

# Gender Representation of Cancer Patients in Medical Treatment and Psychosocial Survivorship Research

## Changes Over Three Decades

Michael A. Hoyt, PhD<sup>1</sup> and Lisa R. Rubin, PhD<sup>2</sup>

**BACKGROUND:** Prior studies raise concern about gender bias in cancer research, including insufficient inclusion of women or men, or studying women and men differently. The 1993 National Institutes of Health Revitalization Act aimed to eliminate gender bias in medicine. To examine changes in medical and psychological literature, this study reviews gender representation in biomedical treatment studies and psychosocial survivorship studies published in a single year. **METHODS:** Research published in *Cancer* in 2007, and all empirical psychological studies about cancer published that year, provided a 15-year update to findings reported by Meyerowitz and Hart. The gender distribution and context of included articles were coded and compared with findings from 1983 and 1992. **RESULTS:** Across biomedical studies, 34.3% of subjects were women (vs 47% of new cancers and 48% of cancer deaths). Among men, 41.3% had sex-specific cancers (vs 12.5% [1983] and 12.3% [1992]). Among women, 46.1% had sex-specific cancers (vs 69.1% [1983] and 64.6% [1992]). Fewer women (36.8%) were represented in sex-nonspecific cancer studies (vs 41.4% [1983] and 42.5% [1992]); however, fewer studies had a significant (>20%) gender disparity. Across psychosocial studies, representation of men increased to 47.9% (vs 30.4% [1983] and 29.9% [1992]). The proportion of men in studies of feelings/relationships increased to 47% (vs 22.9% [1992]); the proportion of women in studies assessing physical/functional ability increased to 58.3% (vs 45.4%). **CONCLUSIONS:** Women remain under-represented in sex-nonspecific biomedical research, whereas men's representation in sex-specific research increased substantially. Psychosocial research trends suggest movement from research questions supporting traditional stereotypes that women feel and men act. *Cancer* 2012;000:000-000. © 2012 American Cancer Society.

**KEYWORDS:** gender bias, research, women, men, cancer.

## INTRODUCTION

Cancer is the second leading cause of death for both men and women in the United States<sup>1</sup>; however, important gender differences exist. Whereas women are more likely to develop cancer younger (before age 60 years), men are more likely to develop and die from cancer over the course of their lifetime. Over the past quarter century, there has been growing recognition of the need for research on contributions of both sex and gender to health, including cancer.<sup>2</sup> Sex and gender are important determinants of cancer risk and mortality, operating separately and interactively to produce different (or similar) risks for men and women, depending on biological and social contexts.<sup>3-5</sup> Sex-linked factors are those related to biological (eg, structural, hormonal, genetic) differences between men and women. In contrast, gender-linked factors are psychological and sociocultural, and include gendered lifestyle and behavioral influences (eg, diet, smoking), as well as gender differences related to: exposure to carcinogens; use of medical and support services; psychological and social responses to cancer risk; and cancer screening, diagnosis, and treatment. Moreover, beyond individual-level risk and treatment variables, gender and gender biases can influence larger structures and processes related to cancer care, ranging from health care access and delivery to the production of medical knowledge,<sup>6,7</sup> for example by influencing funding priorities and research questions.

Manifestations of gender bias in medical research include framing women's health primarily in terms of reproductive capacity and function, exclusion and/or under-representation of women in sex-nonspecific research,<sup>8,9</sup> lack of attention given to men's emotional and psychological adjustment to disease, and relative inattention to gender influences on both men's and women's health. The National Institutes of Health (NIH) Revitalization Act of 1993 aimed to address some of these concerns by requiring inclusion of women and minority groups in NIH-funded clinical research, and specifying that

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The authors are listed alphabetically and have provided equal contribution.

**Corresponding author:** Lisa R. Rubin, PhD, New School for Social Research, Department of Psychology, 80 Fifth Avenue, Seventh Floor, New York, NY 10011; Fax: (212) 989-0846; rubinl@newschool.edu

<sup>1</sup>University of California at Merced, Merced, California; <sup>2</sup>New School for Social Research, New York, New York

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research must be “designed and carried out in a manner to provide for valid analysis of whether the variables being studied in a trial affect women and/or members of minority groups differently than men and/or white subjects.”<sup>10</sup> As a disease that can develop in any body part, including women’s and men’s reproductive organs, cancer is an important context to evaluate the current ways in which gendered assumptions impact biomedical and psychosocial research.

A study by Meyerowitz and Hart<sup>7</sup> provided evidence that assumptions about women and men had indeed influenced the cancer research agenda within medicine and psychology. Surveying the medical literature to examine the representation of men and women in published reports of biomedical cancer treatment studies in the years 1983 and 1992 in the journal *Cancer*, Meyerowitz and Hart<sup>7</sup> found that for women, there was greater research attention, and for men less attention, to breast and reproductive organ cancers than would be warranted by the gender distribution of cancer incidence, whereas the reverse pattern was found for sex-nonspecific cancers. Although we might expect a somewhat greater focus on sex-specific cancers among women, given higher mortality associated with breast and ovarian cancer compared with prostate cancer, they found remarkably low inclusion of men with sex-specific cancers relative to incidence. The patterns they identified are consistent with stereotypic associations of women’s bodies with sexuality and men’s with functionality, which may help to explain these findings.

Moreover, Meyerowitz and Hart’s comprehensive survey of the psychological literature on cancer in the same 2 years examining representations of men and women, which included all empirical articles with samples of adult cancer survivors, revealed similar patterns of bias. Overall, a substantially greater percentage of participants in psychological studies (approximately 70%) were women (compared with approximately 60% in the biomedical literature). Examining the content of research, women were substantially more likely than men to be included as participants in studies of emotion, body image, and social/family functioning, whereas men accounted for a greater percentage of participants in studies of somatic discomfort, functional ability, and employment.

Research published since Meyerowitz and Hart,<sup>7</sup> which reviewed studies conducted before the NIH Revitalization Act of 1993, provide relatively consistent evidence of continued under-representation of women within biomedical studies of sex-nonspecific health con-

cerns,<sup>11</sup> and within cancer research.<sup>12,13</sup> Jagsi and colleagues<sup>12</sup> reviewed the percentage of women and men among study participants in oncology research (including both prospective studies and clinical trials) published across 8 select high-impact journals in 2006, and found that among sex-nonspecific studies, the mean percentage of female participants was 38.8%. Government-funded studies reported a significantly higher percentage of female participants (41.3% vs 36.9%). Murthy et al<sup>13</sup> examined representation by sex, along with race/ethnicity and age, among participants enrolled in therapeutic nonsurgical National Cancer Institute Clinical Trial Cooperative Group breast, colorectal, lung, and prostate cancer clinical trials from 2000 through 2002. Men were more likely than women to be represented in colorectal and lung cancer studies overall, although age-specific analyses found this disparity only among older women, with equivalent representation among men and women aged 30 to 64 years. Although not limited to oncology, a recent study<sup>11</sup> evaluated the inclusion, analysis, and reporting of sex to examine compliance with the NIH Revitalization Act of 1993 in federally funded randomized controlled trials (RCTs) in 9 prominent medical journals in 2009. Despite the specifications of the NIH Revitalization Act, 75% of studies failed to report outcomes by sex. The median enrollment of women was 37% among the published RCTs of sex-nonspecific diseases.

Prior examinations of the impact of the NIH Revitalization Act have excluded psychosocial studies, despite growing recognition and research attention given to the importance of quality of life among individuals affected with cancer. Stereotypes and assumptions about social and emotional differences between men and women<sup>14</sup> have the potential to be reinforced, and important social and emotional needs may go unrecognized, when empirical studies ask different questions to men and women about their psychological adjustment to cancer. The purpose of the current study is to examine gender representation in biomedical treatment studies published in *Cancer* in 2007, as well as among all empirical psychological studies about cancer published that same year, providing a 15-year update to findings reported by Meyerowitz and Hart.<sup>7</sup> Although Jagsi et al<sup>12</sup> provide a valuable context to these findings concerning biomedical research studies, they do not address the psychological research. The current study draws on the strengths of these existing studies by examining the representation of men and women in both biomedical intervention and psychosocial studies of cancer published in 1 year. We report on the proportion

of studies in each of these areas that examine gender comparisons.

## MATERIALS AND METHODS

Procedures defined by Meyerowitz and Hart<sup>7</sup> for searching and selecting peer-reviewed studies were adopted to identify relevant published biomedical treatment and psychosocial survivorship articles.

### ***Procedures for Article Selection and Review of Biomedical Studies***

A comprehensive review of the medical treatment literature was not the primary objective of Meyerowitz and Hart<sup>7</sup> (nor the current study); to represent the biomedical literature, they reviewed only articles published in *Cancer*, the journal of the American Cancer Society, in the years 1983 and 1992. *Cancer* was selected because it had the largest circulation rate of any refereed oncology journal in the original review year. For the current study, all articles published in *Cancer* in the 2007 publication year, 15 years from the original search, were systematically reviewed and hand-coded by a team of 3 pairs of raters for possible inclusion. Only empirical studies related to cancer treatment were included. Animal research, pediatric studies, studies not reporting gender, histological studies, psychosocial-only interventions, and studies of prognosis, diagnosis, or prevention were excluded.

Data were extracted from included articles by rater pairs. These consisted of sample characteristics, study design, and malignancy type. Cancers specific to the reproductive organs (eg, ovarian, cervical, prostate, testis) were coded as sex-specific cancers. As done by Meyerowitz and Hart,<sup>7</sup> breast cancer was coded as specific to women. Notably, there are approximately 2100 new breast cancer cases in men annually in the United States<sup>1</sup>; however, only 1 coded study<sup>15</sup> included a male subject ( $n = 1$ ) as part of a larger sample ( $N = 37$ ) of patients with non-Hodgkin lymphoma of the breast.

To ensure inter-rater reliability, assessments were made independently by each rater, and consensus was reached through discussion. All ratings, including extracted data, relied on clearly detailed (ie, nonsubjective) criteria noted above (eg, is the study animal research?; mean age of sample), with extracted data compared between raters to ensure coding accuracy. Raters had 99% agreement.

### ***Procedures for Article Selection and Review of Psychosocial Literature***

Initially, a systematic search of the PsycINFO database was conducted using the terms *cancer*, *leukemia*, and *neo-*

*plasm* for the 2007 publication year. All yielded abstracts were distributed equally among a team of 3 rater pairs who reviewed and coded them for possible inclusion. Only empirical studies related to psychosocial (nonbiomedical) aspects of cancer survivorship were included. These included studies related to any aspects of life, health, or well-being of individuals diagnosed with cancer. Animal research, pediatric studies, studies not reporting gender, research on purely medical side effects of treatment (having no psychosocial component), and reports not available in English were excluded. The search and selection strategy was then replicated in the MEDLINE database, excluding journals referenced in PsycINFO.

Once again, data were extracted from included articles by rater pairs. These consisted of sample characteristics, study design, measured quality-of-life domains (eg, psychological/emotional, social/interpersonal, somatic, functional/occupational), and malignancy type. Domains of health-related quality of life were combined into 2 broad dimensions. The emotional/social dimension included assessments of psychological states (eg, depression, positive/negative affect, body image, marital satisfaction, family functioning); the physical/functional dimension included assessments of pain, fatigue, sexual function, ability to work, and cognitive ability. As described, cancers were coded as sex-specific or sex-nonspecific. Again, all assessments were made independently by each rater, consensus was reached through discussion, and raters had 99% agreement.

Extracted data were examined with SPSS 17.0 statistical software.<sup>16</sup> Chi-square goodness-of-fit tests and  $t$  tests were used to compare proportionality of gender representation.

## RESULTS

Incidence of new cancer cases and number of reported cancer deaths in the United States for these years are presented in Table 1. In 2007, breast, lung, and colorectal cancers had the highest incidence and were most likely to be causes of death for women; prostate, lung, and colorectal cancers showed similar patterns for men.<sup>17</sup>

### ***Biomedical Treatment Studies***

In 2007, 711 unique articles were published in *Cancer*. In total, 463 studies were excluded as animal (1.7%), pediatric (4.6%), histological (13.2%), psychosocial intervention (3.4%), or prognosis, diagnosis, or prevention (34.7%) research. Studies not reporting participant gender (7.5%) were also excluded. An additional 248 studies

**Table 1.** Estimated Sex-Specific and Sex-Nonspecific New Cancer Cases and Deaths in the United States in 1983, 1992, and 2007

	1983		1992		2007	
	Men	Women	Men	Women	Men	Women
<b>New cancer cases</b>						
Sex-nonspecific	341,200	240,900	424,400	313,500	538,770	421,290
Sex-specific	81,300	191,600	141,600	251,500	228,090	256,770
Total	422,500	432,500	666,000	565,000	766,860	678,060
<b>Cancer deaths</b>						
Sex-nonspecific	213,150	141,800	240,150	175,00	261,830	201,620
Sex-specific	25,350	59,700	34,850	70,000	27,720	68,480
Total	238,500	201,500	275,000	245,000	289,550	270,100

Data are from Cancer Facts & Figures.<sup>17,34,35</sup> Basal and squamous cell skin cancers and in situ carcinomas are excluded.

**Table 2.** Sample Characteristics of Included Studies

Characteristic	Biomedical Intervention Studies, n = 165	Psychosocial Studies, n = 363
<b>Total No.</b>	131,830	2,880,210
Women, No.; %	45,245; 34.3%	1,499,668; 52.1%
Men, No.; %	86,585; 65.7%	1,380,542; 47.9%
<b>Cancer site, No.; %</b>		
Prostate	22; 13.3%	30; 8.3%
Breast	21; 12.7%	93; 25.6%
Lung	19; 11.5%	13; 3.6%
Soft-tissue lymphoma	17; 10.3%	3; 0.8%
Leukemia	15; 9.1%	3; 0.8%
Colorectal	11; 6.7%	4; 1.1%
Bladder/kidney	7; 4.2%	0; 0.0%
Liver	6; 3.6%	1; 0.3%
Melanoma/skin	6; 3.6%	3; 0.8%
Ovarian	6; 3.6%	4; 1.1%
GI	4; 2.4%	5; 1.4%
Testicular	2; 1.2%	0; 0.0%
Head/neck	1; 0.6%	11; 3.0%
Mixed/other	28; 17.0%	193; 53.2%
<b>Studies reporting, No.; %</b>		
Gender comparisons	32; 19.4%	67; 18.5%
SES (income and/or education)	10; 6.1%	150; 41.3%
Ethnicity	36; 21.8%	106; 29.2%
Marital status	9; 5.6%	142; 39.1%

Abbreviations: GI, gastrointestinal; SES, socioeconomic status.

(34.9%) did not investigate cancer treatment. In total, 165 articles met criteria.

Sample characteristics for included studies are presented in Table 2. We examined the overall proportion of women and men included in biomedical treatment studies. Across studies, 34.3% of subjects were female, which differed ( $P < .001$ ) from 59.5% in both 1983 and 1992. Notably, women accounted for nearly 47% of all new cancer cases in 2007<sup>17</sup> and nearly 48%

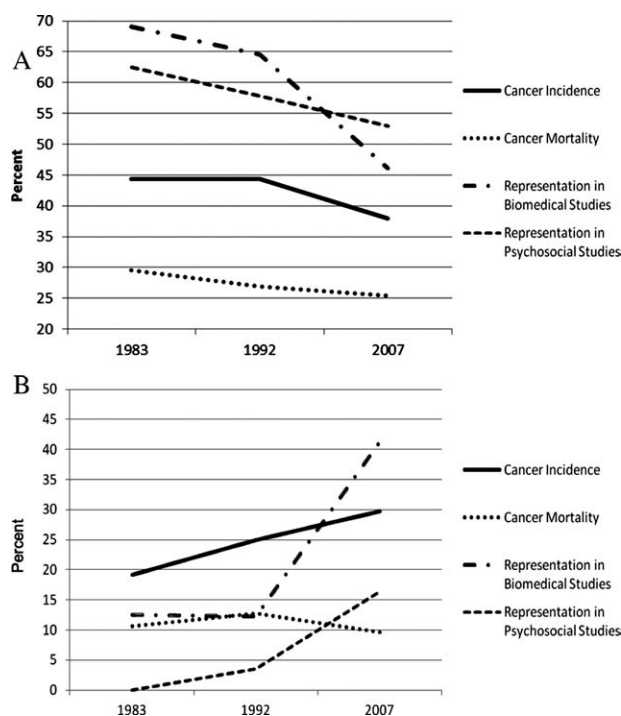
of cancer deaths (see Table 1), suggesting that in 2007, women were under-represented as subjects in *Cancer* articles ( $P < .001$ ).

#### Representation in sex-specific versus sex-nonspecific sites

We examined the inclusion of men and women with reproductive organ or breast (women only) cancer versus studies of cancers of sex-nonspecific sites. Three studies included a sample of patients with various cancer types and were not included in this examination. Notably, 41.3% of men studied in 2007 had sex-specific cancers (ie, prostate or testicular). This represented a sizeable increase from 1983 and 1992, in which 12.5% and 12.3% of studied men had sex-specific cancers, respectively ( $P < .001$ ). In contrast, 46.1% of studied women had a sex-specific cancer (ie, ovarian or breast) in the current study. This represented a noteworthy decline from 1983 and 1992, in which 69.1% and 64.6% of women had sex-specific cancers, respectively ( $P < .001$ ). Taken together, these observations suggest that the proportions of women and men with sex-specific (vs sex-nonspecific) cancers included in biomedical treatment studies are trending in opposite directions for men and women.

To contextualize these changes with national surveillance data, proportions of subjects included for sex-specific cancers, as well as incidence and mortality data for these cancers, are presented for women and men in Figure 1 (*Top and Bottom*, respectively). According to the American Cancer Society,<sup>17</sup> the percentage of new sex-specific cancer cases was approximately 38% for women and 30% for men in 2007 in the United States, which differed from observed proportions ( $P < .001$ ). This compares to 44% and 45% in 1983 and 1992 for women and 19% and 25% for men. Likewise, the percentage of cancer deaths attributable to sex-specific cancers was approximately





**Figure 1.** Percentages of (Top) women and (Bottom) men with sex-specific cancer types are shown. Data for 1983 and 1992 are extracted from Meyerowitz and Hart.<sup>7</sup> Incidence and mortality data are from Cancer Facts & Figures.<sup>17,34,35</sup> Basal and squamous cell skin cancers and in situ carcinomas are excluded.

25% for women and 10% for men in 2007. This compares to 30% and 29% in 1983 and 1992, respectively, for women and 11% and 13%, respectively, for men.

#### Gender representation within sex-nonspecific studies

Among all subjects included in studies of sex-nonspecific cancers, 36.8% were women. This reflected a greater gender gap than observed in 1983 and 1992, where women represented 41.4% and 42.5% of those with sex-nonspecific cancer ( $P < .001$ ). To consider the possibility of skew resulting from individual study sample sizes affecting conclusions, we also examined the number of articles about sex-nonspecific cancers that had more men as subjects than women (and vice versa). Accounting for differences in incidence of sex-nonspecific cancers between men and women, and replicating Meyerowitz and Hart,<sup>7</sup> a difference of 20% was used as a cutoff in determining gender disparity. Studies with 10 or fewer subjects were not counted ( $n = 3$ ). This analysis also revealed a changing picture of discrepancies between women and men over time. As Meyerowitz and Hart reported,<sup>7</sup> in both 1983 and 1992 there was a preponderance of studies of sex-nonspecific cancers with >20%

more men than women (57.6% in 1983; 62.2% in 1992). This compares to 48.6% in the current analysis. Notably, 8.3% of studies of sex-nonspecific cancers had >20% more women than men.

An examination of representation of the 2 sex-nonspecific cancer types with highest incidence and mortality (ie, lung and colorectal) revealed that 67.7% of subjects in lung cancer-only samples were men; however, men comprised only 55.4% of new respiratory cancer cases in 2007<sup>17</sup> ( $P < .001$ ). Men comprised 46.6% of those subjects in colorectal cancer-only samples; whereby men represented 51.2% of new colorectal cancer cases in 2007<sup>17</sup> ( $P < .001$ ).

#### United States-based studies

As the NIH Revitalization Act applies only to studies conducted in the United States, we examined representations of women and men specifically within United States-based studies. Sixty percent ( $n = 99$ ) of included studies were comprised of samples from within the United States. Among these, 31.3% of studied patients were women (68.7% were men). Among female subjects, 56.9% had sex-nonspecific cancers (vs 53.9% across all studies). Similarly, 57.5% of included men had sex-nonspecific cancers (vs 58.7% across all studies). Within US studies, the distribution of male subjects between sex-specific and sex-nonspecific cancers was similar. For female subjects, the distribution more closely reflects actual US cancer incidence.

#### Psychosocial Cancer Survivorship Studies

The initial search in PsycINFO yielded 2086 abstracts with an additional 5940 (number reflects results before removal of duplicates) abstracts identified from MEDLINE. From these, raters initially identified 550 abstracts for full article review. Further exclusions were made, as 68 papers were nonempirical reports, 41 were nonpatient (eg, patient caregiver) studies, 15 were exclusively focused on prevention, 17 studies reported only on physical side effects, 8 studies used pediatric samples, 1 study used an animal sample, and 24 papers were not available in English. An additional 13 papers were excluded because they did not report the gender composition of the sample. Thus, 363 articles were coded.

#### Representation by disease site

Although the gender representation of subjects in psychosocial studies in 2007 differed from the distribution in 2007 cancer incidence ( $P < .001$ ), with a growing emphasis on cancer survivorship after prostate cancer, we had expected that the psychological literature would more

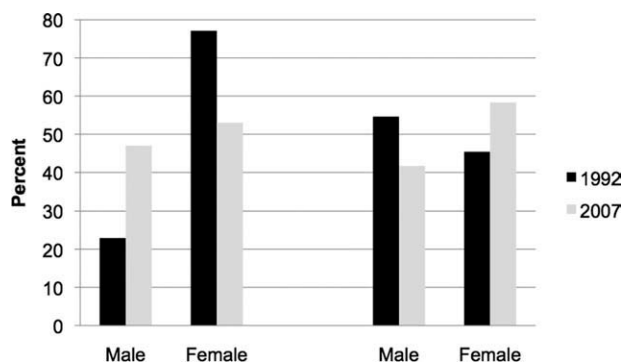
accurately represent men and women in comparison to 24 and 15 years prior. In fact, across 2007 studies, 52.1% of all subjects were women, which compared with 69.6% and 70.1% in 1983 and 1992, respectively ( $P < .001$ ; see Table 2). Accounting for gender differences in cancer incidence, this reflects a notably narrowed gap between men and women.

Unlike biomedical studies, it is common in the psychological literature to examine psychosocial processes as they apply across groups of patients with various cancer diagnoses. Therefore, it is more common to have samples of participants with various cancer subtypes, and so more difficult to distinguish studies of sex-specific and sex-non-specific cancers. In fact, 44.9% of studies included samples heterogeneous in respect to site of disease (compared with 48.9% in 1983 and 38% in 1992). Among those studies that included only 1 cancer site ( $n = 176$ ), 55.1% ( $n = 97$ ) focused on breast and reproductive cancers in women (compared with 62.5% in 1983; 57.9% in 1992). By contrast, 17.1% ( $n = 30$ ) of those studies limited to only 1 cancer site specifically investigated reproductive organ cancers in men (compared with 0% in 1983 and 3.5% in 1992;  $P < .001$ ). This represented a change in gender distribution in psychological studies across time ( $P < .001$ ; as depicted in Fig. 1). In addition, women represented 52.7% of subjects within those studies that were not restricted to sex-specific cancers (but, in many cases, included patients with cancers at these sites).

As with biomedical studies, representation of men and women within lung and colorectal cancer-only samples were examined within the psychosocial literature. This revealed that 57% of subjects in lung cancer-only samples were men (men comprised 55.4% of new cases). Likewise, 52.5% of subjects in colorectal cancer-only samples were men (men comprised 51.2% of new cases in 2007). This suggests that women with these cancers were somewhat under-represented ( $P < .001$ ).

### Quality-of-life domains

Although we expected more accurate representation of men and women in the psychological literature, we predicted that gender differences in domains of study would exhibit less change over time. Meyerowitz and Hart<sup>7</sup> identified 4 domains of health-related quality of life grouped in 2 broad categories: emotional/social (eg, psychological states, emotions, interpersonal relationships) and physical/functional (eg, somatic discomfort, physical ability, occupational functioning). They found that among included studies published in 1992 addressing feelings and social relationships, the majority of subjects were



**Figure 2.** Gender distribution of subjects is shown in studies reporting emotional/social and physical/functional dimensions of health-related quality of life. Data for 1992 are extracted from Meyerowitz and Hart.<sup>7</sup>

women (77.1%); however, women only accounted for 45.4% of subjects in studies addressing physical and functional domains. Comparing 1992 and 2007, gender representation of subjects in studies including quality-of-life domains is displayed in Figure 2. Of the subjects included in studies addressing feelings and/or social relationships ( $n = 297$ ), 47% were men. This compares to 22.9% in 1992 ( $P < .001$ ). In 2007, women accounted for 58.3% of the patients in studies assessing physical and functional ability ( $n = 265$ ). This compares to 45.4% in 1992 ( $P < .001$ ). These observations suggest a change in gender representation across time. Although women continue to be over-represented in the psychological literature in general, these results suggest a shift toward more balanced attention to multiple quality-of-life domains across gender groups over the past 15 years. In fact,  $t$  tests comparing inclusion of men and women in 2007 studies within quality-of-life domains were nonsignificant.

### United States-based studies

Of the identified psychosocial studies, 40.1% (143 studies; 6 studies were undeterminable) occurred in the United States. Among these, 66% of subjects were men, and 43% of studies were samples of individuals of exclusively sex-specific cancer types. Finally, approximately 19% (69 studies) tested a psychological/behavioral intervention; the majority of these were RCTs.

### Availability of Cancer Clinical Trials

As study participation depends on the availability of research trials, we conducted a cursory review of the National Cancer Institute clinical trials website ([www.cancer.gov/clinicaltrials](http://www.cancer.gov/clinicaltrials)) in November 2011. This website allows patients to search open clinical trials (regardless of funding source). Searching 2 of the most

common sex-specific cancers sites, breast and prostate, revealed 1552 clinical trials accepting patients for studies of breast cancer (female) and 684 for prostate cancer. This compared with 775 trials for colon cancer and 1345 trials across all types of lung cancer. The number of trials available is discrepant from patterns of mortality for these cancers in 2011.<sup>1</sup>

## DISCUSSION

The term *cancer* describes a biomedical disease process; however, cancer, like all diseases, emerges within a larger sociocultural context, and its meanings are shaped by psychosocial and environmental factors. A great deal has been written about the metaphors ascribed to cancer in Western culture,<sup>18</sup> including ways cancer has been construed as a gendered illness. Medical historians note a longstanding association between women and cancer.<sup>19</sup> Public health campaigns in the early part of the 20th century promoted the concept that women are particularly vulnerable to cancer and referenced cancer as women's "special worry and responsibility."<sup>20</sup> Although more recent biomedical advances have certainly challenged this association in the public imagination, as men are actually more likely both to develop and to die from cancer, gender continues to be an important lens through which cancer is understood and treated. The current study provides a 15-year update to Meyerowitz and Hart's<sup>7</sup> survey of gender representation in cancer studies and provides insight into both who and what is being studied in cancer research.

Meyerowitz and Hart<sup>7</sup> pointed out that patterns of (under)representation map onto stereotypic associations of women's bodies with sexuality and men's with functionality. We found that although the proportion of women with sex-specific as compared with sex-nonspecific cancers moved toward greater balance in biomedical treatment studies in 2007, women were still under-represented relative to men in studies of sex-nonspecific cancers. Moreover, we were surprised to have found such a notable decline in the overall percentage of women included as study subjects in 2007 compared with 1983 and 1992. Despite continued overall under-representation, our examination of discrepancies between the proportion of men and women included in biomedical studies does suggest some movement toward equity, and adherence to the 1993 NIH Revitalization Act. Our finding that fewer studies were marked by a significant disparity (defined as  $\geq 20\%$  fewer women) suggests that more studies are being designed so as to provide for valid analysis of sex and gender differences and similarities, as specified by the NIH Revitalization Act guidelines.

We also want to highlight the sizeable increase in the proportion of men with sex-specific cancers included among biomedical treatment studies. Although the US Food and Drug Administration approved the prostate-specific antigen test for screening of prostate cancer in 1994,<sup>21</sup> this likely only accounts for a portion of the increase. Perhaps shifting gender roles over the last quarter century have indirectly influenced cancer research, such that reproductive organs and reproductive-related issues are increasingly recognized as relevant for both women and men. Another interpretation is that sexual objectification, which Meyerowitz and Hart<sup>7</sup> connect with overemphasis on women's sex-specific cancers, has extended increasingly to men.<sup>22</sup> This is consistent with our finding that, in 2007, the proportion of men with reproductive organ cancers reported in *Cancer* was notably higher than men's reproductive organ cancer incidence and mortality. At the same time, the low proportion of men with sex-specific cancers in psychosocial studies might indicate a lack of attention to the psychological and relational aspects of sexuality in men and a bias toward a focus on physical functioning. It should also be noted that prostate cancer was by far the most common sex-specific cancer studied in men. The inclusion of only a single male subject with breast cancer and few studies including men with cancer of the testes or other reproductive organs is notable. The under-representation of these cancer groups might limit the generalizability of psychosocial research to men with other reproductive cancers.

Our results also indicate a changing picture of the study of psychosocial aspects of cancer over time. Researchers have increasingly acknowledged the importance of psychosocial issues among men, as evidenced by the more balanced representation of men and women overall in 2007 as compared with 1992. It is also possible that men are increasingly more willing to participate in psychosocial research. We observed a remarkable increase in the inclusion of men in the study of feelings and social relationships, as well as increased attention to questions of physical and functional ability among women. These findings suggest a departure from the traditional stereotype that women feel and men act, which seemed to have shaped the direction of research 15 years earlier.

Despite more equitable inclusion and study of men within the psychosocial literature, and movement toward more balanced representation of women in sex-specific and sex-nonspecific biomedical studies, certain biases remain intact, which may impact cancer risk and prevention behaviors. For example, a proportional overemphasis of research on sex-specific cancers among women, and possibly emerging overemphasis on sex-specific cancers

among men, in biomedical research is likely to lead to an overemphasis on sex-specific cancers in the popular news media and public awareness. It has been speculated that individuals may perceive greater risk of sex-specific cancers because sex-specific physical attributes may play a larger role in self-image and identity compared with less salient, sex-nonspecific attributes.<sup>23</sup> A proportional overemphasis on sex-specific cancers in research, and subsequently in the popular media, may exacerbate such pre-existing patient biases. Studies suggest that women overestimate their risk of developing breast cancer,<sup>24</sup> and may underestimate their risk for other cancers. In a recent national survey,  $\frac{2}{3}$  of women inaccurately described breast cancer as the leading cause of cancer death among women, with only 30% correctly indicating lung cancer.<sup>25</sup> Men also report greater perceived risk for prostate cancer than for other cancer types.<sup>23</sup> Similarly, studies suggest that women may view colorectal cancer as a male disease and minimize perceived susceptibility,<sup>26</sup> despite it being the third most common cancer in incidence and mortality among women.<sup>17</sup> Although variability exists, men are more likely than women to be screened for colorectal cancer, despite men's overall lower use of medical services.<sup>27</sup>

Factors contributing to gender differences in representation are complex, and certainly not limited to researcher biases. In addition to the availability of trials, study participation depends on a host of variables, including cancer incidence, mortality, and relapse rates, that are influenced by both (biological) sex and (psychosocial) gender differences. For example, lung cancer is slightly more common in men than women, and women tend to have lesser morbidity and mortality.<sup>28</sup> Relevant gender-influenced factors such as differential carcinogen exposure or smoking behaviors exist. Other variables influencing trial availability may include patient activism<sup>29</sup> and potential for profit.

To the extent that gender stereotypes inadvertently affect which patients and disease sites are studied, gender norms may also affect study participation. For instance, instrumental and financial resources increased initiation and retention in behavioral human immunodeficiency virus prevention studies more among males, whereas social opportunities (eg, group intervention trials) increased initiation and retention among females.<sup>30</sup> Also, women are less likely to enroll in clinical trials that involve testing new medications,<sup>31</sup> and men are less likely to participate in psychosocial research.<sup>32</sup>

Our findings must be interpreted cautiously. In our review of biomedical studies, we examined only 1 journal. Although with 3 publication years now referenced, the uniqueness of this journal should be considered. Also, this

study focused on only a single publication year. Although this approach is useful for place-marking periods in time, the possibility that selected years do not well represent surrounding publication years should be considered. This study offers an analysis of gender representation of sex-specific and sex-nonspecific cancers; however, we do not suggest that any cancer type should receive less empirical attention. Also, we focus on gender expectations as a frame for interpreting these results. Other sociocultural influences and mediating processes should be considered in setting research agendas (eg, ageism, racial/ethnic bias, media).

A small minority of studies reported the ethnicity of the sample, making considerations of the intersections of ethnicity and gender difficult to evaluate. Likewise, <20% of biomedical or psychosocial studies recorded examination of gender comparisons on primary outcomes, although many had sufficient statistical power to do so. This percentage may reflect the rate of actual analyses, or a file drawer problem,<sup>33</sup> whereby researchers might be less likely to report results that indicate similarities. Although identification of sex differences may be useful for answering for whom treatments are effective, more complex attention to sex and gender similarities and differences will help to identify mechanisms and processes. Elucidation of gender differences within cancer types could reveal important biobehavioral influences and interactions (eg, adherence, neuroendocrine patterns) regarding gender disparities. Furthermore, a focus on sex differences with inattention to complex gender influences might ignore similarities across gender.

The results from this update suggest a shifting picture of the study of cancers among women and men, despite relative stability in the actual proportion of sex-specific to sex-nonspecific cancer incidence. This change might reflect increased awareness and incidence of sex-specific cancers among men as well as changing awareness and attitudes toward gender and cancer more generally. These findings provide insight into the ways that representation of men and women in biomedical treatment and psychosocial survivorship varies across cancer site and type, and across time, suggesting that gender stereotyping, and changing ideas about gender, may be an important component of the story.

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