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THE INFLUENCE OF APPLICATION-BASED MONITORING WITH TELE- HOMECARE MAKASSAR ON 3 MONTHS READMISSION OF PATIENTS WITH HEART FAILURE REDUCED EJECTION FRACTION

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ABSTRACT :

Heart failure is a significant global health issue. Despite advances in management, heart failure patients often face readmission, which is associated with increased mortality and substantial healthcare costs. The Makassar Tele-Homecare application has shown potential in improving patient outcomes. This study aims to evaluate the impact of the Makassar Tele-Homecare application on reducing readmission rates among heart failure patients, potentially offering a cost-effective and efficient approach to chronic disease management. In total, 60 patients were included in this study, in which 33 patients were given teleeducation while 27 patients were set as control group. The mean age of patients teleeducation was older (54.3 ± 11.8 vs 60.02 ± 10.1). The mean ejection fraction in the teleeducation group was slightly lower than in the group without teleeducation (25.8 ± 7.7 vs 26.4 ± 7.3). It was found that patients with teleeducation had fewer total readmissions in 3 months and was statistically significant compared to control group. In addition, a significant difference was observed in the incidence of readmission after 60 days, with teleeducation showing a positive impact ($p = 0.001$). The Makassar Tele-Homecare application has been found effective in reducing the incidence of readmissions within 3 months.

Keywords: Chronic Coronary Syndrome, Angiotensin-converting enzyme, Angiotensin Receptor Blocker, Coronary Intervention.

INTRODUCTION

Heart failure is a collection of clinical symptoms characterized by typical symptoms of shortness of breath, ankle swelling, and fatigue, which are accompanied by signs such as increased jugular venous pressure and pulmonary rales due to structural and/or functional heart abnormalities. This can result in decreased cardiac output and/or increased intracardiac pressure (Ponikowski et al, 2016).

WHO data in 2012 showed that in 2008 there were 17 million or about 48% of total deaths in the world caused by cardiovascular disease. The risk of death in congestive heart failure ranges from 5-10% per year in mild congestive heart failure and increases to 30-40% in severe congestive heart failure. In Southeast Asia, there are 9 million people with heart failure with a prevalence of 6.7% in Malaysia and 4.5% in Singapore (Savarese et al, 2017). Indonesia's Basic Health Research (Riskesdas) in 2013, showed that congestive heart failure is the cause of death in Indonesia about 9.7% of all heart diseases, with the highest prevalence in East Nusa Tenggara (0.8%), Central Sulawesi (0.7%), followed by South Sulawesi and Papua (0.5%) (Riskesdas 2013).

Advances in management have improved life expectancy and reduced hospitalization rates in patients with low EF heart failure, although the result is often unsatisfactory. Therefore, the goals of heart failure management are to improve the clinical status, functional capacity, and quality of life, prevent hospitalization, and reduce mortality (Ponikowski et al, 2016).

Readmissions are episodes when a patient who has been discharged from the hospital is re-hospitalized within a certain interval (Kansagara et al., 2011). Readmissions or rehospitalizations are most encountered in patients with heart failure in clinical practice. Along with the development of medical therapy, technological advances, and improvements in medical services, the mortality rate due to acute heart failure is decreasing. However, along with the course of the disease patients with heart failure are very vulnerable to being re-hospitalized. (O'Connor, 2017). Data in the United States show that as many as 6.5 million patients over the age of 65 with heart failure are hospitalized each year. Readmission is a strong prognostic predictor of increased mortality in patients with heart failure who are readmitted. The costs incurred annually reach 17.4 million US dollars (Gheorghiade et al., 2013). Data in Indonesia

itself, although not specifically mention the number of costs incurred for heart failure, but the amount of costs incurred by the Health Insurance Organizing Agency (BPJS) for cardiovascular disease reaches 6.67 trillion rupiahs per year (Maharani, 2015).

Therefore, heart failure patients benefit from regular follow-up and monitoring. Monitoring can be done in several ways, including through home visits, through clinics in the community or hospital, or through remote monitoring either by telephone or telemedicine. Several meta-analysis studies have shown the benefits of this method (Ponikowski et al, 2016). One of the educational applications through telemedicine (teleeducation) that already exists and can be downloaded through PlayStore is the Makassar Tele-Homecare application which was socialized in 2022. The Makassar Tele-Homecare application makes it easy for people to get information related to disease problems via cellphones without having to go to doctors, health centers or hospitals (Kallo R, 2019). In 2021, there has been one study that examined teleeducation with a one-month application with a decreased ejection fraction which turned out to be very likely to improve the patient's quality of life from the results of the HeartQoL score. This study aimed to explore the effect of monitoring with the Makassar Tele-Homecare application on the incidence of readmission of heart failure patients.

MATERIALS AND METHODS

This study utilizes a quantitative methodology with a randomized controlled trial design. Patients were divided into two groups: a tele-education group through the Makassar Tele-Homecare application and a group without tele-education. Both groups will receive conventional education according to the Heart Failure Zone, and then be asked to have routine control every month for three months. The tele-education group will be given the Makassar Tele-Homecare application and educated and monitored through it. Follow-up will be done for 90 days after hospitalization to compare the incidence of readmission between the two groups. This study was a clinical trial study, on inpatients and outpatients at the Integrated Heart Center of Dr. Wahidin Sudirohusodo Hospital with a diagnosis of heart failure with decreased ejection fraction.

Patient inclusion criteria are inpatients or outpatients with a diagnosis of Congestive Heart Failure with Decreased Ejection Fraction, age 18 years or older, left ventricular ejection fraction below 40%, willing to follow research procedures and examinations and have an active

telephone number and smart phone device that can be used. Meanwhile, the exclusion criteria were patients with neurological, musculoskeletal, or mental disorders that hindered the completion of the study application, as well as patients who could not be contacted.

Samples that met the inclusion and exclusion criteria were taken collectively since admission through inpatient and outpatient care. Basic data on age, and gender, were taken from the patient's identity card. Clinical data such as age and gender were taken from medical records. Ejection fraction results were taken from the echocardiography examination results listed in the medical record. The sample will be divided into two groups, namely the teleeducation group and the group without teleeducation. The teleeducation group will install the Tele-Homecare application, be taught how to use it, and after understanding it will be asked to test the application in front of the researcher. The tele-education group will then be educated about the heart failure zone and routine control at the polyclinic every month. The teleeducation group will be given scheduled notifications containing questions or requests related to clinical complaints symptoms, weight, medication schedule, control schedule, heart failure zone self-reporting, and recommendations to read E-learning. The teleeducation group was also asked to self-report their heart failure zone according to the instructions through the application or WA (Whats App). The non-teleeducation group will not have access to remote consultation. The group without tele-education will receive education about the heart failure zone and routine control to the polyclinic every time.

The data obtained was analyzed by computer using the Statistical Package for Social Science (SPSS) program. The results obtained will be displayed in the form of narratives complemented by tables and graphs. Categorical data is presented in the form of frequencies. Numerical data is done in the form of mean, standard, median, minimum, and maximum. Pearson Chi-Square analysis was used to compare the scores of the two groups. The paired sample t-test analysis was used to compare the quality of life at the beginning of the study and after 30 days. A value of $p < 0.05$ was determined to be statistically significant.

The study received approval from the ethics committee for human biomedical research at Hasanuddin University, located in Makassar.

RESULTS

This study obtained a total sample size of 60 people who were divided into 2 groups, namely 33 people in the teleeducation group and 27 people in the group without teleeducation. The sample characteristics of the two groups can be seen in Table 2. From the sample data of both groups, the mean age of the group without teleeducation was older (54.3 ± 11.8 vs 60.02 ± 10.1), with a significant difference ($p < 0.05$). There were more males than females in both groups, with the difference between groups not significant ($p > 0.05$). The education levels of the subjects in the tele-education group were high school and college with equal numbers (36.4%), elementary school (21%), and junior high school (6.1%), respectively. The highest level of education in the group without teleeducation was high school (51.9%), college (18.5%), elementary school (22.2%), and junior high school (7.4%), respectively. The difference in education level between the two groups was not significant ($p > 0.05$).

Table 1. Characteristics of participants

Variable	Teleeducation group (N = 33)	Control group (N = 27)	p-value
Age (years)			
Min/max	27/81	37/78	0.04
Mean $\pm$ SD	54.3 ± 11.8	60.02 ± 10.1	
Gender			
Male	19 (57.6%)	19 (47.5%)	0.907
Female	14 (42.4%)	8 (40%)	
Education level			
Elementary	7 (21.1%)	6 (22.2%)	0.468
Junior high school	2 (6.1%)	2 (7.4%)	
Senior high school	12 (36.4%)	14 (51.9%)	
College	12 (36.4%)	5 (18.5%)	
Ejection fraction			
Min/max	20/36.3	14/40	0.09
Mean $\pm$ SD	25.8 ± 7.7	26.4 ± 7.3	
History			
NYHA I and II	4 (12.1%)	2 (7.4%)	0.8
NYHA III and IV	29 (87.9%)	25 (92.6%)	

NYHA: New York Heart Association

The mean ejection fraction in the teleeducation group was slightly lower than the group without teleeducation (25.8 ± 7.7 vs 26.4 ± 7.3) and there was no significant difference between the two groups ($p > 0.05$). In the teleeducation group, the severity of heart failure was highest in the NYHA III and IV history category (87.9%), followed by NYHA I and II (12.1%). The same thing also happened in the group without teleeducation, namely NYHA III and IV history (92.6%) and then NYHA I and II history (7.4%). The difference in NYHA class between the two groups was also not significant ($p > 0.05$).

An analysis was then conducted to determine the total number of readmissions at 3 months in patients with and without teleeducation using independent t-test analysis. It was found that patients with teleeducation had fewer total readmissions in 3 months which was statistically significant compared to patients without teleeducation (K = total readmissions).

Table 2. Mean Total Readmissions and No Readmissions in the Teleeducation and Control Groups

		Number of patients with readmission	Number of patients without readmission	p-value
Group	Tele-education (K = 99)	17 (36.1%)	82 (61.7%)	0.001
	Control (K = 81)	30 (63.9%)	51 (38.3%)	
	Total (K=180)	47	133	

Comparison of readmission rates in the teleeducation group and without teleeducation was analyzed using the chi-square method. The results of chi-square analysis can be seen in Table 3.

Table 3. The Results of The Chi-Square Analysis

Table 6: The Results of The Chi-Square Analysis										
Group	Readmission									p-value
	≤30 days			31 – 60 days			>60 days			
	Yes	No	Total	Yes	No	Total	Yes	No	Total	
Teleeducation	5 (15.1%)	28 (84.9%)	33	10 (30.3%)	23 (69.7%)	33	2 (6%)	31 (97%)	33	0.051
Control	10 (37%)	17 (63%)	27	9 (33.3%)	18 (66.7%)	27	11 (40.7%)	16 (59.3%)	27	0.802
Total	15 (25%)	45 (75%)	60	19 (31.7%)	41 (68.3%)	60	13 (21.7%)	47 (78.3%)	60	0.001

Based on Table 3, there is no significant difference between heart failure patients with low ejection fraction who received teleeducation and those without teleeducation on the incidence of readmission at ≤ 30 days and 31 - 60 days ($p > 0.05$). However, there was a significant difference in heart failure patients with low ejection fraction who received teleeducation and without teleeducation on the incidence of readmission above 60 days ($p = 0.001$).

Subsequently, we analyzed other factors associated with the incidence of third-month readmission using the chi-square method and descriptive analysis method because the number of samples was not the same in each subgroup, which can be seen in Table 6. There was no significant difference between age, gender, education level, ejection fraction, and NYHA group on the incidence of readmission in the third month using the chi-square method. However, in the descriptive analysis method, out of a total of 47 subjects in the tele-education group, the mean increase in non-readmission rate was 27.3. Based on this data, male subjects had a higher non-readmission rate than the mean (30 vs 27.3). Subjects with middle and lower education levels had a higher non-readmission rate than the mean (32 vs 27.3). Subjects with a history of NYHA III & IV had a higher non-readmission rate than the mean (41 vs 27.3).

Table 4. Relationship of Variables to the Incidence of Readmission at 3 Months

Variable	No readmission	Readmission	p-value
Total Subjects	N= 47	N=13	
Age			
≤55 years	22 (46.8%)	5 (38.4%)	0.592
>55 years	25 (53.2%)	8 (61.6%)	
Gender			
Male	30 (63.8%)	8 (38.4%)	0.907
Female	17 (36.2%)	5 (61.6%)	
Education level			
Less than college	32 (68%)	11 (84.6%)	0.404
College and above	15 (32%)	2 (15.4%)	
Ejection fraction			
≤25%	21 (44.6%)	3 (23%)	0.159
>25%	26 (55.4%)	10 (77%)	
History			
NYHA I and II	6 (12.8%)	0 (0%)	0.174
NYHA III and IV	41 (87.2%)	13 (100%)	

Table 5 presents the findings of multivariate analysis regarding the risk factors for sensorineural hearing loss (SNHL). According to the Wald values, the duration of diabetes mellitus (DM) emerges as the most significant factor associated with the occurrence of SNHL in Type 2 DM. Individuals with DM lasting more than 5 years exhibit a staggering 30.8-fold higher risk of experiencing SNHL compared to those with DM duration less than 5 years (for the same gender). Furthermore, the gender of DM patients also plays a significant role in the occurrence of SNHL, with men being at a 7.6-fold higher risk of developing SNHL compared to women (for the same duration of DM).

DISCUSSION

In this study, it was found that the readmission rate of subjects with heart failure increased after two months of observation. This is in line with the research of Fonarow et al. in the OPTIMIZE-HF registry which found that the readmission rate of heart failure patients after hospitalization will increase by 30% within 60-90 days (Fonarow et al.2007). This is also in line with the study of Soriano et al. who found that the quality of life of heart failure patients will be impaired and never return to the same as the normal population, especially in the first 3 months. The increase in quality of life impairment is in line with one of the goals of the management of heart failure patients with low ejection fraction, namely improving quality of life. This goal is achieved by the administration of neurohormonal antagonist drugs, and fluid monitoring accompanied by diuretics (Ponikowski et al.2016).

In this study, it was found that education reduced the incidence of readmissions in the first month, days 31-60, and above 60 days. The lowest number of readmissions was in the period above 60 days, with the effect of teleeducation greater in the third-month results compared to no teleeducation. Teleeducation in patients with heart failure with decreased ejection fraction can improve quality of life outcomes by preventing early worsening.

Teleeducation as part of telemedicine is one of the applications of information technology in the health sector. Bertoncello et al. have reviewed various studies on the application of telemedicine and its effectiveness for patients with chronic diseases. According to Bertoncello et al. in a review, the results of telemedicine in heart failure patients vary in various studies. Some studies show that the intensity of the intervention does not affect the outcomes of heart failure patients. Other studies have shown that close monitoring is more effective in improving patient

outcomes, due to early recognition of changes in patient vital signs. This is consistent with the hypothesis that speed of intervention is crucial in preventing readmissions and reducing mortality. Recent studies have shown that remote monitoring in heart failure patients is beneficial in the short period when patients are newly diagnosed or require special attention. After 6 months, the effectiveness of telemedicine on heart failure outcomes has decreased (Bertoncello et al.2018). This study was conducted over a short period of one month and telemedicine is beneficial for heart failure patients in the short term, but further research is needed for a longer period.

In this study, we did not examine the effect of behavioral changes that occurred in subjects using teleeducation related to changes in readmission rates. How the teleeducation intervention relates to the process of changing readmission rates has not been explored in this study. However, from the literature, it appears that behavioral changes after receiving telemedicine intervention affect the quality of life of heart failure patients, which is also in line with readmission rates.

In a short-term study (42 days), regarding the use of telehealth (Telemedicine) in heart failure patients, it was found that telehealth increased patients' self-awareness, and independence and made them more active in seeking help. Patients were more aware of the importance of self-managing their health condition. Routine weighing activities and fluid intake regulation were two significant factors during the telehealth monitoring period. These behavioral improvements were associated with better patient understanding of their condition and better adherence to the system. These behavioral changes improved several physiological parameters, prevented worsening, and made patients understand the importance of making the right decisions to improve their quality of life (Varon et al.2014). In our study, education was also provided through periodic messages regarding routine weighing and fluid intake regulation. Although we did not specifically examine the behavioral changes that occurred, the final result in the form of a decrease in readmission rates is thought to be one of the contributing factors to the improvement in quality of life due to improved subject behavior.

There are several methods for telemedicine to play a role in changing subjects' behavior and improving quality of life. In our study, the subject's motivation is expected to increase by involving the family in the process, so that the subject is not entirely burdened. In addition, the subject is given goals to achieve such as target weight, and a safe zone for him/her. Intervention

goals were kept in mind through reminders and two-way communication through private messaging.

Descriptive analysis of the third-month teleeducation group showed that subjects with male gender had a higher rate of non-readmission than the mean. This suggests that teleeducation was of greater benefit to male subjects.

In this study, NYHA class influenced quality of life, so the readmission rate in the third-month teleeducation group was higher in NYHA III and IV groups, compared to NYHA I and II groups. The study by De Leon et al. showed that patients with greater symptom burden had poorer quality of life. Functional status has a stronger association than other markers such as ejection fraction, or natriuretic peptide levels in influencing quality of life (De Leon et al.2009). Groups with more severe disease severity i.e. NYHA III and IV in this study benefited more from teleeducation. Several randomized clinical trial studies have shown the superiority of telehealth (teleeducation) over usual care in patients with more severe and unstable heart failure. This method is superior in conditions where usual care cannot provide optimal care, and tele-education services are intensive. Another finding from the TIM-HF clinical trial showed that remote monitoring in a group of subjects with well-controlled and stable heart failure found no significant difference compared to usual care by well-qualified health workers (Greenhalgh et al.2017). Another RCT on telemedicine in heart failure found that participants with new or worsening symptoms preferred to use smartphone monitoring (Albert N et al.2017).

The comparison of education levels in the tele-education group in this study was unbalanced (68% lower secondary education level vs 32% higher education level). In another study, it was said that higher education and higher understanding of health were associated with ease of use of the TeleHeartFailure device (Albert N et al.2017). The difference in the percentage of lower secondary and tertiary education level subjects who entered is thought to be due to fewer tertiary education level populations seeking treatment than those experiencing heart failure.

CONCLUSIONS

Telemedicine-based monitoring of patients with decreased ejection fraction heart failure using the Makassar Tele-Homecare application is effective in reducing the incidence of readmissions within 3 months. Teleeducation with the Makassar Tele-Homecare application may

be recommended for use in groups of patients with decreased ejection fraction heart failure. However, further research needs to be done on the effect of teleeducation on readmission rates over a longer period and a wider population of heart failure patients.

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