Published in final edited form as:

Psychooncology. 2018 January ; 27(1): 216–222. doi:10.1002/pon.4439.

The role of body image dissatisfaction in the association between treatment-related scarring or disfigurement and psychological distress in adult survivors of childhood cancer

Stefanie C. Vuotto, PhD¹, Rohit P. Ojha, DrPH¹, Chenghong Li, PhD², Cara Kimberg, PhD¹, James L. Klosky, PhD³, Kevin R. Krull, PhD^{1,3}, Deo Kumar Srivastava, PhD², Leslie L. Robison, PhD¹, Melissa M. Hudson, MD^{1,4}, and Tara M. Brinkman, PhD^{1,3}

¹Department of Epidemiology and Cancer Control, St. Jude Children's Research Hospital, Memphis, Tennessee, 262 Danny Thomas Place, St. Jude Children's Research Hospital, Memphis, TN 38105

²Department of Biostatistics, St. Jude Children's Research Hospital, Memphis, Tennessee, 262 Danny Thomas Place, St. Jude Children's Research Hospital, Memphis, TN 38105

³Department of Psychology, St. Jude Children's Research Hospital, Memphis, Tennessee, 262 Danny Thomas Place, St. Jude Children's Research Hospital, Memphis, TN 38105

⁴Department of Oncology, St. Jude Children's Research Hospital, Memphis, Tennessee, 262 Danny Thomas Place, St. Jude Children's Research Hospital, Memphis, TN 38105

Abstract

Purpose—To examine the potential mediating role of body image dissatisfaction on the association between treatment-related scarring/disfigurement and psychological distress in adult survivors of childhood cancer.

Methods—Participants included 1,714 adult survivors of childhood cancer (mean[SD] age at evaluation = 32.4[8.0] years, time since diagnosis = 24.1[8.1] years) enrolled in the St. Jude Lifetime Cohort Study. Survivors completed measures of body image, emotional distress and posttraumatic stress symptoms (PTSS). Body image dissatisfaction (BID) was categorized into two groups (cancer-related and general) based on factor analysis. Using causal mediation analysis, we estimated the proportion of psychological distress associated with treatment-related scarring/disfigurement that could be eliminated by resolving BID through a hypothetical intervention.

Results—Among survivors with scarring/disfigurement of the head, a sizable proportion of the relative excess of psychological distress could be eliminated if BID was successfully treated (Males: [cancer-related BID: depression: 63%; anxiety: 100%; PTSS: 52%]; [general BID: depression: 70%; anxiety: 100%; PTSS: 42%]; Females: [cancer-related BID: depression: 20%; anxiety: 36%; PTSS: 23%]; [general BID: depression: 32%; anxiety: 87%; PTSS: 38%]). The

Corresponding Author: Tara M. Brinkman, Department of Epidemiology and Cancer Control, 262 Danny Thomas Place, MS 735, St. Jude Children's Research Hospital, Memphis, TN 38105, Phone: 901-595-5891, Fax: 901-595-5845, tara.brinkman@stjude.org.

Conflict of interest: The authors have no conflicts of interest to disclose.

mediating effect of BID was less pronounced for the association between scarring/disfigurement of the body and psychological distress for both males and females.

Conclusions—Body image dissatisfaction mediates the association treatment-related scarring/disfigurement and psychological distress among adult survivors of childhood cancer, particularly among survivors with scarring/disfigurement of the head and male survivors. Successful treatment of body image dissatisfaction has the potential to eliminate a substantial proportion of psychological distress related to scarring/disfigurement among adult survivors of childhood cancer.

Keywords

childhood cancer survivorship; psycho-oncology; body image; scarring; disfigurement

Introduction

Progress in pediatric oncology has led to dramatic improvements in cancer survivorship during the past 40 years [1], but cancer-directed therapies such as surgical resection, chemotherapy and radiotherapy may lead to hair loss, physical disfigurement, scarring, weight loss/gain and dermatologic changes among survivors [2, 3]. Head/neck and arm/leg disfigurement, as well as persistent hair loss, have been associated with psychological distress and reduced quality of life in adult survivors of childhood cancer [2]. However, it is unknown if this association is a direct effect of treatment-related scarring/disfigurement or mediated by another factor, such as body image. Given that reducing scarring/disfigurement through direct intervention may not be feasible or require invasive approaches, elucidating a potential mediating mechanism may provide opportunities for non-invasive intervention if a behaviorally-modifiable factor is identified.

According to the self-discrepancy theory, body image dissatisfaction may develop when one's perception of his/her actual body does not align with his/her perception of an ideal body.[4] This dissatisfaction, in the context of maladaptive cognitions or poor coping, may result in symptoms of psychological distress. For example, negative self-appraisals of body image have been associated with increased risk of depression in non-cancer populations [5] including obese adults.[6] Poor body image has also been associated with posttraumatic stress disorder in women with appearance-altering physical injuries[7], and social anxiety in psychiatric populations [8]. In a study investigating the mediating role of body image dissatisfaction on the relation between obesity and dysphoric psychological states, Friedman and colleagues reported that the association between obesity and depression was partially mediated by body image.[9] These findings support the utility of body image dissatisfaction as a potential mediating factor between perceptions of physical appearance and emotional distress outcomes.

Prior studies have reported negative perception of body image among survivors of childhood cancer [10], including adult survivors of childhood central nervous system (CNS) tumors [11]. Further, the association between poor body image and emotional distress has been demonstrated among survivors of breast [12]and head and neck [13] cancers. We hypothesize that survivors with scarring/disfigurement resulting from cancer-direct therapies

may internalize the physical manifestations of their treatment and develop negative self-perceptions of body image, which may subsequently increase the risk of psychological distress.

Importantly, the location of disease and type of cancer therapy may result in scarring or disfigurement that is more or less visible in varying social contexts. As a result, risk for body image dissatisfaction may vary by the location of disease and treatment. Given previous literature examining negative body image status among survivors of head and neck cancers, we expect that body image dissatisfaction largely mediates the association between scarring and distress among childhood cancer survivors with more highly visible scars.

The large body of literature examining gender differences in body image dissatisfaction collectively suggests females are more likely to report negative self-evaluations of appearance and higher levels of body image dissatisfaction than males.[14] This may be particularly true in Western cultures, where women face unyielding societal pressures and expectations to be thin and/or attractive. However, recent research suggests that body image dissatisfaction is increasingly prevalent among men. [15]Therefore, we hypothesize that body image dissatisfaction may differentially mediate the association between scarring or disfigurement and psychological distress among male and female survivors of childhood cancer.

The potential mediating role of body image dissatisfaction on the association between treatment-related scarring/disfigurement and psychological distress has not been systematically assessed in of adult survivors of childhood cancer. We aimed to assess the direct and indirect (e.g., through body image dissatisfaction) effects of scarring/disfigurement on psychological distress in this population.

Methods

Participants and Procedure

Individuals eligible for our study were adult survivors of childhood cancer from the St. Jude Lifetime Cohort Study (SJLIFE) who were at least 18 years of age, received treatment for a primary diagnosis of childhood cancer at St. Jude Children's Research Hospital, and survived 10 or more years post initial diagnosis. All study procedures were approved by the institutional review board (IRB #:00000029; FWA00004775), and informed consent was obtained from all individual participants included in the study. Details about the SJLIFE cohort and recruitment strategies have been previously described [16]. For the current study, additional eligibility criteria included the completion of a campus visit and surveys of self-reported measures of body image and psychological distress.

Variables

Our outcomes of interest included depression, anxiety, and posttraumatic stress. Depression and anxiety were assessed using the Brief Symptom Inventory-18 (BSI-18); an 18-item self-report measure of acute psychological distress symptoms [17]. Using sex-specific normative data, impairment was defined as scores falling 90th percentile (T-score of 63 or greater) for each subscale. Posttraumatic stress symptoms (PTSS) were assessed using the Posttraumatic

Stress Disorder Checklist (PCL) [18], a 17-item measure of diagnostic symptom criteria listed in the Diagnostic and Statistical Manual for Psychiatric Disorders, 4th Edition (DSM-IV-TR) [19]. PTSS was defined by the report of at least one re-experiencing symptom, at least three avoidance symptoms, and at least two arousal symptoms, each with a minimum response of 3 (“moderate”).

Our exposure of interest, scarring/disfigurement, was assessed using a single survey item (“At the present time, do you have any of the following?”) with the following response choices: persistent hair loss; scarring or disfigurement of the head or neck region (including the face); loss of an eye; scarring or disfigurement of the chest or abdominal region; scarring or disfigurement of the arms or legs (including an abnormally short arm or leg); loss of an arm or a leg. The variable “scarring/disfigurement of the head” combined the first three item responses, and “scarring/disfigurement of the body” combined the latter three. Both variables were coded as present or absent.

Our mediator of interest, body image dissatisfaction, was assessed using the Body Image Scale (BIS); a 10-item scale designed to assess body image and the impact of cancer treatment on body image in cancer patients. Although the scale demonstrated high reliability (Cronbach’s $\alpha=0.93$) and good clinical validity for a sample of British breast cancer patients ($n=682$) [20], we used principal components analysis to assess the factor structure of the BIS in our sample. Two factors were retained with eigenvalues greater than 1.0.[21] The first factor was labeled *general body image dissatisfaction* and included the following items: appearance dissatisfaction, appearance self-consciousness, body dissatisfaction, and difficulty seeing oneself naked. The second factor was labeled *cancer-related body image dissatisfaction* and included the following items: treatment left body less whole, less physically attractive due to treatment, less sexually attractive due to treatment, and less masculine/feminine due to treatment. Both scales demonstrated excellent reliability (Cronbach’s $\alpha=0.90$ for general body image dissatisfaction and $\alpha=0.87$ for cancer-related body image dissatisfaction). Two variables (scar appearance dissatisfaction and avoidance due to appearance) failed to load on either factor, and were not included in the final scales. Scores in the highest 10% of our sample were considered to represent general or cancer-related body image dissatisfaction.

Demographic information including educational attainment (high school/GED or less; some college/post-high school training; college graduate) and marital status (single/never married; separated/divorced/widowed; married/living as married) were obtained from SJLIFE questionnaires. Clinical data related to cancer treatment were abstracted from survivors’ medical records, including chemotherapy (anthracyclines; alkylating agents; corticosteroids; antimetabolites), radiation (head/neck; body), and surgery (head/neck/face; chest/back; hip/abdomen; extremity). An aggregate variable for endocrine dysfunction was created based on the Common Terminology Criteria for Adverse Events Version 4, including grade 2 delayed puberty, grade 1 precocious puberty and/or grade 1 growth hormone abnormality. Body mass index was abstracted from medical records and was adjusted for amputation.

Statistical Methods

We explored the potential mediating effect of body image dissatisfaction on the association between scarring/disfigurement on psychological distress (depression, anxiety, and PTSS) using causal mediation analysis within a potential outcome framework [22]. This approach circumvents the challenges in analysis and interpretation of the Baron and Kenny approach. [22] Supplemental Figure 1 is reduced-form directed acyclic graph (DAG) that encodes our dependency assumptions about the relation between scarring/disfigurement and psychological distress. We used this and related DAGs to specify logistic regression models for the exposure-outcome and exposure-mediator relations, which were used to estimate overall and sex-specific (given *a priori* evidence of potential effect modification by sex [23]) odds ratios (OR) and corresponding 95% confidence intervals (CI) for the marginal total effect and controlled direct effect of scarring/disfigurement on psychological distress [22]. To reduce confounding bias and strengthen assumptions for valid interpretation of the total and controlled direct effects, we adjusted the models for a minimal sufficient set of covariates identified by applying the back-door criterion to the dependency assumptions in our DAGs [24]. We estimated the controlled direct effect because it represents the effect of an exposure on an outcome if the mediator could be set to a specific level ($M=m$) through a hypothetical intervention, which has practical relevance. In our analysis, the controlled direct effect represented the effect of scarring/disfigurement on psychological distress if body image dissatisfaction were resolved through intervention. Controlled direct effects closer to OR=1.0 suggest more profound mediation in the presence of a total effect. Estimation of the total and controlled direct effects also allowed us to estimate the proportion eliminated on a relative scale [25], which represents the proportion (albeit not constrained between 0% and 100%) of the relative excess of psychological distress associated with scarring/disfigurement that could be reduced by resolving body image dissatisfaction.

Results

Of the 2,487 survivors eligible for our study, 1,714 (69%) were included in the analysis (Figure 1). Compared with non-participants, a greater proportion of participants were female (53.0% vs. 44.4%), white (86.5% vs. 81.0%; Supplemental Table 1). The median age of evaluation of study participants was 31.5 years (interquartile range=26–38 years) and the median time from diagnosis was 23.4 years (interquartile range=17–30 years). Table 1 summarizes characteristics of the study population.

The proportion of survivors reporting psychological distress symptoms was greater among survivors with cancer-related body image dissatisfaction compared to survivors without cancer-related body image dissatisfaction (depression: 37% vs. 10%, $P<0.001$; anxiety: 28% vs. 8%, $P<0.001$; PTSS: 33% vs. 7%, $P<0.001$, respectively; Figure 2). Similarly, psychological distress was more frequently reported among survivors with general body image dissatisfaction compared with survivors without general body image dissatisfaction (depression: 43% vs. 10%, $P<0.001$; anxiety: 33% vs. 8%, $P<0.001$; PTSS: 37% vs. 7%, $P<0.001$; respectively).

The Mediating Role of Body Image Dissatisfaction on Psychological Distress

Table 2 summarizes the total effect, controlled direct effect, and proportion eliminated for the association between scarring/disfigurement and psychological distress mediated by body image dissatisfaction. The estimates were adjusted for age at diagnosis, sex, race, chemotherapy, radiation therapy, surgery, age at survey, educational attainment, marital status, body mass index adjusted for amputation, and endocrine dysfunction.

Scarring/Disfigurement of the Head

Among males with scarring/disfigurement of the head, a sizable proportion of the relative excess of psychological distress (depression: 63%; anxiety: 100%; posttraumatic stress: 52%) could be eliminated if cancer-related body image dissatisfaction was not present. Similar effects were observed for males with general body image dissatisfaction, where the proportions eliminated were 70% for depression, 100% for anxiety, and 42% for posttraumatic stress. A smaller proportion of the relative excess of psychological distress among female survivors with scarring/disfigurement of the head could be eliminated if cancer-related body image dissatisfaction (depression: 20%; anxiety: 36%; posttraumatic stress: 23%) and general body image dissatisfaction (depression: 32%; anxiety: 87%; posttraumatic stress: 38%) were not present.

Scarring/Disfigurement of the Body

The mediating effect of body image dissatisfaction for both males and females was less profound for the association between scarring/disfigurement of the body and psychological distress. Among females with scarring/disfigurement of the body, a moderate proportion of psychological distress could be eliminated if cancer-related body image dissatisfaction (depression: 55%; anxiety: 25%; posttraumatic stress: 31%) and general body image dissatisfaction (depression: 46%; anxiety: 28%; posttraumatic stress: 31%) were not present. Compared with females, a slightly more modest relative excess of psychological distress associated with scarring/disfigurement of the body would be eliminated through successful treatment of cancer-related (depression: 42%; anxiety: 38%) and general (depression: 23%; anxiety: 15%; posttraumatic stress: 2%) body image dissatisfaction among males.

Discussion

Prior studies have reported associations between scarring/disfigurement and psychological distress among childhood cancer survivors [2] but have not explored the mechanism for this association. Our results suggest that body image dissatisfaction mediates the association between scarring/disfigurement and psychological distress among adult survivors of childhood cancer. The observed mediation effects were most pronounced among survivors with scarring/disfigurement of the head, particularly for males.

Our findings are supported by prior studies that have reported similar associations between poor body image and psychological distress among survivors of adult onset cancers [26], and head and neck cancers, and may be interpreted in the context of several theoretical frameworks. As a construct, body image has been defined in oncology populations as the perceptions, thoughts, feelings, and behaviors related to one's body and its functioning [27].

Survivors with scarring/disfigurement who view themselves as less physically attractive may experience social physique anxiety, or anxiety associated with the perceived negative evaluation of one's physical self [28]. When negative perceptions of body image are internalized (body image dissatisfaction), they may manifest as mood- or anxiety-based symptoms (e.g., depression, posttraumatic stress). From a developmental perspective, the impact of scarring and/or disfigurement may be particularly detrimental when acquired during childhood or adolescence because these periods are critical for developing a positive body image and healthy sexual identity [29, 30].

Our results suggest body image dissatisfaction is a stronger mediator for scarring/disfigurement of the head, regardless of sex. The head and neck are important in daily social interaction, and persistent hair loss, scarring, or disfigurement to these areas is likely to be more visible than scarring/disfigurement to other areas of the body. Our findings are supported by research demonstrating a high frequency of body image disturbance among survivors of head and neck cancers, where patients who underwent surgical treatment reported concern or embarrassment about at least one type of bodily change after cancer [31]. Survivors with negative perceptions of physical changes to these highly visible areas of the body may experience social physique anxiety and difficulties with interpersonal communication and relationships [13], resulting in distress.

These findings suggest interventions to prevent or ameliorate body image dissatisfaction may be particularly helpful for male survivors with scarring/disfigurement of the head. The manifestation of negative perceptions of body image in male survivors as distress may be attributed, in part, to gender differences in the coping styles and the buffering effects of social support among cancer survivors. Male survivors may be less inclined to employ emotion-focused coping strategies or less willing to seek social support [32, 33]. For example, female survivors of head and neck cancers with scarring and disfigurement have reported benefits of social support (e.g., greater psychosocial adjustment) whereas men have not [34]; a finding consistent with prior studies demonstrating differential gender effects for social support and psychological adjustment to cancer [35].

Limitations

Our findings should be interpreted in the context of several limitations. A notable proportion (31%) of survivors eligible for our study were excluded because of missing data (i.e., did not complete the supplemental questionnaires). A comparison of the distribution of characteristics for participants and nonparticipants (Supplemental Table 1) suggests that survivors are unlikely to be missing completely at random. For example, a greater proportion of participants were female (53% vs. 44%) and White (87% vs. 81%) compared with nonparticipants. If the frequency of scarring/disfigurement, body image dissatisfaction, and psychological distress were higher among participants, then the proportions eliminated may be overestimated. Unfortunately, given the nature of missing data, we are unable to confirm the magnitude or direction of potential bias. A second limitation of the current study is that causal models were not adjusted for cognitive functioning. Solid tumor survivors comprise a substantial proportion of the head-scarring group and because these survivors are also at risk for neurocognitive impairment[36], our inability to adjust for cognitive impairment

introduces the potential for confounding bias. In addition, as with all studies that use self-reported variables, our findings may be sensitive to misclassification, particularly of the mediator. For example, we classified body image dissatisfaction as the top 10% of scores on the Body Image Scale, which may misclassify some individuals because the “true” status is unknown. The proportion of distress that could be eliminated through intervention may be overestimated if misclassification of body image dissatisfaction differed by scarring/disfigurement status or psychological distress. An alternate explanation for our mediation findings is that body image dissatisfaction may simply represent a more proximal manifestation of psychological distress elicited by scarring/disfigurement. Lastly, the cross-sectional nature of our study precludes clarity about the temporal order of body image dissatisfaction and psychological distress. We assumed that body image dissatisfaction preceded psychological distress symptoms based on evidence from prior studies, but we cannot exclude the possibility that psychological distress affected perceptions of body image. Longitudinal studies may strengthen the evidence-base by establishing temporal ordering of body image dissatisfaction and psychological distress.

Clinical Implications

In summary, our results suggest that body image dissatisfaction may be one mechanism by which scarring/disfigurement affects psychological distress among adult survivors of childhood cancer. The practical implication of our finding is that an effective intervention to treat body image dissatisfaction may substantially reduce the relative excess of psychological distress associated with scarring/disfigurement. While the majority of body image interventions in the literature have been implemented with survivors of breast cancer, several interventions may be effective, including cognitive behavior therapy [37], education-based intervention [38], strength training [39], and physical exercise [40]. Further research on such interventions is needed to establish whether they would be efficacious in our cohort of adult survivors of pediatric cancer. Additionally, routine screening of survivors at risk of body image dissatisfaction secondary to scarring/disfigurement is important to identify individuals who may be amenable to intervention, and may prevent the onset of psychological distress symptoms related to scarring/disfigurement.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This work was supported by the National Cancer Institute (CA 195547, M. Hudson, Principal Investigator), the Cancer Center Support (CORE) grant (CA 21765, C. Roberts, Principal Investigator), and by the American Lebanese-Syrian Associated Charities (ALSAC).

References

1. Howlander, NNA., Krapcho, M., Garshell, J., Neyman, N., Altekruse, SF., Kosary, CL., Yu, M., Ruhl, J., Tatalovich, Z., et al. SEER Cancer Statistics Review, 1975–2010. Bethesda, MD: National Cancer Institute; 2013.

2. Kinahan KE, Sharp LK, Seidel K, et al. Scarring, disfigurement, and quality of life in long-term survivors of childhood cancer: a report from the Childhood Cancer Survivor study. *J Clin Oncol*. 2012; 30:2466–2474. [PubMed: 22614987]
3. Belum VR, Washington C, Pratilas CA, et al. Dermatologic adverse events in pediatric patients receiving targeted anticancer therapies: a pooled analysis. *Pediatr Blood Cancer*. 2015; 62:798–806. [PubMed: 25683226]
4. Vartanian L. Self-discrepancy theory and body image. *Encyclopedia of body image and human appearance*. 2012; 2:711–717.
5. Jackson KL, Janssen I, Appelhans BM, et al. Body image satisfaction and depression in midlife women: the Study of Women's Health Across the Nation (SWAN). *Arch Womens Ment Health*. 2014; 17:177–187. [PubMed: 24623160]
6. Sarwer DB, Wadden TA, Foster GD. Assessment of body image dissatisfaction in obese women: specificity, severity, and clinical significance. *Journal of consulting and clinical psychology*. 1998; 66:651–654. [PubMed: 9735582]
7. Weaver TL, Resnick HS, Kokoska MS, Etzel JC. Appearance-related residual injury, posttraumatic stress, and body image: Associations within a sample of female victims of intimate partner violence. *J Trauma Stress*. 2007; 20:999–1008. [PubMed: 18157883]
8. Aderka IM, Gutner CA, Lazarov A, et al. Body image in social anxiety disorder, obsessive-compulsive disorder, and panic disorder. *Body Image*. 2014; 11:51–56. [PubMed: 24095651]
9. Friedman KE, Reichmann SK, Costanzo PR, Musante GJ. Body image partially mediates the relationship between obesity and psychological distress. *Obesity research*. 2002; 10:33–41. [PubMed: 11786599]
10. Fan SY, Eiser C. Body image of children and adolescents with cancer: A systematic review. *Body Image*. 2009; 6:247–256. [PubMed: 19632908]
11. Boman KK, Hornquist L, De Graaff L, et al. Disability, body image and sports/physical activity in adult survivors of childhood CNS tumors: population-based outcomes from a cohort study. *J Neurooncol*. 2013; 112:99–106. [PubMed: 23354653]
12. Rosenberg SM, Tamimi RM, Gelber S, et al. Body image in recently diagnosed young women with early breast cancer. *Psychooncology*. 2013; 22:1849–1855. [PubMed: 23132765]
13. Rhoten BA, Murphy B, Ridner SH. Body image in patients with head and neck cancer: A review of the literature. *Oral Oncology*. 2013; 49:753–760. [PubMed: 23683468]
14. Demarest J, Allen R. Body image: gender, ethnic, and age differences. *The Journal of social psychology*. 2000; 140:465–472. [PubMed: 10981375]
15. Neagu A. Body image: a theoretical framework. *Proc Rom Acad*. 2015; 17:29–38.
16. Hudson MM, Ness KK, Nolan VG, et al. Prospective medical assessment of adults surviving childhood cancer: Study design, cohort characteristics, and feasibility of the St. Jude Lifetime Cohort Study. *Pediatric Blood & Cancer*. 2011; 56:825–836. [PubMed: 21370418]
17. Derogatis, LR. Brief Symptom Inventory 18: Administration, scoring and procedures manual. Minneapolis, MN: NCS Pearson; 2001.
18. Blanchard EB, Jones-Alexander J, Buckley TC, Forneris CA. Psychometric properties of the PTSD checklist (PCL). *Behaviour Research and Therapy*. 1996; 34:669–673. [PubMed: 8870294]
19. American Psychiatric Association. DSM-IV-TR: Diagnostic and statistical manual of mental disorders, text revision. Washington, DC: American Psychiatric Association; 2000.
20. Hopwood P, Fletcher I, Lee A, Al Ghazal S. A body image scale for use with cancer patients. *European Journal of Cancer*. 2001; 37:189–197. [PubMed: 11166145]
21. Kaiser H. The application of electronic computers to factor analysis. *Educational and Psychological Measurement*. 1960; 20
22. Valeri L, Vanderweele TJ. Mediation analysis allowing for exposure-mediator interactions and causal interpretation: theoretical assumptions and implementation with SAS and SPSS macros. *Psychol Methods*. 2013; 18:137–150. [PubMed: 23379553]
23. Feingold A, Mazzella R. Gender Differences in Body Image Are Increasing. *Psychological Science*. 1998; 9:190–195.

24. Greenland S, Pearl J, Robins JM. Causal diagrams for epidemiologic research. *Epidemiology*. 1999; 10:37–48. [PubMed: 9888278]
25. Suzuki E, Evans D, Chaix B, Vanderweele TJ. On the "proportion eliminated" for risk differences versus excess relative risks. *Epidemiology*. 2014; 25:309–310. [PubMed: 24487217]
26. Bullen TL, Sharpe L, Lawsin C, et al. Body image as a predictor of psychopathology in surgical patients with colorectal disease. *J Psychosom Res*. 2012; 73:459–463. [PubMed: 23148815]
27. Fingeret MC, Teo I, Epner DE. Managing body image difficulties of adult cancer patients: Lessons from available research. *Cancer*. 2014; 120:633–641.
28. Frederick CM, Morrison CS. Social physique anxiety: personality constructs, motivations, exercise attitudes, and behaviors. *Percept Mot Skills*. 1996; 82:963–972. [PubMed: 8774039]
29. Blashill AJ, Wilhelm S. Body Image Distortions, Weight, and Depression in Adolescent Boys: Longitudinal Trajectories into Adulthood. *Psychol Men Masc*. 2014; 15:445–451. [PubMed: 25383047]
30. Stice E, Bearman SK. Body-image and eating disturbances prospectively predict increases in depressive symptoms in adolescent girls: a growth curve analysis. *Dev Psychol*. 2001; 37:597–607. [PubMed: 11552756]
31. Fingeret MC, Yuan Y, Urbauer D, et al. The nature and extent of body image concerns among surgically treated patients with head and neck cancer. *Psychooncology*. 2012; 21:836–844. [PubMed: 21706673]
32. Zakowski SG, Harris C, Krueger N, et al. Social barriers to emotional expression and their relations to distress in male and female cancer patients. *Br J Health Psychol*. 2003; 8:271–286. [PubMed: 14606973]
33. Peleg-Oren N, Sherer M, Soskolne V. Effect of gender on the social and psychological adjustment of cancer patients. *Soc Work Health Care*. 2003; 37:17–34.
34. Katz MR, Irish JC, Devins GM, et al. Psychosocial adjustment in head and neck cancer: The impact of disfigurement, gender and social support. *Head & Neck*. 2003; 25:103–112. [PubMed: 12509792]
35. Fife BL, Kennedy VN, Robinson L. Gender and Adjustment to Cancer. *Journal of Psychosocial Oncology*. 1994; 12:1–21.
36. Brinkman TM, Krasin MJ, Liu W, et al. Long-Term Neurocognitive Functioning and Social Attainment in Adult Survivors of Pediatric CNS Tumors: Results From the St Jude Lifetime Cohort Study. *Journal of clinical oncology : official journal of the American Society of Clinical Oncology*. 2016; 34:1358–1367. [PubMed: 26834063]
37. Matthews HJ, Grunfeld EA, Turner A. The efficacy of interventions to improve psychosocial outcomes following surgical treatment for breast cancer: a systematic review and meta-analysis. *Psychooncology*. 2016
38. Helgeson VS, Cohen S, Schulz R, Yasko J. Education and peer discussion group interventions and adjustment to breast cancer. *Arch Gen Psychiatry*. 1999; 56:340–347. [PubMed: 10197829]
39. Speck RM, Gross CR, Hormes JM, et al. Changes in the Body Image and Relationship Scale following a one-year strength training trial for breast cancer survivors with or at risk for lymphedema. *Breast Cancer Research and Treatment*. 2009; 121:421–430. [PubMed: 19771507]
40. Mehnert A, Veers S, Howaldt D, et al. Effects of a Physical Exercise Rehabilitation Group Program on Anxiety, Depression, Body Image, and Health-Related Quality of Life among Breast Cancer Patients. *Oncology Research and Treatment*. 2011; 34:248–253.

Figure 1.
Selection of participants from the St. Jude Lifetime Cohort for the current analysis.

a. Prevalence of psychological distress symptoms among survivors with and without cancer-related body image dissatisfaction

b. Prevalence of psychological distress symptoms among survivors with and without general body image dissatisfaction

Figure 2.

a. Prevalence of psychological distress symptoms among survivors with and without cancer-related body image dissatisfaction

b. Prevalence of psychological distress symptoms among survivors with and without general body image dissatisfaction

Table 1

Demographic and clinical characteristics of participants

	Median (IQR)
Age at evaluation (years)	31.5 (26.2–37.7)
Age at diagnosis (years)	7.5 (3.4–13.2)
Time since diagnosis (years)	23.4 (17.5–30.0)
	<i>n</i> (%)
Sex	
Female	908 (53.0)
Male	806 (47.0)
Race	
White	1,483 (86.5)
Other	231 (13.5)
Diagnosis	
Leukemia	665 (38.8)
Lymphoma	358 (20.9)
CNS tumors	134 (7.8)
Wilms Tumor/Neuroblastoma	198 (11.6)
Osteosarcoma/Ewing Sarcoma	111 (6.5)
Retinoblastoma/Rhabdomyosarcoma	96 (5.6)
Other solid tumors	142 (8.3)
Other	10 (0.6)
Radiation	
None	700 (40.8)
Head/neck	863 (50.4)
Body	520 (30.3)
Chemotherapy	
None	243 (14.2)
Anthracyclines	998 (58.2)
Alkylating agents	993 (57.9)
Corticosteroids	853 (49.8)
Antimetabolites	919 (53.6)
Surgery	
None	950 (55.4)
Head/neck/face	218 (12.7)
Back/chest	727 (42.4)
Hip/abdomen	436 (25.4)
Extremity	109 (6.4)

	Median (IQR)
Education	
High school or GED	424 (25.6)
Some college	562 (33.9)
College graduate	672 (40.5)
Marital Status	
Single/never married	560 (32.7)
Married/living as married	939 (54.8)
Separated/divorced/widowed	215 (12.5)
BMI	
24.9 (Normal, underweight)	611 (36.1)
25–29.9 (Overweight)	475 (28.0)
30 (Obesity, morbid obesity)	608 (35.9)
Scarring or Disfigurement	
Hair loss	254 (15.3)
Head/neck	293 (17.7)
Chest/abdomen	506 (30.6)
Arm/leg	207 (12.5)

Abbreviations: IQR = interquartile range. BMI = body mass index, adjusted for amputation.

Table 2
Sex-specific effects of scarring/disfigurement on psychological distress mediated by body image dissatisfaction

Outcome	Body Image Dissatisfaction	Sex	Marginal total effect	OR (95% CL)	Controlled direct effect	Proportion eliminated
Scarring/disfigurement of the head						
Depression	General	Male	2.06 (1.04, 4.09)	1.24 (0.65, 2.37)	77%	
		Female	2.38 (1.22, 4.65)	1.81 (0.93, 3.51)	41%	
		Male	1.72 (0.93, 3.18)	1.22 (0.65, 2.26)	69%	
		Female	2.33 (1.21, 4.46)	1.97 (1.03, 3.75)	27%	
	Anxiety	Male	1.41 (0.63, 3.14)	0.98 (0.44, 2.14)	105%	
		Female	1.25 (0.61, 2.58)	1.03 (0.50, 2.14)	88%	
		Male	1.25 (0.59, 2.63)	0.99 (0.46, 2.12)	104%	
		Female	1.26 (0.62, 2.56)	1.16 (0.57, 2.35)	38%	
PTSS	General	Male	2.51 (1.11, 5.65)	1.71 (0.78, 3.73)	53%	
		Female	2.08 (0.99, 4.37)	1.57 (0.75, 3.31)	47%	
		Male	2.42 (1.12, 5.25)	1.53 (0.70, 3.32)	63%	
		Female	1.93 (0.94, 3.96)	1.66 (0.81, 3.41)	29%	
	Depression	Male	1.66 (0.88, 3.13)	1.51 (0.81, 2.85)	23%	
		Female	1.56 (0.82, 2.96)	1.30 (0.68, 2.47)	46%	
		Male	1.60 (0.86, 2.98)	1.35 (0.72, 2.53)	42%	
		Female	1.56 (0.82, 2.95)	1.25 (0.66, 2.37)	55%	
Scarring/disfigurement of the body						
Anxiety	General	Male	1.74 (0.82, 3.69)	1.63 (0.77, 3.44)	15%	
		Female	1.67 (0.92, 3.06)	1.48 (0.81, 2.71)	28%	
		Male	1.66 (0.79, 2.97)	1.41 (0.67, 2.97)	38%	
		Female	1.59 (0.88, 2.87)	1.44 (0.80, 2.59)	25%	
	PTSS	General	Male	1.02 (0.40, 2.62)	0.98 (0.38, 2.52)	2.0%
		Female	2.24 (1.16, 4.33)	1.86 (0.96, 3.59)	31%	
		Male	0.98 (0.39, 2.51)	0.83 (0.32, 2.15)	-7.5%	
		Female	2.15 (1.13, 4.07)	1.79 (0.94, 3.40)	31%	