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The effect of digital-based wound care education on the knowledge level of patients after percutaneous coronary intervention (pci)

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Abstract

Background: Percutaneous Coronary Intervention (PCI) procedures may cause both physical and psychological effects, one of which is anxiety, often influenced by patients' lack of knowledge regarding post-procedural wound care. Conventional education is considered suboptimal; therefore, innovation in digital-based educational approaches is needed.

Purpose: To analyze the effect of digital-based wound care education on the level of knowledge among patients after Percutaneous Coronary Intervention (PCI).

Method: A quasi-experimental pre-test-post-test nonequivalent control group design. A total of 44 respondents were recruited and divided into an intervention group and a control group. The intervention group received digital-based wound care education using video media, while the control group received education according to the hospital's standard procedure. Knowledge level was measured using a knowledge questionnaire. Data were analyzed using the Wilcoxon test and Mann-Whitney test.

Results: There was a significant increase in knowledge scores in both the intervention group and the control group after receiving post-PCI wound care education ($p < 0.05$). Between-group comparison analysis showed that post-intervention knowledge scores were significantly higher in the group that received digital-based education using animated video compared to the group that received the hospital's standard education ($p < 0.001$).

Conclusion: Digital-based education using animated video is more effective than the hospital's standard education in improving knowledge among post-PCI patients.

Keywords: Digital Education; Knowledge; PCI; Wound Care.

INTRODUCTION

Coronary heart disease (CHD) remains one of the leading causes of death worldwide. Data from the World Health Organization (WHO) indicate that cardiovascular diseases account for approximately 17.9 million deaths each year, representing nearly one-third of all global deaths (World Health Organization, 2023). In Indonesia, CHD ranks as the second leading cause of death after stroke, with 245,343 reported deaths, and it continues to show an increasing prevalence from year to year (Morgado, Botelho, Machado, Mendes, Adesope, & Proença, 2024). The prevalence of CHD in Indonesia is 1.5%,

while in Central Java it is 1.6%. Coronary heart disease is a condition caused by atherosclerosis of the coronary arteries, resulting in narrowing or obstruction of the blood vessels and leading to inadequate oxygen supply to the myocardium. This condition may trigger myocardial ischemia, which manifests as chest pain or angina pectoris and, if prolonged, may result in myocardial damage or myocardial infarction (Lewis, 2024). One of the management strategies for CHD is revascularization through Percutaneous Coronary Intervention (PCI). PCI is the most commonly used revascularization

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method because it is minimally invasive and carries a lower risk of complications compared to surgical procedures, particularly in patients with severe comorbidities (Hansen, Jensen, Schmidt, Strøm, Vistisen, & Høybye, 2024).

Patients undergoing PCI often experience an increased psychological burden due to a lack of information and education regarding post-discharge healthcare, particularly wound care at the vascular access site, which is at risk of complications and presents a challenge for many patients. Anxiety is reported to arise, in part, from inadequate instructions and insufficient information after discharge (Zhang & Qi, 2021). Lack of knowledge about a condition is considered a source of stress that may lead to crisis and anxiety. Knowledge is the result of knowing, which occurs after individuals perceive specific objects through their senses. Most human knowledge is acquired through the senses of sight and hearing, particularly through the processes of seeing and listening. Assessing patients' level of knowledge and implementing educational interventions by nurses are important to optimize post-PCI patient care, especially for those with lower educational levels (Ashour, Al-Rawashdeh, Tanash, Al-Smadi, Alshraifeen, & Shajrawi, 2023).

Educational interventions provided by nurses before and after percutaneous coronary intervention have been shown to improve the quality of life of post-PCI patients (Chang, Guo, Zhou, Sun, Ma, Gardiner, & Wang, 2020). Previous studies on the effect of video-based education in patients undergoing coronary angiography and angioplasty have reported a significant increase in knowledge scores and a significant reduction in anxiety scores after watching the video. Educational videos have been proven effective in improving knowledge among patients undergoing coronary angiography and angioplasty (Yap, Teo, Foong, Binte Hussin, Wang, Shen, & Yeo, 2020). Video media allow information to be delivered more clearly, attractively, and repeatedly according to patients' needs (Habibzadeh, Milan, Radfar, Alilu, & Cund, 2018).

At Dr. Kariadi Hospital Semarang, post-PCI wound care education is still predominantly delivered through verbal methods and leaflet media. In line with the development of digital-based services in hospitals, the use of video-based digital educational media

represents a promising alternative to improve the effectiveness of patient education. Digital media that can be accessed through smartphones, tablets, digital televisions, and computers enable the integration of images, audio, and text, which can enhance patients' understanding.

RESEARCH METHOD

This study employed a quasi-experimental design using a pre-test–post-test nonequivalent control group design. This design involved direct observation of two groups of participants under two observational conditions, with the inclusion of a comparison group. The two groups consisted of an intervention group and a control group. The population in this study comprised patients undergoing Percutaneous Coronary Intervention (PCI) at Dr. Kariadi Hospital, Semarang. The study was conducted from late October 2025 to mid-November 2025. A total of 44 participants were included in the study and were equally divided into the intervention group and the control group, with 22 participants in each group. The sample was selected using a non-random sampling method, specifically consecutive sampling. The inclusion criteria were: (1) patients undergoing elective trans radial PCI; (2) age ≤ 75 years; (3) patients who were conscious and able to communicate well; and (4) willingness to participate as research respondents. The exclusion criteria included: (1) patients with hearing and/or visual impairments, as well as cognitive impairments that hindered their ability to receive educational information; (2) patients who experienced chest pain, shortness of breath, arrhythmia, shock, or decreased consciousness after PCI; and (3) patients with unstable hemodynamic status after trans radial PCI, defined as systolic blood pressure >180 mmHg or <80 mmHg, diastolic blood pressure >110 mmHg or <50 mmHg, heart rate >110 beats/minute or <50 beats/minute, and respiratory rate >26 breaths/minute.

Ethical clearance was obtained and approved by the Health Research Ethics Committee of Dr. Kariadi General Hospital, Semarang, on October 14, 2025, under approval number: 16606/EC/KEPK-RSDK/2025. The research procedure was carried out after the patients had completed the transradial PCI procedure. Fifteen minutes after the procedure, the

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initial step was the pre-test, in which respondents were asked to complete the knowledge questionnaire. Subsequently, respondents in the intervention group received digital-based post-PCI wound care education using an animated video, whereas respondents in the control group received education according to the hospital's standard procedure. A second educational session was conducted before the patients were scheduled for discharge. Ten minutes later, respondents were again asked to complete the post-PCI knowledge questionnaire (post-test). The instrument used for data collection in this study was a questionnaire. The research

questionnaire consisted of two parts: (1) respondents' demographic data; and (2) a knowledge questionnaire. The developed knowledge questionnaire had undergone validity and reliability testing, and the results indicated that it was valid and reliable, with R-value > 0.361 for all questionnaire items and a Cronbach's alpha coefficient of 0.846 (>0.60). Statistical analysis in this study employed non-parametric tests because the data were not normally distributed. The statistical tests used were the Wilcoxon test and the Mann-Whitney test. All data were analyzed at a 95% confidence level ($\alpha = 0.05$).

RESEARCH RESULTS

Table 1. Respondent Characteristics (N=44)

Variable	Intervention (n= 22)	Control (n= 22)	P-Value
Age (Mean$\pm$SD)(Range)(Year)	(61.86 $\pm$ 7.28)(49-75)	(56.86 $\pm$ 9.71)(42-73)	0.098
Gender (n/%)			
Male	18/81.8	18/81.8	1.000
Female	4/18.2	4/18.2	
Education (n/%)			
Elementary School	1/4.5	1/4.5	0.529
Junior High School	0/0.0	1/4.5	
Senior High School	6/27.3	9/40.9	
University	15/68.2	11/50.0	
Occupation (n/%)			
Employed	8/36.4	11/50.0	0.543
Unemployed	14/63.6	11/50.0	
Marital Status (n/%)			
Married	22/100.0	22/100.0	-
Single	0/0.0	0/0.0	
PCI Experience (n/%)			
Never	21/95.5	19.86.3	0.607
Yes	1/4.5	3/13.6	

Table 1 presents the baseline characteristics of respondents in the intervention and control groups. The mean age of participants in the intervention group was 61.86 $\pm$ 7.28 years (range 49–75), while in the control group it was 56.86 $\pm$ 9.71 years (range 42–73), with no significant difference between groups ($p = 0.098$). Most respondents in both groups were male (81.8%), married (100.0%), had a university-level education, were unemployed in the

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intervention group and evenly distributed by employment status in the control group, and had no previous PCI experience. Overall, there were no statistically significant differences in demographic and clinical characteristics between the two groups ($p > 0.05$), indicating that the groups were comparable at baseline.

Table 2. Knowledge Levels Before and After Education (N = 44)

Level of Knowledge	Intervention			Control		
	Mean $\pm$ SD	Min-Max	CI 95%	Mean $\pm$ SD	Min-Max	CI 95%
Before	9.68 $\pm$ 1.91	5 - 13	8.83-10.53	9.55 $\pm$ 2.48	4 - 13	8.44 -10.65
After	13.73 $\pm$ 1.45	10 - 15	13.08-14.37	10.32 $\pm$ 2.12	7 - 14	9.38 – 11.26

Table 2 shows the level of knowledge before and after the intervention in both groups. In the intervention group, the mean knowledge score increased from 9.68 $\pm$ 1.91 before the intervention to 13.73 $\pm$ 1.45 after the intervention. In the control group, the mean knowledge score also increased from 9.55 $\pm$ 2.48 to 10.32 $\pm$ 2.12. These findings indicate that both groups experienced an improvement in knowledge after education; however, the increase was more pronounced in the intervention group than in the control group.

Table 3. Results of the Test of Differences in Knowledge Levels

Knowledge Variables	Ranking	n	Mean Rank	Z	p-value*
Intervention Group	Negative ranks (Post < Pre)	0	0.00	-4.057	<0.001
	Positive ranks (Post > Pre)	21	11.00		
	Ties (Post = Pre)	1			
Control Group	Negative ranks (Post < Pre)	0	0.00	-3.025	0.002
	Positive ranks (Post > Pre)	11	6.00		
	Ties (Post = Pre)	11			

*Wilcoxon Signed-Rank test: a p-value < 0.05 indicates a statistically significant result

The results of the statistical test for the difference in mean knowledge levels after the intervention in Table 5 show a p-value of <0.001 (<0.05), indicating a statistically significant difference in knowledge levels following post-PCI wound care education between the intervention and control groups. This implies that the digital-based wound care education intervention using animated videos is more effective than standard hospital education in improving knowledge scores among post-PCI patients.

Table 4. Results of the Test of Differences in Knowledge Levels

Knowledge Variables	Mean Rank	Z	p-value*
Before		-0.190	0.849
Intervention	22.86		
Control	22.14		
After		-4.749	<0.001
Intervention	31.59		
Control	13.41		

*In the Mann-Whitney test, a p-value <0.05 indicates that the results of the analysis are statistically significant

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Table 4 presents the comparison of knowledge scores between the intervention and control groups before and after the intervention. Before the intervention, there was no significant difference in knowledge scores between the intervention and control groups (mean rank = 22.86 vs. 22.14; $Z = -0.190$; $p = 0.849$), indicating comparable baseline knowledge. However, after the intervention, the intervention group showed a significantly higher knowledge score than the control group (mean rank = 31.59 vs. 13.41; $Z = -4.749$; $p < 0.001$), suggesting that digital-based wound care education was more effective in improving patients' knowledge compared with standard hospital education.

DISCUSSION

Based on the study findings, the respondents had a mean age of 59.36 ± 8.85 years (Arafat & Purwanti, 2020). Patients undergoing PCI in this study had a mean age of less than 60 years, specifically 56 years. These findings differ from those of another study describing patients who underwent PCI from 2007 to 2020, in which 41.2% were aged < 60 years, with a mean age of 62 years (Chen, Liu, Zhou, Huang, Xie, Huang, & Chen, 2022). Age is one of the non-modifiable risk factors for coronary heart disease. Increasing age is associated with a greater risk of coronary heart disease (Rodgers, Jones, Bolleddu, Vanthenapalli, Rodgers, Shah, & Panguluri, 2019). Advancing age leads to a reduction in endogenous anti-inflammatory mechanisms, thereby contributing to age-related inflammation. This inflammatory process increases the activation of leukocytes, endothelial cells, and vascular smooth muscle cells, which accelerates vascular aging and atherosclerosis. Inflammation associated with aging also promotes the progression of atherothrombotic complications by increasing platelet reactivity and predisposing individuals to plaque rupture and erosion (Liberale, Montecucco, Tardif, Libby, & Camici, 2020). Therefore, age is recognized as an important risk factor for coronary heart disease.

The results of this study showed that most respondents were male, accounting for 37 individuals (84.1%). These findings are not substantially different from a previous study, which reported that the majority

of patients undergoing PCI were male (74.3%), while females accounted for 25.7% (Kim, 2022). These figures are consistent with the higher prevalence of coronary heart disease among men. One study reported that the incidence of myocardial infarction was three times higher in men than in women. The annual incidence of myocardial infarction per 10,000 population was 7.76 (95% CI: 7.37–8.16) in women and higher in men at 24.35 (95% CI: 23.57–25.16) (Millett, Peters, & Woodward, 2018). This difference may be associated with evidence showing that primary prevention strategies, such as adherence to healthy lifestyle behaviors and medication compliance, are generally better among women than men (Walli-Attaei, Joseph, Rosengren, Chow, Rangarajan, Lear, & Yusuf, 2020).

Most respondents had a higher educational level, with 25 individuals (59.1%) holding a university degree. Educational level is often associated with health knowledge. Low health literacy is one of the social determinants of health that may affect patients' ability to make health-related decisions, including decisions regarding PCI among patients with coronary heart disease (Brørs, Dalen, Allore, Deaton, Fridlund, Osborne, & Norekvål, 2022). In this study, more respondents were unemployed, totaling 26 individuals (59.1%). A previous study showed that unemployment is associated with poorer outcomes and an increased risk of mortality in patients with coronary heart disease compared with those who are employed. Unemployment may lead to unfavorable behavioral and lifestyle changes that contribute to conditions such as hypertension, hypercholesterolemia, diabetes mellitus, and obesity, all of which increase the risk of coronary heart disease and mortality (Wilson, Yadalam, Sakr, Gold, Jain, Razavi, & Quyyumi, 2025). All respondents in this study were married (100%). According to previous findings, unmarried patients—including those who are divorced, separated, widowed, or never married—have a higher rate of cardiovascular events than married individuals. Several studies suggest that marriage has a more pronounced protective effect for men than for women. Social support provided by a spouse plays an important role in maintaining individual health within marriage (Dhindsa,

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Khambhati, Schultz, Tahhan, & Quyyumi, 2020). Most respondents in this study had never undergone PCI previously, accounting for 40 individuals (90.9%). This finding is supported by previous research reporting that 77.6% of patients were undergoing PCI for the first time, while 17.6% underwent PCI for the second time, and 4.8% had undergone PCI three times or more (Brown & Lewis, 2017). However, other evidence suggests that 67.3% of patients were not first-time PCI recipients and had previous PCI experience. Many patients require PCI more than once due to the increasing proportion of patients with multivessel disease and multiple complex stenoses (Su, Liao, & Wu, 2018). In complex cases, staged PCI is often required, making it possible for patients to undergo PCI in several phases rather than in a single procedure (Werner, Nickenig, & Sinning, 2018).

The findings of this study demonstrated that digital-based post-*Percutaneous Coronary Intervention* (PCI) wound care education using animated video significantly improved patients' knowledge levels in the intervention group compared with standard hospital education. The greater increase in mean knowledge scores, accompanied by a reduction in standard deviation, indicates that animated video media not only improved patients' understanding quantitatively but also resulted in a more uniform level of comprehension among respondents. These findings are consistent with evidence showing that audiovisual education is able to deliver clinical information in a more structured, consistent, and understandable manner than verbal education or leaflets alone (Grilo, Ferreira, Ramos, Carolino, Pires, & Vieira, 2022).

Theoretically, the effectiveness of animated video can be explained by the principles of multimedia learning, in which the integration of visual and auditory information strengthens the process of receiving, understanding, and retaining information in adult patients. Step-by-step visualization of wound care procedures and warning signs after PCI helps simplify complex medical concepts, enabling patients to better remember and independently apply care instructions after discharge (Park & Jeong, 2021). This more consistent improvement in knowledge is particularly important in the context of vascular access wound care, given that adherence to wound care instructions plays a major role in preventing post-procedural

complications such as bleeding, hematoma, or distal ischemia (Guo, Gao, Wang, & Shan, 2023).

In this study, although the control group that received standard hospital education also demonstrated an increase in knowledge, the improvement was smaller than that observed in the intervention group. This suggests that conventional education still provides benefits; however, its effectiveness is often influenced by time limitations, variations in nurses' communication skills, and patients' limited ability to retain information without repeatable visual support (Oshvandi, Movaheditabar, Naghshtabrizi, Mohammadi, & Shamsizadeh, 2021). Animated video serves as a reinforcing medium for the educational messages delivered by nurses, helping to ensure that the information is conveyed more clearly, comprehensively, and consistently. The significant difference in post-intervention knowledge levels between the intervention and control groups confirms that digital-based wound care education offers substantial added value compared with conventional methods (Yujeong, 2022). These findings are consistent with various previous studies showing that educational videos improve knowledge and strengthen patient engagement in self-care following cardiovascular procedures (Aliakbari, Ebrahimi, & Barati, 2025).

Overall, the findings of this study support the integration of digital video-based education as part of discharge planning for post-PCI patients. This approach may improve patients' knowledge and readiness to perform wound care independently, while also strengthening adherence to clinical instructions after discharge. The implementation of standardized, easily accessible, and repeatedly reviewable video education is consistent with international recommendations regarding the use of information technology to improve the effectiveness of patient education and post-cardiovascular procedural care (Bordbar & Najafi, 2023).

CONCLUSION

Post-PCI patients, the majority of whom are elderly and have no prior experience with PCI procedures, have a high need for structured wound care education as part of their discharge planning. Digital wound care education using animated videos has been shown to yield more effective and efficient

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outcomes compared to standard hospital education, as evidenced by a significantly higher increase in knowledge. Access to digital educational media that can be reviewed repeatedly contributes to improving patients' understanding, confidence, and readiness to perform self-care at home safely and appropriately.

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