Investigating the Effect of a Structured Intervention on the Development of Self-Care Behaviors With Arteriovenous Fistula in Hemodialysis Patients

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Abstract

This study aimed to assess the effectiveness of a structured intervention on the frequency of self-care behaviors with arteriovenous fistula (AVF) by patients on hemodialysis. This is a quasi-experimental study with pre- and post-measurements. Participants were assigned to an intervention group (IG) (*n* = 48) or to a control group (CG) (*n* = 41). IG patients were subject to a structured intervention on self-care with AVF (SISC-AVF) consisting of both a theoretical and a practical part. After SISC-AVF application, patients in the IG showed better overall self-care behaviors with AVF than patients in the CG (79.2% and 91.4%, respectively, *p* < .001) as well as better self-care concerning both the management of signs and symptoms (90.1% and 94.4% respectively, *p* = .004) and the prevention of complications (72.7% and 89.5%, respectively, *p* < .001). The study results suggest that the SISC-AVF had positive effects on patients in the IG.

Introduction

End-stage kidney disease (ESRD) is a public health problem in developed or developing countries, especially in the United States, Europe, Brazil, and in some countries in Asia (Enrica & Manjula Kurella, 2016; Clementi et al., 2020). Portugal is among the European countries with the highest incidence and prevalence of ESRD with 235.9 and 1577.9 per million population (pmp) in 2010, and 226.49 and 1661.9 pmp in 2011 (Coelho et al., 2014; Clementi et al., 2020). Patients with this disease need a vascular access to undergo hemodialysis (HD) treatment.

The scientific community considers the arteriovenous fistula (AVF) as the best vascular access for HD when compared with other access types (graft and central venous catheter). Prior studies have reported that central venous catheters and arteriovenous grafts are associated with a higher risk of mortality in HD patients than the AVF (NKF-K/DOQI, 2006; Tordoir et al., 2007; Kukita et al.,

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2015; Ibeas et al., 2017). Furthermore, the AVF is less prone to complications and thromboses than central venous catheters and arteriovenous grafts (Ibeas et al., 2017). Dialysis teams (nephrologist, dialysis nurse, and vascular access nurse) are required to educate patients on how to appropriately carry out self-care behaviors concerning access maintenance and preservation (Wingard, 2005; Moist et al., 2013).

Several guidelines recommend that patients with ESRD should be educated on how to take care of their own AVF (NKF-K/DOQI, 2006; Tordoir et al., 2007; Kukita et al., 2015; Ibeas et al., 2017; Schmidli et al., 2018). Some studies have shown that patients generally do not carry out those behaviors required to prevent infection of the AVF, preserve its functioning and identify signs and symptoms of distal hypoperfusion (Pessoa & Linhares, 2015; Ozen et al., 2017; Sousa et al., 2017, 2020; Teixeira et al., 2017). Furthermore, a number of studies have also shown that patients have little or almost no knowledge on AVF care and, in fact, the proportion of such patients can reach nearly 98% (Pessoa & Linhares, 2015).

The literature describes very accurately those behaviors that must be taught by dialysis teams to promote self-care (NKF-K/DOQI, 2006; Sousa, 2012; Ibeas et al., 2017; Sousa et al., 2014, 2017). Dialysis units should design educational programs to empower patients for self-care behaviors (Trask et al., 2016), especially concerning infection and thrombosis.

A few articles only are available in the literature on self-care behaviors with AVF and there is virtually no information on the type of interventions that can be used in educational programs whose purpose is empowering patients for care with AVF (Sousa et al., 2014; Pessoa et al., 2020). Some studies propose theoretical lecturing as a possible intervention in this context (Sousa et al., 2014) but do not explain how such intervention should be carried out. The identification of the most effective interventions on self-care behaviors with AVF and of unsuitable interventions for patients is required. The aim of this study was assessing the effectiveness of a structured intervention on the frequency of self-care behaviors with AVF in patients with ESRD on regular HD programs.

Methods

Study Design and Setting

This was a quasi-experimental study in dialysis units, involving patients on HD using AVF. The dialysis units are located in the north of Portugal (two units) and in the Autonomous Region of the Azores (one unit). Patients located in the north of Portugal and in the Azores were assigned to the Control Group (CG) and to the Intervention Group (IG) respectively. Random sampling was the method used and the allocation of the dialysis units to the groups was intentional, for reasons of convenience of the research team.

Participants' eligibility criteria for the study were as follows: participants should be 18 years or older, on HD with AVF for a period of more than 6 months, have no memory problems and be medically stable. The exclusion criteria were: patients with double vascular access (central venous catheter and AVF) or grafts as vascular access and hospitalized patients at the time of data collection. Participants were invited for the study. Those with no interpretation problems completed the questionnaire autonomously whereas those who had trouble to understand it or suffered from vision impairment were assisted by the researcher. The population size was 177 patients and 89 participants were included in the study after application of the criteria (Figure 1).

Data Collection and Instrument

All data were collected between January and February 2018. Data concerning the sample demographic characteristics (age, gender, education, employment, marital status) and clinical characteristics (ESRD etiology, dialysis vintage, previous AVFs, AVF duration, information on care with AVF) were collected with a questionnaire designed by the authors.

Information concerning self-care behaviors with AVF was collected from the Scale of Assessment of Self-Care Behaviors with Arteriovenous Fistula in Hemodialysis (ASBHD-AVF) (Sousa et al., 2015). This scale has 16 items in two self-care subscales: Management of Signs and Symptoms (6 items) and Prevention of Complications (10 items). Responses to each item are based on a 5-point Likert-type scale. Higher scores show patients' higher frequency of self-care with AVF. The ASBHD-AVF scale was applied to Portuguese patients with Cronbach's alpha of .797, .797, and .722 for the overall scale and the two subscales mentioned above respectively. Memory problems were assessed by the Six-Item Cognitive Impairment Test (6CIT), Portuguese version (Apóstolo et al., 2017).

Intervention Protocol: Structured Intervention for Self-Care With AVF

The intervention concerning self-care with the AVF (SISC-AVF) was carried out based on the structure of Sousa (2012) which enables nurses to train patients for self-care and for the development of instrumental skills required for surveillance of the AVF.

The structured intervention designed for this study was a multimethod approach with the purpose of capturing the learning styles of most patients through the use of written, listening, and visual learning (Kitchie, 2016). The SISC-AVF had the purpose of identifying the signs/symptoms or situations jeopardizing AVF working and includes both a theoretical and a practical part. The relationship between Sousa's structure (Sousa, 2012) and SISC-AVF is displayed in Figure 2.
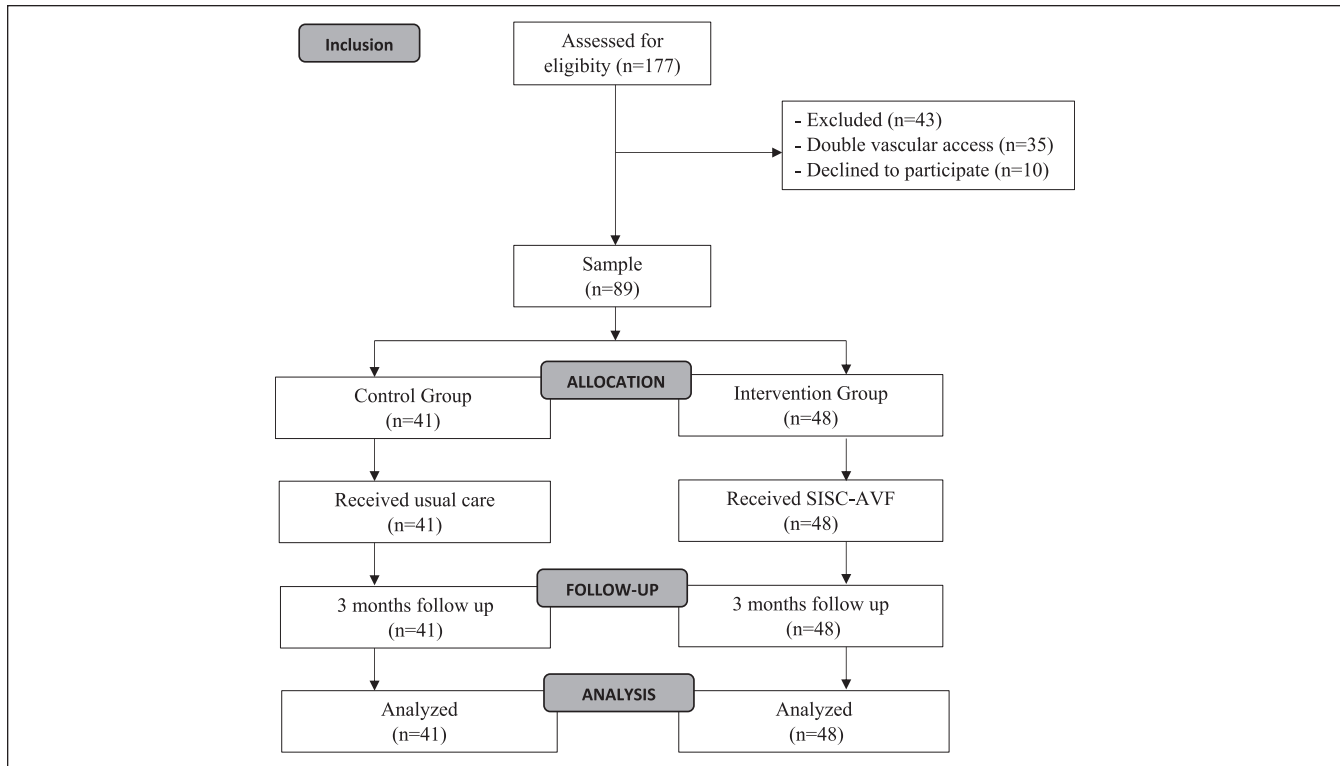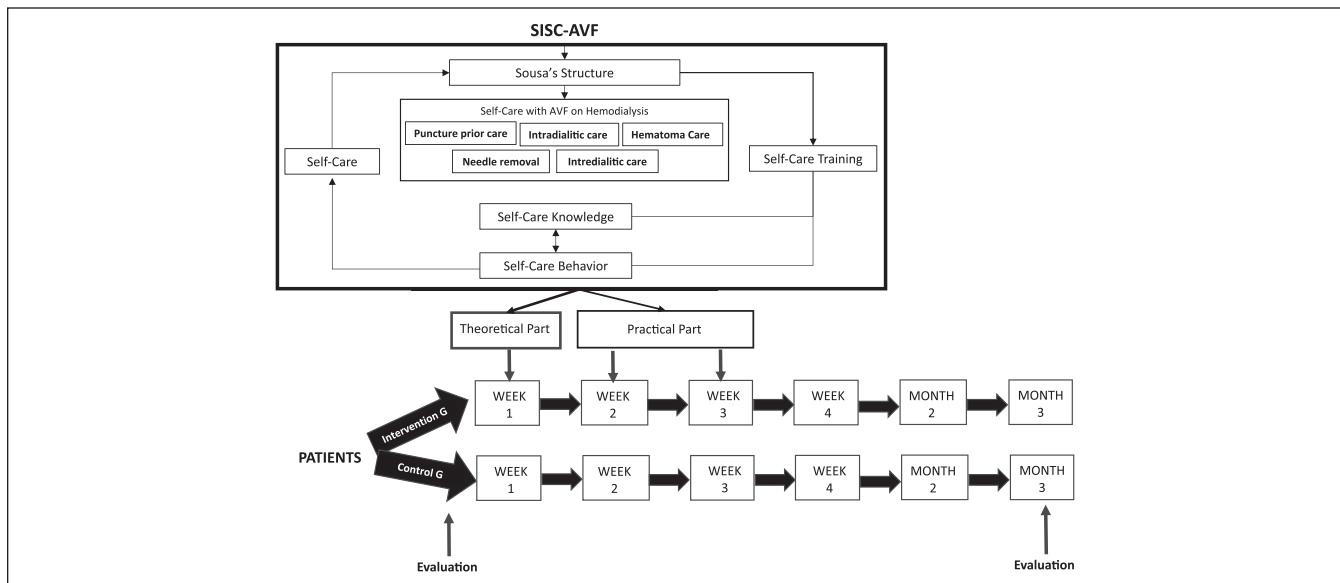
Figure 1. Participant flow diagram.

Figure 2. Monitoring of the intervention group.

SISC-AVF: Theoretical Part

The theoretical part of this structured intervention involved an educational group session called "Care with AVF" with the purpose of teaching patients how to identify situations that can compromise AVF working. The session, presented by the researcher to all study participants, included six presentations held in an appropriate room for 2 days before patients started HD treatment. Each presentation allowed a maximum of eight patients and took 30 min. The lecturing-participating method was selected for this part, encouraging participants' interactivity. The session's theoretical assumptions, described

in Sousa (2012) were included in the presentation of the following topics: AVF general concepts; AVF importance for ESRD patients; AVF functionality; prevention and detection of signs and symptoms of infection, thrombosis and steal syndrome. Each presentation was assessed in the end by asking participants to identify the signs and symptoms of infection, thrombosis and steal syndrome and to describe the care to be taken during dialysis and in the period outside dialysis.

SISC-AVF: Practical Part

The SISC-AVF practical part started a week after the theoretical part, lasted 2 weeks and was provided to each participant in an appropriate room at the beginning of the HD treatment. Interactive training sessions were conducted using an informal approach with the objective of developing skills of inspection and palpation of the AVF arm. Inspection had the purpose of enabling participants to identify situations that could compromise AVF working. They were also trained to recognize AVF working by palpation. Each patient was given two 15-min sessions. Participants were given an information leaflet on the care to be taken with the AVF in the end of the SISC-AVF.

Usual Care Control

Educational training was given during HD sessions. The dialysis nurse provided information on AVF care and trained patients whenever they felt such need. Such information was handed out occasionally, without a plan, and no assessment was ever made. Based on his/her perception of the information requirements, the dialysis nurse decided when training was provided. Dialysis units had no documentation concerning the educational training given to patients and the moments to provide such information were not defined.

Statistical Analysis

Quantitative variables were described by the minimum, maximum, mean, median, quartiles, and standard deviation (*SD*). The distribution of categorical variables was described by proportions. Comparisons between the two groups (independent samples) were made by the Chi-Square Test for categorical variables and by the Mann-Whitney Test for quantitative variables, whereas pre- and post-intervention comparisons for each group were made by the Wilcoxon Test for paired samples (5% significance level). Analysis was performed with the Statistical Package for the Social Sciences Software (version 26.0; IBM Co., USA) and with the R language (version 3.6.3, R Foundation for Statistical Computing, Austria). In statistical decisions, $p < .05$ was considered statistically significant.

Ethical Considerations

All participants were protected from physical and psychological injury and retained their right to privacy and to informed consent, according to the Declaration of Helsinki. The study started after approval by the institutions' ethics committees. All participants signed an informed consent at the moment of inclusion in the study.

Results

Patient Characteristics

The study involved 89 patients with AVF (41 and 48 patients in the CG and IG, respectively). No statistically significant differences were found between the CG and the IG concerning demographic and clinical variables other than age, employment, and information on AVF care (Table 1). Therefore, with the exception of these three variables, both groups had similar demographic characteristics. Patients in the CG were older than those in the IG (average of 65.8 years and 58.7 years, respectively, $p = .013$). Concerning employment, most patients in the CG and half of those in the IG were retired (85.4% and 50.0%, respectively, $p = .003$). Finally, information on AVF care was provided by the nurse to 48.8% and 77.1% of the CG and IG patients, respectively and by the nephrologist to 51.2% and 20.8% of those patients respectively ($p = .011$), that is, information was provided by nurses to a larger proportion of patients in the IG and by nephrologists in the CG.

Intervention Effect on Self-Care Behaviors With AVF

Implementation of the SISC-AVF had a very positive effect on patients in the IG. In fact, they showed better results than patients in the CG concerning the overall self-care behaviors with AVF (79.2% and 91.4%, respectively, $p < .001$), the self-care subscale of signs and symptoms management (90.1% and 94.4%, respectively, $p = .004$) and the self-care subscale of prevention of complications (72.7% and 89.5%, respectively, $p < .001$).

Furthermore, the IG self-care behavior minimum and maximum values increased after the SISC-AVF both for the overall scale and the self-care subscales: from 34.4% to 68.8% and from 95.3% to 100%, respectively for the scale; from 16.7% to 58.3% and staying equal to 100% in both periods respectively for the subscale of signs and symptoms management; and from 42.5% to 70% and from 97.5% to 100%, respectively for the subscale of prevention of complications.

Therefore, the SISC-AVF led to a statistically significant increase of average self-care behaviors with AVF in the IG, both for the overall scale and for the two self-care subscales (Table 3). On the contrary, pre- and post-intervention average self-care behaviors are approximately the same for the overall scale and the subscales in the CG, leading to a non-significant difference.

During follow-up (3 months), one patient had an AVF infection and another had a thrombosis in the CG. No AVF infection or thrombosis were reported in the IG.

Table 1. Pre-Intervention Demographic Baseline Characterization.

	Overall (n = 89)	CG (n = 41)	IG (n = 48)	p-value
Gender (M/F) (%)	65.2/34.8	65.9/34.1	64.6/35.4	>.999
Age, years (mean; *SD*)	62.0; 13.9	65.8; 12.5	58.7; 14.3	.013
Education (%)				.248
None	4.5	4.9	4.2	
≤4 years	48.3	53.7	43.8	
5–6 years	13.5	4.9	20.8	
7–9 years	14.6	14.6	14.6	
10–12 years	12.4	14.6	10.4	
College	6.7	7.3	6.3	
Employment (%)				.003
Self-employed	2.2	0.0	4.2	
Employee	9.0	7.3	10.4	
Unemployed	21.3	7.3	33.3	
Retired	66.3	85.4	50.0	
Student	1.1	0.0	2.1	
Marital status (%)				.561
Married	65.2	65.9	64.6	
Non-martial partnership	3.4	2.4	4.2	
Divorced	7.9	9.8	6.3	
Single	12.4	7.3	16.7	
Widow	11.2	14.6	8.3	
ESRD ethiology (%)				.407
Diabetic nephropathy	32.6	26.8	37.5	
Hypertension	15.7	12.2	18.8	
Glomerulonephritis				
Unknown	24.7	34.1	16.7	
Dialysis vintage (%)				.218
<1 year	21.3	14.6	27.1	
1 year–5 years	37.1	39.0	35.4	
>5 years	41.6	46.3	37.5	
AVF duration (months) (mean; *SD*)	51.0; 52.3	58.0; 59.1	45.0; 45.6	.184
AVF complications (%)	25.8	24.4	27.1	.963
Thrombosis	52.2	50.0	53.8	
Infection	8.7	0.0	15.4	
Hemorrhage	13.0	0.0	23.1	
Aneurysm	8.7	20.0	0.0	
Other	17.4	30.0	7.7	
Number previous AVFs (%)				.453
1	74.4	35.9	78.9	
2	7.7	2.6	10.5	
3	7.7	5.1	5.3	
≥4	10.3	7.7	5.3	
Information on the AVF (%)				.011
Doctor	1.1	0.0	2.1	
Nephrologist	34.8	51.2	20.8	
Nurse	64.0	48.8	77.1	

Note. CG = control group; IG = intervention Group; AVF = arteriovenous fistula; ESDR = end stage renal disease; SD = standard deviation.

Discussion

The study results suggest that the SISC-AVF had a statistically significant positive effect, since patients in the IG exhibited better post-intervention self-care behaviors with AVF than those in the CG. Very few quantitative studies are available in the literature assessing self-care behaviors with AVF and most analyze the level of knowledge of self-care with the AVF. The majority assesses the frequency of such behaviors (Ozen et al., 2017; Sousa et al., 2017; Yang et al.,

Table 2. Scale and Sub-Scales Descriptive Measures.

	Pre-intervention				Post-intervention			
	Overall	CG	IG	p-value	Overall	CG	IG	p-value
Overall scale								
Mean (*SD*)	78.0 (12.1)	80.1 (11.3)	75.8 (12.6)	.078	85.4(9.8)	79.2 (8.1)	91.4 (7.4)	<.001
Minimum	34.4	42.2	34.4		59.4	59.4	68.8	
Maximum	95.3	95.3	95.3		100.0	93.8	100.0	
First quartile	71.1	76.6	67.6		78.1	73.4	87.9	
Median	79.7	81.3	77.4		87.5	81.3	93.0	
Third quartile	87.5	89.1	84.0		93.8	84.4	96.9	
Management of signs and symptoms sub-scale								
Mean (*SD*)	83.5 (16.8)	89.6 (13.3)	77.5 (17.8)	.0002	92.3 (9.3)	90.1 (8.9)	94.4 (9.3)	.004
Minimum	16.7	37.5	16.7		58.3	62.5	58.3	
Maximum	100.0	100.0	100.0		100.0	100.0	100.0	
First quartile	75.0	87.5	66.7		87.5	83.3	91.7	
Median	87.5	91.7	79.2		95.8	91.7	100.0	
Third quartile	97.9	100.0	90.7		100.0	100.0	100.0	
Prevention of complications sub-scale								
Mean (*SD*)	74.6 (13.6)	74.4 (13.9)	74.8 (13.5)	.967	81.2 (12.5)	72.7 (10.4)	89.5 (7.9)	<.001
Minimum	42.5	45.0	42.5		50.0	50.0	70.0	
Maximum	100.0	100.0	97.5		100.0	95.0	100.0	
First quartile	65.0	70.0	65.0		72.5	62.5	83.1	
Median	75.0	75.0	75.0		82.5	75.0	92.5	
Third quartile	85.0	85.0	86.9		92.5	80.0	95.0	

Note. CG = control group; IG = intervention group; *SD* = standard deviation.

2019) but none of them discusses the methods used to teach patients. Our study assessed the effect of a structured intervention on the development of HD patients' self-care behaviors with AVF.

In this study, patients subject to the SISC-AVF exhibited an increase in the average overall frequency of self-care behaviors with AVF (75.8%–91.4%, $p < .001$), as well as in both self-care subscales: 77.5% to 94.4% ($p < .001$) and 74.8% to 89.5% ($p < .001$) for the management of signs and symptoms subscale and for the prevention of complications subscale respectively (Table 3). On the contrary, the frequency remained approximately constant for patients in the CG ($p = .437$, $p = .561$ and $p = .722$, respectively, Table 3).

Prior to the intervention, the difference between the groups' average self-care is not significant concerning both the overall scale ($p = .078$) and the prevention of complications subscale ($p = .967$) (Table 2). On the contrary, such difference is significant concerning the management of signs and symptoms subscale with a larger average self-care in the CG than in the IG (89.6% and 77.5%, respectively, $p = .0002$). After the intervention, IG patients' average self-care is higher concerning the overall scale and both subscales. These findings may mean that, regardless of demographic or clinical characteristics, patients had similar levels of self-care behaviors before the intervention (with the exception of the management of signs and symptoms), implying that self-care was not affected by such baseline characteristics. We could not

Table 3. Pre- and Post-Intervention Comparison for Each Self-Care Group.

	p-value
CG	
Overall scale	.437
Management of signs and symptoms sub-scale	.561
Prevention of complications sub-scale	.722
IG	
Overall scale	<.001
Management of signs and symptoms sub-scale	<.001
Prevention of complications sub-scale	<.001

Note. CG = control group; IG = intervention group.

find any article or study in the literature assessing the effect of an intervention on self-care with AVF.

The increase in self-care after the intervention appears to be due to the SISC-AVF. In fact, unlike CG patients, whose average self-care behaviors remained constant, IG patients exhibited an increase in both the overall scale and the two subscales ($p < .001$ in the three cases, Table 3) which means that the intervention affected all self-care behaviors and was then successful from every point of view.

In a study of 71 HD patients, Alsaqri et al. (2019) reported that the average scores of knowledge on self-care with AVF concerning infection prevention and concerning identification

of the fistula's function increased from 2.0 to 2.3 ($p = .000$) and from 2.0 to 2.7 ($p = .000$) respectively after the implementation of the instructional module on AVF care. Therefore, the strategy used (educational group session) led to an improvement of the knowledge on self-care with AVF. In our study, a similar educational group session was provided (theoretical educational strategy) and a practical educational strategy was added. We believe that the introduction of the practical part in the SISC-AVF enabled patients to understand and develop the appropriate skills required to identify potentially problematic situations.

Research on HD patients' self-care behaviors with AVF is scarce but even less is available concerning the assessment of the effect of an intervention on the development of such behaviors. The literature shows the positive effect of structured nursing interventions in patients with inflammatory bowel disease (Tu et al., 2015), in patients at risk of anaphylaxis (Brockow et al., 2015) and on the modification of risk factors in patients with coronary heart disease (Fernandez et al., 2007). We are not aware of any studies assessing strategies with the purpose of enabling ESRD patients in HD to develop self-care behaviors with AVF. However, the need for interventions or programs specifically designed to enable ESRD patients to perform self-care behaviors with AVF can be found in the literature (Sousa et al., 2014). Replication of our study with the same methodology in other regions or countries is required in order to assess the effectiveness of the SISC-AVF and its success or failure. We think that testing other strategies is very important, especially those using a technological approach such as video devices or computer apps. Patient-to-patient education or an exclusively theoretical strategy are other possible alternatives.

Further research on this issue is required, possibly involving randomized control trials in order to confirm the effectiveness of each single intervention or of the combination of different interventions. Such studies can help designing educational programs whose interventions are adjusted to the patients' characteristics, that is, more than one sort of intervention may be appropriate in the implementation of such programs in the dialysis units, depending on the patients' individual characteristics.

Patients subject to intervention were able to improve their self-care behaviors and consequently they have become more careful in the identification of possible problems with the AVF. In fact, no cases of infection and associated thrombosis in the vascular access were found in the IG. This absence of complications needs to be explored in future studies, namely in order to assess the impact/relationship of self-care behaviors on the reduction and identification of AVF complications.

The same researcher assessed patients for eligibility and conducted the intervention process which might have increased the risk of bias and may be a possible shortcoming of our study. Another possible limitation was the study time span that prevented the analysis of the impact of self-care behaviors on AVF complications. The small group sizes (41 and 48 patients in the CG and IG, respectively) and the sampling method can also be considered a weakness. Nevertheless, this study should be considered as a first step for the identification of possible interventions with the purpose of improving the development of self-care behaviors with AVF.

Conclusion

The purpose of this research is to contribute to the identification of interventions leading to the development and improvement of self-care behaviors with the arteriovenous fistula based on a sample of Portuguese adults with chronic renal disease on HD. The results suggest that the SISC-AVF has a statistically significant and positive effect. Further experiments should be conducted in order to assess whether this intervention yields the same effect on other populations. Moreover, testing the effect of other interventions on the development and improvement of self-care behaviors is required in the future.

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Supplemental Material

Supplemental material for this article is available online.

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