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A Habit-Forming Exercise Approach Promotes Positive Exercise Beliefs and Behaviours: A Survey of People After Stroke

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ABSTRACT

Background and Aims: LiFE is a habit-forming functional exercise program that is not widely used in stroke but could facilitate exercise and support long-term physical activity. The purpose of this study was to determine, in people after stroke participating in the Falls After Stroke Trial: (1) exercise beliefs and behaviours, (2) differences between LiFE and usual care participants and (3) in LiFE participants, perceptions of the program.

Methods: Participants ($n = 49$) were consecutively invited to complete a 43-item survey about exercise beliefs and behaviours. LiFE participants also provided program feedback. Data were analysed using descriptive and frequency analyses, Wilcoxon rank-sum tests, Fisher's exact tests and content analyses.

Results: Thirty-eight complete surveys ($n = 22$ LiFE, $n = 16$ usual care) were analysed. Participants had moderately strong outcome expectations for exercise and reported a mean (SD) of 2 (2) barriers and 2 (1) facilitators to exercise. Only 15 participants (39%) reported meeting Australian physical activity guidelines, of which most (67%) received LiFE. More LiFE than usual care participants were confident in overcoming barriers to exercise (62% *vs.* 33%, $p = 0.18$) and satisfied with their reported physical activity levels (50% *vs.* 37%, $p = 0.41$). Most LiFE participants (95%) agreed that the program made it easier for them to be more physically active and all agreed that they would continue with the program.

Conclusion: People after stroke in both the LiFE and usual care groups had positive views of exercise; however, most reported that they were not completing recommended physical activity levels. There appeared to be some differences in exercise beliefs and behaviours between LiFE and usual care participants, though these were not statistically significant. LiFE participants provided positive feedback about the program and reported that it could help them to engage in physical activity behaviours.

1 | Introduction

People after stroke are highly inactive despite the multiple health and functional benefits of ongoing physical activity [1–3]. The observed inactivity in people after stroke may be linked to various physical, personal and environmental barriers to physical activity such as poor balance or mobility, lack of motivation or fear of injury, and limited access to programs, respectively [4, 5]. Facilitators of physical activity have also been reported within the same domains, for example, improved

balance in the physical domain, exercise self-efficacy in the personal domain, and support from caregivers, peers and therapists in the environmental domain [4, 5]. There is currently no definitive intervention that can improve physical activity in people after stroke [6]. Some evidence suggests that the home environment may support long-term physical activity participation after stroke and that intervention programs based in the home may be just as, if not more, effective than supervised programs [7]. Moreover, tailored approaches and those which target behaviour change may positively influence physical activity levels in people after stroke in the long term [8]. Therefore, interventions that account for these factors may reduce barriers to physical activity and, therefore help to facilitate physical activity in people after stroke.

A tailored and home-based habit-forming functional exercise approach, the Lifestyle-integrated Functional Exercise (LiFE) program, was investigated as a key component of the Falls After Stroke Trial (FAST) experimental intervention [9]. The premise of LiFE, unlike traditional structured exercise programs, is to integrate exercise into a person's daily routine to form habits to exercise, which may translate to improved long-term adherence to physical activity [10]. Whilst LiFE can increase physical activity in older people the program has not been widely used after stroke [10]. As such, the impact of this habit-forming exercise program on beliefs about physical activity and common barriers and facilitators to exercise compared to usual care in people after stroke is unknown.

Therefore, the objective of this survey was to understand, in a subset of community-dwelling people after stroke who participated in FAST, exercise beliefs and physical activity behaviours, and perceptions of LiFE [11]. A subset of FAST participants was used to explore exercise beliefs and behaviours in this survey study as the main trial analysis focuses on falls. In the current survey, exercise refers to planned, structured, repetitive and intentional activity completed to improve or maintain physical fitness [12]. Physical activity was considered any bodily movement resulting in energy expenditure and included but was not limited to exercise [12]. We were interested in intentional and general activity because LiFE overlaps in both categories. More specifically, the primary aim of this survey was to determine beliefs about benefits, barriers and facilitators to exercise; satisfaction with physical activity levels; future intentions to exercise; and in LiFE participants, perceptions of the habit-forming functional exercise program. The secondary aim was to understand if exercise beliefs and perceptions differ between LiFE and usual care participants.

2 | Methods

2.1 | Design

This study used an online survey of a subset of participants from a randomised trial, the Falls After Stroke Trial (FAST, trial registration: ACTRN12619001114134). FAST participants were required to be over 50 years of age, within 5 years of their first stroke, able to walk ten metres on flat ground with or without a walking aid and living independently in the community having completed formal rehabilitation [9]. In FAST, eligible participants were randomised to either the experimental group, which received habit-forming exercise (LiFE) as a key component of a multicomponent intervention delivered by physiotherapists and occupational therapists, or the usual care group, which received no active intervention (i.e. participants were engaged in usual care which could involve no therapy at all or private therapy not related to the trial) [9]. The multicomponent intervention was delivered over 6 months via ten 60-min face-to-face visits (7 weekly home visits and three booster visits) and two 30-min telephone calls. LiFE was delivered throughout the intervention period and consisted of strength and balance exercises which were tailored to each participant. There was no set dose but participants were encouraged to perform the exercises in relevant situations within their daily routine [10]. This survey aimed to recruit a subset of up to fifty FAST participants based in Sydney, NSW. Recruitment commenced in January 2021 and occurred consecutively. Participants were recruited parallel to the main trial and provided additional written consent to participate in this survey. Ethical approval for this survey sub-study was provided by the Macquarie University Human Research Ethics Committee (approval no.: 5201500456). The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) was followed (see Table 1 in Supporting Material) [13].

The survey was designed and administered on Research Electronic Data Capture (REDCap) hosted by Macquarie University [14, 15]. It consisted of 43 items delivered in the same order to all participants (LiFE and usual care), with an additional five items delivered to LiFE participants only using branching logic. A combination of question types were included (mandatory multiple choice, checkbox and Likert scale), and there were also optional open-ended questions to enable more in-depth responses. There was no 'back' or 'review' option, and participants were advised to complete the survey from start to finish (estimated completion time was 15 min). The survey was pilot-tested by three authors, after which some questions and wording were modified to improve clarity. Demographic and health data were collected from the main study records to avoid duplication of questions.

The survey was provided at the post-intervention assessment (6-months). Participants were asked to complete it within 2 weeks of receipt in a quiet place at home to reduce distractions. Participants were given the option to complete the survey online on a personal device (via a personalised link sent to their email address) or on the phone with a research team member. Survey data were collected between July 2021 and April 2023.

Survey questions related to the following key areas:

2.1.1 | Perceived Benefits of Exercise

Participants were asked about the perceived benefits of exercise using the Outcome Expectations for Exercise (OEE) Scale [16]. The OEE scale is a reliable and valid measure of outcome expectations for exercise for older adults [15]. It consists of nine items that describe physical and mental health benefits derived

from exercise (refer to Figure 1 in Supporting Material for differentiation). For each item, participants were asked to rate their level of agreement on a 5-point Likert scale. Scores for all items were summed and divided by the number of responses for a total OEE score ranging from 1 to 5, with a higher score indicating more substantial outcome expectations of exercise [16].

2.1.2 | Barriers to Exercise

Participants were asked to identify barriers to exercise that they experienced. A list of 14 barriers (factors that hindered engagement in exercise) was derived from current qualitative literature on common barriers to physical activity and exercise experienced by people after stroke and presented in the survey (refer to Table 2) [4, 5, 17]. Participants selected any barriers that applied to them at the time of completing the survey (which was implied as a time period was not specified for this question), or they could indicate if none applied. A count of identified barriers was used as the measure of interest. Participants were also asked to rate their confidence level in overcoming these barriers to exercise on a 4-point Likert scale (Very confident; Fairly confident; Somewhat confident; Not at all confident) and to comment on how they overcame barriers to exercise (optional).

2.1.3 | Facilitators of Exercise

Participants were asked to identify factors that helped them to be more active. Researchers derived a list of seven exercise facilitators (factors that aided engagement in exercise), refer to Table 2). Participants were asked to select all facilitators that applied to them when completing the survey (which was implied as a time period was not specified for this question), or could indicate if none applied. A count of identified facilitators was used as the measure of interest. Participants could also comment on what would most likely help them to be more active (optional).

2.1.4 | Physical Activity

Participants were asked to indicate the number of days in the past week in which they completed 30 min or more of moderate-intensity physical activity. Moderate-intensity physical activity was defined for participants as any activity (deliberate exercise, incidental movement, or work-related activity) that made them breathe more deeply than usual. This definition was based on the current Australian physical activity recommendations, which state that older adults should perform "at least 30 min of moderate activity on most (preferably all) days" [18]. Participants were also asked to describe the types of physical activity that they completed in the past week (optional) and rate their level of satisfaction with their current physical activity levels on a 5-point Likert scale (Very dissatisfied; Dissatisfied; Neither satisfied nor dissatisfied, Satisfied; Very satisfied).

2.1.5 | Future Intentions to Exercise

Participants were asked to indicate what types of exercise they intended to complete in the future. They could select from a list of six common exercise modalities (walking, cycling, swimming, balance training, strength training and stretching) and add other types of exercise they intended to complete (optional).

2.1.6 | Program Feedback

For LiFE participants, the survey automatically redirected them to an additional set of questions asking about their opinion of the habit-forming exercise program concerning their physical activity. Five statements were presented and related to whether the habit-forming exercise program impacted their desire or made it easier for them to be more physically active, whether they would continue with the LiFE program and knew how to progress their LiFE activities, and whether they could continue LiFE in the long-term. Participants were asked to rate their level of agreement with each of the statements on a 5-point Likert scale.

2.2 | Data Analysis

Data were exported from REDCap into a Microsoft Excel spreadsheet. Data were reviewed and cleaned before being imported into IBM SPSS Statistics for Windows, Version 27 (IBM Corp, Armonk, NY). Final data analyses included data from completed surveys only. Data analyses consisted of (1) descriptive and frequency analyses for demographic data, multiple choice and checkbox responses, (2) Wilcoxon rank-sum tests to compare between groups, (3) Fisher's exact tests for categorical data and (4) conventional content analyses for free-text responses where responses were coded into common themes by two researchers independently then discussed to reach agreement, with any conflicts resolved via discussion [19]. p-values less than 5% were considered significant.

3 | Results

The survey was distributed to 41 of 49 participants who initially consented to the study. The survey was not distributed to eight participants for the following reasons: withdrawn ($n = 3$), died by the assessment period ($n = 1$) and declined the survey at the assessment period ($n = 4$). The survey had a 93% completion rate. Of the 38 completed surveys ($n = 22$ LiFE, $n = 16$ usual care), participants completed the survey online ($n = 24$) or via telephone ($n = 14$).

3.1 | Participant Characteristics

Characteristics of the participants are presented in Table 1. Participants were a mean (SD) of 74 (11) years, had experienced their first stroke 2.4 (1.5) years ago and had experienced 3 (3) falls in the past year. More participants were male (63%), and nearly half lived alone (47%).

TABLE 1 | Baseline characteristics of participants presented as mean (SD) or *N* (%).

Characteristic	*N*	All	*N*	Usual care (Con)	*N*	LiFE (Exp)
Age (*year*), mean (SD)	38	74.4 (10.7)	16	73.8 (9.7)	22	74.9 (11.6)
Sex, number female (%)	38	14 (37%)	16	6 (38%)	22	8 (36%)
Time since first stroke (*year*), mean (SD)	38	2.4 (1.5)	16	2.8 (1.3)	22	2.1 (1.6)
Falls in past 12 months, mean (SD)	27	3 (3)	10	3 (1)	17	3 (3)
Lives alone, number yes (%)	38	18 (47%)	16	5 (31%)	22	13 (59%)
Functional Comorbidity Index score[a], mean (SD)	38	5 (2)	16	5 (2)	22	5 (2)
Comfortable walking speed (*m/s*), mean (SD)	38	0.75 (0.22)	16	0.83 (0.18)	22	0.70 (0.24)

Abbreviations: Con = Control, Exp = Experimental, LiFE = Lifestyle-integrated Functional Exercise.
[a]0–18, higher score indicates higher level of comorbid illness.

3.2 | Perceived Benefits of Exercise

Participants had moderate outcome expectations for exercise with a median (IQR) OEE score of 3.8 (3.3, 4.0) out of 5, and this was similar to that of usual care and LiFE participants (3.8 [3.3, 4.1] and 3.8 [3.2, 4.0] respectively, $p = 0.48$). Most participants agreed with all but one item of the OEE scale (*Exercise helps me feel less tired*) (see Figure 1 in Supporting Material).

3.3 | Barriers to Exercise

Participants reported a median (IQR) of 2 (0, 3) barriers to exercise, which was similar between usual care and LiFE participants (2 [0, 3] and 2 [1, 3] respectively, $p = 0.83$).

The three most common barriers to exercise reported by all participants were *poor balance* (45%), *being too tired* (37%) and *poor weather* (32%) (Table 2). Only LiFE participants reported that *not having time* (18%) and *being worried about having another stroke* were barriers to exercise (14%). Only usual care participants reported that *not feeling in control of life* was a barrier to exercise (19%).

Of all participants, thirty-six (95%) responded to the question about confidence to overcome barriers to exercise. Three participants (8%) felt that they were not at all confident in overcoming barriers to exercise. Fewer usual care than LiFE participants (33% *vs.* 62%) reported feeling fairly or very confident about overcoming barriers to exercise, though this was not significant ($p = 0.18$) (Figure 1).

Of all participants, the most common ways to overcome barriers to exercise involved internal motivation $n = 12$; "Force myself... Know that if I want to improve/get better, I've got to keep doing it", "Making myself do it") and having a support person ($n = 6$; "Find someone to help you do exercise", "Would do a lot more if I had someone with me"). Other ways to overcome barriers to exercise identified by more than one participant included knowledge of the benefits of exercise ($n = 2$) and improved health ($n = 2$).

3.4 | Facilitators of Exercise

Participants reported a median (IQR) of 1 (1, 2) exercise facilitators and LiFE participants reported fewer facilitators than usual care participants (1 [1, 2] and 2 [1, 3] respectively), though this was not significant ($p = 0.18$).

The most commonly reported facilitators of exercise by all participants were more *energy* (53%), a *greater ability* (45%) and *more motivation* (32%) (Table 2). More usual care than LiFE participants reported that they would exercise more if they had the *motivation* (50% *vs.* 18%), *energy* (69% *vs.* 41%) and *resources* (25% *vs.* 5%).

When considering all participants, the thing that was most likely to help them to be more active were better health or physical improvements ($n = 11$; "Stronger in the left leg", "... As I improve physically, I'll be able to exercise more", "Getting back some of your memory and eyesight", "Get rid of neck pain"). Other facilitators identified by more than one participant were related to internal motivation and self-efficacy ($n = 6$), having a support person ($n = 2$) and access to resources such as local activities, equipment or time ($n = 3$).

3.5 | Physical Activity

Few participants (39%, $n = 15$) reported performing 30 min or more of moderate-intensity physical activity on most (four or more) days per week (Table 3). Of these, 67% ($n = 10$) were LiFE participants.

The most common forms of physical activity were walking (67%) and household tasks (37%). Other forms of physical activity that were completed but were less common included resistance/strength training, rehabilitation exercises, LiFE, balance exercises, bike riding and Pilates.

Of all participants, seventeen (45%) were satisfied or very satisfied with their current physical activity levels. Ten participants (26%) were dissatisfied or very dissatisfied with their current physical activity levels. A larger proportion of LiFE than usual care participants reported being satisfied or very satisfied with their physical activity levels (50% *vs.* 37%) and a smaller proportion of LiFE than usual care participants reported being dissatisfied or very dissatisfied (23% *vs.* 31%), though these differences were not significant ($p = 0.41$) (Figure 2).

TABLE 2 | Barriers and facilitators to exercise presented as *n* (%).

Statement	All ($n = 38$)	Usual care ($n = 16$)	LiFE ($n = 22$)	*p*
Barriers				
I don't have time to exercise	4 (11%)	0 (0%)	4 (18%)	0.12
I'm too tired to exercise	14 (37%)	6 (38%)	8 (36%)	1.00
I might get injured	1 (2%)	0 (0%)	1 (5%)	1.00
I can't afford to exercise	0 (0%)	0 (0%)	0 (0%)	—
I have no one to exercise with	4 (11%)	3 (19%)	1 (5%)	0.29
The weather is not good	12 (32%)	3 (19%)	9 (41%)	0.18
There is nothing to do where I live	2 (5%)	1 (6%)	1 (5%)	1.00
I don't have transport	2 (5%)	1 (6%)	1 (5%)	1.00
I'm afraid I'll wear out	3 (8%)	1 (6%)	2 (9%)	1.00
I have lost my sense of purpose	5 (13%)	3 (19%)	2 (9%)	0.63
My stroke stops me from exercising	6 (16%)	2 (13%)	4 (18%)	1.00
I am worried I will have another stroke	3 (8%)	0 (0%)	3 (14%)	0.25
My balance is not good enough	17 (45%)	6 (38%)	11 (50%)	0.52
I don't feel in control of my life	3 (8%)	3 (19%)	0 (0%)	0.07
None of these statements apply to me	11 (29%)	6 (38%)	5 (23%)	0.47
Facilitators				
Ability	17 (45%)	7 (44%)	10 (45%)	1.00
Knowledge	5 (13%)	2 (13%)	3 (14%)	1.00
Motivation	12 (32%)	8 (50%)	4 (18%)	0.08
Energy	20 (53%)	11 (69%)	9 (41%)	0.11
Time	5 (13%)	1 (6%)	4 (18%)	0.37
Support	3 (8%)	3 (19%)	0 (0%)	0.07
Resources	5 (13%)	4 (25%)	1 (5%)	0.14

Abbreviation: LiFE = Lifestyle-integrated Functional Exercise.

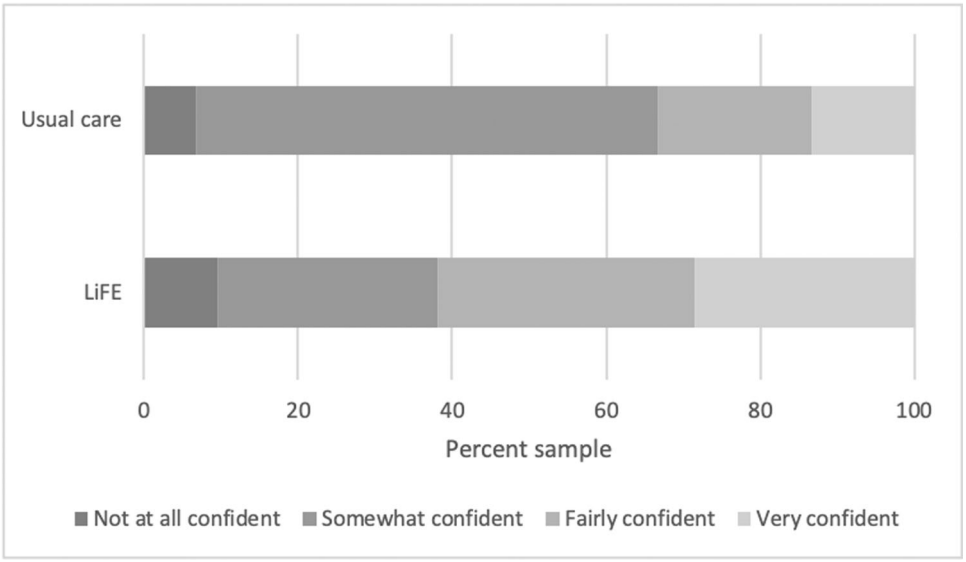

FIGURE 1 | Level of confidence to overcome barriers to exercise comparing LiFE ($n = 22$) and usual care ($n = 16$) participants.

TABLE 3 | Self-reported days per week of moderate physical activity presented as n (%).

Days per week of moderate physical activity	All ($n = 38$)	Usual care ($n = 16$)	LiFE ($n = 22$)	p
0 days	8 (21%)	3 (19%)	5 (23%)	1.00
1 to 3 days	15 (39%)	8 (50%)	7 (32%)	0.32
4 or more days	15 (39%)	5 (31%)	10 (45%)	0.51

Abbreviation: LiFE = Lifestyle-integrated Functional Exercise.

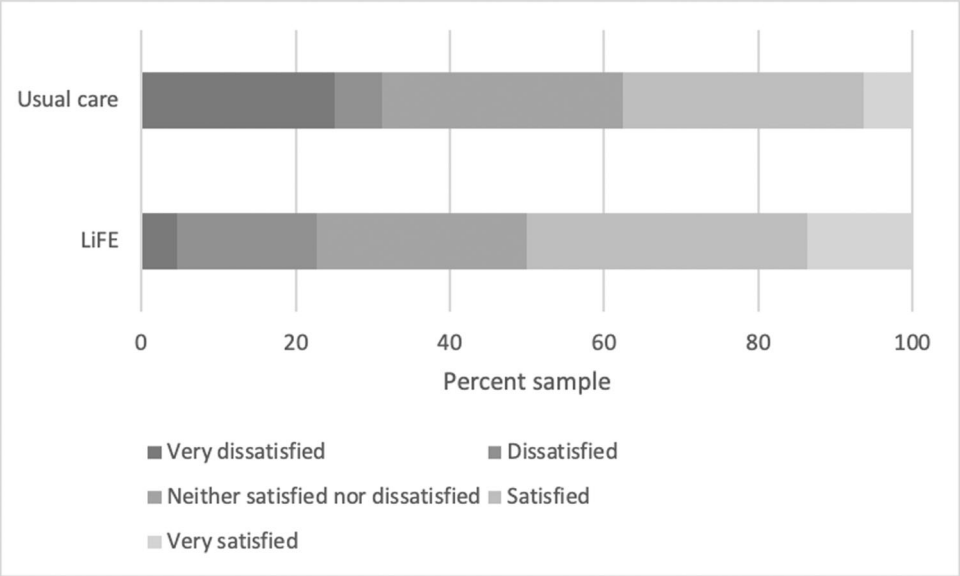

FIGURE 2 | Satisfaction with reported physical activity levels comparing LiFE ($n = 22$) and usual care ($n = 16$) participants.

3.6 | Future Intentions to Exercise

All participants reported walking as the top exercise modality (78%). There was a clear difference in the number of usual care and LiFE participants who planned to complete balance training in the future (38% and 76% respectively, $p = 0.02$). Other modalities of exercise that participants intended to complete in the future were varied.

3.7 | Program Feedback

Most LiFE participants agreed or strongly agreed that the LiFE program increased their desire to be more physically active (90%) and made it easier for them to be more physically active (95%). Similarly, all agreed or strongly agreed that they would continue with the LiFE program (100%), and most knew how to adjust their LiFE activities (85%) and felt that the LiFE program was something they could continue doing for a long time (95%). Further details can be found in Figure 2 of the Supporting Material.

4 | Discussion

This survey sub-study, which had high response and completion rates, found that people after stroke involved in FAST, generally had a positive outlook on the benefits of exercise and expected exercise to improve physical and mental health. Participants reported few barriers to exercise; although most felt at least somewhat confident to overcome them, the habit-forming exercise (LiFE) group appeared to have greater confidence to overcome barriers to exercise than the usual care group, though statistical significance was not reached. Similarly, though most participants reported that they were not completing levels of physical activity recommended in the Australian guidelines (30 min or more of moderate-intensity physical activity on four or more days per week), more LiFE than usual care participants reported that they completed physical activity of sufficient intensity and dose which met the guidelines, and were satisfied with their reported physical activity levels, though this finding was not statistically significant.

Interestingly, more than half of the usual care reported that they would be more active if they had the motivation and energy. Though statistical significance was not reached, these differences may be attributed to whether or not participants received LiFE, which, unlike traditional structured exercise, integrates exercise into daily life without additional resources [9, 10]. Participants who received LiFE reported that it increased their desire to be more active and made it easier for them to do so. However, whether LiFE is superior to usual care in improving overall physical activity requires objective investigations, as correlations between subjective and objective measures of physical activity in people after stroke have been reported as weak [20].

This study provides insights into the relationship between exercise beliefs and behaviours in older people after stroke. In this survey study, participants generally expected exercise to improve health and reported few barriers to exercise, with the barriers reported by participants, such as poor balance and fatigue, being similar to other studies in stroke as these are common impairments experienced by people after stroke [4, 5, 21, 22]. Despite this, most of the participants in this current study were not completing the recommended levels of physical activity for older adults in Australia which is common for people after stroke [1–3]. However, an interesting finding of this study is that more LiFE than usual care participants reported that they met Australian physical activity guidelines, had greater satisfaction and less dissatisfaction with physical activity levels, and greater confidence to overcome barriers to exercise, though these findings were not statistically significant. LiFE provides an approach where exercise is incorporated into a person's day and routine [10], thus LiFE can provide the person with a greater sense of confidence that they can overcome barriers to exercise. These findings provide preliminary evidence that the habit-forming exercise approach may positively impact exercise beliefs and behaviours in people after stroke and further investigation is warranted.

There were some limitations to this survey. First, LiFE was delivered as part of a multicomponent intervention which also included home safety and community mobility goal setting. However, these two components did not directly address exercise and it is likely that LiFE was the factor that impacted study results. Second, there was a lack of statistical significance in the results meaning that interpretation of the results should be taken with caution. Other limitations include the basic approach to physical activity assessment and the potential for recall bias and over- or underestimation of physical activity levels by participants [22, 23]. However, a simplistic assessment approach was chosen to cater for the study population and self-reporting was unavoidable due to the survey-based nature of this sub-study. It was also not within the scope of the study for researchers to follow up on responses provided for open-ended questions due to the survey design and the relatively small sample size presents a limitation. Ultimately, the methodology and sample size were chosen to reduce assessment burden on the participants given that this was a sub-study and numerous assessments were part of the main trial. However, the results of this study give a good overview of influences relating to physical activity in people after stroke. Regarding the survey, there may be order effects although the question order was designed for best flow of topics, and we acknowledge that online and telephone completion of the survey may yield different results, though this is limited by the fact that questions were identical in both administration methods. Lastly, a few participants who had opted to complete the survey over the phone completed the hard copies provided to them instead, meaning that a few mandatory questions were not completed as originally designed.

5 | Conclusions

The results of this survey provide valuable insights into reported physical activity levels, exercise beliefs, and perceptions about barriers and facilitators to exercise in community-dwelling people after stroke. It provides a holistic overview of factors influencing long-term physical activity after stroke. It appears that people after stroke are aware of the many benefits of exercise, but some influences affect participation in exercise. These findings can guide health professionals involved in rehabilitation (such as physiotherapists) in their interactions with and when choosing exercise interventions for people after stroke. A habit-forming program such as LiFE appears to promote positive beliefs about exercise which may improve exercise behaviours and, therefore, participation in physical activity after stroke. LiFE may break down some barriers to exercise whilst engaging facilitators of exercise, but its effect on objective physical activity is not yet known. Health professionals may consider LiFE as an alternative approach to traditional structured exercise when intervening at the activity level in people after stroke.

Author Contributions

Ingrid Lin: conceptualization, investigation, methodology, formal analysis, writing – original draft, project administration. **Catherine Dean:** funding acquisition, supervision, writing – review and editing. **Joanne Glinsky:** methodology, writing – review and editing, supervision. **Lindy Clemson:** funding acquisition, writing – review and editing. **Elisabeth Preston:** writing – review and editing. **Katharine Scrivener:** methodology, investigation, writing – review and editing, supervision, funding acquisition, project administration.

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Ethics Statement

Ethical approval for this survey sub-study was provided by the Macquarie University Human Research Ethics Committee (approval no.: 5201500456).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Transparency Statement

The lead author Ingrid Lin affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.