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Symptom Screening for Hospitalized Pediatric Patients With Cancer
A Randomized Clinical Trial

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IMPORTANCE Pediatric patients with cancer experience severely bothersome symptoms during treatment. It was hypothesized that symptom screening and provision of symptom reports to the health care team would reduce symptom burden in pediatric patients with cancer.

OBJECTIVE To determine if daily symptom screening and provision of symptom reports to the health care team was associated with lower total symptom burden as measured by the Symptom Screening in Pediatrics Tool (SSPedi) compared to usual care among pediatric patients with cancer admitted to a hospital or seen in a clinic daily for at least 5 days.

DESIGN, SETTING, AND PARTICIPANTS This randomized clinical trial enrolled participants from July 2018 to September 2023 from 8 Canadian tertiary care centers that diagnose and treat pediatric patients with cancer. Patients aged 8 to 18 years with cancer expected to be in a hospital or clinic daily for at least 5 consecutive days were eligible for inclusion. Participants were randomized to intervention (n = 176) vs control (n = 169) groups. Data were analyzed from November 2023 to December 2023.

INTERVENTION Intervention participants completed the SSPedi once daily for 5 days. Printed symptom reports were provided daily to the health care team, and email alerts were distributed for severely bothersome symptoms. Control participants received usual care.

MAIN OUTCOMES AND MEASURES The primary outcome was self-reported total SSPedi score on day 5. Secondary outcomes were individual SSPedi symptoms, pain, quality of life, symptom documentation, and intervention provision. The primary analysis compared the day 5 total SSPedi scores between randomized groups using a multiple linear regression model. For the secondary analysis comparing individual SSPedi symptom scores, the odds ratio for the intervention was estimated using a proportional odds model. Pain and quality of life were analyzed using the same approach as the primary outcome. Fisher exact test was used to compare symptom documentation, any intervention, and symptom-specific intervention between groups.

RESULTS A total of 345 participants were enrolled; median (range) participant age was 13.8 (8.0-18.8) years, and 150 participants (43.5%) were female. Day 5 SSPedi score was significantly better with symptom screening compared to usual care (adjusted mean difference, −2.5; 95% CI, −3.8 to −1.2). Symptom screening reduced the odds of higher individual symptom scores; 8 of 15 symptom reductions were statistically significant. There were no significant differences in pain or quality of life scores between groups. Five symptoms were documented or treated significantly more often with symptom screening than usual care.

CONCLUSIONS AND RELEVANCE In this randomized clinical trial, among pediatric patients with cancer admitted to a hospital or seen in a clinic daily for at least 5 days, symptom screening with SSPedi improved total symptom scores compared to usual care.

TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT03593525

Visual Abstract

Supplemental content

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Pediatric cancer survival outcomes are excellent, but patients often require intensive therapies to achieve a cure. Cancer and cancer-specific treatments are frequently associated with severely bothersome symptoms.[1] Among adult patients with cancer, routine collection of patient-reported outcomes (PROs) improves quality of life (QOL)[2,3] and may even improve overall survival.[4] Consequently, the standard of care has moved toward universal implementation of symptom screening among adult patients.[2,5-7] However, progress has lagged in pediatric oncology, as there are limited data on the efficacy of symptom screening in pediatric patients.[8]

To address this issue, we previously developed the Symptom Screening in Pediatrics Tool (SSPedi) for pediatric patients receiving cancer therapies.[9-12] We then integrated SSPedi into a web-based platform named Supportive care Prioritization, Assessment, and Recommendations for Kids (SPARK) that enables email or text reminders, viewing of SSPedi score bar or line graphs, and distribution of symptom reports to the health care team.

This study's primary objective was to determine if daily symptom screening and provision of symptom reports to the health care team was associated with lower total symptom burden as measured by SSPedi compared to usual care among pediatric patients with cancer admitted to a hospital or seen in a clinic daily for at least 5 consecutive days.

Key Points

Question Does daily symptom screening and provision of symptom reports to the health care team reduce total symptom burden as measured by the Symptom Screening in Pediatrics Tool (SSPedi) compared to usual care among pediatric patients with cancer admitted to a hospital or seen in a clinic daily for 5 days?

Findings In this randomized clinical trial, day 5 SSPedi score was significantly better with symptom screening compared to usual care.

Meaning Among pediatric patients with cancer admitted to a hospital or seen in a clinic daily for at least 5 days, symptom screening improved total symptom scores compared to usual care.

Methods

This was a multicenter, open-label randomized clinical trial involving 8 Canadian tertiary care centers that diagnose and treat pediatric patients with cancer (eTable 1 in Supplement 2). This study was approved by the research ethics board at each participating trial site. Patients were recruited from July 2018 to September 2023, and data were analyzed from November 2023 to December 2023. The trial protocol is available in Supplement 1. All participants and their guardians provided written informed consent and written or oral assent as appropriate. This study was registered with ClinicalTrials.gov (NCT03593525) and followed the Consolidated Standards of Reporting Trials (CONSORT) reporting guidelines for randomized clinical trials.

Participants

Individuals with cancer who were 8 to 18 years old, understood English, and were expected to be in a hospital or clinic daily for at least 5 consecutive days were eligible for inclusion. Exclusion criteria were illness severity, cognitive disability, or visual impairment that precluded use of SPARK according to the primary health care team.

Procedures

Potential participants were identified by clinical or research staff and were recruited from inpatient wards and outpatient clinics by site clinical research associates. For consenting participants, demographic information was obtained from the participant, their guardian, and the medical record. Information included sex, age at enrollment, race (reported by participant's guardian among limited categories, with more than 1 option available for selection), first language, diagnosis, metastatic disease, relapse status, whether the participant was on active treatment, treatments received (chemotherapy, radiotherapy, surgery, or hematopoietic cell transplantation), inpatient status at enrollment, school attendance, and guardian or family characteristics.

Consenting participants were randomized to either the intervention group (routine symptom screening and provision of symptom reports to the care team) or the control group (usual care) using permuted block sizes stratified by age (8 to 10, 11 to 14, and 15 to 18 years) and treatment (currently undergoing hematopoietic cell transplant, yes or no). The allocation sequence was computer generated by an internet-based randomization service (randomize.net) and was concealed from participants, the health care team, and the research team. When eligible patients consented, a clinical research associate entered the participant stratification factors into the website, generating an allocation. The clinical research associate needed to know participants' allocation to set up their SPARK account, since only intervention participants required that protected health information (name and medical record number) be entered into SPARK to enable symptom feedback. However, allocation was not disclosed before participants completed baseline procedures, including SSPedi. After completing the baseline procedures, participants were provided instructions consistent with allocation.

For participants randomized to the intervention group, clinical research associates taught participants how to log in to SPARK, complete SSPedi self-reports, save SSPedi scores, and view previous SSPedi results in SPARK reports. Participants completed SSPedi once daily using SPARK on a study-supplied tablet. SSPedi focuses on the following 15 symptoms: (1) feeling disappointed or sad, (2) feeling scared or worried, (3) feeling cranky or angry, (4) problems with thinking or remembering things, (5) changes in how your body or face look, (6) feeling tired, (7) mouth sores, (8) headache, (9) hurt or pain (other than headache), (10) tingly or numb hands or feet, (11) throwing up or feeling like you may throw up, (12) feeling more or less hungry than you usually do, (13) changes in taste, (14) constipation, and (15) diarrhea. Participants self-reported the degree of symptom bother experienced "yesterday or today" on a 5-point Likert scale ranging from "not at all bothered" (0) to "extremely bothered" (4).

For inpatient participants, the tablet was left with the participant overnight, and reminders to complete SSPedi appeared on the tablet. Symptom reports could be viewed by members of the health care team and participants at any time. For outpatient participants, clinical research associates brought a tablet to the participant daily, and reports could be viewed at these encounters. SPARK reports containing the SSPedi bar graph[13] depicting the degree of bother for each of the 15 symptoms were printed each day and delivered to the bedside nurse and direct participant clinician (physician, nurse practitioner, or physician assistant). A copy was also entered in the participant's medical record. On days 1 and 3, an email alert was distributed to the most responsible physician if any symptom was "a lot" or "extremely" bothersome (score of 3 or 4). Reports and alerts contained links to SPARK-housed clinical practice guidelines to address symptoms. Participants randomized to the control group received usual care according to local institutional standards.

For both intervention and control groups, clinical research associates visited participants at baseline and at day 5 to facilitate completion of PROs including SSPedi. If a participant was to be discharged early or was not available on day 5, PROs were collected on day 4 (preferred) or day 6. Medical record review was conducted on days 4, 5, and 6 to abstract symptom documentation and the provision of interventions for symptoms using the procedures developed for this study, which included preestablished lists of synonyms and standard operating procedures.[14] Two clinical research associates independently abstracted these data. Disagreements were resolved by consensus or arbitrated by a third reviewer (L.S.) if required.

Outcomes

The primary outcome was the self-reported total SSPedi score on day 5. The total SSPedi score was the sum of the Likert scores of each of the 15 SSPedi items and ranged from 0 (no bothersome symptoms) to 60 (worst bothersome symptoms). The SSPedi is reliable, valid, and responsive to change in English-speaking patients aged 8 to 18 years receiving cancer therapies.[9] For participants not available on day 5, the day 4 or 6 SSPedi was used as the primary outcome only if the other PROs (pain and QOL) were collected that day.

Secondary outcomes were the self-reported 15 individual SSPedi symptom scores (score 0 to 4), the Faces Pain Scale-Revised (FPR-R) score, and the PedsQL 3.0 Acute Cancer Module domain scores. The FPR-R consists of a series of horizontal faces that depict a neutral facial expression of no pain on the left and worst pain on the right. The scale has 6 faces and may be scored on a 0 to 10 scale in which higher numbers denote more pain.[15] Pain intensity is assessed at that moment. The FPR-R is psychometrically sound and feasible for patients aged 4 to 18 years.[16] The PedsQL 3.0 Acute Cancer Module is a multidimensional instrument that is reliable and valid in pediatric patients with cancer.[17-20] It produces the following 8 domain scores on a 0 to 100 scale: pain and hurt, nausea, procedural anxiety, treatment anxiety, worry, cognitive problems, perceived physical appearance, and communication. Higher numbers indicate better QOL. The recall period is the preceding 7 days.

Interventions included both prophylactic and therapeutic intent; the 2 types of interventions determined were any intervention and symptom-specific intervention. Any intervention, regardless of attribution, was abstracted from a list of potential, previously defined interventions for specific symptoms (eTable 2 in Supplement 2).[14] For example, acetaminophen was included as an intervention for pain even if it was given for fever or the reason for administration was not documented. This approach was taken as the reason was often not stated and because administration could have influenced symptoms, even if not given for that indication. In contrast, symptom-specific intervention was abstracted where clinical documentation clearly noted that administration was for that particular symptom. These outcomes were specific to each of the 15 SSPedi symptoms and were binary variables (yes or no).

Statistical Analysis

It was previously determined that the total SSPedi score minimal important difference was 2.7 and standard deviation was 8.5 using data from the SSPedi validation study.[9] In that study, total SSPedi score was measured at baseline and 3 days later when a global change scale was also administered. A mean absolute difference of 2.7 was found for participants who reported they were a little better or a little worse compared to baseline. Assuming 80% power and an α of .05, 157 participants were required per group, or 314 participants total. We planned to recruit 345 participants to allow for 10% missing day 5 SSPedi scores.

Analysis followed the intention-to-treat principle. The primary analysis compared the day 5 total SSPedi scores between randomized groups using a linear regression model (analysis of covariance), adjusting for the baseline SSPedi score, 2 stratification variables of age group (8 to 10, 11 to 14, and 15 to 18 years) and treatment (current hematopoietic cell transplant, yes or no), diagnosis group (leukemia, lymphoma, solid tumor, or brain tumor) and relapse status (yes or no). The model-based estimated mean difference in day 5 scores between groups was presented with the 95% confidence interval.

For the secondary analysis comparing individual SSPedi symptom scores, a proportional odds model was fit adjusting for the baseline symptom score and 2 stratification variables (age and treatment) as covariates. As some individual symptoms might have been uncommon, an a priori decision was made to only use this minimal set of 3 covariates to avoid model overfitting. The odds ratio (OR) for the intervention was estimated and presented with 95% confidence intervals. An OR less than 1 suggested that symptom screening was associated with lower symptom scores, or less bothersome symptoms. FPR-R and PedsQL 3.0 Acute Cancer Module domain scores were treated as continuous variables and analyzed using the same approach as the primary outcome.

For comparing symptom documentation, any intervention, and symptom-specific intervention between groups, the difference in proportions was calculated. *P* values were computed using the Fisher exact test and 95% confidence intervals were calculated using the Newcombe method. Multiple

logistic regression was not used, because for some symptoms, documentation and interventions were anticipated to be rare. The initial documentation and interventions analysis focused on including all participants. However, if symptom screening reduced symptoms, there might be fewer symptoms in that group. Thus, we also planned to compare documentation and interventions among those with a symptom-specific SSPedi score of 1 or greater (any symptom) and an SSPedi score of 3 or greater (severely bothersome symptom).

No interim analysis or subgroup analyses were planned. If more than 5% data were missing for the primary outcome, individual symptom scores, FPS-R, or PedsQL 3.0 Acute Cancer Module domain scores, multiple imputation was planned. The statistical analytic plan was uploaded to ClinicalTrials.gov before analysis began. Analysis was performed using R version 4.3.2 (R Foundation). All tests of significance were 2-sided, and $P < .05$ was considered statistically significant.

Results

Between July 2018 and September 2023, 516 patients were assessed for eligibility and 345 were enrolled—176 participants were randomized to the symptom screening group and 169 were randomized to the usual care group. Screening and enrollment were halted between March 12, 2020, and July 20, 2020, because of the COVID-19 pandemic. However, some sites had substantially longer pandemic-related closure durations. **Figure 1** illustrates the flow diagram of patient identification and reasons for exclusion or declining participation. There were no significant differences between those who agreed to and those who declined study participation by participant age (median age, 13.8 years vs 13.0 years, respectively), female sex (43.5% vs 40.9%, respectively), or leukemia or lymphoma diagnosis (63.5% vs 61.4%, respectively). One participant randomized to the intervention group withdrew from the study after enrollment, and thus, baseline SSPedi and PROs were available for 344 of 345 participants. Among these 344 participants, 12 did not complete the day 5 PROs (7 intervention group and 5 control group participants) and consequently, the proportion missing the primary outcome was 3.8%. The timing of day 5 PRO collection for 332 participants was on day 5 for 321 participants, day 4 for 5 participants, and day 6 for 6 participants.

Table 1 illustrates the baseline demographic characteristics of the participants, stratified by group. The median (range) participant age was 13.8 (8.0-18.8) years, and 150 participants (43.5%) were female. The most common underlying diagnosis group was leukemia (156 of 345 [45.2%]). English was not the first language for 69 participants (20.0%). Baseline characteristics were generally well balanced between the groups.

Table 2 and **Table 3** show the results of the primary and secondary PRO analyses, with details included in eTables 3 and 4 in Supplement 2. In the adjusted analysis, the day 5 total SSPedi scores were significantly better in the symptom screening group compared to the usual care group (adjusted mean difference, −2.5; 95% CI, −3.8 to −1.2). Since the analysis adjusted for baseline SSPedi score, the effect is the same as the analysis in which the change score is the outcome. Using a simple 2-group comparison, the mean difference was −2.5 (95% CI, −4.2 to −0.8). Table 3 and **Figure 2** show results of the proportional odds models comparing individual SSPedi symptoms between groups. All 15 symptoms were reduced in the symptom screening group, with statistically significant reductions for 8 symptoms. eFigure 1 in Supplement 2 shows stacked bar plots for each symptom by group. There were no significant differences between groups in FPS-R score (Table 2). While all adjusted mean differences for PedsQL 3.0 Acute Cancer Module domain scores were greater than 0, no differences were statistically significant (Table 2; eFigure 2 in Supplement 2).

eTable 5 in Supplement 2 shows the comparison of symptom documentation, any interventions, and symptom-specific interventions between groups. Among all participants, symptom screening was associated with significantly more documentation related to hurt or pain (difference, 10.8%; 95% CI, 0.3%-20.9%) and feeling more or less hungry than participants usually did (difference, 9.2%; 95% CI, 0.9%-17.4%). Intervention for tingly or numb hands or feet was significantly more common for symptom screening vs usual care (difference, 9.0%; 95% CI, 2.7%-15.4%). There was more symptom-specific interventions for hurt or pain associated with symptom screening (difference, 10.8%; 95% CI, 0.4%-20.8%). While there were significantly more symptom-specific interventions for

Figure 1. Flow of Participant Identification, Enrollment, and Analysis

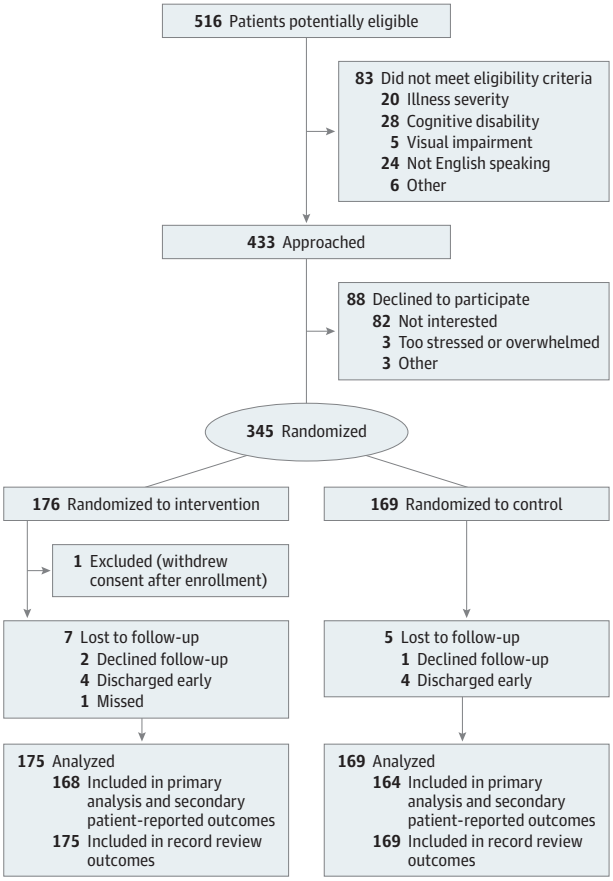


Table 1. Baseline Demographic Characteristics by Group

Characteristic	No. (%)	
	Symptom screening (n = 176)	Usual care (n = 169)
Sex		
Female	76 (43.2)	74 (43.8)
Male	100 (56.8)	95 (56.2)
Age, median (range), y	13.9 (8.0-18.4)	13.6 (8.0-18.8)
Age group, y		
8-10	45 (25.6)	42 (24.9)
11-14	69 (39.2)	70 (41.4)
15-18	62 (35.2)	57 (33.7)
Current treatment is hematopoietic cell transplantation	19 (10.8)	14 (8.3)
Race[a]		
Aboriginal	1 (0.6)	3 (1.8)
Arab or West Asian	10 (5.7)	13 (7.7)
Asian	53 (30.1)	27 (16.0)
Black or African American	5 (2.8)	7 (4.1)
Latin American	4 (2.3)	5 (3.0)
White	78 (44.3)	92 (54.4)
Other race or mixed race	20 (11.4)	20 (11.8)
Unknown or missing	2 (1.1)	2 (1.2)
Prefer not to say	3 (1.7)	0 (0.0)
First language		
English	132 (75.0)	140 (82.8)
Not English	42 (23.9)	27 (16.0)
Unknown	2 (1.1)	2 (1.2)
Cancer diagnosis		
Leukemia	80 (45.5)	76 (45.0)
Lymphoma	36 (20.5)	27 (16.0)
Solid tumor	49 (27.8)	55 (32.5)
Brain tumor	11 (6.2)	11 (6.5)
Metastatic disease	48 (27.3)	53 (31.4)
Relapsed cancer	37 (21.0)	41 (24.3)
Active treatment	169 (96.0)	161 (95.3)
Received treatment		
Systemic chemotherapy	168 (95.5)	158 (93.5)
Radiotherapy	37 (21.0)	31 (18.3)
Surgery	35 (19.9)	40 (23.7)
Hematopoietic cell transplant in past	23 (13.1)	15 (8.9)
Inpatient at enrollment	137 (77.8)	119 (70.4)
In school	137 (77.8)	131 (77.5)
Guardian married	140 (79.5)	129 (76.3)
Guardian employment full time	87 (49.4)	97 (57.4)
Guardian education ≥college	137 (77.8)	143 (84.6)
Annual household income ≥$60 000	98 (55.7)	90 (53.3)

[a] Race was reported by a participant's parent or guardian among limited categories, with more than 1 option available for selection.

problems with thinking or remembering things with usual care, this intervention only occurred 5 times in total.

eTable 5 in Supplement 2 also shows that when the symptom and interventions analyses were restricted to symptoms with an SSPedi score of 1 or higher, hurt or pain and constipation were documented significantly more often in the symptom screening group. Symptom screening was associated with nonsignificantly more documentation for mucositis (difference, 21.0%; 95% CI, 0.3%-39.5%) and more interventions for constipation (difference, 17.8%; 95% CI, 0.4%-33.6%). When symptom and interventions analyses were restricted to symptoms with an SSPedi score of 3 or higher, symptom screening was associated with significantly more documentation for constipation and more interventions for feeling cranky or angry. Overall, 5 symptoms (pain, changes in hunger, peripheral neuropathy, constipation, and anger) were documented or treated significantly more often with symptom screening.

Discussion

In this study, we showed that daily symptom screening and provision of symptom reports to the health care team for 5 consecutive days reduced total symptom burden compared to usual care. This improvement was observed across a range of individual symptoms, with significantly higher documentation and intervention provision rates for 5 symptoms.

It is interesting that many psychosocial symptoms improved with symptom screening, including feeling disappointed or sad, scared or worried, and cranky or angry. These symptoms are less amenable to pharmacological therapies, and it is possible that acknowledgment of the symptom or the ability to talk about them helped participants feel better.

While the mean difference in total SSPedi score of 2.5 was statistically significant, this fell below the minimal important difference of 2.7 used for sample size calculation. We believe this change, while below the set threshold, is meaningful for the following reasons. First, minimal important difference is an estimate, and the difference between 2.5 and 2.7 is likely not clinically discernible. Second, 2.7 was the mean difference among pediatric participants reporting they were a little better or worse on follow-up assessment. This means that many participants who reported a change in their clinical status had smaller differences than 2.7. Third, as symptom screening was only applied for 5 days, longer duration may result in larger differences.

SSPedi was chosen to serve as both the intervention and outcome because our goal was to reduce bothersome symptoms, and SSPedi was the only validated instrument to measure this construct in this population when the study was developed.[2] In addition, we were worried that QOL measures would not be sensitive enough to detect meaningful changes, which explains why QOL was a secondary outcome. In fact, despite showing significant differences in total SSPedi scores between groups, significant differences were not observed in FPS-R or PedsQL 3.0 Acute Cancer Module domain scores. Potential explanations include the difference in constructs measured by these instruments. SSPedi focuses on bother, while FPS-R and PedsQL focus on severity and frequency. Second, the mean day 5 FPS-R score in the control group was 1.4 (on a 0 to 10 scale). Thus, the analysis may have been disadvantaged by a floor effect, leaving little room for reduction of average pain severity. Finally, it is possible that daily

Table 2. Primary and Secondary Participant-Reported Outcomes by Group

Outcome	Mean (SD)				Treatment effect estimate[a]		
	Baseline		Day 5		Mean difference (95% CI)		
	Symptom screening (n = 175)	Usual care (n = 169)	Symptom screening (n = 168)	Usual care (n = 164)	Unadjusted	Adjusted	*P* value, adjusted
Primary outcome							
Total SSPedi score	13.2 (8.0)	13.1 (8.2)	10.2 (7.4)	12.7 (8.3)	−2.5 (−4.2 to −0.8)	−2.5 (−3.8 to −1.2)	<.001
Secondary outcomes							
Faces Pain Scale-Revised score	1.6 (1.9)	1.4 (1.9)	1.7 (2.1)	1.4 (1.9)	0.3 (−0.2 to 0.7)	0.2 (−0.2 to 0.5)	.42
PedsQL 3.0 Acute Cancer Module domain scores							
Pain and hurt	66.5 (26.5)	68.3 (24.5)	73.1 (22.6)	72.8 (26.1)	0.4 (−4.9 to 5.6)	1.4 (−3.0 to 5.9)	.53
Nausea	69.2 (22.2)	71.6 (20.7)	69.2 (21.8)	69.5 (22.7)	−0.3 (−5.1 to 4.5)	0.3 (−3.3 to 3.8)	.89
Procedural anxiety	65.5 (29.4)	63.8 (32.7)	69.5 (29.9)	66.5 (31.8)	3.0 (−3.7 to 9.7)	2.5 (−1.3 to 6.3)	.20
Treatment anxiety	77.0 (25.7)	78.6 (25.8)	80.5 (23.7)	81.9 (23.5)	−1.4 (−6.5 to 3.7)	0.3 (−2.9 to 3.4)	.87
Worry	62.4 (26.9)	62.9 (27.0)	68.7 (26.2)	69.1 (25.4)	−0.4 (−6.1 to 5.2)	0.3 (−2.9 to 3.5)	.85
Cognitive problems	69.7 (21.3)	70.1 (21.3)	74.2 (21.4)	74.4 (21.3)	−0.2 (−4.8 to 4.4)	0.5 (−2.2 to 3.2)	.71
Perceived physical appearance	75.3 (24.4)	75.4 (26.2)	79.2 (22.6)	78.2 (25.5)	1.0 (−4.2 to 6.2)	1.4 (−1.8 to 4.7)	.39
Communication	72.9 (22.7)	75.1 (23.1)	76.4 (22.3)	78.1 (21.2)	−1.7 (−6.4 to 3.0)	0.3 (−3.0 to 3.5)	.87

Abbreviation: SSPedi, Symptom Screening in Pediatrics Tool.

[a] For continuous outcomes, treatment effect was mean difference; analysis of covariance was adjusted for baseline SSPedi score, 2 stratification variables (age group and treatment), diagnosis group, and relapse status.

Table 3. Symptom Screening in Pediatrics Tool (SSPedi) Symptom Secondary Outcomes by Group

SSPedi symptoms	Describing severely bothersome SSPedi symptoms, No. (%)[a]				Evaluating symptoms as ordinal outcomes, treatment effect estimate[b]		
	Baseline		Day 5		OR (95% CI)		
	Symptom screening (n = 175)	Usual care (n = 169)	Symptom screening (n = 168)	Usual care (n = 164)	Unadjusted	Adjusted	*P* value, adjusted
Feeling disappointed or sad	18 (10.3)	11 (6.5)	8 (4.8)	10 (6.1)	0.63 (0.41-0.95)	0.54 (0.35-0.84)	.007
Feeling scared or worried	18 (10.3)	17 (10.1)	4 (2.4)	6 (3.7)	0.60 (0.39-0.91)	0.46 (0.29-0.72)	<.001
Feeling cranky or angry	10 (5.7)	11 (6.5)	8 (4.8)	16 (9.8)	0.69 (0.46-1.03)	0.63 (0.41-0.97)	.04
Problems with thinking or remembering things	11 (6.3)	8 (4.7)	2 (1.2)	9 (5.5)	0.56 (0.36-0.88)	0.53 (0.33-0.86)	.01
Changes in how your body or face look	16 (9.1)	15 (8.9)	9 (5.4)	18 (11.0)	0.69 (0.45-1.05)	0.66 (0.42-1.05)	.08
Feeling tired	55 (31.4)	54 (32.0)	31 (18.5)	53 (32.3)	0.70 (0.47-1.04)	0.69 (0.47-1.03)	.07
Mouth sores	12 (6.9)	9 (5.3)	9 (5.4)	12 (7.3)	0.83 (0.51-1.35)	0.77 (0.46-1.29)	.32
Headache	10 (5.7)	11 (6.5)	8 (4.8)	8 (4.9)	0.68 (0.44-1.03)	0.69 (0.44-1.07)	.10
Hurt or pain (other than headache)	24 (13.7)	24 (14.2)	15 (8.9)	22 (13.4)	0.84 (0.56-1.26)	0.72 (0.47-1.10)	.13
Tingly or numb hands or feet	10 (5.7)	5 (3.0)	4 (2.4)	4 (2.4)	0.64 (0.39-1.04)	0.58 (0.34-1.00)	.05
Throwing up or feeling like you may throw up	17 (9.7)	19 (11.2)	17 (10.1)	23 (14.0)	0.66 (0.44-0.97)	0.64 (0.43-0.95)	.03
Feeling more or less hungry than you usually do	40 (22.9)	30 (17.8)	21 (12.5)	35 (21.3)	0.68 (0.46-1.01)	0.66 (0.44-0.99)	.04
Changes in taste	24 (13.7)	19 (11.2)	14 (8.3)	18 (11.0)	0.89 (0.59-1.34)	0.83 (0.54-1.28)	.40
Constipation (hard to poop)	16 (9.1)	10 (5.9)	6 (3.6)	14 (8.5)	0.61 (0.39-0.94)	0.57 (0.37-0.90)	.02
Diarrhea (watery, runny poop)	15 (8.6)	11 (6.5)	8 (4.8)	11 (6.7)	1.00 (0.61-1.63)	0.89 (0.52-1.50)	.65

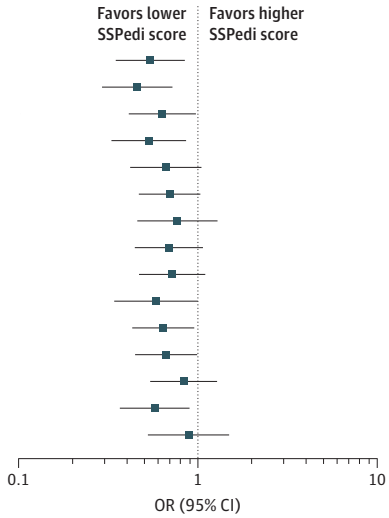
Abbreviation: OR, odds ratio.

[a] Score of 3 or 4 on a 5-point degree of bother Likert scale ranging from 0 (not at all bothered) to 4 (extremely bothered).

[b] For individual SSPedi symptoms, treatment effect is odds ratio; proportional odds model adjusted for baseline SSPedi score and 2 stratification variables.

Figure 2. Association Between Symptom Screening Intervention and Higher (ie, Worse) Symptom Screening in Pediatrics Tool (SSPedi) Scores for Each Symptom Included in SSPedi at Day 5

Symptom	OR (95% CI)
Feeling disappointed or sad	0.54 (0.35-0.84)
Feeling scared or worried	0.46 (0.29-0.72)
Feeling cranky or angry	0.63 (0.41-0.97)
Problems with thinking or remembering things	0.53 (0.33-0.86)
Changes in how your body or face look	0.66 (0.42-1.05)
Feeling tired	0.69 (0.47-1.03)
Mouth sores	0.77 (0.46-1.29)
Headache	0.69 (0.44-1.07)
Hurt or pain (other than headache)	0.72 (0.47-1.10)
Tingly or numb hands or feet	0.58 (0.34-1.00)
Throwing up or feeling like you may throw up	0.64 (0.43-0.95)
Feeling more or less hungry than you usually do	0.66 (0.44-0.99)
Changes in taste	0.83 (0.54-1.28)
Constipation (hard to poop)	0.57 (0.37-0.90)
Diarrhea (watery, runny poop)	0.89 (0.52-1.50)



Odds ratios from a proportional odds model adjusting for baseline SSPedi score and 2 stratification variables (age group and treatment). An odds ratio less than 1 suggests that symptom screening was associated with a lower SSPedi score for that symptom, or less bothersome symptoms. OR indicates odds ratio.

administration of SSPedi leads to habituation, or a decreased perception of symptoms. However, similar total SSPedi scores at baseline and day 5 in usual care participants argues against habituation. Strengths of this study include its randomized and multicenter design.

Limitations

The results of this study should be considered in the context of several limitations. First, while we provided access to clinical practice guidelines, we know that guidelines are difficult to use in routine clinical care.[21] A better strategy might have been to enable access to adapted care pathways, an approach used in our more recent research.[22] Second, it is possible that there was contamination, in that health care professionals caring for intervention participants may have had heightened awareness of symptoms and may have behaved differently for control participants under their care. Thus, these results may be an underestimation of the true treatment effect. Third, given the multiple secondary analyses, these results should be considered hypothesis generating. Fourth, we did not compare specific intervention details, such as specific medication administrations.

Conclusions

In this randomized clinical trial, among pediatric participants with cancer in Canada admitted to hospital or seen in clinic daily for at least 5 days, symptom screening with health care team feedback improved total symptom scores compared to usual care. Future work should focus on implementation of symptom screening into routine care and facilitation of symptom-specific and clinical practice guideline-consistent care delivery.

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