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TELEREHABILITATION TO IMPROVE PHYSICAL ACTIVITY IN HEARTH FAILURE PATIENTS

Telerehabilitasi Dapat Meningkatkan Aktivitas Fisik Pasien Gagal Jantung

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ABSTRAK

Gagal jantung mengakibatkan penurunan fungsi tubuh yang dikaitkan dengan gangguan kemampuan jantung dalam memompa darah. Kondisi ini mengakibatkan pasien mudah merasa lelah dan sesak napas, sehingga mengurangi kemampuan dalam melakukan aktivitas fisik. Telerehabilitasi manjadi alternatif intervensi yang memanfaatkan teknologi komunikasi jarak jauh untuk memonitor pasien secara berkala. Penelitian ini bertujuan untuk mengidentifikasi efektivitas telerehabilitasi dalam meningkatkan kemampuan aktivitas fisik pada pasien gagal jantung. Studi eksperimental dilakukan pada 118 pasien gagal jantung yang dibagi menjadi kelompok intervensi dan kelompok kontrol. Intervensi yang diberikan berupa edukasi terstruktur mengenai rehabilitasi fase 4 dan monitoring dilakukan jarak jauh selama 4 minggu dilakukan menggunakan telepon seluler. Instrumen International Physical Activity Questionnaire (IPAQ) digunakan untuk menilai tingkat kemampuan aktivitas fisik. Hasil analisis uji paired sample t-test menunjukkan adanya peningkatan yang signifikan secara statistik pada rata-rata skor aktivitas fisik sebesar 0,66 pasca intervensi telerehabilitasi (p<0,001). Telerehabilitasi terbukti efektif dalam meningkatkan kemampuan aktivitas fisik pasien gagal jantung. Intervensi ini dapat dijadikan alternatif tindakan mandiri perawat yang efektif dan efisien.

Kata kunci: *aktivitas fisik, gagal jantung, IPAQ, telerehabilitasi*

ABSTRACT

Heart failure reduces the heart's ability to pump blood, leading to fatigue and shortness of breath, thus reducing the capacity to perform physical activities. Telerehabilitation is an alternative intervention that utilizes remote communication technology to monitor patients regularly. This study examined the effectiveness of telerehabilitation in improving physical activity in heart failure patients. The experimental study was conducted on 118 heart failure patients divided into intervention and control groups. The intervention included four weeks of structured education on phase 4 rehabilitation and monitoring via cell phone. Physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ). The Result of paired sample t-test analysis showed a statistically significant increase in the mean physical activity score of 0.66 after the telerehabilitation intervention (p<0,001). This demonstrates that telerehabilitation effectively enhances physical activity in heart failure patients and can serve as a valuable alternative for nursing care.

Keywords: heart failure, IPAQ, physical activity, telerehabilitation

INTRODUCTION

Heart failure is a common chronic cardiovascular disorder, characterized by a functional condition of the heart that is not optimal in pumping blood to meet the blood supply to the entire body that is needed to support the body's metabolic processes[1], [2]. American Heart Association (AHA), more than 200 thousand people in the world suffer from heart failure[3]. In Indonesia, heart failure is a serious health problem, with

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an estimated 877,531 cases in 2023, with 0.79% of these cases occurring in Central Java[4].

Several studies show that some heart failure patients experience a decrease in physical activity patterns which has an impact on reducing the quality of life, which occurs due to a decrease in cardiorespiratory frequency due to a lack of blood supply containing oxygen and nutrients[5] In some patients, complaints such as shortness of breath and fatigue become factors that limit daily activities[6], [7]. Previous studies have shown that regular physical activity contributes to minimizing the risk of complications and recurrence rates in heart failure patients, as well as helping improve heart function during the recovery phase[8]. Therefore, interventions to support the improvement of functional abilities and quality of life of patients play an important role in the management of heart failure[9], [10].

Numerous studies support that cardiac rehabilitation is an effective intervention approach in improving functional capacity, increasing well-being, and enhancing quality of life leading to a reduced risk of hospitalization, death, and the risk of complications[11], [12]. Cardiac rehabilitation at a healthcare center is a rehabilitation program that involves patients attending rehabilitation services, divided into four phases: the acute phase in the hospital (phase 1), the post-hospitalization phase (phase 2), the intensive training phase (phase 3), and the long-term maintenance phase (phase 4)[11], [13]. Phase 4 has been recommended to maintain the long-term effects of the previous rehabilitation phases[14]. Previous studies found that phase 4 rehabilitation can improve functional capacity in cardiorespiratory fitness and quality of life[14], [15].

Several studies have shown that cardiac rehabilitation programs in healthcare centers have not fully adapted to the physical or social conditions of some patients, which can hinder rehabilitation therapy and reduce levels of satisfaction[16]. Low patient participation in cardiac rehabilitation programs at healthcare centers, as reported in various studies, is influenced by cost constraints, limited access to transportation, inadequate facilities, and low patient motivation[17], [18], [19] Low patient participation in cardiac rehabilitation programs is a challenge that can encourage nursing services to develop innovative approaches to supporting patients' quality of life and functional capacity.

Telerehabilitation was introduced as an alternative in updating central cardiac rehabilitation services by utilizing telecommunications technology such as mobile phones and short messages[20] Telerehabilitation is recommended by Dutch multidisciplinary cardiac rehabilitation guidelines as an alternative that has the potential to reduce some of the barriers encountered in in-center cardiac rehabilitation by offering flexibility in time and location, increasing patient engagement, and allowing continuous monitoring without the need for in-person visits to a healthcare center.[21]Several studies have shown that telerehabilitation has a positive contribution in supporting physical fitness and quality of life and is also effective in increasing physical exercise resistance, reducing the incidence of hospitalizations and mortality[20], [22], [23].

However, most telerehabilitation research still focuses on phases 2 and 3 of cardiac rehabilitation, which emphasize measuring physical endurance[24], [25]. This does not fully reflect the patient's ability to sustain physical activity at home. Studies on the effectiveness of telerehabilitation in phase 4 rehabilitation are still relatively scarce in the literature, especially when compared to phases 2 and 3, even though phase 4 can actually maintain the long-term effects of rehabilitation that patients have undergone. Furthermore, previous studies generally focused more on quality of life and hospitalization rates, without measuring physical activity as a primary outcome[17], [26]On the other hand, studies on telerehabilitation for heart failure patients are still dominated by research from developed countries. In Indonesia, research specifically

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evaluating the impact of telerehabilitation on physical activity in heart failure patients is still scarce.

Based on the description above, there is still a gap in the scientific literature regarding the effectiveness of telerehabilitation in phase 4 of cardiac rehabilitation, particularly in efforts to increase long-term physical activity. This study aims to address the limitations of previous literature by identifying the effectiveness of telerehabilitation as an effective and sustainable strategy for increasing physical activity in heart failure patients during the maintenance phase.

METHODS

The quantitative research method used a two-group Randomized Control Trial (RCT) experimental design with a pre-post test control group. This study involved a population of heart failure patients at the Heart Clinic of Salatiga Regional Hospital between January and February 2025. 118 people were included in the sample.obtained through calculations using GPower. The study sample was divided into two groups, namely the intervention group and the control group, each consisting of 59 patients. The sampling process applied a probability sampling method with a simple random sampling strategy. The randomization process was carried out using a lottery method based on odd and even numbers, with respondents with odd numbers entering the intervention group, and respondents with even numbers entering the control group.

The sample inclusion criteria included: patients included in the New York Heart Association (NYHA) functional class classification I, II, III, entering phase 4 of cardiac rehabilitation, age >18 years, able to perform self-care independently, willing to be research respondents, and patients can be contacted by cell phone. Exclusion criteria: patients who frequently experience chest pain, including NYHA IV classification, pregnant, post Coronary Artery Bypass Grafting (CABG) surgery <3 months, using a pacemaker <6 weeks, HR >90x/minute, tachypnea, have a history of chronic lung disease, experience disability, have a history of acute or chronic infectious diseases, and patients who are not willing to participate in the study. Informed consent was signed by respondents selected through a direct visit as a form of agreement to be involved in the research respondents, carried out before being divided into the intervention group and the control group.

Physical activity ability was measured using the International Physical Activity Questionnaire (IPAQ). The instrument is available in English and can be freely used. Researchers used the Indonesian version, which had been translated by previous researchers[27]. The results of the IPAQ validity and reliability tests show that the CVI is 0.94; Cronbach Alpha is 0.84[27]. IPAQ contains 27 questions consisting of 5 components, namely walking physical activity, physical activity at work, physical activity in transportation, physical activity in household activities, and physical activity in recreation, sports, and leisure activities. From these components, a total Metabolic Equivalent of Task (METs) score will be produced which will be classified into low physical activity levels <600 METs/week, moderate physical activity ≥600 METs/week, and heavy physical activity ≥3000 METs/week.

Data collection techniques were carried out in week 1 and week 5.The data collection techniques and intervention techniques in this study consist of:

1. Week 1: For 10 minutes, both groups will have a face-to-face Q&A session. The questions and answers will be related to daily physical activity and the completion of the IPAQ pre-test questionnaire. The control group will continue with the therapy they received post-treatment for the next 4 weeks. Meanwhile, the intervention group will receive education through face-to-face visits about physical exercise, covering the benefits of physical activity for heart failure

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patients, the frequency and intensity of light exercise stages, the frequency and intensity of strength, flexibility before exercising, and motivation to carry out daily physical activity independently. Monitoring of the intervention group will be carried out once a week via text message and telephone, covering adherence to the phase 4 physical exercise schedule, early detection of deterioration if any, reminders regarding physical activity and light exercise to be implemented, and providing patient motivation to be consistent. Respondents who have limitations in operating a cell phone will be accompanied by a second party, namely their child. In Week 1, the intervention group was given a schedule to do the following:

a. Light exercise: choose one of leisurely cycling, leisurely walking, or jogging, 20 minutes twice a week.
b. Light weight lifting exercise 1x/week 10x two sets.
c. Active in carrying out daily activities.

2. Weeks 2, 3, and 4:The intervention group was monitored remotely using mobile phone text messages and given a physical exercise schedule via text message, as in the first week.However, there is an increase in training intensity in the form ofincrease the frequency of light exercise by 1 time/week Andadditional 5 minutes of duration every week. Light weight training is also enhanced byincrease frequency 1 time every 2 weeks And**increase the number of sets by 2 times/week**. Researchers routinely motivate patients to be active in their daily activities independently.
3. Week 5: Post-test data collection was conducted between the intervention and control groups with a telephone Q&A session regarding daily physical activity. The control group received the same telephone education as the intervention group in week 1, but without the telerehabilitation intervention.

The research protocol has been reviewed by the Health Research Ethics Committee of Salatiga City Hospital and has passed the ethical review (No. 045/EC/RSUD Salatiga/2024). All respondents will be provided with an explanation of their involvement in this study and asked to sign an informed consent form before participating.The data obtained will go through the paired sample t-test analysis stage to assess the differences in physical activity levels before and after the intervention in each group, and the independent sample t-test to measure the comparison of the final physical activity levels between groups (intervention and control).

RESULT

The characteristics of respondents with heart failure in the study are described in Table 1 below:

Table1. Respondent Characteristics

Characteristics	n	%
Age		
20-60 Years (≤ 60 Years)	57	48.3
61-84 Years (>60 Years)	61	51.7
Gender		
Man	61	51.7
Woman	57	48.3
Education		
No school	5	4.2
Elementary School	48	40.7
JUNIOR HIGH SCHOOL	15	12.7
SENIOR HIGH SCHOOL	30	25.4
D3/D4	5	4.2
Bachelor	13	11
Postgraduate	2	1.7
Smoke		

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Characteristics	n	%
Yes	43	36.4
No	75	63.6
Hypertension		
Yes	56	47.5
No	62	52.5
DM		
Yes	22	18.6
No	96	81.4
Cardiac Functional Class (NYHA)		
I	26	22.0
II	70	59.3
III	22	18.6

The respondent characteristics data parameters in this study were dominated by those aged over 60 years (51.7%), while 48.3% were under 60 years old. Respondents who had limitations in operating a mobile phone would be accompanied by a second party, namely their child. Based on gender, respondents consisted of 51.7% men and 48.3% women. The most common level of education found was elementary school at 40.7%, followed by high school 25.4%, junior high school 12.7%, bachelor's degree 11%, D3/D4 4.2%, and postgraduate 1.7%. Most respondents did not have a history of smoking (63.6%). Regarding the history of hypertension, 47.5% had a history of hypertension, while 52.5% did not. Only 18.6% of respondents had a history of diabetes, while 81.4% did not have a history of diabetes. Based on the classification of abilityAccording to NYHA functional cardiac status, the majority of respondents were in NYHA class II (59.3%), indicating mild impairment during physical activity. Meanwhile, 22.0% of respondents were in NYHA II classification and 18.6% in NYHA III classification.

Table 2. Characteristics of Physical Activity Levels

Group	Physical Activity Level	Pre-Intervention (n=59)			Post Intervention (n=59)		
		n	%	Mean METs	n	%	Mean METs
Intervention	Low <600 METs	38	64.41	955.19	8	13.56	2178.64
	Moderate ≥600 METs	18	30.51		39	66.10	
	Height ≥3000 METs	3	5.08		12	20.34	
Total		59	100.0		59	100.0	
Control	Low <600 METs	25	42.37	1415.09	26	44.07	881.23
	Moderate ≥600 METs	30	50.85		33	55.93	
	Height ≥3000 METs	4	6.78		0	0	
Total		59	100.0		59	100.0	

Table 2 shows that before the intervention, the majority of respondents in the intervention group were at a low level of physical activity (64.41%), followed by a moderate level of physical activity (30.51%), and a high level of physical activity (5.08%). Meanwhile, in the control group, baseline data showed that most respondents were at a moderate level of physical activity (50.85%), followed by a low level of physical activity (42.37%), and a high level of physical activity (6.78%).

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After the telerehabilitation intervention in the intervention group, the low physical activity level decreased to 13.56%. Conversely, the moderate physical activity level increased from 30.51 to 66.10%, and the high physical activity level increased from 5.08% to 20.34%. This increase was also reflected in the average METs value in the intervention group, which increased from 955.19 before the intervention to 2178.64 after the telerehabilitation intervention. After the same time period without intervention in the control group, the proportion of respondents with low physical activity increased to 44.07%, while moderate physical activity increased insignificantly to 55.93%, and the high physical activity level decreased to 0%. The average METs value in the control group was 1415.09 at baseline and decreased to 881.23 at the end of the same time period as the intervention group. The increase in the average METs value indicates that the telerehabilitation intervention was effective in increasing respondents' physical activity levels.

Table 3. Differences in Physical Activity Levels*Pre and Post*

Group	*Mean Pre (Mean Post)*	*Coefficient*	*Std. Error*	*t(df)*	*p-value*(p<0.005)
Intervention	1.41 (2.07)	-0.661	0.099	-6,709 (58)	<0.001
Control	1.64 (1.56)	0.085	0.103	0.820 (58)	0.416

*T Test

A paired sample t-test based on Table 3 showed a significant difference in physical activity levels between the intervention group and the post-telerehabilitation group (t=-6.709; p<0.001). Meanwhile, the control group did not show any significant difference in physical activity levels between the pre- and post-telerehabilitation group (t=0.820; p=0.416).

Table 4. Differences in Physical Activity Levels*Post Intervention Group With Control Group*

Group	*Mean (SD)*	*t*	*df*	*p*(p<0.005)	*d*
Intervention	2.07 (0.583)	5,081	116	<0.001	0.935
Control	1.56 (0.501)				

*T Test

The results of the independent sample t-test showed a significant difference in the average level of physical activity after the telerehabilitation intervention (t=5.081; p<0.001). The mean score in the intervention group (Mean=2.07; SD=0.583) was higher than the mean score in the control group (Mean=1.56; SD=0.501). The very large effect of telerehabilitation in the intervention group (Cohen'd = 0.935) contributed to the difference in the physical activity levels of the two groups.

DISCUSSION

Characteristics of Research Respondents

The majority of respondents in this study were aged >60, which is considered elderly. Elderly individuals tend to experience declines in physical abilities and immune systems.[28]Previous research shows that respondents aged over 60 years have a greater risk of experiencing heart failure[29]. In addition to age, gender also appears to influence respondents' health conditions. Rudolof et al studies have shown that the prevalence of heart failure is higher in men than in women[30]. This is likely related to behavioral factors, such as the tendency for men to smoke. Furthermore, the role of the hormone estrogen in women is known to protect the cardiovascular system[31].

Understanding a healthy lifestyle is based on an individual's ability to access, understand, and appropriately manage health information. One factor influencing this is education level. Research shows that individuals with higher levels of education tend to have better skills in seeking health information and making decisions regarding promotive and preventive measures[32]. During data collection in this study,

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respondents with higher educational backgrounds appeared more responsive when discussing their health. In this study, the majority of respondents had an elementary school education. This finding aligns with research by Kristinawati & Khasanah who reported that the majority of heart failure patient respondents in their study also had an elementary school education level[33].

Heart failure is often triggered by various medical conditions, includinghypertension, diabetes mellitus, and smoking habits[34]Smoking contributes to decreased heart function through the nicotine and carbon monoxide content, which can inhibit oxygen supply to tissues and cause the formation of atherosclerotic plaque in blood vessels[35],[36]. In this study, hypertension was recorded as the most common comorbidity, with nearly half of respondents experiencing high blood pressure. Uncontrolled blood pressure increases the heart's workload and triggers impaired ventricular function, ultimately contributing to the development of heart failure[37], [38]. Although the percentage of respondents with diabetes mellitus in this study was relatively low, this condition remains an important risk factor that can worsen heart function, uncontrolled blood pressure, and atherosclerosis, which can trigger heart failure[39], [40].

The ability to carry out physical activities in heart failure patients is greatly influenced by how well their heart functions[41]. In this study, most respondents were classified in NYHA II category, which indicates that they can still perform light to moderate physical activity, but tend to experience symptoms such as fatigue or shortness of breath during strenuous activity. NYHA I category was the second most common classification, with respondents stillRespondents in the NYHA III category were able to perform normal daily physical activities, but they still needed adequate rest to prevent fatigue or shortness of breath. Meanwhile, respondents in the NYHA III category showed more significant limitations, as symptoms such as shortness of breath and fatigue quickly appeared even with light activity, leading to a tendency to avoid physical activity. Overall, low levels of physical activity were found in most respondents in this study, related to their limited physical condition. Previous research has shown that some people with heart failure generally experience decreased cardiorespiratory fitness, which results in fatigue and shortness of breath when engaging in physical activity beyond their body's capacity[5], [6]. In fact, sufficient physical activity is still needed to maintain oxygen circulation to the tissues, including the heart muscle, and to prevent a decline in heart function[42].

The telerehabilitation intervention in this study demonstrated a significant contribution to improving physical activity among heart failure patients. Prior to the telerehabilitation program, the intervention group reported low levels of physical activity, with some respondents expressing reluctance to engage in activities due to perceived physical limitations. After participating in a series of telerehabilitation sessions via telephone and text messaging, a gradual increase in physical activity among the intervention group, particularly in light exercise, was noted. This improvement was reflected in the increase in the average METs score among the respondents.This is in line with the goal of cardiac rehabilitation, namely optimizing functional capacity and improving the quality of life of heart failure patients[12]. In addition, literature suggests that regular exercise of approximately 150 minutes per week can have a positive effect in helping improve heart function and reduce the risk of complications associated with heart failure[43].

Differences in Physical Activity Levels Before and After Telerehabilitation Intervention

The increase in physical activity among heart failure respondents in the intervention group in this study was closely related to the telerehabilitation program. The increase in physical activity among respondents in the intervention group was demonstrated by the increase in average physical activity levels following the telerehabilitation intervention. This program contributed to helping heart failure respondents in the intervention group

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develop healthy lifestyle habits and encouraged active involvement in physical activities appropriate to their physical capacity, thus supporting functional improvement of the heart. This indirectly impacted the physical aspects of quality of life. The effectiveness of telerehabilitation achieved in this study supports the primary goals of cardiac rehabilitation, namely improving functional capacity and enhancing physical well-being[11]. Parameters for increasing functional capacity and physical well-being are measured through the average METs value of physical activity, an increase in this average value has implications for achieving physical well-being, which is characterized by good physical fitness, regular exercise habits, and sufficient energy availability to carry out daily activities[11]. This result is in line with Schacksen's findings[19], which shows that telerehabilitation is significantly proven to be effective in increasing physical exercise capacity, so that the quality of life of heart failure respondents can improve.

Consistent support provided in the telerehabilitation program contributed to increased respondent compliance in maintaining their health during the recovery phase. This aligns with Supraja's findings[44], which found that heart failure patient respondents involved in a telerehabilitation program tended to be better able to manage their physical activity because they received regular monitoring and motivational support. Research by Sunamura et al also showed that the group of respondents who underwent physical activity training for three months experienced a significant increase in cardiac functional capacity[45]. In contrast, the control group that did not receive telerehabilitation intervention showed no tendency to experience changes in physical activity levels, which is likely related to a lack of external support and motivation. The study conducted by Wijayanti[46]emphasized that motivation plays an important role in improving self-care management skills. This is reinforced by Lacraru's research[47], which showed that the exercise capacity in the control group did not show any significant increase, presumably due to limited motivation received during the monitoring period.

Effectiveness of Telerehabilitation Interventions

The significant impact of telerehabilitation programs can be an alternative intervention solution for heart failure patients who experience limited access to center-based cardiac rehabilitation. The significant difference in average post-intervention physical activity levels between the intervention and control groups confirms that telerehabilitation is effective in increasing respondents' physical activity. Through remote monitoring, patients still have the opportunity to improve their physical abilities without having to visit a health care center in person. This program can be run from home and can be adjusted to each individual's daily schedule, thus increasing flexibility and affordability of services. A study conducted by Lundgren[48], participants reported feeling safe and comfortable participating in telerehabilitation programs because the intervention was easily accessible, physical activity was regularly monitored, and exercise could be performed safely under the direct supervision of researchers. Furthermore, the effectiveness of telerehabilitation has been supported by several international guidelines, which state that this approach has comparable success rates to conventional cardiac rehabilitation programs in healthcare settings[21], [49].

This study has limitations, including limited access and digital literacy among elderly respondents, physical activity monitoring relying on self-reporting, and the study's scope being limited to a single institution with a relatively short intervention duration. For elderly respondents who have difficulty operating a mobile phone, the intervention will be accompanied by a second party, namely their child. These factors can affect external validity, potentially introducing subjective bias, and limiting the generalizability of the results. Nevertheless, the RCT design used strengthens internal validity. The telerehabilitation approach, as an innovative intervention, has been shown to increase

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active patient participation and is effective in improving physical activity capacity in patients with heart failure.

The results of this study provide important implications for technology-based healthcare practices, particularly in the rehabilitation of patients with chronic diseases. Telerehabilitation can be an adaptive and sustainable alternative intervention, particularly in areas with limited access to conventional rehabilitation services. Further studies with broader population coverage and long-term follow-up are needed to strengthen the evidence of its effectiveness and support the integration of telerehabilitation into national healthcare policies.

CONCLUSION

Telerehabilitation has emerged as a relevant, innovative approach to developing home-based cardiac rehabilitation, particularly for heart failure patients facing limited access to conventional rehabilitation services. The combination of structured education and motivation delivered through remote communication has been shown to contribute to fostering a more active lifestyle and increasing respondents' engagement in productive daily physical activity. The provision of gradual physical exercise, accompanied by regular monitoring via telephone or text messages, plays a role in supporting improved physical activity patterns and self-management skills. The results of this study support the development of home-based heart failure rehabilitation programs as part of sustainable cardiovascular care, particularly in areas with limited resources and access to healthcare facilities. To ensure the sustainability of this program, it is recommended to strengthen healthcare workers through specialized training, the development of appropriate digital systems, and the comprehensive integration of telerehabilitation systems into hospital rehabilitation services.

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