A Longitudinal Implementation Evaluation of a Physical Activity Program for Cancer Survivors: LIVESTRONG® at the Y.

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Abstract

Purpose: Increased physical activity (PA) levels in cancer survivors are associated with decreased risk of recurrence and mortality as well as additional positive health outcomes. PA interventions have shown to be efficacious, though many lack translation to and sustainability in community settings. We used dimensions of the RE-AIM framework to evaluate LIVE STRONG® at the YMCA, a nation-wide community-based PA program for cancer survivors delivered at Ys.

Methods: LIVE STRONG at the Y national data compiled by YMCA of the USA and Y Association Program Managers between the years of 2010-2018 was examined. We assessed reach (number of participants), adoption (Associations offering the program), implementation (conducting 3 fidelity checks), setting-level maintenance (Associations recently offering program) and participant-level maintenance (membership conversion rate). We also examined relationships between organizational characteristics (years of program existence and Association area household income), and program implementation factors with member conversion.

Results: As of 2018, LIVE STRONG at the Y has reached 62,044 survivors and 245 of the 840 (29.2%) of Y Associations have adopted the program. Among the adopters, 91% were aware of fidelity checks; implementation of Observational (62.3%), Goal-setting (49.9%), and Functional (64.6%) checklists varied. Most (95.1%) adopters reported offering ≥1 LIVE STRONG session per year (setting-level maintenance) and a facility-level mean membership conversion percentage of 46.9±31.2% (participant-level maintenance). Fewer years implementing the program and higher Association area household income were significantly associated with a greater membership conversion rate vs their comparison (all t-test p's <0.05). In a multiple regression model controlling for organizational characteristics, conducting the fidelity checks (Observational, β=8.41; Goal-setting, β=9.70; and Functional, β=9.61; all p’s <0.01) was positively associated with higher membership conversion rates.

Conclusions: LIVE STRONG at the Y, in its early years, has shown promise for high reach, while adoption at more Associations could be facilitated. Implementing fidelity checks along with organizational characteristics were associated with higher participant-level maintenance. Identification of Association-level strategies to increase reach, adoption,
implementation and maintenance may increase the impact of this community-based PA program.

Background
In the United States, the number of cancer survivors has increased steadily as cancer death rates have decreased [1]. There were 16.9 million survivors in 2018, a number which is expected to increase to 20.3 million by 2026 [2]. Health priorities among survivors include decreasing risk of cancer recurrence, improving quality of life and mental health outcomes and general health promotion [3]. Regular physical activity (PA) has been associated with lower secondary cancer recurrence and improvements in quality of life, fatigue, fitness, body composition, mood, self-esteem and physical function [4-6]. The American College of Sports Medicine has determined the efficacy and safety of PA for survivors [8]. American Cancer Society (ACS) guidelines recommend engaging in 150 minutes and two days of strength training per week [9]. However, less than < 30% of survivors are meeting guidelines [7].

The ACS guidelines and the Institute of Medicine recommend PA prescriptions and/or referrals be provided to survivors; however, specific recommendations on how to prescribe or where to refer patients are not included [10]. Patient barriers to PA include lack of instruction on exercise in survivorship plans [11], difficult to access exercise facilities, financial constraints, and inconvenient parking [12]. Preferences include programs that are safe, effective, convenient and performed in a “survivor friendly” environment [13-15]. Additionally, there are considerable disparities in the population being served in PA programs for survivors [16]. As survivorship numbers grow and PA program effectiveness data increases, the need for national dissemination of programs addressing survivor needs has become evident [17].

To address this need, in 2007 the YMCA of the USA (Y-USA) partnered with LIVESTRONG® to design an evidence-based 12-week exercise intervention free of cost for cancer patients and survivors, LIVESTRONG at the Y [17]. In brief, trained Y instructors facilitate two weekly sessions over 12 weeks designed to improve participants aerobic fitness, muscle mass, strength flexibility and balance, and social support. The program has evidenced increases in cardiorespiratory fitness, PA levels and quality of life [18, 19]. Since the initial pilot in 2008, a national infrastructure was created to increase
its dissemination and implementation [17]. Since 2010, Y-USA has collected nationwide data about the program [20].

Using the RE-AIM implementation framework we assessed the dissemination and implementation of LIVESTRONG at the Y using this nationwide data collected between 2010 through 2018 [20]. RE-AIM is concerned with issues related to impact in real-world settings, incorporates both individual and organizational setting level variables and describes the population-based impact of an intervention [21]. While a prior study reported on the reach and adoption of the program as of 2015 [17], we also examined implementation, organizational maintenance and participant-level maintenance. Participant-level maintenance ensures the long-term benefits the program provides to survivors; thus, a secondary aim was to determine associations between organizational characteristics and implementation measures with this metric.

Methods

**Study Design and Participants:**

This was a longitudinal study design using data from LIVESTRONG at the Y between 2010-2018. The Y serves 22 million people in over 800 Associations and 2,700 individual branches across all 50 states. Y Associations may consist of a single or multiple branches (up to 40) within their Association and operate independently of other Associations. Y Associations interested in offering the program apply to the Y-USA and complete an organizational readiness assessment followed by a 6-month on-boarding process. The Y-USA is the national resource office for all Ys and exists to serve Ys. Y-USA offers technical and administrative support throughout, though Association Program Directors are responsible for marketing, administration, oversight and funding within their Association. This study was approved by the Institutional Review Board of the University of Massachusetts Medical School.

**Data Sources**

Data for this study included 1) Routine evaluation data collected between January 2010 to June 2018 from Association Program Directors and 2) 2010 US Census data. Y data included organizational characteristics, overall number of participants completing the program (as well as broken down by
priori membership or decision to join after the program), awareness and implementation of three fidelity check tools separately. Reporting of all data by Program Directors is encouraged, but not required. Program data is sent to Y-USA quarterly: January 1st – March 31st, April 1st - June 30th, July 1st - September 30th and October 1st - December 31st. 2010 U.S. Census data were used to assess household income of each Association.

**Measures**

**Reach and Adoption**

Reach consisted of the total number of participants completing the program. Adoption was conceptualized as the percentage of Associations (out of all possible Associations) completing LIVESTRONG at the Y training and offering the program. We calculated this rate as the number of Associations offering the program divided by the total number of Y Associations.

**Implementation**

Fidelity checklists were implemented from January 2017- June 2018. Program Directors were encouraged to use three fidelity tools conducted at least annually: 1) Observation Assessment Tool - Used by the Program Director to observe each Instructor conducting a session, 2) Instructor Goal Setting - Following feedback from the observation, the Instructor and Program Director worked collaboratively to identify the Instructor’s areas of strength and opportunities for improvement and document these goals, and 3) Functional Assessments Checklist - Program Directors observed a minimum of two Functional Assessments (baseline or 12-weeks) implemented by program Instructors. Implementation was conceptualized as the percentage of Associations implementing fidelity checks during each reporting quarter. Program Directors reported on whether they were aware of the fidelity checklists (yes/no) and whether they completed each of the three fidelity checks (yes/no).

**Maintenance**

We defined organizational-level maintenance as the percentage of Associations offering at least one
12-week session since the last full reporting year, 2017 divided by the total number of on-boarded Associations. At the participant-level, we conceptualized maintenance as the percentage of non-members purchasing a membership following the programs cessation. Membership conversion rate (rate of non-members purchasing membership) may serve as a proxy to the lack of national-level PA data following program cessation and has been shown to predict future PA [22]. Program Directors reported the number of members and non-members who completed the program and the number of non-members who became members following the program. We divided the total number completing the program who became members by the total number of non-members completing program to obtain this rate.

**Organizational Characteristics**

Y-USA maintains the number of years the Association has implemented the program along with the city and zip code of the corporate branch. We categorized the duration of program implementation into low and high, by splitting Associations on the median number of years (n=7) offering the program. Using U.S. Census Bureau [23], median household income data was collected for each Association. The sample’s area household income was divided at the median ($47,300) to classify into high and low household income.

**Statistical Analyses**

Descriptive statistics were calculated. Independent t tests were used to compare membership conversion rates between organizational characteristics and implementation of fidelity checklists. Multiple linear regression analyses adjusted for organizational characteristics and were used to determine the independent relationships between implementation of fidelity checks and membership conversion rate. Separate models were run for all 3 fidelity variables due to collinearity. Missing data were removed from the analyses. Analyses were conducted using STATA. All statistical tests were two-tailed and considered significant at p<0.05.

**Results**

Descriptive statistics for organizational characteristics are shown in Table 1.
## Table 1
Descriptive statistics for Associations offering LIVESTRONG at the Y.

| RE-AIM Element                  | Variable                                                                 | Total N, Frequency (%) or M ± SD |
|---------------------------------|--------------------------------------------------------------------------|----------------------------------|
| Reach                           | Number of survivors completing program                                    | 62,044                           |
| Adoption                        | Number and percentage of Y Associations delivering program, N (%)           | 245 (29.2%)                      |
| Implementation                  | Percent aware of fidelity checklists²                                      | 89.51%                           |
|                                 | Percent implemented Observational checklist                                | 62.24%                           |
|                                 | Percent implemented Goal-setting checklist                                  | 50.19%                           |
|                                 | Percent implemented Functional checklist                                     | 65.10%                           |
| Maintenance (Setting-level)     | Percentage of Associations reporting ≥ 1 sessions within last full calendar year | 95.1%                            |
| Maintenance (Participant-level) | Mean membership conversion rate per Association (M ± SD)                   | 46.44 ± 30.9                     |
| Organizational Characteristics  | N/A Number of years Association implementing program                         | 6.3 ± 2.1                        |
| N/A                             | Mean Association area household income (M ± SD)                           | 53,582.42 ± 24,522.83            |

¹Partial data year
²Fidelity checklists represent data collected in 2017–2018.

INSERT Table 1

Reach and Adoption

Figure 1. Cumulative number of participants completing the program between the years of 2010 and 2018.

Implementation

During 2017–2018, an estimated 91% of Y Associations offering LIVESTRONG at the Y were aware of the fidelity checklists. Overall, 62.6% implemented the observational assessment checklist, 50.2% the goal-setting checklist and 65.1% the functional assessment checklist. Of those Associations aware of all checklists, 62.3% implemented the observational assessment checklist, 49.9% the goal-setting checklist and 64.6% the functional assessment checklists, while only 40% implemented all three checklists.

Maintenance

At the organizational level, sessions were offered during 68.2% of possible reporting quarters, while 95.1% of all on-boarded Associations offered at least one session since the reporting year 2017. At the participant-level, the mean membership conversion rate was 46.4% ± 30.9, with a range from 0
Factors associated with participant-level maintenance

Membership conversion rates were significantly greater in Associations that implemented observational, goal-setting and functional checklists (all p’s < 0.01; See Table 2). We found similar results for those Associations implementing all three checklists. In a linear regression model adjusting for organizational characteristics, implementing observational (β = 8.40), goal-setting (β = 9.7) and functional (β = 9.61) checklists independently (all p’s < 0.05) and collectively (β = 10.82, p < 0.01) were significantly associated with greater membership conversion rates. Associations implementing the program for < 7 years had a significantly greater membership conversion rate than those implementing for ≥ 7 years. Membership conversion rate was significantly greater in higher household income areas as compared to lower household income areas (48.5 vs. 44.29; p < 0.01).

Table 2
Independent sample t-tests comparing membership conversion rates between between organizational characteristics and fidelity checklists awareness and implementation.

| Variable                      | Membership conversion rate (M ± SD) | CI                      | p-value |
|-------------------------------|------------------------------------|-------------------------|---------|
| **Organizational Characteristics** |                                    |                         |         |
| Program maturity (years)      |                                    |                         |         |
| < 7 years                     | 49.3 ± 31.6                        | 47.6 to 51.0            | < 0.001 |
| > 7 or more years             | 42.8 ± 29.7                        | 41.0 to 44.6            |         |
| Association area household income (median)* | 44.3 ± 30.3                        | 42.5 to 46.1            | 0.001   |
| ≤ 47,300                      | 48.5 ± 31.4                        | 46.7 to 50.2            |         |
| > $47,300                     |                                    |                         |         |
| **Fidelity Checklists**       |                                    |                         |         |
| Aware of fidelity checklists  |                                    |                         |         |
| Yes                           | 46.6 ± 37.5                        | 37.3 to 56.0            | 0.832   |
| No                            | 47.5 ± 32.1                        | 44.8 to 50.3            |         |
| Implemented Observational checklist | 50.6 ± 1.7                        | 47.2 to 54.0            | 0.002   |
| Yes                           | 41.6 ± 30.3                        | 37.2 to 46.0            |         |
| No                            | 42.2 ± 30.7                        | 38.4 to 46.0            |         |
| Implemented Goal setting checklist | 52.5 ± 1.9                        | 48.7 to 56.3            | < 0.001 |
| Yes                           | 42.2 ± 30.7                        | 38.4 to 46.0            |         |
| No                            | 40.8 ± 30.4                        | 36.2 to 45.4            |         |
| Implemented Functional checklist | 50.6 ± 32.4                        | 47.2 to 54.0            | 0.001   |
| Yes                           | 40.8 ± 30.4                        | 36.2 to 45.4            |         |
| No                            | 42.8 ± 31.2                        | 39.3 to 46.3            |         |
| Implemented all 3 checklists  |                                    |                         |         |
| Yes                           | 54.2 ± 32.3                        | 49.9 to 58.4            | < 0.001 |
| No                            | 42.8 ± 31.2                        | 39.3 to 46.3            |         |

P-value significant at < 0.05.

*Association area median household income was acquired using data from the US Census Bureau.

**Fidelity checks only apply to data collected in 2017–2018.

INSERT Table 2
Discussion
Our results suggest that while LIVESTRONG at the Y has linearly increased its participant reach and organizational adoption rates, it has room to continue to grow. Implementing community-based programs with high fidelity is challenging, and our findings suggest implementation measures of fidelity checks can be improved, and these measures were associated with participant-level maintenance. Further, we found that area household income was associated with participant-level maintenance, supporting the notion that inequities in survivor PA exist in low socioeconomic status areas [24].

The estimated 60,000 survivors that the program has reached is only a small fraction of the roughly 16.9 million survivors in 2018 [2]. Increasing the number of participants is an important research priority. A prior examination of a subset of program participants (7%) showed the highest reported method of referral to LIVESTRONG at the Y was from a doctor or other healthcare professional [17]. Providers may serve on the front line to screen and refer patients to appropriate programs that fit their medical, geographic, social and economic preferences [25]. Recent health reforms have placed an emphasis on using electronic medical health records for surveillance [26]. Thus, integrating PA surveillance into standard of care may provide better insight into patient characteristics, medical clearances and referral to appropriate PA programs, such as LIVESTRONG at the Y.

Reach may also be increased if additional Ys adopt the program. A previous study examining a health program in Y-affiliated sites found that adoption facilitators included organizational support, on-going financial support, matching the Ys mission and target population, novelty of the program, invitations from established partners and program champions [27]. Barriers included limited resources and expertise, competing programs and space and costs of offering the program. The American Society of Clinical Oncology has encouraged a third-party payer system to provide coverage of services for cancer prevention and control, including those for PA [28]. Payer financial assistance may alleviate fundraising burden from Ys and provide opportunities for more Ys to adopt the program, run additional sessions and reach more individuals.

Program fidelity may potentially moderate the relationship between an intervention and its outcomes
Less than 40% of Associations were implementing all three checks, and consistent with evidence that fidelity is associated with an intervention’s outcomes, implementing fidelity checks was associated with greater membership conversion rates. Fidelity monitoring delivered in non-research-based settings presents several logistical concerns of self-report measures, time and resources to complete checks while concurrently implementing the program, as well adaption to the local setting and drift from the intervention. We also found that fewer years implementing the program was associated with a higher membership conversion rate. Examining setting-specific variables affecting programs implemented over a longer time, such as funding, community saturation, change in organizational structure, adaptability of the intervention and support from leadership, are warranted.

Consistent with prior data that the purchase of a fitness membership is limited to those of higher socioeconomic status, we found that household area income was associated with membership conversion rate despite that the Y offers financial assistance to those in need. Strategies to motivate and support participants facing financial stress are needed to reduce the disparities in participation. Survivors report spending 1/3 of their household income on cancer care. Third-party payer systems covering survivor PA services may provide a re-allocation of funds to overcome financial barriers to program attendance, including childcare, transportation and athletic gear.

Several limitations should be noted. First, data is optionally self-reported from Program Directors; thus, it is unclear if an Association with no report conducted sessions and our results may underestimate the outcomes of interest. Second, data is reported from Y Associations rather than individual branches; therefore, it is unclear as to how individual branches perform within each Association as well as a lack of branch-specific contextual factors (such as staffing, financial resources, facilities, equipment and leadership) which may influence the capacity and performance of programs. Third, the RE-AIM metrics identified in this study are limited to the data provided. This is a strength, as measures are collected by all Associations similarly, though a weakness as these measures do not fully capture all indicators of each RE-AIM aspect (such as the unknown characteristics of those not participating in the program). In lieu of PA maintenance measures, participant-level maintenance was
limited to membership conversion rates upon program cessation. This does not account for those who purchase a membership later nor assess membership use or PA behaviors in alternative settings. Lastly, the metric of Associations offering at least one session per full reporting year provides only preliminary insight into an Association’s organizational maintenance.

Conclusions
Applying RE-AIM to evaluate a community based health program presents a number of complexities that are not present in traditional research-based programs [36]. We provided insight into the public health impact of this program, which will become more needed as the number of cancer survivors increases and opportunities for structured, evidence-based PA programs become critical. LIVESTRONG at the Y has the potential to reach many communities, successfully implement, sustain and expand the program over the course of a decade. However, disparities in the programs reach remain, and processes need to be integrated into standard of care to screen and refer survivors. Future efforts should address setting-specific contextual factors to allow for the identification of strategies and tools to enhance program implementation and maintenance.

Abbreviations
ACS
American Cancer Society
PA
Physical activity
RE-AIM
Reach Effectiveness Adoption Implementation Maintenance
YMCA
Young Men’s Christian Association

Declarations

Ethics approval and consent to participate
This study was approved by the Institutional Review Board of the University of Massachusetts Medical School

Consent for publication
Not applicable

Availability of data and materials
The data that support the findings of this study are available from Y-USA but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Y-USA.

**Competing interests**

The authors declare that they have no competing interests.

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**Authors’ contributions**

JF led the conception and design of the study, was closely involved in the data cleaning, analysis and interpretation, and wrote the manuscript. AHH, KH and HH aided in data interpretation and contributed to intellectual content. BW was closely involved in data cleaning, analysis and interpretation and revised the manuscript for intellectual content. HA, SL and TK were involved in the design of the study, data interpretation and revised the manuscript for intellectual content. RS was closely involved in the study design, data analysis, interpretation and intellectual content of the manuscript. All authors read and approved the final manuscript.

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Not Applicable

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Contributions To The Literature

LIVESTRONG at the Y is a nationwide physical activity program with the capacity to reach many cancer survivors, though the public health impact has yet to be examined using an implementation framework.

Although we found the program reached many survivors, increasing adoption rates has the potential to reach a greater number of survivors. Of those reached, implementation measures and program characteristics influenced participant-level maintenance.

This study is the first to determine the public health impact of a survivor community-based physical activity program and highlight the need for additional insight into implementation and setting-level characteristics to create more sustainable programs.

Figures
Figure 1
Cumulative number of participants completing the program between the years of 2010 and 2018.

Figure 2
Adoption rate and number of Associations trained to deliver LIVESTRONG at the Y between the years of 2010 and 2018.
Supplementary Files
This is a list of supplementary files associated with this preprint. Click to download.
STROBE_checklist.docx