



Preferences for exercise and physical activity support in adolescent and young adult cancer survivors: a cross-sectional survey

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Abstract

Purpose Exercise and physical activity (hereafter, collectively referred to as PA) preferences and benefits are becoming increasingly well characterised in cancer survivors, yet evidence from adolescent and young adult cancer survivors (AYAs) is scant. We describe the overall PA behaviour and support preferences of AYAs and explore subgroup differences to inform AYA-specific research and support.

Methods AYAs diagnosed with cancer between the ages of 18–39 years, irrespective of current age, were approached in clinic at a large cancer centre for this cross-sectional survey that assessed self-reported demographics, medical history, PA behaviour and PA support preferences.

Results A total of 318 AYAs completed the survey. Approximately 40% of AYAs were not meeting PA guidelines, and only 5% reported engagement with cancer PA support services. Most AYAs wanted PA support (78%), to increase PA levels (70%), and were interested in engaging in PA interventions that were individually supervised (82%), home-based (79%), performed ≥ 3 days/week (75%) and for ≥ 30 minutes/session (78%), offered following treatment (63%), restricted by age (63%), and involved strength (83%), walking (78%), and flexibility (75%) exercise. PA preferences most often differed according to sex, treatment status, current PA behaviour and PA support setting.

Conclusion AYAs have a great capacity and interest in specific types of PA support. Poor engagement with existing PA support services highlights the need for further AYA-specific research. Better understanding of AYAs' unique PA behaviour and support preferences can inform the development of urgently needed research and support services for this understudied and rapidly growing population.

Keywords Needs assessment · Survivorship · Health behaviour · Behavioural medicine · Patient preference

Introduction

Almost 80,000 adolescents and young adults (i.e. aged 15–39 years) are diagnosed with cancer in North America each year

[1–3]. Improved cancer screening and treatment strategies have resulted in an overall five-year relative survival rate of 83% for adolescent and young adult cancer survivors (AYAs), with many expected to live 50–60 years beyond diagnosis [1].

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However, exposure to anti-cancer therapies and concomitant changes in protective health behaviours during these formative years increases the risks of numerous physiological (e.g. cardiovascular disease) and biopsychosocial (e.g. fatigue) sequelae in AYAs [4]. The complex mechanisms underlying these sequelae make them difficult to prevent and treat, often leading to chronic impairments in physical functioning and quality of life [4]. For example, highly burdensome health issues in AYAs like cancer-related cardiovascular disease [5], fatigue [6] and psychological distress [7] are known to be caused and influenced by interactions between cancer-, behavioural- and life stage-related physical and psychosocial factors [8–12]. Importantly, there is a growing body of evidence that multi-system interventions, like exercise, are among the most effective therapies to mitigate and reverse adverse effects associated with cancer and its treatment [13–15].

Indeed, a rapidly expanding evidence-base supports the benefits of exercise in cancer survivors [16]. However, comparatively few studies have been conducted in AYAs [17–24]; and, the findings of these studies provide inconsistent evidence of benefit. This relative dearth of evidence is problematic as AYAs have unique and well-recognized age- and life stage-related support needs, preferences, and barriers that may limit engagement in protective health behaviours such as exercise [25–27]. The lack of engagement and inconsistent benefits reported in the few AYA-focused exercise trials to date may reflect researchers' incomplete understanding of AYAs' exercise support needs and preferences and, relatedly, a failure to adapt their intervention approaches to account for these needs and preferences [25, 27].

Several previous studies have assessed the exercise and physical activity (hereafter, collectively referred to as PA) support needs, barriers and facilitators of AYAs [28–30]. However, the findings from these studies may have limited generalizability given the studies included samples that were not representative or not described according to age, diagnosis, ethnicity, sex or treatment status. Consideration of these factors in AYAs may be important as previous needs assessments in older cancer survivors have demonstrated that PA support preferences differ according to personal (e.g. sex, PA behaviour) and medical (e.g. receiving chemotherapy) characteristics [31, 32]. A better understanding of how these factors influence PA behaviour and preferences is needed to inform the development of AYA-tailored PA support services and optimize engagement with them.

Therefore, the primary purpose of this study was to characterise PA behaviour and support preferences in a representative sample of AYAs to inform the development of AYA-tailored PA research and clinical-/community-based support services. The secondary purpose of this survey was to expand upon the findings of similar needs assessments in cancer survivors by assessing novel PA preferences (e.g. program

supervision and restrictions) and exploring PA preferences for select demographic (i.e. sex, relationship status), medical (e.g. treatment status), behavioural (i.e. current physical activity participation), and PA support location-specific AYA subgroups. These preferences and subgroup analyses were included to inform the development of targeted research and intervention approaches.

Methods

Study design and eligibility

A convenience sample of AYAs was recruited from Princess Margaret Cancer Centre (Toronto, ON) for this cross-sectional survey study. Study methods were approved by the University Health Network Research Ethics Board (#16-5083). This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Online Resource 1). Participants were eligible if they had a confirmed history of cancer diagnosed between the ages of 18 and 39 years, irrespective of time since diagnosis, and could communicate in English, with or without assistance from a translator. Appointment lists from 11 hospital clinics (i.e. bone marrow transplant, breast, chemodermatology, central nervous system, endocrine, gastrointestinal, genitourinary, gynecological, leukemia, lymphoma and sarcoma) were screened and potentially eligible participants were approached in clinic to confirm their eligibility and interest in participation. All eligible and interested participants reviewed the study details and signed informed consent with a study team member.

Survey instrument

Participants completed a self-administered survey consisting of validated questionnaires and investigator-developed items (further described below). The survey incorporated questions that reflect and complement items used to assess PA preferences within similar needs assessments of AYAs [28] and older cancer survivors [31, 33]. See Online Resource 2 for all analysis factors, scales and dichotomies.

Participant characteristics

Demographic characteristics AYAs' age, sex, ethnicity, relationship status, body height and weight, residence community size and location (via postal code) were collected via self-report. Body height and weight were used to calculate and classify individuals according to body mass index (BMI). Demographic variables were dichotomized for sub-group analysis as sex (male vs. female), age (median split of younger

(< 32 years) vs. older (\geq 32 years) and relationship status (single vs. in relationship).

Medical characteristics AYA's date of diagnosis, diagnosis type, disease stage, cancer treatment status and cancer treatment history (when applicable) were self-reported. Medical variables were dichotomized for sub-group analysis as BMI classification (not obese (< 30 kg/m²) vs. obese (\geq 32 kg/m²)), disease stage (earlier (stage 1 and 2) vs. later (stage 3 and 4)) and treatment status (current treatment vs. no/post-treatment).

PA behaviour and facilitators

PA behaviour and history PA engagement was measured via a commonly used modified version of the Godin Leisure Time Exercise Questionnaire (GLTEQ) [34]. Briefly, participants reported the average duration and frequency of light, moderate and vigorous PA within a typical seven-day period. The total number of moderate intensity PA minutes, vigorous intensity PA minutes and combined moderate-to-vigorous intensity PA minutes (MVPA; i.e. total moderate intensity minutes plus 2× vigorous intensity minutes) were calculated. Weekly MVPA levels were used to classify participants as being sedentary (no PA minutes per week), inactive (1–149 PA minutes per week) and active (meeting public health guidelines of \geq 150 PA minutes per week) [35]. Current PA behaviour was dichotomized for sub-group analysis as not meeting guidelines (< 150 min of MVPA per week) vs. meeting guidelines (\geq 150 min of MVPA per week). Participants were asked to describe their PA behaviour during childhood and adolescence as 'Not active', 'A little active' or 'Very active'.

PA facilitators AYAs were asked to indicate whether they had access to a home gym or gym membership (Yes/No) and rate the degree to which they enjoy participating in PA alone and with others (5-point Likert, *Not at all* to *Very much*).

PA support, program delivery and prescription preferences

Participants' PA preferences were assessed using investigator-developed questions with dichotomous, categorical or 5-item Likert response options.

PA support interests and program delivery preferences

Adapted from similar reviews [33, 36], we included PA support and program delivery items to inform the need for, and planning of, PA research and programs for AYAs. Questions related to interest in PA support (i.e. no, maybe, yes), PA behaviour goals (i.e. none, decrease, maintain, increase) and preferences towards the: (1) overall timing of PA support (e.g. before, during, after treatment); (2) weekly timing of PA support (i.e. none, weekday, weekend, both); (3) daily timing of PA support (e.g. morning, afternoon, evening); (4) PA support

setting (e.g. hospital, home); (5) type of PA support supervision (e.g. individual, group); (6) sport participation (e.g. individual, team sports); and (7) restriction of program participation (e.g. by cancer type or sex) .

PA prescription preferences PA prescription-related items were designed to guide research and clinical intervention planning by assessing AYAs' preferred PA frequency (e.g. 1×/week, 2×/week), time (e.g. < 10 min, 10–20 min) and type (modality; e.g. aerobic, resistance, flexibility).

Sample size

There was no primary outcome defined for this study. However, sample size was estimated using a between-groups comparison by sex of MVPA behaviour measured using the GLTEQ. Based on previous research [37, 38], with two groups of 176 male and female participants (total $n = 352$), we had 80% power to detect an effect size of $d = 0.3$ with significance set to $p < 0.05$.

Statistical analyses

Statistical analyses were performed using SPSS statistical software version 24 (IBM Corporation, Armonk, NY). Continuous and ordinal variables that could potentially influence PA behaviour and preferences were dichotomized for analysis purposes (Online Resource 2). Exploratory analyses were conducted to identify demographic and medical characteristics that were frequently associated with differences in PA support preferences between dichotomized sub-groups. Variables that were associated with significant ($ps < 0.05$) sub-group specific differences in at least 20% of the assessed PA behavioural and support preference outcomes were included in the sub-group analyses. PA setting-specific support preferences (i.e. hospital, university/college, home, online) were also included in the sub-group analyses to inform the development of targeted research and support services.

Descriptive statistics (frequencies, percentages, means and standard deviations) were calculated for all categorical and continuous data, as appropriate. Student's t tests and chi-square, and exact McNemar's tests were used to assess between-group differences in means, percentages and proportions, respectively. Participants were excluded using an investigator-established cut-off of $\geq 40\%$ missing data to facilitate PA comparisons. No additional missing data strategy (e.g. imputation) was used given that most items were independent and could not reliably be predicted. The Benjamini and Hochberg method [39, 40] was applied to each group of analyses to help limit the potential bias from multiple testing. Results are reported with uncorrected and corrected significance levels for each group of analyses.

Results

Participant characteristics

Three hundred and sixty-six of the 533 AYAs approached from June 2018 to September 2019 consented to participate. Forty-eight AYAs were excluded upon retrieval of the questionnaire ($n = 16$) and during data entry ($n = 32$) due to missing data (Fig. 1), resulting in a final sample of $n = 318$ AYAs (59% completion rate). AYAs' demographic and medical characteristics are provided in Table 1. Four variables (i.e. sex, relationship status, treatment status and PA behaviour) had significant ($p < 0.05$) sub-group specific differences in over 20% of the assessed PA behavioural and support preference outcomes and were thus included in the sub-group analyses. Other subgroups (e.g. those defined according to age (< 32 vs. ≥ 32 years), obesity status (BMI < 30 vs ≥ 30 kg/m²) and childhood/adolescence PA behaviour (low vs. high)) were also explored but were not included in our subgroup analyses due to lack of observed differences in PA support, program delivery and prescription preferences.

PA behaviour and facilitators

Overall and subgroup-specific PA behaviour are reported in Tables 1 and 2. The majority of AYAs ($n = 198$; 62.3%) were meeting the PA guidelines [35] and reported a mean of 308.7 ± 298.0 min of MVPA per week. AYAs who identified as male and were not receiving treatment performed significantly greater levels of vigorous-intensity and MVPA ($ps \leq 0.01$; Table 2). Seventeen (5%) AYAs reported previous engagement in hospital- and community-based exercise support services for cancer survivors.

PA support, program delivery and prescription preferences

Complete overall and subgroup-specific PA support, program delivery and prescription preferences are provided in Fig. 2, Table 3 and Online Resources 3–6.

PA support interest and goals

The majority of AYAs reported an interest in receiving PA support (78.4%) and had an explicit goal of increasing their PA engagement (70.8%). The relative interest in PA support was greater in AYAs receiving treatment (87.0%) compared to those who were not (72.9%; $p = 0.003$).

PA support start preferences

A combined ~80% of AYAs reported preferring commencing exercise support in the post-treatment setting. A greater

percentage of AYAs preferred commencing exercise support within the first-year post-treatment compared to other phases ($ps < 0.001$). Compared to AYAs not receiving treatment, a greater percentage of AYAs receiving treatment were interested in starting PA support during treatment (30.4% vs. 9.6%; $p < 0.001$) and were less interested in starting PA support > 1-year post-treatment (3.4% vs. 25.3%; $p < 0.001$). The percentage of AYAs interested in receiving PA support during treatment was also greater in people with later vs. earlier stages of disease (28.6% vs. 9.7%; $p = 0.001$).

PA support setting and supervision preferences

Home-based (79%), online (47%) and university-/college-based (44%) exercise settings were all preferred more than hospital-based programs (25%; $ps < 0.001$). A significantly greater proportion of AYAs preferred participating in programs that were supervised individually (82%) and combined (i.e. individual and group; 70%) rather than exclusively group-based (61%; $ps < 0.001$).

Sports participation preferences

More respondents identified a preference for participating in individual (57%) versus team (50%) sports ($p = 0.02$) and recreational (57%) versus competitive (36%) sports ($p < 0.001$). Compared to females, a significantly greater percentage of males reported preferring most types of sports participation ($ps < 0.001$), except for recreational sports.

PA program restriction preferences

Greater percentages of AYAs reported a preference for participating in PA programs that were (1) age-specific (63%) compared to programs that were restricted by cancer type (47%), sex (48%), and both age and sex (48%; $ps < 0.001$), and (2) inclusive of cancer survivors (50%) rather than being restricted to cancer survivors (45%; $p = 0.02$). Identifying as female was most consistently associated with preferring participation in PA programs restricted to cancer type, sex, age and sex, and cancer survivors.

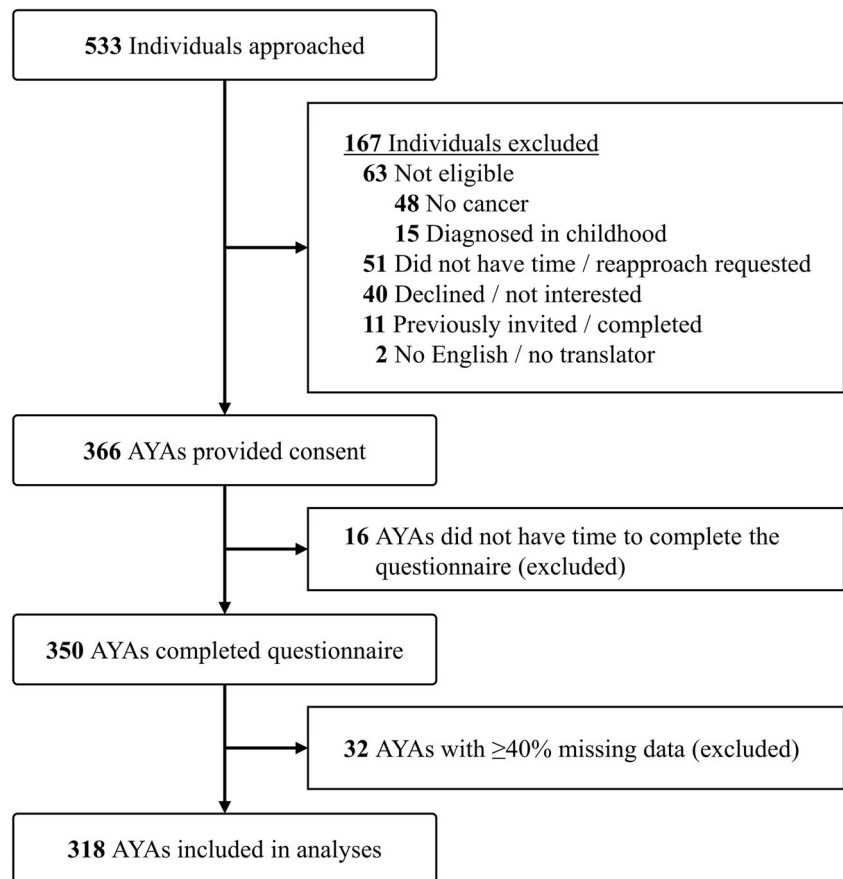
PA prescription preferences

The majority ($\geq 75\%$) of AYAs preferred performing ≥ 30 min of exercise on ≥ 3 days per week. Compared to those who were inactive, a greater percentage of AYAs who were active preferred ≥ 3 days per week ($p = 0.003$) and ≥ 30 min of exercise per session ($p < 0.001$).

The percentage of AYAs preferring strength training (82.6%), walking (78.3%) and flexibility (74.7%) was greater than all other exercise modalities ($ps < 0.001$). Compared to all other exercise modalities, boot camp-based exercise was

Fig. 1 STROBE participant flow.

Notes: AYAs, adolescent and young adult cancer survivors; reapproach, asked to be reapproached to complete the survey during a subsequent visit



the least preferred (37%; $p < 0.001$). A greater percentage of females than males reported preference towards multiple individual exercise modalities, including boot camps ($p = 0.01$), flexibility ($p = 0.01$), walking ($p < 0.001$) and yoga ($p < 0.001$). Yoga was preferred by greater percentages of AYAs who were receiving treatment ($p = 0.002$), compared to those who were not.

Setting-specific PA preferences

Complete setting-specific preferences are provided in Online Resources 3–6. AYAs preferring public (i.e. hospital and university/college) PA support were interested in programs with a group-based component delivered either as (1) combined individual- and group-based support (hospital: 87% vs. 64%; university/college: 88% vs. 55%) or (2) exclusively group-based (hospital: 83% vs. 53%; university/college: 79% vs. 46%); while, AYAs preferring private (i.e. home and online) PA support were interested in individual programs (home: 88% vs. 63%; online: 90% vs. 75%). AYAs interested in public, but not private, PA support preferred participating in sports at recreational (hospital: 81% vs. 48%; university/college: 77% vs. 41%) and competitive (hospital: 55% vs. 30%; university/college: 54% vs. 21%) levels. Finally, unlike AYAs interested in private support, greater percentages of

AYAs interested in public PA support preferred specific modalities of exercise.

Discussion

This study provides important insight into AYAs' overall and subgroup-specific PA preferences to facilitate AYA-tailored PA research and enhance supportive care programming. AYAs report a great interest and capacity to engage in PA, particularly if interventions incorporate home-based training, individual supervision, and include strength, walking, and flexibility exercise components. Our subgroup analyses revealed that PA support preferences in AYAs most often differed on the basis of sex, treatment status, current PA behaviour and preferred support setting—highlighting the need to tailor PA interventions when working within specific contexts. Finally, our finding that only 5% of AYAs had engaged with local cancer PA support services is particularly striking given AYAs' great interest in PA support and that our sample was recruited from one of the few cancer centres in the province with dedicated cancer PA support programming [41]. These seemingly incongruous findings suggest that existing cancer PA support services may not be well-aligned with the unique needs and preferences of AYAs [25].

Table 1 Demographic and medical profile of participants overall and by sex

Participant characteristics	Overall (<i>n</i> = 318)		Males (<i>n</i> = 174)		Females (<i>n</i> = 144)		<i>p</i> *
	No. of patients	%	No. of patients	%	No. of patients	%	
Demographic profile							
Age, years							
Mean (SD)	32.0 (6.6)		31.5 (7.4)		32.7 (5.5)		0.12
Range	18–68		18–68		18–39		
Ethnicity							
Caucasian	190	59.7	118	67.8	72	50.0	0.001
Southeast Asian	49	15.4	21	12.1	28	19.4	0.07
East Asian	24	7.5	11	6.3	13	9.0	0.36
Latino/Latina	12	3.8	6	3.4	6	4.2	0.74
Middle Eastern	9	2.8	4	2.3	5	3.5	0.53
West Asian	8	2.5	4	2.3	4	2.8	0.79
Black	8	2.5	2	1.1	6	4.2	0.09
West Indian	4	1.3	3	1.7	1	0.7	0.41
Native American	2	0.6	2	1.1	0	0.0	0.20
Not reported	12	3.8	3	1.7	9	6.3	
Relationship status							
Single	105	33.1	65	37.4	40	27.8	0.07
Relationship, not living with	45	14.2	23	13.2	22	15.3	0.60
Married/living with partner	167	52.7	85	48.9	82	56.9	0.15
Residence community size [†]							
Large urban centres	189	59.4	97	55.7	92	63.9	0.14
Medium population centres	22	6.9	17	9.8	5	3.5	0.03
Small population centres	14	4.4	9	5.2	5	3.5	0.46
Not reported	93	29.2	51	29.3	42	29.2	
Medical profile							
Weight (kg)							
Mean (SD)	77.1 (18.9)		83.4 (17.1)		69.5 (18.3)		< 0.001
BMI, kg/m ²							
Mean (SD)	25.9 (5.3)		26.1 (4.7)		25.6 (6.0)		0.39
BMI classification							
Underweight	12	3.8	4	2.3	8	5.6	0.13
Normal weight	145	45.6	71	40.8	74	51.4	0.06
Overweight	92	28.9	63	36.2	29	20.1	0.002
Obese	62	19.4	32	18.4	30	20.8	0.58
Not reported	7	2.2	4	2.3	3	2.1	
Time since diagnosis (months)							
Mean (SD)	39.6 (52.1)		46.6 (59.4)		31.3 (40.7)		0.01
Range	0–478		1–478		0–224		
Disease stage							
Stage 1	82	25.8	51	29.3	31	21.5	0.11
Stage 2	55	17.3	24	13.8	31	21.5	0.07
Stage 3	48	15.1	24	13.8	24	16.7	0.48
Stage 4	22	6.9	10	5.7	12	8.3	0.37
Unsure	102	32.1	63	36.2	39	27.1	
Not reported	9	2.8	2	1.1	7	4.9	
Disease type							
Urological	130	40.9	128	73.6	2	1.4	< 0.001

Table 1 (continued)

Participant characteristics	Overall (<i>n</i> = 318)		Males (<i>n</i> = 174)		Females (<i>n</i> = 144)		<i>p</i> *
	No. of patients	%	No. of patients	%	No. of patients	%	
Hematological	59	18.6	29	16.7	30	20.8	0.34
Breast	38	11.9	0	0.0	38	26.4	< 0.001
Gynecological	34	10.7	-	-	34	23.6	< 0.001
Head and neck	20	6.3	1	0.6	22	13.2	< 0.001
Sarcoma	18	5.7	10	5.7	8	5.6	0.94
Gastrointestinal	9	2.8	4	2.3	5	3.5	0.53
Skin	6	1.9	1	0.6	5	3.5	0.06
CNS/neuroendocrine	4	1.3	1	0.6	3	2.1	0.23
Treatment status							
Currently receiving treatment	124	39.0	49	28.2	75	52.1	< 0.001
Treatment exposure**							
Surgery	192	60.4	113	68.5	79	57.7	0.05
Chemotherapy	206	64.8	124	75.2	82	59.9	0.004
High-dose chemotherapy	38	11.9	21	12.7	17	12.4	0.93
Radiotherapy	74	23.3	26	15.8	48	35.0	< 0.001
Stem cell	20	6.3	17	10.3	3	2.2	0.005
Other	25	7.9	6	3.6	19	13.9	0.001
PA profile							
Meeting PA guidelines	198	62.3	122	70.1	76	52.8	0.001
PA history							
Very active during childhood	268	84.3	148	86.0	120	83.3	0.50
Very active during adolescence	233	73.3	132	76.7	101	70.6	0.22
PA facilitators							
Home gym	126	39.6	72	41.4	54	38.3	0.58
Gym membership	128	40.3	71	40.8	57	40.7	0.99
Enjoy PA alone	221	69.5	130	76.5	91	65.0	0.03
Enjoy PA with others	178	56.0	105	60.7	73	52.9	0.17
Cancer PA program participation	17	5.3	5	2.9	12	8.4	0.03

Notes: BMI, body mass index; CNS, central nervous system; PA, physical activity; kg, kilograms; m, meter; No., number; SD, standard deviation

† Population centre sizes: large ($n \geq 100,000$), medium ($n = 30,000$ to 99,999), small ($n = 1000$ to 29,999)

*Italicized *p* values reflect those that remained significant following Benjamini and Hochberg correction with a calculated significance threshold set to $p < 0.011$

**Total percentage exceeds 100% due to multiple treatment exposures

Compared to prior PA needs assessments in AYAs, our results indicate that similar percentages of AYAs prefer participating in PA programming that is age-restricted [28, 29] but that greater percentages of AYAs are meeting PA guidelines [28, 29], interested in PA support [28], want to further increase PA levels [28], and prefer home- [28, 29] and hospital-based [28] support. Our findings also suggest that AYAs' PA behaviour and support needs are different from older cancer survivors. For example, indirect comparisons with the findings of PA needs assessments in older cancer survivors most often reveal that a greater proportion of AYAs are: (1) meeting PA guidelines, (2) want PA support,

(3) want to increase their PA levels, and prefer interventions that are (4) individually supervised, (5) home- and hospital-based, (6) include resistance training and flexibility exercise, and (7) are offered in the evenings [31, 36, 42]. These findings are particularly revealing within our local context. To our knowledge, at the time of this survey, the cancer PA support services offered within the study's sampling region (e.g. CaRE [43] and Wellspring [44]) were (1) exclusively facility-based, (2) delivered in a group, (3) offered during the day, (4) open to all ages of adult cancer survivors and (5) likely not providing adequate options for resistance training. Overall, our data confirm previous assertions [25, 30] that AYAs have

Table 2 PA engagement overall and by demographic, medical, PA experience, PA interests and PA facilitators subgroups

Participant characteristics	n	Moderate-intensity PA minutes				Vigorous-intensity PA minutes				Total MVPA* minutes						
		Mean	SD	Diff.	95% CI	p	Mean	SD	Diff.	95% CI	Mean	SD	Diff.	95% CI	p	
Overall	318	110.9	127.8				99.1	122.8			308.7	298.0				
Demographic factors																
Sex																
Male	174	117.0	132.1	13.5	-14.9 to 41.9	0.35	128.8	139.5	65.5	40.3–90.7	< 0.001	374.5	323.5	145.2	82.7–207.7	< 0.001
Female	143	103.5	122.5				63.3	86.7				229.3	242.1			
Age (mean split)																
Younger (< 32 years)	133	106.2	122.4	-8.8	-37.6 to 20.0	0.55	112.4	125.5	22.1	-5.4 to 49.7	0.11	330.2	303.7	34.7	-32.2 to 101.6	0.31
Older (≥ 32 years)	183	115.0	132.2				90.2	120.7				295.5	294.4			
Relationship status																
Single	105	110.5	117.0	-0.04	-30.2 to 30.1	0.99	125.0	130.6	38.2	8.5–67.9	0.01	359.3	313.5	75.3	5.6–144.9	0.03
In relationship	212	110.5	133.1				86.8	117.1				284.1	288.1			
Medical factors																
Obesity status																
Not obese	249	115.6	130.1	22.1	-14.0 to 58.3	0.23	104.4	127.0	30.1	-4.1 to 64.2	0.09	324.4	308.4	83.7	0.7–166.8	< 0.05
Obese	62	93.5	121.9				74.4	101.3				240.7	248.4			
Treatment status																
No Tx/post Tx	194	131.9	144.9	53.9	28.3–79.4	< 0.001	117.9	132.2	48.2	22.5–73.9	< 0.001	367.1	320.8	149.6	88.6–210.7	< 0.001
Current Tx	124	78.1	86.2				69.7	100.0				217.5	231.4			
PA experience																
Childhood PA behaviour																
Low	48	80.6	98.1	-36.2	-68.6 to -3.7	0.03	109.0	131.3	11.8	-26.1 to 49.7	0.54	298.5	295.1	-12.2	-104.4 to 80.0	0.80
High	268	116.8	132.1				97.2	121.4				310.8	299.6			
Adolescent PA behaviour																
Low	82	118.0	151.4	8.9	-23.6 to 41.3	0.59	78.8	98.2	-27.6	-54.8 to -0.4	< 0.05	275.6	283.0	-45.9	-121.3 to 29.6	0.23
High	233	109.1	119.2				106.4	129.9				321.4	303.8			
PA interests and facilitators																
PA support interest																
No	68	139.0	149.0	35.3	-3.9 to 74.6	0.08	115.0	149.2	19.5	-13.7 to 52.6	0.25	367.0	359.3	72.2	-21.2 to 165.7	0.13
Yes	247	103.6	121.0				95.6	114.9				294.8	278.8			
PA goals																
No PA increase	90	119.7	147.4	12.9	-18.6 to 44.4	0.42	139.6	159.1	56.4	20.6–92.3	0.002	398.8	369.0	126.2	41.9–210.5	0.004
PA increase	218	106.8	118.5				83.2	100.7				272.6	255.9			
Home gym access																
No	189	95.0	109.1	-39.8	-70.4 to -9.2	0.01	85.2	112.1	-35.0	-62.5 to -7.4	0.01	265.5	268.0	-108.7	-177.7 to -39.7	0.002

Table 2 (continued)

Participant characteristics	n	Moderate-intensity PA minutes			Vigorous-intensity PA minutes			Total MVPA* minutes			
		Mean	SD	Diff. 95% CI	Mean	SD	Diff. 95% CI	Mean	SD	Diff. 95% CI	p
Yes	126	134.8	149.3		120.2	134.9		374.1	326.6		
Gym membership											
No	186	101.8	123.7	-22.7 -51.6 to 6.2	60.8	86.0	-94.9 -123.1 to -66.7	222.9	227.2	-213.1 -280.8 to -145.3	< 0.001
Yes	128	124.5	133.4		155.7	145.0		436.0	339.9		
Enjoy PA alone											
No	89	94.3	115.3	-24.0 -55.8 to 7.8	50.6	80.3	-69.0 -93.2 to -44.8	194.4	206.3	-163.1 -223.1 to -103.0	< 0.001
Yes	221	118.3	133.0		119.6	131.8		357.5	316.1		
Enjoy PA with others											
No	133	101.8	141.9	-16.8 -45.8 to 12.2	76.2	113.1	-42.1 -69.5 to -14.7	254.1	293.0	-100.4 -166.8 to -34.1	0.003
Yes	178	118.6	117.2		118.3	127.4		354.5	295.3		

Notes: CI, confidence interval; mins, minutes; MVPA, moderate-to-vigorous intensity physical activity; PA, physical activity; SD, standard deviation; Tx, treatment

*Total MVPA minutes calculated as 2 × vigorous-intensity minutes + moderate-intensity minutes

*Italicized p values reflect those that remained significant following Benjamini and Hochberg correction with a calculated significance threshold set to $p < 0.023$

distinct support needs and preferences from older cancer survivors and provide direction for tailoring AYA-focused PA research and program development.

To our knowledge, this is the first study to assess the effects of preferred PA support setting on PA support and prescription preferences in any cancer survivor group. Compared to individuals preferring private (i.e. home-based or online) PA support, AYAs preferring public (i.e. hospital or university/college-based) PA support indicated strong preferences towards programming that included a group supervision component, a sport component, strength and flexibility exercise, and that was restricted to similar others (e.g. restricted by age or exclusive to cancer survivors). These findings are particularly salient for clinicians and researchers developing and delivering remote monitored exercise interventions to AYAs preferring in-person PA support in the era of COVID-19. Specifically, to optimize recruitment and retention, our findings suggest that clinicians and researchers may benefit from (1) pre-screening program and study participants to identify individuals preferring in-person PA support and (2) preemptively adapting their distance-based intervention approaches to reflect and accommodate the PA preferences of these AYAs.

Finally, exercise is emerging as a promising clinical therapy to prevent and mitigate cancer and treatment-related late effects in cancer survivors [13–15] and may be an attractive non-pharmacological therapy to protect vulnerable groups of AYAs. Few studies, however, have assessed the potential benefits of exercise therapy in AYAs to date [17–24]. Unfortunately, these studies provide inconsistent evidence of health benefits potentially due to their diverse aims (e.g. assessing the feasibility of distance-based delivery methods) [22, 23], scope (e.g. behaviour change) [18, 22, 23], methodological issues (e.g. inadequate power) [18, 23] and, based on our findings, poor alignment with AYAs' PA support preferences (e.g. no strength training or flexibility components) [18, 22, 23]. These findings are in contrast to two more recent trials involving supervised, individually tailored and rigorously prescribed (i.e. adherent to principles of exercise prescription [45]) exercise interventions that produced significant improvements in physical [17, 21] and psychosocial [24] outcomes in AYAs. These mixed results highlight the need for rigorous exercise and physical activity research in AYAs. To this end, our findings can be used to support the development and testing of exercise and physical activity interventions that reflect AYAs' unique overall- and subgroup-specific support preferences and, ultimately, support the development of evidence-based clinical and community support services for them.

This study adds to the evidence base by confirming, extending and contrasting with the findings of previous PA needs assessments in oncology. First, our PA preference findings may be more generalizable than related AYA-specific

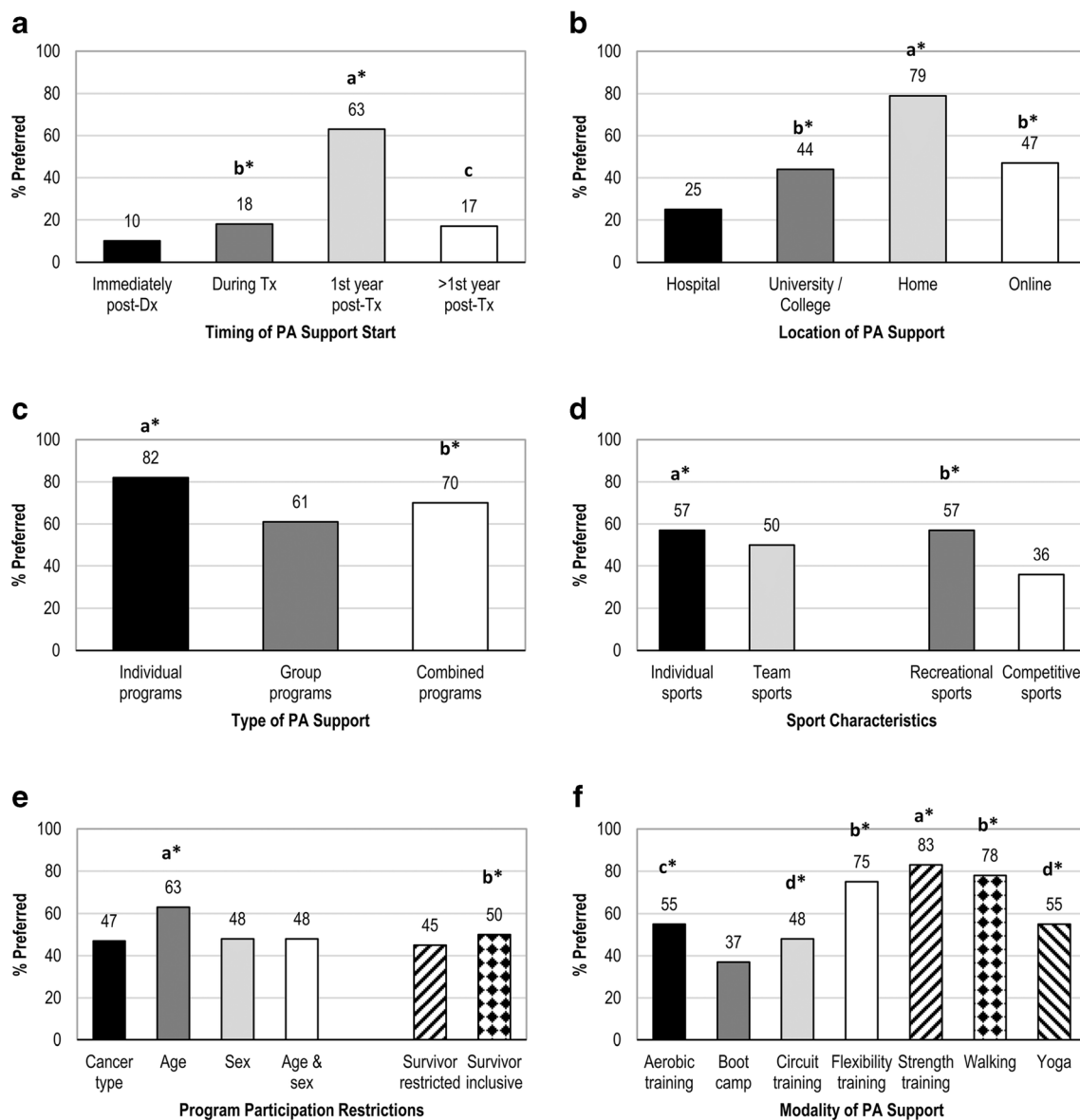


Fig. 2 Panels A–F: physical activity (PA) support preferences in AYA cancer survivors. Panel A) Preferred timing of PA support start. *Notes:* Dx, diagnosis; Tx, treatment; ^a $p < 0.001$ relative to all other groups; ^b $p = 0.007$ relative to *Immediately post-Dx*; ^c $p = 0.04$ relative to *Immediately post-Dx*. Panel B) Preferred location of PA support. *Notes:* ^a $p < 0.001$ relative to all other groups; ^b $p < 0.001$ relative to *Hospital*. Panel C) Preferred type of PA program supervision. *Notes:* ^a $p < 0.001$ relative to all other types; ^b $p < 0.001$ relative to *Group programs*. Panel D) Preferred characteristics of sports participation. *Notes:* ^a $p = 0.02$ relative to *Team sports*; ^b $p < 0.001$ relative to *Competitive sports*. Panel E) Preferred PA program participation restrictions. *Notes:* ^a $p < 0.001$

relative to all other groups; ^b $p = 0.02$ relative to *Survivor restricted*. Panel F) Preferred modality of PA support. *Notes:* ^a $p < 0.001$ relative to all other groups (except walking; $p =$ not significant); ^b $p < 0.001$ relative to *Aerobic*, *Yoga*, *Circuit training* and *Boot camp*; ^c $p \leq 0.01$ relative to *Circuit training* and *Boot camp*; ^d $p < 0.001$ relative to *Boot camp*. * p values reflect those that remained significant following Benjamini and Hochberg correction with calculated significance thresholds set to: Panel A) PA support start ($p < 0.029$); Panel B) PA location ($p < 0.036$); Panel C) type of PA supervision ($p < 0.038$); Panel D) sports preference ($p < 0.033$); Panel E) PA support timing within week ($p < 0.029$); Panel F) PA modality ($p < 0.039$)

studies given that our data were obtained from one of the largest and arguably the most representative (e.g. sex, cancer type, treatment status, time since diagnosis) sample of AYAs surveyed to date. Second, our findings provide novel insight to support the tailoring of future AYA-specific PA research and support services by: (1) highlighting numerous, and

potentially important, differences in PA support preferences between AYAs and older survivors; (2) focusing on preferences for PA program delivery and exercise prescription, rather than PA counselling; and, (3) exploring the associations between PA behaviour and preferences and novel demographic, medical, and behavioural moderators.

Table 3 Overall and subgroup-specific PA support, program delivery and prescription preferences

Outcomes	Overall		Demographic, medical and behavioural subgroup preferences						<i>p</i> *	
	<i>n</i>	%	Moderators	Group	<i>n</i>	%	Group	<i>n</i>		%
PA support interests and program delivery preferences										
PA program support interest ^a <i>n</i> = 315 respondents	247	78.4	Sex	Male	128	74.4	Female	119	83.2	0.06
			In relationship	No	89	85.6	Yes	158	75.2	0.04
			On treatment	No	140	72.9	Yes	107	87.0	0.003
			Physically active	No	94	79.7	Yes	153	77.7	0.68
Increase current PA (goal) ^b <i>n</i> = 308 respondents	218	70.8	Sex	Male	117	69.2	Female	101	72.7	0.51
			In relationship	No	72	70.6	Yes	146	71.2	0.91
			On treatment	No	131	68.9	Yes	87	73.7	0.37
			Physically active	No	83	72.2	Yes	135	69.9	0.68
PA support start ^c										
After diagnosis <i>n</i> = 297 respondents	31	10.4	Sex	Male	15	9.4	Female	16	11.7	0.52
			In relationship	No	7	7.0	Yes	24	12.2	0.17
			On treatment	No	19	10.7	Yes	12	10.1	0.87
			Physically active	No	3	2.7	Yes	28	15.1	0.001
During treatment <i>n</i> = 297 respondents	53	17.8	Sex	Male	23	14.4	Female	30	21.9	0.09
			In relationship	No	17	17.0	Yes	36	18.3	0.79
			On treatment	No	17	9.6	Yes	36	30.3	< 0.001
			Physically active	No	21	18.8	Yes	32	17.3	0.75
1st year post-treatment <i>n</i> = 297 respondents	187	63.0	Sex	Male	101	63.1	Female	86	62.8	0.95
			In relationship	No	67	67.0	Yes	120	60.9	0.31
			On treatment	No	114	64.0	Yes	73	61.3	0.64
			Physically active	No	72	64.3	Yes	115	62.2	0.71
≥ 1st year post-treatment <i>n</i> = 297 respondents	49	16.5	Sex	Male	32	20.0	Female	17	12.4	0.08
			In relationship	No	16	16.0	Yes	33	16.8	0.87
			On treatment	No	45	25.3	Yes	4	3.4	< 0.001
			Physically active	No	25	22.3	Yes	24	13.0	0.04
PA program setting ^d										
Hospital <i>n</i> = 308 respondents	77	25.0	Sex	Male	39	23.1	Female	38	27.3	0.39
			In relationship	No	26	26.3	Yes	51	24.5	0.74
			On treatment	No	49	26.1	Yes	28	23.3	0.59
			Physically active	No	29	25.0	Yes	48	25.0	0.99
University/College <i>n</i> = 304 respondents	134	44.1	Sex	Male	77	45.6	Female	57	42.2	0.56
			In relationship	No	55	55.0	Yes	79	38.9	0.008
			On treatment	No	86	46.0	Yes	48	41.0	0.40
			Physically active	No	41	36.6	Yes	93	48.4	< 0.005
Home <i>n</i> = 308 respondents	243	78.9	Sex	Male	128	74.0	Female	115	85.2	0.02
			In relationship	No	73	74.5	Yes	170	81.3	0.17
			On treatment	No	143	74.9	Yes	100	85.5	0.03
			Physically active	No	91	81.3	Yes	152	77.6	0.44
Online <i>n</i> = 310 respondents	145	46.8	Sex	Male	64	37.2	Female	81	58.7	< 0.001
			In relationship	No	51	49.5	Yes	94	45.6	0.52
			On treatment	No	87	45.5	Yes	58	48.7	0.58
			Physically active	No	60	52.2	Yes	85	43.6	0.14
PA program timing										
Within week ^e										
No preference <i>n</i> = 318 respondents	147	46.2	Sex	Male	83	47.7	Female	64	44.4	0.56
			In relationship	No	50	47.6	Yes	96	45.3	0.70
			On treatment	No	91	46.9	Yes	56	45.2	0.76
			Physically active	No	56	46.7	Yes	91	46.0	0.90
Weekday <i>n</i> = 318 respondents	75	23.6	Sex	Male	54	31.0	Female	21	14.6	0.001
			In relationship	No	26	24.8	Yes	49	23.1	0.75
			On treatment	No	53	27.3	Yes	22	17.7	0.05
			Physically active	No	21	17.5	Yes	54	27.3	< 0.005
Weekend <i>n</i> = 318 respondents	114	35.8	Sex	Male	47	27.0	Female	67	46.5	0.001
			In relationship	No	36	34.3	Yes	78	36.8	0.66
			On treatment	No	63	32.5	Yes	51	41.1	0.12
			Physically active	No	47	39.2	Yes	67	33.8	0.34
Within day ^f										
Morning <i>n</i> = 318 respondents	134	42.1	Sex	Male	68	39.1	Female	66	45.8	0.23
			In relationship	No	47	44.8	Yes	87	41.0	0.53
			On treatment	No	81	41.8	Yes	53	42.7	0.86
			Physically active	No	44	36.7	Yes	90	45.5	0.13
Afternoon	59	18.6	Sex	Male	33	19.0	Female	26	18.1	0.84

Table 3 (continued)

Outcomes	Overall		Demographic, medical and behavioural subgroup preferences						<i>p</i> *	
	<i>n</i>	%	Moderators	Group	<i>n</i>	%	Group	<i>n</i>		%
<i>n</i> = 318 respondents			In relationship	No	24	22.9	Yes	35	16.5	0.17
			On treatment	No	29	14.9	Yes	30	24.2	0.04
			Physically active	No	21	17.5	Yes	38	19.2	0.71
Evening	143	45.0	Sex	Male	82	47.1	Female	61	42.4	0.40
<i>n</i> = 318 respondents			In relationship	No	55	52.4	Yes	87	41.0	0.06
			On treatment	No	96	49.5	Yes	47	37.9	0.04
			Physically active	No	54	45.0	Yes	89	44.9	0.99
PA program/participant supervision ^g										
Individual exercise	260	82.3	Sex	Male	142	81.6	Female	118	83.1	0.73
<i>n</i> = 318 respondents			In relationship	No	89	85.6	Yes	171	81.0	0.32
			On treatment	No	160	82.5	Yes	100	82.0	0.91
			Physically active	No	97	81.5	Yes	163	82.7	0.78
Group exercise	194	61.4	Sex	Male	102	58.6	Female	92	64.8	0.26
<i>n</i> = 316 respondents			In relationship	No	72	69.2	Yes	122	57.8	0.05
			On treatment	No	116	59.8	Yes	78	63.9	0.46
			Physically active	No	69	58.0	Yes	125	63.5	0.33
Combined exercise	220	70.3	Sex	Male	114	66.3	Female	106	75.2	0.09
<i>n</i> = 313 respondents			In relationship	No	81	77.9	Yes	139	66.8	0.04
			On treatment	No	128	67.0	Yes	92	75.4	0.11
			Physically active	No	82	68.9	Yes	138	71.1	0.68
Varsity athlete mentored	89	28.9	Sex	Male	57	33.7	Female	32	23.0	0.04
<i>n</i> = 308 respondents			In relationship	No	40	39.2	Yes	49	23.9	0.005
			On treatment	No	59	31.4	Yes	30	25.0	0.23
			Physically active	No	21	18.4	Yes	68	35.1	0.002
Sport participation ^h										
Individual sports	172	56.6	Sex	Male	113	66.5	Female	59	44.0	< 0.001
<i>n</i> = 304 respondents			In relationship	No	58	56.3	Yes	113	56.5	0.98
			On treatment	No	106	57.0	Yes	66	55.9	0.86
			Physically active	No	57	50.0	Yes	115	60.5	0.07
Team sports	149	49.5	Sex	Male	101	60.5	Female	48	35.8	< 0.001
<i>n</i> = 301 respondents			In relationship	No	53	52.5	Yes	95	47.7	0.44
			On treatment	No	98	53.6	Yes	51	43.2	0.08
			Physically active	No	49	43.4	Yes	100	53.2	0.10
Recreational sports	176	57.1	Sex	Male	104	60.8	Female	72	52.6	0.15
<i>n</i> = 308 respondents			In relationship	No	61	59.8	Yes	115	56.1	0.54
			On treatment	No	115	61.2	Yes	61	50.8	0.07
			Physically active	No	65	55.6	Yes	111	58.1	0.66
Competitive sports	111	36.2	Sex	Male	78	46.2	Female	33	23.9	< 0.001
<i>n</i> = 307 respondents			In relationship	No	47	46.1	Yes	64	31.4	0.01
			On treatment	No	78	41.9	Yes	33	27.3	0.009
			Physically active	No	26	23.0	Yes	85	43.8	< 0.001
PA program restriction ⁱ										
Cancer type specific	146	46.5	Sex	Male	67	38.7	Female	79	56.0	0.002
<i>n</i> = 314 respondents			In relationship	No	46	43.8	Yes	100	48.1	0.48
			On treatment	No	77	40.5	Yes	69	55.6	0.009
			Physically active	No	60	50.8	Yes	86	43.9	0.23
Age-specific	196	62.6	Sex	Male	106	61.6	Female	90	63.8	0.69
<i>n</i> = 313 respondents			In relationship	No	75	71.4	Yes	121	58.5	0.03
			On treatment	No	117	61.6	Yes	79	64.2	0.64
			Physically active	No	74	63.2	Yes	122	62.2	0.86
Sex specific	150	47.9	Sex	Male	64	37.4	Female	86	60.6	< 0.001
<i>n</i> = 313 respondents			In relationship	No	47	45.2	Yes	103	49.5	0.47
			On treatment	No	88	46.6	Yes	62	50.0	0.55
			Physically active	No	57	48.3	Yes	93	47.7	0.92
Age and sex specific	150	47.9	Sex	Male	70	40.9	Female	80	56.3	0.007
<i>n</i> = 313 respondents			In relationship	No	51	48.6	Yes	99	47.8	0.90
			On treatment	No	86	45.5	Yes	64	51.6	0.29
			Physically active	No	55	47.0	Yes	95	48.5	0.80
Exclusive to survivors	141	44.9	Sex	Male	69	39.9	Female	72	51.1	< 0.005
<i>n</i> = 314 respondents			In relationship	No	51	48.6	Yes	90	43.3	0.37
			On treatment	No	81	42.4	Yes	60	48.8	0.27
			Physically active	No	58	49.2	Yes	83	42.3	0.24
With other survivors	158	50.0	Sex	Male	80	46.2	Female	78	54.5	0.14

Table 3 (continued)

Outcomes	Overall		Demographic, medical and behavioural subgroup preferences						<i>p</i> *	
	<i>n</i>	%	Moderators	Group	<i>n</i>	%	Group	<i>n</i>		%
<i>n</i> = 316 respondents			In relationship	No	57	54.3	Yes	101	48.1	0.30
			On treatment	No	89	46.4	Yes	69	55.6	0.11
			Physically active	No	59	50.0	Yes	99	50.0	0.99
PA Prescription Preferences										
PA session frequency ^j	234	74.8	Sex	Male	128	74.4	Female	106	75.2	0.88
≥ 3 days per week			In relationship	No	76	73.8	Yes	158	75.6	0.73
<i>n</i> = 313 respondents			On treatment	No	145	75.5	Yes	89	73.6	0.70
			Physically active	No	75	65.2	Yes	159	80.3	0.003
PA session duration ^k	225	77.6	Sex	Male	130	81.8	Female	95	72.5	0.06
≥ 30 min per session			In relationship	No	79	79.0	Yes	145	76.7	0.66
<i>n</i> = 290 respondents			On treatment	No	147	65.3	Yes	78	72.9	0.14
			Physically active	No	65	61.9	Yes	160	86.5	< 0.001
PA training modality ^l										
Aerobic	169	55.2	Sex	Male	86	51.2	Female	83	60.1	0.12
<i>n</i> = 306 respondents			In relationship	No	45	44.1	Yes	123	60.6	0.006
			On treatment	No	102	55.1	Yes	67	55.4	0.97
			Physically active	No	58	50.4	Yes	111	58.1	0.19
Boot camp	113	37.0	Sex	Male	52	30.8	Female	61	44.9	0.01
<i>n</i> = 305 respondents			In relationship	No	41	39.8	Yes	72	35.8	0.50
			On treatment	No	64	34.4	Yes	49	41.2	0.23
			Physically active	No	42	36.5	Yes	71	37.4	0.88
Circuit training	146	48.2	Sex	Male	80	47.6	Female	66	48.9	0.83
<i>n</i> = 303 respondents			In relationship	No	48	46.6	Yes	97	48.7	0.72
			On treatment	No	82	44.6	Yes	64	53.8	0.12
			Physically active	No	38	33.3	Yes	108	57.1	< 0.001
Flexibility	233	74.7	Sex	Male	119	69.2	Female	114	81.4	0.01
<i>n</i> = 312 respondents			In relationship	No	73	70.2	Yes	160	77.3	0.17
			On treatment	No	136	71.6	Yes	97	79.5	0.12
			Physically active	No	83	71.6	Yes	150	76.5	0.33
Strength	256	82.6	Sex	Male	137	80.6	Female	119	85.0	0.31
<i>n</i> = 310 respondents			In relationship	No	78	76.5	Yes	178	86.0	0.04
			On treatment	No	157	83.1	Yes	99	81.8	0.78
			Physically active	No	92	78.6	Yes	164	85.0	0.15
Walking	246	78.3	Sex	Male	123	70.7	Female	123	87.9	< 0.001
<i>n</i> = 314 respondents			In relationship	No	73	69.5	Yes	173	83.2	0.005
			On treatment	No	149	77.6	Yes	97	79.5	0.69
			Physically active	No	103	87.3	Yes	143	73.0	0.003
Yoga	170	54.7	Sex	Male	67	39.2	Female	103	73.6	< 0.001
<i>n</i> = 311 respondents			In relationship	No	51	49.5	Yes	118	57.0	0.21
			On treatment	No	90	47.6	Yes	80	65.6	0.002
			Physically active	No	59	50.9	Yes	111	56.9	0.30

Notes: *n*, number; Overall, overall participant preferences; PA, physical activity

*Italicized *p* values reflect those that remained significant following Benjamini and Hochberg correction with a calculated significance threshold set to:

^a PA interest ($p < 0.0167$); ^b PA goals (N/A); ^c PA support start ($p < 0.0071$); ^d PA support setting ($p < 0.0024$); ^e PA support timing within week ($p < 0.0063$); ^f PA support timing within day (N/A); ^g PA supervision ($p < 0.0024$); ^h Sports ($p < 0.0143$); ⁱ Program restriction ($p < 0.0125$); ^j PA frequency ($p < 0.0083$); ^k PA duration ($p < 0.0083$); ^l PA modality ($p < 0.0139$)

Our study also has several limitations. First, ~ 60% of our sample consisted of respondents who identified as Caucasian and ~ 41% were testicular cancer survivors which may limit the generalizability of our findings to more ethnically and medically diverse individuals. Second, questionnaires had to be completed on-site during survivors' medical appointments which may have discouraged the participation of AYAs who did not feel comfortable completing the questionnaire in front of the study staff, potentially leading to participation bias. Relatedly, our on-site recruitment approach resulted in a

sample of AYAs who predominantly reside in large urban centres and whose PA support needs and interests may not reflect those living in smaller and more remote rural communities. Third, we included participants that met the common North American definition of an AYA (i.e. 18–39 years). Thus, our findings may not be completely generalizable to groups of AYAs defined by other age ranges (i.e. 15–24) [46]. Finally, the level of PA engagement across participants was extremely variable—possibly suggesting that the conditioning status of participants was similarly variable. While

conditioning status is difficult to accurately evaluate via self-report methods, it bears mention that the assessment and consideration of fitness levels are critically important to developing appropriately tailored exercise prescriptions for individuals, including AYAs [47].

Conclusion

In summary, most AYAs are active and interested in increasing their PA participation; yet, remarkably few engage with existing PA support services. AYAs' PA preferences most often differ according to sex, treatment status, PA behaviour and preferred location of PA participation—and appear to be distinct from the preferences of older cancer survivors. Our findings highlight a potentially important discordance between the perceived and actual PA support preferences of AYAs that may partially explain their poor engagement with existing PA support services and the limited success of PA interventions in AYAs to date. Our findings, if generalizable, can be used to conduct the rigorous research needed to address the considerable gaps in the AYA-specific PA evidence base. Ultimately, these efforts will support the development of clinical- and community-based PA supportive care services to help reduce healthcare costs associated with treating and managing potentially preventable forms of chronic cancer-related sequelae within this rapidly growing survivor population.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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Code availability NA

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