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Factors associated with physical activity among Thai women with breast cancer postmastectomy at a university hospital, Thailand: A cross-sectional study

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The primary treatment for breast cancer patients is surgery which often impacts physical activity (PA). This study aimed to investigate factors associated with the PA level of Thai women with breast cancer after surgical mastectomy at Siriraj Hospital, Thailand. Ninety-three participants completed the questionnaires which included personal information, the Global Physical Activity Questionnaire, perceived benefits, perceived barriers, perceived self-efficacy, interpersonal influence and situational influence, the Thai Body Image Index score, and the Thai Hospital Anxiety and Depression Scale. Data was analysed using descriptive statistics, Chi-square statistics (Odds-Ratio and 95% Confidence Interval) and multiple logistic regression analysis. The study found that post-mastectomy Thai women participated in sufficient PA (2.8 metabolic equivalent of tasks (METs)). It was also found that PA at work was associated with occupation, higher incomes, moderate satisfaction as assessed by the Thai Body Image Index score, and higher levels of anxiety and depression. Participation in recreational activities was associated with older age, higher perceived self-efficacy, and greater interpersonal influence. However, statistically significant associations from the chi-square test did not remain significant after analysis with the multiple logistic regression. By exploring these associations, we can tailor supportive care strategies to address the PA needs of individuals affected by breast cancer which is essential for the development of comprehensive interventions that optimize patient health and well-being throughout the cancer journey.

Keywords Breast cancer, Physical activity, Body image index, Perceived self-efficacy, Anxiety, Depression

Breast cancer is the major female cancer globally, accounting for 11.7% of all new cancers[1]. In comparison to Asian populations, Western populations, including those in Australia and New Zealand, North America, and Western Europe, have a significantly higher incidence of breast cancer[1]. However, due to the early detection and advancements in treatment, the fatality rate for breast cancer has significantly decreased in Western populations. Contrary to this, the prevalence of breast cancer in Thailand is increasing at an alarming rate. In Thailand the annual incidence of breast cancer is showing an increasing trend, from 17.8 per 100,000 in 1998 to 26.6 per 100,000 in 2012 to 31.4 per 100,000 in 2015. The condition is most prevalent in the 40 to 60-year age group[2–3].

Among the various treatment options for breast cancer, surgery remains the primary approach, with mastectomy being one of the key procedures performed to remove cancerous tissue[4–5]. There are several types of mastectomy procedure involved in the treatment of breast cancer, specifically: total (simple) mastectomy, modified radical mastectomy, radical mastectomy, skin-sparing mastectomy, and nipple-sparing mastectomy[4,5]. The choice of mastectomy type depends on a range of factors, the reason for the procedure, the size and location

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of any tumors, and the overall health of the patient[4,5]. After a mastectomy, breast reconstruction surgery can be performed to restore the appearance of the breast[4,5].

Breast cancer diagnosis and treatment have a significant impact on the physical performance and psychological health of patients, especially when surgery is involved[4,5,6]. Every year, more than 10,000 women in Thailand undergo a mastectomy[7]. The psychological impact on patients affects various aspects of quality of life including self-image, self-esteem, and sexual relationships. The procedure is also associated with high rates of depression[8].

The positive impact of physical activity (PA) has been well-documented with regard to its substantial health benefits[9,10]. PA can include all forms of movement, from light activities like walking and gardening to vigorous activities such as running and swimming. Physical inactivity is associated with factors associated with increased cardiovascular risk including hypertension, diabetes, dyslipidaemia, and obesity[9,11]. Regular PA can prevent and manage these conditions, reduce stress, enhance self-esteem, and improve quality of life[12,13]. Among women with breast cancer after mastectomy, PA reduces postoperative complications, hospitalizations, and healthcare costs[14]. In addition, exercise in a planned and structured form of PA[10], improves cardiorespiratory fitness, physical function, and fatigue, and may reduce cancer recurrence and improve survival[10,14,15].

Despite these benefits, barriers to PA are common among women after mastectomy. Biological factors, treatment side effects, psychological challenges, and comorbidities may limit participation[16,17]. Social support from family, friends, and healthcare providers is important in encouraging engagement with PA[18,19], while cultural norms and increasingly sedentary lifestyles also influence activity levels[18-20]. In Thailand, the absence of a patient-centered approach to the promotion of PA may discourage participation even further. Understanding factors such as personal motivation[8,22], social support[22], body image and self-esteem[4,8], physical limitations[8,21], and access to appropriate resources[23,24] is essential for the development of effective strategies to promote active lifestyles among women after mastectomy.

This study aimed to explore PA levels among women with breast cancer postmastectomy at Siriraj Hospital, Thailand's largest university hospital. We examined whether perceived factors better predict PA behaviour than motivators and identified key influences on PA engagement. Our findings provide insights into modifiable factors that can help physiotherapists develop strategies for the promotion of long-term PA adherence. By focusing on an underexplored group—Thai women over 30—this study addresses a critical gap in the literature. Additionally, given the established links between PA and non-communicable diseases, which are related to inflammation after surgery, our findings have broader implications for addressing these major health challenges in breast cancer survivors globally. Understanding PA engagement in non-Western contexts with distinct cultural and socioeconomic influences is crucial, particularly as breast cancer prevalence continues to rise in these regions.

Methods

Study design and setting of the study

This study was cross-sectional in design with the aim of exploring the level of PA of women with breast cancer postmastectomy in outpatients from Siriraj Breast Clinic, Division of Head-Neck and Breast Surgery, Siriraj Hospital, Thailand from September 2023 to March 2024. Data collection was performed at a single session during the follow-up period with the doctors (DS and VL).

Participants and sampling

Previous studies have suggested that a minimum of 50 samples is necessary for exploratory factor analysis, with around 100 samples typically recommended[25,26]. The required sample size in this study was also calculated using an odds ratio (OR) of 1.97, derived from a significant association between age and PA levels in a previous study[21]. A power analysis was conducted using G*Power (version 3.1.9.7) for a Chi-Square Goodness-of-Fit Test, applying a medium effect size ($w = 0.30$) to account for the sample. The analysis indicated that a sample size of 88 would provide 80% power to detect significant differences at an alpha level of 0.05. Therefore, the proposal to the ethics committee included a sample size of approximately 100 participants, after considering both prior research and the sample size calculation outlined above. However, only 93 participants met the criteria.

The inclusion criteria were: (1) women age ≥ 30 years with a diagnosis of breast cancer who had undergone surgery. These criteria were chosen in line with the statistics from a previous study which reported that the highest incidence rate among Thai women occurred between 40 and 60 years old[3]. However, we decreased the age from 30 following guidance from the medical experts in breast cancer (DS and VL); (2) all types of mastectomy e.g. total mastectomy with sentinel node biopsy, modified radical mastectomy, and total mastectomy; (3) mastectomy both with and without reconstruction carried out more than 1 year prior, and (4) able to follow commands and instructions. The exclusion criteria were: (1) a cognitive impairment score ≤ 24/30 assessed using the Thai Mental State Examination[27], (2) any use of medication for anxiety and/or dizziness; (3) self-reported neurological, musculoskeletal, or other problem which could influence the completion of the questionnaires, and, (4) any problems involving completion of the questionnaire which resulted in stopping of the interview and exclusion from the study. Medical records relating to the primary diagnosis were used to provide details regarding tumor characteristics and treatment. Baseline questionnaires included information regarding adjuvant therapies.

Ethical considerations

The Ethical Committee of Mahidol University Institutional Review Board, Mahidol University, Thailand gave approval for the study (COA No. MU-MOU 2023/127.2808). Written informed consent was obtained from each participant which was carried out in full accordance with International Guidelines for Human Research Protection and the ethical standard guidelines of the Declaration of Helsinki.

Data collection

The cohort study was recruited through research advertisements posted at outpatient departments at Siriraj Breast Clinic, Division of Head-Neck and Breast Surgery, Siriraj Hospital, Thailand. Women who met the inclusion criteria without any exclusions were invited to participate. The researcher provided detailed information about the purpose of the study, procedures, and potential benefits before obtaining informed consent. Participants who agreed to enrolment on the study signed an informed consent form before proceeding. All participants completed the self-administered questionnaires on the same occasion. The questionnaires assessed physical activity levels, body image perception, and psychological well-being. The collected data included demographic information, physical activity, self-perceived body image, and symptoms of anxiety and depression. Standardized and validated tools were used to ensure reliability and accuracy in the measurement of these outcomes.

Outcome measure and questionnaires

All participants self-administered the questionnaires on the same occasion. The questionnaires included:

1. Physical activity (PA) levels were assessed using the original English "Global Physical Activity Questionnaire"[28,29] which was translated into Thai[30]. Participants indicated how often and for how long they engaged in moderate and vigorous physical activities as part of their work, transportation, or recreational activities during a typical week. This questionnaire was selected due to its satisfactory level of convergent validity (Spearman's rho = 0.33, $p < 0.01$) when compared with physical activity measurements obtained from accelerometers, and its strong seven-day test-retest reliability (Spearman's rho = 0.77, $p < 0.01$) among adults in Thailand[30]. In addition, a previous study had reported good test-retest reliability (0.97, $p < 0.0001$) and internal consistency (Cronbach's alpha = 0.88), and had been confirmed as appropriate Thai working age people[31]. The questionnaire consists of mixed types of questions, including both open-ended and closed-ended formats. The details of the questionnaires are:

   Part 1 Collection of demographic data including gender, age, education level and occupation. The history of breast cancer was recorded from medical records.

   Part 2 Assessment of PA, specifically 4 main sections: activities at work, transport, recreational activities and sedentary behaviour, 16 questions in total. The total PA and sub-domains of PA from moderate to vigorous PA and the sufficient level of PA were calculated in accordance with the World Health Organization's recommendations (WHO)[29], 600 metabolic equivalent (MET)-minutes/week.

   Part 3 Assessment of each domain of PA by the perceived benefits 12 items, perceived barriers 10 items, perceived self-efficacy 8 items, interpersonal influence 10 items and situational influence 8 items. The scores were used to calculate each domain with scoring criteria as follows[31]:

   Score 3.1-4 = High, indicating a strong feeling of each domain.
   Score 3.1-4 = High, indicating a strong feeling of each domain.
   Score 2.1-3 = Moderately high, indicating a moderate feeling of each domain.
   Score 1.1-2 = Low, indicating a slight feeling of each domain.
   Score 0–1 = Very low, indicating a very slight feeling of each domain.
2. The Body Image Index score was translated into Thai[32], consisted of 10 questions, to evaluate a self-perception about physical appearance[33]. The Body Image Index score shows high internal consistency (Cronbach's alpha = 0.93) and has demonstrated good clinical validity based on the prevalence of responses, discriminant validity ($p < 0.0001$, Mann–Whitney test), sensitivity to change ($p < 0.001$, Wilcoxon signed ranks test), and consistency of scores across different breast cancer treatment centres[32]. Responses can evaluate body image concerns and self-perception. These tools are commonly used in psychological and medical research to understand body image issues, in this case in women with breast cancer postmastectomy[32].
3. The Thai Hospital Anxiety and Depression Scale (Thai HADS) was used to assess depression or anxiety in participants. Thai HADS includes a 7-item anxiety sub-scale (HADS-A) and a 7-item depression sub-scale (HADS-D). The sensitivity of the anxiety and depression subscales of Thai HADS are 100% and 85.71%, respectively, while specificity is 86.0% for anxiety and 91.3% for depression[34]. Thai HADS also shows a good internal consistency, with Cronbach's alpha for the anxiety subscale and 0.8259 for the depression subscale[34].

All questionnaires in this study were used after being granted permission by the relevant authors and organisations.

Statistical analysis

SPSS version 29.0 (IBM Corporation, Armonk, NY) was used for statistical analysis. Descriptive statistics were used to present the characteristics of the participants. The Chi-square test, Odds-Ratio (OR) and 95% Confidence Interval (CI) were applied to investigate the association between the factors, including demographic data (e.g., age, gender, education level, occupation, income, and underlying disease), and aspects of medical records pertinent to breast cancer and mastectomy, Thai Body Image Index, Thai HADS, perceived benefits, perceived barriers, perceived self-efficacy, interpersonal influence, situational influence, and PA characteristics (activities at work, transportations, recreational activities, and total physical activities). An OR exceeding 1 indicates a higher probability of the factor being associated among the independent variables, while an OR below 1 indicates a reduced likelihood of such an association. Furthermore, independent factors were derived from the statistically significant variables identified through univariate analysis and were used in multiple logistic regression. The statistical significance was set at $p < 0.05$.

Results

Demographic data and medical records of women with breast cancer postmastectomy

The average age of participants was 60.5 ± 10.5 years and time from mastectomy surgery was 6.0 ± 5.1 years. Most patients presented as breast cancer stage 1 (n = 38, 40.9%), and had undergone a total mastectomy (n = 48, 51.6%), and had breast cancer on the left side (n = 54, 58%). All had received adjuvant therapies and were independently ambulant without using an assistive device (n = 93, 100%). No lymphedema was reported in the majority (n = 79, 84.9%) and no complications after mastectomy (n = 52, 55.9%). The most common comorbidities were hypertension (n = 38; 40.9%). Most of the participants graduated at Bachelor degree level (n = 36; 37.8%) and continued working in their usual employment (n = 54, 58.1%) with a salary income of more than 30,000 Thai baht per month (about $857). Other demographic data and details of medical records of participants are shown in Table 1.

Reporting of engagement in physical activity (PA) of women with breast cancer postmastectomy

72% of participants travelled to and from activities either on foot or by using a bicycle (pedal cycle), 64% were engaged in recreational activities, and 51% performed work-based activities (Table 2). With regards to subgroup domains of PA, 54.8% of participants performed moderate activity at work for 55 min per day over 7 days, whereas only 10.8% of participants performed vigorous activity at work on 1 day for 74 min per day. In the recreational domain 14% of participants performed vigorous-intensity recreational activities and 62% of participants performed moderate-intensity recreational activities. For those that travelled to and from places, either on foot or using a bicycle (pedal cycle), 73.1% walked for at least 10 min continuously. Finally, sedentary behaviour was reported as an average of 224.9 min a day. Total PA averaged 1680 MET-minutes/week, and an adequate PA level of 2.8 METs.

Reporting of body image index and Thai hospital anxiety and depression scale of women with breast cancer postmastectomy

76% of participants were very satisfied according to the Thai Body Image Index, 15% were moderately satisfied, and 2% were slightly satisfied (Table 3). With regards to Thai HAD, no patient reported having depression or anxiety[34] (Table 3).

Perceived benefits, perceived barriers, perceived self-efficacy, interpersonal influence, and situational influence on the physical activity (PA) of women with mastectomy

Figure 1 demonstrates the outcomes regarding the impact of perceived benefits, perceived barriers, perceived self-efficacy, interpersonal influence, and situational influence on the PA of women with mastectomy for all 93 participants. The perceived benefits were notably high, indicating a strong belief in the benefits and capabilities (mean ± SD = 3.54 ± 0.46). Perceived self-efficacy, interpersonal influence, and situational influence scored relatively high (mean ± SD = 2.82 ± 0.72, 2.33 ± 0.76 and 2.68 ± 0.8, respectively), while perceived barriers were low (mean ± SD = 1.57 ± 0.44), indicating minimal barriers for the Thai women with mastectomy who participated in this study.

Factors associated with physical activity (PA) in Thai women with breast cancer after mastectomy

In this cohort of 93 women with breast cancer postmastectomy (Table 4), the factors associated with an appropriate level of PA included recreational and overall PA levels, specifically: those engaging in activity at work (OR = 3.2, 95% CI = 1.357–7.548), an income of more than 30,000 Thai baht (OR = 4.5, 95% CI = 4.500 (1.549–13.070), moderate satisfaction on Body Image Index score (OR = 4, 95% CI = 1.045–15.317) and a higher score of Thai Hospital Anxiety and Depression Scale (OR = 2.969, 95% CI = 1.103–7.992). In addition, the findings indicate that individuals engaging in recreational activities were of older age (OR = 0.245, 95% CI = 0.088–0.682), recorded significantly higher scores of perceived self-efficacy (OR = 3.284, 95% CI = 11.110–9.719), and significantly high scores of interpersonal influences (OR = 3.382, 95% CI = 1.215–9.416). No significant associations were found between the factors and transportation on foot or using a bicycle (pedal cycle) (Table 4). However, the significant associations observed in the univariable analysis did not yield significant results when multiple logistic regression analysis was applied (Table 5).

Discussion

This study aimed to investigate the level of physical activity (PA) and the factors associated with PA levels among Thai women with breast cancer postmastectomy at Siriraj hospital, Thailand. Given the increasing recognition of PA as a crucial component in the recovery and quality of life of breast cancer survivors, understanding the determinants of PA in this specific population is essential. Previous research has established that PA can improve physical function, psychological well-being, and reduce the risk of recurrence[12-14]. However, barriers such as physical limitations, psychological distress, and sociocultural influences often hinder engagement in PA.

The findings indicated that participants generally maintained a sufficient level of PA, engaging in work-related, recreational, and transportation-related activities. The majority of participants met the recommended WHO guidelines[28,29], suggesting that Thai women with breast cancer postmastectomy demonstrate a willingness to remain active despite undergoing surgery. This result contrasts with the previous studies that carried out in the Western world and in Brazil and reported a decline in PA levels postmastectomy[35-37]. There are several possible reasons that Thai women who have undergone mastectomy maintain their PA levels. Firstly, the perceived benefits of PA, Thai women may perceive numerous benefits associated with PA, such as improved

Characteristics	*n* = 93
Age (years): mean ± SD (range)	60.5 ± 10.5 (38, 85)
Thai mental state examination: mean ± SD (range)	27.9 ± 3.82 (26, 30)
Time from mastectomy surgery (years): mean ± SD (range)	6.0 ± 5.1 (1, 31.6)
Stage of breast cancer	
0 (n, %)	8 (8.6%)
1 (n, %)	38 (40.9%)
2 (n, %)	27 (29.0%)
3 (n, %)	19 (20.4%)
4 (n, %)	1 (1.1%)
Side of breast cancer	
Right (n, %)	30 (32.3%)
Left (n, %)	54 (58.0%)
Both (n, %)	9 (9.7%)
Type of mastectomy	
Total mastectomy (n, %)	48 (51.6%)
Modified radical mastectomy (n, %)	38 (40.9%)
Nipple sparing mastectomy (n, %)	7 (7.5%)
Adjuvant therapies	
Yes	93 (100%)
Lymphedema phenomenon	
Yes	14 (15.1%)
No	79 (84.9%)
Complication of mastectomy	
Yes	41 (44.1%)
No	52 (55.9%)
Ambulation (n, %)	
Independent without assistive device	93 (100%)
Number of comorbidities (n, %)	
Hypertension	38 (40.9%)
Diabetes mellitus	17 (18.3%)
Dyslipidemia	25 (26.9%)
Heart disease	11 (11.8%)
Others	9 (9.7%)
Marital status (n, %)	
Single	25 (26.9%)
Married	53 (57.0%)
Divorce/Widow	15 (16.1%)
Education levels (n, %)	
Uneducated	-
Primary school	18 (19.4%)
Secondary school	15 (16.1%)
Diploma degree	11 (11.8%)
Bachelor degree	36 (38.7%)
Master/Doctoral degree	13 (14.0%)
Occupation (n, %)	
Unemployed	39 (41.9%)
Employed	54 (58.1%)
Government employee	26 (48.1%)
Self-employed	15 (27.7%)
Employees of the company	7 (12.9%)
Farmers	4 (7.4%)
Income per month (n, %)	
None	1 (1.1%)
≤ 10,000	25 (26.9%)
> 10,000–20,000	16 (17.2%)
> 20,000–30,000	8 (8.6%)
Continued	

Characteristics	*n* = 93
> 30,000	39 (41.9%)
No data	4 (4.3%)

Table 1. Demographic data of women with breast cancer postmastectomy. *n* number of participants, *%* percent, *SD* standard deviation.

Physical activity characteristics	*n* = 93
Physical activity (n, %)	
Activity at work	51 (54.8%)
Transportation	67 (72.0%)
Recreational	64 (68.8%)
Sub-domain of physical activity (n, %)	
Vigorous work (n, %)	12 (10.8%)
Moderate work (n, %)	51 (54.8%)
Transportation (n, %)	68 (73.1%)
Vigorous recreation (n, %)	13 (14.0%)
Moderate recreation (n, %)	62 (66.7%)
Sitting (mean ± SD (range))	224.9 ± 171.9 (10, 840)
Total Physical Activity MET-minutes/week: median (range)	1680 (80, 13440)
The adequate physical activity level (MET)	2.8 (0.13, 22.40)

Table 2. Physical activity characteristics of women with breast cancer postmastectomy. *MET* metabolic equivalent of task. *n* number of participants, *%* percent.

Score	*n* = 93
Body Image Index score: mean ± SD (range)	14.0 ± 5.8 (10, 36)
Very satisfied	76 (81.7%)
Moderate satisfied	15 (16.1%)
Little satisfied	2 (2.2%)
Thai hospital anxiety and depression scale	
Total: mean ± SD (range)	5.6 ± 4.8 (0, 19)
Score 0–7	67 (72.1%)
Score 8–10	11 (11.8%)
Score 11–21	15 (16.1%)
Anxiety: mean ± SD (range)	3.4 ± 2.9 (0, 10)
Depression: mean ± SD (range)	2.2 ± 2.3 (0, 9)

Table 3. Body image index score and Thai hospital anxiety and depression scale of women with breast cancer postmastectomy. *n* number of participants, *%* percent, *SD* standard deviation.

physical fitness, mental well-being, and overall quality of life. These perceived benefits may motivate them to continue engaging in PA[14]. Secondly, engaging in PA and health benefits postmastectomy can instill a sense of empowerment and control over one's health. It allows women to regain a sense of agency and resilience, demonstrating their ability to overcome physical challenges and maintain an active lifestyle[38]. It was evident that highly intelligent, high-earning women and the majority of those employed, are more likely to engage with the positive aspects of PA compared to those that are in the lower-earning demographic, potentially less well-educated women with lower expectations.

Our findings also indicate that the majority of participants graduated with a Bachelor's degree and work as a government employee. Higher educational attainment with a good job may be associated with greater health awareness, which could encourage these individuals to pursue physical activity outside of work hours to balance their typically sedentary jobs[39]. Thirdly, social support from family, friends, healthcare professionals, and support groups can play a crucial role in encouraging women to remain physically active after mastectomy. Positive social interactions and encouragement from peers can provide motivation and accountability for the maintenance of PA levels[40]. Finally, the perceived benefits of PA among participants were high, indicating a strong belief in the positive outcomes associated with PA. Similarly, perceived self-efficacy, interpersonal influence, and situational influence were relatively high, suggesting that participants felt confident in their ability to engage in PA and were

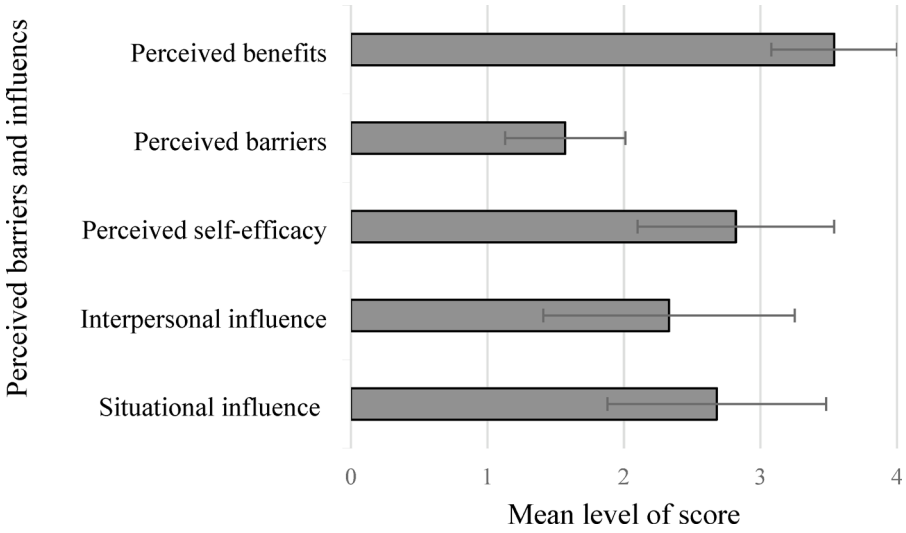

Fig. 1. The perceived benefits, perceived barriers, perceived self-efficacy, interpersonal influence, and situational influence of the physical activity.

influenced by social and environmental factors. These findings are supported by Mishra and colleagues in 2023 who reported the underlying importance of addressing psychosocial factors in promoting PA among women with breast cancer postmastectomy[41].

Our analysis of factors associated with PA revealed several noteworthy findings. PA at work was associated with occupation type, income level, and moderate satisfaction with body image. Individuals with higher income were more likely to engage in PA at work, which may be attributed to greater access to resources and a higher likelihood of employment in positions that require movement[42]. The association between PA and satisfaction with body image suggests that individuals who perceive themselves positively may be more inclined to engage in PA. This is in alignment with prior research indicating that body image concerns significantly impact participation in PA in breast cancer survivors[43]. In addition, the workplace environment may serve as an important setting for the promotion of PA interventions tailored to women recovering from breast cancer surgery[40]. It is also important to acknowledge that individual differences and contextual factors can influence the relationship between PA at work and satisfaction with body image. Further research is needed to explore these dynamics and to develop targeted interventions that promote positive body image through workplace PA initiatives.

As a negative finding, higher levels of anxiety and depression were linked to PA engagement, particularly in work related activities. While PA is often considered beneficial for mental health, this finding suggests a complex relationship in which individuals experiencing distress may turn to exercise[44], potentially increasing their PA levels as a coping mechanism. Alternatively, work status and social factors could contribute to both PA engagement and increased psychological distress[40,43]. Future studies should explore the role of work status and social environment in PA programmes that support mental well-being among breast cancer survivors.

Recreational PA was positively associated with older age, higher perceived self-efficacy, and greater interpersonal influence. Older individuals were more likely to participate in leisure-time PA[45,46], emphasizing the importance of structured recreational programme for aging breast cancer survivors. Self-efficacy, or confidence in one's ability to engage in PA, emerged as a crucial factor in recreational PA participation. Previous studies have shown that interventions targeting self-efficacy can enhance PA adherence in cancer survivors[16,21]. Additionally, interpersonal influences, such as encouragement from family, friends, and healthcare providers, played a significant role in motivating participation in recreational activities[14]. These findings underscore the need for social support mechanisms to facilitate PA engagement in this population.

Contrary to expectations, there was no significant association between levels of PA and breast cancer stage or mastectomy type. This suggests that other factors, such as psychological and social determinants, may play a more prominent role in influencing PA behaviour than the physical impact of surgery itself. Furthermore, while the univariable analysis identified several significant associations, these did not remain statistically significant after analysis by multiple logistic regression. This highlights the complexity of PA behaviour and the potential influence of unmeasured confounding factors.

This study has some limitations. The sample size is relatively small compared to previous studies[13,21], which may affect the generalizability of our findings. Additionally, participants were recruited from a single breast cancer clinic at Siriraj Hospital, which again may limit the representation of the sample. Despite these limitations, the study provides a useful starting point for further exploration of PA levels in this population. Future research could enhance the contribution of this study by exploring new theoretical frameworks, cultural factors, or intervention-based strategies for improving PA levels. A larger, more diverse cohort would help validate the results and improve generalizability. In particular, inclusion of a different demographic would add weight to the findings, for example a cohort with fewer high-level qualifications and lower income. A study in these areas could compare the findings in Thailand with those from Western studies to investigate whether the positive

Factors	Activity at work Odds ratio (95% CI)	Transportation Odds ratio (95% CI)	Recreational activities Odds ratio (95% CI)	Total Odds ratio (95% CI)
Age (years)				
< 60	1.000	1.00	1.000	1.000
≥ 60	0.431 (0.183, 1.013)	2.443 (0.969, 6.158)	0.245 (0.088, 0.682)*	0.676 (0.117, 3.887)
Status				
Single/widowed/divorced/separate	1.000	1.000	1.000	1.000
Married	1.180 (0.517, 2.692)	0.615 (0.240, 1.574)	1.113 (0.460, 2.695)	0.645 (0.112, 3.708)
Education				
Non-primary school	1.000	1.000	1.000	1.000
Secondary school – vocational	0.781 (0.231, 2.646)	2.171 (0.609, 7.739)	1.091 (0.325, 3.667)	0.958 (0.143, 6.404)
Bachelor-higher than bachelor	2.578 (0.854, 7.783)	02.764 (0.878, 8.698)	3.120 (0.977, 9.958)	6.000 (0.509, 70.668)
Occupation				
No	1.000	1.000	1.000	1.000
Yes	3.200 (1.357, 7.548)*	0.403 (0.150, 1.085)	2.194 (0.899, 5.355)	2.971 (0.516, 17.110)
Incomes				
≤ 10,000	1.000	1.000	1.000	1.000
> 10,000–30,000	3.750 (1.160, 12.122)	0.476 (0.131, 1.735)	1.875 (0.556, 6.324)	0.200 (0.021, 1.934)
> 30,000	4.500 (1.549, 13.070)*	0.536 (0.163, 1.759)	1.591 (0.555, 4.564)	1.520 (0.091, 25.434)
Body Image Index score				
Very satisfied	1.000	1.000	1.000	1.000
Moderate satisfied	4.000 (1.045, 15.317)*	0.381 (0.122, 1.191)	0.923 (0.284, 2.996)	0.361 (0.060, 2.178)
Little satisfied	1.000 (0.060, 16.577)	N/A	N/A	N/A
Thai hospital anxiety and depression scale				
No (< 8)	1.000	1.000	1.000	1.000
Yes (≥ 8)	2.969 (1.103, 7.992)	1.418 (0.496, 4.060)	1.742 (0.614, 4.942)	N/A
Underlying disease				
Hypertension	0.600 (0.260, 1.382)	1.149 (0.454, 2.904)	0.426 (0.174, 1.042)	0.673 (0.128, 3.528)
Diabetes mellitus	0.376 (0.126, 1.123)	1.324 (0.389, 4.509)	0.582 (0.197, 1.724)	N/A
Dyslipidemia	0.686 (0.274, 1.723)	1.319 (0.459, 3.792)	0.741 (0.281, 1.952)	0.338 (0.064, 1.801)
Heart disease	0.652 (0.184, 2.309)	1.040 (0.253, 4.265)	1.238 (0.303, 5.051)	0.649 (0.069, 6.135)
Duration since surgery (years)	0.963 (0.886, 1.047)	1.025 (0.929, 1.130)	1.098 (0.969, 1.243)	1.031 (0.848, 1.253)
Stage of breast cancer				
0	1.000	1.000	1.000	N/A
1	2.292 (0.477, 11.010)	2.455 (0.519, 11.601)	1.473 (0.299, 7.250)	
2	2.424 (0.478, 12.302)	3.500 (0.668, 18.343)	1.425 (0.273, 7.439)	
3	1.667 (0.311, 8.928)	3.000 (0.539, 16.689)	1.114 (0.203, 6.105)	
Side of breast cancer				
Right	0.613 (0.148, 2.544)	0.605 (0.113, 3.227)	1.267 (0.280, 5.730)	1.200 (0.124, 11.659)
Left	2.300 (0.492, 10.743)	0.980 (0.165, 5.825)	0.909 (0.189, 4.366)	N/A
Both	1.000	1.000	1.000	1.000
Type of mastectomy				
Total mastectomy	1.000	1.000	1.000	1.000
Modified radical mastectomy	1.451 (0.608, 3.462)	1.040 (0.397, 2.723)	0.714 (0.283, 1.800)	3.364 (0.360, 31.422)
Nipple sparing mastectomy	0.141 (0.016, 1.262)	0.495 (0.097, 2.519)	0.495 (0.097, 2.519)	0.545 (0.052, 5.728)
Complications				
No	1.000	1.000	1.000	1.000
Yes	1.872 (0.811, 4.321)	1.379 (0.547, 3.473)	0.424 (0.173, 1.037)	1.625 (0.283, 9.344)
Perceived benefits				
Low (1.00–3.46)	1.000	1.000	1.000	1.000
High (3.47–4.00)	0.811 (0.352, 1.867)	1.086 (0.434, 2.722)	1.032 (0.423, 2.516)	0.708 (0.123, 4.077)
Perceived barriers				
Low (1.00–1.45)	1.000	1.000	1.000	1.000
High (1.46–4.00)	0.625 (0.271, 1.444)	0.819 (0.324, 2.068)	0.635 (0.256, 1.578)	1.417 (0.270, 7.422)
Perceived self-efficacy				
Low (1.00–3.12)	1.000	1.000	1.000	1.000
Continued				

Factors	Activity at work	Transportation	Recreational activities	Total
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
High (3.13–4.00)	1.818 (0.748, 4.420)	0.923 (0.355, 2.401)	3.284 (1.110, 9.719)*	N/A
Interpersonal influence				
Low (1.00–2.78)	1.000	1.000	1.000	1.000
High (2.79–4.00)	1.832 (0.779, 4.312)	2.071 (0.768, 5.587)	3.382 (1.215, 9.416)*	N/A
Situational influence				
Low (1.00–3.00)	1.000	1.000	1.000	1.000
High (3.01–4.00)	1.069 (0.457, 2.498)	1.427 (0.543, 3.753)	1.425 (0.560, 3.622)	

Table 4. Factors associated with physical activity of women with breast cancer postmastectomy. * statistically significant $p < 0.05$. *N/A* Not applicable. *CI* Confident interval.

Factors	Activity at work	Transportation	Recreational activities	Total
	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Age (years)				
< 60	1.000	1.000	1.000	-
≥ 60	0.959 (0.314, 2.934)	2.118 (0.738, 6.077)	0.209 (0.048, 0.906)	
Occupation				
No	1.000	1.000	1.000	-
Yes	1.759 (0.473, 6.538)	0.569 (0.187, 1.732)	1.009 (0.292, 3.484)	
Incomes				
≤ 10,000	1.000	-	-	-
> 10,000–30,000	3.301 (0.729, 14.953)			
> 30,000	2.624 (0.433, 15.901)			
Body Image Index score				
Very	1.000	-	-	-
Moderate	1.946 (0.371, 10.196)			
Little	N/A			
Perceived self-efficacy				
Low (1.00–3.12)	-	-	1.000	-
High (3.13–4.00)			2.235 (0.643, 7.767)	
Interpersonal influence				
Low (1.00–2.78)		1.000	1.000	
High (2.79–4.00)		2.271 (0.809, 6.378)	3.104 (0.962, 10.015)	

Table 5. Factors associated with physical activity (Multivariable analysis by multiple logistic regression: $p < 0.10$ from univariable analysis).

attitude to PA has a cultural aspect. Finally, self-reported PA levels may be subject to recall bias, so future studies should incorporate objective PA measurements and explore longitudinal changes in PA behaviour.

Conclusion

This study provides valuable insights into the factors influencing PA among Thai women with breast cancer postmastectomy. An adequate level of PA was observed in this population. The findings highlight the significance of occupation, income, body image satisfaction, anxiety, depression, self-efficacy, and social support in shaping PA behaviour. These results can inform the development of targeted interventions to promote PA engagement and enhance the overall well-being of breast cancer survivors.

Data availability

The data presented in this study are available from the corresponding author upon reasonable request.

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Author contributions
All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by F.K, P.W., D.S, S.P., S.P., V.L. and W.K. The first draft of the manuscript was written by F.K and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Competing interests
The authors declare no competing interests.

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