



Understanding rural-living young adult cancer survivors' motivation during a telehealth behavior change intervention within a single-arm feasibility trial

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Jenson Price 

School of Human Kinetics, University of Ottawa, Ottawa, ON, Canada

Jennifer Brunet

School of Human Kinetics, University of Ottawa, Ottawa, ON, Canada; Cancer Therapeutic Program, Ottawa Hospital Research Institute, the Ottawa Hospital, Ottawa, ON, Canada; Institut du savoir Montfort, Hôpital Montfort, Ottawa, ON, Canada

Abstract

A single-arm feasibility trial was conducted to explore rural-living young adult cancer survivors' physical activity, fruit and vegetable consumption, and motivational processes underlying any behavior changes during a telehealth behavior change intervention grounded in self-determination theory. Participants ($n = 7$; 85.7% female; $M_{age} = 33.9$, range = 28–37) met with a health coach once a week for 60 min for 12 weeks. Participants completed pre- and post-intervention surveys that assessed their behaviors, basic psychological needs satisfaction, and behavioral regulations. Participants also completed a semi-structured interview post-intervention. Quantitative results indicate behavioral outcomes, basic psychological needs satisfaction, and behavioral regulations increased from pre- to post-intervention. Five themes provide context for the observed increases. Results provide preliminary evidence that motivation for physical activity and fruit and vegetable consumption may be facilitated by a one-on-one telehealth intervention among rural-living young adult cancer survivors. Large scale studies are needed to determine effectiveness of the intervention and identify mechanisms underpinning behavioral outcomes.

Corresponding author:

Jennifer Brunet, School of Human Kinetics, University of Ottawa 125 University Private, Montpetit Hall, Room 339 Ottawa, ON K1N 6N5, Canada.

Email: jennifer.brunet@uottawa.ca



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Keywords

Distanced-based, experimental, oncology, qualitative, quantitative

Introduction

Physical activity (PA) and fruit and vegetable (FV) consumption can reduce cancer-related sequelae, improve overall survival rates, promote physical and psychosocial health, and enhance quality of life among cancer survivors.¹ It is recommended that cancer survivors engage in aerobic PA at moderate-to-vigorous intensity for ≥ 90 min weekly² and consume \geq five servings of FVs daily.³ Among the 80% of young adult cancer survivors (YAs) who are expected to survive at least 5 years post-diagnosis,⁴ approximately 10–30% meet PA guidelines and 20–30% meet FV consumption guidelines.^{5,6} Rates are even lower among rural-living cancer survivors.⁷ Interventions promoting adherence to PA and FV consumption guidelines that work in urban areas may not work in rural areas.^{8,9} As rural-living persons struggle to access quality supportive care services,¹⁰ ensuring their access to interventions promoting adherence to PA and FV consumption guidelines is critical to reduce observed health disparities.^{7,8}

Interventions offering high accessibility and flexible scheduling are favored by rural-living cancer survivors and YAs in general.^{11,12} As such, telehealth interventions (i.e., interventions accessible remotely via teleconferencing or the Internet) are now considered an appropriate means of addressing access concerns for rural-living cancer survivors and incorporating YAs' preferences.^{13,14} Moreover, based on qualitative studies with rural-living cancer survivors,^{15,16} synchronous interventions in which a facilitator interacts with participants in real-time are favored for their impact on participants' motivation for engaging in lifestyle behaviors. Although preliminary evidence suggests interventions delivered remotely can lead to behavior change in adults,^{17,18} studies exploring the motivational processes underlying behavior change are rare, especially among rural-living individuals (including YAs).

Autonomous motivation (i.e., engaging in a behavior because it aligns with one's intrinsic goals and emanates from the self) is a robust predictor of health behavior change.^{19,20} However, maintaining autonomous motivation for PA and FV consumption remains challenging.^{20,21} Based on self-determination theory (SDT),²² increasing peoples' autonomous motivation largely depends on the extent to which an intervention satisfies their basic psychological needs²³—that is, their perceptions of autonomy (i.e., the sense that the individual is in control of their environment), competence (i.e., an individual's perception of being able to complete a task or activity), and relatedness (e.g., the belief that an individual is being supported and feels connected to others). Indeed, basic psychological needs satisfaction has been associated with greater adoption and adherence to health-promoting behaviors.²⁴ Therefore, to promote autonomous motivation for PA and FV consumption among rural-living YAs, we developed a SDT-based 12-week telehealth behavior change intervention targeting these processes. We then sought to describe participants' behaviors before and after the intervention and explore underlying motivational processes (i.e., SDT constructs) using qualitative and quantitative methods to identify possible mechanisms by which the intervention *may* exert its effects on PA and FV consumption. In turn, this information can be used to refine the intervention, and derive hypotheses to test during implementation and effectiveness testing.

Intervention studies incorporating qualitative and quantitative methods can furnish an in-depth understanding of the impact of a telehealth behavior change intervention on targeted processes and behavior change. Quantitative methods can help describe the magnitude of change in behaviors and

SDT constructs, whereas qualitative methods enable participants to describe how their behaviors changed and the processes they saw as underlying their behavior change. Leveraging the strengths of both methods can guide the refinement and adaptation of the intervention to improve its effectiveness and guide implementation of a larger, ensuing hypothesis testing study. Therefore, the specific aims of this sub-study were to describe rural-living YAs' PA and FV consumption before and after the intervention, and explore the motivational processes underlying any behavior change in the context of a single-arm, mixed-methods feasibility study.

Methods

Data analyzed and reported herein were collected as part of a single-arm feasibility trial designed to: (1) assess the feasibility of the intervention and study methods, (2) assess the acceptability of the intervention, and (3) explore motivational processes that may be associated with changes in PA and FV consumption in order to refine components of the intervention and/or study methods prior to proceeding to a larger, hypothesis testing study. The feasibility and acceptability outcomes are presented elsewhere.²⁵ The trial was registered in the [ClinicalTrials.gov](https://clinicaltrials.gov) database (NCT03691545) and a detailed description of the protocol has been published.²⁶ The Template for Intervention Description and Replication²⁷ and the Standards for Reporting Qualitative Research²⁸ checklists were followed in the preparation of this manuscript to ensure complete reporting and transparency. A brief overview of the study design, intervention, and measures pertaining to this study are presented below.

A concurrent triangulation design was used for the single-arm, mixed-methods feasibility study, wherein quantitative and qualitative data were collected and analyzed concurrently.²⁹ This methodology was favored to comprehensively address the research objectives.²⁹ The quantitative data were used to describe participants' behaviors and motivational process before and after the intervention, and the qualitative data provided insight into how changes (or lack thereof) may have occurred. Triangulation of quantitative and qualitative data enabled a better understanding of how SDT constructs may have contributed to changes in PA and FV consumption.

Participants

Research Ethics Board approval was granted from the University of Ottawa (file number: H-08-18-882). To participate in the single-arm, mixed-methods feasibility study, YAs had to: (1) be between 20 and 39 years of age,³⁰ (2) live in a rural community with fewer than 35,000 inhabitants,^{31,32} (3) self-report participating in <150 min of moderate-to-vigorous intensity PA weekly,¹ (4) self-report consuming < five servings of FVs daily, (5) have completed primary treatment for cancer, (6) have access to the Internet and an audio-visual device, (7) be able to read and speak English, (8) be able and willing to provide informed consent via an online form, and (9) be ambulatory. YAs who self-reported physical impairments precluding PA (e.g., symptomatic heart or vascular diseases, severe hypertension) were not eligible. 18 YAs expressed interest in the study; nine met inclusion criteria, though one dropped out before the first intervention session and one dropped out after the first session. Seven participants took part in the intervention and completed all assessments. Further details on exclusion are presented elsewhere.²⁵

Procedures

Recruitment was open for 12 months (September 2018–September 2019). Community-based recruitment methods were used (e.g., postings on social media, sharing of study details in community partner newsletters), and interested YAs were invited to contact the first author. YAs were screened for eligibility by telephone and provided detailed information about the study. Eligible YAs were emailed a link to a digital consent form. After providing informed consent digitally, they were directed to an online, pre-intervention questionnaire (T0). Once participants completed the questionnaire, they began the 12-week intervention, which consisted of weekly 60-min sessions one-on-one with the first author. Sessions were delivered using an online synchronous video platform of participants' choosing (e.g., Skype). Post-intervention (T1), participants completed an online questionnaire within 1 week of completing the last intervention session and took part in an interview the following week.

Intervention

The 12-week intervention was a complex intervention consisting of relational and content components chosen based on previous literature^{33–35} and was delivered by the first author. The *relational* component focused on fostering participants' perceptions of autonomy, competence, and relatedness, and facilitating autonomous forms of motivation (or self-determined behavioral regulations) using autonomy support and motivational interviewing techniques. To provide autonomy support,^{23,33} the first author actively supported participants' capacity to be self-initiating and autonomous in their behavior change decisions and actions. She further facilitated autonomy support by employing motivational interviewing techniques, including:^{34,36} (1) resisting the righting reflex (i.e., resist giving suggestions to participants for their problems), (2) understanding and exploring participants' motivations (i.e., be a curious listener and attempt to elicit underlying motivation for change), (3) listening empathically (i.e., listen with a patient-centered, empathic approach), and (4) empowering participants' decision making (i.e., remind participants that they are in control of their actions, and that desired change requires they take steps toward that change).

The *content* component used behavior change techniques (BCTs) and focused on the following six content areas: (1) education on PA and FV consumption for cancer survivors, (2) goal setting, (3) barriers assessment and management, (4) social support from others (e.g., family, friends), (5) self-monitoring, and (6) modification of the external environment. Sessions were tailored to participants' unique needs, preferences, and abilities; accordingly, participants were not prescribed weekly goals to achieve PA and FV guidelines but were supported to set and achieve goals they found personally important. Sessions were semi-structured; a typical session began with facilitated discussion of participants' current PA, FV consumption, and motivation to engage in these behaviors followed by education on the scheduled topic and use of relevant BCTs (see [Table 1](#) for schedule). Afterward, the first author and participants completed engaging worksheets focused on using the learned information for self-managing their behaviors and addressing any concerns they may have in implementing the information to make desired changes. Finally, participants were provided with relevant links (e.g., Canada Food Guide) and had an opportunity to further discuss their PA, FV consumption, and motivation for these behaviors. To ensure the first author had the necessary knowledge and skills to implement the intervention, she received training on SDT, motivational interviewing, and BCTs from the second author who is an experienced researcher in the field. For further details on training, refer to the published protocol.²⁶

Table 1. Intervention schedule for the 12-week behavior change intervention.

Sessions	Behavior change techniques	Example activities
1 and 2 Introduction and education on PA and FV consumption	Provide information on consequences of behaviors in general Provide information about the benefits and costs of action or inaction to participants	Review cancer specific guidelines for PA and FV consumption Discuss benefits of health-promoting behaviors and illicit participants' reasons for increasing behaviors
3 and 4 Goal setting	Goal setting for behavioral resolution Outcome goal setting achieved by behavioral means Action planning	Review SMART goal approach Facilitate short- and long-term goal development Situate goals in larger contextual environment
5 and 6 Barrier identification	Action planning Barrier identification/problem solving Set graded tasks	Elicit potential barriers that participants may experience Develop plans to overcome barriers
7 and 8 Social support	Plan social support/social change Instruction to perform behaviors Prompt practice	Review four main types of social support Develop reasons and plans to include others in their lifestyle changes
9 and 10 Self-monitoring	Record of specified behaviors Record of outcomes related to specific behaviors	Review methods of self-monitoring Encourage the use of a self-monitoring technique to evaluate progress post-intervention
11 and 12 Environmental restructuring	Provide information on where and when to perform behaviors Environmental restructuring Relapse prevention/coping planning	Encourage participants to examine their current behaviors in the larger contextual environment Have participants examine their current environment and determine methods for creating a health-promoting environment

Notes. PA = physical activity; FV = fruit and vegetable; SMART = specific, measurable, action-based, realistic, time-bound.

Measures

Personal and medical factors [T0]

Participants self-reported personal (i.e., age, self-identified sex [Male/Female/You do not have an option that applies to me. I identify as (please specify):], annual household income, education attainment, school/work status) and medical information (i.e., cancer diagnosis, treatment protocol, time since treatment, co-morbid conditions). These data were used to describe the sample.

Physical activity behavior [T0, T1]

Self-reported PA was assessed using the International Physical Activity Questionnaire-Short form.³⁷ It includes seven questions about participation in vigorous and moderate intensity PA, as well as participation in walking and sedentary behaviors. Weekly PA was determined by summing reported min of moderate-to-vigorous intensity PA.

Fruit and vegetable consumption [T0, T1]

Self-reported FV consumption was assessed using the Behavioral Risk Factor Surveillance System-FV questionnaire.³⁸ Daily FV consumption was determined by summing participants' responses to six questions about the frequency of fruits, vegetables, and potatoes consumed daily (e.g., "Not including juices, how often did you eat fruit per day?").

Psychological needs satisfaction for physical activity [T0, T1]

Perceptions of autonomy, competence, and relatedness in PA contexts were assessed using the 18-item Psychological Need Satisfaction in Exercise Scale.³⁹ The word "exercise" was replaced with "physical activity." Each item was rated on a scale ranging from 1 = *false* to 6 = *true*. Scores were computed for each psychological need by summing scores for autonomy, competence, and relatedness, respectively, with higher scores representing higher needs satisfaction.

Psychological needs satisfaction for fruit and vegetable consumption [T0, T1]

The 21-item Psychological Need Satisfaction questionnaire^{40,41} was used to assess the degree to which participants' basic psychological needs were satisfied in regards to their FV consumption. The questionnaire was modified by adding "fruit and vegetable" to the question stems. Each item was rated on a scale ranging from 1 = *not at all true* to 7 = *very true*. Scores were computed for each psychological need by summing scores for autonomy, competence, and relatedness, respectively, with higher scores representing higher needs satisfaction.

Behavioral regulations for physical activity [T0, T1]

Behavioral regulations for PA were assessed using the Exercise Treatment Self-Regulation Questionnaire.⁴² It consists of four subscales reflecting controlled (i.e., external regulation, introjected regulation) and autonomous motivation (i.e., identified regulation, intrinsic motivation). The word "exercise" was replaced with "physical activity." Each item was rated from 1 = *not at all true* to 7 = *very true*. Scores were calculated by summing scores for autonomous and controlled motivation subscales, respectively. Higher scores represent higher autonomous and controlled motivation.

Behavioral regulations for fruit and vegetable consumption [T0, T1]

Behavioral regulations for FV consumption were assessed using the Dietary Self-Regulation questionnaire.⁴³ It consists of three subscales that assess: autonomous motivation, controlled motivation, and amotivation. Each item was rated from 1 = *not at all true* to 7 = *very true*. Scores were calculated by summing scores for autonomous and controlled motivation, respectively. Higher scores represent higher autonomous and controlled motivation.

Participants' perspectives—Interview [T1]

Participants took part in a semi-structured, audio-recorded interview with the first author, who was trained by the second author. Interviews lasted between 38 and 66 min ($M = 56$ min). An interview guide with open-ended questions was used so that each participant would be taken through the same

Table 2. Topics covered and sample questions from the interview guide with rural-living young adult cancer survivors who completed a 12-week behavior change intervention.

Topic	Sample question
Perceptions of Autonomy	— How do you feel about the amount of choice, options, and input you were allowed to have throughout the intervention?
Competence	How has this intervention influenced how capable you feel about participating in physical activity and eating more fruits and vegetables?
Relatedness	How has this intervention influenced your relationships with others?
Motivation for engaging in behaviors	What would you say had the biggest impact on your motivation to participate in physical activity and eat more fruits and vegetables?
Experiences in the intervention	Did you feel like the intervention empowered you to make lifestyle changes?
Changes made to behaviors	Do you think this intervention helped you (or did not help you) to eat more fruits and vegetables and/or participate in more physical activity?

Notes. Probes and follow-up questions, not shown here, were used to elicit more information, ask for further reflection, depth, or context, and/or to clarify statements.

central questions covering: (1) their perceptions of autonomy, competence, and relatedness in relation to PA and FV consumption, (2) their motivation for engaging in these behaviors, (3) their experiences in the intervention, and (4) any changes they made to their PA and FV consumption and their intentions to sustain (any) changes. See Table 2 for sample questions. Probes were used when responses lacked sufficient detail, depth, or clarity, and follow-up questions were used to pursue emerging ideas, elaborate the context of answers, and explore the implications of what had been said. To ensure participants felt comfortable sharing their thoughts and experiences (positive and negative), the interviewer sought to adopt an attitude of openness, and created an empathetic, caring, and empowering atmosphere of equality during the interviews to attempt to mitigate power differences.

Sample Size

Given the feasibility design, sample size calculations were not performed.^{44,45} Rather, recruitment remained open for 12 months and feasibility metrics were tracked. Nevertheless, it is worth noting that data saturation was achieved for the qualitative data as experiences relayed by participants began to recur, and additional interviewing failed to identify new insights.

Data analysis

Quantitative data were analyzed using SPSS (Version 26; SPSS Inc. Chicago, Illinois, USA). Descriptive statistics were used to describe and summarize the data (i.e., describe central tendencies [via medians] and dispersions of variables [via interquartile ranges] at T0 and T1), and non-parametric tests were used to examine trends between T0 and T1 because of the small sample size and non-normality of some of the data. Specifically, Wilcoxon matched-pairs signed-rank tests were conducted to describe the magnitude of differences in behaviors and SDT constructs between T0 and T1. As this study was not powered to detect statistically significant differences, correlational effect sizes (r) were computed using the following equation: $r = z/\sqrt{(n_{T0} + n_{T1})}$, with $n_{T0} = n$ at pre-

intervention and $n_{T1} = n$ at post-intervention, and interpreted as: $r = \pm 0.1$ indicates a small effect, $r = \pm 0.3$ indicates a medium effect, and $r = \pm 0.5$ indicates a large effect.⁴⁶ Effect sizes, rather than p values which are related to the sample size, were interpreted to describe whether potential differences may exist between T0 and T1. Since the analyses were meant to summarize the data that were collected, the analysis did not consider intention-to-treat analysis; dropouts were excluded from analysis (i.e., per-protocol analysis) given the early timing of dropouts. Qualitative data were thematically analyzed deductively to establish how participants' accounts added to, or undermined, existing research on SDT and behavior change. A detailed semantic level analysis was conducted following six steps to explore common themes across interviews.⁴⁷ Descriptions were prepared and anonymized illustrative quotations were selected for reporting. Last, quantitative results were compared against the emergent themes from participants' accounts to gain insight into similarities as well as nuances, discrepancies, and contradictions between the quantitative and qualitative data.

Study rigor

Throughout the single-arm, mixed-methods feasibility and this sub-study, several steps recommended in the literature were taken to enhance the quality and trustworthiness of data.⁴⁸ First, the researchers recruited a sample appropriate for the study objectives and collected data to inform meaningful and significant claims. Second, the research process is presented above to elucidate the depth and breadth of analysis, and to enhance transparency. Third, the first author developed a strong rapport with participants over the course of the intervention to help gain participants' trust, which is essential for a constructive qualitative interview.^{49, 50} In addition, prolonged contact with the interviewer helped participants feel safe sharing their experiences during the interview and discuss 'negative' thoughts and experiences, as previously reported.²⁵ To this end, the interviewer informed participants that she was there to listen to them and framed the interview as an opportunity for participants to share any/all thoughts and experiences to contribute to the refinement or improvement of the intervention. Finally, the researchers acknowledged and reflected on their preconceptions, life experiences, and knowledge of the literature as they interpreted the results.

Results

Quantitative

Table 3 summarizes the sociodemographic and medical characteristics of the seven participants included in the analyses for this study. Participants attended 95.2% of the sessions, with session attendance ranging between 66.7% (8/12 sessions) and 100% (12/12 sessions). Behavioral outcomes and SDT constructs increased from T0 to T1 ($r = 0.31$ – 0.63 ; see Table 4). Large effects were observed for PA and FV consumption ($r = 0.63$), perceptions of autonomy, competence, and relatedness related to PA and FV consumption ($r = 0.43$ – 0.63), and autonomous motivation for PA and FV consumption ($r = 0.51$ – 0.54). Medium effects were observed for controlling motivation for PA and FV consumption ($r = 0.31$ – 0.34).

Qualitative

Participants' reflections and researcher interpretations have been summarized as five main themes, which are described below: (1) connecting with the health coach in an autonomy supportive environment, (2) developing capacity to have positive connections with others, (3) developing

Table 3. Participants' sociodemographic and medical characteristics (N = 7).

Pseudonym	F/ M	Age (years)	Type of cancer diagnosed	Time since treatment	Annual household income (\$ CAD)	Marital status	Education attainment	Work status
Sarah	F	37	Leukemia	1 week	75,000–99,999	Single with no children	Completed university/college	On disability
Lauren	F	34	Lymphoma	3 months	75,000–99,999	Married with 1 child <18 years	Completed university/college	On disability
Stephanie	F	35	Thyroid	1 year, 7 months	30,000–34,999	Married with 3 children <18 years	Completed university/college	Homemaker
Rebecca	F	37	Lymphoma	2 years, 2 months	50,000–74,999	Married with no children	High school	Full-time employment
Nicole	F	33	Thyroid	6 years, 1 month	150,000–199,999	Married with no children	Completed university/college	Part-time employment
Ryan	M	33	Testicular	3 years, 8 months	150,000–199,999	Married with no children	Completed university/college	Full-time employment
Ashley	F	28	Leukemia	18 years, 10 months	Do not know	Single with no children	Some university/college	On disability

Notes. F = Female; M = Male; CAD = Canadian dollars.

Table 4. Wilcoxon matched-pairs signed-rank tests of differences between pre (T0) and post-intervention (T1) PA, FV consumption, and SDT constructs (N = 7).

	Scale range	T0 [Mdn (IQR)]	T1 [Mdn (IQR)]	T	p	r
Behavioral outcomes						
PA participation (<i>min/week</i>)	0-∞	30 (60)	150 (145)	28	0.018*	0.63
FV consumption (<i>servings/day</i>)	0-∞	2 (0.71)	4.71 (3)	28	0.018*	0.63
FV basic psychological needs						
Autonomy	0-7	5.14 (1.29)	6 (1)	20	0.046*	0.53
Competence	0-7	4.5 (1)	5.5 (1.17)	28	0.018*	0.63
Relatedness	0-7	4 (1.25)	4.88 (1)	27	0.028*	0.59
PA basic psychological needs						
Autonomy	0-6	4.67 (1.33)	6 (1)	21	0.027*	0.59
Competence	0-6	2.5 (2.17)	4 (1.16)	21	0.028*	0.59
Relatedness	0-6	4.5 (3.67)	4.83 (1.83)	23.5	0.108	0.43
FV behavioral regulations						
Autonomous	0-7	5.83 (1.17)	6.67 (2)	19.5	0.058	0.51
Controlling	0-7	2 (3.17)	3 (2.5)	16	0.246	0.31
PA behavioral regulations						
Autonomous	0-7	5 (3.17)	6.13 (2.83)	26	0.043*	0.54
Controlling	0-7	3.17 (2.42)	3.5 (0.74)	6.5	0.204	0.34

Notes. PA = physical activity; FV = fruit and vegetable; SDT = self-determination theory; Mdn = Median; IQR = Interquartile range.

*= $p < 0.05$.

competence by autonomously mastering challenging tasks, (4) being in control of decisions promotes perceptions of autonomy, and (5) motivation for behavior change is dynamic and complex. Anonymized quotations are presented in [Table 5](#).

Theme 1: Connecting with the health coach in an autonomy supportive environment

Communicating in real-time with a health coach allowed participants to give updates on their progress and celebrate that progress. Participants felt the health coach's supportive actions and words communicated investment, acceptance, warmth, and affection, and this encouraged them to be honest about their goal progress. For example, participants were determined to keep trying to reach their goals in the face of challenges and setbacks because the health coach conveyed to them that behavior change is a process. Participants believed the health coach interacted with them in a manner that conveyed patience, respect, and understanding, which helped them to feel comfortable during the intervention. Participants described that receiving emotional support during the sessions and having enjoyable interactions with the health coach enhanced their behavioral goals' value and intensified their motivation for PA and FV consumption.

Theme 2: Developing capacity to have positive connections with others

Participants talked about the benefits of learning how to build social support networks with existing and new sources. It helped them reach their behavioral goals because it increased opportunities to engage in PA with others (e.g., family, friends, co-workers) and knowledge of how to consume more

Table 5. Direct quotations from rural-living young adult cancer survivors (N = 7) who completed the 12-week behavior change intervention.

Themes	Quotations
<p>Theme 1: Connecting with the health coach in an autonomy supportive environment</p>	<p>I think the biggest thing of the whole intervention is actually having you at the other end. To have a person to actually talk to. I can go out and buy a Fitbit myself and I can do these planning things all by myself, but to know you're there every week, to say 'how are you doing' - the check-ins and seeing where you are, that was the biggest part that I think helped me. (Stephanie, 35 years of age, Thyroid cancer)</p> <p>When I didn't feel like I had done well, that: 'Yes, you are still doing good. Keep on going.' So, it was alright if I stayed status quo. I will just increase it next week. (Sarah, 37 years of age, Leukemia)</p> <p>You weren't really hard on me and I think if you were hard on me, I probably would've backed off. A lot. Because I know that I can't do what I used to be able to do. (Rebecca, 37 years of age, Lymphoma)</p>
<p>Theme 2: Developing capacity to have positive connections with others</p>	<p>You really just encouraged me and got me on track and I just loved it. I really enjoyed it and I think because I enjoyed it so much that I will continue it. It was never like 'Oh no, you were gonna call' - never. 'Yay got her today' and it just really helped a lot. (Rebecca, 37 years of age, Lymphoma)</p> <p>It's still a little weird but other people might be doing similar things, and you bring it up and they're willing to talk about it and you're willing to talk about it. It strengthens the social bond a little more and you use each other for social support. I mean look at me, I go to spin class now with my co-worker. (Ryan, 33 years of age, Testicular cancer)</p> <p>I have gotten recipes for salads and stuff from people. It's nice. Different things that maybe I have eaten before that I had liked but wouldn't have made for myself. I have reached out and gotten those different veggie recipes. (Lauren, 34 years of age, Lymphoma)</p> <p>I can honestly say that I usually don't have much support at my house, but I've actually had a lot of support over the past 12 weeks of this program, between you and everybody in this house. It's actually been good. (Stephanie, 35 years of age, Thyroid cancer)</p> <p>My kids, their support was great because they started eating everything that I was eating so to see that I wasn't doing it alone was really good. (Stephanie, 35 years of age, Thyroid cancer)</p> <p>We found out that people, despite being at a house party or social get-together, people actually aren't that opposed to eating healthy. So, people are willing to eat it if you put it out and they will even talk about how good it is. (Ryan, 33 years of age, Testicular cancer)</p> <p>They [friends] were just there checking-in, seeing how it is going [...] It felt good, it felt like they were interested in what I was doing and cheering me on. (Sarah, 37 years of age, Leukemia)</p> <p>[My husband's] always encouraging me to do my workout, 'Way to go, you did it again, so proud of you.' So, he's my biggest coach for sure. (Rebecca, 37 years of age, Lymphoma)</p>

(continued)

Table 5. (continued)

Themes	Quotations
Theme 3: Developing competence by autonomously mastering challenging tasks	<p>I think the program gave me hope that things will come in time. They're just not going to come as fast as I would like and that's okay. I'm comfortable with that now and knowing that every little bit helps. (Rebecca, 37 years of age, Lymphoma)</p> <p>I can see how far I have come from the first couple weeks. The first week, I said I would do 5000 steps but I didn't even get 3000 steps in most of the time and by the end of it I was doing 10,000 2–3 times a week, so it showed me that I had increased dramatically from the beginning to the end. (Sarah, 37 years of age, Leukemia)</p> <p>In the beginning, it was fear of not being able to do something. With chemo and radiation, the fatigue, aches and pains that just happened were sometimes unbearable and you didn't want to make things worse, but in reality, if you got up and moved, it made things a little better. It was just nice to have you come in and say, 'Start slow' and say, 'Just do this for 10 min a day.' Just to get moving was a big thing for me. (Lauren, 34 years of age, Lymphoma)</p> <p>Especially that my activity level is higher, I can actually go for a walk with people without getting winded when I'm talking and walking. And I can go on the soccer field with [my son] and kick the soccer ball around. [...] It's nice that I have become more able to do things. (Lauren, 34 years of age, Lymphoma)</p> <p>Well, I used to put myself down all the time, be like 'ugh no you can't do that, you just can't do that anymore' and truthfully now I don't think I've said that in the past 6 weeks. Really in the middle of the whole thing, I went 'woo, you need to stop telling yourself that you can't do something and continuously tell yourself that you can do something'. So, my new thing is 'get up, get going, because you can do this.' (Stephanie, 35 years of age, Thyroid cancer)</p>
Theme 4: Being in control of decisions promotes perceptions of autonomy	<p>I felt like this program gave me some control back. (Rebecca, 37 years of age, Lymphoma)</p> <p>I don't think I had any point where I wasn't fully or at least had like 98% of the choice in it, and the additional encouragement and positivity when I succeeded in doing things was good and has spread into actually occasionally talking about eating fruits and vegetables with other people. (Ryan, 33 years of age, Testicular cancer)</p> <p>You listened to where I was in the beginning and we modified it, so the program worked for me. There wasn't like 'you have to do this, or you have to do that' and if you don't do it, you're not succeeding in the program. Even throughout you were always asking if I wanted to modify or change anything. (Sarah, 37 years of age, Leukemia)</p> <p>Having a health coach talk to you about ways that you can just incorporate it into your daily routine and pick things that are fun or ways to make things that you have to do a little more fun is certainly helpful. (Nicole, 33 years of age, Thyroid cancer)</p>

(continued)

Table 5. (continued)

Themes	Quotations
Theme 5: Motivation is dynamic and complex	<p>I just want to do more stuff now; the motivation is there now. Before, I didn't have any motivation. (Ashley, 28 years of age, Leukemia)</p> <p>It definitely motivated me when I was like 'Oh I don't want to do it' but was like well I'm going to have to talk about this this week, so I better do it. (Nicole, 33 years of age, Thyroid cancer)</p> <p>I really am not good at being accountable for myself but if I said, 'No I have to do these because my health coach is depending on me to do it', then I am more adept to do something than not. (Lauren, 34 years of age, Lymphoma)</p> <p>I've upped everyone's FV intake in this household, so that makes me feel good because everyone in this house was really eating a lot of junk. (Stephanie, 35 years of age, Thyroid cancer)</p> <p>I try and walk in the evenings because the air is different. It's not as hot and I enjoy it a lot more and I always knew of those things but just didn't really consciously think about them. Now I consciously think about them, like where does it make me most happy to be active. (Rebecca, 37 years of age, Lymphoma)</p> <p>One thing that makes me want to continue my physical activity is that I fit into my pants. Not just stretchy pants - I wore my jeans to the award ceremony the other night, and I thought Holy Crap I actually fit into my pants. (Stephanie, 35 years of age, Thyroid cancer)</p>

Notes. Names have been replaced with pseudonyms to maintain confidentiality; age in brackets reflects age at the time of enrollment.

FVs. Receiving support from family and friends was a new and good thing for some. Observing that others were open to changing their behaviors enthused participants. Having others to check-in with and give updates on their progress made them feel good. Moreover, receiving praise for success motivated them to continue.

Theme 3: Developing competence by autonomously mastering challenging tasks

Participants explained that the intervention taught them the value of making progress and that progress is not “all or nothing.” At the start of the intervention, they set targets and they wanted to achieve them right away, but over time, they realized that seeing improvements (however small) kept them going and helped them believe they could achieve their goals. They appreciated that the health coach provided feedback and encouragement that conveyed confidence in their ability to make changes and overcome barriers. This, coupled with making goal progress, encouraged participants to seek out opportunities to engage in PA with others and was inexplicably linked to feeling empowered and worthy.

Theme 4: Being in control of decisions promotes perceptions of autonomy

Participants stressed that cancer made them feel like they had lost control of everything, including their bodies. However, they felt that the intervention gave them back some control. They explained that having choice played an important role in helping them to step outside their comfort zones and involve others to reach their goals. Participants felt the constant communication with the health coach who listened to them and helped them create their own goals motivated them to remain in the intervention and continue working towards their goals. Participants appreciated the flexibility of the intervention and the open-mindedness of the health coach because both allowed them to have input over what was covered during the sessions. Participants became more motivated because they had someone to talk to about their own ideas for how to reach their goals.

Theme 5: Motivation for behavior change is dynamic and complex

When asked to reflect on their motivation throughout the intervention, participants described a fluidity to their reasons for engaging in PA and consuming FVs. Participants had primarily extrinsic reasons at the start of the intervention that began to shift to internalized reasons by the end of the intervention. Initially, they adopted a more controlled orientation towards engaging in PA and consuming FVs. The reasons mentioned included social recognition and avoidance of feelings of shame and/or guilt. With time, participants’ motivation became more internalized, and they no longer engaged in the behaviors to “please” the health coach or “avoid feelings of guilt.” Rather, participants engaged in PA and consumed FVs because it made them feel good, which fed their inner drive to keep up with these behaviors. Participants also looked forward to engaging in PA and consuming FVs because they learned that there were different things that they enjoyed and focused on those. Nevertheless, improvements in body composition continued to drive their PA and FV consumption as well post-intervention.

Triangulation

In support of the quantitative data, the qualitative data suggest the intervention facilitated autonomous motivation and behavioral persistence. Indeed, the large effects ($r = 0.51$ – 0.53) observed

for changes in autonomous motivation likely suggests that participants developed an inner drive for PA and FV consumption, which is supported by participants' accounts that they developed intrinsic reasons to participate in PA and consume FVs over the course of the intervention. However, the medium effects ($r = 0.31\text{--}0.34$) for controlled motivation suggests that participants continued to have external reasons for PA and FV consumption, and the qualitative data points to weight loss as a reason to stay active and eat FVs.

Moreover, the quantitative and qualitative data suggest the intervention may have facilitated satisfaction of participants' perceptions of competence, autonomy, and relatedness. Considering the large effects observed and participants' accounts during the interviews, the environment created by the health coach, along with the use of BCTs, may have helped to enhance participants' perceptions of competence in making behavioral changes, helped them feel supported and connected to others, and allowed them to decide when and how to take steps to reach their target goals. In addition, the qualitative data helps illustrate how the basic psychological needs possibly relate to each other. For instance, competence and relatedness seem connected because as participants felt optimally challenged and capable of achieving their PA goals and desired outcomes, they also felt more connected to and engaged in PA with others. Participants also highlighted that the provision of choice and freedom to set their behavior goals and pace to meet their goals facilitated feelings of acceptance and connectedness with the health coach, which in turn motivated them to stay in the intervention and continue working towards their behavior goals. These instances of connections between SDT constructs illustrate their potential interrelationship.

Discussion

Framed within SDT,²² a single-arm feasibility trial was conducted to explore rural-living young adult cancer survivors' PA, FV consumption, and the motivational processes underlying any behavior changes during a telehealth behavior change intervention. The quantitative and qualitative data were generally aligned and provide some indication that this intervention may help to promote perceptions of relatedness, competence, and autonomy in relation to PA and FV consumption, and facilitate internalization of motivation for these behaviors. Although derived from a small sample, quantitative estimates suggest that changes in SDT constructs and behavioral outcomes from T0 to T1 were generally large, except for controlling motivation for PA and FV consumption. Overall, these estimates, coupled with the qualitative findings, support the notion that a behavior change intervention delivered via synchronous videoconferencing sessions may help to assist rural-living YAs in making positive lifestyle behavior change by enhancing basic psychological needs satisfaction and autonomous motivation for PA and FV consumption. This information can be used to justify a large-scale study to determine the effectiveness of the intervention and identify mechanisms by which the intervention exerts its effects on behavioral outcomes.

In line with SDT propositions,²³ participants felt the supportive environment created by the health coach helped satisfy their need for autonomy, competence, and relatedness, and this enhanced their autonomous motivation for PA and FV consumption. Further, several BCTs were featured in the intervention to provide participants with tangible strategies to self-manage their behavior. Whilst their detailing in this manuscript enables other researchers to replicate components of the intervention,³⁵ Hagger and Hardcastle⁵¹ suggest the interpersonal style of the person delivering the intervention may influence participants' uptake of BCTs. For this reason, it is unclear whether the success of the current intervention was due to the content or the way the first author delivered the intervention and communicated with participants. Furthermore, as with many interventions,^{52, 53} the aggregation of intervention components was done to create as potent an intervention as possible

based on theory and literature.⁵⁴ Although the results suggest that each component of the intervention may have contributed to participants' motivation and subsequent behavior change, it will be important to investigate if all components equally contributed to the outcomes. Thus, while testing whether the intervention is effective will be important, investigation of the key ingredients that lead to the observed changes in SDT constructs and behaviors will help to optimize the intervention and inform future SDT-based telehealth interventions.

The qualitative results suggest that the satisfaction of one basic psychological need may help to promote satisfaction of another need, highlighting possible connections between the three needs, which has support in the literature.⁵⁵ Therefore, it may be prudent to explore how to best capture this connection, whilst maintaining and still capturing the unique presentation of each need. Although they have been conceptualized and operationalized as distinct constructs, in practice, it is hard to target and measure a single need without considering other needs.⁵⁶ Intervention strategies that promote perceived competence may also promote perceptions of relatedness and autonomy (and vice versa). Accordingly, it may be beneficial to investigate how each need is impacted by an intervention generally and by its specific components.

Cancer provokes a range of emotional responses,⁵⁷ close scrutiny of survivors' lifestyles,⁵⁸ threats to people's social and personal identity,⁵⁹ and the need to construct a new identity.⁶⁰ It is therefore not surprising that participants' motivation for change was externally driven initially. However, the current results are consistent with the assertion that motivation is dynamic rather than static,²³ as participants described during the interviews changes in their motivation and experiencing autonomous and controlled motivation concurrently by the end of the intervention. Moreover, although definitive conclusions cannot be made based on the quantitative descriptive analyses, these also suggest that motivation may change. Experiencing both controlled and autonomous motivation is common among populations seeking behavior change due to health reasons. In a qualitative study exploring motivational experiences of people newly diagnosed with diabetes, Sebire and colleagues⁶¹ found that participants described several types of motivation and those further along in their behavior change journey expressed more autonomous reasons for engaging in PA and consuming a nutritious diet.

Notwithstanding the implications of this study, there are limitations that must be considered. First, the quantitative results should be interpreted with caution because of the small sample size and absence of a comparison group. Whilst the results can serve as the foundation for generating hypotheses surrounding possible causal mechanisms, to make definitive conclusions and valid causal inferences, a larger randomized controlled trial employing inferential statistics (e.g., causal mediation analysis) is needed to compare the differences between the intervention group and a comparison group (e.g., usual care, alternative intervention) and draw conclusions about the causal mechanisms. Second, the majority of participants enrolled self-identified as White and female, and they were between 28 and 37 years of age. Including the perspectives of a more diverse sample may have provided a more varied response to the intervention. Additionally, participants were at different stages along the cancer continuum. Although this helped to provide maximal variance within a homogenous sample, it is possible that treatment status and time since treatment completion affected participants' perspectives and experiences. Fourth, the first author delivered the intervention and conducted the interviews. Although this could have helped to develop rapport with participants, the inherent power imbalance between the first author and participants could have made participants reticent to share negative perspectives, and thus lead them to filter their answers. Last, PA and FV consumption are complex behaviors that may not have been fully captured using the current measures. More comprehensive assessment of PA and FV consumption in future studies is

necessary to capture the effects of the intervention on different parameters (e.g., frequency, duration, context of PA; quantity and quality of FV consumption).

Conclusion

Although definitive conclusions cannot be made based on the quantitative descriptive analyses, collectively, the quantitative and qualitative findings suggest that this synchronous one-on-one telehealth behavior change intervention is a potentially promising intervention that may help to support autonomous motivation for PA and FV behavior possibly by satisfying rural-living YAs' basic psychological needs. Further, findings point to the importance of having a positive attitude, developing resilience to barriers, persistence, and having a health coach who encourages gradual change in order to facilitate autonomous motivation. Hence, these are potentially important targets for future studies seeking to develop new interventions or refine existing interventions aiming to promote motivation for behavior change among those living in rural areas who may be at greater risk of health problems due to limited access to quality supportive care services. However, a larger, hypothesis testing study including an adequate comparison group is needed to determine the effectiveness of this intervention and identify the mechanisms by which it exerts its effect.

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ORCID iD

Jenson Price  <https://orcid.org/0000-0003-0630-4155>

Note

1. Inclusion criteria were based on PA guidelines in use at study conception (Schmitz et al., 2010).

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