Effect of warming gown use on shivering and body temperature in chronic kidney disease patients undergoing hemodialysis via catheter

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Abstract

Background: Haemodialysis is often accompanied by shivering, especially in patients with catheter access, which can reduce comfort, impair treatment efficacy, increase the risk of complications and contribute to inadequate dialysis. Addressing this issue through non-pharmacological means, such as a warming gown, offers a potentially effective, safe, and economical solution to improve patient outcomes.
Purpose: To develop a warming gown as an innovation to reduce the incidence of shivering in chronic kidney disease patients undergoing haemodialysis with a haemodialysis catheter.
Methods: This study employed a two-stage Research and Development design. In the first stage, a reusable, adaptive warming gown for HD catheter patients was developed and validated (S-CVI/Ave = 0.99). Second, a quasi-experiment was conducted with 60 patients recruited through total sampling. Subsequently, patients were randomly allocated to either the intervention group (warming gown) or the control group (blanket) using computer-generated randomisation based on their identification numbers. Shivering (Crossley and Mahajan scale) and body temperature (digital thermometer) were measured at 0, 15, 30, 60, and 120 minutes. Data were analysed using Wilcoxon, Friedman, and Bonferroni-corrected repeated Mann–Whitney tests.
Results: The intervention group showed a significant reduction in shivering levels from 2.63 ± 1.27 to 0.37 ± 0.49 ($p < 0.001$) and an increase in body temperature from 36.36 ± 0.52 to 36.84 ± 0.29 ($p < 0.001$). In contrast, the control group showed no significant changes ($p > 0.05$).
Conclusion: The warming gown was proven effective in reducing shivering and increasing body temperature in haemodialysis patients, offering advantages in comfort, safety, and cost efficiency.

Keywords: body temperature, chronic kidney failure, haemodialysis, nursing innovation, shivering, warming gown

Introduction

Hemodialysis (HD) is a globally recognized renal replacement therapy. Up to 70-90% of chronic kidney disease patients choose HD as their renal replacement therapy (Agarwal et al., 2019). In 2022, an estimated 843.6 million people worldwide were diagnosed with chronic kidney disease (Kovesdy, 2022). In Indonesia, as of 2018, there were 132,142 active HD patients (IRR, 2019), and this number is predicted to increase annually. At RSUD Banyumas, the number of chronic kidney disease patients undergoing hemodialysis in February 2024 reached 279 patients.

In performing HD procedures, all patients require vascular access. Vascular access for HD patients consists of two types: permanent vascular access and temporary vascular access. Permanent vascular access includes Arteriovenous Fistula (AVF) and Arteriovenous Graft (AVG) (Lok et al., 2020). Meanwhile, temporary vascular access currently involves central venous catheters or HD Catheters (Lok et al., 2020). However, in countries with limited facilities and resources, creating ideal permanent vascular access poses significant challenges (Agarwal et al., 2019).

The use of HD Catheters in hemodialysis is associated with risks such as bloodstream infections, thrombosis, and venous stenosis (Al-Balas et al., 2019). The primary complications of HD Catheter use include infection and catheter dysfunction, which can lead to morbidity and mortality in HD patients using Hemodialysis Catheters (Winnicki et al., 2018). Infection is a leading cause of morbidity and hospitalization in hemodialysis patients and the second most common cause of death after cardiovascular disease (Shepshelovich et al., 2017). Clinical manifestations of HD Catheter-related infections often include fever accompanied by shivering and rigidity during the HD process (Sedhain et al., 2019). One manifestation of infection in HD patients is shivering, reported in up to 40% of cases (with or without fever) during HD (Syed et al., 2022).

Shivering is a common complication in hemodialysis patients, with incidence rates in Vietnamese hospitals ranging from 2.1% (shivering alone) to 14.4% (shivering with fever) per dialysis session. Common causes include catheter-related infections and physiological reactions to cold dialysate. Patients experiencing shivering during HD are typically hospitalized for broad-spectrum antibiotic therapy and observation until infection is ruled out (Shepshelovich et al., 2017).

Shivering during HD disrupts patient comfort and can be managed with pharmacological and non-pharmacological therapies. Pharmacological therapies include non-narcotic analgesics, antipyretics, NSAIDs, vasodilators, opioid analgesics, anesthetics, and sedatives. Non-pharmacological therapies, such as active skin warming (warming gowns), antipyretics, magnesium sulfate, and β-agonists, are more commonly used to enhance patient comfort. The use of warming gowns has been shown to effectively alleviate shivering and improve comfort during HD procedures (Jain et al., 2018).

One of the most frequently used non-pharmacological therapies for shivering in HD patients is the warming gown. Previous studies in anesthetic nursing have demonstrated that preoperative warming gown use for 30 minutes effectively reduces post-anesthetic temperature drops (de Bernardis et al., 2016). Additionally, optimal active warming strategies, such as warming gowns for cesarean section patients, reduce the incidence of shivering and hypothermia, enhance surgical optimization, and promote faster recovery. Other benefits of active warming include reduced complications such as wound infections, maternal shock, maternal mortality, neonatal hypothermia, and prolonged hospital stays (Chen et al., 2019).

Thermal gowns are more effective than warm cotton blankets in improving patient comfort and accelerating body temperature recovery, particularly when the patient's body temperature is below 36°C. Thermal gowns also provide better comfort and reduce the duration of stay in postoperative recovery rooms. Postoperative warming equipment must be safe, fast, reliable, and prevent burns in patients (Lee et al., 2015). Enhancing patient comfort through the use of warming gowns aligns with Kolcaba's theory of comfort, which encompasses physical, psychospiritual, environmental, and psychosocial aspects (Krinsky et al., 2014).

HD patients who experience chills and shivering during the HD process are typically rested (temporarily halting the HD process) and warmed using blankets. Currently, a better technology is available in the form of warming gowns. Warming gowns can be used to optimize the management of patients experiencing chills (de Bernardis et al., 2016). Warming gowns can be used to manage HD patients with HD Catheters who experience shivering during HD. By using warming gowns, the time required for patients to rest due to shivering can be reduced. Chills in haemodialysis patients may result from the use of an HD catheter or the dialysis process itself. Catheters can increase the risk of bloodstream infections, which often present with chills and fever. Additionally, the HD procedure may cause a drop in body temperature due to cool dialysate or room conditions, triggering shivering as a natural response. Both infection-related and non-infectious factors should be considered when assessing chills during dialysis.

Warming gowns, commonly used for post-anesthesia patients to manage shivering, are typically made of disposable spunbond material and cost approximately IDR 323,000. This study introduces an innovative reusable warming gown made of thick fabric as a heat insulator and a soft inner layer to prevent skin irritation. The production cost is approximately IDR 450,000, and the gown is washable and reusable. The warming gown for HD patients is equipped with a CDL Port to facilitate use without interfering with HD Catheter dressings. Its use reflects the principle of beneficence in nursing, aiming to improve the comfort of hemodialysis patients

Based on bibliometric analysis, no studies have evaluated the effectiveness of warming gowns in reducing the incidence of shivering in chronic kidney disease patients undergoing hemodialysis with HD Catheters. At RSUD Banyumas, among 279 CKD patients undergoing HD, 68 patients (24.3%) use HD Catheters, and 20 of them (29%) experience shivering during hemodialysis. To address the shivering, the nurse applied warm water compresses to specific areas, such as the chest, and covered the patient with a standard blanket. However, these measures were ineffective in alleviating the shivering, necessitating a temporary interruption of the dialysis session until the condition subsided. As a result, the duration of dialysis was shortened, leading to inadequate dialysis delivery. Therefore, strategies are needed to reduce the incidence of shivering and enhance patient comfort (Anggraeni et al., 2024). Accordingly, this study aimed to design and develop a warming gown as a non-pharmacological innovation to mitigate shivering among chronic kidney disease patients undergoing haemodialysis using catheter access.

Materials and Methods

Design

This study was conducted in two phases. The research design employed was a Research and Development (R&D) design with a Prototype model, involving the development of the device and testing the product's effectiveness.

In the first phase, surveys and interviews were conducted with haemodialysis nurses to identify the need for a warming device. Based on their feedback, the warming gown design was developed using thick outer fabric and a soft inner lining. The device was equipped with an inlet for connection to a warm air source and a port for double-lumen catheters. Testing by five experts (comprising an electromedical technician from the hospital, a renal and hypertension specialist, a haemodialysis physician, and two haemodialysis nurses) demonstrated that the prototype was valid and reliable, after which it was further refined. Further refinement was carried out by incorporating a temperature sensor capable of automatically activating and deactivating the device based on the predetermined temperature range. The thermal sensor was configured to switch off when the temperature reached 40 °C and to reactivate when it dropped to 36°C.

In the second phase, the researcher conducted a product effectiveness test using a quantitative approach with a quasi-experimental pre–post test design involving a control group. A quantitative test was conducted on 60 HD patients at RSUD Banyumas, divided into two groups: an intervention group (using the warming gown) and a control group (using blankets). Patients were randomly assigned to intervention (warming gown) or control (blanket) groups using computer-generated randomisation based on identification numbers.

Sample and setting

This study was conducted in the Haemodialysis Unit of RSUD Banyumas. The sample size consisted of 60 respondents, who were subsequently divided into two groups: the control group and the intervention group. Simple random sampling was employed for sample allocation, whereby all respondents' identification numbers were input into a computer programme that generated a random assignment to groups.

The inclusion criteria for the study included patients who routinely underwent HD twice a week, had vascular access through an HD catheter, were fully conscious (compos mentis), were willing to participate in the study, and underwent haemodialysis for 4.5 hours. The exclusion criteria included patients with vascular access through an AV shunt or femoral access, patients undergoing emergency or initial HD sessions, patients who refused to participate, and patients with hyperthermia (body temperature ≥38°C). Cases of hyperthermia were excluded to avoid potential bias in temperature data analysis, as the temperature trend in hyperthermic patients typically decreases over time, in contrast to hypothermic patients whose temperature trend increases. Including both conditions could confound the interpretation of temperature changes.

Patients meeting the criteria were randomly assigned using simple random sampling to ensure an even distribution between the intervention and control groups. Additional data, such as patient characteristics, were also collected to support a more in-depth analysis.

Variable

The independent variable in this study is the use of the warming gown. The dependent variables are the level of shivering and body temperature. The measured variables are body temperature and shivering level, with a sample size of 30 participants per group.

Instruments

The research instrument used in this study was an observation sheet designed for CKD patients undergoing HD with an HD catheter, receiving either the warming gown treatment or standard treatment. The instrument included patient data, shivering levels, and body temperature.

Patient data covered information such as name, age, gender, comorbidities, education, weight, height, body mass index, and duration of haemodialysis. The level of shivering was measured using the Crossley and Mahajan Scale, a numerical scale used to assess the degree of shivering (Table 1). This instrument has undergone validity and reliability testing in previous studies.

Validity testing of the shivering degree measurement showed that the calculated r-value exceeded the critical r-value, with a p-value < 0.05, indicating the instrument was valid. Reliability testing yielded a Cronbach's Alpha value of 0.617, confirming the instrument's reliability (Nasution et al., 2022).

Patient body temperature was measured using a thermometer. The thermometer used was the SAMMORA Thermometer Gun, model IT-122, which features a red focus beam and is registered with the Indonesian Ministry of Health under registration number KEMENKES RI AKL 20901120621.

Intervention

After selecting participants based on the inclusion criteria, the researcher divided them into two groups: the control group and the intervention group. Simple random sampling was employed for sample allocation, whereby all respondents' identification numbers were input into a computer programme that generated a random assignment to groups. In the intervention group, participants experiencing shivering were provided with the warming gown as an intervention, while in the control group, participants received the standard intervention of being warmed with a blanket. Subsequently, the research flow in this study can be seen in Figure 1.

Data collection

Data collection in this study was conducted through direct observation of CKD patients on HD with an HD catheter who met the inclusion and exclusion criteria. The data collected included the shivering level, measured using the Crossley and Mahajan Scale (Crossley & Mahajan, 1994), and the patient's body temperature, measured using a SAMMORA IT-122 digital thermometer. Measurements were taken at five time intervals: before the intervention (0 minutes) and after the intervention at 15, 30, 60, and 120 minutes. The intervention group received treatment using the warming gown, while the control group used only standard blankets.

Data analysis

The data analysis method in this study involved processing observational data on body temperature and shivering levels using statistical analysis. The statistical tests applied included the Wilcoxon test, Friedman test, and Mann-Whitney test. These tests aimed to compare within-group and between-group differences across various time intervals (0, 15, 30, 60, and 120 minutes). The analysis was conducted to measure changes in the dependent variables—shivering level and body temperature—as a response to the intervention of using the warming gown in the intervention group compared to the use of blankets in the control group.

The data used were on an interval and ratio scale, and the results of the analysis were utilised to test the research hypotheses. This allowed for conclusions to be drawn regarding the effectiveness of the warming gown in reducing shivering levels and increasing body temperature in patients.

Ethical consideration

This study received ethical approval from the Health Research Ethics Committee (HREC) of RSUD Banyumas, with the approval number 265/KEPK-RSUDBMS/VIII/2024. Data collection was conducted after the ethical clearance letter was issued, ensuring that the study adhered to the principles of research ethics, including informed consent, anonymity, confidentiality, beneficence, and justice.

Results

Phase 1 Study

The first phase of this study aimed to develop a prototype of a warming gown for haemodialysis patients. Based on surveys and interviews with nurses, it was found that existing warming tools had weaknesses, such as thin and easily torn fabrics. Therefore, the researchers designed a prototype with an outer layer made of thick fabric as a heat insulator and an inner layer made of smooth, soft, non-irritating fabric. The design was also compatible with HD catheters, allowing patients to remain comfortable without removing the catheter.

Validity testing using the Content Validity Index (CVI) showed excellent results, with an S-CVI/Ave score of 0.99 and an S-CVI/UA score of 0.93, indicating high content validity. Only item 8 had an I-CVI score of 0.80, which requires attention for future revisions. This aligns with a study by Ayu Dessy Sugiharni (2018), which states that an I-CVI score above the threshold of 0.80 indicates very high validity. According to Suryadi et al. (2023) content validity can be assessed by experts, with a minimum of three experts; however, this study involved five experts (comprising an electromedical technician from the hospital, a renal and hypertension specialist, a haemodialysis physician, and two haemodialysis nurses), further strengthening the validity results.

Reliability testing between experts using the Cohen's Kappa test resulted in a kappa value of 1.000 (p-value = 0.002), demonstrating a very strong and almost perfect level of reliability among experts. Additionally, usability testing using the USE questionnaire with five nurses showed highly favourable results, with scores ranging from 80–100%, indicating that the tool is highly effective, comfortable, and easy to use in haemodialysis units. These findings are consistent with a study by Parlika et al. (2022), which demonstrated excellent agreement among evaluators, with a Cohen's Kappa value of 1, and questionnaire analysis showing 100% validity. This assessment also aligns with the standards set by ISO 9241–11:2018 concerning user efficiency, effectiveness, and satisfaction.

The safety of this tool was ensured through automatic temperature regulation between 36°C and 40°C, adhering to recommendations for safe active warming temperatures. The temperature control feature, equipped with a thermal sensor and temperature controller, ensures safe warming without the risk of thermal injury. This is consistent with a study by Plengpanich et al. (2023), which recommends that active warming temperatures should not exceed 38°C to prevent discomfort. From this point onwards, the warming gown is referred to as 'TRESN0' by the researchers.

Overall, the study results show that the "TRESN0 warming gown" is an innovative solution that not only meets functional needs but also considers safety, comfort, and efficiency aspects in supporting the care of haemodialysis patients. This makes it highly suitable for use in CKD patients experiencing shivering during HD sessions.

Phase 2 Study

In the second phase of the study, quantitative testing was conducted to evaluate the effectiveness of the warming gown in reducing shivering levels and

2 Shivering Scale From Crossley & Mahajan

Level	Patient Behaviour	Explanation (Crossley & Mahajan, 1994)	Observed Condition
0	None	No visible signs or symptoms of shivering.	No shivering symptoms.
1	No visible muscle activity, but one or more of piloerection, peripheral vasoconstriction, or peripheral cyanosis.	No visible muscle activity, but reactions such as hair standing on end (piloerection), narrowing of blood vessels in the peripheral region (vasoconstriction), or peripheral skin discolouration (cyanosis).	Goosebumps, pale and cold extremities. Intermittent and mild tremors in the jaw and neck muscles.
2	Muscle activity in one muscle group.	At shivering level 2, visible muscle activity occurs in more than one muscle group, but does not involve the entire body. Examples include uneven muscle movements that do not affect the whole body.	Noticeable tremors in the chest muscles.
3	Muscle activity in more than one muscle group, but no visible generalised shivering.	Muscle activity in more than one muscle group without visible generalised shivering indicates movements in multiple muscle groups, but not to the extent of generalised tremors.	Intermittent tremors affecting the entire body.
4	Generalised muscle activity throughout the body.	Generalised muscle activity throughout the body at shivering level 4 is when visible muscle movements involve the entire body.	Strong and continuous muscle activity throughout the body.

increasing the body temperature of chronic kidney disease patients undergoing haemodialysis with HD catheters. The study used a quasi-experimental pre-post test design with a control group, in which 60 patients were randomly divided into two groups. The intervention group consisted of 30 patients who were provided with the warming gown as a warming device, while the control group consisted of 30 patients who were given standard warming using blankets. The research flow and intervention flow of this study can be seen in Figure 1 and Figure 2.

Respondent Characteristics

The characteristics of the respondents (Table 2) in this study include age, gender, and a history of comorbidities. The average age of the respondents was 57.1 years, with an age range of 30–70 years. Most respondents were male (66.7%), and the majority had comorbidities, including hypertension (70%) and diabetes mellitus (30%). All respondents were fully conscious (compos mentis) and underwent routine haemodialysis twice a week for 4.5 hours, with vascular access via an HD catheter.

Effect of Warming Gown on Shivering Levels and Body Temperature

Measurements were conducted at five time intervals: before the intervention (0 minutes) and at 15, 30, 60, and 120 minutes post-intervention. Shivering levels were assessed using the Crossley and Mahajan scale, while body temperature was measured with a digital thermometer.

The results showed that the use of the warming gown had a significant impact on the intervention group. The average shivering level significantly decreased from 2.63 ± 1.27 to 0.37 ± 0.49, with a p-value of <0.001 (Tables 3 & 4), indicating that the warming gown was highly effective in reducing shivering in patients. Additionally, the body temperature of patients in the intervention group significantly increased from an average of 36.36 ± 0.52°C to 36.84 ± 0.29°C, with a p-value of <0.001 (Tables 3 & 4).

In contrast, in the control group, which used blankets for warmth, no significant changes were observed in either shivering levels or body temperature, with a p-value of >0.05. The graphical representation of shivering levels and body temperature data for patients in both the control and intervention groups is presented in Figure 3.

Discussion

Respondent Characteristics

This study found no significant differences between the intervention and control groups across various variables, including gender, age, education level, comorbidities, BMI, duration of haemodialysis, and duration of CDL use, with p-values greater than 0.05 for each variable. These findings are consistent with (Plengpanich et al., 2023) and (Kameda & Okada, 2023), who stated that similar baseline characteristics between groups do not significantly influence study outcomes.

The prevalence of shivering was higher among patients with low body weight, aged ≥60 years, and females, aligning with the findings of (Salu et al., 2024), which identified age, gender, and BMI as risk factors for shivering. Furthermore, advanced age, female gender, and low BMI are associated with an increased risk of shivering due to impaired thermoregulation, body temperature fluctuations, and reduced fat reserves. (S. Syed et al., 2022) also noted a higher risk of shivering in older

Table 2. Respondent Charateristic

Variabel		Group				P Value
		Intervention (n=30)	Persentase (%)	Control (n=30)	Persentase (%)	
Gender	Male	11	36.7	12	40	0.791
	Female	19	63.3	18	60	
Age (years)	0–19	1	3.3	1	3.3	0.896
	20–24	0	0	0	0	
	25–39	4	13.3	3	10	
	40–59	16	53.3	17	56.7	
	60 and above	9	30	9	30	
Education Level	Elementary School	12	40	18	73.33	0.122
	Junior High School	7	23.33	5	16.67	
	Senior High School	7	23.33	5	10	
	Bachelor's Degree	3	10	2	3.33	
	Master's Degree	1	3.3	0	0	
Comorbid-ities	Hypertension	19	31.67	15	50	0.373
	Diabetes Mellitus	2	6.67	6	20	
	Hypertension and DM	6	20	3	10	
	Cervical Cancer	1	3.33	1	3.33	
	Kidney Inflammation	1	3.33	1	3.33	
	Lupus (SLE)	1	3.33	1	3.33	
	Kidney Stones	0	0	3	10	
Body Mass Index (BMI)	Underweight	8	26.7	4	13.3	0.670
	Normal Weight	9	30	13	43.3	
	Overweight	9	30	10	33.3	
	Obesity	4	13.3	3	10	
Body Mass Index (BMI)	< 6 months	25	83.33	26	86.67	0.500
	> 6 months	5	16.67	4	13.33	
Duration of CDL Usage	< 3 months	25	83.33	25	83.33	0.635
	> 3 months	5	16.67	5	16.67	

Table 3. Friedman Test Table for Shivering Level and Body Temperature Data in the Intervention and Control Groups

Measurement Time	Shivering Level			Body Temperature		
	Intervention group (n=30) (Mean ± SD)	Control group (n=30) (Mean ± SD)	P Value	Intervention group (n=30) (Mean ± SD)	Control group (n=30) (Mean ± SD)	P Value
0 minutes	2.57 ± 1.25	2.00 ± 1.08	0.078	36.31 ± 0.42	36.38 ± 0.42	0.801
15 minutes	2.20 ± 1.03	2.00 ± 1.08	0.412	36.46 ± 0.52	36.41 ± 0.45	0.331
30 minutes	1.67 ± 0.80	2.00 ± 1.08	0.337	36.63 ± 0.35	36.38 ± 0.38	0.023
60 minutes	1.03 ± 0.62	1.97 ± 1.13	0.001	36.73 ± 0.36	36.35 ± 0.36	0.001
2 hours	0.37 ± 0.49	1.93 ± 1.08	<0.001	36.84 ± 0.29	36.43 ± 0.39	<0.001
P Value (overall)	<0.001	0.632		<0.001	0.799	

Table 4. Mann-Whitney Test Table for Shivering Level and Body Temperature Data in Intervention and Control Groups

Measurement Time	Shivering Level				Body Temperature			
	Intervention group (n=30) (Mean ± SD)	Control group (n=30) (Mean ± SD)	Uji Mann Whitney	P Value As per Benferonni Correction	Intervention group (n=30) (Mean ± SD)	Control group (n=30) (Mean ± SD)	Mann Whitney Test	P Value As per Benferonni Correction
0 minutes	2.63 ± 1.27	2.07 ± 1.08	0.078	0.01	36.36 ± 0.52	36.37 ± 0.43	0.801	0.200
15 minutes	2.23 ± 1.04	2.03 ± 1.13	0.412	0.103	36.49 ± 0.57	36.39 ± 0.45	0.331	0.083
30 minutes	1.70 ± 0.84	2.03 ± 1.13	0.337	0.084	36.64 ± 0.36	36.39 ± 0.39	0.023	0.006
60 minutes	1.00 ± 0.64	2.00 ± 1.17	0.001	<0.001	36.74 ± 0.37	36.34 ± 0.34	0.001	<0.001
2 hours	0.37 ± 0.49	1.97 ± 1.16	<0.001	<0.001	36.84 ± 0.29	36.40 ± 0.38	<0.001	<0.001

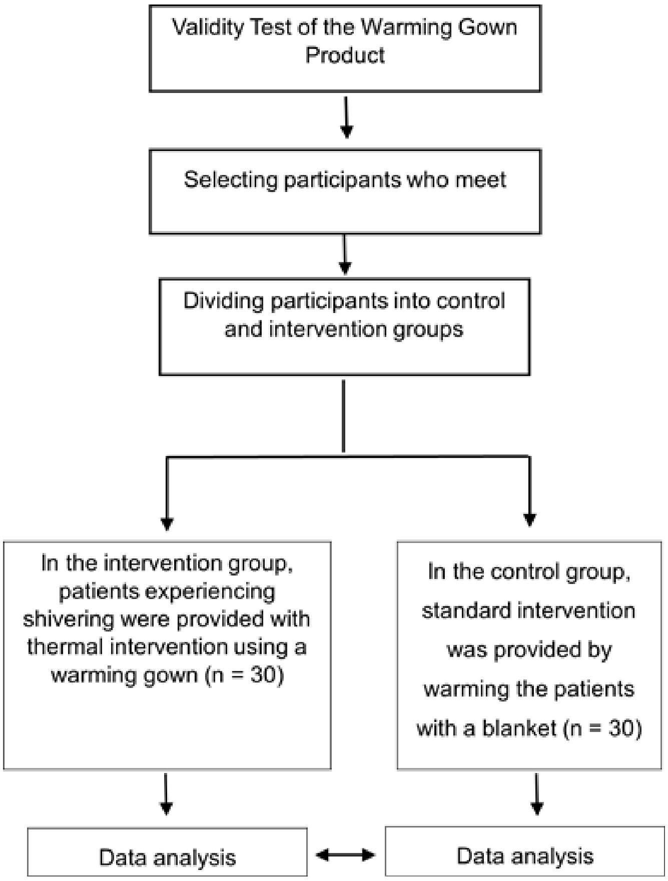

Figure 1. Research flow

The figure presents the research process, beginning with the validation of the developed instrument and concluding with data analysis. It further indicates that participants were randomly allocated to the intervention and control groups.

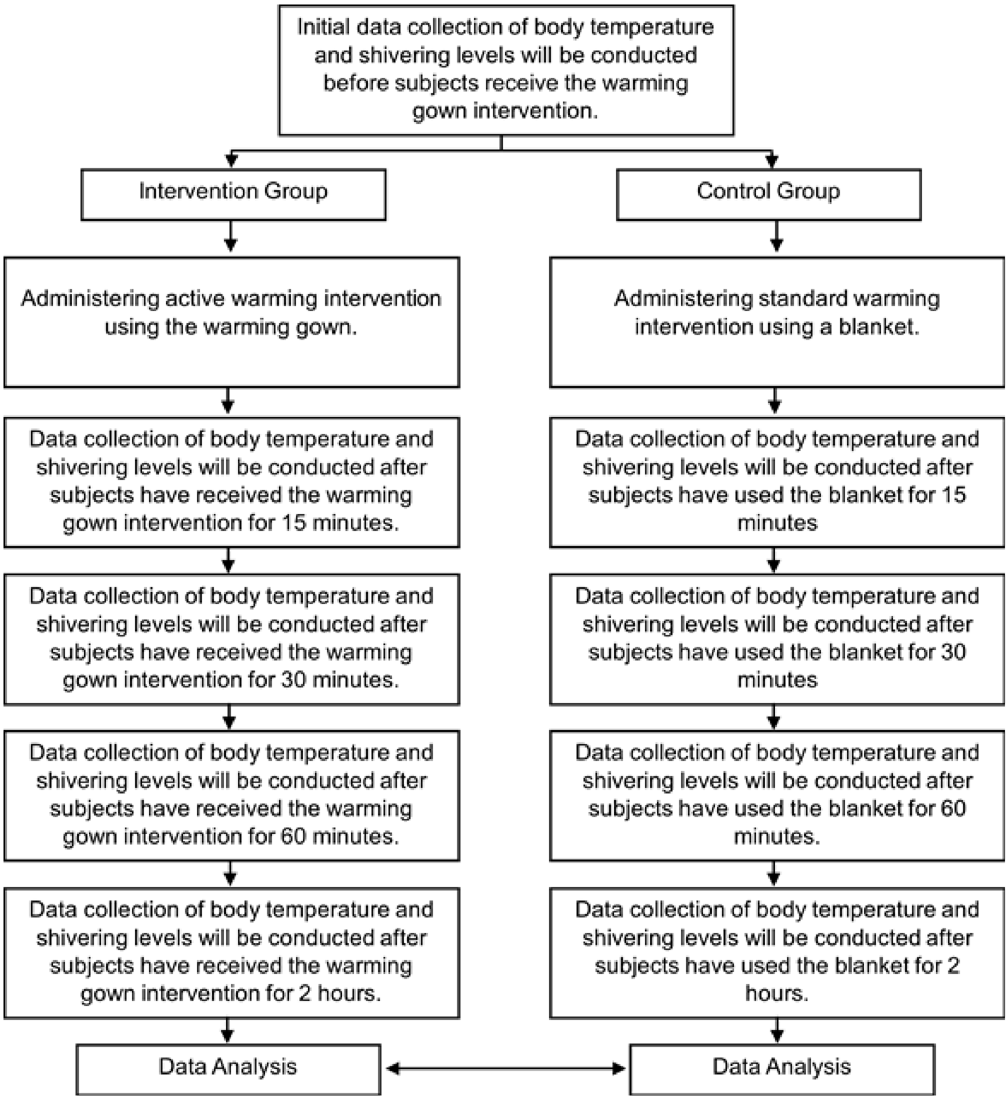

Figure 2. Intervention flow

This figure illustrates the intervention flow for both the intervention and control groups, beginning from the allocation of patients to their respective groups through to the data analysis stage

haemodialysis patients.

Hypertension and diabetes mellitus (DM) were the most prevalent comorbidities in both groups, with DM and hypertension being primary risk factors for ESRD (Saran et al., 2018). DM can exacerbate immunodeficiency, thereby increasing the risk of infection and shivering (Luh Widani & Suryandari, 2021).

Longer durations of haemodialysis and CDL use exceeding six months increase the risk of infection and shivering (Miller et al., 2016). The prevalence of CDL use among patients newly starting haemodialysis also heightens their vulnerability to complications, including shivering (S. A. Syed et al., 2020).

Low education levels among haemodialysis patients, with the majority having only primary school education, may impact their understanding of shivering and infection prevention. Adequate education is essential to reducing the risk of infection and shivering (Saran et al., 2018).

Discussion on the Effect of Warming Gown on Shivering Levels

This study demonstrated a significant reduction in shivering levels in the intervention group using the "warming gown" compared to the control group. In the intervention group, the average shivering score decreased from 2.57 ± 1.25 (0 minutes) to 0.37 ± 0.49 (2 hours) with a p-value of 0.001, while the control group showed only minimal changes from 2.00 ± 1.08 (0 minutes) to 1.93 ± 1.08 (2 hours) with a p-value of 0.632. This indicates that the warming gown intervention is more effective in reducing

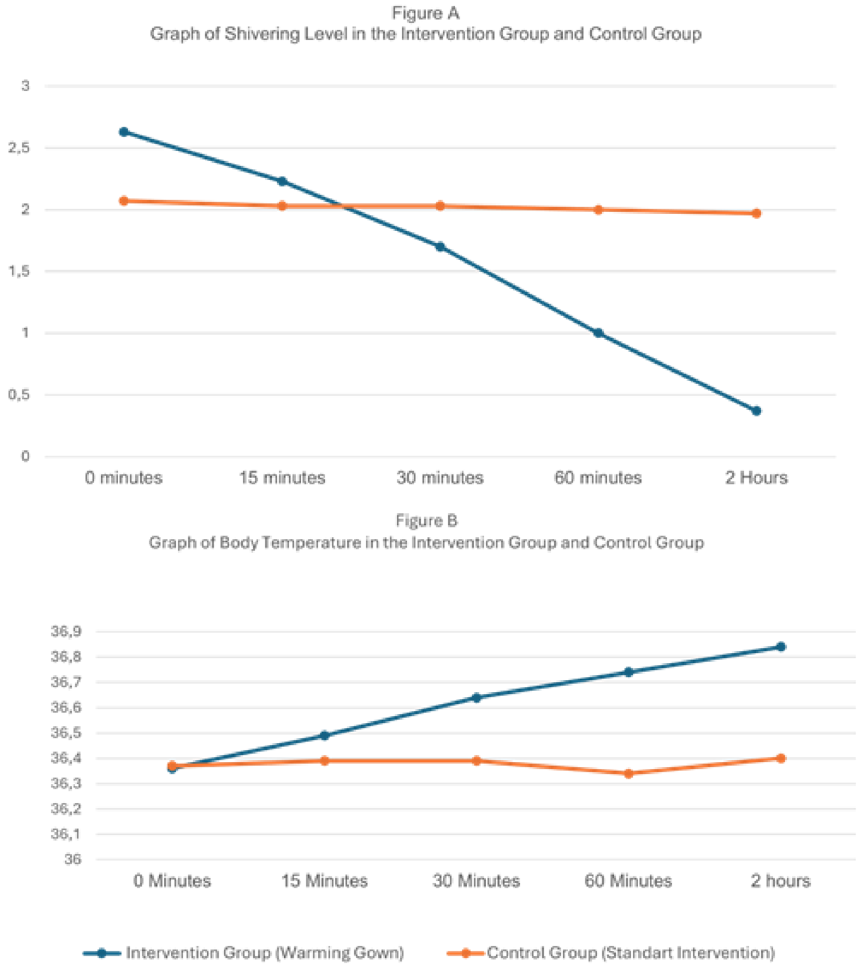

Figure 3. Graph of Shivering Level and Body Temperature in The Intervention Group and Control Group

This figure provides a graphical depiction of the changes in shivering levels and body temperature among patients in both the intervention and control groups, from 0 minutes up to 2 hours following the administration of the intervention in each group

shivering compared to standard care.

These findings align with the study by Kameda & Okada (2023), which showed that active warming therapy reduces the incidence of shivering and enhances patient thermal comfort. Non-pharmacological therapies, such as active warming (e.g., electric warming, water-circulating garments, and forced-air warming), have also been proven effective in managing shivering, particularly in clinical settings (Chen et al. (2019). Similarly, Switzer Tiara (2024) found that forced-air warming significantly reduced shivering incidence in patients with hypothermia, while the control group using passive warming exhibited more intense shivering. Additionally, Lee et al. (2015) reported that thermal gowns effectively reduced shivering levels and accelerated the return to normal body temperature in postoperative spinal patients. Susanto, (2022) confirmed the benefits of electric blankets in reducing postoperative hypothermia-induced shivering.

Graphical data demonstrate that the warming gown in the intervention group was more effective in reducing shivering within 60 minutes, compared to the control group, which showed no significant decrease (Figure 3). This is consistent with findings from (de Bernardis et al., 2016), which showed that thermal gowns delivering warm airflow at 40°C effectively prevented body heat loss and reduced shivering, unlike the control group that relied on standard blankets without active warming.

Discussion on the Effect of Warming Gown on Body Temperature

The study also showed that the use of the “warming gown” (intervention group) was effective in increasing patients’ body temperatures compared to the control group using standard care. In the intervention group, body temperature significantly increased from 36.36°C at 0 minutes to 36.84°C at 2 hours, with consistent improvements at each time

Figure 4. Design of TRESN0 Warming Gown
At the upper section, two CDL ports are positioned on the right and left sides, allowing for adjustment according to the patient's CDL placement. In the lower section, three thermal ports are provided to allow the entry of warm air from a device equipped with thermal sensors. One of these thermal ports may be selected based on the unoccupied side of the patient or the side opposite the haemodialysis machine.

point, particularly at 30 minutes, 60 minutes, and 2 hours (p = 0.001). Conversely, in the control group, body temperature increased only slightly from 36.37°C to 36.40°C, with no significant difference (p > 0.05).

These findings align with (Susanto, 2022), who found that electric blankets (active warming) effectively increased postoperative body temperature from 34.92°C to 36.57°C. (Lopez, 2018) also highlighted that active warming therapies improve body temperature by limiting heat redistribution and reducing radiant heat loss. (Dewi Listiyanawati & Studi Ilmu Keperawatan Universitas Alma Ata Yogyakarta, 2018) reported that electric blankets significantly increased body temperature (1.54°C) compared to regular blankets (0.85°C) with a p-value of 0.001.

According to de (de Bernardis et al., 2016), thermal gowns with active warming at 40°C for 30 minutes effectively prevented body temperature drops in the intervention group, especially in post-caesarean patients. (Kameda & Okada, 2023) also noted that active warming therapies help stabilise body temperature postoperatively, preventing hypothermia and reducing shivering. (Chen et al., 2019) similarly found that warm gowns and heated blankets effectively maintained body temperature during surgical procedures, particularly for operations lasting over 30 minutes.

Figure 3 illustrates that the intervention group using the "warming gown" experienced a faster and more significant rise in body temperature compared to the control group. This aligns with (Febriani et al., 2020), who found that electric blankets increased body temperature more effectively than regular blankets, with temperature gains ranging from 1.50°C to 1.96°C. (T. Lee et al., 2015) also reported that thermal gowns were more effective in raising body temperature and improving patient comfort postoperatively compared to cotton garments.

Based on Tables 3 and 4, the warming gown was effective in increasing body temperature after 30 minutes of use, with its effectiveness further improving after 2 hours. Statistical tests also showed that the warming gown effectively reduced shivering levels after more than 60 minutes of use, as supported by various studies. (de Bernardis et al., 2016) demonstrated that warming gowns reduced shivering and increased body temperature within 30 minutes before spinal anaesthesia induction and during surgery. Similarly, (T. Lee et al., 2015) reported that by the 30th minute, 48% of patients using thermal gowns achieved body temperatures above 36°C, showing significant improvement within that time frame. (Bodhipadma, 2017)noted that heating devices were effective in increasing body temperature and reducing shivering after 2–3 hours of use, reflecting the time needed to achieve normothermia (36.5°C). Clinical practice guidelines also support these findings, indicating that in ICUs, it takes approximately 2 hours to raise body temperature from 35.0°C to 36.0°C and 3 hours to reach 36.5°C.

Electric blankets have also been shown to provide faster warming compared to regular blankets. According to (Febriani et al., 2020), the heat convection mechanism of electric blankets significantly increased body temperature and reduced shivering within 10–30 minutes. (Chen et al., 2019) also stated that the warming effects of therapies such as warm gowns and heated blankets became significant after 30 minutes of use. During this period, the body has enough time to respond to the warming, increasing core temperature. These active warming strategies are crucial, particularly during surgical procedures lasting over 30 minutes, to prevent hypothermia and related complications.

However, the study acknowledges certain limitations, such as variations in patient conditions that may affect the warming process. For instance, patient movements can disrupt heat distribution and reduce effectiveness. Overall, the warming gown has been proven to be an effective solution for improving patient comfort and safety during haemodialysis.

Conclusions

The use of a warming gown significantly reduced shivering levels from 2.63 ± 1.27 to 0.37 ± 0.49 and increased body temperature from 36.36 ± 0.52°C to 36.84 ± 0.29°C in chronic kidney disease patients undergoing haemodialysis with a catheter ($p < 0.001$). This demonstrates that the warming gown is an effective, safe, and comfortable non-pharmacological intervention to improve patient comfort during dialysis.

Declaration of Interest

There's no conflict of interest

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Data Availability

The data supporting the findings of this study are available upon reasonable request from the corresponding author, NA. Due to privacy or ethical restrictions, access to the data may be restricted.

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