

Stoma Location and Ostomy-Related Quality of Life Among Cancer Survivors with Ostomies: A Pooled Analysis

Julia Mo

University of Pennsylvania Hospital: Hospital of the University of Pennsylvania <https://orcid.org/0000-0002-6850-2184>

Virginia Sun

City of Hope Department of Population Sciences

Mark C. Hornbrook

Kaiser Permanente Center for Health Research

Marcia Grant

City of Hope Division of Nursing Research and Education

Elizabeth Ercolano

Yale University School of Nursing

S. Bruce Malkowicz

University of Pennsylvania Hospital: Hospital of the University of Pennsylvania

Nancy J. Tallman

Wound, Ostomy, and Continency Nurse

Ruth C. McCorkle

Yale University School of Nursing

Robert S. Krouse (✉ robert.krouse@penncmedicine.upenn.edu)

University of Pennsylvania Hospital: Hospital of the University of Pennsylvania <https://orcid.org/0000-0002-7176-461X>

Research

Keywords: Cancer survivors, ostomy, colostomy, ileostomy, urostomy, stoma location, HRQOL

Posted Date: January 13th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-141891/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at The American Journal of Surgery on September 1st, 2021. See the published version at <https://doi.org/10.1016/j.amjsurg.2021.09.023>.

Abstract

INTRODUCTION Ostomies have substantial impacts on many aspects of cancer survivors' daily lives. We sought to describe how stoma location may affect clothing style, ostomy appliance leakage, skin irritation around the stoma, weight changes after ostomy surgery, and health-related quality of life (HRQOL). **METHODS** A pooled dataset was obtained from three multi-site studies that had used the modified City of Hope Quality of Life-Ostomy questionnaire to measure HRQOL and ostomy-specific concerns in cancer survivors with ostomies. Questions pertaining to stoma location, clothing issues, weight change since ostomy surgery, and HRQOL were analyzed. Ostomy bag change frequency was assessed in two of the three studies. Respondents were categorized by self-reported stoma location quadrant: lower left side, upper left side, lower right side, or upper right side. Predicted means for HRQOL and individual items were generated for every stoma location, adjusting for sex, ostomy type (fecal or urinary), and body mass index (BMI). **RESULTS** Of 607 cancer survivors included in this analysis, abdominal quadrant ostomy groups were: 138 (23%) upper left, 298 (49%) lower left, 51 (8%) upper right, and 120 (20%) lower right. The majority of participants (>50%) reported changing their clothing styles due to their ostomies. Cancer survivors with ostomies on the lower right side had significantly more weight gain after ostomy surgery ($p=0.02$) and reported more frequent ostomy bag changes or emptying over a 24-hour period. Overall HRQOL did not vary by stoma location, with predicted means of 6.90 to 7.18 (out of 10). Survivors with ostomies on the right half of the abdomen reported statistically significantly different QOL scores spiritual well-being ($p=0.031$), sleep disruptions ($p=0.03$), satisfaction with appearance ($p<0.001$) and interference with social activities ($p=0.005$) compared to survivors with ostomies on the left half of the abdomen. **DISCUSSION** Stoma location is associated with HRQOL, ostomy bag usage, and difficulties related to adjusting to the ostomy, which may affect long-term survivorship and QOL. Moreover, even after controlling for ostomy type, there were sustained significant differences in ostomy-related QOL associated with stoma location. Our results indicate that stoma location should be considered when designing interventions for cancer survivors with ostomies.

Introduction

A stoma, or ostomy, is the externalization of the bowel to serve as an outlet for stool or urine. The location of the stoma is individualized for each patient based on type of stoma and body habitus. The stoma is typically placed on the lower abdomen for optimal care; however, for obese patients, the stoma may be placed higher on the abdomen to improve visibility. In addition, skin creases, belt lines, and the umbilicus should be considered to ensure quality of the skin seal and adherence of the skin seal and ostomy appliance (1). A poorly positioned stoma may incur additional health care expenses and exacerbate maladaptive behaviors (2).

Current literature suggests that cancer survivors with ostomies face various challenges to their health-related quality of life (HRQOL), including body image issues (3, 4), intimacy problems (3, 5–7), decreases in psychological well-being (7–9) and spiritual HRQOL (10), and difficulty returning to work (11). Additionally, we have observed sex-specific trends in HRQOL concerns among rectal cancer survivors with

ostomies, such as worse feelings of depression among men with ostomies and worsening perceptions of HRQOL for females with ostomies (12). However, while various studies have investigated the impact an ostomy has on a cancer survivor's daily life, little research has been done to examine how stoma location affects HRQOL and ostomy-specific issues.

A thorough analysis of the impact of stoma location on HRQOL and ostomy-specific issues can inform the development, testing, and implementation of robust, evidence-based self-care recommendations for cancer survivors with ostomies. The objective of this pooled analysis was to explore the relationships between issues encountered by cancer survivors with ostomies and location of the stoma on the abdomen. Specifically, we attempted to answer the following questions: 1) Does stoma location affect ostomy bag usage, weight changes after surgery, or clothing adjustments made to accommodate the ostomy? 2) Does HRQOL vary by stoma location? We hypothesized that HRQOL and ostomy-related quality of life will vary by stoma location.

Methods

Studies included in the pooled analysis

We utilized three studies from our team that used the Modified City of Hope Quality of Life-Ostomy (mCOH-QOL-O) survey (13) to assess HRQOL: HRQOL in Colorectal Cancer Survivors with Stomas (Grant # NCI R01 CA106912, "Study 1"); the renewal of HRQOL in Colorectal Cancer Survivors with Stoma, a continuation of Study 1 (Renewal of Grant # NCI R01 CA106912, "Study 2"); and the OSMT Telehealth Intervention (Grant # CDR 1507-31690, "Study 3"). Study 1 was a cross-sectional mail survey study that collected HRQOL data from colorectal cancer survivors with ostomies and those without ostomies (12). Study 2 expanded data collection among minority patients and further investigated behavioral and dietary adjustments in relation to long-term outcomes (14). The most recent study, Study 3, was initiated to test a telehealth-enabled ostomy self-management program, which was developed for any cancer survivor with an ostomy and was based on lessons learned from the previous studies mentioned (15). Unlike Study 1 and Study 2, which only collected data from cancer survivors with colostomies or ileostomies, Study 3 collected data from cancer survivors with colostomies, ileostomies, or urostomies. Study 2 and Study 3 included cancer survivors with temporary ostomies.

Stoma Location

The mCOH-QOL-O instrument contained scaled HRQOL questions, non-scaled questions that assessed demographic, personal (e.g. diet, physical activity), and clinical data, and open-ended questions related to ostomy-specific issues and challenges. At baseline for all three studies, respondents reported stoma location on the mCOH-QOL-O survey by marking the location on an image of an abdomen (Fig. 1) and also by choosing the abdominal quadrant that the stoma falls under: upper left side, lower left side, upper right side, or lower right side.

Self-Care Events

Weight changes after ostomy surgery, issues with clothing, and clothing changes due to the ostomy were selected as self-care events for this analysis. Demographics were obtained from survey responses, including approximate weight at the time of the ostomy surgery, current weight and height. Approximate weight at ostomy surgery and current weight were used to calculate weight change. Self-reported current weight and height were used to calculate body mass index (BMI). Data relevant to clothing issues or clothing changes due to the ostomy were obtained from the non-scaled portion of the mCOH-QOL-O survey.

Ostomy Bag Usage

Ostomy bag change or emptying frequency was not assessed Study 1, but the renewal study, Study 2, collected responses from a modified version of the Memorial Sloan-Kettering Cancer Center Bowel Function Index (BFI) (16) that asked respondents to report on the changing or emptying of the ostomy bag in a typical 24-hour period. Study 3 utilized a separate burden of ostomy care survey, which was based on the model developed by Given et al. for long-term care (17), to collect data on ostomy-related health care utilization, including ostomy bag usage and emptying. In Study 3, participants were asked to report their frequency of ostomy bag emptying or changes in the past 24 hours by selecting one of the following categories: 1–4 times; 5–8 times; or more than eight times. The responses collected from Study 2 were then converted into the categorical buckets that Study 3 utilized: for example, if a respondent in Study 2 reported emptying his ostomy bag three times in the past 24 hours, that response would be categorized as “1–4 times” in the dataset.

HRQOL

The scaled, 43-item HRQOL portion of the mCOH-QOL-O instrument was designed for adults with ostomies (ostomates) and has a four domain framework (physical, psychological, social and spiritual well-being) (13). Participants were asked to rate each item as it related to their ostomy on a 10-point scale, with higher scores indicating better QOL. Overall HRQOL and sub-scale scores were derived by arithmetic mean of non-missing items. To further examine the impact of stoma location on specific aspects of an ostomate’s daily life, the following individual items were selected in an exploratory manner: sleep disruptions, odor, issues with the skin surrounding the ostomy, leaking from the pouch, difficulty adjusting to the ostomy, difficulty caring for the ostomy, satisfaction with appearance, interference with sports or recreational activities, interference with social activities, and ability to be intimate. For all individual items, overall HRQOL, and sub-scale scores, higher scores indicated higher QOL.

Statistical Analyses

Data were analyzed using R 3.5.0 (18). A p-value of less than 0.05 was considered statistically significant. Participants with multiple ostomies (N = 7) or with incomplete stoma data, such as no ostomy type or location reported, (N = 48) were excluded from all analyses. After exclusion, the final analysis sample was 612 cancer survivors with ostomies. Patient and study demographics were summarized descriptively for each study and for the pooled sample. Rates of self-care event incidence were recorded

for each stoma location quadrant and compared using Fisher's exact test for categorical variables and one-way ANOVA for continuous variables. Due to small sample size, ostomy bag usage was only summarized descriptively using a stacked bar chart from the R package ggplot2 (19). Adjusted means and standard errors for HRQOL and stoma location-related items were generated controlling for sex, ostomy type (fecal or urinary) and BMI. Two comparisons were conducted (left half versus right half of the abdomen, and upper half versus lower half of the abdomen) using two-way ANOVA, adjusting for sex and BMI. No adjustments were made for multiple comparisons.

Two additional sub-analyses for HRQOL were conducted with and without the urostomy respondent population (11% of the total sample). Due to small sample size, overall HRQOL, sub-domains, and individual ostomy-related items were summarized descriptively for cancer survivors with urostomies on the upper right quadrant and lower right quadrant. These two stoma location quadrants were selected because urostomy stomas are typically placed on the right side of the abdomen due to anatomical restrictions (i.e. the stoma must be within the mesenteric range). We compared the two urostomy stoma location quadrants using two-tailed unpaired t-tests. The other analysis excluded urostomy respondents and only looked at survivors with either a colostomy or ileostomy. Similarly, predicted means and standard errors, adjusted for sex and BMI, were generated for this sample, and differences were evaluated using two-way ANOVA controlling for those two factors.

Results

Patient Demographics

Six hundred and seven cancer survivors with ostomies were included in this analysis. Table 1 presents participant demographics. Overall, 60% of the participants were male, 81% were age 60 or older, and 40% had BMI of 24.9 or lower. Study 1 and Study 2 recruited colorectal cancer survivors with either colostomies or ileostomies, with 90–93% of participants having a colostomy. For Study 3, which accrued patients with any type of ostomy (colostomy, ileostomy, or urostomy), 43% of participants had colostomies, 21% had ileostomies, and 36% had urostomies. Most colostomies (90%) were located on the left side of the abdomen, whereas a majority of ileostomies (83%) and urostomies (97%) were situated on the right side of the abdomen. Overall, 68–79% of ostomies were located in the lower half of the abdomen.

Table 1
Participant characteristics^a

	All (N = 607)	Study 1: HRQOL in Colorectal Cancer Survivors with Stomas (N = 264)	Study 2: Renewal to HRQOL in Colorectal Cancer Survivors with Stomas (N = 158)	Study 3: OSMT Telehealth Intervention (N = 185)
Sex	363 (60%)	153 (58%)	105 (66%)	105 (57%)
Male	244 (40%)	111 (42%)	53 (34%)	80 (43%)
Female				
Age at baseline	35 (6%)	6 (2%)	3 (2%)	26 (14%)
49 and younger	80 (13%)	32 (12%)	8 (5%)	40 (22%)
50–59	154 (25%)	61 (23%)	39 (25%)	54 (29%)
60–69	201 (33%)	99 (38%)	55 (35%)	47 (25%)
70–79	137 (23%)	66 (25%)	53 (34%)	18 (10%)
80 and older				
BMI (kg/m) ²	244 (40%)	99 (38%)	64 (41%)	81 (44%)
<24.9	215 (35%)	102 (39%)	58 (37%)	55 (30%)
25.0-29.9	141 (23%)	59 (22%)	35 (22%)	47 (25%)
≥30.0	7 (1%)	4 (2%)	1 (1%)	2 (1%)
Unknown/Not reported				
Type of Ostomy	465 (77%)	238 (90%)	147 (93%)	80 (43%)
Colostomy	76 (13%)	26 (10%)	11 (7%)	39 (21%)
Ileostomy	66 (11%)	-	-	66 (36%)
Urostomy				

^a Percentages are rounded to the nearest whole number

	All (N = 607)	Study 1: HRQOL in Colorectal Cancer Survivors with Stomas (N = 264)	Study 2: Renewal to HRQOL in Colorectal Cancer Survivors with Stomas (N = 158)	Study 3: OSMT Telehealth Intervention (N = 185)
Stoma Location	138 (23%)	64 (24%)	43 (27%)	31 (17%)
Upper left side	298 (49%)	155 (59%)	95 (60%)	48 (26%)
Lower left side	51 (8%)	22 (8%)	4 (3%)	25 (14%)
Upper right side	120 (20%)	23 (9%)	16 (10%)	81 (44%)
Lower right side				
^a Percentages are rounded to the nearest whole number				

Self-Care Event Incidence

Table 2 summarizes self-care event incidence by stoma location. Clothing issues and clothing style changes did not vary by stoma location, with 37–43% of participants reporting clothing issues and 50–62% of participants reporting clothing style changes due to their ostomy, across all four stoma location quadrants. No statistically significant differences were observed. Participants with ostomies on the lower right side of the abdomen experienced a higher frequency of weight gain after ostomy surgery (68%) compared to the other three quadrants ($p = 0.02$). Median weight gain from ostomy surgery for participants with ostomies on the lower right side was 15 pounds. Weight loss was experienced more frequently in participants with ostomies on the upper left side, lower left side, and upper right side compared to those with ostomies on the lower right side ($p = 0.002$).

Table 2
Self-care event incidence by stoma location

	Upper Left Side (N = 138)	Lower Left Side (N = 298)	Upper Right Side (N = 51)	Lower Right Side (N = 120)	p-value
Issues with clothing	59 (42.8)	114 (38.3)	19 (37.3)	45 (37.5)	0.79
Changed style of clothing	81 (58.7)	159 (53.4)	32 (62.7)	60 (50.0)	0.32
Change in body mass after ostomy surgery					
Weight gain	70 (50.7)	156 (52.3)	30 (58.8)	81 (67.5)	0.02
No change	13 (9.4)	17 (5.7)	5 (9.8)	14 (11.7)	0.15
Weight loss	51 (37.0)	111 (37.2)	15 (29.4)	23 (19.2)	0.002

Ostomy Bag Usage

Only two studies collected ostomy bag usage data: Study 2 and Study 3. The frequency of ostomy bag usage is shown in Fig. 2. Out of 310 respondents, 178 (57%) participants reported changing or emptying their ostomy bag 1–4 times in the past 24 hours. Over half of these participants had ostomies located in the lower left side of the abdomen. Participants with ostomies on the lower right side of the abdomen reported changing or emptying their ostomy bag more often, with 79% of respondents reporting five or more bag changes or emptying events in the past 24 hours. A majority of participants with colostomies (69%) reported changing or emptying their ostomy bag 1–4 times in the past 24 hours, whereas most of the participants with ileostomies (75%) and with urostomies (79%) reported changing or emptying their ostomy bag five or more times a day.

HRQOL

Adjusted HRQOL scores by the four stoma location quadrants are presented in Table 3. Overall HRQOL scores did not vary by stoma location, with predicted means of 6.90 to 7.18. Participants with ostomies on the left side of the abdomen had statistically significantly different QOL scores for spiritual well-being ($p = 0.031$), sleep disruptions ($p = 0.03$), satisfaction with appearance ($p < 0.001$) and interference with social activities ($p = 0.005$). In a separate analysis excluding survivors with urostomies, interference with social activities ($p = 0.03$), and satisfaction with appearance ($p = 0.001$) retained significance when comparing the left and right side of the abdomen for cancer survivors with fecal (colostomy or ileostomy) ostomies.

Table 3
 HRQOL and individual QOL items by stoma location, adjusted for ostomy type (fecal or urinary), BMI and sex

	Upper Left Side (N = 124)	Lower Left Side (N = 287)	Upper Right Side (N = 46)	Lower Right Side (N = 94)
Total QOL	7.18 (0.50)	7.16 (0.79)	6.90 (0.27)	6.98 (0.22)
Physical Well-being	8.18 (0.56)	7.91 (0.91)	6.82 (0.30)	7.34 (0.24)
Sleep disruptions	7.49 (0.80) ^a	7.50 (1.51) ^a	7.00 (0.56)	7.32 (0.38)
Odor	7.80 (0.87)	8.71 (1.28)	6.62 (0.62)	7.88 (0.40)
Issues with skin surrounding the ostomy	8.44 (0.82)	9.10 (1.28)	7.35 (0.53)	7.60 (0.36)
Leaking from pouch	8.36 (0.81)	8.55 (1.38)	7.56 (0.62)	7.31 (0.38)
Psychological Well-being	6.72 (0.55)	7.03 (0.87)	6.94 (0.29)	6.83 (0.26)
Difficulty adjusting to the ostomy	6.45 (0.86)	6.77 (1.52)	6.56 (0.50)	6.97 (0.41)
Difficulty caring for the ostomy	7.24 (0.79)	6.83 (1.37)	7.23 (0.57)	7.04 (0.39)
Satisfaction with appearance	6.86 (0.82) ^a	4.96 (1.28) ^a	6.71 (0.55)	6.69 (0.40)
Social Well-being	6.86 (0.67)	7.39 (1.08)	6.97 (0.42)	7.33 (0.26)
Interference with recreational/sports activities	4.95 (1.16)	5.96 (2.01)	5.78 (0.79)	5.73 (0.50)
Interference with social activities	7.44 (0.78) ^a	9.33 (1.35) ^a	8.43 (0.42)	7.97 (0.45)
Ability to be intimate	5.33 (1.07)	5.08 (1.65)	4.28 (0.95)	7.21 (0.49)

^a p < 0.05 compared to the right side (upper + lower)

Higher scores indicate higher QOL on the mCOH-QOL-0

	Upper Left Side (N = 124)	Lower Left Side (N = 287)	Upper Right Side (N = 46)	Lower Right Side (N = 94)
Spiritual Well-being	7.11 (0.65) ^a	5.92 (1.11) ^a	6.88 (0.43)	6.11 (0.29)
^a p < 0.05 compared to the right side (upper + lower)				
Higher scores indicate higher QOL on the mCOH-QOL-0				

Although the differences were not significant, cancer survivors with ostomies on the upper half of the abdomen (left and right) reported consistently worse adjusted scores for odor (-0.91, -1.26, on a 10-point scale), issues with skin surrounding the ostomy (-0.66, -0.25), difficulty adjusting to the ostomy (-0.32, -0.41), and social well-being (-0.53, -0.36). Survivors with ostomies on the upper half of the abdomen reported slightly higher (better) scores for difficulty caring for the ostomy (+ 0.41, + 0.19), satisfaction with appearance (+ 1.90, + 0.02), and spiritual well-being (+ 1.19 + 0.77) compared to those with ostomies on the lower half of the abdomen (left and right), respectively. Additionally, survivors with ostomies on the right side of the abdomen (upper right and lower right side) had consistently worse scores for satisfaction with appearance (-0.76, -0.81), difficulty caring for the ostomy (-0.44, -1.09), and interference with social activities (-0.48, -0.39), though all of these differences were also not statistically significant.

Only 39 cancer survivors with urostomies from Study 3 completed the scaled portion of the mCOH-QOL-0 survey: 8 had urostomies on the upper right quadrant and 31 had urostomies on the lower right quadrant. Table 4 presents mean and standard deviation for overall HRQOL and individual items for cancer survivors with urostomies. Survivors with urostomies on the upper right side had significantly different QOL scores for social well-being (p = 0.004), interference with recreational or sports activities (p = 0.032) and ability to be intimate (p = 0.008).

Table 4

HRQOL and individual QOL items by stoma location for cancer survivors with urostomies¹

	Upper Right Side (N = 8)	Lower Right Side (N = 31)
Total QOL	6.30 (0.69)	7.36 (1.57)
Physical Well-being	6.69 (1.31)	7.81 (1.66)
Sleep disruptions	7.25 (2.38)	7.87 (2.47)
Odor	7.13 (2.75)	8.29 (2.07)
Issues with skin surrounding the ostomy	7.38 (2.00)	7.73 (2.24)
Leaking from pouch	8.38 (1.3)	7.77 (2.84)
Psychological Well-being	6.45 (0.79)	7.30 (2.01)
Difficulty adjusting to the ostomy	6.38 (2.33)	7.32 (2.66)
Difficulty caring for the ostomy	8.38 (1.85)	8.10 (2.06)
Satisfaction with appearance	5.38 (1.85)	6.90 (2.66)
Social Well-being	6.14 (1.09) ^a	7.71 (1.47)
Interference with recreational/sports activities	4.38 (2.67) ^a	6.97 (2.63)
Interference with social activities	6.63 (1.77)	7.65 (2.89)
Ability to be intimate	3.00 (2.68) ^a	7.43 (3.23)
Spiritual Well-being	5.70 (1.96)	6.23 (2.11)
¹ All items are presented as mean (standard deviation)		
^a p < 0.05 compared to the lower right side		
Higher scores indicate higher QOL on the mCOH-QOL-O		

Discussion

The aim of this pooled analysis was to examine the impact stoma location may have on ostomy-related issues and HRQOL in cancer survivors. Our results suggest that cancer survivors with ostomies may experience different self-care events and may report varying severity of ostomy-specific QOL issues, depending on stoma location.

Overall, about half of our participants experienced clothing issues and changed their clothing style due to their ostomies. Clothing restrictions and adaptations were identified as common and persistent concerns

for long-term colorectal cancer survivors with ostomies, with both male and female ostomates reporting the need to wear large, loose-fitting shirts and pants to accommodate their ostomies (20). Stoma location may further motivate clothing style changes because the ostomy bag extends past the stoma at varying lengths, which can result in skin irritation or discomfort. For example, the edges of the ostomy bag may scratch against the genitalia or inner thigh if the stoma is located on the lower half of the abdomen. As a result, an ostomate may wear different underwear or opt for smaller ostomy bags, but these choices can result in more frequent bag changes to prevent overflow and increased costs. Furthermore, as ostomies can cause permanent changes in perceived body image (3), clothing style adaptations may further exacerbate this negative impact, regardless of stoma location.

Our results revealed that a majority of our participants experienced weight change after their ostomy surgery, with about half of the participants gaining weight post-surgery. This may be due to behavioral adjustments to cope with the ostomy, such as avoidance of physical activity or changes in diet. BMI has been implicated as a significant risk factor for stomal and peristomal complications, such as increased retractions, skin irritation, and peristomal hernias (21–23). Weight change in particular was shown to be associated with an increased risk of ostomy-related issues in long-term colorectal cancer survivors (24). An increase in weight may displace the stoma location to a less ideal position, making self-care more time-consuming. In our study, over 60% of cancer survivors with ostomies on the lower right side of the abdomen experienced weight gain, and these survivors also reported a higher frequency of ostomy bag changes or emptying compared to the other three quadrants. This may imply that our population of cancer survivors with ostomies on the lower right side consumed comparatively more calories, resulting in higher stomal output and weight gain. Further research is needed to determine the mechanism behind weight loss and stoma location on the lower right side of the abdomen.

We found that cancer survivors with ostomies on the right side of the abdomen reported on average worse issues with the skin surrounding the ostomy compared to those with ostomies on the left side of the abdomen. Peristomal skin complications may be associated with the composition of the stoma effluent (25) or with ostomy leakage. For example, colostomies placed at the right colon have an output that is more dilute than colostomies at the left colon due to the physiology of the colon: the ascending (right) portion of the colon is responsible for a large majority of water and salt reabsorption compared to the descending (left) colon (26), so effluent from colostomies placed at the left colon would therefore have a lower water content and be less liquid. Additionally, ileostomies tend to have more caustic effluent due to a higher content of proteolytic enzymes and a more alkaline liquid output (25). Similarly, urostomies collect urine, which may cause skin irritation if there is ostomy leakage that exposes the skin to the stoma effluent. Skin complications are a frequent concern for individuals with ostomies (27), and our results suggest further counseling or guidance for proper skin care are needed for cancer survivors who receive ostomies on the right side of their abdomen.

To date, few studies have evaluated the relationship between stoma location and ostomy-related QOL. In colorectal cancer survivors with colostomies or ileostomies, stoma location on the left side of the abdomen was shown to be associated with higher cognitive and social function (28). Similarly, in our

analysis, we found that cancer survivors with ostomies on the left side of the abdomen had significantly different scores for the ostomy's interference with social activities compared to those with ostomies on the right side of the abdomen, but we did not find differences in overall social well-being. This discrepancy can once again be explained by the consistency of the stomal output, as there may be a more pronounced need for frequent ostomy bag changes for survivors with ostomies on the right side of the abdomen, resulting in anxiety of social activities and being out in public. Cancer survivors with ostomies on the right side of the abdomen also reported significantly different scores for sleep disruptions due to the ostomy. Ostomates have difficulty getting an appropriate amount of sleep due to leakage disruptions, sleep position issues, and the need to change ostomy bags (29), all of which may be further exacerbated by stomal output consistency. Overall, cancer survivors with ostomies reported low (< 7/10) scores for the ability to be intimate. Our results mirror prior reports about the negative effect of ostomy on sexuality and intimacy (5, 30, 31), suggesting that intimacy is a pervasive concern for survivors with ostomies regardless of stoma location.

This pooled analysis has a few limitations that should be noted. First, all three studies surveyed highly motivated cancer survivors with ostomies who were willing to respond to surveys (Study 1 and Study 2) or were willing to participate in an ostomy self-management intervention (Study 3). Therefore, our results may not be representative of the general population of cancer survivors with ostomies. Second, as our analysis was exploratory, we did not adjust for multiple comparisons, raising the possibility of false positives (Type I errors). Finally, due to the retrospective nature of our analysis, the timing of the surveys were not standardized across all three studies: participants in Study 3 were eligible after at least 6 weeks had passed after the ostomy surgery, and participants in the other two studies had to be long-term (\geq 5 years post-diagnosis) colorectal cancer survivors, but time since surgery was not specified or collected. Our weight change observations did not consider time since surgery. However, our objective was to begin to explore the relationship between stoma location and incidence of self-care events rather than delve into the minutiae of any one event. In the event that a pattern or association was observed, more rigorous methods can be utilized to further elucidate these observations.

Conclusion

Even when controlling for type of ostomy, stoma location on the right side of a cancer survivor's abdomen was associated with weight gain after ostomy surgery and worse skin irritation issues, interference with social activities, and satisfaction with appearance. The unique experiences encountered by cancer survivors with ostomies on different abdominal quadrants should be considered when providing guidance to new ostomates and when designing interventions to improve HRQOL in these survivors.

Declarations

Ethics approval and consent to participate: All studies were approved by the following Institutional Review Boards: University of Arizona, Kaiser Permanente Northwest, and Kaiser Permanente Northern

California (R01 CA106912); and University of Pennsylvania, Beckman Research Institute of the City of Hope, and Yale University (PCORI CDR1507-31690).

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: A portion of the research reported in this publication was supported through a Patient-Centered Outcomes Research Institute® (PCORI®) Program Award (CDR 1507-31690). All statements presented in this publication are solely the responsibility of the authors and do not necessarily represent the views of the Patient-Centered Outcomes Research Institute® (PCORI®), its Board of Governors or Methodology Committee. Additional portions of the research were supported by National Cancer Institute Grant R01 CA106912, an unrestricted donation from the Sun Capital Partners Foundation, Arizona Cancer Center Support Grant CA023074, and The Benjamin & Mary Siddons Measey Foundation (Miss Mo).

Authors' contributions: JM and RSK contributed to the study conception and design. Material preparation, data collection, and analysis were performed by JM. The first draft of the manuscript was written by JM and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Acknowledgements: Not applicable.

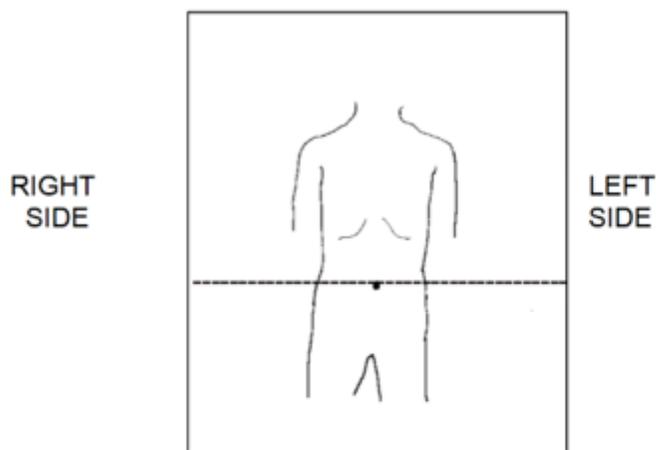
References

1. Brand MI, Dujovny N. **Preoperative Considerations and Creation of Normal Ostomies**. Clin Colon Rectal Surg. 2008 **Feb**;21(1):5–16.
2. BI R. **The value of a well-placed stoma**. Cancer Pract. 1997 Nov 1;5(6):347–52.
3. Kiliç E, Taycan O, Bell AK, Özmen M. **The Effect of Permanent Ostomy on Body Image, Self-Esteem, Marital Adjustment, and Sexual Functioning**:8.
4. Krouse RS, Grant M, Wendel CS, Mohler JM, Rawl SM, Baldwin CM. **et al. A Mixed-Methods Evaluation of Health-Related Quality of Life for Male Veterans with and without Intestinal Stomas: Dis Colon Rectum**. 2007 **Dec**;50(12):2054–66.
5. Sun V, Grant M, Wendel CS, McMullen CK, Bulkley JE, Herrinton LJ. **et al. Sexual Function and Health-Related Quality of Life in Long-Term Rectal Cancer Survivors**. J Sex Med. 2016 **Jul**;13(7):1071–9.
6. Symms MR, Rawl SM, Grant M, Wendel CS, Coons SJ, Hickey S. **et al. Sexual Health and Quality of Life Among Male Veterans With Intestinal Ostomies**. Clin Nurse Spec. 2008 **Feb**;22(1):30–40.
7. Ayaz-Alkaya S. Overview of psychosocial problems in individuals with stoma: A review of literature. Int Wound J. 2019;16(1):243–9.

8. Kenderian S, Stephens EK, Jatoi A. Ostomies in rectal cancer patients: what is their psychosocial impact? *Eur J Cancer Care (Engl)*. 2014;23(3):328–32.
9. Mitchell KA, Rawl SM, Schmidt CM, Grant M, Ko CY, Baldwin CM. **et al. Demographic, Clinical, and Quality of Life Variables Related to Embarrassment in Veterans Living With an Intestinal Stoma: J Wound Ostomy Continence Nurs.** 2007 Sep;34(5):524–32.
10. Baldwin CM, Grant M, Wendel C, Rawl S, Schmidt CM, Ko C. **et al. Influence of Intestinal Stoma on Spiritual Quality of Life of U.S. Veterans. J Holist Nurs.** 2008 Sep 1;26(3):185–94.
11. Sprangers MAG, Taal BGMD, Aaronson NK, te Velde AMS. Quality of life in colorectal cancer: Stoma vs. nonstoma patients. *Dis Colon Rectum*. 1995 Apr;38(4):361–9.
12. Krouse RS, Herrinton LJ, Grant M, Wendel CS, Green SB, Mohler MJ, **et al. Health-Related Quality of Life Among Long-Term Rectal Cancer Survivors With an Ostomy: Manifestations by Sex. J Clin Oncol.** 2009 Oct 1;27(28):4664–70.
13. Grant M, Ferrell B, Dean G, Uman G, Chu D, Krouse R. **Revision and Psychometric Testing of the City of Hope Quality of Life– Ostomy Questionnaire. Qual Life Res.** 2004 Oct 1;13(8):1445–57.
14. Wendel CS, Grant M, Herrinton L, Temple LKF, Hornbrook MC, McMullen CK, **et al. Reliability and validity of a survey to measure bowel function and quality of life in long-term rectal cancer survivors. Qual Life Res.** 2014 Dec 1;23(10):2831–40.
15. Sun V, Ercolano E, McCorkle R, Grant M, Wendel CS, Tallman NJ. **et al. Ostomy telehealth for cancer survivors: Design of the Ostomy Self-management Training (OSMT) randomized trial. Contemp Clin Trials.** 2018 Jan 1;64:167–72.
16. Temple LK, Bacik J, Savatta SG, Gottesman L, Paty PB, Weiser MR. **et al. The Development of a Validated Instrument to Evaluate Bowel Function After Sphincter-Preserving Surgery for Rectal Cancer. Dis Colon Rectum.** 2005 Jul;48(7)(1):1353–65.
17. Given BA, Given CW, Stommel M. Family and out-of-pocket costs for women with breast cancer. *Cancer Pract.* 1994 Jun;2(3):187–93.
18. **R Core Team. R: A Language and Environment for Statistical Computing [Internet]. R Foundation for Statistical Computing; 2020. Available from: <https://www.R-project.org/>.**
19. Wickham H. **ggplot2: Elegant Graphics for Data Analysis [Internet]. Springer-Verlag New York; 2016. Available from: <https://ggplot2.tidyverse.org/>.**
20. Sun V, Grant M, McMullen CK, Altschuler A, Mohler MJ, Hornbrook MC. **et al. Surviving Colorectal Cancer: Long-Term, Persistent Ostomy-Specific Concerns and Adaptations. J Wound Ostomy Cont Nurs Off Publ Wound Ostomy Cont Nurses Soc WOCN.** 2013 Jan;40(1):61–72.
21. Sung YH, Kwon I, Jo S, Park S. Factors Affecting Ostomy-Related Complications in Korea. *J Wound Ostomy Continence Nurs.* 2010 Apr;37(2):166–72.
22. Arumugam PJ, Bevan L, Macdonald L, Watkins AJ, Morgan AR, Beynon J. **et al. A prospective audit of stomas-analysis of risk factors and complications and their management. Colorectal Dis.** 2003;5(1):49–52.

23. Mahjoubi B, Moghimi A, Mirzaei R, Bijari A. Evaluation of the end colostomy complications and the risk factors influencing them in Iranian patients. *Colorectal Dis.* 2005;7(6):582–7.
24. Skeps R, McMullen CK, Wendel CS, Bulkley J, Grant M, Mohler J, **et al.** **Changes in body mass index and stoma related problems in the elderly.** *J Geriatr Oncol.* 2013 Jan 1;4(1):84–9.
25. Herlufsen P, Olsen AG, Carlsen B, Nybaek H, Jemec GB, Karlsmark T. **et al.** Study of peristomal skin disorders in patients with permanent stomas. *Br J Nurs.* 2006 Sep;15(16)(1):854–62.
26. Sandle GI. Salt and water absorption in the human colon: a modern appraisal. *Gut.* 1998 Aug;43(2)(1):294–9.
27. Liao C, Qin Y. **Factors associated with stoma quality of life among stoma patients.** *Int J Nurs Sci.* 2014 Jun 1;1(2):196–201.
28. Ferreira EC, Barbosa MH, Sonobe HM, Barichello E, Ferreira E da Barbosa C **MH, et al.** **Self-esteem and health-related quality of life in ostomized patients.** *Rev Bras Enferm.* 2017 Apr;70(2):271–8.
29. Baldwin Carol M, Marcia G, Christopher W, Hornbrook Mark C, Herrinton Lisa J, McMullen, Carmit. **et al.** Gender Differences in Sleep Disruption and Fatigue on Quality of Life Among Persons with Ostomies. *J Clin Sleep Med.* 2009 Aug;15(04):335–43.. ;05.
30. Wiel HBM. **van D, Schultz WCMW, Hengeveld MW, Staneke A.** **Sexual functioning after ostomy surgery.** *Sex Marital Ther.* 1991 May 1;6(2):195–207.
31. Mahjoubi B, Mirzaei R, Azizi R, Jafarina M, Zahedi-Shoolami L. **A cross-sectional survey of quality of life in colostomates: a report from Iran.** *Health Qual Life Outcomes.* 2012 Nov 21;10(1):136.
32. McDonald ML, Liss MA, Nseyo UU, Gal DB, Kane CJ, Kader AK. **Weight Loss Following Radical Cystectomy for Bladder Cancer. Characterization and Effect on Survival.** *Clin Genitourin Cancer.* 2017 Feb 1;15(1):86–92.

Figures



Please choose one of the following to describe the location of your ostomy?

- Lower Left Side;
- Lower Right Side;
- Upper Left Side;
- Upper Right Side

Figure 1

Baseline COH-QOL-CRC survey question on stoma location, with quadrants reported by patients

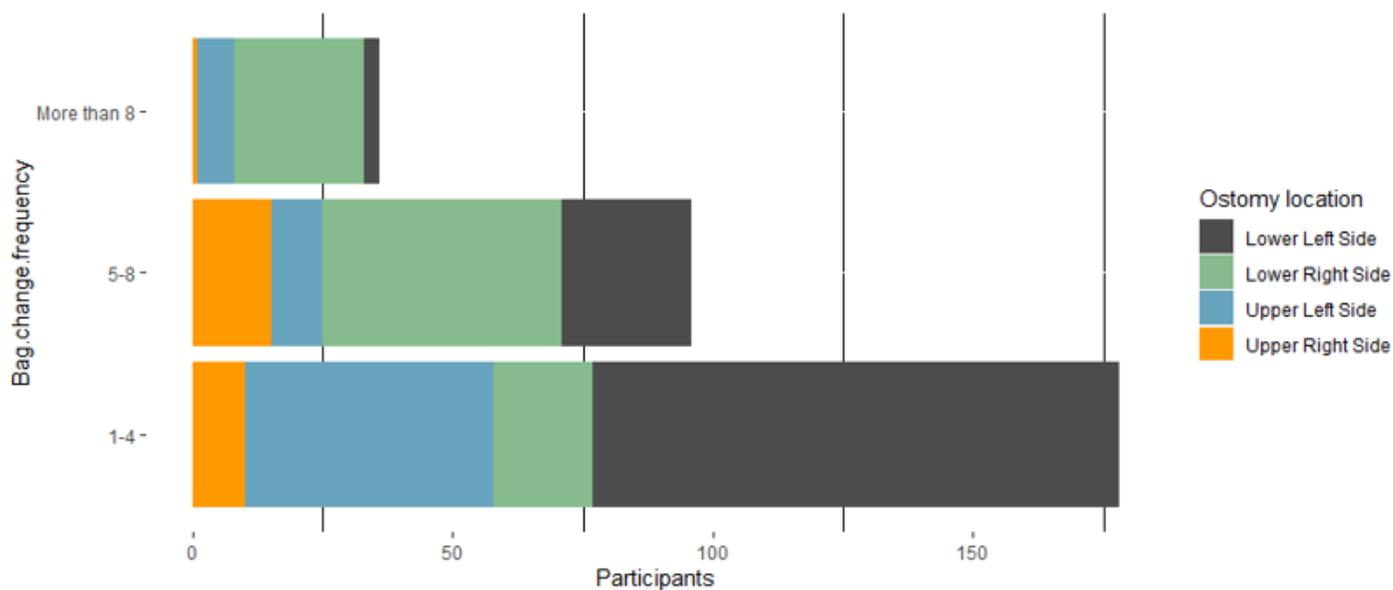


Figure 2

Frequency of ostomy bag changes or emptying in the past 24 hours by stoma location