BMC Cardiovascular Disorders

RESEARCH

Open Access

JUMPSTART: evaluation of an early mobilization program following transcatheter aortic valve replacement

Marija Corovic[1*], Karen Mosleh[1], Olivia Puglisi[2], Malcolm Cameron[2], Jacob Crawshaw[3], Rima Styra[4], Patrick Magloire[2], Jon-David Schwalm[2], James Velianou[2], Tej Sheth[2] and Madhu Natarajan[2]

Abstract

Background Patients with aortic stenosis undergoing a transcatheter aortic valve replacement (TAVR) are typically discharged from hospital the next day, leaving little time to support their mobilization needs. Therefore, to improve the early mobilization of post-TAVR patients, we investigated the adoption and acceptability of a self-directed, tailored and home-based exercise program (JUMPSTART), which consists of four exercise modules, available in virtual and paper formats.

Methods This prospective, observational, non-randomized and comparative study was conducted at one regional cardiac centre in Ontario, Canada. The development of the JUMPSTART program was informed by the Knowledge-to-Action Cycle and the choice of study outcomes were guided by the RE-AIM Framework. Program adoption and acceptability were captured through two follow-up surveys, 14-days and three-months post-TAVR; survey questions were informed by the Consolidated Framework for Implementation Research. The target program adoption rate was 70% by three-months post-TAVR. Impact of program participation on quality-of-life scores, and study participants' cardiac rehabilitation attendance, were also assessed.

Results There were 144 study participants. Survey response rates were 86% at 14-days post-TAVR, and 78% at three-months post-TAVR. The program adoption rate was 75% while the cardiac rehabilitation attendance rate was 30%. Approximately 70% of participants preferred the paper-based program format. The technological requirement was the most common barrier to engaging with virtual formats. Most (70%) rated the exercises as being the right level of difficulty. There were no reports of major health or safety concerns while exercising. Quality-of-life scores significantly increased from baseline to three-months post-TAVR; however, this could not be attributed to frequency of program participation. Furthermore, 73% of program participants felt that their recovery was improved because of their participation in the program, and 96% reported that they would recommend it to others. The study team regularly reviewed preliminary findings and took action to improve the program and the implementation process.

Conclusions Participants were satisfied with the JUMPSTART program, which will continue to be offered to post-TAVR patients. Despite the increasing use of virtual technologies, most of this patient population prefers paper-based

*Correspondence:
Marija Corovic
corovicm@mcmaster.ca

Full list of author information is available at the end of the article

resources. Future planning will involve developing additional modules and exploring ways to increase program adoption, as well as cardiac rehabilitation attendance.

Clinical trial number Not applicable.

Keywords Aortic stenosis, Aortic valve replacement, TAVR, TAVI, Early mobilization, Exercise program, Virtual program, Home-based program

Background

Transcatheter aortic valve replacement (TAVR) is a minimally invasive procedure which has rapidly become the predominant method for treating calcific aortic stenosis [1–3]. Patients who undergo TAVR are a heterogeneous group, ranging in age from 65 to 95 years; many experience concomitant cardiac risk factors that affect their quality and length of life [4–6]. Cardiac rehabilitation (CR) is a widely accredited program which educates patients on managing their cardiac risk factors, among other aspects of heart health [7, 8]. Enrollment in CR can improve TAVR patients' functional capacity, exercise tolerance and quality of life [9–12]; however, TAVR patients enroll in CR at a significantly lower rate compared to those who undergo surgical aortic valve replacement (29.7% versus 39.2%, respectively) [13]. In addition to benefiting from the long-term management of cardiac risk factors, early mobilization and return to daily activities soon after TAVR are crucial for achieving positive health outcomes [14]. CR programs do not address early mobilization, as patients generally begin CR several weeks after discharge [15]. Previously, TAVR patients were hospitalized for several days after their procedure, allowing time for staff to support early mobilization through inpatient physiotherapy services; however, optimization of the TAVR procedure has led to a significant change in practice [16]. Currently, more than 80% of TAVR patients undergo same day ambulation and next-day discharge (i.e., an overnight-model pathway) [17, 18]. The present approach is efficient and timely; however, it presents little to no opportunity for staff to offer standardized early mobilization protocols.

A regional cardiac centre, located in Ontario, Canada, has established one of the largest TAVR programs in the country. To identify gaps in care related to TAVR patient discharge, an informal survey was conducted in early 2021 with approximately 35 TAVR patients, 30 days post-discharge. Survey findings demonstrated that many patients and their family members sought advice from cardiac centre staff members, regarding safe and appropriate physical activity post-TAVR, with nearly all patients surveyed expressing an interest in participating in a structured home-based exercise program, if it were to be offered. Therefore, the JUMPSTART program, a self-directed, tailored and home-based early mobilization program, was developed for patients undergoing TAVR procedures at the regional cardiac centre. The goals of this research study were to assess the adoption and acceptability of the JUMPSTART program, assess the preliminary effect of the JUMPSTART program on quality of life, and identify barriers to participating in early mobilization and attending CR. Previously published literature has highlighted the potential of home-based programs to improve CR participation rates [19]. In general, many clinicians and researchers have focused on expanding virtual/ home-based and hybrid options for CR and other similar services, since the COVID-19 pandemic [20].

Methods

Intervention: JUMPSTART

The JUMPSTART program focuses on early mobilization and is intended to precede or coincide with (not replace) conventional CR. It consists of four low-intensity exercise modules, which were developed in consultation with a physiotherapist and CR specialist, to be safe and appropriate for the TAVR patient population. The exercise modules are available in virtual formats (i.e., video modules, and group-based virtual sessions led by CR physiotherapists) as well as a paper-based format (i.e., exercise instructions handouts) [21]. A pilot JUMPSTART evaluation, reporting on the acceptability and feasibility of the preliminary exercise module developed for the program, took place from January 2022 to March 2023 at the regional cardiac centre. Patients who piloted the module were satisfied with the exercises and they agreed that the program would be beneficial to post-TAVR patients.

Study design

This was a prospective, observational, non-randomized and comparative study, conducted at one site in Ontario, Canada.

Study recruitment

Patients planned for TAVR received an information sheet detailing how to access the exercise modules and were introduced to the research study during an initial assessment at the aortic valve clinic at the regional cardiac centre. Written consent was collected from individuals who agreed to participate in the research study; participation involved completion of two surveys at 14 days and three months post-TAVR procedure. All patients, regardless

of their participation in the research study, received the information sheet, as well as a physical copy of the level one exercise instructions, prior to discharge.

Study eligibility

The research study team confirmed patient eligibility post-TAVR. Patients were eligible to participate if they were outpatients who underwent a trans-femoral TAVR procedure at the cardiac centre, were managed through the overnight-model pathway, successfully completed ambulation assessments after their procedure and were deemed eligible for next day discharge. Patients were excluded if they were inpatients (i.e., hospitalized before or after the procedure), had an alternate approach for TAVR (i.e., not trans-femoral), had a temporary pacemaker left in at the end of their TAVR procedure, or had received a permanent pacemaker in the month before their procedure.

Study sample size

More than 400 TAVR procedures are performed annually at the regional cardiac centre. The goal was to recruit 150 eligible patients for the study in a one-year period.

Patient baseline data

Demographic information, Rockwood Score and Katz Index were collected from patients' clinical records, pre-TAVR [22, 23]. Baseline quality of life (QoL) was evaluated via the Toronto Aortic Stenosis QoL (TASQ) Questionnaire [24]. At the aortic valve clinic, a nurse practitioner or their delegate conducted the TASQ questionnaire along with two frailty assessments: a 5-metre walk test and a hand-grip test [25, 26]. The post-TAVR ambulation assessments, conducted and reported by cardiac care nurses, were the timed get up and go (TUG) test and the 2-minute walk (2MW) test [27, 28]. A comparison of baseline data was made between three-month survey respondents who had reported doing the program five or more times, and those that had reported doing it less than five times or not at all.

Surveys

Eligible study participants who provided an email address while visiting the aortic valve clinic received email invitations to complete the two follow-up surveys online. If study participants had not provided an email address or did not complete the surveys after receiving invitations and reminders, they were contacted by a research assistant to complete the surveys over the phone. The survey questions were based in part on selected domains of the Consolidated Framework for Implementation Research [29]. Surveys contained closed, open-ended and Likert scale questions which addressed program adoption, barriers and facilitators to participating, satisfaction with program formats and content, CR awareness and intentions to attend, and beliefs about JUMPSTART program impact. Survey data were collected through a secure online platform called REDCap [30]. Responses were exported into Excel, analyzed (i.e., descriptive statistics) and summarized by the study coordinator.

Additional data

Reports of meeting minutes were documented by the study coordinator to inform implementation activities and program refinement. Additionally, 12 individual interviews were conducted with patients and caregivers after the study commenced; while these methods and findings were not included in the main text of this article, they have been included as Supplemental File 1.

Implementation and evaluation frameworks

A stepwise implementation approach was based on the Knowledge-to-Action Cycle [31]. This approach began with identifying a clinical issue—a gap in care concerning early mobilization support for post-TAVR patients. Knowledge was then adapted to the local context, and barriers to implementation were assessed through a pilot evaluation. This process led to the creation of a tailored exercise program. During the study period, program uptake was continuously monitored, preliminary findings were reviewed, and necessary adjustments, to both the program and its implementation, were made. The study outcomes were evaluated using the RE-AIM framework, a widely recognized tool for measuring the impact of interventions [32]. The JUMPSTART study outcomes encompassed the RE-AIM domains: Reach, Effectiveness, Adoption, Implementation, and Maintenance. Effectiveness was measured by evaluating program acceptability, changes in quality-of-life scores, and CR attendance, while the fidelity outcome represented Implementation.

Study outcomes

Adoption

Program adoption was reported as the proportion of eligible survey respondents who had completed a JUMPSTART exercise module three or more times by three-months post-TAVR. The target was to reach 70% adoption. The study team decided that participating in the program three or more times demonstrated a patient's consistent effort to engage in JUMPSTART exercises, thus qualifying them as having adopted the program. This was not as strict as the cutoff for the QoL analysis, as no inferences were being made. Frequency of participation was self-reported in the two follow-up surveys. Barriers and facilitators to participating in the JUMPSTART program were addressed through open-ended survey questions which were summarized for the purposes of this study. The JUMPSTART virtual session

attendance rate was documented in patients' clinical records.

Acceptability (effectiveness)

Acceptability and feasibility of the JUMPSTART program were self-reported in the two follow-up surveys. Closed, open and Likert scale questions addressed format preferences, physical limitations when exercising, and satisfaction with the program formats and content. Some questions were asked only once, and others were repeated in both surveys.

Quality of life scores (effectiveness)

The TASQ questionnaire is a 16-item QoL survey where total scores range from 16 to 112; higher scores reflect greater perceived QoL [23]. JUMPSTART study participants' baseline TASQ scores were collected by a nurse practitioner or their delegate at the aortic valve clinic. The TASQ questionnaire was also incorporated into the three-month follow-up survey to assess QoL at a second timepoint. The three-month follow-up survey contained a question about the frequency of program participation (i.e., how often respondents have completed an exercise module). To evaluate the preliminary impact of the JUMPSTART program on QoL, changes in TASQ scores among two groups: individuals who had reported doing the program five or more times, and those that had reported doing it less than five times or not at all, were compared. To infer that participation in JUMPSTART may have had a preliminary impact on QoL, a high cutoff for program participation was chosen (i.e., participating in the program five or more times). Independent t-tests were conducted to assess differences in baseline TASQ scores, three-month TASQ scores, and change in TASQ scores, between the two groups. In addition, a multivariate linear regression was completed, in which the dependent variable was TASQ change score (i.e., three-month TASQ score minus baseline TASQ score) and the independent variable was frequency of program participation by three months post-TAVR (i.e., five or more times versus less than five times). Demographics, baseline frailty scores and clinical characteristics were included as covariates in the analysis.

Cardiac rehabilitation attendance (effectiveness)

The CR attendance rate was defined as the proportion of study participants who attended at least one CR class at the regional cardiac centre by three months post-TAVR. Referrals, bookings and attendance were collected from patients' clinical records. Additional information, including CR program awareness, intentions to attend CR, and barriers and facilitators to attending, were self-reported in the three-month follow-up survey.

Reach

Reach was defined as the proportion of eligible study participants who completed both follow-up surveys. It was not possible to measure the reach of the JUMPSTART program itself as all patients initially planned for TAVR were introduced to the program at the aortic valve clinic; they were offered access to program content, regardless of their decision to participate in the research study.

Fidelity (implementation)

Fidelity applied to both the JUMPSTART program (i.e., clinical) activities as well as research study activities, and included adjustments made to the intervention and implementation strategies. Fidelity was discussed informally at biweekly meetings, ad hoc meetings, as well as at structured touchpoint meetings held four months and eight months after patient recruitment began.

Maintenance

Maintenance referred to strategies to maintain and improve JUMPSTART program participation rates and CR awareness and attendance rates, as well as establishing program sustainability. These topics were discussed informally at biweekly meetings and ad hoc meetings; they were more formally reviewed at structured touchpoint meetings held four months and eight months after patient recruitment began.

Results

Study consent and eligibility

Study consent and eligibility is summarized in Fig. 1. Initially, 358 individuals who visited the aortic valve clinic between April 1, 2023, to March 31, 2024, consented to participate in the study; however, 12 later revoked their consent, leaving 346 participants. Of these, 144 (42%) were eligible for the study, while 202 (58%) were deemed ineligible either before or after TAVR.

Study population

Table 1 (Appendix) describes the study population's demographics, baseline frailty assessments and clinical characteristics. The mean age of the participants was 79 years, with 68 individuals (47%) being female. The mean TASQ score was 72.2 before TAVR and significantly increased to 97.8 by three-months post-TAVR. Most study participants had hypertension (83%) and dyslipidemia (76%). Over one third of participants smoked cigarettes (38%), had diabetes (33%) and experienced atrial fibrillation (31%). As a group, they demonstrated weak performance on both the 5-metre walk test and the 2MW test, and their TUG test result indicated they were at risk of falling.

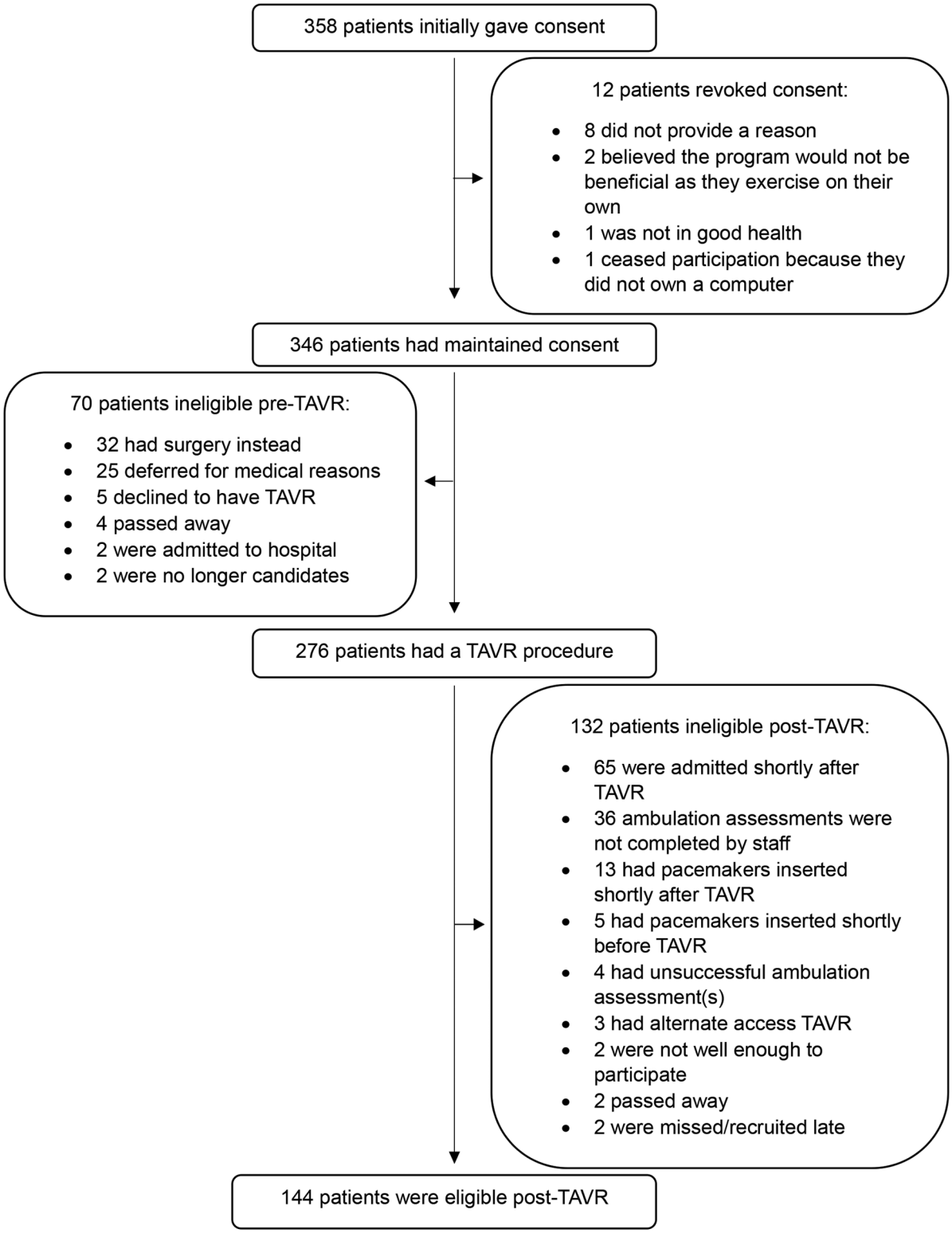

Fig. 1 JUMPSTART study consent and eligibility

Table 1 JUMPSTART follow-up survey completion and respondents' demographics

Follow-up Surveys	14-day	3-month
Number of Responses	124	112
Response Rate	86%	78%
Respondent:		
Patient with caregiver	68 (55%)	62 (55%)
Patient alone	52 (42%)	47 (42%)
Caregiver, on patient's behalf	4 (3%)	3 (3%)
Survey Format:		
Telephone	65 (52%)	58 (52%)
Online	59 (48%)	54 (48%)
Age		
	M = 79.0 (SD = 7.6)	M = 79.1 (SD = 7.5)
Sex:		
Female	58 (47%)	55 (49%)
Male	66 (53%)	57 (51%)

Note: M = mean and SD = standard deviation

Survey completion

Table 1 describes follow-up survey completion and respondents' demographic information. Survey response rates were 86% for 14-day follow-up and 78% for three-month follow-up. At both timepoints: 55% of respondents had a caregiver present while they completed the survey; 52% had completed the survey over the phone; the mean age of the respondents was 79 years; and slightly more than half of the respondents were male.

Adoption

The JUMPSTART program adoption rate at three-months post-TAVR was 75%, surpassing the study target rate of 70%. Figure 2 illustrates the frequency of program participation. Reasons for not participating in the program by 14-days post-TAVR were being unwell ($n = 7$), prior commitments preventing them from trying the program ($n = 6$) and engaging in other forms of exercise ($n = 3$). Reasons for not participating in the program by three-months post-TAVR were engaging in other forms of exercise ($n = 2$), stating they are not interested ($n = 2$), believing that the program is too simple ($n = 1$) and being unable to find time to participate ($n = 1$). Only 17% ($n = 24/144$) of the eligible study participants attended a group-based virtual JUMPSTART exercise session. More than 40 survey respondents at each follow-up time point indicated that the main reason for not attending a virtual session was lack of access to a device with internet. The study team met regularly with the CR physiotherapists who led the virtual sessions to discuss options to increase access.

Acceptability (effectiveness)

At both timepoints, less than half of the survey respondents had reported watching a JUMPSTART video module (32% ($n = 40/124$) at 14-days and 42% ($n = 47/112$) at three-months post-TAVR). The primary reasons for not having watched a module were lack of access to a device with internet ($n = 27$ at 14-days and $n = 29$ at three-months post-TAVR) and preference to use the exercise instructions handout instead ($n = 11$ at 14-days and $n = 9$ at three-months post-TAVR). In comparison, a very high proportion of survey respondents reported that they had read the exercise instructions handout (88% ($n = 109/124$) at 14-days and 90% ($n = 101/112$) at three-months post-TAVR). Respondents described being satisfied with the handouts (mean = 5.51; standard deviation = 1.21) and the videos (mean = 5.61; standard deviation = 1.42) (Likert

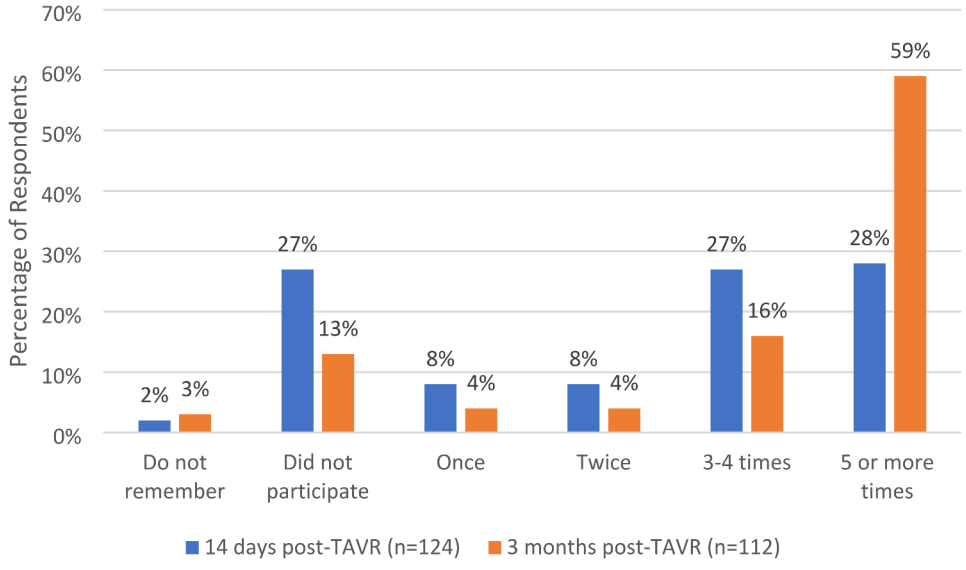

Fig. 2 Frequency of participation in the JUMPSTART program, at two timepoints

scale: 1 = strongly dissatisfied and 7 = strongly satisfied). Everyone who had engaged in the program by watching videos reported that they were easy to follow ($n = 44/44$). Figure 3 presents the format preferences of survey respondents who had tried the JUMPSTART exercises at least once ($n = 89$ at 14-days and $n = 97$ at three-months post-TAVR); most program participants preferred strictly using exercise instructions handouts to engage in the program ($n = 61/89$ at 14-days and $n = 67/97$ at three-months post-TAVR). A sub analysis on differences in age and gender, based on format preference at three-months post-TAVR, was conducted. Individuals who preferred strictly using the paper handouts ($n = 67$) were significantly older in age (80.7 years of age) than those who preferred watching videos or used a combination of video and paper ($n = 30$; 77.2 years of age) (p-value = 0.02). There were no significant differences in gender between the two groups.

A hypothetical question was added to the three-month follow-up survey in October 2023, to explore patients' interest in virtual options, if lack of access to a device was not a barrier. When asked if a tablet computer, containing educational resources and exercise videos for post-TAVR patients, could be borrowed from the hospital at no cost to help with their recovery, only 27% ($n = 18/66$) of the respondents said that they would be interested in accepting the offer.

At 14-days post-TAVR, most survey respondents did not experience any physical limitations while engaging in the exercises (89%; $n = 114/124$). However, 10 individuals described minor difficulties while exercising, such as feeling unsteady ($n = 4$), experiencing light-headedness ($n = 3$), soreness ($n = 2$) or shortness of breath ($n = 1$). Furthermore, 70% ($n = 62/89$) of the respondents who attempted a set of JUMPSTART exercises at least once by 14-days post-TAVR, believed that the exercises were at the right level of difficulty; 27% ($n = 24/89$) said that they were too easy and only 3% ($n = 3/89$) felt that they were too difficult. Three months post-TAVR, 96% ($n = 93/97$) of survey respondents who had attempted a set of exercises at least once reported that they would recommend the program to other TAVR patients, and 73% ($n = 71/97$) believed that their overall recovery was improved because of their participation in the program. Many who stated that the JUMPSTART program did not support their recovery felt that the exercises were too simple and had preferred to engage in other forms of exercise ($n = 13$).

Quality of life scores (effectiveness)

In the three-month follow-up survey, 59% ($n = 66/112$) of the respondents reported that they had done the exercise program five or more times, and 41% ($n = 46/112$) had done it less than five times or not at all. Table 2 (Appendix) compares the demographics, clinical characteristics and baseline assessment scores of these two groups. Only one statistically significant difference was observed; a significantly larger proportion of individuals who participated in the program five or more times had Class 3 dyspnea (20%), compared to those who participated less than five times (4%) (p-value = 0.02). Baseline TASQ scores were available for 87% ($n = 97/112$) of the three-month survey respondents, while three-month post-TAVR TASQ scores had been reported for all. Table 2 compares baseline TASQ score means, three-month TASQ score

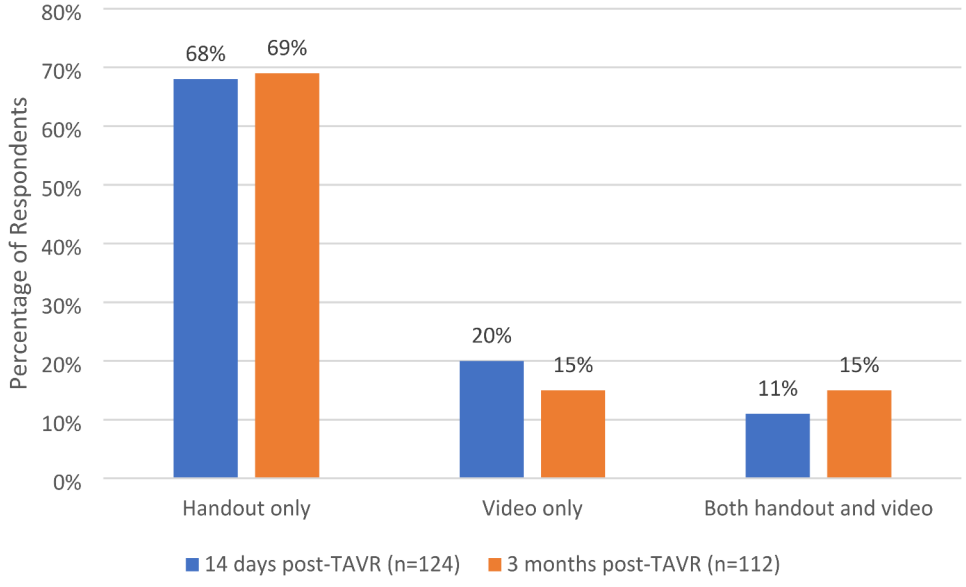

Fig. 3 Preferred format when participating in the JUMPSTART program, at two timepoints

Table 2 Comparison of mean TASQ scores at baseline and three-months post-TAVR, based on frequency of JUMPSTART program participation

JUMPSTART Program Participation Frequency	*Baseline (pre-TAVR) (n = 97)*	*Three months post-TAVR (n = 112)*	*Difference/ Change in TASQ Score (n = 97)*
5 or more times (n = 66)	73.5 (21.1) *Available n*= 58	98.2 (15.1) *Available n*= 66	23.9 (23.8) *Available n*= 58
Less than 5 times (n = 46)	66.9 (21.9) *Available n = 39*	97.1 (15.7) *Available n*= 46	30.3 (25.6) *Available n*= 39
P-value (independent t-test)	$p = 0.14$	$p = 0.72$	$p = 0.22$

means, and difference in TASQ score means, between the two groups. No statistically significant differences were observed.

For the regression analyses, data were available from 97 participants for the main dependent variable, change in TASQ score (missing 33%; 47/144), and from 112 participants for the main independent variable, frequency of program participation (missing 22%; 32/144). Univariate linear regression analysis was used to test if JUMPSTART participation explained changes in TASQ scores. The results of the regression indicated that JUMPSTART participation explained 2% of the variation in changes in TASQ scores [$F(1,95) = 1.54$, $p = 0.22$]. Univariate linear regression analyses were done for 10 other variables (i.e., age, sex, KATZ index score, Rockwood score, hand grip, 5-metre walk test, TUG test, 2MW test, CR attendance and Society of Thoracic Surgeons (STS) score). None of these variables predicted over 2% of the variation in changes in TASQ scores and none showed significant relationships at the $p < 0.05$ level. Multivariate linear regression including 11 variables found a non-significant model explaining 8% of the variation in changes to TASQ scores [$F(11,55) = 0.42$, $p = 0.94$]. Supplementary File 2 describes the regression analyses findings in detail.

Cardiac rehabilitation attendance (effectiveness)

Study participants' CR attendance rate was 30% ($n = 43/144$). To elaborate, 81% ($n = 116/144$) of the study participants had been referred to CR at the regional cardiac centre. Of those referred, 76% ($n = 88/116$) agreed to attend and were subsequently scheduled for a class. Of those scheduled, 49% ($n = 43/88$) attended. Most attendees joined a virtual CR class (74%; $n = 32/43$) while a smaller number attended in person (26%; $n = 11/43$). Survey respondents cited several reasons for not attending, including believing that the program would not be beneficial ($n = 17$), prioritizing other health-related issues ($n = 12$), and being unaware that CR was being offered or that virtual options were available ($n = 8$). Survey respondents' awareness of CR programs in the community was only 49% ($n = 55/112$).

Reach

Among the eligible study participants, 76% ($n = 109/144$) completed both follow-up surveys.

Fidelity (implementation)

The study team assessed whether the JUMPSTART program and research activities were being implemented as planned throughout the study period and took action to revise and improve processes, as needed. Some examples include the following:

- A presentation was held for the cardiac centre staff in March 2023, to discuss the JUMPSTART program, outline staff responsibilities and answer questions.
- Post-TAVR ambulation assessments, which are standard practice and necessary for study eligibility, were not being consistently recorded. Consequently, the study team, including the nurse educator and cardiologist, addressed the cardiac care nurses on the unit, both informally and during meetings, to emphasize the importance of completing and documenting these patient assessments.
- JUMPSTART program activities were incorporated into corporate Continuous Quality Improvement processes at the cardiac centre in February 2024. As part of this initiative, nurses receive reminders to provide program materials and educate patients, and to complete and record patients' post-TAVR ambulation assessments.

Maintenance

The study team formally reviewed JUMPSTART program adoption and CR attendance during two touchpoint meetings, held in June and October 2023. Upon review of preliminary survey results and clinical documentation at the second meeting, actions were taken to revise and improve uptake of both JUMPSTART and CR (Table 3).

Table 3 Preliminary findings and actions taken to improve participation in the JUMPSTART program and cardiac rehabilitation (CR)

Issue Identified	Resolution/Action Taken
Preference for using exercise instruction handouts to video modules.	Printable PDF documents of all four exercise modules were uploaded to the JUMPSTART webpage.
Lack of computer/internet access was identified as a barrier to both watching the videos and attending the virtual group-based sessions.	Question was added to the three-month post-TAVR survey to explore patients' interest in virtual options when lack of computer/internet is no longer a barrier: *"If a tablet computer (e.g., iPad), containing only educational resources and exercise videos for post-TAVR patients, could be borrowed from the hospital at no cost, would you be interested in taking it home and using it to help you with your recovery?"*
Low CR attendance rates were observed.	A one-page CR information sheet was added to the TAVR patient discharge package. Study team met with CR outpatient clinic manager and booking clerk to discuss CR booking processes. The booking clerk then switched to calling patients to offer virtual or in-person CR classes (versus mailing patients scheduled bookings without their input).

Discussion

The JUMPSTART program was developed at a regional cardiac centre in Ontario, Canada, to encourage early mobilization in post-TAVR patients. JUMPSTART supports patients at a potentially vulnerable time (i.e., post-discharge but before CR). The program allows individual patients to tailor the program to their needs, to engage in the exercises using various formats, and to perform the exercises at home, where they often feel most comfortable and most safe [33]. The goal of the JUMPSTART research study was to evaluate and refine the JUMPSTART program, while also addressing barriers to CR attendance. There were 144 consented patients who met eligibility criteria, and 76% completed both follow-up surveys.

The JUMPSTART program saw excellent adoption and received overall positive feedback on its available formats and content. The exercises were deemed safe and appropriate for the intended patient population; however, approximately one third of program participants felt that the exercises were not challenging enough for them. Most survey respondents believed that their participation in the program positively impacted their overall recovery from TAVR and would recommend the program to other post-TAVR patients. The positive perception of the effects of the program may have been influenced by a sense of control by patients over their recovery. Study participants' QoL significantly increased from baseline (pre-TAVR) to three-months post-TAVR; however, this could not be attributed to frequency of program participation. The finding that some participants desired a more intensive exercise program suggests that future data collection on patients' baseline (i.e., pre-TAVR) exercise levels could potentially reveal differences in QoL scores. Overall, participants preferred the paper-based program format to virtual options (i.e., video modules and group-based virtual sessions). The primary barrier to engaging in virtual options was the technological requirement. This aligns with the JUMPSTART pilot evaluation findings and other previously published literature regarding barriers to using e-health [34]. However, even when the technological barrier was removed, by hypothetically offering patients tablet computers with tailored resources, most stated that they would still not be interested. Also, older patients had a stronger preference for traditional paper-based instructions. Ferraz et al. [35] provide insight, explaining that older adults prefer traditional paper-based formats for health education due to their familiarity and lower learning curve; the authors recommended continued use of paper-based media for older adults, along with screen-based options.

Although the JUMPSTART program achieved a high adoption rate of 75%, the CR program attendance rate was only 30%. When focusing solely on those who had received a CR referral, the CR attendance rate increased to 37%. These findings are consistent with previously reported CR attendance rates for TAVR patients (30.6%) [36] but are significantly lower than attendance rates for all cardiac patients referred to CR in Ontario, Canada (55–59%) [37]. Awareness and education about the benefits of CR could be improved as approximately half of the survey respondents indicated that they were unaware of existing CR programs in their communities; furthermore, many who opted out believed that CR would not be beneficial to their health and did not consider it a priority. To address these barriers, a CR information sheet emphasizing the benefits of CR, was created for TAVR patients receiving care at the regional cardiac centre. Furthermore, greater participation in the JUMPSTART program, compared with CR, may be attributed to preference for a paper-based program. Additionally, the strong relationship with the TAVR cardiac team, the trust in their guidance, and the tailored approach for patients who have undergone the TAVR procedure, may have encouraged participation in JUMPSTART. Moving forward, the study team may consider incorporating a different virtual component into the program, such as motivational telephone calls, to improve both JUMPSTART program and CR program participation. This strategy has been shown to effectively increase CR appointment attendance [38]. The TAVR patient population has many comorbidities that will affect long-term outcomes (Table 1, Appendix). There is a need to further explore ways to enhance patient engagement in early mobilization and CR, to

improve health outcomes and to reduce the burden on the healthcare system.

Strengths

A major strength of the research study was the availability of two formats for survey completion (i.e., online and telephone) which resulted in high survey response rates. A significant advantage of the JUMPSTART program itself is its cost-effective implementation. Cardiac nursing staff members introduce patients to the program and provide printed materials during routine discharge practices. Due to the program's self-directed and home-based format, staff are not required to undertake any extra tasks, such as developing individualized early mobilization plans, scheduling or conducting in-person exercise sessions, or following up with patients.

Limitations

Due to the study's small sample size of 144 patients, there was low statistical power to detect clinically meaningful differences in TASQ scores. Therefore, no definitive conclusions could be made. Future studies with larger sample sizes are necessary to more accurately assess QoL outcomes. Another limitation was that the impact of frequency of program participation on frailty test scores (i.e., 5-metre walk test and hand grip test) and functionality (i.e., 2MW test and TUG test) was not assessed; unfortunately, these four assessments could not be repeated at a follow-up post-TAVR, due to resource constraints and challenges with scheduling patients for in-person visits. Fifteen three-month follow-up survey respondents did not have baseline TASQ scores. Lack of staff available to administer baseline assessments, as well as TASQ reporting issues caused this problem (e.g., in cases when individual item scores were missing, a final score could not be calculated). Thirty-six potentially eligible patients were excluded from the study because their post-TAVR ambulation assessments were either missing or incomplete. Since documentation of post-TAVR ambulation assessments was an eligibility criterion, these patients could not be included in the analyses. Discussions with cardiac care nurses revealed that logistical issues, such as limited staffing, prevented the completion and documentation of the assessments. Furthermore, 28 eligible participants did not receive a referral to CR, and this ultimately impacted the CR attendance rate. Recent administrative changes in CR had disrupted the referral process, and some referrals were made to CR programs outside the regional cardiac centre, making it impossible to confirm and include their attendance in this evaluation. Finally, the evaluation focused on gathering opinions on the video modules and exercise instructions handouts. It would have been valuable to also gather formal feedback from the virtual group-based session attendees about their experiences. Such findings could have led to adjustments and improvements in the virtual sessions.

Conclusions

The JUMPSTART program is a simple, low-cost and safe intervention, designed to bridge an important clinical gap by providing a standardized early mobilization protocol for TAVR patients, who are typically discharged within 24 h post-procedure. Positive feedback from survey respondents supports the continuation of the program. Next steps may involve continuing the iterative process to further refine the program, aiming to more precisely target outcomes such as change in QoL scores, and progressing towards an effectiveness trial that includes clinical outcomes. To improve program participation, higher-intensity exercise modules may be developed. Additionally, ongoing collaboration with the cardiac centre and regional CR staff will focus on improving CR education and increasing attendance rates. Lastly, the feasibility of incorporating other virtual components, such as motivational phone calls, to increase participation in both the JUMPSTART program and CR, may be considered.

Abbreviations

TAVR	Transcatheter aortic valve replacement
CR	Cardiac rehabilitation
QoL	Quality of life
TASQ	Toronto aortic stenosis quality of life (questionnaire)
TUG	Timed get up and go (test)
2MW	2-minute walk (test)

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12872-025-04665-0.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Acknowledgements

The authors thank the students who ran baseline data collection at the aortic valve clinics and the specialist physiotherapists who led the virtual group-based JUMPSTART exercise sessions.

Author contributions

MC analyzed and summarized baseline data and survey responses. OP collected and summarized clinical record data. JC performed and summarized the regression analyses. MC and MN interpreted the study results. MC was the primary contributor in writing the manuscript. All authors read and approved of the final manuscript.

Funding

This study was funded by Edwards Lifesciences.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This research was conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki. This study was approved by the Hamilton Integrated Research Ethics Board (REB Project 15474). The JUMPSTART program was offered to all potentially eligible patients as part of standard clinical care, regardless of their consent to participate in the research study; however, no data were collected for research purposes from those who did not provide consent to participate in the research study. Research data were only collected from individuals who explicitly agreed to participate in the study and provided written informed consent.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Medicine, McMaster University, 1280 Main Street West, Hamilton, ON L8S 4L8, Canada
[2]Hamilton Health Sciences, King West, P.O. Box 2000, Hamilton, ON L8N 3Z5, Canada
[3]Centre for Implementation Research, Ottawa Hospital Research Institute, 501 Smyth Box 511, Ottawa, ON K1H 8L6, Canada
[4]University Health Network, 190 Elizabeth Street, Toronto, ON M5G 2C4, Canada

Received: 13 December 2024 / Accepted: 13 March 2025
Published online: 25 March 2025

References

1. Mack MJ, Leon MB, Thourani VH, Makkar R, Kodali SK, Russo M, et al. Transcatheter aortic-valve replacement with a balloon-expandable valve in low-risk patients. N Engl J Med. 2019;380(18):1695–705. https://doi.org/10.1056/NEJMoa1814052. Epub 2019 Mar 16. PMID: 30883058.
2. Popma JJ, Deeb GM, Yakubov SJ, Mumtaz M, Gada H, O'Hair D, et al. Transcatheter aortic-valve replacement with a self-expanding valve in low-risk patients. N Engl J Med. 2019;380(18):1706–15. https://doi.org/10.1056/NEJMoa1816885. Epub 2019 Mar 16. PMID: 30883053.
3. Siontis GCM, Overtchouk P, Cahill TJ, Modine T, Prendergast B, Praz F et al. Transcatheter aortic valve implantation vs. surgical aortic valve replacement for treatment of symptomatic severe aortic stenosis: an updated meta-analysis. Eur Heart J. 2019;40(38):3143–3153. https://doi.org/10.1093/eurheartj/ehz275. PMID: 31329852.
4. Alfaraidhy MA, Regan C, Forman DE. Cardiac rehabilitation for older adults: current evidence and future potential. Expert Rev Cardiovasc Ther. 2022;20(1):13–34. https://doi.org/10.1080/14779072.2022.2035722. Epub 2022 Feb 13. PMID: 35098848; PMCID: PMC8858649.
5. Sperlongano S, Renon F, Bigazzi MC, Sperlongano R, Cimmino G, D'Andrea A, Golino P. Transcatheter aortic valve implantation: the new challenges of cardiac rehabilitation. J Clin Med. 2021;10(4):810. https://doi.org/10.3390/jcm10040810. PMID: 33671340; PMCID: PMC7922533.
6. Forman DE, Maurer MS, Boyd C, et al. Multimorbidity in older adults with cardiovascular disease. J Am Coll Cardiol. 2018;71(19):2149–61. https://doi.org/10.1016/j.jacc.2018.03.022. PMID: 29747836; PMCID: PMC6028235.
7. Simon M, Korn K, Cho L, Blackburn GG, Raymond C. Cardiac rehabilitation: A class 1 recommendation. Cleve Clin J Med. 2018;85(7):551–558. https://doi.org/10.3949/ccjm.85a.17037. PMID: 30004380.
8. Ritchey MD, Maresh S, McNeely J, Shaffer T, Jackson SL, Keteyian SJ, et al. Tracking cardiac rehabilitation participation and completion among medicare beneficiaries to inform the efforts of a National initiative. Circ Cardiovasc Qual Outcomes. 2020;13(1):e005902. https://doi.org/10.1161/CIRCOUTCOMES.119.005902.
9. Zou J, Yuan J, Liu J, Geng Q. Impact of cardiac rehabilitation on pre- and post-operative transcatheter aortic valve replacement prognoses. Front Cardiovasc Med. 2023;10:1164104. https://doi.org/10.3389/fcvm.2023.1164104. PMID: 38152609; PMCID: PMC10751363.
10. Anayo L, Rogers P, Long L, Dalby M, Taylor R. Exercise-based cardiac rehabilitation for patients following open surgical aortic valve replacement and transcatheter aortic valve implant: a systematic review and meta-analysis. Open Heart. 2019;6(1):e000922. PMID: 31168371.
11. Ribeiro GS, Melo RD, Deresz LF, Dal Lago P, Pontes MR, Karsten M. Cardiac rehabilitation programme after transcatheter aortic valve implantation versus surgical aortic valve replacement: systematic review and meta-analysis. Eur J Prev Cardiol. 2017;24(7):688–97. PMID: 28071146.
12. Voller H, Salzwedel A, Nitardy A, Buhlert H, Treszl A, Wegscheider K. Effect of cardiac rehabilitation on functional and emotional status in patients after transcatheter aortic-valve implantation. Eur J Prev Cardiol. 2015;22(5):568–74. PMID: 24577878.
13. Chow CTR. Completion of a phase 2 outpatient cardiac rehabilitation program following transcatheter aortic valve implantation or surgical aortic valve replacement. J Cardiopulm Rehabil Prev. 2021;41(6):413–8. 10.1097.
14. Hart L, Frankel R, Crooke G, Noto S, Moors MA, Granger BB. Promoting early mobility in patients after transcatheter aortic valve replacement: an evidence-based protocol. Crit Care Nurse. 2021;41(5):e9–16. https://doi.org/10.4037/ccn2021925.
15. Cardiac Care Network of Ontario. Standards for the provision of cardiovascular rehabilitation in Ontario. 2014 Sep [cited 2024 Nov 1]. Available from: https://www.corhealthontario.ca/resources-for-healthcare-planners-%26-providers/rehabilitation/CCN_Cardiovascular_Rehab_Standards_2014.pdf
16. American College of Cardiology. Patients who stay in hospital less than 3 days after TAVR fare better. 2019 Mar 4 [cited 2024 Oct 28]. Available from: https://www.acc.org/about-acc/press-releases/2019/03/04/13/53/patients-who-stay-in-hospital-less-than-3-days-after-tavr-fare-better
17. Krishnaswamy A, Isogai T, Agrawal A, Shekhar S, Puri R, Reed GW et al. Feasibility and safety of same-day discharge following transfemoral transcatheter aortic valve replacement. JACC Cardiovasc Interv. 2022;15(6):575–589. https://doi.org/10.1016/j.jcin.2022.01.013. PMID: 35331449.
18. Wood DA, Lauck SB, Cairns JA, Humphries KH, Cook R, Welsh R et al. The Vancouver 3 M (Multidisciplinary, Multimodality, But Minimalist) Clinical Pathway facilitates safe next-day discharge home at low-, medium-, and high-volume transfemoral transcatheter aortic valve replacement centers: The 3 M TAVR study. JACC Cardiovasc Interv. 2019;12(5):459–469. https://doi.org/10.1016/j.jcin.2018.12.020. PMID: 30846085.
19. Darvishzadehdaledari S, Harrison A, Gholami F, Azadnia A. Examining the effectiveness of home-based cardiac rehabilitation programs for heart failure patients with reduced ejection fraction: a critical review. BMC Cardiovasc Disord. 2023;23(1):593.
20. Moulson N, Bewick D, Selway T, Harris J, Suskin N, Oh P, et al. Cardiac rehabilitation during the COVID-19 era: guidance on implementing virtual care. Can J Cardiol. 2020;36(8):1317–21. https://doi.org/10.1016/j.cjca.2020.06.006. Epub 2020 Jun 14. PMID: 32553606; PMCID: PMC7293761.
21. Hamilton Health Sciences Centre for Evidence-Based Implementation. JUMPSTART Exercise Program (webpage). 2024. [cited 2025 Feb 14]. Available from: https://hhscebi.ca/projects/jumpstart
22. Afilalo J, Lauck S, Kim DH, Lefèvre T, Piazza N, Lachapelle K, et al. Frailty in older adults undergoing aortic valve replacement: the FRAILTY-AVR study. J Am Coll Cardiol. 2017;70(6):689–700. https://doi.org/10.1016/j.jacc.2017.06.024. Epub 2017 Jul 7. PMID: 28693934.
23. Puls M, Sobisiak B, Bleckmann A, Jacobshagen C, Danner BC, Hünlich M et al. Impact of frailty on short- and long-term morbidity and mortality after transcatheter aortic valve implantation: risk assessment by Katz Index of activities of daily living. EuroIntervention. 2014;10(5):609– 19. https://doi.org/10.4244/EIJY14M08_03. PMID: 25136880.
24. Styra R, Dimas M, Svitak K, Kapoor M, Osten M, Ouzounian M, et al. Toronto aortic stenosis quality of life questionnaire (TASQ): validation in TAVI patients. BMC Cardiovasc Disord. 2020;20(1):209. https://doi.org/10.1186/s12872-020-01477-2. PMID: 32370791; PMCID: PMC7201733.
25. Kazui T, Hsu CH, Hamidi M, Acharya D, Shanmugasundaram M, et al. Five-meter walk test before transcatheter aortic valve replacement and 1-year noncardiac mortality. JTCVS Open. 2022;12:103–17. PMID: 36590743; PMCID: PMC9801278.
26. Gouda P, Paterson C, Meyer S, Shanks M, Butler C, Taylor D, et al. Effects of transcatheter aortic valve implantation on frailty and quality of life. CJC Open. 2020;2(3):79–84. https://doi.org/10.1016/j.cjco.2019.12.006. PMID: 32462120; PMCID: PMC7242504.
27. Podsiadlo D, Richardson S. The timed Up & Go: a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8. https://doi.org/10.1111/j.1532-5415.1991.tb01616.x. PMID: 1991946.

28. Brooks D, Parsons J, Tran D, Jeng B, Gorczyca B, Newton J et al. The two-minute walk test as a measure of functional capacity in cardiac surgery patients. Arch Phys Med Rehabil. 2004;85(9):1525-30. https://doi.org/10.1016/j.apmr.2004.01.023. PMID: 15375829.
29. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci. 2009;4:50. https://doi.org/10.1186/1748-5908-4-50. PMID: 19664226; PMCID: PMC2736161.
30. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)– A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inf. 2009;42(2):377–81.
31. Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W et al. Lost in knowledge translation: time for a map? J Contin Educ Health Prof. 2006;26(1):13–24. https://doi.org/10.1002/chp.47. PMID: 16557505.
32. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. Am J Public Health. 1999;89(9):1322–7. https://doi.org/10.2105/ajph.89.9.1322. PMID: 10474547; PMCID: PMC1508772.
33. Meredith SJ, Cox NJ, Ibrahim K, Higson J, McNiff J, Mitchell S, Rutherford M, Wijayendran A, Shenkin SD, Kilgour AH, Lim SER. Factors that influence older adults' participation in physical activity: a systematic review of qualitative studies. Age Ageing. 2023;52(8):afad145. https://doi.org/10.1093/ageing/afad145.
34. Wilson J, Heinsch M, Betts D, Booth D, Kay-Lambkin F. Barriers and facilitators to the use of e-health by older adults: a scoping review. BMC Public Health. 2021;21(1):1556. https://doi.org/10.1186/s12889-021-11623-w. PMID: 34399716; PMCID: PMC8369710.
35. Ferraz LT, Santos AJT, Lorenzi LJ, Frohlich DM, Barley E, Castro PC. Design considerations for the migration from paper to screen-based media in current health education for older adults: a scoping review. BMJ Open. 2024;14(4):e078647. https://doi.org/10.1136/bmjopen-2023-078647. PMID: 38604627; PMCID: PMC11015264.
36. Sukul D, Albright J, Thompson MP, Villablanca P, Keteyian SJ, Yaser J, et al. Predictors and variation in cardiac rehabilitation participation after transcatheter aortic valve replacement. JACC Adv. 2023;2(8):100581. https://doi.org/10.1016/j.jacadv.2023.100581. PMID: 38938330; PMCID: PMC11198261.
37. CorHealth Ontario. Cardiovascular Rehabilitation Stakeholder Forum (presentation). 2023. [cited 2024 Oct 22]. Available from: https://www.corhealthontario.ca/CR-Stakeholder-Forum-6-Slides_October-11-2023.pdf
38. Harkness K, Smith KM, Taraba L, Mackenzie CL, Gunn E, Arthur HM. Effect of a postoperative telephone intervention on attendance at intake for cardiac rehabilitation after coronary artery bypass graft surgery. Heart Lung. 2005;34(3):179–86. https://doi.org/10.1016/j.hrtlng.2004.07.010.
39. Mathiowetz V, Kashman N, Volland G, Weber K, Dowe M, Rogers S. Grip and pinch strength: normative data for adults. Arch Phys Med Rehabil. 1985;66(2):69–74. PMID: 3970660.
40. Bohannon RW, Wang YC, Gershon RC. Two-minute walk test performance by adults 18 to 85 years: normative values, reliability, and responsiveness. Arch Phys Med Rehabil. 2015;96(3):472–7. https://doi.org/10.1016/j.apmr.2014.10.006. Epub 2014 Oct 25. PMID: 25450135.

Publisher's note