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Original article

Self-management in liver transplantation

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ABSTRACT

Background: Self-management is crucial for liver transplant (LT) recipients to maintain transplants and optimize health outcomes. However, previous literature has been primarily limited to examining medication adherence; there is a knowledge gap regarding self-management in the LT population.

Aim: The aims of this study were to 1) comprehensively describe self-management behaviors and activities in LT recipients, 2) explore levels of overall self-management, and 3) explore the relationships of self-efficacy, cognition, and health information seeking behavior with self-management.

Methods: Adult LT recipients (n = 113) who had a functioning transplant for at least 6 months participated in this cross-sectional, descriptive study. Participants were asked to identify self-management behaviors and rate their performance of those behaviors, including symptom management and medication adherence. They also completed a cognitive assessment and questionnaires measuring self-efficacy and health information seeking behavior. Descriptive statistics, latent profile analysis, and probit model for path analysis were used for the data analysis.

Results: LT recipients acknowledged engaging in various self-management behaviors including symptom management, physical activity, maintenance of positive attitudes, and communication with healthcare providers. Three levels of self-management (i.e., low, medium, and high) were found; a high level of self-management was related to self-efficacy and health information seeking behavior.

Conclusions: The findings indicate that self-management may be improved with interventions aimed at increasing self-efficacy and health information seeking behavior. Findings from this study will inform future interventions, to improve self-management and subsequent health outcomes in this population. Future longitudinal studies are necessary to confirm the causality of the identified relationships.

1. Introduction

People with liver failure need a liver transplant (LT) to survive. The improved clinical outcomes of LT recipients, especially increased survival rates and decreased graft failure rates, have made LT more prevalent than ever before with nearly 8000 transplants being performed in 2016 (Kim et al., 2018). Nevertheless, LT recipients are at risk for health problems after transplant. LT recipients may experience metabolic disorder (Jiménez-Pérez, González-Grande, Guzmán, Trillo, & López, 2016), cardiovascular disease, and renal failure (Lucey, Terrault, Ojo, et al., 2013), and are at a higher risk of developing a malignancy than healthy populations (Schrem, Kurok, Kaltenborn, et al., 2013). Also, all LT recipients are at risk for rejecting their transplanted organ (Duffy, Kao, Ko, et al., 2010; Nacif, Pinheiro, de Arruda Pécora, et al., 2017). Given that these health problems are major causes of morbidity and mortality in the LT population (Lucey et al., 2013), a preventative approach is critical.

Current evidence supports that transplant recipients can prevent and manage these potential health problems by participating in self-management (De Geest, Dobbels, Fluri, Paris, & Troosters, 2005; Kallwitz et al., 2013). Self-management is defined as "behaviors and activities an individual employs for the practical management of an illness" (Bratzke et al., 2015). Self-management comprises various behaviors and activities, including medication adherence, symptom management, health directed behaviors such as physical activity, following up with healthcare providers, and stress management (Osborne, Elsworth, & Whitfield, 2007). Similar to patients with multiple chronic diseases (Bratzke et al., 2015), LT recipients also need to coordinate and

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prioritize such self-management behaviors and activities in order to maintain their transplants. However, there is a lack of knowledge regarding self-management in LT recipients; a recent review documents that previous studies have been narrowly focused on describing medication adherence and alcohol recidivism (Ko, Muehrer, & Bratzke, 2018). To improve our understanding of self-management in LT recipients, it is necessary to comprehensively describe behaviors and activities beyond medication adherence and alcohol recidivism.

Further, little is known about how variables such as self-efficacy, cognition, and health information seeking behavior are related to self-management in LT recipients. Previous studies of patients with chronic disease have found a positive relationship between self-efficacy and self-management (Riegel & Dickson, 2008; Yoo, Kim, Jang, & You, 2011). In their study of people with chronic disease such as diabetes or arthritis, Yoo et al. (2011) found that people with higher self-efficacy were better able to self-manage than those with lower self-efficacy. However, the relationship between self-efficacy and self-management has not been studied in LT recipients.

As demonstrated in other literature, self-management is negatively influenced by cognitive impairment. For instance, researchers have found that individuals with heart failure who had cognitive impairment reported less ability to self-manage than those with intact cognition (Harkness et al., 2014; Hjelm, Brostrom, Riegel, Arestedt, & Stromberg, 2015). Although LT is known to improve memory or attention (Ahluwalia, Wade, White, et al., 2016), cognitive impairment is still common in the LT population (Campagna, Biancardi, Cillo, Gatta, & Amodio, 2010; Tryc, Pflugrad, Goldbecker, et al., 2014). However, although evidence exists that LT recipients have cognitive impairment, its relationship with self-management has not been adequately explored.

With the free access to information (Johnson & Case, 2012) and increased patients' responsibility on treatment related decisions (Coulter & Ellins, 2009), patients seek and obtain more information than ever before. Health information seeking behavior refers to obtaining information by using specific actions or strategies to better manage health (Lambert & Loiselle, 2007; Longo, Schubert, Williams, & Clore, 2010; Newton, Asimakopoulou, & Scambler, 2012). In general population studies, researchers have documented that health information seeking behavior leads to positive behavioral outcomes such as improved self-management (Lewis, Martinez, Freres, et al., 2012; Ramírez A, Freres, Martinez, et al., 2013). Only one previous study has described health information seeking behavior in the LT population. Ko, Lee, and Muehrer (2016) found that LT recipients engage in health information seeking behavior to fulfill their informational needs related to self-management. Nevertheless, the relationship between health information seeking behavior and self-management has not been well explored in the LT population.

In summary, there are several gaps in our knowledge of self-management in the LT population. Self-management other than medication adherence and alcohol recidivism has not been adequately described. Also, the relationships of self-efficacy, cognition, and health information seeking behavior with self-management have not been explored. The purpose of this study was to better understand self-management in community-dwelling LT recipients. The specific aims were to 1) comprehensively describe self-management behaviors and activities in LT recipients, 2) explore levels of overall self-management, and 3) explore the relationships of self-efficacy, cognition, and health information seeking behavior with self-management. We hypothesized that multiple self-management behaviors and activities would be affirmed by LT recipients. We also hypothesized that there would be different levels of overall self-management. Finally, we hypothesized that there would be relationships between levels of overall self-management and 1) self-efficacy, 2) cognition, and 3) health information seeking behavior.

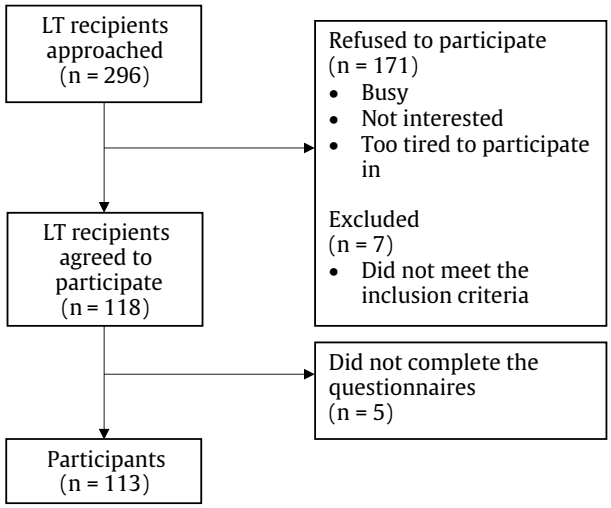

Fig. 1. Enrollment flowchart.

2. Methods

2.1. Design

This study used a cross-sectional, descriptive design.

2.2. Participants

Convenience sampling was used to recruit participants from a transplant clinic at a major Midwestern university hospital from June to October 2016. A total of 296 LT recipients were approached during the study period; 178 declined to participate or were not eligible to participate. Among 118 who consented to participate, a total of 113 recipients completed the questionnaires (Fig. 1). LT recipients were eligible to participate if they were 1) over 18 years old, 2) had a functioning LT for at least 6 months, 3) living at home, and 4) able to read and write English. LT recipients were excluded if they 1) received a multi organ transplant or any other transplant, 2) were institutionalized in facilities such as a nursing home, or 3) diagnosed with dementia.

2.3. Data collection

After receiving approval from the Institutional Review Board, all eligible LT recipients were identified prior to scheduled clinic appointments by staff at the transplant clinic. During eligible LT recipients' visits to the transplant clinic, the first author (DK) approached eligible LT recipients and explained the purpose and procedures of this study. Those recipients who agreed to participate in the study provided written informed consent. Following consent, the first author (DK) administered the cognitive assessment in a private room at the transplant clinic. Participants then completed paper-pencil self-administered questionnaires. Those participants who could not complete the questionnaires at the clinic due to the lack of time took the questionnaires home and sent the completed questionnaires back to the research team. The cognitive assessment took approximately 10 min and questionnaires took approximately 20 min to complete.

2.4. Measures

2.4.1. Self-efficacy

Self-efficacy was evaluated with the 6-item Self-efficacy for Managing Chronic Disease (Lorig et al., 1996). The scale measures self-efficacy on behaviors such as symptom management and medication adherence using a 10-point Likert scale from 1 "not at all confident" to 10 "totally confident." Higher scores indicate higher self-efficacy. Cronbach's alpha was 0.91 in this study indicating high internal consistency.

2.4.2. Cognition

The 30-item Montreal Cognitive Assessment (MoCA) was used as a measure of cognition. Scores range from 0 to 30 and are typically categorized as normal (scores ≥ 26), mild cognitive impairment (22 to 25), moderate cognitive impairment (17 to 21), and dementia (< 17) (Athilingam et al., 2013). The MoCA has been validated in multiple chronic disease populations (McLennan, Mathias, Brennan, & Stewart, 2011) and demonstrated a higher sensitivity for the detection of mild cognitive impairment compared to other cognitive screening measures such as the Mini-Mental Status Examination (Nasreddine, Phillips, Bedirian, et al., 2005).

2.4.3. Health information seeking behavior

Health information seeking behavior was measured with two items from the 7-item "Looking for health information" subscale of the Health Information National Trends Survey (HINTS) 4 (National Cancer Institute, 2014). The original two items were: "Have you ever looked for information about health or medical topics from any source?" and "Overall, how confident are you that you could get advice or information about cancer if you needed it?" For this study, the word "cancer" was replaced with "liver transplantation" on the survey. Participants were asked to respond to two questions: "Have you ever looked for information about health or medical topics from any source?" and "Overall, how confident are you that you could get advice or information about liver transplantation if you needed it?" These two questions best fit the aims of the study by providing a means of classifying LT recipients as "seeker" or "non-seeker" and further delineating their confidence related to health information seeking behavior. The survey has been widely used by the National Cancer Institute and evaluated through cognitive interviewing (Health Information National Trends Survey, 2015).

2.4.4. Self-management

Self-management was assessed with two instruments, the Health Education Impact Questionnaire (heiQ) (Osborne et al., 2007) and the Basel Assessment of Adherence with Immunosuppressive Medication Scale (BAASIS©) (Glass, De Geest, Weber, et al., 2006).

The heiQ has 40 items and eight scales including positive and active engagement in life (5 items), health directed activities (4 items), skill and technique acquisition (4 items), constructive attitudes and approaches (5 items), self-monitoring and insight (6 items), health service navigation (5 items), social integration and support (5 items), and emotional distress (6 items). Participants were asked to rate various self-management behaviors and activities on a 4-point Likert scale: from 1 "strongly disagree" to 4 "strongly agree." The emotional distress scale was reverse scored. The heiQ has been validated with various chronic disease populations (Morita et al., 2013; Schuler, Musekamp, Faller, et al., 2013). Cronbach's alpha of each scale was between 0.73 and 0.90 in this study indicating moderate to high internal consistency.

Medication adherence was assessed using four items derived from the BAASIS©, assessing immunosuppressant taking, regularity of immunosuppressant taking, dose reduction, and persistence of immunosuppressant taking (Cleemput & Dobbels, 2007). Participants responded "yes" or "no" to the following four items: "Do you remember missing a dose of your anti-rejection medications in the last 4 weeks?" "Do you remember having taken your anti-rejection medications more than 2 hours before or after the prescribed dosing time in the last 4 weeks?" "Have you altered the prescribed amount of your anti-rejection medications during the last 4 weeks, without your doctor telling you to do so?" and "Have you stopped taking your anti-rejection medications completely within the last year, without your doctor telling you to do so?" If participants responded "yes" to any of the items, they were categorized as non-adherent to medication. The BAASIS© has been validated with transplant recipients as a predictor of rejection (Ducci, De Simone, Denhaerynck, Dobbels, & De Geest, 2013).

2.4.5. Demographics

Demographic information such as age, gender, and residential classification (urban versus rural based on United States Census Bureau classification) and disease characteristics including time elapsed since LT and multi-morbidity were collected. Multi-morbidity was measured by the Self-Administered Comorbidity Questionnaire (Sangha, Stucki, Liang, Fossel, & Katz, 2003). Thirteen chronic diseases including heart disease, diabetes, and depression are listed in the questionnaire. Participants indicated if they had been diagnosed with any of the thirteen chronic diseases, received treatment for the diseases, or if the diseases limited their activities. Scores were derived from the number of "yes" responses.

2.5. Data analysis

Data were analyzed using statistical software, IBM Statistical Package for Social Sciences® version 22.0 (SPSS Inc. Chicago, IL, USA), NCSS version 11 (NCSS LLC), and Mplus version 7.4 (Muthén & Muthén).

Descriptive statistics were used to describe demographics, self-efficacy, cognition, health information seeking behavior, and self-management. In order to describe levels of overall self-management, we classified participants using latent profile analysis. Latent profile analysis is a method used "to classify individuals into groups based on responses" (Hart et al., 2016) over multiple variables. We classified LT recipients based on their responses to the eight scales from the heiQ and the medication adherence scale from the BAASIS.

The first step of latent profile analysis was to determine the optimal number of subgroups. In this step, we considered 1) lowest Akaike information criterion (AIC) and consistent AIC (CAIC), 2) lowest Bayesian information criterion (BIC) and sample size adjusted BIC, 3) interpretability, 4) parsimony, 5) Entropy > 0.75, 6) average posterior probability in each class higher than 0.75 and having a maximal 10% overlap of posterior probabilities, and 7) at least 2.5% of the total participants in each subgroup (Chen, Brown, Bowers, & Chang, 2015). Once the subgroups were determined, the participants were allocated into the identified subgroups.

Probit model for path analysis was conducted to explore relationships of self-efficacy, cognition, and health information seeking behavior with self-management. Identified subgroups of overall self-management were categorical dependent variables of this model. Weighted Least Square Means and Variance (WLSMV) estimation with bootstrap simulation technique was used. Probit coefficients were transformed to logits by multiplying unstandardized probit coefficients by 1.7 (Amemiya, 1981). Then, odds ratios (OR) and 95% confidence intervals (CI) were calculated. The variables including age, sex, residential classification (urban versus rural), race, education level, marital status, time since LT, rejection ("yes" or "no"), and multi-morbidity were controlled for in exploring the relationships. The McKelvey and Zavoina Pseudo R-square was used to evaluate a goodness of model fit in this study. This measure may be interpreted similar to R square measures in ordinary least square regression. Listwise deletion was used to deal with missing data.

Measurement errors of two latent variables, self-efficacy and cognition, were considered in the model. Due to the relatively small sample

Table 1
Descriptive information of participants

	Mean (SD[a])	Min–Max[b]	n (%)
Age	61.2 (1.1)	20–81	
Sex			
Female			43 (38.1)
Male			70 (61.9)
Marital status			
Married or living as married			77 (68.1)
Single			36 (31.9)
Race			
White			106 (93.8)
Black or African American			1 (0.9)
Asian			2 (1.8)
American Indian or Alaska native			2 (1.8)
Others			2 (1.8)
Education (years)	13.8 (3.2)	4–23	
Residential classification			
Rural			53 (46.9)
Urban			60 (53.1)
Years from LT	7.8 (6.4)	0.6–28	
Donor type			
Cadaveric			93 (87.7)
Living			9 (8.5)
Missing			11
Rejection			
No			83 (73.5)
Yes			28 (24.8)
Multi-morbidity	12.2 (5.2)	0–26	

[a] Standard deviation
[b] Minimum–Maximum

size of current study, measurement errors were fixed in the model using Composite Indicator Structural Equation-alpha (CISE-alpha) modeling. CISE-alpha allows one to build measurement error into the model by creating a composite of items of a latent variable which gives one parameter to estimate (McDonald, Behson, & Seifert, 2005). CISE-alpha estimates measurement error of a latent variable using internal consistency reliability and variance of a measurement: $\varepsilon = (1 - Cronbach's\ alpha)\sigma^2$ (Petrescu, 2013). The measurement error of MoCA was 3.1 and the measurement error of Self-efficacy for Managing Chronic Disease was 0.6.

3. Results

3.1. Demographics

Table 1 describes the demographics and disease-related characteristics of the participants. The majority of participants were male (62%), white (94%), and married or living as married (68%), with a mean age of 61.2 (SD = 1.1). The mean years since LT was 7.8 (SD = 6.4) and mean years of education was 13.8 (SD = 3.2).

3.2. Self-efficacy, cognition, and health information seeking behavior

Table 2 describes the mean scores or frequency of self-efficacy, cognition, and health information seeking behavior. The mean score of self-efficacy was 7.7 (SD = 1.9). The mean MoCA score was 24.4 (SD = 3.1). The majority of participants were seekers to health information (85%) and had a high confidence to seek health information (Mean = 4.5, SD = 0.7).

Table 2
Self-efficacy, cognition, and health information seeking behavior

	Mean (SD[a])	n (%)
Self-efficacy	7.7 (1.9)	
Cognition	24.4 (3.1)	
Health information seeking behavior		
Seeker		96 (85%)
Non-seeker		17 (15%)
Confidence to health information seeking behavior	4.5 (0.7)	

[a] Standard deviation

3.3. Self-management

Most of the eight self-management scales of the heiQ had mean scores above three (Fig. 2). Physical activity was categorized under health directed behavior; that scale had a mean score < 3, indicating lower levels of participation in physical activity. Regarding medication adherence, 59.3% (n = 67) were non-adherent to their medication.

The latent profile analysis found a best fit for a three-class model indicating there are three levels of overall self-management. Class 1 (n = 26, 23%) was labeled as low, class 2 (n = 56, 50%) as medium, and class 3 (n = 31, 27%) as high self-management. Table 3 describes the means and proportions of self-management scales by classes.

3.4. Relationships among self-efficacy, cognition, health information seeking behavior, and self-management

Fig. 3 and Table 4 demonstrate the direct and indirect relationships among self-efficacy, cognition, health information seeking behavior, and self-management. Self-efficacy had a significant direct relationship with high self-management (β* = 0.800, p = .000 (OR 2.06, 95% CI 1.62–2.39)). Confidence to health information seeking behavior had a significant direct relationship with self-efficacy (β* = 0.334, p = .001) and an indirect relationship with high self-management through self-efficacy (β* = 0.267, p = .010 (OR 2.35, 95% CI 1.14–4.02)). Total effect of health information seeker status on high self-management was significant (β* = 0.307, p = .048 (OR 6.27, 95% CI 1.04–32.02)), although direct and indirect relationships through self-efficacy were not significant. The covariates, including age, sex, residential classification (urban versus rural), education level, marital status, time since LT, rejection ("yes" or "no"), and multi-morbidity, were not significantly related to the levels of self-management. Pseudo R-square indicated that the models containing self-efficacy, cognition, and health information seeking behavior explained 27% of the variance in medium self-management and 78% in high self-management.

4. Discussion

Self-management in LT recipients has not been adequately examined in spite of documented evidence of improved health outcomes with adequate self-management (Chen et al., 2011; Otsu & Moriyama, 2011). The purpose of this study was to better understand self-management in LT recipients. Specifically, this study aimed to 1) comprehensively describe self-management behaviors and activities, 2) explore levels of overall self-management, and 3) explore the relationships between self-efficacy, cognition, health information seeking behavior, and self-management in LT recipients. Participants endorsed several self-management behaviors and activities that have not been previously described in the LT population. Three levels of overall self-management were established, low, medium, and high. The high level of self-management showed a significant positive relationship with self-efficacy and health information seeking behavior. Taken as a whole, findings indicate that it is necessary to consider self-management in LT recipients beyond medication adherence.

This study was the first to comprehensively describe self-management behaviors and activities in the LT population. As we hypothesized, LT recipients in this study agreed that they participate in other self-management behaviors and activities beyond medication adherence, including symptom management, maintenance of positive attitudes, stress management, and effective communication with healthcare providers. This finding supported that, similar to other chronic disease populations, LT recipients participate in multitude self-management

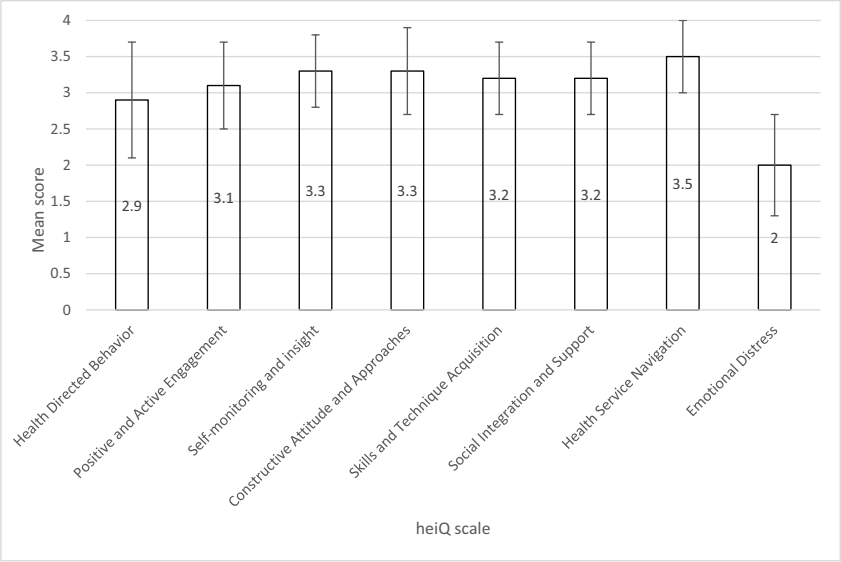

Fig. 2. Mean scores of self-management assessed by heiQ (Health Education Impact Questionnaire).

Table 3
Means and proportions of self-management by classes

	Low SM[a]		Medium SM		High SM	
	Mean	Prop.[b]	Mean	Prop.	Mean	Prop.
Health directed behavior	2.3		2.9		3.5	
Positive and active engagement	2.5		3.1		3.7	
Self-monitoring and insight	2.8		3.3		3.8	
Constructive attitude and approaches	2.6		3.3		3.9	
Skills and technique acquisition	2.6		3.1		3.8	
Social integration and support	2.6		3.2		3.7	
Health service navigation	3.0		3.4		4.0	
Emotional distress	2.9		1.9		1.5	
Medication adherence						
Adherent		0.2		0.4		0.6
Non-adherent		0.8		0.6		0.4

[a] Self-management.
[b] Proportion.

behaviors and activities. Therefore, future studies should include more comprehensive measures of self-management.

LT recipients in this study showed moderate levels of self-management behaviors and activities with the exception of medication adherence and physical activity. In spite of the significance of medication adherence on health outcomes such as decreased rejection rates in this population (Lieber & Volk, 2013; Spivey, Chisholm-Burns, Damadzadeh, & Billheimer, 2014), more than half of LT recipients in this study were non-adherent to their medication regimens. This finding is well documented in previous studies, which report medication non-adherence ranging from 40% (Lamba et al., 2012; Wang, Wang, Yi, et al., 2013) to 60% (Beckebaum, Iacob, Sweid, et al., 2011; Lieber & Volk, 2013). Medication non-adherence is related to a higher risk of graft failure (Lieber & Volk, 2013). What remain elusive in the literature are methods to improve medication adherence of LT recipients (Ko et al., 2018). Future studies should explore novel interventions to improve long-term medication adherence.

Physical activity is beneficial in preventing metabolic syndrome, further cardiovascular disease and renal disease (Kallwitz et al., 2013). Yet, LT recipients in this study reported low levels of physical activity (e.g., no physical activity for at least 30 min most days of the week). Previous studies that have explored physical activity in this population are equivocal. Some reported that LT recipients have sedentary life styles (Xing et al., 2015), while others found high levels of physical activity (Kallwitz et al., 2013; van den Berg-Emons, van Ginneken, Nooijen, et al., 2014). This inconsistency may be the result of the use of numerous physical activity instruments, some of which largely rely on participants' memory. To obtain an accurate assessment of physical activity, future studies should utilize objective measurements such as an accelerometry-based activity monitor in addition to the self-report instruments. Further, considering the benefits of physical activity, factors related to higher levels of physical activity in this population should be explored.

This study found three levels of overall self-management and self-efficacy was a variable that explained differences among the levels of self-management. Self-efficacy had a positive relationship to high level of self-management, indicating LT recipients who have higher self-efficacy have a higher probability of being in the high level self-management group. This finding is supported by previous studies, which demonstrated a positive relationship between self-efficacy and self-management in other chronic disease and transplant populations (Vellone, Riegel, D'Agostino, et al., 2013; Weng, Dai, Huang, & Chiang, 2010; Yoo et al., 2011). Future research should consider the potential influence of self-efficacy on self-management specific to the LT population.

Given previous literature reports that LT recipients seek information to self-manage (Ko et al., 2016), effective health information seeking behavior is critical. The majority of LT recipients in this study reported that they are information seekers and confidently seek health information as needed. This study found that health information seeking behavior was related to self-management mediated by self-efficacy. Specifically, recipients who were more confident seeking health information were more likely to have higher self-efficacy and a higher probability of being in the high level self-management group.

We also found a significant total effect of health information "seeker" status on self-management. This finding indicates that health information seekers have a higher probability of being in the high level self-management group. It supports previous findings that health information seekers are more likely to perform higher levels of self-management (Graffigna, Barello, Bonanomi, & Riva, 2017; Lewis et al., 2012; Ramírez A et al., 2013). However, health information "seeker" status was not directly related to self-management in this study. This result may be due to the insufficient assessment regarding health information seeking behavior and a relatively small sample size. The current study dichotomized LT recipients as "seeker" or "non-seeker."

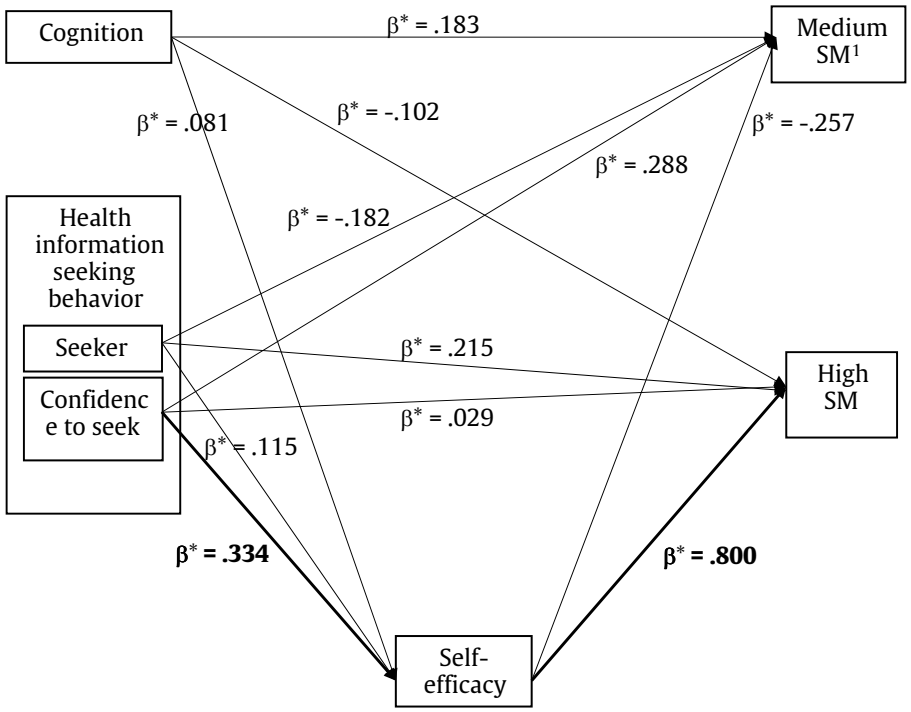

Fig. 3. Estimated model of the relationships among self-efficacy, cognition, health information seeking behavior, and self-management.
[1]Self-management.
β*: STDYX standardized estimate.
Note. Bold lines and numbers indicate $p < .05$.

Yet, other studies document that health information seeking behavior can be assessed using multiple categories (Lambert, Loiselle, & Macdonald, 2009a, 2009b). For example, Lambert et al. (2009a, 2009b) explained that cancer patients showed five different health information seeking patterns, from "intensive seeking" to "guarded (selective) seeking." Assessing health information seeking behavior exclusively as "seeker" or "non-seeker" may have limited our ability to identify a relationship between health information seeking behavior and self-management. Future studies should explore multiple categories of health information seeking behavior in order to provide greater sensitivity for examining its relationship with self-management in a larger sample of LT recipients.

LT recipients in this study were classified as having mild cognitive impairment. Other studies from the LT literature document that LT recipients have residual (Campagna et al., 2010; Duffy et al., 2010) and/or new-onset cognitive impairment (Tryc et al., 2014). While the etiology of cognitive impairment is unknown, it is likely multifactorial, including pre-transplant hepatic encephalopathy, ischemic damage during LT surgery, immunosuppressive toxicity, and/or comorbidities (Campagna et al., 2010). Residual or new-onset cognitive impairment of LT recipients may affect self-management, which requires intact cognition to learn, process, recall, and use information. However, cognition was not related to self-management in the current study. This finding is inconsistent with studies from other chronic disease populations. For example, cognition had a significant relationship with self-management among individuals with heart failure (Harkness et al., 2014; Hjelm et al., 2015). Our finding implies that other factors influence self-management in the LT population. One potential factor is caregivers' participation in recipients' self-management. Beckmann, Kunzler-Heule, Biotti, and Spirig (2016) found that caregivers play a major role in conducting self-management when recipients have an impaired ability to self-manage due to other health conditions (e.g., cognitive impairment) (Beckmann et al., 2016). Further, since caregivers may believe that LT was the last option for recipients to survive (Weng et al., 2011), they will put a great deal of effort into supporting recipients after LT. LT recipients with cognitive impairment may maintain adequate levels of self-management because they are assisted by caregivers. Future studies should consider how much assistance is provided by caregivers when examining the relationship between cognition and self-management.

5. Conclusion and implications

The current study revealed that self-management within the LT population consists of multiple behaviors and activities beyond medication adherence and alcohol recidivism. Further, we found three levels of self-management, with the high level of self-management being related to self-efficacy and health information seeking behavior.

These findings have practical implications for healthcare providers in transplant clinics. First, providers should comprehensively address self-management. Beyond assessing medication adherence and alcohol recidivism, providers should also regularly assess other self-management behaviors and activities such as symptom management and stress management. Second, self-efficacy and health information seeking behavior should be assessed, as they have a significant relationship with higher levels of self-management. Healthcare providers should consider integrating assessments of self-efficacy and health information seeking behavior into a self-management assessment during recipients' clinic visits. Further, healthcare providers should encourage health information seeking behavior by informing recipients of available health information resources and search strategies.

This study also has implications for further research. Since LT recipients reported their participation in self-management behaviors and activities, it is necessary to explore how recipients coordinate and prioritize various self-management behaviors and activities. The processes involved with coordinating and prioritizing will inform future self-management interventions.

Although self-efficacy and health information seeking behavior were found to be related to self-management, further efforts should be made to examine whether assistance by caregivers influences self-

Table 4
Probit coefficients and odds ratios of direct, indirect, and total effects across self-efficacy, cognition, health information seeking behavior, and self-management

	β (S.E.[a])	95% CI[b]	β*	OR[c] (95% CI)	Two-tailed *P*-value
Direct effect					
Cognition → Self-efficacy	0.106 (0.228)	−0.345–0.510	0.081		0.641
Seeker → Self-efficacy	0.761 (0.600)	−0.460–1.811	0.115		0.205
Confidence to seek → Self-efficacy	**1.182 (0.366)**	**0.402–1.823**	**0.334**		**0.001**
Self-efficacy → Medium SM[4]	−0.118 (0.101)	−0.290–0.085	−0.257	0.82 (0.61–1.16)	0.241
Self-efficacy → High SM	**0.426 (0.078)**	**0.284–0.513**	**0.800**	**2.06 (1.62–2.39)**	**0.000**
Cognition → Medium SM	0.111 (0.169)	−1.683–0.315	0.183	1.21 (0.06–1.71)	0.510
Cognition → High SM	−0.071 (0.186)	−0.287–0.435	−0.102	0.89 (0.61–2.09)	0.700
Seeker → Medium SM	−0.555 (0.462)	−1.496–0.286	−0.182	0.39 (0.08–1.63)	0.230
Seeker → High SM	0.756 (0.520)	−0.184–1.738	0.215	3.62 (0.73–19.19)	0.146
Confidence to seek → Medium SM	0.469 (0.306)	−0.167–1.034	0.288	2.22 (0.75–5.80)	0.125
Confidence to seek → High SM	0.055 (0.362)	−0.568–0.767	0.029	1.10 (0.38–3.68)	0.880
Indirect effect					
Cognition → Self-efficacy → Medium SM	−0.013 (0.044)	−0.138–0.039	−0.021	0.98 (0.79–1.07)	0.774
Cognition → Self-efficacy → High SM	0.045 (0.107)	−0.197–0.229	0.064	1.08 (0.72–1.48)	0.673
Seeker → Self-efficacy → Medium SM	−0.090 (0.145)	−0.465–0.062	−0.030	0.86 (0.45–1.11)	0.534
Seeker → Self-efficacy → High SM	0.324 (0.313)	−0.277–0.950	0.092	1.73 (0.62–5.03)	0.301
Confidence to seek → Self-efficacy → Medium SM	−0.140 (0.141)	−0.392–0.112	−0.086	0.79 (0.51–1.21)	0.321
Confidence to seek → Self-efficacy → High SM	**0.503 (0.197)**	**0.076–0.819**	**0.267**	**2.35 (1.14–4.02)**	**0.010**
Total effect					
Cognition → Medium SM	0.099 (0.172)	−0.405–0.321	0.162	1.18 (0.50–1.73)	0.566
Cognition → High SM	−0.026 (0.218)	−0.311–0.453	−0.037	0.96 (0.59–2.16)	0.904
Seeker → Medium SM	−0.644 (0.451)	−1.533–0.248	−0.211	0.33 (0.07–1.52)	0.153
Seeker → High SM	**1.080 (0.546)**	**0.023–2.039**	**0.307**	**6.27 (1.04–32.02)**	**0.048**
Confidence to seek → Medium SM	0.330 (0.270)	−0.209–0.842	0.202	1.75 (0.70–4.18)	0.222
Confidence to seek → High SM	0.558 (0.382)	−0.135–1.107	0.296	2.58 (0.79–6.57)	0.144

β* STDYX standardized estimate
Note. Bold numbers indicate $p < .05$
[a] Standard error.
[b] 95% confidence interval.
[c] Odds ratios.
[d] Self-management.

management in recipients with cognitive impairment. Future studies should include measures of caregiver assistance as well as caregiver validation of the self-management behaviors and activities that are being performed independently. The knowledge obtained from such studies will provide foundations to develop future self-management interventions for LT recipients and their caregivers.

6. Limitations

The findings from this study must be viewed in light of various limitations. We cannot assume a causality of the relationships since this study used a cross-sectional design. Longitudinal studies are needed to confirm the causality of the relationships. The participants were recruited from a single center, which may limit the generalizability of the findings. Cognition was not assessed with a comprehensive battery and this may have limited our ability to identify relationships between cognition and the other variables of interest. Further, the participants in this study were overall cognitively impaired, which may have led to an overestimation of self-management behaviors and activities.

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