



Physical activity barriers, facilitators, and preferences in primary and tertiary prevention of breast cancer: a French national observational study

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Abstract

Background The benefits of physical activity are widely recognized in primary and tertiary breast cancer prevention. Most women do not meet the international physical activity recommendations for breast cancer prevention despite public health policies. The aim of this study is to better understand barriers, facilitators, and preferences for physical activity among adult women in France.

Methods A web-based observational study was conducted between February and March 2021 through a Seintinelles French collaborative research platform. Women with and without a history of breast cancer were asked to complete an online questionnaire measuring sociodemographic and health characteristics, physical activity behaviors, physical activity barriers and facilitators, and physical activity preferences.

Results A total of 2,306 women participated in this study, including women without breast cancer ($n = 1,245$), women with localized breast cancer undergoing treatment ($n = 530$), or post-treatment ($n = 396$), and women with metastatic breast cancer ($n = 135$). The mean age was 48.7 years ($SD = 13.2$) and 63.8% of the population were classified as insufficiently active. Lack of motivation was the most common physical activity barrier in all groups while the main physical activity facilitators were women's desire to improve their abilities and quality of life, to feel better about their bodies and to experience pleasure. Walking remains the preferred physical activity for all women in the study, as they particularly like to be active outdoors, under supervision, on any day of the week, at a moderate intensity, for 30–60 min per session. Some differences of physical activity barriers, facilitators and preferences were observed between women who are still undergoing treatment compared to women who have completed the treatment or without breast cancer history. Women with metastatic breast cancer emphasized their need for physical activity counselling. Overall, physically inactive women reported more barriers to exercise (17 out of 22 items), whereas physically active women reported more facilitators (20 out of 22 items).

Conclusions Women across the breast cancer spectrum identified similar and unique determinants and preferences for physical activity. These determinants and preferences may contribute to targeted activity guideline development to promote physical activity for women before, during, and after treatment for breast cancer.

Implications for Cancer Survivors Women who had completed treatment for localized breast cancer share both common and specific determinants and preferences for physical activity compared with women without breast cancer, those undergoing treatment, and those with metastatic disease, highlighting the need for tailored physical activity counselling and programs.

Keywords Breast Cancer · Cancer Prevention · Fitness and Exercise Culture · Motivated Behavior · Health Promotion and Disease Prevention · Gender and Health

Abbreviations

BC	Breast cancer
BMI	Body mass index
GLTEQ	Godin Leisure-Time Exercise Questionnaire

Extended author information available on the last page of the article

Background

Breast cancer (BC) is the most commonly diagnosed cancer and the leading cause of cancer death in women worldwide [1]. In France, breast cancers accounted for 33% of incidence and 18% of mortality for all cancers in women in 2022 [2].

That year, 65,659 new cases of breast cancer ranking it as the country with the highest incidence rate [1]. It is estimated that more than 900,000 French women actually living with a diagnosis of breast cancer [3].

There is strong evidence that higher levels of physical activity are associated with a reduced risk of pre- and post-menopausal breast cancer [4–6]. Physical activity is also beneficial during and after treatments of breast cancer patients, physiologically (e.g. improved cardiorespiratory fitness, muscle quality, body composition) and psychologically (e.g. reduced fatigue, anxiety, depression, and improved quality of life) [7–9]. Physically active women with breast cancer may also have a lower risk of recurrence and mortality compared to women with lower levels of physical activity [10–12]. Furthermore, improvements in fatigue and health related quality of life have also been reported even in patients with breast cancer at a metastatic stage [13–16].

Despite the well documented benefits of physical activity, one in three women worldwide do not meet the World Health Organization (WHO) recommendations for physical activity (i.e., not doing at least 150 min of moderate intensity). The prevalence of insufficient physical activity has been rising, with an estimated 31.3% of adults (1.8 billion people) being insufficiently active in 2022, compared to 23.4% (900 million) in 2000 [17]. Notably, women had a higher prevalence of insufficient physical activity (33.8% [95% UI: 29.9–37.7]) than men (28.7% [25.0–32.6%]), representing a difference of 5 percentage points. In France, in 2022, 41% of women over 18 years of age did not meet the WHO recommendations with an increase in recent years [18]. Once diagnosed with breast cancer, women are likely to reduce their physical activity levels even further [19, 20].

Promoting physical activity among women is important to reduce the risk of breast cancer (primary prevention) but also at the time of diagnosis, during cancer treatments, and beyond to prevent short and long-term side effects (tertiary prevention). To encourage physical activity, it is essential to understand the determinants (barriers and facilitators) and preferences of individuals to enhance physical activity adherence throughout the cancer care continuum, from prevention to survivorship [21, 22].

Based on individual studies that included either women with or without breast cancer, some physical activity barriers could be common to all women (e.g. lack of self-confidence), while others could be specific to women with localized breast cancer (e.g. fatigue) or with metastatic breast cancer (e.g. fear of injury) [29–34]. The same applies for physical activity facilitators and preferences that could be common to all women and specific for categories of women based on the disease and treatment status, by pooling composite data from heterogeneous studies. To date, no studies have compared physical activity barriers, facilitators, and preferences in a large cohort of women with or without breast cancer to determine the impact of breast cancer,

its treatments and its severity on women needs and preferences regarding physical activity. This will lead to a better understanding of the ways of integrating physical activity into daily life among women with and without a history of breast cancer and to design future physical activity programs adapted to the needs and preferences of this population.

The objective of this study was to describe and compare barriers, facilitators, and preferences for physical activity among women in primary and tertiary breast cancer prevention.

Methods

Design and data source

This web-based observational study was conducted between February and March 2021 through the Seintinelles platform (<https://www.seintinelles.com/>), a collaborative research platform on cancer launched in 2013 in France [23]. In February 2021, the web platform included 32,277 volunteers, men and women, who do or do not have cancer, and gathered 7,199 patients with a personal history of breast cancer.

The study received ethical approval from the Research Ethics Board at the Léon Bérard Cancer Center in Lyon on November 18, 2020 (note #2020–004). All collected data were securely stored on the Cancer Center Léon Bérard's servers, ensuring compliance with data protection regulation and maintaining participant confidentiality.

Study population and recruitment

The Seintinelles platform sent an email to all its members, regardless of inclusion criteria, informing them about the study objectives, along with the information sheet. All women from the Seintinelles, with or without any personal history of breast cancer (other cancers excluded), engaged or not in regular physical activity, could participate in the study. If they were interested, participants completed a self-administered questionnaire using the LimeSurvey online survey tool [24].

Data collection

Sociodemographic characteristics and health information

We collected sociodemographic data, including age, living situation, education level (categorized as low for those without a diploma or with vocational training, medium for those with a high school diploma or up to two years of post-secondary education, and high for those with at least three years of post-secondary education), occupational status, and residence location. Health characteristics included

height, weight, number of children, comorbidities, and history of breast cancer (no history of breast cancer, undergoing treatment, post-treatment). For participants with breast cancer, disease stage at the time of questionnaire completion (localized, metastatic) and type of treatments received since diagnosis (surgery, chemotherapy, radiotherapy, hormonotherapy, immunotherapy, targeted therapy) were additionally collected.

Physical activity

Physical activity level was measured by the Godin Leisure-Time Exercise Questionnaire (GLTEQ) [25, 26]. The GLTEQ is a validated self-administrated questionnaire to estimate a physical activity level score. It includes three main questions about the frequency of low (e.g. easy walking), moderate (e.g. brisk walking), and strenuous (e.g. jogging) leisure-time physical activity of at least 15 min duration in a typical week. The physical activity level score, called a Leisure Score Index (LSI), was calculated by summing the frequencies of mild, moderate, and strenuous physical activity multiplied by a corresponding Metabolic Equivalents of Task (i.e., 3, 5, and 9 for mild, moderate, and strenuous intensity, respectively). Based on this score, two categories were generated ($LSI \geq 24$ is equivalent to active, and $LSI \leq 23$ is equivalent to insufficiently active) [27]. Previous research with and without breast cancer survivors has found the GLTEQ to be a valid and reliable tool for classifying participants into active and insufficiently active categories [25, 26]. One item measuring the frequency of strength training during a typical week was added to the GLTEQ. Women were categorized as meeting or not the additional WHO strength training recommendations (i.e. do muscle-strengthening activities on at least 2 days a week) [28].

Physical activity barriers and facilitators

Physical activity barriers and facilitators were assessed using a self-administered questionnaire specifically developed for this study. Questionnaire items were generated from published studies in women with or without breast cancer [29–31]. Two separate lists were presented: one addressing barriers (“I am not as physically active as I would like because...”) and the other addressing facilitators (“My practice of physical activity is facilitated by the fact that...”). Each list included statements addressing personal, social, organizational and environmental domains. For each item, participants were asked to indicate how often the statement applied to their current situation, using a 5-point Likert scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = very

often). For example, a barrier item was: “I’m not as physically active as I would like because I’m too tired” while a facilitator item was: “My practice of physical activity is facilitated by the fact that I feel pleasure when exercising.” The complete set of 22 barrier items and 22 facilitator items is provided in Appendix 2.

Physical activity preferences

Physical activity preferences were assessed using a self-administered questionnaire with items generated from studies in women with or without breast cancer [32–34]. The first domain was physical activity programming including questions about participants’ interest and ability to participate in a physical activity program and their preferred modalities for exercising (i.e., type of exercise, location, company, supervision, intensity, structure, variety of exercise, time of day, day of week, frequency per week, time per session). As we specifically focused on structured exercise, we included only exercise types (e.g., walking, swimming, strengthening) and not other forms of physical activity such as gardening. Location options included home, outside, work, club, and health care facility (including hospital, health center, or rehabilitation center). Within the “company” modality, “in pairs” referred to exercising with any partner (e.g., friend, family member), whereas “with another patient” specifically referred to exercising with another person who had also been diagnosed with cancer. The second domain was physical activity counselling including questions about participants’ interest in physical activity counselling at the time of cancer diagnosis, and their preferred source and modalities of counselling (i.e. counselling source such as family doctor or physiotherapist, and counselling delivery such as phone or group format).

Statistical analysis

Categorical variables were characterized using distributions, frequencies, and percentages. Continuous variables were summarized using means, standard deviations, medians, minimum, and maximum values. Participants were grouped into four categories according to their breast cancer status: 1) women with no history of breast cancer, 2) women undergoing treatment for localized breast cancer, 3) women who had completed treatment for localized breast cancer, and 4) women with metastatic breast cancer. A participant was classified as having completed treatment if she had finished all forms of primary and adjuvant treatments by the time of completing the questionnaire, including hormone therapies known for their significant side effects. Hypothesis testing was conducted to investigate the association between breast cancer status and barriers, facilitators, and preferences for physical activity. In

addition, we compared physically active women ($LSI \geq 24$) and physically inactive women ($LSI \leq 23$) across the entire study population with respect to their barriers, facilitators, and selected preferences for physical activity. Chi-square tests were utilized to examine relationships between two categorical variables, and the Kruskal–Wallis test was applied to non-parametric continuous variables. Body mass index (BMI) was categorized into ordinal categorical variables as follows: underweight ($< 18.5 \text{ kg/m}^2$), normal (18.5 to 24.9 kg/m^2), overweight (25 to 29.9 kg/m^2), and obese ($\geq 30 \text{ kg/m}^2$). Given the extensive number of statistical analyses performed, a two-sided p -value of < 0.01 was selected as the threshold for statistical significance. This rigorous threshold was chosen to rigorously control for type I errors, ensuring robustness in our findings against the backdrop of multiple comparisons. The chosen significance level and analytical methods aim to balance comprehensive data exploration with the precision needed for valid scientific conclusions. All statistical analyses were executed using R software, version 4.0.4.

Results

Patient characteristics

A total of 2,306 women from all over France were included in this study (Supplementary Appendix 1). This represents 1,245 women without breast cancer (54%), 530 localized breast cancer undergoing treatment (23%), 396 post-treatment localized breast cancer (17%), and 135 metastatic breast cancer (6%).

Sociodemographic characteristics of the study population can be found in Table 1. The mean age of participants was 48.7 (SD = 13.2) years, with a higher proportion of younger women among those without breast cancer (mean age of 43.9 years) as compared to women with a history of breast cancer (the mean ages of 51.5–58.2 years) ($p < 0.001$). Nearly two-thirds of women had a high level of education with at least a bachelor's degree. Women without breast cancer had a higher level of education compared to women with a history of breast cancer. The majority of women were employed full-time and lived in a big city or its suburb, except for those who had completed localized breast cancer treatment.

Health characteristics of the sample is located in Table 1. While the study population consisted mainly of women of normal weight (65.1%), BMI differed significantly between the four groups ($p < 0.001$) with women with metastatic breast cancer being the group with the highest proportion of overweight or obese women (37.8%) ($p = 0.002$). The number of comorbidities differed

significantly between groups ($p < 0.001$) with more than half of the breast cancer patients having comorbidities; the latter being most frequent in women with metastatic breast cancer. Nearly 9 out of 10 women with localized breast cancer undergoing treatment was receiving hormone therapy at the time of the questionnaire completion (vs. 50.4% for metastatic breast cancer).

Physical activity level

More than half (63.8%) of the study population were classified as insufficiently active according to GLTEQ score (Table 1). More than half of the participants (58.0%) did not meet the recommended strength training guidelines. There was no significant difference between the groups regarding physical activity level nor frequency of strength training.

Physical activity barriers

The main barriers to physical activity are shown in Fig. 1. Lack of motivation was the most common exercise barrier for nearly half of the women (from 49% in post-treatment localized breast cancer to 63% in without breast cancer), followed by fatigue and bad weather. For women undergoing localized breast cancer treatment and with metastatic breast cancer, “severe pain” and “significant side effects” were barriers more often reported ($p < 0.001$). A larger percentage of metastatic breast cancer patients also reported “fear of injury” as a physical activity barrier ($p < 0.001$). “No motivation”, “schedule” and “no organization” were more important barriers in women without a history of breast cancer ($p < 0.001$).

Physically inactive women reported significantly greater barriers than physically active women (17 out of 22 items, $p < 0.001$). The barriers that did not differ significantly between groups were “bad weather to practice”, “prefer to see friends”, “significant side effects”, “no transport” and “fear of insecurity”.

Physical activity facilitators

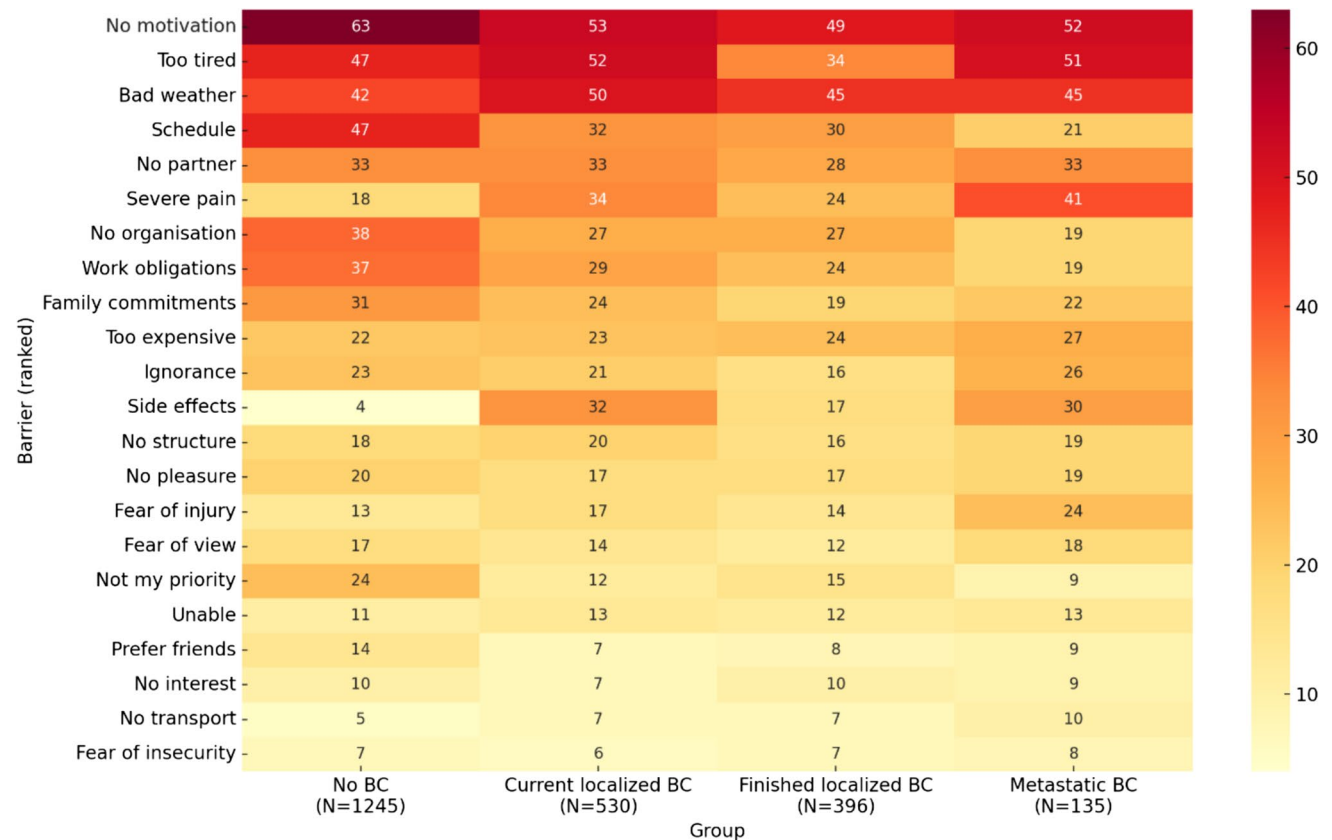
Figure 2 shows physical activity facilitators according to women in the study. Key facilitators to participating in physical activity among the 4 groups were “better in her body”, “improve capacity”, “improve quality of life”, “health control”, “regain energy”, and “feel pleasure” for more than 80%. Facilitators related to the disease, such as “doctor recommendation,” “improve symptom,” and “decrease fatigue,” were among the least reported, especially by women without breast cancer ($p < 0.001$). A larger percentage of women

Table 1 Characteristics of the study population according to breast cancer category ($n = 2306$)

	No breast cancer ($N = 1245$)	Current localized breast cancer ($N = 530$)	Completed localized breast cancer ($N = 396$)	Metastatic breast cancer ($N = 135$)	<i>P</i> -value
Age of participants					
Mean (SD)	43.9 (13.3)	51.5 (9.82)	58.2 (10.7)	53.5 (10.3)	< 0.001
BMI of participants (kg/m ²)					
Mean (SD)	23.5 (4.36)	24.3 (4.67)	23.5 (4.14)	24.8 (4.94)	< 0.001
Underweight	84 (6.7%)	17 (3.2%)	21 (5.3%)	5 (3.7%)	
Normal	820 (65.9%)	329 (62.1%)	274 (69.2%)	79 (58.5%)	
Overweight	239 (19.2%)	124 (23.4%)	70 (17.7%)	32 (23.7%)	
Obesity	102 (8.2%)	60 (11.3%)	31 (7.8%)	19 (14.1%)	
Marital status					
Married-civil partner	679 (54.5%)	336 (63.4%)	258 (65.2%)	79 (58.5%)	< 0.001
Common-law partner	206 (16.5%)	56 (10.6%)	34 (8.6%)	16 (11.9%)	
Divorced	78 (6.3%)	49 (9.2%)	53 (13.4%)	19 (14.1%)	
Widowed	22 (1.8%)	13 (2.5%)	12 (3.0%)	3 (2.2%)	
Single	260 (20.9%)	76 (14.3%)	39 (9.8%)	18 (13.3%)	
Education level					
Low level	47 (3.8%)	35 (6.6%)	33 (8.3%)	12 (8.9%)	< 0.001
Medium level	280 (22.5%)	152 (28.7%)	130 (32.8%)	42 (31.1%)	
High level	918 (73.7%)	343 (64.7%)	233 (58.8%)	81 (60.0%)	
Occupational status					
Employed full time	724 (58.2%)	186 (35.1%)	136 (34.3%)	26 (19.3%)	< 0.001
Employed part time	195 (15.7%)	113 (21.3%)	60 (15.2%)	22 (16.3%)	
On sick leave	16 (1.3%)	97 (18.3%)	11 (2.8%)	28 (20.7%)	
Disabled	9 (0.7%)	13 (2.5%)	9 (2.3%)	19 (14.1%)	
Retired	136 (10.9%)	82 (15.5%)	153 (38.6%)	26 (19.3%)	
Student	58 (4.7%)	1 (0.2%)	1 (0.3%)	0 (0%)	
Looking for work	73 (5.9%)	20 (3.8%)	12 (3.0%)	6 (4.4%)	
Not working	34 (2.7%)	18 (3.4%)	14 (3.5%)	8 (5.9%)	
No. of children living at home					
0	712 (57.2%)	235 (44.3%)	264 (66.7%)	80 (59.3%)	< 0.001
1	217 (17.4%)	125 (23.6%)	73 (18.4%)	29 (21.5%)	
2	242 (19.4%)	132 (24.9%)	49 (12.4%)	21 (15.6%)	
≥ 3	74 (6.0%)	38 (7.2%)	10 (2.5%)	5 (3.7%)	
Residential location/area					
Big city and its suburb	488 (39.2%)	164 (30.9%)	114 (28.8%)	46 (34.1%)	< 0.001
Town/small city and its subdivision	324 (26.0%)	137 (25.8%)	114 (28.8%)	28 (20.7%)	
Village and its subdivision	258 (20.7%)	132 (24.9%)	98 (24.7%)	38 (28.1%)	
Isolated/hamlet	175 (14.1%)	97 (18.3%)	70 (17.7%)	23 (17.0%)	
Treatment received since diagnosis					
Surgery	NA	522 (98.5)	393 (99.2)	119 (88.1)	< 0.001
Chemotherapy	NA	354 (66.8)	250 (63.1)	120 (88.9)	
Radiotherapy	NA	464 (87.5)	343 (86.6)	121 (89.6)	
Hormonotherapy	NA	466 (87.9)	210 (53.0)	108 (80.0)	
Immunotherapy	NA	35 (6.6)	13 (3.3)	13 (9.6)	
Targeted therapy	NA	43 (8.1)	25 (6.3)	45 (33.3)	
Number of comorbidities					
0	717 (57.59)	257 (48.49)	151 (38.13)	46 (34.07)	< 0.001
≥ 1	528 (42.41)	273 (51.51)	245 (61.87)	89 (65.93)	< 0.001
Type of comorbidities					
Cardiovascular diseases	106 (8.5%)	80 (15.1%)	61 (15.4%)	25 (18.5%)	< 0.001

Table 1 (continued)

	No breast cancer (<i>N</i> = 1245)	Current localized breast cancer (<i>N</i> = 530)	Completed localized breast cancer (<i>N</i> = 396)	Metastatic breast cancer (<i>N</i> = 135)	<i>P</i> -value
Neurological diseases	11 (0.9%)	7 (1.3%)	10 (2.5%)	1 (0.7%)	0.077
Endocrine pathology	97 (7.8%)	54 (10.2%)	62 (15.7%)	19 (14.1%)	< 0.001
Respiratory diseases	81 (6.5%)	23 (4.3%)	32 (8.1%)	9 (6.7%)	0.127
Inflammatory diseases	21 (1.7%)	7 (1.3%)	13 (3.3%)	2 (1.5%)	0.137
Autoimmune diseases	43 (3.5%)	8 (1.5%)	16 (4.0%)	6 (4.4%)	0.079
Musculoskeletal diseases	234 (18.8%)	155 (29.2%)	147 (37.1%)	50 (37.0%)	< 0.001
Psychiatric disorders	117 (9.4%)	44 (8.3%)	42 (10.6%)	15 (11.1%)	0.599
Musculoskeletal surgery	38 (3.1%)	26 (4.9%)	22 (5.6%)	12 (8.9%)	0.003
Other cancer	24 (1.9%)	15 (2.8%)	19 (4.8%)	13 (9.6%)	< 0.001
Physical activity level (according to LSI score)					
Insufficiently active (LSI ≤ 23)	799 (64.2%)	323 (60.9%)	262 (66.2%)	89 (65.9%)	0.367
Active (LSI ≥ 24)	446 (35.8%)	207 (39.1%)	134 (33.8%)	46 (34.1%)	
Muscle strengthening (times per week)					
Mean (SD)	2.01 (1.56)	2.11 (1.73)	1.96 (1.55)	1.96 (1.56)	0.773
Insufficient (< 2 days/week)	713 (57.3%)	308 (58.1%)	235 (59.3%)	83 (61.5%)	0.744
Meeting recommendation	532 (42.7%)	222 (41.9%)	161 (40.7%)	52 (38.5%)	

**Fig. 1** Physical activity barriers of the study population according to groups of women (*n* = 2306). Scores represent the proportion of participants who reported each barrier “often” or “very often” on the 5-point Likert scale, with darker colors indicating higher proportions

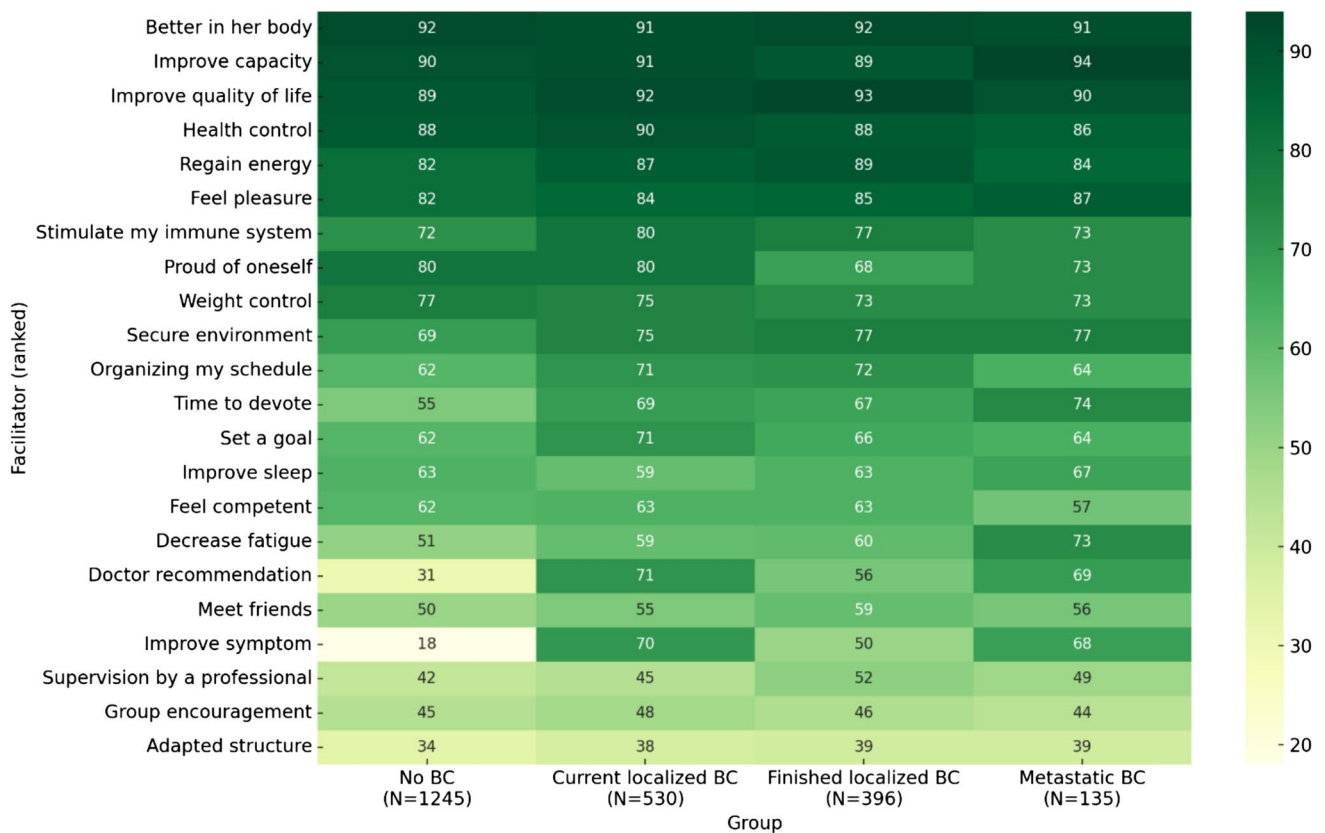


Fig. 2 Physical activity facilitators of the study population according to groups of women ($n = 2306$). Scores represent the proportion of participants who reported each facilitator “often” or “very often” on the 5-point Likert scale, with darker colors indicating higher proportions

undergoing localized breast cancer treatment reported “set a goal” as a physical activity facilitator ($p < 0.001$).

Physically active women reported significantly greater facilitators than physically inactive women (18 out of 22 items, $p < 0.001$). The facilitators that did not differ significantly between groups were “doctor recommendation”, “meet friends”, “adapted structure”, and “group encouragement”.

Physical activity preferences

Table 2 presents the physical activity programming preferences among the study participants. A large majority of women reported being interested in a physical activity program adapted to their abilities (89.3%) and feeling able to exercise (89.6%). Across the four groups, walking was the most preferred activity. All four groups also preferred to be active outside, with supervision, on any day of the week, 30–60 min per session, and at a moderate intensity. Women in all groups also preferred to practice leisure rather than competitive physical activities. The group without breast cancer preferred to be active in pairs/in groups, the group undergoing localized breast cancer treatment alone, the

group post-treatment localized breast cancer in a group of non-patients, and the group with metastatic breast cancer in a group of patients. Women without breast cancer preferred to have a flexible activity program in the evening, whereas women with an history of breast cancer preferred to have a planned physical activity program in the morning. Women without breast cancer and post-treatment localized breast cancer preferred to be active three times a week compared to women undergoing localized breast cancer treatment and with metastatic breast cancer who preferred to be active ≥ 5 times per week. Women without breast cancer preferred running, fitness, and team sport, and exercising at work or in a club at a vigorous intensity compared to other groups. Women undergoing localized breast cancer treatment less preferred to be active outside compared to other groups.

Compared with physically inactive women, physically active women were more likely to prefer walking, swimming, biking, running, strengthening, racket sports, and team sports (all $p < 0.01$). They were also more likely to prefer practicing physical activity outside ($p < 0.01$). No significant differences were found between groups regarding preferred modalities of practice (i.e. alone, in groups, etc.).

Table 2 Preference in physical activity programming of the study population according to groups of women ($n = 2306$)

	No breast cancer ($N = 1245$)	Current localized breast cancer ($N = 530$)	Completed localized breast cancer ($N = 396$)	Metastatic breast cancer ($N = 135$)	<i>P</i> -value
Interest in physical activity					
Yes	1112 (89.3%)	487 (91.9%)	335 (84.6%)	126 (93.3%)	0.009
No	9 (0.7%)	5 (0.9%)	7 (1.8%)	1 (0.7%)	
Maybe	124 (10.0%)	38 (7.2%)	54 (13.6%)	8 (5.9%)	
Ability to be physically active					
Yes	1102 (88.5%)	488 (92.1%)	355 (89.6%)	121 (89.6%)	0.400
No	10 (0.8%)	4 (0.8%)	3 (0.8%)	0 (0%)	
Maybe	133 (10.7%)	38 (7.2%)	38 (9.6%)	14 (10.4%)	
Type of exercise*					
Walking	689 (55.3%)	324 (61.1%)	231 (58.3%)	88 (65.2%)	0.036
Swimming	563 (45.2%)	241 (45.5%)	168 (42.4%)	66 (48.9%)	0.581
Gym	259 (20.8%)	138 (26.0%)	114 (28.8%)	41 (30.4%)	0.001
Biking	316 (25.4%)	123 (23.2%)	107 (27.0%)	27 (20.0%)	0.301
Dance	480 (38.6%)	189 (35.7%)	137 (34.6%)	51 (37.8%)	0.443
Running	330 (26.5%)	110 (20.8%)	67 (16.9%)	29 (21.5%)	< 0.001
Strengthening	571 (45.9%)	239 (45.1%)	174 (43.9%)	69 (51.1%)	0.536
Yoga	602 (48.4%)	259 (48.9%)	169 (42.7%)	62 (45.9%)	0.206
Pilates	567 (45.5%)	284 (53.6%)	195 (49.2%)	66 (48.9%)	0.020
Fitness	316 (25.4%)	130 (24.5%)	69 (17.4%)	28 (20.7%)	0.001
Racket	158 (12.7%)	55 (10.4%)	32 (8.1%)	11 (8.1%)	0.040
Team sports	124 (10.0%)	37 (7.0%)	18 (4.5%)	8 (5.9%)	0.003
Location*					
Outside	1008 (81.0%)	418 (78.9%)	282 (71.2%)	108 (80.0%)	< 0.001
Home	611 (49.1%)	268 (50.6%)	169 (42.7%)	62 (45.9%)	0.083
Work	164 (13.2%)	32 (6.0%)	16 (4.0%)	5 (3.7%)	< 0.001
Club	621 (49.9%)	221 (41.7%)	177 (44.7%)	57 (42.2%)	0.007
Health care facility	310 (24.9%)	215 (40.6%)	136 (34.3%)	58 (43.0%)	< 0.001
No preference	97 (7.8%)	62 (11.7%)	44 (11.1%)	12 (8.9%)	0.036
Company*					
Alone	513 (41.2%)	223 (42.1%)	144 (36.4%)	42 (31.1%)	0.040
In pairs—in groups	563 (45.2%)	208 (39.2%)	147 (37.1%)	45 (33.3%)	0.002
With another patient	192 (15.4%)	196 (37.0%)	113 (28.5%)	59 (43.7%)	< 0.001
Group of non-patients	395 (31.7%)	207 (39.1%)	167 (42.2%)	51 (37.8%)	< 0.001
No preference	351 (28.2%)	115 (21.7%)	94 (23.7%)	32 (23.7%)	0.022
Supervision*					0.152
Supervised face-to-face	502 (40.3%)	208 (39.2%)	155 (39.1%)	50 (37.0%)	0.002
Supervised distance	50 (4.0%)	25 (4.7%)	17 (4.3%)	11 (8.1%)	
Unsupervised	136 (10.9%)	58 (10.9%)	48 (12.1%)	10 (7.4%)	
Supervised face-to-face then distance	203 (16.3%)	106 (20.0%)	70 (17.7%)	19 (14.1%)	
Supervised face-to-face then unsupervised	166 (13.3%)	51 (9.6%)	39 (9.8%)	14 (10.4%)	
Supervised distance then unsupervised	60 (4.8%)	26 (4.9%)	21 (5.3%)	13 (9.6%)	
No preference	128 (10.3%)	56 (10.6%)	46 (11.6%)	18 (13.3%)	
Intensity					
Low	54 (4.3%)	26 (4.9%)	23 (5.8%)	8 (5.9%)	0.002
Moderate	849 (68.2%)	399 (75.3%)	304 (76.8%)	100 (74.1%)	
Vigorous	286 (23.0%)	88 (16.6%)	53 (13.4%)	22 (16.3%)	
No preference	56 (4.5%)	17 (3.2%)	16 (4.0%)	5 (3.7%)	
Structure					0.022

Table 2 (continued)

	No breast cancer (<i>N</i> = 1245)	Current localized breast cancer (<i>N</i> = 530)	Completed localized breast cancer (<i>N</i> = 396)	Metastatic breast cancer (<i>N</i> = 135)	<i>P</i> -value
Flexible	560 (45.0%)	223 (42.1%)	161 (40.7%)	50 (37.0%)	
Planned	558 (44.8%)	242 (45.7%)	169 (42.7%)	67 (49.6%)	
No preference	127 (10.2%)	65 (12.3%)	66 (16.7%)	18 (13.3%)	
Variety of exercise					0.191
Same	232 (18.6%)	99 (18.7%)	91 (23.0%)	24 (17.8%)	
Different	662 (53.2%)	281 (53.0%)	180 (45.5%)	68 (50.4%)	
No preference	351 (28.2%)	150 (28.3%)	125 (31.6%)	43 (31.9%)	
Type of activity					0.477
Competition	9 (0.7%)	1 (0.2%)	0 (0%)	0 (0%)	
Leisure	965 (77.5%)	417 (78.7%)	324 (81.8%)	113 (83.7%)	
Both	221 (17.8%)	94 (17.7%)	61 (15.4%)	19 (14.1%)	
No preference	50 (4.0%)	18 (3.4%)	11 (2.8%)	3 (2.2%)	
Time of day					< 0.001
Morning	348 (28.0%)	203 (38.3%)	161 (40.7%)	60 (44.4%)	
Lunch	120 (9.6%)	46 (8.7%)	13 (3.3%)	7 (5.2%)	
Afternoon	141 (11.3%)	72 (13.6%)	69 (17.4%)	23 (17.0%)	
Evening	403 (32.4%)	123 (23.2%)	89 (22.5%)	24 (17.8%)	
No preference	233 (18.7%)	86 (16.2%)	64 (16.2%)	21 (15.6%)	
Day of week					0.053
Week-end	102 (8.2%)	24 (4.5%)	26 (6.6%)	10 (7.4%)	
Monday–Friday	353 (28.4%)	161 (30.4%)	133 (33.6%)	51 (37.8%)	
All week long	629 (50.5%)	279 (52.6%)	191 (48.2%)	55 (40.7%)	
No preference	161 (12.9%)	66 (12.5%)	46 (11.6%)	19 (14.1%)	
Frequency per week					0.003
1	46 (3.7%)	9 (1.7%)	13 (3.3%)	4 (3.0%)	
2	285 (22.9%)	97 (18.3%)	83 (21.0%)	26 (19.3%)	
3	412 (33.1%)	150 (28.3%)	125 (31.6%)	31 (23.0%)	
4	191 (15.3%)	105 (19.8%)	66 (16.7%)	22 (16.3%)	
≥ 5	311 (25.0%)	169 (37.9%)	109 (27.5%)	52 (38.5%)	
Time per session					0.532
< 15 min	16 (1.3%)	8 (1.5%)	4 (1.0%)	0 (0%)	
15–30 min	222 (17.8%)	83 (15.7%)	69 (17.4%)	19 (14.1%)	
30–60 min	835 (67.1%)	367 (69.2%)	255 (64.4%)	99 (73.3%)	
> 60 min	172 (13.8%)	72 (13.6%)	68 (17.2%)	17 (12.6%)	

* Several answers possible

Table 3 shows the physical activity counselling preferences. The majority of women in all four groups were interested in physical activity counselling (60.1% overall). Women with metastatic breast cancer were the most interested in physical activity counselling (78.5%) and women without breast cancer the least interested (53.4%). In all four groups, the preferred professional for physical activity counselling was the hospital physical activity specialist. The video was the preferred modality for physical activity counselling, except for women in post-treatment localized breast cancer where the preferred method was mail. Women

with a history of breast cancer preferred an oncologist, a nurse, a physical activity specialist of a health care facility, and another patient as a source for counselling compared to women without breast cancer who preferred a gym coach. Women undergoing localized breast cancer treatment and with metastatic breast cancer preferred the phone, online and the group as a modality for counselling compared to other groups.

There were no significant differences between physically inactive and physically active women regarding their preferences for physical activity counselling.

Table 3 Preference in physical activity counselling of the study population according to groups of women ($n=2306$)

	No breast cancer ($N=1245$)	Current localized breast cancer ($N=530$)	Completed localized breast cancer ($N=396$)	Metastatic breast cancer ($N=135$)	<i>P</i> -value
Interest in counselling					< 0.001
No	186 (14.9%)	44 (8.3%)	37 (9.3%)	7 (5.2%)	
Yes	665 (53.4%)	371 (70.0%)	243 (61.4%)	106 (78.5%)	
Maybe	394 (31.6%)	115 (21.7%)	116 (29.3%)	22 (16.3%)	
Counselling source*					
Family doctor	186 (14.9%)	74 (14.0%)	59 (14.9%)	17 (12.6%)	0.861
Oncologist	41 (3.3%)	141 (26.6%)	62 (15.7%)	31 (23.0%)	< 0.001
Nurse	27 (2.2%)	34 (6.4%)	12 (3.0%)	10 (7.4%)	< 0.001
PA specialist in a health care facility	563 (45.2%)	348 (65.7%)	201 (50.8%)	86 (63.7%)	< 0.001
Gym coach	524 (42.1%)	177 (33.4%)	124 (31.3%)	30 (22.2%)	< 0.001
Patient	36 (2.9%)	90 (17.0%)	49 (12.4%)	29 (21.5%)	< 0.001
Personal coach	466 (37.4%)	167 (31.5%)	94 (23.7%)	34 (25.2%)	< 0.001
Physiotherapist	449 (36.1%)	206 (38.9%)	143 (36.1%)	45 (33.3%)	0.575
No preference	308 (24.7%)	86 (16.2%)	89 (22.5%)	28 (20.7%)	< 0.001
Counselling delivery*					
Phone	32 (2.6%)	36 (6.8%)	12 (3.0%)	13 (9.6%)	< 0.001
Text message	114 (9.2%)	58 (10.9%)	29 (7.3%)	13 (9.6%)	< 0.001
Mobile application	478 (38.4%)	197 (37.2%)	98 (24.7%)	52 (38.5%)	0.310
Mail	609 (48.9%)	249 (47.0%)	192 (48.5%)	52 (38.5%)	< 0.001
Web	347 (27.9%)	121 (22.8%)	78 (19.7%)	27 (20.0%)	0.139
DVD	20 (1.6%)	12 (2.3%)	10 (2.5%)	5 (3.7%)	0.002
Video	638 (51.2%)	278 (52.5%)	175 (44.2%)	73 (54.1%)	0.303
Leaflet	359 (28.8%)	155 (29.2%)	115 (29.0%)	35 (25.9%)	0.044
Online	275 (22.1%)	153 (28.9%)	77 (19.4%)	45 (33.3%)	0.895
Podcast	170 (13.7%)	63 (11.9%)	30 (7.6%)	20 (14.8%)	< 0.001
Face to face	458 (36.8%)	207 (39.1%)	135 (34.1%)	51 (37.8%)	0.011
Group format	360 (28.9%)	208 (39.2%)	134 (33.8%)	53 (39.3%)	0.484

*Several answers possible

Discussion

To the best of our knowledge, this is the first study to compare barriers, facilitators, and preferences for physical activity in women across the breast cancer care continuum. Our study population was composed of mostly inactive women, with a similar level of physical activity, whether or not the women had breast cancer, whether they were undergoing treatment or had completed it, whether the disease was localized or metastatic. Overall, many barriers, facilitators and preferences for physical activity were similar across our study population, revealing the disease and treatment status are not necessarily a game changer in terms of physical activity needs and preferences in women with and without breast cancer. In contrast, specificities were identified between groups, particularly between women undergoing treatment compared to women without breast cancer or in remission, and specifically for patients with metastatic breast

cancer, showing the necessary to tailor common strategies to promote physical activity in primary and tertiary breast cancer. We also observed differences between physically inactive and active women, with the former reporting more barriers to exercise and the latter more facilitators, underlining the relevance of considering physical activity level when developing recommendations.

While about 90% of all women were interested in physical activity, close to two thirds of them, either with or without a history of breast cancer, were categorized as insufficiently active according to the GLTEQ score. This is in line with previous studies among women showing a high interest in physical activity, but a high level of inactivity at the same time, even in women with metastatic breast cancer [35–37]. There is, therefore, a need to create conditions that can promote physical activity among women, in particular by relying on their barriers, facilitators and preferences.

Common and specific barriers to physical activity

Common barriers were identified for all four groups, which cover several fields: personal (motivation, fatigue), social (no partner), organizational (schedule) and environmental (bad weather). Other studies have also reported multi-level barriers in women with or without breast cancer [29, 38, 39], emphasizing the need to promote physical activity in multi-level approaches of individual, social environment, physical environment, and policy level [40–42]. However, environmental barriers, such as lack of transportation or place to practice, were not often identified by the women in the study. Cho and colleagues have previously reported that 28.8% of 97 breast cancer survivors reported organizational/environmental barriers to physical activity while 72.7% reported individual-level barriers, in line with the observation that motivation was the most reported barrier in our study population [43].

Our study also highlighted different barriers between groups that can be explained by the disease and treatment status of each group of women. Severe pain and significant side effects were barriers more often reported by women undergoing localized breast cancer treatment or with metastatic breast cancer, fear of injury by women with metastatic breast cancer, and schedule by women without breast cancer. Other studies have reported that the most commonly physical activity barrier was treatment-related side effects in breast cancer patients during treatment [44, 45]. The side effects of treatment are both the main barriers for women with breast cancer and the main factors on which physical activity has demonstrated positive effects [7, 8]. A recent review also highlights that the lack of access to appropriate physical activity services is more frequently reported as a barrier during treatment (50% of studies) than post-treatment (22%), while other barriers remain consistent across both phases, suggesting that barriers may evolve with treatment phases [45]. Fear of injury was more often reported by women with metastatic breast cancer. In a study involving 23 breast cancer patients during treatment, less than 10% of women reported fear of injury as a barrier, but patients with metastatic disease were excluded [46]. Because of bone metastases, women with metastatic breast cancer could be more likely to be afraid of injury [47]. Finally, schedule was a predominant barrier for no breast cancer which can be explained by their younger age and busier schedules, because of work, family obligations and dependent care responsibilities.

Beyond these findings, our study highlights that physically inactive women reported significantly more barriers than active women (17 out of 22 items), indicating that inactivity is not linked to a single obstacle but to a cumulative burden. While certain barriers are specific to disease and treatment status and warrant targeted strategies, these

results reinforce the need for a socio-ecological approach that simultaneously addresses personal, social, organizational, and environmental factors, as previously emphasized in other research [29, 40, 43].

Promoting physical activity health benefits rather than disease

Our study showed that most frequent facilitators for all four groups were related to perceived personal well-being (capacities, pleasure) rather than the disease (tolerance to treatments, recurrence) or environment (exercise facilities). Similar findings were reported in the qualitative meta-analysis by Lavallée and colleagues which highlighted the theme "focus on health not illness" as a clear key physical activity facilitator in women with breast cancer receiving adjuvant treatment [29]. A relevant strategy would therefore be to empower women with breast cancer, understood as strengthening their capacity to make autonomous choices regarding physical activity. By doing so, they may be more likely to experience the well-being and pleasure of physical activity, while distancing themselves from the disease and its treatments, over which they have little power of action. As with physical activity barriers, individual facilitators rather than environmental ones should be prioritized to promote physical activity in women with or without breast cancer, even if a promising evidence support a positive association between the environment and physical activity in women with breast cancer [48, 49].

Not focusing on the disease seems even more important for no breast cancer who logically reported fewer disease-related physical activity facilitators to promote physical activity. Although numerous studies have shown that physical activity can reduce the risk of chronic diseases [50, 51], including breast cancer [52, 53], highlighting disease-related factors to promote physical activity practice does not seem appropriate in women without breast cancer. In a review including 91 studies on correlates of physical activity in women, social support was reported as an overwhelmingly positive determinant of physical activity for women [54]. Building on social support in addition to positive well-being messages may be an effective complementary strategy to promote physical activity for women, especially without breast cancer history.

Physically active women reported more facilitators than inactive women (18 out of 20 items), suggesting that many facilitators may be perceived through lived experiences of physical activity. Key facilitators such as improved capacity, quality of life, and feeling better in her body may therefore be more strongly endorsed because active women are directly experiencing these benefits.

Walking as the preferred activity, but preferences vary by cancer history and treatment status

In our study, all women, either with or without a history of breast cancer, preferred walking as a primary mode of activity. Walking is simple, safe, convenient and with wide-ranging health benefits that should be promoted to all women with or without breast cancer in all its forms (e.g., in groups, at home, supported by mobile devices) [55, 56]. Other preferences were also the same between the four groups, that are different non-competitive physical activities (e.g. yoga, Pilates, strengthening), being active on any day of the week, activity outside, with face-to-face supervision, for 30–60 min per session, and at a moderate intensity. Although these preferences have been reported in previous studies with breast cancer patients [32, 33, 57], this is the first study to show that activity preferences do not vary substantially between women without and with breast cancer.

In the other hand, our study remarked differences in term of physical activity preferences between the groups, for example, in women without a history of breast cancer who preferred to exercise in the evening rather than in the morning and to have a planned rather than a flexible program compared to women with a history of breast cancer. This may be due to the fact that most of the women with breast cancer have taken time off work (almost 6 months on average) since diagnosis, having more flexibility to physical activity [58]. Women undergoing treatment also preferred to exercise more frequently than women without cancer or after cancer treatment. Recently, a study have shown that physical activity preferences can shift during physical activity intervention in breast cancer patient moving towards more flexible or home-based options [59]. This change in preferences reflects the importance of tailoring exercise intervention to accommodate these evolving needs for optimal long-term engagement and benefits.

Compared with physically inactive women, physically active women reported a broader range of activity preferences, including swimming, biking, running, strengthening, racket sports, and team sports, and were also more likely to prefer practicing outside. This suggests that activity level may shape preferences, with active women being more open to a diversity of activities, particularly those of higher intensity. Similar associations between higher activity levels and preferences for more intense exercise have been reported in other studies [32, 36, 60].

Counselling preferences: strong demand among metastatic breast cancer patients

Our study showed that more than three-quarters of metastatic breast cancer were interested in physical activity

counselling whereas only half of no breast cancer were interested. This is in line with the study of Delrieu and colleagues who reported that 85% of women with metastatic breast cancer were interested in receiving physical activity counselling [33]. Many metastatic breast cancer do not know which type and intensity of exercise to engage in according to their metastasis localizations and their fear of fractures [33]. Recently, a physical activity recommendation for patients with bone metastases has been developed, in particular, to weigh the perceived risk of skeletal complications against the potential health benefits [61, 62]. There is a need for counselling from members of the medical team and physical activity professionals to consider this emerging body of evidence to improve the integration of physical activity into the care of women with metastatic breast cancer.

All the women in the study reported that they would prefer receiving counselling from a physical activity specialist in a health care facility, confirming the need for a well-qualified environment to provide adapted counselling irrespective of cancer history [34, 60]. Interestingly, this preference was also expressed by women without cancer, with nearly half indicating a preference for counselling by such a specialist and one quarter reporting a preference for exercising in a health care facility. This may reflect the presence of comorbidities in this population or a broader perception that health care environments provide greater safety and supervision. All the women in the study preferred to receive counselling through video or e-mail, showing the recent shift towards information and communication technologies, specifically in physical activity promotion in women with breast cancer [63].

No significant differences were observed between physically inactive and active women regarding their preferences for physical activity counselling, indicating that counselling needs appear relatively stable regardless of activity level. This is in line with our subgroup analyses across the breast cancer care continuum, which similarly showed no major variations in preferred counselling source or delivery, thereby reinforcing the value of counselling as a universally relevant support strategy.

Strengths and limitations

This study was based on a collaborative research platform that allowed more than 2,300 women to answer our survey in only two months. The study was conducted on a national scale, representing each of the regions in France; two-thirds of women were living in cities and the other third in the countryside, which is comparable to the French population. However, there is a selection bias in our study as the majority of women were of normal weight, had a high level of education and a high socio-professional category, which limits the generalizability of the results for other socio-demographic

categories. Moreover, we primarily relied on a division into four different groups from a medical perspective, while we were also able to differentiate between physically inactive and active women. In a future study, we plan to implement a clustering approach that includes additional dimensions (e.g., age, living situation, residence location, more detailed physical activity level) to better identify groups of women with similar physical activity barriers, facilitators, and preferences.

The very high proportion of women being interested in physical activity may reflect a selection bias in the present study. Almost two thirds of all participants were considered insufficiently active according to the GLTEQ, which estimates physical activity levels based on self-reported data and is therefore subject to reporting bias. Finally, the lack of evidence on the validity and reliability of the physical activity preferences, barriers, and facilitators scales used in this study also needs to be noted. Such measures are not currently available in the literature.

Conclusions and recommendations

In conclusion, barriers (lack of motivation), facilitators (well-being), and preferences (walk-based programs) are generally common in primary and tertiary breast cancer prevention. However, it is also necessary to tailor programs along the breast cancer prevention continuum as specificities can be identified between groups, particularly between patients undergoing treatment who are more impacted by medical factors compared to women without breast cancer or in remission who are more affected by organizational factors. It is also important to consider the particularities of each group, as for patients with metastatic breast cancer who are in high demand for physical activity counselling. Physical activity level should also be considered, as inactive women reported more barriers and active women more facilitators, emphasizing the need to integrate both dimensions when developing recommendations.

Based on this survey's findings, we recommend to promote: multilevel and especially individual-level strategies to address physical activity barriers and facilitators in women with or without breast cancer, well-being and pleasure of physical activity rather than benefits related to the disease and treatments, access to environments that encourages walking and to group-based walking programs, access to physical activity programs that match women preferences in terms of location (outside), day of week (all week), duration (30–60 min per session), and intensity (moderate), and access to virtual programs at home, exercise programs offered by well-qualified physical activity professionals, both in clubs and at hospital, and leisure activities rather than competitive activities. We also recommend to take into

account the specific needs according to the group of women, in particular among women who are still undergoing treatment (mainly affected by medical factors) and women who have completed the treatment or without breast cancer history (organizational factors), and to promote a variety of physical activity programs, based on individual preferences of women (e.g., type of exercise, frequency, time of day), and counselling on physical activity for women with metastatic breast cancer, in particular on how to exercise safely.

Finally, while these findings highlight important and novel patterns between subgroups of women with different disease and treatment statuses, they should not be applied as universal recommendations. Rather, they provide valuable guidance for designing interventions, which in clinical practice would ideally consider each woman's individual barriers, facilitators, and preferences to better tailor support.

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Author contribution BFou and LD supervised the project and conceived the design of the study together with JV, SP, HN, OP, FR and BFer. BFou and LD coordinated the data collection. FH, LD and BFou analyzed the data. BFou and LD wrote the original draft. BFou, LD, JV, SP, HN, MG, OP, FR, AH and BFer reviewed and revised the final manuscript.

Data availability The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate The study was approved on 18th November 2020 by the ethical group committee of the Léon Bérard Cancer Centre in Lyon, France. All the data have been stored on the secure servers of the Léon Bérard Cancer Centre.

Consent for publication Not applicable.

Competing interest The authors declare no competing interests.

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References

- Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2024;74(3):229–63.
- Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: Cancer J Clin*. 2021;71(3):209–49.
- Institut national du cancer (INCa). Panorama des cancers en France - Edition 2022. Etat des lieux et des connaissances / Épidémiologie; 2022.
- Neilson HK, Farris MS, Stone CR, Vaska MM, Brenner DR, Friedenreich CM. Moderate-vigorous recreational physical activity and breast cancer risk, stratified by menopause status: a systematic review and meta-analysis. *Menopause*. 2017;24(3):322–44.
- Guo W, Fensom GK, Reeves GK, Key TJ. Physical activity and breast cancer risk: results from the UK Biobank prospective cohort. *Br J Cancer*. 2020;122(5):726–32.
- Chan DSM, Abar L, Cariolou M, Nanu N, Greenwood DC, Bandera EV, et al. World Cancer Research Fund International: Continuous Update Project—systematic literature review and meta-analysis of observational cohort studies on physical activity, sedentary behavior, adiposity, and weight change and breast cancer risk. *Cancer Causes Control*. 2019;30(11):1183–200.
- Juvet LK, Thune I, Elvsaas IKØ, Fors EA, Lundgren S, Bertheussen G, et al. The effect of exercise on fatigue and physical functioning in breast cancer patients during and after treatment and at 6 months follow-up: a meta-analysis. *Breast*. 2017;33:166–77.
- Lahart IM, Metsios GS, Nevill AM, Carmichael AR. Physical activity for women with breast cancer after adjuvant therapy. *Cochrane Database Syst Rev*. 2018;1(1):CD011292.
- Gebruers N, Camberlin M, Theunissen F, Tjalma W, Verbelen H, Van Soom T, et al. The effect of training interventions on physical performance, quality of life, and fatigue in patients receiving breast cancer treatment: a systematic review. *Support Care Cancer*. 2019;27(1):109–22.
- Spei ME, Samoli E, Bravi F, La Vecchia C, Bamia C, Benetou V. Physical activity in breast cancer survivors: a systematic review and meta-analysis on overall and breast cancer survival. *Breast*. 2019;44:144–52.
- Lahart IM, Metsios GS, Nevill AM, Carmichael AR. Physical activity, risk of death and recurrence in breast cancer survivors: a systematic review and meta-analysis of epidemiological studies. *Acta Oncol*. 2015;54(5):635–54.
- Friedenreich CM, Stone CR, Cheung WY, Hayes SC. Physical activity and mortality in cancer survivors: a systematic review and meta-analysis. *JNCI Cancer Spectr*. 2020;4(1):pkz080.
- Delrieu L, Pialoux V, Pérol O, Morelle M, Martin A, Friedenreich C, et al. Feasibility and health benefits of an individualized physical activity intervention in women with metastatic breast cancer: intervention study. *JMIR MHealth UHealth*. 2020;8(1):e12306.
- Ligibel JA, Giobbie-Hurder A, Shockro L, Campbell N, Partridge AH, Tolane SM, et al. Randomized trial of a physical activity intervention in women with metastatic breast cancer: exercise Intervention in metastatic breast cancer. *Cancer*. 2016;122(8):1169–77.
- Scott JM, Iyengar NM, Nilsen TS, Michalski M, Thomas SM, Herndon J, et al. Feasibility, safety, and efficacy of aerobic training in pretreated patients with metastatic breast cancer: a randomized controlled trial. *Cancer*. 2018;124(12):2552–60.
- Hiensch AE, Depenbusch J, Schmidt ME, Monnkshof EM, Pelaez M, Clauss D, et al. Supervised, structured and individualized exercise in metastatic breast cancer: a randomized controlled trial. *Nat Med*. 2024;1–10.
- Strain T, Flaxman S, Guthold R, Semenova E, Cowan M, Riley LM, et al. National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5.7 million participants. *Lancet Glob Health*. 2024;12(8):e1232–43.
- Verdot C, Salanave B, Aubert S, Ramirez Varela A, Deschamps V. Prevalence of physical activity and sedentary behaviors in the french population: results and evolution between two cross-sectional population-based studies, 2006 and 2016. *Int J Environ Res Public Health*. 2022;19(4):2164.
- Foucaut AM, Berthouze SE, Touillaud M, Morelle M, Bourne-Branchu V, Kempf-Lépine AS, et al. Deterioration of physical activity level and metabolic risk factors after early-stage breast cancer diagnosis. *Cancer Nurs*. 2015;38(4):E1–9.
- Irwin ML, McTiernan A, Bernstein L, Gilliland FD, Baumgartner R, Baumgartner K, et al. Physical activity levels among breast cancer survivors. *Med Sci Sports Exerc*. 2004;36(9):1484–91.
- Wong JN, McAuley E, Trinh L. Physical activity programming and counseling preferences among cancer survivors: a systematic review. *Int J Behav Nutr Phys Act*. 2018;15(1):48.
- Jones LW, Courneya KS. Exercise counseling and programming preferences of cancer survivors. *Cancer Pract*. 2002;10(4):208–15.
- Pannard M, Bauquier C, Bassoleil L, Sablon L, Jacob G, Reyat F, et al. Citizens who volunteer as participants for cancer research—results of the Sentinelles Barometer 2018]. *Bull Cancer (Paris)*. 2020;107(3):333–43.
- LimeSurvey. <https://www.limesurvey.org/fr/> Accessed 13 Dec 2022.
- Amireault S, Godin G, Lacombe J, Sabiston CM. Validation of the Godin-shephard leisure-time physical activity questionnaire classification coding system using accelerometer assessment among breast cancer survivors. *J Cancer Surviv*. 2015;9(3):532–40.
- Amireault S, Godin G, Lacombe J, Sabiston CM. The use of the Godin-Shephard Leisure-Time Physical Activity Questionnaire in oncology research: a systematic review. *BMC Med Res Methodol*. 2015;15(1):60.
- Godin G. The Godin-Shephard leisure-time physical activity questionnaire. *The Health Fit J Can*. 2011;4(1):18–22.
- Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451–62.
- Lavallée JF, Abidin S, Faulkner J, Husted M. Barriers and facilitators to participating in physical activity for adults with breast cancer receiving adjuvant treatment: a qualitative metasynthesis. *Psychooncology*. 2019;28(3):468–76.
- Brunet J, Taran S, Burke S, Sabiston CM. A qualitative exploration of barriers and motivators to physical activity participation in women treated for breast cancer. *Disabil Rehabil*. 2013;35(24):2038–45.
- Makama M, Awoke MA, Skouteris H, Moran LJ, Lim S. Barriers and facilitators to a healthy lifestyle in postpartum women: a systematic review of qualitative and quantitative studies in postpartum women and healthcare providers. *Obes Rev*. 2021;22(4):e13167.
- Vallance J, Lavallee C, Culos-Reed N, Trudeau M. Rural and small town breast cancer survivors' preferences for physical activity. *Int J Behav Med*. 2013;20(4):522–8.

33. Delrieu L, Vallance JK, Morelle M, Fervers B, Pialoux V, Friedenreich C, et al. Physical activity preferences before and after participation in a 6-month physical activity intervention among women with metastatic breast cancer. *Eur J Cancer Care (Engl)*. 2020;29(1):e13169.
34. Daley A, Stokes-Lampard H, Wilson S, Rees M, Roalfe A, MacArthur C. What women want? Exercise preferences of menopausal women. *Maturitas*. 2011;68(2):174–8.
35. Phillips SM, Conroy DE, Keadle SK, Pellegrini CA, Lloyd GR, Penedo FJ, et al. Breast cancer survivors' preferences for technology-supported exercise interventions. *Support Care Cancer*. 2017;25(10):3243–52.
36. Rogers LQ, Markwell SJ, Verhulst S, McAuley E, Courneya KS. Rural breast cancer survivors: exercise preferences and their determinants. *Psychooncology*. 2009;18(4):412–21.
37. Sturgeon KM, Fisher C, McShea G, Sullivan SK, Sataloff D, Schmitz KH. Patient preference and timing for exercise in breast cancer care. *Support Care Cancer Off J Multinatl Assoc Support Care Cancer*. 2018;26(2):507–14.
38. Moreno JP, Johnston CA. Barriers to physical activity in women. *Am J Lifestyle Med*. 2014;8(3):164–6.
39. Oyekanmi G, Paxton RJ. Barriers to physical activity among African American breast cancer survivors: barriers to physical activity. *Psychooncology*. 2014;23(11):1314–7.
40. Hiensch AE, Peeters PHM, Jansen M, van der Wall E, Backx FJG, Velthuis MJ, et al. Socio-ecological correlates of physical activity in breast and colon cancer survivors 4 years after participation in a randomized controlled exercise trial (PACT study). Brown JC, éditeur. *PLOS ONE*. 2020;15(4):e0231663.
41. Lee Y, Park S. Understanding of physical activity in social ecological perspective: application of multilevel model. *Front Psychol*. 2021;12:622929.
42. Tehrani H, Majlessi F, Shojaeizadeh D, Sadeghi R, Hasani Kabootarkhani M. Applying socioecological model to improve women's physical activity: a randomized control trial. *Iran Red Crescent Med J*. 2016;18(3):e21072.
43. Cho D, Park CL. Barriers to physical activity and healthy diet among breast cancer survivors: a multilevel perspective. *Eur J Cancer Care (Engl)*. 2018;27(1):e12772.
44. Lavallée JF, Abidin S, Faulkner J, Husted M. Barriers and facilitators to participating in physical activity for adults with breast cancer receiving adjuvant treatment: a qualitative metasynthesis. *Psychooncology*. 2019;28(3):468–76.
45. Gildea GC, Spence RR, Jones TL, Turner JC, Macdonald ER, Hayes SC, et al. Barriers, facilitators, perceptions and preferences influencing physical activity participation, and the similarities and differences between cancer types and treatment stages-A systematic rapid review. *Prev Med Rep*. 2023;34:102255.
46. Rogers LQ, Courneya KS, Shah P, Dunnington G, Hopkins-Price P. Exercise stage of change, barriers, expectations, values and preferences among breast cancer patients during treatment: a pilot study. *Eur J Cancer Care (Engl)*. 2007;16(1):55–66.
47. Macmillan Cancer Support. Physical activity in patients with metastatic bone disease: Guidance for healthcare professionals. 2020. Available from: https://www.macmillan.org.uk/_images/physical-activity-for-people-with-metastatic-bone-disease-guidance_tcm9-326004.pdf. Accessed 03 Aug 2022.
48. Keegan THM, Shariff-Marco S, Sangaramoorthy M, Koo J, Hertz A, Schupp CW, et al. Neighborhood influences on recreational physical activity and survival after breast cancer. *Cancer Causes Control*. 2014;25(10):1295–308.
49. Jones A, Paxton RJ. Neighborhood disadvantage, physical activity barriers, and physical activity among African American breast cancer survivors. *Prev Med Rep*. 2015;2:622–7.
50. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. *Compr Physiol*. 2012;2(2):1143–211.
51. Anderson E, Durstine JL. Physical activity, exercise, and chronic diseases: a brief review. *Sports Med Health Sci*. 2019;1(1):3–10.
52. Wu Y, Zhang D, Kang S. Physical activity and risk of breast cancer: a meta-analysis of prospective studies. *Breast Cancer Res Treat*. 2013;137(3):869–82.
53. Chen X, Wang Q, Zhang Y, Xie Q, Tan X. Physical activity and risk of breast cancer: a meta-analysis of 38 cohort studies in 45 study reports. *Value Health*. 2019;22(1):104–28.
54. Eyster AE, Wilcox S, Matson-Koffman D, Evenson KR, Sanderson B, Thompson J, et al. Correlates of physical activity among women from diverse racial/ethnic groups. *J Women's Health Gend-based Med*. 2002;11(3):239–53.
55. Hanson S, Jones A. Is there evidence that walking groups have health benefits? A systematic review and meta-analysis. *Br J Sports Med*. 2015;49(11):710–5.
56. Yuan Y, Lin L, Zhang N, Xie C, Liang J, Qi Y, et al. Effects of home-based walking on cancer-related fatigue in patients with breast cancer: a meta-analysis of randomized controlled trials. *Arch Phys Med Rehabil*. 2022;103(2):342–52.
57. Paxton RJ, Nayak P, Taylor WC, Chang S, Courneya KS, Schover L, et al. African-American breast cancer survivors' preferences for various types of physical activity interventions: a Sisters Network Inc. web-based survey. *J Cancer Surviv Res Pract*. 2014;8(1):31–8.
58. Drolet M. Work absence after breast cancer diagnosis: a population-based study. *Can Med Assoc J*. 2005;173(7):765–71.
59. Schleicher E, McAuley E, Courneya KS, Anton P, Ehlers DK, Phillips SM, et al. Breast cancer survivors' exercise preferences change during an exercise intervention are associated with post-intervention physical activity. *J Cancer Survivorship*. 2024;18(5):1453–63.
60. Rogers LQ, Courneya KS, Verhulst S, Markwell SJ, McAuley E. Factors associated with exercise counseling and program preferences among breast cancer survivors. *J Phys Act Health*. 2008;5(5):688–705.
61. Weller S, Hart NH, Bolam KA, Mansfield S, Santa Mina D, Winters-Stone KM, et al. Exercise for individuals with bone metastases: a systematic review. *Crit Rev Oncol Hematol*. 2021;166:103433.
62. Campbell KL, Cormie P, Weller S, Alibhai SMH, Bolam KA, Campbell A, et al. Exercise recommendation for people with bone metastases: expert consensus for health care providers and exercise professionals. *JCO Oncol Pract*. 2022;18(5):e697–709.
63. Ester M, Eisele M, Wurz A, McDonough MH, McNeely M, Culos-Reed SN. Current evidence and directions for future research in ehealth physical activity interventions for adults affected by cancer: systematic review. *JMIR Cancer*. 2021;7(3):e28852.

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