

# Factors Associated With Physical Activity Levels in Patients With Breast Cancer

Paulina S. Marell<sup>1</sup>,<sup>ORCID</sup> Robert A. Vierkant<sup>2</sup>, Janet E. Olson<sup>2</sup>, Joerg Herrmann<sup>3</sup>, Nicole Larson<sup>2</sup>, Nathan K. LeBrasseur<sup>4</sup>, Stacy D. D'Andre<sup>5</sup>, Andrea L. Cheville<sup>4</sup>,<sup>ORCID</sup> Toure Barksdale<sup>4</sup>, Charles L. Loprinzi<sup>5</sup>, Fergus Couch<sup>6</sup>, Kathryn J. Ruddy<sup>5</sup>,<sup>ORCID</sup>

<sup>1</sup>Internal Medicine, Mayo Clinic, Rochester, MN, USA

<sup>2</sup>Quantitative Health Sciences, Rochester, MN, USA

<sup>3</sup>Cardiovascular Medicine, Rochester, MN, USA

<sup>4</sup>Physical Medicine and Rehabilitation, Rochester, MN, USA

<sup>5</sup>Medical Oncology, Rochester, MN, USA

<sup>6</sup>Laboratory Medicine and Pathology, Mayo Clinic, Rochester, MN, USA

\*Corresponding author: Paulina S. Marell, MD, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA. Tel: +1 507 284 5278; Email: [marell.paulina@mayo.edu](mailto:marell.paulina@mayo.edu)

## Abstract

Physical activity (PA) is associated with improvement in breast cancer treatment-related symptoms and survival, yet most breast cancer survivors do not meet national PA guidelines. This study aimed to identify characteristics of participants that were associated with an increased likelihood of meeting PA guidelines. Adults with breast cancer seen at Mayo Clinic (Rochester, MN) were surveyed regarding their PA participation, and those who self-reported at least 150 minutes of moderate and/or strenuous aerobic PA weekly on average were considered to be “meeting guidelines”. Three thousand participants returned PA data. Younger age, completion of the survey 7–12 years after diagnosis, absence of recurrence, no bilateral mastectomy, absence of metastatic disease, and lower BMI at the time of survey completion were associated with PA participation ( $P < .05$  in univariate and multivariate analyses). Findings were similar when a threshold of 90 minutes was applied. These results may inform the development of targeted PA-facilitating interventions.

**Key words:** exercise; breast neoplasms; cancer survivors; health behavior.

## Background

Each year in the US, more than 250 000 people are expected to receive a diagnosis of breast cancer, with 90% expected to survive at least 5 years after diagnosis.<sup>1</sup> Many breast cancer survivors experience treatment side effects, including menopausal symptoms, sexual dysfunction, infertility, osteoporosis, fatigue, and neuropathy.<sup>2</sup> Lifestyle factors, including physical activity (PA), are known to impact the incidence and course of various malignancies, as well as the symptoms that result from cancer and its treatment.<sup>1</sup> PA is associated with decreased breast cancer mortality and recurrence and improvement in overall and disease-free survival, including in those with metastatic disease.<sup>3–5</sup> PA has also been shown to decrease lymphedema,<sup>6</sup> sexual dysfunction,<sup>3</sup> and fatigue,<sup>3,6</sup> and to improve physical functioning and quality of life.<sup>7</sup>

The American Cancer Society's nutrition and physical activity guidelines recommend at least 150 minutes of moderate and/or strenuous physical activity weekly for adults (in addition to strengthening exercises).<sup>1</sup> A study published in 2013 followed 631 women over 10 years and analyzed PA (in MET-hours/week) during the year prior to diagnosis (baseline), 24 months after diagnosis, 5 years after diagnosis, and 10 years after diagnosis. They found that 34%, 40%, and

21% of women met those guidelines at 2, 5, and 10 years after study enrollment, respectively, indicating that a minority of women met PA guidelines at any time point and participation in PA decreased over the decade after breast cancer diagnosis. Meeting guidelines during the baseline period was associated with meeting guidelines at 5 and 10 years after diagnosis. No demographic factors were found to predict the 10-year change in MET-hours/week.<sup>8</sup> Additional research to further characterize PA trends and determine barriers to meeting PA guidelines in breast cancer survivors will inform the development of interventions to increase PA levels. This study aimed to elucidate which demographic and disease factors were associated with meeting PA guidelines.

## Methods

Patients seen at least once at Mayo Clinic Rochester who provide informed consent are prospectively enrolled in the Mayo Clinic Breast Disease Registry (MCBDR), following an initial diagnosis of breast cancer at age 18 or older. In 2016, a survey was mailed to MCBDR participants who were diagnosed with breast cancer between 2003 and 2015. That survey included a modified Godin Leisure-Time Exercise

**Table 1.** Univariate associations of participant and tumor characteristics with meeting guidelines of at least 150 minutes of moderate and/or strenuous exercise per week.

	Meeting guidelines of 150 or more minute per week of strenuous or moderate exercise			P-value
	No (N = 1772)	Yes (N = 1228)	Total (N = 3000)	
Age at diagnosis, years, <i>n</i> (%)				<.001 <sup>†</sup>
18-39	81 (45.5%)	97 (54.5%)	178 (5.9%)	
40-49	397 (53.4%)	346 (46.6%)	743 (24.8%)	
50-59	501 (54.6%)	417 (45.4%)	918 (30.6%)	
60-69	520 (64.4%)	288 (35.6%)	808 (26.9%)	
≥70	273 (77.3%)	80 (22.7%)	353 (11.8%)	
Sex, <i>n</i> (%)				.455 <sup>†</sup>
Female	1763 (59.0%)	1224 (41.0%)	2987 (99.6%)	
Male	9 (69.2%)	4 (30.8%)	13 (0.4%)	
Race, <i>n</i> (%)				.335 <sup>†</sup>
African/African American/Black	3 (30.0%)	7 (70.0%)	10 (0.3%)	
American Indian/Alaskan Native	2 (50.0%)	2 (50.0%)	4 (0.1%)	
Asian	16 (53.3%)	14 (46.7%)	30 (1.0%)	
Other	11 (52.4%)	10 (47.6%)	21 (0.7%)	
Unknown/choose not to provide	46 (53.5%)	40 (46.5%)	86 (2.9%)	
White	1694 (59.5%)	1155 (40.5%)	2849 (95.0%)	
Ethnicity, <i>n</i> (%)				.330 <sup>†</sup>
Hispanic/Latino	11 (78.6%)	3 (21.4%)	14 (0.5%)	
Not Hispanic/Latino	1569 (59.0%)	1092 (41.0%)	2661 (88.7%)	
Unknown/choose not to provide	192 (59.1%)	133 (40.9%)	325 (10.8%)	
Years between diagnosis and survey completion, <i>n</i> (%)				.020 <sup>†</sup>
<3	207 (56.7%)	158 (43.3%)	365 (12.2%)	
3-4.9	222 (56.9%)	168 (43.1%)	390 (13.0%)	
5-6.9	292 (57.1%)	219 (42.9%)	511 (17.1%)	
7-8.9	324 (60.9%)	208 (39.1%)	532 (17.8%)	
9-10.9	293 (59.7%)	198 (40.3%)	491 (16.4%)	
11-12.9	219 (67.6%)	105 (32.4%)	324 (10.8%)	
13+	211 (55.4%)	170 (44.6%)	381 (12.7%)	
Missing	4	2	6	
Recurrence, <i>n</i> (%)				.008 <sup>†</sup>
Did not recur	1604 (58.3%)	1145 (41.7%)	2749 (92.0%)	
Recurred	160 (67.2%)	78 (32.8%)	238 (8.0%)	
Missing	8	5	13	
Breast surgery, <i>n</i> (%)				<.001 <sup>†</sup>
Bilateral mastectomy	486 (52.1%)	447 (47.9%)	933 (31.1%)	
Lumpectomy	694 (61.0%)	444 (39.0%)	1138 (37.9%)	
None, biopsy only, other surgery, or unknown	219 (66.8%)	109 (33.2%)	328 (10.9%)	
Unilateral mastectomy	373 (62.1%)	228 (37.9%)	601 (20.0%)	
Radiation therapy, <i>n</i> (%)				.099 <sup>†</sup>
No radiation	612 (57.0%)	462 (43.0%)	1074 (36.1%)	
Breast radiation	1144 (60.1%)	760 (39.9%)	1904 (63.9%)	
Missing	16	6	22	
Hormonal therapy, <i>n</i> (%)				.911 <sup>†</sup>
Did not receive	621 (58.8%)	435 (41.2%)	1056 (35.6%)	
Received	1129 (59.0%)	784 (41.0%)	1913 (64.4%)	
Missing	22	9	31	
Chemotherapy, <i>n</i> (%)				.074 <sup>†</sup>
Did not receive	1007 (60.2%)	666 (39.8%)	1673 (56.8%)	
Received	724 (56.9%)	548 (43.1%)	1272 (43.2%)	
Missing	41	14	55	

Table 1. Continued

	Meeting guidelines of 150 or more minute per week of strenuous or moderate exercise			P-value
	No (N = 1772)	Yes (N = 1228)	Total (N = 3000)	
Nodal status, n (%)				.568 <sup>1</sup>
N0/X/unknown	1298 (58.8%)	911 (41.2%)	2209 (73.6%)	
N1-3	474 (59.9%)	317 (40.1%)	791 (26.4%)	
Metastasis status, n (%)				.030 <sup>1</sup>
M0/X/unknown	1743 (58.8%)	1219 (41.2%)	2962 (98.7%)	
M1	29 (76.3%)	9 (23.7%)	38 (1.3%)	
Current body mass index, mean (SD)	28.6 (6.4)	25.9 (5.0)	27.5 (6.0)	<.001 <sup>2</sup>

<sup>1</sup>Chi-square P-value.<sup>2</sup>Equal variance 2 sample t test;

Questionnaire (GLTEQ), in which participants were asked to report the minutes per day and days per week in which they engaged in mild, moderate, and/or strenuous physical activity. The GLTEQ is used frequently in oncology research and has been validated to identify active and insufficiently active breast cancer survivors.<sup>9</sup> They were asked to return their completed survey in a pre-stamped and pre-addressed envelope to the MCBDR study team. Respondents who answered questions about PA were considered to be “meeting guidelines” for PA if they self-reported at least 150 minutes of moderate and/or strenuous aerobic PA per week on average. We assessed associations between “meeting guidelines” and various characteristics, including age at diagnosis, sex, race, ethnicity, current body mass index (BMI), years since diagnosis at time of survey completion, treatments received (surgery, radiation, chemotherapy, and/or hormonal therapy), and tumor characteristics, including nodal (N) and metastasis (M) status, as well as whether or not there was a cancer recurrence prior to the survey. Because it is well known that most adults aged 18-64 in the US do not meet national PA guidelines,<sup>10</sup> we also analyzed a lower PA threshold of 90 minutes of moderate and/or strenuous PA per week. Associations were initially assessed using chi-square tests and 2-sample *t* tests. All variables significantly associated with meeting guidelines in univariate analyses ( $P < .01$ ) were simultaneously included in a multivariate logistic regression model. This study was approved by the Mayo Clinic institutional review board.

## Results

Of the 4838 surveys mailed, 3348 were received (overall response rate 69%), and 3000 breast cancer survivors provided information regarding their usual quantity of moderate and/or strenuous weekly aerobic PA (PA response rate 62%). Of these, 1228 (41%) met PA guidelines as defined above. Eighty-one percent of respondents were between the ages of 40 and 70. The average age of those meeting and not meeting guidelines was 54 and 58 years, respectively ( $P < .001$ ). Fifty-four percent of respondents under age 40 met aerobic exercise guidelines, compared to 24% of those older than 70 ( $P = .01$ , Table 1). Those meeting guidelines were more likely to have had their diagnosis between 7 and 12 years prior to survey completion, to have not had disease recurrence, and to have not undergone bilateral mastectomy, compared to those not meeting guidelines. Those

meeting and not meeting guidelines were similar in terms of sex, race, ethnicity, and non-surgical treatment regimens received (chemotherapy, hormonal therapy, and radiation), and presence of nodal disease. Only 24% of patients who had metastatic disease at diagnosis met exercise guidelines, compared to 41% of those without metastatic disease ( $P < .001$ ). Those who met guidelines had an average BMI of 25.9, compared to 28.6 for those not meeting guidelines ( $P < .001$ ). Associations were similar when assessing a 90-minute threshold instead of a 150-minute threshold (Supplementary Table S1). Multivariate analyses confirmed that age, years between diagnosis and survey completion, recurrence status, type of surgery, metastatic disease, and BMI were independent predictors of meeting PA guidelines ( $P < .05$  for each, Table 2).

## Discussion

Overall, 41% of breast cancer survivors met aerobic PA guidelines (150 minutes moderate and/or strenuous physical activity weekly). Among adult women in the general population, 33% meet PA or muscle-strengthening guidelines,<sup>10</sup> possibly suggesting that breast cancer survivors engage in more PA than others. A cancer diagnosis may spur lifestyle change for some; some previous studies show a high prevalence of exercise in cancer survivors.<sup>11</sup> We found that younger age, absence of metastatic disease at diagnosis, a diagnosis 7-12 years prior to survey completion, absence of disease recurrence, not having undergone a bilateral mastectomy, and a lower BMI at the time of survey completion were significantly associated with PA participation amongst breast cancer survivors in a cross-sectional analysis of a cohort at an academic institution. These characteristics remained significant independent predictors when a multivariate analysis was applied. Furthermore, findings were similar when a 90-minute PA threshold was applied, expanding the generalizability of these findings to less stringent PA guidelines. Overall, it appears that older adults, those with more advanced disease (metastases, recurrence, and undergoing a bilateral mastectomy), and those with higher BMI are less likely to be physically active. Although these results are not surprising, they support the development of PA-facilitating interventions aimed at these groups specifically. It is interesting that there appears to be a U-shaped relationship between time since diagnosis and PA levels; a study following individual PA patterns

**Table 2.** Multivariate-adjusted associations of participant and tumor characteristics with likelihood of meeting guidelines of at least 150 minutes of moderate and/or strenuous exercise per week.

Characteristic	Odds ratio (95% CI)	P-value
Age at diagnosis		<.001
18-39	3.67 (2.34-5.73)	
40-49	2.85 (2.06-3.93)	
50-59	2.81 (2.06-3.83)	
60-69	1.97 (1.45-2.69)	
≥ 70	1.00 (ref)	
Years between diagnosis and survey completion		.007
<3	1.00 (ref)	
3-4.9	1.00 (0.72-1.38)	
5-6.9	0.85 (0.63-1.14)	
7-8.9	0.76 (0.56-1.02)	
9-10.9	0.76 (0.56-1.03)	
11-12.9	0.55 (0.39-0.78)	
≥ 13	0.93 (0.66-1.32)	
Recurrence		.04
Did not recur	1.00 (ref)	
Recurred	0.70 (0.50-0.98)	
Breast surgery		.03
Bilateral mastectomy	1.00 (ref)	
Lumpectomy	0.84 (0.66-1.08)	
None, biopsy only, other surgery or unknown	0.75 (0.54-1.05)	
Unilateral mastectomy	0.70 (0.56-0.89)	
Radiation therapy		.78
No radiation	1.00 (ref)	
Breast radiation	0.97 (0.76-1.21)	
Chemotherapy		.50
Did not receive	1.00 (ref)	
Received	0.93 (0.78-1.13)	
Metastasis status		.02
M0/X/unknown	1.00 (ref)	
M1	0.32 (0.12-0.82)	
Current body mass index	0.92 (0.90-0.93) <sup>1</sup>	<.001

Logistic regression analysis, simultaneously modeling all variables found to be univariately significant with meeting guidelines ( $P < .10$ ).

<sup>1</sup>Decreased odds of meeting guidelines per one unit increase in BMI.

serially over time would better elucidate the drivers of this finding. Although a large sample is a strength of the current study, it is important to recognize that the respondent population from this survey may not be representative of other survivors in the US or the world. A more diverse cohort will be required to analyze race and ethnicity in relation to exercise participation.

## Funding

This research was supported by the Mayo Clinic Breast Registry. Funding was provided through the Breast Cancer Research Foundation.

## Conflict of Interest

**Charles L. Loprinzi:** PledPharma, Disarm Therapeutics, Asahi Kasei, Metys Pharmaceuticals, OnQuality, Mitsubishi Tanabe, NKMax, Novartis, HengRui, Nuro Bio, Osmol Therapeutics, Inc., Grunenthal (personal fees outside the submitted work). The other authors indicated no financial relationships.

(C/A) Consulting/advisory relationship; (RF) Research funding; (E) Employment; (ET) Expert testimony; (H) Honoraria received; (OI) Ownership interests; (IP) Intellectual property rights/inventor/patent holder; (SAB) Scientific advisory board.

## Author Contributions

Conception/design: P.S.M., K.J.R. Provision of study material or patients: J.E.O., N.L., F.C., K.J.R. Collection and/or assembly of data: N.L. Data analysis and interpretation: P.S.M., K.J.R. Manuscript writing: P.S.M., J.E.O., S.D.D., C.L.L., K.J.R. Final approval of manuscript: All authors.

## Data Availability

The data underlying this article will be shared on reasonable request to the corresponding author.

## Supplementary Material

Supplementary material is available at *The Oncologist* online.

## References

- American Cancer Society. (2021). *Cancer facts & figures 2021*. Atlanta: American Cancer Society.
- Stan D, Loprinzi CL, Ruddy KJ. Breast cancer survivorship issues. *Hematol Oncol Clin*. 2013;27(4):805-827.
- Cormie P, Zopf EM, Zhang X, Schmitz KH. The impact of exercise on cancer mortality, recurrence, and treatment-related adverse effects. *Epidemiol Rev*. 2017;39(1):71-92.
- Delrieu, L, Jacquet, E, Segura-Ferlay, C, et al. Analysis of the StoRM cohort reveals physical activity to be associated with survival in metastatic breast cancer. *Sci Rep*. 2020;10(1):1-12.
- Hayes, SC, Steele, ML, Spence, RR, et al. Exercise following breast cancer: exploratory survival analyses of two randomised, controlled trials. *Breast Cancer Res Treat*. 2018;167(2):505-514.
- Baumann FT, Reike A, Reimer V, et al. Effects of physical exercise on breast cancer-related secondary lymphedema: a systematic review. *Breast Cancer Res Treat*. 2018;170(1):1-13.
- McNeely M, Campbell K, Rowe B, et al. A systematic review and meta-analysis of exercise interventions in breast cancer patients and survivors. *CMAJ*. 2006;175(34):2006-2041.
- Mason C, Alfano CM, Smith AW, et al. Long-term physical activity trends in breast cancer survivors. *Cancer Epidemiol Prev Biomarkers*. 2013;22(6):1153-1161.
- Amireault S, Godin G, Lacombe J, Sabiston CM. Validation of the Godin-Shepherd Leisure-Time Physical Activity Questionnaire classification coding system using accelerometer assessment among breast cancer survivors. *J Cancer Surviv*. 2015;9(3):532-540.
- Blackwell DL, Clarke TC. State variation in meeting the 2008 federal guidelines for both aerobic and muscle-strengthening activities through leisure-time physical activity among adults aged 18-64: United States, 2010-2015. *National Health Stat Rep*. 2018;(112):1-22.
- Pinto BM, Trunzo JJ. Health behaviors during and after a cancer diagnosis. *Cancer*. 2005;104(S11):2614-2623.