A quasi-experimental study examining a nurse-led educational program to improve disease knowledge and self-care for patients with acute decompensated heart failure with reduced ejection fraction

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Abstract

Background. Nurse-led education can improve heart failure (HF) knowledge and self-care behaviors, and consequently lead to better patient outcomes.

Objectives. To assess the effectiveness of "The Weak Heart" educational model in enhancing the level of disease knowledge and self-care behaviors among patients hospitalized with acute decompensated heart failure with reduced ejection fraction (HFrEF).

Materials and methods. An evidence-based, standardized educational program was implemented for HF patients in Poland. We compared the initial level of HF knowledge – as rated using a self-developed questionnaire and self-care behaviors, evaluated according to the 9-item European Heart Failure Self-care Behavior Scale (9-EHFScBS) – to the results obtained at the 3-month follow-up period with a sample of patients (n = 231) hospitalized with acute decompensated HF (ADHF).

Results. The results showed a significant increase in total score of HF knowledge test depending on the time of measurement ($\chi^2 = 356.526$, p < 0.001) and in all individual questions on HF. The significant change of the 9-EHFScBS self-care questionnaire was also found in total score ($Z = -7.317$, p < 0.001), in all domains: autonomous-based adherence ($Z = -5.870$, p < 0.001); consulting behavior ($Z = -7.238$, p < 0.001); provider-based adherence ($Z = -4.162$; p < 0.001) and in relation to all individual statements except statement 7 ("I eat a low salt diet") and statement 9 ("I exercise regularly"). Within 3 months of hospital discharge, 84% (193 out of 231) of participants visited their primary care physician and 79% (183 out of 231) visited a cardiologist in accordance with their individual treatment plan.

Conclusions. "The Weak Heart" educational model is effective in enhancing the level of HF knowledge and self-care behaviors among patients with decompensation of HFrEF.

Key words: heart failure, cardiology, disease management, adherence, disease education

Background

Heart failure (HF) is an important public health problem, with an estimated prevalence of 1–2% among adults and >10% among people aged >70 years in developing countries.[1] In Poland, over 700,000 patients suffer from HF, which can lead to premature death.[2,3] Heart failure requires multidisciplinary management programs, including self-care education.[1,4,5] Indeed, self-management interventions often led by nurses are effective at improving knowledge, self-care behaviors, quality of life, and reducing the number of hospitalizations and mortality among patients with HF.[6–16] Furthermore, the active post-discharge monitoring of patients with HF (e.g. via post-discharge phone calls) should translate into better adherence, a reduction in the number of decompensated HF cases and slower disease progression.[1,17]

The European Society of Cardiology (ESC), American College of Cardiology Foundation (ACCF) and American Heart Association (AHA) practice guidelines recommend a nurse-led HF education in HF patients.[1,4,5,18] The correlations between patients' knowledge of HF and self-care skills were found in studies conducted in the USA.[13,19]

To meet this need, multidisciplinary HF programs, including various types of nurse-led interventions, should be implemented.[1,18,20–23] Similarly, a disease management system for patients with HF named "KONS" (Comprehensive Care for Patients with Heart Failure) was proposed in Poland.[24]

Objectives

The purpose of this study was to implement a standardized nurse-led HF education program focused on improving disease knowledge and self-care behaviors in patients hospitalized with acute decompensated heart failure with reduced ejection fraction (HFrEF) and evaluate its effectiveness.

Materials and methods

Study population and design

"The Weak Heart" program was a nurse-led HF educational program conducted in 2019 in 14 cardiology centers in Poland and consisted of 2 hospital educational visits and 3 post-discharge phone calls. Prior to initiating patient education, nurse educators completed HF training and certification in accordance with the HF nurse curriculum developed by experts of Nurses and Medical Technicians and the Heart Failure Section of the Polish Cardiac Society.[25] Total number of 259 patients hospitalized due to acute decompensated heart failure (ADHF) were consecutively recruited based on the following inclusion criteria:

diagnosed HF with reduced ejection fraction (ejection fraction (EF) < 40% as evaluated using echocardiography), cognitive function enabling the participation in the program and a declaration of the patient's involvement in the treatment; there were no exclusion criteria to enter the program. To assess the effectiveness of the program in a clinical setting, a prospective, quasi-experimental, pre-test and post-test method was applied.

"The Weak Heart" program was based on HF guidelines of European Society of Cardiology[1] and tailored to the needs of patients with HFrEF. The scope of education included the following topics: basic information about HF, etiology, symptoms, principles of self-care, basics of treatment, and the importance of lifestyle, diet and exercise, based on the content from patient portal (www.slabeserce.pl) displayed on tablet. After completing educational sessions, participants received a heart failure passport[26] with an individual treatment plan, a cover letter to primary care physician and a drug dispenser. A detailed description of "The Weak Heart" educational program has already been published.[27]

Ethical aspects and recommendations

The Bioethical Commission at the University of Warsaw has approved the project (approval No. KB/3/A/2019). The study was performed in accordance with the ethical principles for clinical research based on the Declaration of Helsinki.

Data collection

Trained HF nurses interviewed participants using the questionnaires to assess the level of HF knowledge and self-care behaviors. Measurements were conducted before the implementation of any educational activities (visit 1), before discharge but after finishing all educational activities (visit 2 – only for the assessment of HF knowledge) and at the end of the 3-month follow-up period (visit 5).

Instruments

The research team has developed a 10-item HF knowledge questionnaire to assess the level of disease knowledge. Patient's responses were scored on a scale from 0 to 2 (0 – incorrect response, 1 – partially correct, 2 – correct), based on key words. The maximal score was 20 points – the higher the score, the better the level of HF knowledge. The calculated Cronbach's alpha for the knowledge test was 0.86. The value of the correlation coefficient of individual test items was not less than the minimum acceptable value of 0.20.

The 9-item European Heart Failure Self-care Behavior Scale (9-EHFScBS) contains 9 statements concerning self-care behaviors among HF patients.[28,29] The answers to the statements were given on the 5-point Likert scale,

with the result being the aggregation of the points from all statements included in the 9-EHFScBS. The scores vary from 9 to 45 – the higher the score, the lower the self-care capability. The questionnaire also enables the assessment of the level of self-care in terms of individual statements.[28,29] Additionally, a patient's self-care can also be measured by computing the scores for each subdimension of self-care: consulting behavior, autonomy-based adherence and provider-based adherence.[30] The calculated Cronbach's alpha for the behavior test was 0.89.

Statistical analysis

Statistical analysis was performed using SAS® software v. 9.4 (SAS Institute, Cary, USA). The Friedman's test was applied to verify the hypotheses of influence of the intervention program on scores of the knowledge test. Time of measurement was considered the within-group factor: before the commencement of the program (visit 1) compared to directly after finishing all educational activities (visit 2) compared to 3 months after its end (visit 5). The Bonferroni correction was used to adjust the significance value for multiple tests. The adjusted significance level was 0.017.

The Spearman's rank correlation coefficient was used to verify the correlation between scores on the 1st knowledge test and duration of the disease. The Mann–Whitney U test was conducted to compare the scores of patients participating in any educational activities on HF with those who did not, as well as patients who required several hospitalizations and those hospitalized for the first time.

The verification of assumptions about the impact of the intervention program on self-care behaviors and subjective knowledge was carried out using the Wilcoxon test. Time of measurement was considered the within-group factor: before the commencement of the program (visit 1) compared to 3 months after its end (visit 5). A two-tailed value of $p < 0.05$ was considered significant for all tests.

Results

The final analysis consists of 231 patients who signed written consent and fulfilled all educational visits, while a sample size of 199 patients was required to achieve a statistical significance of $p < 0.05$.[27] Out of 259 patients included in the program, all visits were finished regarding 89% of patients (Fig. 1). The baseline characteristics of patients included in the study are presented in Table 1.

The results showed a significant difference in performance in the level-of-knowledge test depending on the time of measurement ($\chi^2 = 356.526$, $p < 0.001$). The scores from the 1st measurement were significantly lower than those from the 2nd ($Z = -1.227$, p-value adjusted with Bonferroni correction (p_{adj}) <0.001) and 3rd measurement ($Z = -1.649$, $p_{adj} < 0.001$). The scores from the 2nd measurement were significantly lower than those from the 3rd measurement ($Z = -0.422$, $p_{adj} < 0.001$). The results are presented in Table 2. A significant improvement in HF knowledge has been observed for all individual questions (Fig. 2).

The results demonstrated that patients educated on HF prior to the program, patients who underwent several

259 (259 (100%) patients were recruited and provided informed consent)

Visit 1
(in hospital – baseline)

- 259 (100%) patients finished visit 1

Visit 2
(in hospital)

- 257 (99%) patients finished visit 2
- 2 (0.8%) patients refused to continue

Visit 3
(1st phone call)

- 244 (94%) patients finished visit 3
- 6 (2.3%) died, 2 (0.8%) refused to continue, 5 (1.5%) did not pick up the phone

Visit 4
(2nd phone call)

- 238 (92%) patients finished visit 4
- 1 (0.4%) died, 1 (0.4%) refused to continue, 4 (1.5%) did not pick up the phone

Visit 5
(3rd phone call - final)

- 231 (89%) patients finished visit 5
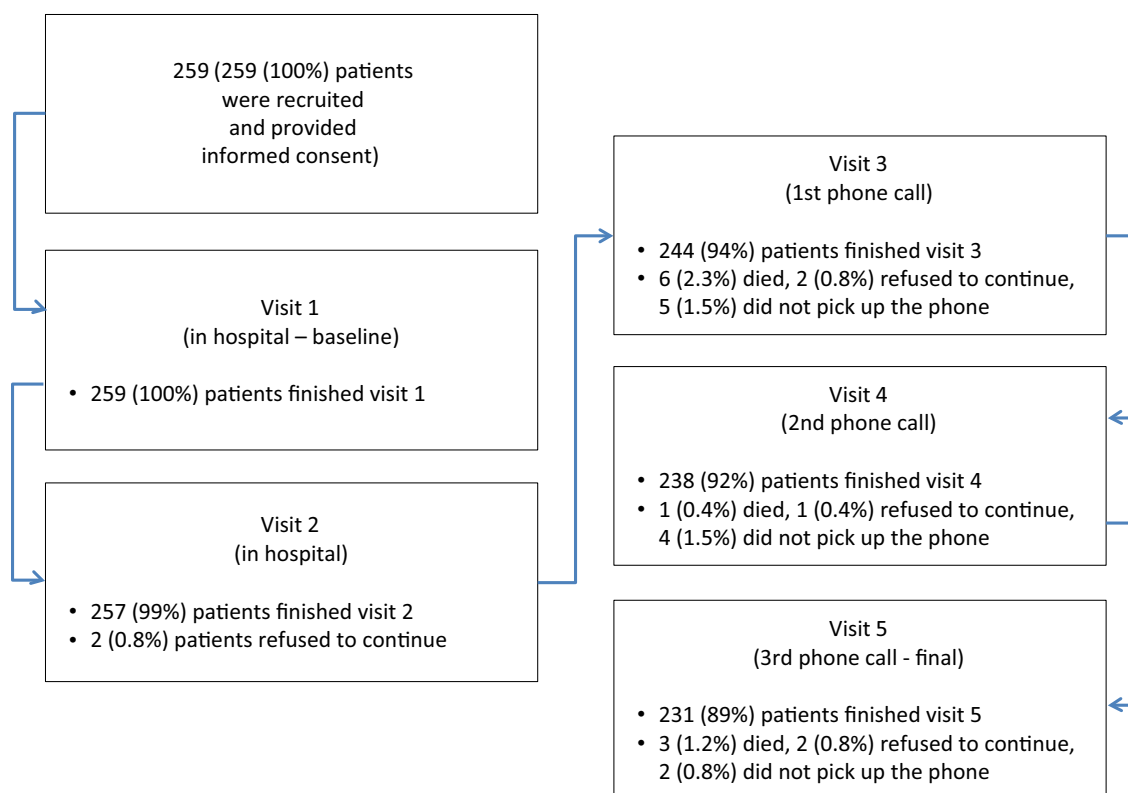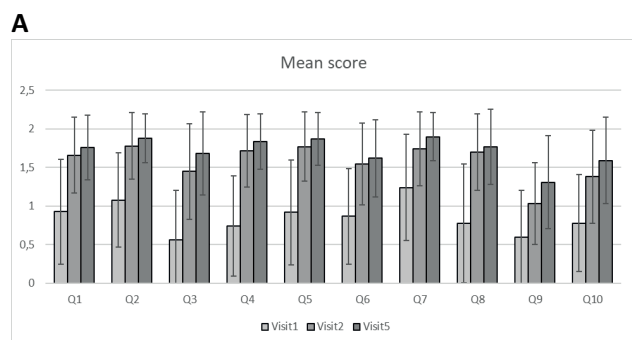- 3 (1.2%) died, 2 (0.8%) refused to continue, 2 (0.8%) did not pick up the phone

Fig. 1. Patient flowchart

A

The HF knowledge questionnaire: answers were assessed on 3-point scale (0 – incorrect response, 1 – partially correct response, 2 – correct response). A maximum score for individual question was 2 points with higher score indicating better knowledge.

Individual questions: Q1 – What does HF mean?; Q2 – What are the HF symptoms?; Q3 – What does HF decompensation mean?; Q4 – How HF decompensation can be detected?; Q5 – What diet recommendations do you know?; Q6 – What are the physical activity benefits?; Q7 – What is the role of diuretics in HF treatment?; Q8 – How much time after hospital discharge first ambulatory visit should be scheduled?; Q9 – What drugs are used in HF treatment?; Q10 – What can lead to HF decompensation?

B
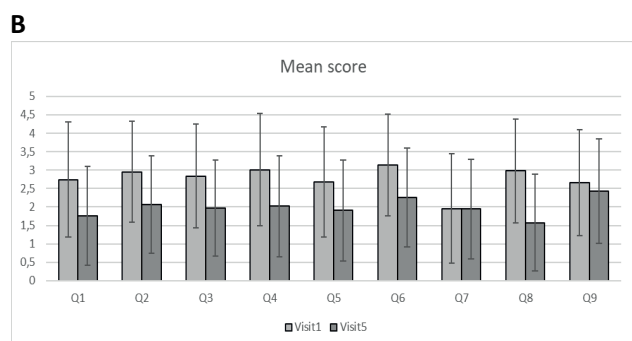
9-EHFScBS questionnaire: answers were assessed on 5-point Likert scale from 1 (completely agree) to 5 (completely disagree). A maximum score for individual question was 5 points with a lower score indicating better self-care.

Individual statements: Q1 – I weigh myself every day; Q2 – If shortness of breath (SOB) increases, I contact my doctor or nurse; Q3 – If legs/feet are more swollen, I contact my doctor or nurse; Q4 – If I gain weight more than 2 kg in 7 days, I contact my doctor or nurse; Q5 – I limit the amount of fluids (not more than 1.5–2 litres a day); Q6– If I experience fatigue, I contact my doctor or nurse; Q7 – I eat a low-salt diet; Q8 – I take my medication as prescribed; Q9 – I exercise regularly.

Fig. 2. A. Comparison of scores to the individual questions on the heart failure (HF) knowledge; B. Comparison of scores to the 9-item European Heart Failure Self-care Behavior Scale (9-EHFScBS) questionnaire. The comparisons are based on the results of repeated measures analysis of variance (ANOVA) test

Table 1. Baseline characteristic of patients with heart failure (HF)

Variable (categorical)	Features	n (%)
Age, years (%)	<40	17 (6.6%)
	40–70	176 (67.9%)
	>70	66 (25.5%)
Gender	female	61 (23.6%)
	male	198 (76.4%)
Education	primary	69 (26.7%)
	secondary	163 (62.9%)
	higher	27 (10.4%)
Residence	city	173 (66.8%)
	rural area	86 (33.2%)
Professional activity	working	60 (23.2%)
	retired	128 (49.4%)
	on pension	71 (27.4%)
Comorbidities*	none	66 (25.5%)
	1	104 (40.1%)
	>1	89 (34.4%)
HF education by HCP	no	194 (74.9%)
	yes	65 (25.1%)
Marital status	single	43 (16.6%)
	married	216 (83.4%)
Mean time from HF diagnosis to the commencement of the program	0	36 (13.9%)
	<1 year	47 (18.1%)
	>1 year	176 (68.0%)
Hospitalizations	none	73 (28.2%)
	once in the last year	99 (38.2%)
	>1 in the last year	87 (33.6%)
Previous HF education	no	194 (74.9%)
	yes, by:	
	cardiologist	51 (19.7%)
	primary care physician	7 (2.7%)
	nurse	7 (2.7%)
Variable (continuous)	Features	Results
Duration of the HF [years]	M (SD)	6.71 (8.85)
	Me	2.98
	Min–Max	0–42
	Q1; Q3	0.27; 9.86

* Comorbidities: diabetes, chronic obstructive pulmonary disease, atrial fibrillation, past stroke. HCP – healthcare personnel; HF – heart failure; M – mean; Me – median; SD – standard deviation; Q1 – 1st quartile; Q3 – 3rd quartile.

hospitalizations and with long-lasting HF scored better on the knowledge test compared to patients not educated previously, hospitalized for the first time and with HF de novo (Table 3).

The results indicate that self-care behaviors improved after the intervention (Z = –7.317, p < 0.001 (higher score means lower self-care capability)). Enhanced autonomous-based adherence type of self-care behaviors (Z = –5.870, p < 0.001) was demonstrated. The level of consulting behavior also significantly increased after 3 months following the intervention (Z = –7.238, p < 0.001). Likewise, the level of provider-based adherence behaviors was more frequent after 3 months of follow-up than prior to the intervention (Z = –4.162; p < 0.001). The significant improvement in self-care was seen in all individual questions except statements 7 ("I eat a low salt

Table 2. Comparisons of the scores on heart failure (HF) knowledge test prior to, directly after and 3 months after participation in the program, based on the results of the Friedman's test

Measurement	Mean rank	Me	χ^2	Dunn–Bonferroni post hoc		
				Z statistic		
				1	2	3
1	1.04	8	$\chi^2 = 356.526$, $p < 0.001$	–	–	–
2	2.27	16		1.227***	–	–
3	2.69	18		1.649***	0.422***	–

*** $p_{adj} < 0.001$. The Bonferroni correction was used to adjust the p-values for multiple tests; Me – median.

Table 3. Summary of differences in the knowledge test scores based on the results of the Mann–Whitney U-test

Patients	Score on the knowledge test			
	Mean rank	Z-value	Mann–Whitney U test	p-value
Previously educated on HF	165.71	−4.451	3984.00	<0.001
Without prior education on HF	118.04			
>1 hospitalization	144.94	−5.137	4009.50	<0.001
First hospitalization	91.92			

HF – heart failure.
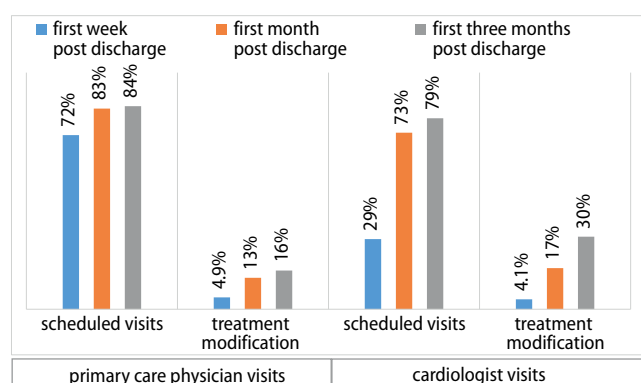
Fig. 3. Fulfillment of ambulatory visits to primary care physicians and cardiologists within the follow-up period in accordance with the individual treatment plan

diet") and 9 ("I exercise regularly") of the 9-EHFScBS questionnaire (Fig. 2).

All patients were educated about the importance of post-hospital ambulatory visits and treatment optimization. Most patients fulfilled their individualized post-discharge treatment plan (Fig. 3).

Discussion

Like previous studies, we found disease awareness and self-management skills initially poor among Polish patients with HF.[31–35] However, "The Weak Heart" model, prepared based on HF guidelines and practical recommendations,[1,4,7,36] was effective in enhancing HF patients' knowledge and developing self-management behaviors. In the study, the education program was delivered by a certified nurse educator working in a given cardiology ward. From a practical perspective, it is worth mentioning that

3.5 h in total were allocated to an individual patient's education. Based on nurses' feedback, in most cases, the time devoted to education was sufficient from the patient's point of view, but it caused a considerable burden on staff. Therefore, there is a need to introduce a qualified HF educator working in the cardiology wards responsible for patients' education, or to consider group education instead – to reduce the staff burden.

This observation is of significance since previous meta-analysis showed that self-management interventions in patients with HF improve the outcomes.[11,22,35] Therefore, evidence-based educational programs should be considered when designing multidisciplinary programs of coordinated care.[24] Unfortunately, any direct comparison of the effectiveness of our program with other educational interventions of this kind is difficult due to the heterogeneity of the design and methodology used in the research (Table 4).

Telephone support may reduce mortality and hospitalizations and improve quality of life among patients with HF.[20,21,35] Currently, it is the most commonly used monitoring strategy.[39,41–43] We found post-discharge phone calls performed by nurses had an additional, positive effect on patients' HF knowledge and self-care behaviors. Yet another important strategy is to deliver educational programs during hospitalization, as patients after an acute episode are at a higher risk of recurrent hospitalizations.[43] Moreover, it helps in building a trusting relationship with patients and caregivers.[38,39] The time of hospitalization can also be used successfully to teach patients perform regular pulse, blood pressure and weight measurements, which was well received by participants of our program.

Early ambulatory visits within 7 days of discharge may lower the risk of hospital readmissions for patients with HF.[20,21,42,44] According to the study by Chuda et al.,[45] over 90% of cardiac ward patients were referred to cardiac

Table 4. Summary of recent studies evaluating effectiveness of educational programs for heart failure (HF) patients

Study (author/year/ref)	Study design	Sample size (location)	Population	Key components of intervention/control	Follow-up period	Outcome variables	Main findings
Kolasa et al., 2021	Multicenter, non-randomized, quasi-experimental study; pre-test and post-test methodology (14 centers)	n = 259 (Poland)	HFrEF patients hospitalized with decompensated HF	Intervention: standardized educational program based on the ESC guidelines, multimedia education with the content of www.slabeserce.pl website displayed on tablet, individual treatment plan, HF passport, cover letter to primary care physician. Two individual teaching sessions (60 min) and 3 telephone calls 7, 30 and 90 days post-discharge delivered by a nurse. Control: N/A	3 months	Change in HF knowledge (self-developed questionnaire) and self-care (9-EHFScBS). The percentage of ambulatory visits realized in accordance with the treatment plan.	A significant change in HF knowledge test ($\chi^2 = 356.526$, $p < 0.001$) and in all individual questions. A significant change in self-care in total score ($Z = -7.317$, $p < 0.001$) in all domains: autonomous-based adherence ($Z = -5.870$, $p < 0.001$); consulting behavior ($Z = -7.238$, $p < 0.001$); provider-based adherence ($Z = -4.162$; $p < 0.001$) and in relation to all individual statements except statement 7 ("I eat a low salt diet") and statement 9 ("I exercise regularly"). Within 3 months of hospital discharge, 84% (193 out of 231) of participants visited their primary care physician and 79% (183 out of 231) visited a cardiologist in accordance with their individual treatment plan.
Sahlin et al., 2021[37]	Multicenter, randomized trial (7 centers)	n = 118 (Sweden)	Ambulatory HF patients	Intervention: home-based mobile device in a form of tablet wirelessly connected to a weight scale and incorporated symptom monitoring, interactive education, adjustment of loop diuretics and alerts of HF deterioration. Control: N/A	8 months	Change in self-care behavior (9-EHFScB). The number of in-hospital days due to HF. Event-free survival, defined as the composite endpoint of time to the 1st occurrence of HF-related emergency room (ER) visit, HF admission, or death and unplanned hospital visits due to HF after 240 days of intervention.	A significant change in self-care (21.5 (13.25; 28) compared to 26 (18; 29.75), $p = 0.014$). Significantly shorter time in the hospital when admitted for HF (2.2 days less, RR: 0.48; 95% CI: [0.32; 0.74]; $p = 0.001$). A significant difference in HF-related event-free survival (HR = 0.50, 95% CI: [0.24; 0.98], $p = 0.046$). Non-significant difference in all-cause hospital admission or death (HR = 0.77, 95% CI: [0.46; 1.28], $p = 0.32$).
Huynh et al., 2019[38]	Multicenter, randomized trial (2 centers)	n = 412 (Tasmania)	Patients hospitalized with HF	Intervention: standard care plus leaflet and video instruction, "transition coach" to provide telephone support, home visits of a cardiac nurse during the 1st and 2nd week of discharge, additional telephone calls if needed. Control: standard care including guideline-based care, self-care education during the hospital stays, a standard discharge plan with a formal discharge summary and advice sent to primary care physicians, treatment plan for comorbidity, and routine preventive care from treating physicians. A follow-up telephone call was conducted within a month after discharge.	3 months	All-cause readmission (defined as at least 24 h unplanned stay in hospital) or death within 30 and 90 days of discharge.	Readmission or death occurred in 74/197 (37%) of usual care patients and 50/215 (23%) of DMP patients within 30 days (RR: 0.62, 95% CI: [0.46; 0.84]), and 113/197 (57%) of usual care patients and 78/215 (36%) of DMP patients within 90 days (RR: 0.63, 95% CI: [0.51; 0.78]).

Study (author/year/ref)	Study design	Sample size (location)	Population	Key components of intervention/control	Follow-up period	Outcome variables	Main findings
Awoke et al., 2019[16]	Multicenter non-randomized quasi-experimental study, pre-test and post-test methodology (2 centers)	n = 29 (USA)	Patients hospitalized with HF	Intervention: standardized educational program based on AHA guidelines, standard education based on printed material in a form of visual color-coded guide to monitor symptoms. One teaching session delivered by a nurse reinforced with daily follow-up education sessions and telephone follow-up 7, 30 and 90 days post-discharge. Control: N/A	3 months	All-cause unplanned hospital readmissions 30 days after hospital discharge. Change in HF knowledge (DHFKS) and self-care (SCHFI).	A significant difference in HF knowledge test at day 7 (p ≤ 0.001) and day 90 (p ≤ 0.032). A significant difference in self-care maintenance at day 7 (p ≤ 0.000) and day 30 (p ≤ 0.000), self-care management at day 7 (p ≤ 0.001) and day 30 (p ≤ 0.013), in self-care confidence at day 30 (p ≤ 0.017), but not at day 7 follow-up call. No significant change in 30-day readmissions (p ≥ 0.05).
Boyde et al., 2018[39]	Single center, randomized trial	n = 200 (Australia)	Patients diagnosed with HF referred to the hospital	Intervention: multimedia education based on an individual patient's needs (verbal discussions with a HF nurse, written manuals and a DVD to use at home). One teaching session (60–90 min) delivered by a nurse. Control: standard care	12 months	All-cause unplanned hospital readmissions. Change in HF knowledge (DHFKS) and self-care (SCHFI).	No significant change in HF knowledge test at 3 months (p = 0.132) and 12 months post-recruitment (p = 0.612) between groups. No significant differences in self-care maintenance (p = 0.241), management (p = 0.232) or confidence (p = 0.194) between the intervention and control groups at 3 months and at 12 months, for maintenance (p = 0.604), management (p = 0.903) or self-confidence (p = 0.132). Reduced risk of readmission at 12 months by 30% (RR: 0.703; 95% CI: [0.548; 0.903]).
Moon et al., 2018[40]	Single-center, quasi-experiment study	n = 38 (South Korea)	Ambulatory patients with HF (EF < 50%)	Intervention: the telephone-based self-management support program. One 30-minute face-to-face education session and 4 telephone follow-up consultations. Control: not described	5 weeks	Change in the self-care behavior (9-EHFScB), NT-proBNP, LVEF, LVEDP and depression score.	A significant change in self-care behavior (t = 6.65, p < 0.001), decreased N-terminal pro-brain natriuretic peptide level (U = −2.28, p < 0.022), improved LVEF values (t = 2.24, p < 0.032), and decreased depression scores (t = 3.49, p < 0.001).

9-EHFScBS – European Heart Failure Self-care Behavior Scale; DHFKS – Dutch Heart Failure Knowledge Scale; SCHFI – Self-Care of Heart Failure Index; ESC – European Society of Cardiology; N/A – not applicable; 95% CI – 95% confidence interval; AHA – American Heart Association; EF – ejection fraction; NT-proBNP – N-terminal pro B-type natriuretic peptide; LVEF – left ventricular ejection fraction; LVEDP – left ventricular end-diastolic pressure; RR – relative risk; HR – hazard ratio; DMP – Disease Management Program; HFrEF – heart failure with reduced ejection fraction.

ambulatory care after hospital discharge, compared to only 60% among those discharged from the internal medicine ward. In our program, all patients were educated about the importance of post-discharge ambulatory visits and were given individual treatment plans. This strategy proved to be effective, with 72% of patients fulfilling visits in primary care and 30% visiting a cardiologist within 7 days of discharge.

The results of our study showed that patients undergoing any kind of education before participating in the program and patients hospitalized due to HF many times have higher initial knowledge of HF and obtained higher tests scores than the patients who had not been previously educated or hospitalized due to HF. It suggests that patients build their disease awareness from multiple educational sources and learn through their own experience during hospitalizations.[46] Although 68% of patients recruited to the study had history of HFrEF for more than 1 year and 72% had been hospitalized for HF decompensation at least once in the previous year, only 25% of participants declared being educated by a healthcare provider prior to the program. According to the participants, the cardiologist (78%), nurses (11%) and primary care physicians (11%) were the helthcare professionals who most frequently delivered disease education. This indicates that currently in Poland, there is no structured approach to health education for HF patients.

Limitations

Some important limitations of the "The Weak Heart" program have to be acknowledged. Firstly, this program had quasi-experimental, non-randomized design, without an appropriate control group, with short observation period and relatively small sample of patients. Secondly, the cohort recruited was relatively young, had a higher education level, lived with family, and the majority lived in the city. However, these factors had a limited impact on the effectiveness of the proposed program. The multivariable analysis, the results of which were presented elsewhere,[46] has shown that only age may affect self-care behaviors, but not the level of HF knowledge. Lastly, only patients with HFrEF hospitalized with ADHF were included in the study. All these factors suggest that those patients may present a higher level of health literacy and initial disease knowledge and may be significantly different from "an average patient" in routine practice. The other important limitations are the utilization of unstandardized HF knowledge questionnaire and short follow-up period. Finally, limitations resulting from the design of the project including small group size and the lack of longer-term, longitudinal data precludes a comment regarding the impact of investigated intervention on clinical outcomes, only allowing to draw general conclusions about the short-term effect of the tested model on the level of HF knowledge and self-care behaviors in the studied population of HFrEF patients hospitalized due to decompensation.

Conclusions

The HF knowledge and self-care behaviors among patients with HFrEF can be improved by introducing a structured, nurse-led educational programs to clinical practice. "The Weak Heart" educational model created based on HF guidelines recommendations proved to be effective in enhancing the level of HF knowledge and self-care behaviors among patients with HFrEF hospitalized with ADHF. The time spent in hospital should be used to prepare patients for challenges of post-discharge "vulnerable phase" by providing a proper training on self-care skills delivered by certified nurses.

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