PEC Innovation 1 (2022) 100024

Contents lists available at ScienceDirect

PEC Innovation

journal homepage: www.elsevier.com/locate/pecinn

Disseminating education to solid organ transplant recipients to promote engagement in physical activity

Sunita Mathur [a,b,c,*], Neha Dewan [b], Tania Janaudis-Ferreira [c,d,e,f], Patrick Antonio [g], Holly Surins [h], Robin Deliva [b,i], Catherine Patterson [b,i], Stephanie So [b,i]

[a] School of Rehabilitation Therapy, Queen's University, Kingston, Canada
[b] Department of Physical Therapy, University of Toronto, Toronto, Canada
[c] Canadian Donation and Transplantation Research Program, Edmonton, Canada
[d] School of Physical and Occupational Therapy, McGill University, Montreal, Canada
[e] Translational Research in Respiratory Diseases Program, Research Institute of the McGill University Health Centre, Montreal, Canada
[f] Centre for Outcomes Research and Evaluation (CORE), Research Institute of the McGill University Health Centre, Montreal, Canada
[g] Rehabilitation Sciences Institute, University of Toronto, Toronto, Canada
[h] Department of Occupational Therapy and Occupational Science, University of Toronto, Toronto, Canada
[i] Department of Rehabilitation Services, Hospital for Sick Children (SickKids), Toronto, Canada

ARTICLE INFO

Keywords:
Organ transplant
Exercise
Physical activity
Workshop
Dissemination, education

ABSTRACT

Objective: To evaluate the dissemination of education through a workshop to promote engagement in physical activity (PA) among solid organ transplant (SOT) recipients.
Methods: The in-person workshop consisted of expert-led lectures on topics related to physical activity (day 1) and sports and fitness training with volunteer coaches (day 2). There were separate streams for children/adolescents and adults. RE-AIM (Reach, Efficacy, Adoption, Implementation, and Maintenance) framework was used to evaluate the impact of the workshop. Presenters and participants completed evaluations of the workshop using a 5-point Likert scale. A subgroup of adults completed a self-reported PA questionnaire at baseline and 4-weeks after the workshop.
Results: 103 individuals (71 SOT recipients, 32 caregivers) attended the workshop (ages 4 to 71 + years). Sessions were highly rated (median = 5) for both quality and content on both days. There was no significant change ($p = 0.16$) in PA. However, 56% of SOT recipients reported changing their level of PA.
Conclusion: An educational-workshop with hands-on training was an efficient and well-received method for disseminating awareness about the benefits of PA in SOT recipients.
Innovation: Dissemination of evidence-based knowledge through a novel educational-workshop in a real-world setting has the potential to inform the decisions about PA behavior among SOT recipients.

1. Introduction

Solid organ transplant (SOT) is considered a lifesaving therapeutic option for patients with end-stage organ failure of the lungs, liver, heart, pancreas, or kidney, to increase survival and regain function and fulfillment in their daily lives [1]. In 2019, there were a total of 3014 SOT procedures conducted in Canada, an increase of 42% since 2010 [2]. Despite the positive impact of SOT and the growing number of recipients, long term studies show that SOT recipients experience impaired exercise capacity and low levels of physical activity (PA) for years after transplant [3,4]. Low exercise capacity impacts on quality of life, return to work [3,5,6], and ability to fulfill family and societal roles [6-8]. Furthermore in children, their life-long medical condition can impact school performance, [9] and impair key motor-skill development and exercise behavior, which can limit engagement in an active lifestyle [10,11]. More concerning is that low exercise capacity is associated with increased post-transplant mortality [8,12-15].

There is strong evidence that exercise capacity can be improved through regular participation in PA and structured exercise training across SOT groups [16,17]. Among SOT recipients, several barriers and facilitators for engaging in and adhering to PA have been identified [18-22]. A Canadian web-based questionnaire of 113 SOT recipients revealed that a large proportion of participants never engaged in light, moderate or strenuous exercises [20]. Findings from this survey suggested that 'understanding health benefits' of PA and exercise was reported as the facilitator by 97% of the respondents. Furthermore, 37% reported 'lack of knowledge' as the barrier to not participate in the PA [20]. Another qualitative study revealed that limited physical mobility, low energy levels, comorbidities and fear of

* Corresponding author at: School of Rehabilitation Therapy, Queen's University, Louise D Acton Building, 31 George St, Rm 219, Kingston, ON K7L 3N6, Canada.
E-mail address: sunita.mathur@queensu.ca (S. Mathur).

http://dx.doi.org/10.1016/j.pecinn.2022.100024
Received 24 October 2021; Received in revised form 28 January 2022; Accepted 13 February 2022

damaging the organ were perceived as major barriers to participate in PA among SOT recipients [21]. Major facilitators were motivation, coping, understanding the consequences of inactivity, having a routine/habit, goals/goal priority, and responsibility for the transplanted organ [21]. Similarly, in a study of children after liver transplant and their families, perceived lack of information around safe participation was a major barrier for engagement in PA and there was a need for continuing education to ensure that families felt confident encouraging their children to participate in PA [23].

In chronic disease populations including SOT recipients, having realistic goals, positive attitude and proper health behavior towards exercise and PA is considered important for engaging in and adhering to PA programs [20,21,24-26]. Increasing knowledge related to PA, its health benefits and how to safely engage in PA may be an initial step towards changing and supporting positive PA behavior in SOT recipients. To address this knowledge gap, we implemented an educational workshop, specifically targeted to SOT recipients and their caregivers, to disseminate evidence-based information on PA, with a goal to raise awareness and provide guidelines on how to engage in PA.

The Reach, Efficacy, Adoption, Implementation, and Maintenance (RE-AIM) framework is widely recognized as a valuable tool to evaluate interventions intended for widespread dissemination in the real world setting [27,28]. The RE-AIM framework describes impact of dissemination of evidence based information under five dimensions [27]: Reach (i.e. the absolute number, proportion and representativeness of individuals who participate in a given initiative or program), Efficacy (i.e. the impact of a program or intervention on important outcomes), Adoption (i.e. the absolute number or proportion of target settings involved), Implementation (the extent to which a program or intervention is delivered with consistency, and the time and costs of the program), and Maintenance (extent to which the program or intervention was sustained over time) [28].

The purpose of our project was to deliver the educational workshop to SOT recipients and their caregivers to raise awareness of the benefits and promote engagement in PA. We evaluated the impact of the workshop with a focus on reach, implementation and efficacy aspects of the RE-AIM framework.

2. Methods

The present study served as an evaluation of the implementation of two-day, educational workshop for SOT recipients and their caregivers to promote engagement in PA. The workshop was titled 'Ready, Set, Go! An Educational Workshop on Exercise for Solid Organ Transplant Recipients' and was held in October 2015, in (location removed for anonymized manuscript) with Toronto, Ontario.

2.1. Workshop advertisement and data collection

The workshop was advertised to patients and families through the local, partner transplant centers using posters and flyers distributed by the healthcare team: University Health Network (UHN), SickKids Hospital, and St Michael's Hospital as well as through emails to members of national networks: the Canadian Transplant Association (CTA), Canadian Donation and Transplantation Research Program (CDTRP), and using the online directory of Canadian transplant rehabilitation programs, provided online by Canadian Network for Rehabilitation and Exercise for Solid Organ Transplant Optimal Recovery (CAN-RESTORE).

SOT recipients across all age groups (adults, adolescents and children over 4 years of age) along with their family caregivers/parents were invited to participate in the educational workshop. The workshop was open to SOT recipients from any organ group (heart, lung, liver, kidney, and pancreas) and was provided in English language.

2.2. Development and description of the educational workshop

The content of the workshop was developed as a collaborative effort among local rehabilitation and transplant experts from the University of Toronto, UHN, The Hospital for Sick Children (SickKids), and St Michael's Hospital. The content experts were brought together for a meeting to develop the session objectives and to streamline the content. For speakers, healthcare professionals (HCPs) with clinical experience in transplantation and rehabilitation, as well as a few speakers with expertise in nutrition and sports related training (not specific to transplant) were invited, in order to cover all of the topics for the workshop. All speakers were from Ontario and had at least five years of clinical experience in their area of expertise.

The two-day educational workshop had two distinct streams based on age groups: one for the adult recipients/family caregivers and the second for adolescents/children and their parents. The goal of the workshop was to raise awareness about the benefits of PA to improve physical function and quality of life after organ transplant; and "how to" engage in a structured PA program. The first day of the workshop was held at a university and consisted of presentations from expert HCPs (see Appendix A for the list of topics and schedule of the workshop). The presentation slides were made freely available online as a sustainable educational resource (https://canrestore.wordpress.com/video-resources/). The second day of the workshop consisted of an optional hands-on coaching and training session at a community fitness center offering services to people with all levels of ability. This session was limited to 20 children/youth and 30 adults due to space limitations at the venue (Variety Village, Toronto). This hands-on session was specifically tailored to provide SOT recipients an opportunity to learn essential skills to train for the sports offered in the Canadian Transplant Games and also general fitness activities (e.g. aerobics). The schedule for Day 2 is provided in Appendix A.

2.3. Evaluation of the educational workshop

We used the RE-AIM framework to evaluate the dissemination and impact of the educational workshop. A survey questionnaire was developed to evaluate reach, implementation and effectiveness domains of the RE-AIM framework and its related factors.

2.3.1. Reach was reported as the number and proportion of target population that participated on day 1 and 2 of the workshop [27,28]. Demographic characteristics of all SOT recipients were also recorded including age, gender, and region of residence, organ transplanted, current PA level, and source from where they heard about the workshop. At the time of registration to the workshop, attendees were asked to report their PA level using the Rapid Assessment of Physical Activity (RAPA) questionnaire [29,30]. The information was used by the organizers to develop the training day based on expected level of fitness of the participants.

Implementation was evaluated as the extent to which the program was delivered as intended and consider costs of the program [27,28]. The HCPs who presented a session at the educational workshop received an e-mail invitation containing the link to answer a nine-item e-questionnaire (FluidSurvey™) at one week following the workshop. Presenters were asked if they were able to meet their intended objectives or any challenges they came across while delivering their presentations. Completion reminders were sent out to the presenters at two and four weeks after the initial contact. Workshop attendees were provided with a paper-based evaluation questionnaire to collect their opinions and satisfaction with the content, quality, and delivery of the workshop. The responses to the closed-ended questions were scored using a 5-point Likert-type scale [31] (1 = poor to 5 = excellent; or 1 = strongly disagree to 5 = strongly agree). Workshop participants were reminded verbally to complete the questionnaires at the end of the days 1 and 2. No further follow-up attempts were made.

Efficacy was assessed as the impact of intervention on important outcomes [27,28]. A pre-post survey of the adult SOT recipients was conducted to evaluate the effectiveness component of the RE-AIM framework. The survey was limited to only the adult participants of the workshop, as they received a session specifically on writing personal goals for improving PA behavior. The pre-test package was in paper-based format and consisted of a questionnaire to assess the PA using the Physical Activity Scale for the Elderly (PASE) and a self-developed questionnaire about demographics,

attitudes, and behaviors towards PA, fitness goals, barriers and facilitators to PA [32-35]. The PASE is a 10-item questionnaire that has been validated to measure the level of physical activity in individuals aged 65 years or older, and has been used in both lung and kidney transplant candidates [32-35]. The package contained the participant's unique identifier number on it. Study participants were allowed to complete the questionnaires on site or return them via a self-addressed, postage paid envelope.

The post-test package which was sent four weeks after the workshop consisted of two questionnaires: the PASE and a follow-up version of the self-developed questionnaire. The post-test package was created using FluidSurvey™ and distributed through individualized emails. The email with the survey link was sent four weeks after the workshop. Participants were provided with their unique identifier number in the email and asked to enter this on the first page of the survey to match findings to their pre-test questionnaire. Completion reminders were sent out two and four weeks after the initial email. A copy of the self-developed survey questionnaires used to evaluate implementation and effectiveness of educational workshop are listed under Appendix B. Ethical approval for data collection on the survey questionnaire was obtained from the University of Toronto Health Sciences Research Ethics Board (protocol #31996) and subjects provided written, informed consent.

2.4. Data analysis

The demographic characteristics of the workshop attendees were described using frequencies and percentages. Frequencies for questions with categorical response options and quotations on textual comments for open ended questions were used to describe the response to 9-item survey questionnaire answered by HCPs. Descriptive statistics and frequencies were used to describe survey evaluations completed by SOT recipients and caregivers/parents. Data were checked for out of range values (e.g. <1 or > 5). The PASE scores were tested for normality using Shapiro-Wilk test and a P value of <0.05 was considered statistically significant. Wilcoxon signed-rank test was used to compare PASE scores before and after the educational workshop. Frequencies, percentages, median/range and textual summary were used to summarize the information on goal setting, barriers, facilitators, participant attitude and behavior towards PA. Data were entered and analyzed using Microsoft Excel.

3. Results

The results of this dissemination project are presented based on three of the RE-AIM elements: Reach, Implementation and Effectiveness.

3.1. Reach

There were 103 individuals who attended Day 1 of the educational workshop and 31 individuals attended Day 2. Among 103 individuals, who attended Day 1, there were 71 SOT recipients (43 adults, 28 adolescents/children) and 32 family caregivers/parents of SOT recipients. Although the workshop was advertised and developed for SOT recipients as the target audience, seven individuals who were waiting for transplant

Table 1
Baseline Characteristics of all SOT recipients. Day 1 $N = 71$*.

Demographic Characteristics		N (%)
Age (years)	4–6	6 (8)
	7–10	7 (10)
	11–14	4 (6)
	15–18	10 (14)
	19–30	3 (4)
	31–40	6 (8)
	41–50	5 (7)
	51–60	14 (20)
	61–70	7 (10)
	71 +	1 (1)
	Not reported	8 (11)
Gender	Male	15 (21)
	Female	31 (44)
	Not reported	25 (35)
Region	Rural	12 (17)
	Urban	55 (77)
	Not reported	4 (6)
Organ Transplanted	Heart	18 (25)
	Lung	7 (10)
	Liver	17 (24)
	Kidney	11 (15)
	Multi-Organ (Kidney + Pancreas)	5 (7)
	Other (pre-transplant)	7 (10)
	Not reported	6 (9)
Physical activity level	I do 20 min or more of vigorous physical activity, 3 or more days a week	7 (10)
	I do vigorous physical activities every week, but less than 20 min a day or 3 days a week	6 (9)
	I do 30 min or more a day of moderate physical activity, 5 or more days a week	21 (30)
	I do moderate physical activities every week, but less than 20 min a day or 5 days a week	13 (18)
	I do some light or moderate physical activity, but not every week	5 (7)
	I do some light physical activity every week	13 (18)
	I rarely or never do any physical activity	3 (4)
	Not reported	3 (4)
How did you hear about the symposium?	Canadian Transplant Association Events	25 (35)
	Email	1(1)
	Hospital advertisement	29 (41)
	Symposium Website	2 (3)
	Word of Mouth/ From a friend	8 (11)
	Other (Social media, other newsletter)	6 (8)

* Parents/caregiver of SOT recipients are not included here.

Table 2
Results of the nine-question survey distributed to the symposium presenters.

Question	Response	N = 7
Did you meet your intended objectives?	Yes	7
	No	0
Did you make changes to the content or objectives of your presentation between the June meeting and the symposium?	Yes	3
	No	4
Did you make any changes during your presentation to adapt to the audience?	Yes	2
	No	5
Did you feel that the audience was engaged during the presentation?	Yes	7
	No	0
Did you encounter any challenges in preparing your presentation for the symposium?	Yes	4
	No	3
Did you encounter any challenges when you were delivering your session at the symposium?	Yes	1
	No	6
How would you rate the whole symposium (in terms of number of lectures, topics of lectures, duration etc.)?	Excellent	7
	Good	0
	Neutral	0
	Fair	0
	Poor	0

and interested in exercise asked for special permission from the organizers to attend the workshop. Demographics of SOT recipients are presented in Table 1. The majority of adult SOT attendees were > 50 years old, female, and living in urban regions within Ontario. There were almost equal number of participants among adolescents (11–18 year olds) and children (under 10 years old). Prior to the workshop, PA varied among attendees with the majority performing moderate PA on a regular basis.

3.2. Implementation

Seven HCPs completed the evaluation of their presentation after the workshop (see Table 2). The majority of the presenters felt they had met their intended objectives and that the audience remained engaged throughout the presentations. The presenters noted that there was lot of information delivered as part of the workshop. However, small group size and multiple breaks in between the sessions enabled them to have adequate discussion and interaction with the participants. For future sessions, presenters recommended having a pre-post assessment of audience knowledge about PA promotion after SOT. Another interesting suggestion was to consider having a session on benefits of PA on mental health and depression for SOT recipients.

For participant Day 1 evaluations, 31/43 adults (72%), 3/14 (21%) adolescents, 9/13 (69%) children, and 17/32 (53%) parents of SOT recipients completed or partially completed their evaluation survey. Overall, adult SOT recipients had primarily positive opinions about the workshop content and presenters (see Table 3a). Based on the open-ended comments from adult SOT recipients, excellent presentations with a great deal of information, knowledge of the presenters, meeting and hearing from other transplant recipients were the best part what participants liked about the educational workshop. These workshop attendees felt that there was something for everyone regardless of interests and PA level. A few adult participants provided valuable suggestions to improve the workshop such as to include some more information on nutrition/diet for transplant recipients, donor recovery, medications intake while exercising, and effects of immunosuppressant drugs. Adolescents, children and parents of SOT recipients rated all the sessions as excellent and strongly agreed that they had a positive overall opinion of the workshop. Participants across all age groups agreed that they would attend a similar event and that it would be valuable for other transplant recipients to attend as well.

On Day 2 (hands-on training day), among 31 registrants; 14 (45%) adults, 5 (16%) adolescents, and 5 parents of SOT recipients (16%) completed or partially completed their evaluation survey regarding their ability to understand the content, overall satisfaction and opinion about the quality of content presented during the training day. Both adult SOT recipients and parents of SOT recipients rated all the sessions as excellent and strongly agreed that they had a positive overall opinion of the workshop (see Table 3b). The components of the training day that were highly valued included “variety of the level of sports”, “coaches were terrific, friendly and knowledgeable”, “positive encouragement”, and “patience, empathy and respect”. Adolescents rated all the sessions either good or excellent and agreed that they had a positive overall opinion of the workshop.

A total of $16,000 (Canadian dollars) was used to run the dissemination event. Most of the amount was used to pay research personnel for project coordination and for the food/catering services offered to the workshop attendees.

Table 3a
Adult SOT recipient evaluation of Day 1 (N = 31).

Topic	Item	Number of responses	Median	Range
Session 1: Science behind exercise for transplant recipients	Level of complexity and volume of material	27	4	4–5
	Knowledge, organization and effectiveness of the presenter	27	5	4–5
	Overall session rating	27	5	4–5
Session 2: Safe and effective exercise training	Level of complexity and volume of material	28	4	4–5
	Knowledge, organization and effectiveness of the presenter	28	5	4–5
	Overall session rating	28	5	4–5
Session 3: Medical issues with exercise	Level of complexity and volume of material	29	5	3–5
	Knowledge, organization and effectiveness of the presenter	29	5	4–5
	Overall session rating	29	5	4–5
Session 4: How to exercise safely, injury prevention	Level of complexity and volume of material	28	5	3–5
	Knowledge, organization and effectiveness of the presenter	27	5	3–5
	Overall session rating	27	5	3–5
Session 5: Diet and nutrition for exercise	Level of complexity and volume of material	31	5	3–5
	Knowledge, organization and effectiveness of the presenter	31	5	3–5
	Overall session rating	31	5	3–5
Session 6: Training for sports	Level of complexity and volume of material	28	5	3–5
	Knowledge, organization and effectiveness of the presenter	28	5	3–5
	Overall session rating	28	5	3–5
General questions	A wide range of topics were covered	29	5	4–5
	The sessions were an appropriate length	29	4	3–5
	I was able to ask questions and interact in the session if I wanted to	29	5	3–5
	The visual aids and handouts were clear	29	5	4–5
	The education day was beneficial for me to attend	28	5	4–5
	I would attend a similar education day in the future	29	5	3–5
	I would recommend that my friends and/or family attend a symposium like this	29	5	3–5
	I think that this education day would be important for other transplant recipients	29	5	4–5
	Overall rating of the transplant day	26	5	4–5

Table 3b
Adult SOT recipient evaluations of Day 2: Fitness Day ($N = 14$).

Item	Number of responses	Median	Range
The coaches and PTs leading the sessions were knowledgeable, prepared and effective	14	5	4–5
The coaches and PTs leading the sessions were motivating and encouraging	14	5	4–5
I was able to participate in a wide variety of activities that interest me	14	5	4–5
I was able to ask questions and interact if I wanted to	14	5	4–5
The fitness day was beneficial for me to attend	14	5	4–5
I would attend a similar fitness day in the future	14	5	N/A
I would recommend that my friends and/or family attend a similar fitness day	14	5	N/A
I think a fitness day similar to this is important for other transplant recipients	14	5	N/A
Overall rating of the fitness day	14	5	N/A

3.3. Efficacy

There were 16/43 (37%) adult SOT recipients who completed the pre-post survey. At the baseline, majority of them were females (68%), aged 31to 71 + year old, had a variety of transplanted organs such as heart, lung, liver, kidney and multi-organ (95% single organ, 5% multi organ), and the time since transplant varied (16% within 1 year, 5% within 1–2 years ago, 21% 2–3 years ago, 5% 3–4 years ago, 26% 4–5 years ago and 26% 5+ years ago). There was no significant difference in PASE scores from baseline to 4-week follow-up (124 $\pm$ 42 versus 154 $\pm$ 68, $p = 0.16$). Regarding attitudes towards PA, 19/43 adult SOT recipients completed a survey questionnaire at baseline and all participants agreed that exercise and PA were beneficial for them and 16/19 (84%) agreed that they enjoy participating in PA. Out of them, 16 participants fully or partially completed a follow-up survey on their attitudes and behaviors towards PA four weeks after the workshop. 56% of attendees reported making a positive change to their type/duration of PA following the workshop. 77% of attendees mentioned high level of motivation to stay healthy and 55% endorsed losing weight as the main reasons which brought change in their attitude and behavior towards PA.

For barriers and facilitators to achieve PA goals following the transplant, 19/43 SOT recipients responded. The majority of the participants cited experiencing side effects from their transplant (42%), not having access to a gym (37%) and not having somebody to exercise with (31%) as major barriers, whereas the cost of exercise was only reported as a barrier in a small number of participants (16%). Commonly cited facilitators (>74% of the participants) were gaining a feeling of improved health, a desire to get in better shape/ lose weight, a high level of motivation to stay healthy, support from family and friends, having knowledge and confidence about exercise, and a physician/HCPs recommendation for the exercise. 58% of the participants reported close proximity to the gym or recreation center as a facilitator.

Furthermore, 16/43 adult SOT participants completed a survey on the exercise related goal setting and goal attainment at four weeks after the workshop (Table 4). 44% of the participants had a set goal before and after the workshop and 90% agreed that they would achieve their goal in the next three months. Medical complication/injury (45%), lack of time or other commitments (27%), cost (18%), and exhaustion (1%), were described as barriers for goal setting. In regard to the type of goal setting, participants reported that they made plans to increase the exercise time, compete in a competition, taking an exercise class, increasing overall performance and restarting previous exercise regime.

4. Discussion and conclusion

4.1. Discussion

In this project, we successfully disseminated and raised the awareness about the best evidence available on benefits of PA to SOT recipients and

Table 4
Examination of goal setting and goal attainment 4-weeks after the symposium ($N = 16$).

Question	Response Options	Number of Responses
Did you set a goal at the symposium ($N = 16$)	Yes	7
	No	7
	Do not remember	2
Did you set a goal after the symposium ($N = 9$)	Yes	4
	No	5
What type of goal did you set ($N = 11$)	Compete in a competition (swimming, race etc.)	2
	Increase the time spent exercise	4
	Increase overall performance	1
	Start taking a class	3
	Re-start previous exercise regime	2
	Maintain current exercise regime	0
How would you rate your success in taking action to meet your goal ($N = 11$)	Poor	2
	Fair	2
	Average	3
	Good	4
	Excellent	0
I feel that I will achieve my goal in the next 3 months ($N = 11$)	I strongly agree	1
	I agree	9
	I don't agree or disagree	1
	I disagree	0
	I strongly disagree	0
Have you experienced any barriers to taking action towards meeting your goal? ($N = 11$)	Yes	9
	No	2
	Prefer not to answer	0
What were these barriers? (categorized)	Lack of time and other commitments	3
	Exhaustion	1
	Injury/ Medical complication	5
	Cost	2

their caregivers. Reach, implementation and efficacy domains of the RE-AIM framework were used to evaluate the impact of the dissemination event. Overall, our two-day educational workshop delivered to SOT recipients and their caregivers was well received. All the participants rated presentations and hands on sessions delivered throughout the workshop as highly beneficial and enjoyable. Our workshop was designed to meet the needs of various range of age groups and transplant types. The interest shown by the broad audience reinforces the importance of having similar programs for this population. The valuable information obtained from the workshop such as what participants liked, what could be improved, and what should be added to the workshop can be helpful to design future workshops.

Regarding barriers to achieve PA goals, the adult SOT recipients reported side effects from the transplant as their biggest barrier. Results from another qualitative study conducted among seven SOT recipients and six exercise professionals also reported side effects post-transplant and cost of the fitness centers as the major barriers to join a community based exercise program for the SOT recipients [36]. This indicates that rehabilitation professionals should consider transplant related side effects while prescribing the PA program for SOT recipients. In contrast, we did not find cost of exercise as the major barrier for our study participants however we had a small number of participants ($n = 19$) who responded to the survey questionnaire related to barriers, so this may not be representative of all participants in the workshop.

In our project, the health-related factors such as 'gaining the feeling of improved health', a desire to get in better shape/ lose weight and social support systems such as a support from family and friends, high level of motivation to stay healthy, and physician/HCP recommendation for the exercise were described as facilitators by majority of the SOT recipients. Previous studies also reported similar findings among organ transplant recipients [37,38]. Interestingly, 78% of our SOT recipients identified that having knowledge and confidence about exercise as a facilitator to participate in the PA program. Also, 90% of our participants agreed that they would achieve their exercise related goals in the next three months. This emphasizes the fact that disseminating knowledge and increasing awareness of SOT recipients about benefits of PA as done in this project should be recommended for a wider group of SOT recipients.

For PA levels, SOT recipients did not show any statistically significant change in the PASE scores at four weeks following the workshop. This could be due to the small sample [39] of 19 participants who participated in the questionnaire about their PA levels pre-post workshop. Nevertheless, there was a clinically significant trend (~30 points) of improvement in PA levels [40]. Also, most people who attended the workshop were already interested in exercise (we didn't get many who were not doing any physical activity based on RAPA). Furthermore, those individuals who volunteered to do the pre-post survey also had good PA levels initially. This volunteer bias may have been why we didn't see much of an improvement in PA after the workshop.

Using the RE-AIM framework to evaluate the impact of the workshop from multiple aspects and providing a theoretically sound approach for translating evidence from research to the broader audience in the community was a strength of this project. The evaluation of our workshop had a few limitations. We did not evaluate adoption and maintenance aspects of RE-AIM for our workshop due to shorter, one-time follow up. In future, long-term follow-up periods should be used to ensure that both adoption and maintenance of PA behavior are assessed. We did not fully evaluate the effectiveness of our workshop on changing PA behavior using a rigorous, experimental study design. Although it is suggested that RE-AIM framework can be used to evaluate interventions with studies other than randomized controlled trials [27], the extent to which external factors could have influenced the changes in PA behavior could be made clear by using an equivalent control group in the future studies. Additionally, we did not evaluate knowledge of the SOT recipients prior to the workshop, so that limited our ability to report if our workshop resulted in increased awareness about the importance and benefits of PA. In future projects, both pre-post assessment of knowledge and PA behavior (using questionnaires or activity monitors) should be considered.

Larger number of participants should be targeted in future dissemination events to generalize the findings we have evaluated in this project. This might be possible by changing the workshop to an online format which would give an opportunity to the audience from a wider geographical region to attend. Although, participants would miss the hands on component of the educational workshop in the online format. Further, it would be interesting to see if we can reach more SOT recipients by offering the workshop at the beginning of spring or summer instead of fall as participants may be more motivated to exercise and/or engage in outdoor PA in the warm weather. Given the unprecedented challenges such as the COVID-19 pandemic and immunocompromised status for SOT recipients, researchers might consider exploring the effectiveness and long-term sustainability of using virtual dissemination events in the future.

4.2. Innovation

Knowledge translation is a complex process [41,42] but our prior work [43] and evidence from others [44,45] suggests that systematic engagement of key stakeholders such as researchers, HCPs, community service providers, organizational decision makers, funders, and patients can make it possible. As low PA is an important concern for the SOT recipients their caregivers, our findings encourage transplant centers to organize similar dissemination events where both HCP and SOT recipients can together share their first-hand experience to raise awareness about benefits of exercise and PA. We believe our dissemination event will inform the development of a robust virtual educational program that can be used during the COVID-19 pandemic and beyond.

4.3. Conclusion

The assessment of reach, implementation and efficacy of the two-day educational workshop showed its potential to address research to practice gap by disseminating awareness about evidence based benefits of PA among SOT recipients. In order to establish external validity of our workshop, all the dimensions of RE-AIM evaluation framework should be applied on a larger sample of SOT recipients and their caregiver population in future research.

Funding

This project was funded by an Education Innovation Grant - Toronto Transplant Institute (#07012015), University Health Network, Toronto, Canada; unrestricted education grant from Astellas Pharma, and funding from the Canadian Transplant Association.

Submission declaration

This study is not under consideration for publication elsewhere. These data were presented as an oral presentation and a poster at 2016 Canadian Society of Transplantation, Canadian National Transplant Research Program and the Société Québécoise de Transplantation (CST-CNTRP-SQT) Joint Scientific Meeting and 2018 International Congress of The Transplantation Society, respectively. The abstract was published as conference proceedings (Transplantation: July 2018 - Volume 102 - Issue - p S615).

Credit authorship contribution statement

Sunita Mathur: supervision, conception and design of the study, acquisition of data, analysis and interpretation of data, writing-reviewing, editing or providing feedback on all versions of the manuscript drafts, final approval of the version to be submitted **Neha Dewan:** data analysis and interpretation, writing- manuscript draft, editing, formatting and making subsequent revisions **Tania Janaudis-Ferreira:** conception and design of the study, analysis and interpretation of data, editing or providing feedback on all versions of the manuscript drafts, final approval of the version to be submitted **Holly Surins:** acquisition of data, analysis and interpretation

of data, writing- manuscript draft, final approval of the version to be submitted **Patrick Antonio:** acquisition of data, analysis and interpretation of data, final approval of the version to be submitted **Robin Deliva, Catherine Patterson, Stephanie So:** conception and design of the study, acquisition of data, final approval of the version to be submitted.

Declaration of Competing Interest

None.

Acknowledgements

We thank the Rehabilitation Sciences Sector, University of Toronto for providing space, in-kind, to hold Day 1 of the workshop. We extend our thanks to the volunteer coaches who assisted with Day 2 of the workshop.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pecinn.2022.100024.

References

[1] Mathur S, Janaudis-Ferreira T, Wickerson L, et al. Meeting report: consensus recommendations for a research agenda in exercise in solid organ transplantation. Am J Transplant. 2014;14:2235–45.
[2] Canadian Institute for Health Information. Annual Statistics on Organ Replacement in Canada: Dialysis, Transplantation and Donation, 2010 to 2019. Ottawa, ON: CIHI; 2020..
[3] Williams TJ, McKenna MJ. Exercise limitation following transplantation. Compr Physiol. 2012;2:1937–79. https://doi.org/10.1002/cphy.c110021.
[4] Mathur S, Reid WD, Levy RD. Exercise limitation in recipients of lung transplants. Phys Ther. 2004;84:1178–87.
[5] Macdonald JH, Kirkman D, Jibani M. Kidney transplantation: a systematic review of interventional and observational studies of physical activity on intermediate outcomes. Adv Chronic Kidney Dis. 2009;16:482–500. https://doi.org/10.1053/j.ackd.2009.07.011.
[6] Langer D, Gosselink R, Pitta F, Burtin C, Verleden G, Dupont L, et al. Physical activity in daily life 1 year after lung transplantation. J Hear Lung Transplant. 2009;28:572–8.
[7] Langer D, Cebria Iranzo MA, Burtin C, Verleden SE, Vanaudenaerde BM, Troosters T, et al. Determinants of physical activity in daily life in candidates for lung transplantation. Respir Med. 2012;106:747–54. https://doi.org/10.1016/j.rmed.2012.01.003.
[8] Zelle DM, Corpeleijn E, Stolk RP, de Greef MH, Gans RO, van der Heide JJ, et al. Low physical activity and risk of cardiovascular and all-cause mortality in renal transplant recipients. Clin J Am Soc Nephrol. 2011;6:898–905. https://doi.org/10.2215/CJN.03340410.
[9] Castelli DM, Hillman CH, Buck SM, Erwin HE. Physical fitness and academic achievement in third- and fifth-grade students. J Sport Exerc Psychol. 2007;29:239–52. https://doi.org/10.1123/jsep.29.2.239.
[10] Alonso EM, Sorensen LG. Cognitive development following pediatric solid organ transplantation. Curr Opin Organ Transplant. 2009;14:522–5. https://doi.org/10.1097/MOT.0b013e3283307a62.
[11] Kohl 3rd HW, Hobbs KE. Development of physical activity behaviors among children and adolescents. Pediatrics. 1998;101:549–54.
[12] Ting SMS, Iqbal H, Kanji H, Hamborg T, Aldridge N, Krishnan N, et al. Functional cardiovascular reserve predicts survival pre-kidney and post-kidney transplantation. J Am Soc Nephrol. 2014;25:187–95. https://doi.org/10.1681/ASN.2013040348.
[13] Martinu T, Babyak MA, O'Connell CF, Carney RM, Trulock EP, Davis RD, et al. Baseline 6-Min Walk Distance Predicts Survival in Lung Transplant Candidates. Am J Transplant. 2008;8:1498–505. https://doi.org/10.1111/j.1600-6143.2008.02264.x.
[14] Carey EJ, Steidley DE, Aqel BA, Byrne TJ, Mekeel KL, Rakela J, et al. Six-minute walk distance predicts mortality in liver transplant candidates. Liver Transplant. 2010;16:1373–8. https://doi.org/10.1002/lt.22167.
[15] Hume E, Ward L, Wilkinson M, Manifield J, Clark S, Vogiatzis I. Exercise training for lung transplant candidates and recipients: a systematic review. Eur Respir Rev. 2020.;29:200053. https://doi.org/10.1183/16000617.0053-2020.
[16] Didsbury M, McGee RG, Tong A, Craig JC, Chapman JR, Chadban S, et al. Exercise training in solid organ transplant recipients: a systematic review and meta-analysis. Transplantation. 2013;95:679–87. https://doi.org/10.1097/TP.0b013e31827a3d3e.
[17] Janaudis-Ferreira T, Mathur S, Deliva R, Howes N, Patterson C, Räkel A, et al. Exercise for solid organ transplant candidates and recipients: a joint position statement of the Canadian society of transplantation and CAN-RESTORE. Transplantation. 2019;103:e220–38. https://doi.org/10.1097/TP.0000000000002806.
[18] Patterson C, So S, Schneiderman JE, Stephens D, Stephens S. Physical activity and its correlates in children and adolescents post-liver transplant. Pediatr Transplant. 2016;20:227–34. https://doi.org/10.1111/petr.12662.
[19] Pang A, Lingham S, Zhao W, Leduc S, Räkel A, Sapir-Pichhadze R, et al. Physician practice patterns and barriers to counselling on physical activity in solid organ transplant recipients. Ann Transplant. 2018;23:345–59.
[20] Gustaw T, Schoo E, Barbalinardo C, Rodrigues N, Zameni Y, Motta VN, et al. Physical activity in solid organ transplant recipients: Participation, predictors, barriers, and facilitators. Clin Transplant. 2017;31. https://doi.org/10.1111/ctr.12929.
[21] van Adrichem EJ, van de Zande SC, Dekker R, Verschuuren EA, Dijkstra PU, van der Schans CP. Perceived barriers to and facilitators of physical activity in recipients of solid organ transplantation, a qualitative study. PLoS One. 2016.;11:e0162725. https://doi.org/10.1371/journal.pone.0162725.
[22] Gerhardt A, Weidner G, Grassmann M, Spaderna H. Everyday physical activity in ambulatory heart transplant candidates: the role of expected health benefits, social support, and potential barriers. Int J Behav Med. 2014;21:248–57. https://doi.org/10.1007/s12529-013-9304-3.
[23] Patterson C, So S, DeAngelis M, Ghent E, Southmayd D, Carpenter C. Physical activity experiences in children post–liver transplant: developing a foundation for rehabilitation interventions. Pediatr Transplant. 2018.;22:e13179. https://doi.org/10.1111/petr.13179.
[24] van Adrichem EJ, Dekker R, Krijnen WP, Verschuuren EAM, Dijkstra PU, van der Schans CP. Physical activity, sedentary time, and associated factors in recipients of solid-organ transplantation. Phys Ther. 2018;98:646–57. https://doi.org/10.1093/ptj/pzy055.
[25] Leek RB, Park JM, Koerschner C, Mawby J, Sonnenday CJ, Wright Nunes JA, et al. Novel educational and goal-setting tool to improve knowledge of chronic kidney disease among liver transplant recipients: A pilot study. PLoS One. 2019;14:1–11.
[26] Goetzmann L, Scholz U, Dux R, Roellin M, Boehler A, Muellhaupt B, et al. Attitudes towards transplantation and medication among 121 heart, lung, liver and kidney recipients and their spouses. Swiss Med Wkly. 2012.;142:w13595. https://doi.org/10.4414/smw.2012.13595.
[27] Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. Am J Public Health. 1999;89:1322–7. https://doi.org/10.2105/ajph.89.9.1322.
[28] Glasgow RE, McKay HG, Piette JD, Reynolds KD. The RE-AIM framework for evaluating interventions: what can it tell us about approaches to chronic illness management? Patient Educ Couns. 2001;44:119–27. https://doi.org/10.1016/s0738-3991(00)00186-5.
[29] Wickerson L, Helm D, Gottesman C, Rozenberg D, Singer LG, Keshavjee S, et al. Telerehabilitation for Lung Transplant Candidates and Recipients During the COVID-19 Pandemic: Program Evaluation. JMIR Mhealth Uhealth. 2021.;9:e28708. https://doi.org/10.2196/28708.
[30] Topolski TD, LoGerfo J, Patrick DL, Williams B, Walwick J, Patrick MB. The Rapid Assessment of Physical Activity (RAPA) among older adults. Prev Chronic Dis. 2006;3:A118. [Epub 2006 Sep 15].
[31] Vagias WM. Likert-type Scale Response Anchors. Clemson, South Carolina: Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University; 2006..
[32] Washburn RA, McAuley E, Katula J, Mihalko SL, Boileau RA. The Physical Activity Scale for the Elderly (PASE): Evidence for validity. J Clin Epidemiol. 1999;52:643–51.
[33] Washburn RA, Smith KW, Jette AM, Janney CA. The physical activity scale for the elderly (PASE): Development and evaluation. J Clin Epidemiol. 1993;46:153–62.
[34] Rosas SE, Reese PP, Huan Y, Doria C, Cochetti PT, Doyle A. Pretransplant physical activity predicts all-cause mortality in kidney transplant recipients. Am J Nephrol. 2012;35:17–23.
[35] Mendes P, Wickerson L, Helm D, Janaudis-Ferreira T, Brooks D, Singer LG, et al. Skeletal muscle atrophy in advanced interstitial lung disease. Respirology. 2015;20:953–9.
[36] Bednarczyk C, Tansey CM, Fontaine S, Baker S, Laberge É, Mathur S, et al. Community-based exercise program for solid organ transplant recipients: Views of exercise professionals and patients. McGill J Med. 2021;19:1–12.
[37] Schoo E, Gustaw T, Barbalinardo C, Rodrigues N, Zameni Y, Mathur S, et al. Solid organ transplant recipients' opinions of pre- and post-transplant supervised exercise programmes: a brief report. Physiother Canada. 2017;69:178–83.
[38] Sánchez ZV, Cashion AK, Cowan PA, Jacob SR, Wicks MN, Velasquez-Mieyer P. Perceived barriers and facilitators to physical activity in kidney transplant recipients. Prog Transplant. 2007;17:324–31.
[39] Hackshaw A. Small studies: strengths and limitations. Eur Respir J. 2008;32:1141–3. https://doi.org/10.1183/09031936.00136408.
[40] Granger CL, Parry SM, Denehy L. The self-reported Physical Activity Scale for the Elderly (PASE) is a valid and clinically applicable measure in lung cancer. Support Care Cancer. 2015;23:3211–8. https://doi.org/10.1007/s00520-015-2707-8.
[41] Green LW, Ottoson JM, García C, Hiatt RA. Diffusion theory and knowledge dissemination, utilization, and integration in public health. Annu Rev Public Health. 2009;30:151–74. https://doi.org/10.1146/annurev.publhealth.031308.100049.
[42] Tetroe JM, Graham ID, Scott V. What does it mean to transform knowledge into action in falls prevention research? Perspectives from the Canadian Institutes of Health Research. J Safety Res. 2011;42:423–6. https://doi.org/10.1016/j.jsr.2011.08.005.
[43] Janaudis-Ferreira T, Mathur S, Tansey CM, Blydt-Hansen T, Hartell D. Disseminating Knowledge to Providers on Exercise Training After Solid Organ Transplantation. Prog Transplant. 2020;30:125–31. https://doi.org/10.1177/1526924820913506.
[44] Finlayson M, Cattaneo D, Cameron M, Coote S, Matsuda PN, Peterson E, et al. Applying the RE-AIM framework to inform the development of a multiple sclerosis falls-prevention intervention. Int J MS Care. 2014;16:192–7.
[45] Li F, Harmer P, Fitzgerald K. Implementing an evidence-based fall prevention intervention in community senior centers. Am J Public Health. 2016;106:2026–31.