for 8 minutes, twice a day, with a 7-hour interval between sessions, following the Standard Operating Procedure (SOP) for therapy. The ankle pump exercise was performed by moving the ankle joint in dorsiflexion and plantarflexion, which stimulates a muscle pump mechanism that forces excess interstitial fluid into the blood vessels and directs it toward the heart. This process enhances circulation, reduces fluid accumulation, and helps prevent obstruction in the peripheral vascular system.

The evaluation in this case study was conducted at each session over the course of three days and demonstrated that the targeted outcomes (SLKI) were successfully achieved. The evaluation results indicate that the implementation of Ankle Pump Exercise for 8 minutes per session, twice daily with a 7-hour interval over a period of three days (November 26–28, 2024) was proven to reduce the degree of edema in three patients with CKD.

Table 2

Evaluation Results

No.	Patient	Indicator	Evaluation Results			Score
			Day-1	Day-2	Day-3	
1.	Ny. T Before Intervention	Depth	6 mm	5 mm	4 mm	2
		BP	185/90 mmHg	170/90 mmHg	165/70 mmhg	3
		Weight	65 kg	64,80 kg	64 kg	3
		CRT	50 seconds	40 seconds	15 seconds	4
	After Intervention	Depth	6 mm	5 mm	3 mm	4
		BP	175/85 mmhg	170/90 mmhg	160/80 mmhg	5
		Weight	65 kg	64,80 kg	64,10 kg	3
		CRT	50 seconds	40 seconds	10 detik	5
2	Ny. S Before Intervention	Depth	6 mm	4 mm	3 mm	2
		BP	170/95 mmhg	165/90 mmhg	165/70 mmhg	3
		Weight	55 kg	54 kg	54,10 kg	2
		CRT	60 seconds	15 seconds	10 seconds	3
	After Intervention	Depth	5 mm	3 mm	2 mm	5
		BP	175/85 mmhg	150/70 mmhg	150/80 mmhg	4
		Weight	54,85 kg	54 kg	54 kg	4
		CRT	50 seconds	15 seconds	3 seconds	5
3	Ny. D Before Intervention	Depth	4 mm	3 mm	2 mm	1
		BP	150/90 mmhg	160/70 mmhg	145/80 mmhg	2
		Weight	50 kg	49,50 kg	48,80 kg	3
		CRT	15 seconds	10 seconds	5 seconds	2
	After Intervention	Depth	4 mm	2 mm	1 mm	3

BP	150/80 mmhg	150/70 mmhg	140/65 mmhg	4
Weight	50 kg	49 kg	48,50 kg	5
CRT	10 seconds	8 seconds	3 seconds	5

The evaluation results for the first patient (Mrs. T) showed that prior to the ankle pump exercise therapy, a pretest was conducted on the first day using the pitting edema observation sheet. The initial findings indicated grade 3 edema with a depth of 6 mm (score: 2), blood pressure of 185/90 mmHg (score: 3), body weight of 65 kg (score: 3), and capillary refill time (CRT) of 50 seconds (score: 4). After receiving the intervention consistently for three consecutive days, the patient reported feeling happy due to the reduced the lower extremity edema and expressed greater motivation to recovery. On the third day, a posttest was conducted, revealing grade 2 edema with a depth of 3 mm (score: 4), blood pressure of 160/80 mmHg (score: 5), body weight of 64.10 kg (score: 3), and a CRT of 10 seconds (score: 5). These results indicate that Mrs. T experienced a reduction in the degree of extremity edema following the intervention and the nursing problem of hypervolemia has been partially resolved.

The evaluation results for the second patient (Mrs. S) showed that before receiving ankle pump exercise therapy, a pretest was conducted on the first day using the pitting edema observation sheet. The initial findings revealed grade 3 edema with a depth of 6 mm (score: 2), blood pressure of 170/95 mmHg (score: 3), body weight of 55 kg (score: 2), and capillary refill time (CRT) of 1 minute (score: 3). After undergoing the intervention for three consecutive days, the patient reported that her right leg felt lighter and easier to move due to the reduced lower extremity edema, and patient felt more motivated to recovery. At the end of the third day, a posttest was performed, showing grade 1 edema with a depth of 2 mm (score: 5), blood pressure of 150/80 mmHg (score: 4), body weight of 54 kg (score: 4), and CRT of 3 seconds (score: 5). These results indicate that Mrs. S experienced a reduction in the degree of extremity edema following the intervention and the nursing problem of hypervolemia has been resolved.

The evaluation results for the third patient (Mrs. D) indicated that prior to the ankle pump exercise therapy, a pretest was conducted on the first day using the pitting edema observation sheet. The findings showed grade 2 edema with a depth of 4 mm (score: 2), blood pressure of 150/90 mmHg (score: 2), body weight of 50 kg (score: 1), and a capillary refill time (CRT) of 15 seconds (score: 2). After receiving the intervention for three consecutive days, the patient stated that the swelling in right leg had decreased and that it could be moved freely and comfortably. At the end of the third day, a posttest was conducted, revealing grade 1 edema with a depth of 1 mm

(score: 3), blood pressure of 140/65 mmHg (score: 4), body weight of 48.50 kg (score: 5), and CRT of 3 seconds (score: 5). These results indicate that Mrs. D experienced a reduction in the degree of extremity edema following the intervention and the nursing problem of hypervolemia has been resolved.

Discussion

The assessment results in this case study indicate that all three respondents with CKD and edema were female. This may be due to higher hormonal activity in females compared to males, such as increased levels of estrogen and progesterone during menstruation, which can influence fluid volume retention and excessive thirst, thereby contributing to edema in CKD patients [15]. All three respondents had an educational background of junior and senior high school. Educational level affects patient behavior in fluid management and medication adherence to reduce the incidence of edema. The higher a patient's level of education, the greater their awareness of maintaining health. CKD patients with higher education tend to have better knowledge of recommended fluid restriction diets and are more likely to adhere to therapy to prevent edema[16]. The majority of respondents (two out of three) with CKD were elderly, aged over 60 years. Age is one of the clinical factors contributing to the development of edema in CKD patients. Elderly patients generally have a poorer memory capacity for receiving information regarding fluid restriction management, making them more prone to experiencing edema[17]. The case study findings show that respondents Mrs.T and Mrs.S both aged >60 years old, had grade 3 edema before therapy was administered, while Mrs.D, aged 37, experienced grade 2 edema. These results suggest that older patients face greater difficulty in managing fluid intake to reduce the occurrence of edema.

The case study findings indicated that all three respondents were diagnosed with the nursing problem of hypervolemia related to impaired regulatory mechanisms, as evidenced by complaints of dyspnea and lower limb swelling, the presence of peripheral edema in the lower extremities, edema depth of 4–6 mm, edema grade 2–3, capillary refill time (CRT) >2 seconds, and elevated blood pressure (D.0022)[12]. Edema is a common clinical manifestation in patients with chronic kidney disease (CKD), often resulting from increased intravascular pressure—the force exerted by cardiac output driving blood through the vasculature. This elevated pressure promotes

fluid transudation from the plasma into the interstitial space, thereby leading to the development of edema, particularly in the lower extremities[18].

The case study implementing hypervolemia management through a therapeutic intervention specifically, ankle pump exercise demonstrated outcomes aligned with the predetermined targets, namely improved fluid balance, as evidenced by a reduction in the degree of edema in CKD patients. This intervention is consistent with previous studies indicating that regular performance of ankle pump exercises is effective in reducing lower extremity edema in patients with CKD. The ankle pump exercise functions through a muscle pump mechanism, facilitating the movement of extracellular fluid back into the vascular system and toward the heart, thereby promoting the redistribution of accumulated interstitial fluid and reducing peripheral edema[6].

Other research also supports the efficacy of ankle pump exercises in significantly decreasing edema depth in CKD patients by enhancing venous return through muscle contractions, which assist circulatory function and metabolic clearance, thereby preventing fluid accumulation[19]. Further evidence demonstrated that this intervention effectively reduced edema from grades 2–3 (7–5 mm depth) to grades 2–1 (2–5 mm depth)[20]. These findings support the use of ankle pump exercise as a non pharmacological therapeutic alternative to reduce edema in patients with chronic kidney disease.

Conclusion

The implementation of ankle pump exercise, conducted for 8 minutes per session, twice daily over a period of three days, has been proven to reduce the degree of edema in CKD patients. The limitations of this case study include the short duration of the intervention, which lasted only three days and may not have been sufficient to observe the long-term effects of Ankle Pump Exercise on edema in patients with Chronic Kidney Disease (CKD). Recommendations for future research include extending the duration of the intervention to evaluate the long-term effectiveness of Ankle Pump Exercise in reducing edema among CKD patients.

References

1. Oktario F, Hanan A, Rahmawati I, Sujarwo E. 2023. Asuhan Keperawatan Pada Klien CKD (Chronic Kidney Disease) Dengan Masalah Hipervolemia di RSUD Mardi Waluyo Blitar.

J Soc Sci Res [Internet]. 3:1767–79. Available from: https://j-innovative.org/index.php/Innovative.

2. McGregor T, Jones S. 2021. Fluid and electrolyte problems in renal dysfunction. Anaesth Intensive Care Med [Internet]. 22(7):406–9. Available from: https://doi.org/10.1016/j.mpaic.2021.05.008.
3. Global Burden Disease. 2020 Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020;395(10225):709–33.
4. Faqih Fatchur M, Marinda Palupi L, Yani JA. 2020. Kombinasi Ankle Pumping Exercise dan Contrast Bath Terhadap Penurunan Edema Kaki Pada Pasien Gagal Ginjal Kronik. Indones J Nurs Heal Sci ISSN. 5(1):1–10.
5. Kemenkes RI. 2020. Laporan Riskesdas 2018 Nasional.pdf [Internet]. Lembaga Penerbit Balitbangkes. 2018.p. hal 156. Available from: https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan Riskesdas 2018 Nasional.pdf.
6. Sertin Oktavia Maro, Yuliani Pitang. 2024. Pemberian Terapi Angle Pump Exercise Dan Elevasi 30^0 Untuk Mengurangi Edema Pada Pasien CKD. Protein J Ilmu Keperawatan dan Kebidanan . 2024;2(1):311–8.
7. Nursanti, Afrilia, Rosyida Ratna Wirawati YS. 2024. The Combination of Ankle Pump Exercise and 30 Degree Leg Elevation on Foot Edema in Chronic Kidney Disease. J Kesehat Prima [Internet]. 2024;18(2):61–8. Available from: http://jkp.poltekkes-mataram.ac.id/index.php/home/index.
8. Shi J, Weng X, Liu C, Ge Y, Chai L, Ru X, et al. 2023. The effect of the Ankle Pump Exercise (APE) counter system assisted ankle pump motion in patients after femoral neck fracture. BMC Musculoskelet Disord. 2023;24(1):1–9.
9. Miyaguchi, T., Fukuda, H., & Yamamoto Y. 2020. Influence of ankle exercises on venous blood flow velocity in the lower limbs. Adv Rehabil Sci Pract. 2020;6(11):12–8.
10. Manawan, Sheeilia Maria Elsye Rosa. 2021. Efektivitas Latihan Kaki terhadap Diameter Edema. J Telenursing [Internet]. 2021;3(2):84–8. Available from: https://doi.org/10.31539/joting.v3i2.2954%0.
11. Miftahul Anisa TS. 2023. Penerapan Pemberian Terapi Kombinasi Ankle Pump Exercise

Dan Elevasi Kaki 30° Pada Edema Pasien Chronic Kidney Disease (CKD). Progr Stud Profesi Ners Progr Profesi Fak Ilmu Kesehat Univ Kusuma Husada Surakarta 2023 [Internet]. 19(2):1–7. Available from: https://eprints.ukh.ac.id/id/eprint/5030/1/Naspub Miftahul Anisa.pdf.

12. Yin R. 2018. Case Study Research and Applications: Design and Methods (6th ed.). 6th ed. Thousand Oaks, CA: Sage.
13. Melnyk, B. M., & Fineout-Overholt E. 2019. Evidence-Based Practice in Nursing & Healthcare: A Guide to Best Practice. Philadelphia: Wolters Kluwer.
14. PPNI. 2017. Standar Diagnosis Keperawatan Indonesia:Definisi dan Indikator Diagnostik. 1 ed. Jakarta: PPNI.
15. PPNI. 2018. Standar Intervensi Keperawatan Indonesia. 1 ed. Jakarta: PPNI.
16. PPNI. 2019. Standar Luaran Keperawatan Indonesia: Definisi dan Kriteria Hasil Keperawatan. 1 ed. Jakarta: PPNI.
17. Riyadina, W., Rahajeng, E., & Driyah S. 2020. Gambaran gangguan fungsi ginjal pada kasus baru penderita diabetes melitus, jantung koroner, dan stroke dalam Studi Kohor Risk Factor Penyakit Tidak Menular Bogor, Indonesia. Media Penelit dan Pengemb Kesehat [Internet]. 2020;30(4). Available from: https://doi.org/10.22435/mpk.v30i4.3231.
18. Lestari W, Asyrofi A, Prasetya HA. 2018. Manajemen Cairan Pada Pasien Penyakit Ginjal Kronis Yang Menjalani Hemodialisis. J Manaj Asuhan Keperawatan. 2018;2(2):20–9.
19. Oka IGP. 2023. Hubungan Dukungan Keluarga dengan Kepatuhan Pembatasan Asupan Cairan pada Pasien Gagal Ginjal Kronik yang Menjalani Hemodialisa di RSUD Tabanan. J Nurs Res Publ Media. 2023;2(3):156–66.
20. Armila Damayanti, Resti Yuliati Sutrisno, Purnomo Widiyanto. 2024. Pengaruh Penerapan Terapi Ankle Pump Exercise Dengan Elevasi Kaki 30˚Terhadap Edema Kaki Pada Pasien Gagal Ginjal Kronik Yang Menjalani Hemodialisa. Corona J Ilmu Kesehat Umum, Psikolog, Keperawatan dan Kebidanan. 2024;2(2):171–9.
21. Zuj, K. A., Prince, C. N., Hughson, R. L., & Peterson SD. 2018. Enhanced muscle blood flow with intermittent pneumatic compression of the lower leg during plantar flexion exercise and recovery. J Appl Physiol [Internet]. 2018;124(2):302–11. Available from: https://doi.org/10.1152/japplphysiol.00784.2017.
22. Sari KI. 2024. Studi Kasus: Intervensi Ankle Pump dan Elevasi 30° dalam Menurunkan

Derajat Edema Tungkai pada Pasien Chronic Kidney Disease. J Ris Kesehat Mod. 2024;6(3).