

RESEARCH ARTICLE

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Physical Activity, Sedentary Behavior, Obesity and Perceived Stress in Relation to Breast Cancer Risk among Moroccan Women: A Case - Control Study

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Abstract

Background: Breast cancer is the most prevalent cancer among Moroccan women. Although certain lifestyle factors like physical activity, sedentary habits, obesity, and psychological stress are suspected to play a role, evidence from North African populations remains limited. This study investigates the association between these factors and breast cancer among Moroccan women. **Methods:** A case-control study was conducted in the Rabat region involving 148 women, with 74 newly diagnosed breast cancer cases and 74 controls. Data were collected via a structured questionnaire covering sociodemographic characteristics, reproductive and hormonal history, and lifestyle behaviors. Physical activity was evaluated using the validated Arabic version of the International Physical Activity Questionnaire, sedentary behavior was based on daily sitting time, and stress was measured using the Arabic Perceived Stress Scale (PSS-10). Bivariate and multivariate logistic regression analyses were used to calculate odds ratios (ORs) and their 95% confidence intervals (CIs). **Results:** High physical activity was associated with a lower risk of breast cancer, while sedentary behavior and high stress were associated with an increased risk. Women with high stress levels had a notably higher risk than those with low stress. A family history of breast cancer and using hormonal contraceptives were also independently linked to a higher risk. These findings held true even after accounting for potential confounding factors. **Conclusion:** This study emphasizes how lifestyle and psychosocial factors like physical activity, sedentary habits, and psychological stress play a significant role in breast cancer risk for Moroccan women. Encouraging physical activity, reducing sedentary time, and managing stress could be vital in preventing breast cancer in this population.

Keywords: Lifestyle factors, Risk factors, oncology, Morocco

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Introduction

Breast cancer is the most commonly diagnosed cancer in women globally and poses a significant public health challenge. Its incidence is rising, especially in low- and middle-income countries, driven by demographic shifts, urbanization, and lifestyle changes that add to the disease's growing burden [1-2]. In Morocco, breast cancer is the most common cancer in women and contributes significantly to cancer-related illness and death [3]. While non-modifiable factors like age, genetic predisposition, and reproductive history are well-known contributors to breast cancer, there is increasing focus on modifiable lifestyle factors [4]. Obesity, lack of physical activity, sedentary habits, and psychological stress are key factors influencing breast cancer risk through hormonal, metabolic, inflammatory,

and immune pathways [5]. Excess body fat is linked to higher estrogen levels, insulin resistance, and chronic low-grade inflammation, all of which can contribute to the development of breast cancer [6].

Regular physical activity helps lower breast cancer risk by regulating sex hormones, improving metabolism, and boosting immune function [7]. Furthermore, sedentary behavior, which is becoming more common in urban areas, is now seen as a separate risk factor that can harm health regardless of overall physical activity. Meanwhile, psychological stress is also being recognized as a potential cancer risk due to its effects on neuroendocrine systems and immune suppression [8].

Although evidence is mixed and varies by context, the psychosocial impact of rapid societal changes makes it an important factor to study alongside behavioral

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habits. However, data from North African and Moroccan populations are still limited. In these regions, cultural, socioeconomic, and behavioral specificities shape unique lifestyles where traditional and modern risk factors coexist, underscoring the need for locally generated evidence [9]. Understanding how physical activity, sedentary behavior, obesity, and psychosocial stress interact in the Moroccan context is crucial for creating targeted and culturally relevant prevention strategies.

This study aimed to explore the associations between physical activity, sedentary behavior, obesity, and perceived stress in relation to breast cancer risk among Moroccan women in the Rabat region, using a case-control approach.

Materials and Methods

A case-control study was carried out in the Rabat region of Morocco, gathering data from two major oncology centers: the National Institute of Oncology (INO) and the Lalla Salma Reference Center. These centers provide specialized cancer care to a diverse population from both urban and rural areas

Study population

The study involved 148 women, including 74 newly diagnosed breast cancer cases and 74 controls. The cases were women with a confirmed breast cancer diagnosis made during the study period at the participating oncology centers. The control group consisted of 74 healthy women without a history of breast cancer or any other malignancy, recruited at the Lalla Salma Reference Center in Rabat during routine breast cancer screening visits. Eligible controls were age-matched to cases and had a negative screening result at the time of inclusion. This recruitment strategy ensured that controls were drawn from the same source population as the cases, thereby minimizing potential selection bias.

The sample size was determined based on feasibility within the study period and was comparable to similar case-control studies conducted in similar settings, which showed enough power to identify significant associations between lifestyle factors and breast cancer risk.

Inclusion and exclusion criteria

Women aged 18 and older were eligible to participate. Cases had to have a confirmed diagnosis of primary breast cancer, while controls could not have a personal history of breast cancer or other cancers. Women with severe cognitive impairment, inability to give informed consent, or incomplete data were excluded from the study.

Data collection

Data were gathered through a structured questionnaire administered by trained investigators. The questionnaire covered sociodemographic characteristics (like age, marital status, education, employment, socioeconomic level, place of residence, and health insurance), reproductive and hormonal history (parity, contraceptive use, menopausal status, and family history of breast cancer), and lifestyle behaviors.

Anthropometric measurements were obtained using standard methods to calculate body mass index (BMI), which was determined as weight in kilograms divided by height in meters squared (kg/m^2).

Assessment of physical activity and sedentary behavior

Physical activity was assessed using the Arabic version of the International Physical Activity Questionnaire (IPAQ) [10], with participants classified into low, moderate, or high activity levels based on IPAQ scoring guidelines. Sedentary behavior was evaluated through self-reported daily sitting time and grouped into categories (≤ 4 hours/day, 5–7 hours/day, and ≥ 8 hours/day).

Assessment of perceived stress

Perceived stress was assessed using the Arabic version of the 10-item Perceived Stress Scale (PSS) [11], a validated tool previously adapted for Arabic-speaking populations. Total scores were calculated and grouped into low, moderate, and high levels of perceived stress.

Statistical analysis

Data were analyzed using standard statistical software. Descriptive statistics summarized participant characteristics, with continuous variables presented as means and standard deviations, and categorical variables as frequencies and percentages.

Bivariate analyses explored associations between potential risk factors and breast cancer status using chi-square tests or Student's t-tests as needed, calculating crude odds ratios (ORs) and 95% confidence intervals (CIs).

Multivariate logistic regression identified factors independently linked to breast cancer risk. Variables included in the model were chosen based on their statistical significance in bivariate analysis and clinical importance. Adjusted odds ratios (aORs) and 95% CIs were reported, with statistical significance set at $p < 0.05$.

Ethical considerations

This study was approved by the local ethics committee (University Mohammed V, Faculty of Medicine and Pharmacy of Rabat, Morocco, reference number CERB: 80/23). All participants were informed about the study's objectives and provided verbal informed consent before taking part. Confidentiality and anonymity were strictly upheld, and participants were free to withdraw at any time without any consequences.

Results

A total of 148 women were included in the analysis, with 74 breast cancer cases and 74 controls. The two groups were well matched on age, marital status, place of residence, education level, socioeconomic status, and health insurance coverage. However, unemployment was more common among the cases than the controls (Table 1). In bivariate analyses, lifestyle-related factors showed significant associations with breast cancer risk (Table 2). High levels of physical activity were associated with a significant reduced breast cancer risk. Women

Table 1. Sociodemographic Characteristics of Breast Cancer Cases and Controls

Variable	Controls (n=74)	Cases (n=74)	p-value
Age (years), mean $\pm$ SD	52.1 $\pm$ 14.1	54.8 $\pm$ 14.6	0.28
≤ 39 years	16 (21.6%)	14 (18.9%)	
40–50 years	17 (23.0%)	15 (20.3%)	
51–61 years	23 (31.1%)	20 (27.0%)	
≥ 62 years	18 (24.3%)	25 (33.8%)	0.41
Urban residence	50 (67.6%)	54 (73.0%)	0.46
Married	43 (58.1%)	42 (56.8%)	0.97
Illiterate	44 (59.5%)	51 (68.9%)	0.32
Unemployed	58 (78.4%)	68 (91.9%)	0.02
Low socioeconomic level	42 (56.8%)	43 (58.1%)	0.98
No health insurance	17 (23.0%)	16 (21.6%)	0.94

with moderate and high physical activity levels had significantly lower odds of breast cancer compared to those with low activity. Sedentary behavior was linked to breast cancer risk, with women reporting 5–7 hours of daily sitting having a significantly higher risk than those sitting ≤ 4 hours/day. Perceived stress showed a strong dose-response relationship with breast cancer risk. Women with moderate stress had a significantly higher risk of breast cancer, while those with high stress levels had more than a fourfold increased risk compared to women with low stress. The analysis of body mass index (BMI) revealed a significant disparity between the two groups. Women with a normal BMI (<25) were more frequent in the control group (31.08%) than among cases (17.57%), whereas obesity ($\text{BMI} \geq 30$) was markedly more prevalent in the case group (48.65%) compared to controls (27.03%). In addition, a positive family history of breast cancer and hormonal contraception were significantly linked to an increased risk of breast cancer. In terms of reproductive history, women with one to three pregnancies had a significantly lower risk of breast cancer compared to those with four or more pregnancies.

In a multivariate logistic regression analysis that adjusted for sociodemographic characteristics, physical

activity, sedentary behavior, perceived stress, family history of breast cancer, and hormonal contraception, several factors were found to be independently associated with breast cancer risk (Table 3).

High physical activity retained a strong protective effect, reducing the risk by 83% compared to low activity (AOR = 0.17; 95% CI: 0.06–0.46; $p < 0.001$). Whereas high perceived stress, family history of breast cancer, and hormonal contraceptive use remained significant independent risk factors. Psychological stress emerged as a major risk factor. Women reporting high stress levels had a 4.07 fold higher risk of breast cancer compared to those with low stress. Employment status also was found to be protective compared to being unemployed (AOR = 0.41; $p = 0.047$).

Discussion

This case-control study examined the associations between physical activity, sedentary behavior, obesity-related factors, psychological stress, and breast cancer risk among Moroccan women in the Rabat region. The findings highlight the significant role of modifiable lifestyle factors in breast cancer risk and provide original

Table 2. Body Mass Index, Physical Activity, Sedentary Time, Perceived Stress Scale and Family History of Breast Cancer Associated with Breast Cancer Risk (Bivariate Analysis)

Variable	Category	Controls (n=74)	Cases (n=74)	p-value	Crude OR (95% CI)
Body mass index (BMI)	BMI < 25	23 (31.08%)	13 (17.57%)	0.02	1
Body mass index (BMI)	BMI 25–29.9	31 (41.89%)	25 (33.78%)	0.418	1.427 [0.604 – 3.373]
Body mass index (BMI)	BMI ≥ 30	20 (27.03%)	36 (48.65%)	0.009	3.85 [1.331 – 7.621]
IPAQ level	Low	10 (13.51%)	27 (36.49%)	0.002	1
IPAQ level	Moderate	38 (51.35%)	35 (47.30%)	0.014	0.341 [0.145 – 0.805]
IPAQ level	High	26 (35.14%)	12 (16.22%)	< 0.001	0.171 [0.063 – 0.463]
Sedentary time	≤ 4 hours	24 (32.43%)	18 (24.32%)	0.033	0.338 [0.125 – 0.914]
Sedentary time	5–7 hours	41 (55.41%)	36 (48.65%)	0.044	0.395 [0.160 – 0.977]
Sedentary time	≥ 8 hours	9 (12.16%)	20 (27.03%)	0.077	1
PSS level	Low	46 (62.16%)	26 (35.14%)	—	1
PSS level	Moderate	18 (24.32%)	25 (33.78%)	0.023	2.475 [1.134 – 5.326]
PSS level	High	10 (13.51%)	23 (31.08%)	0.002	4.069 [1.680 – 9.855]
Family history of breast cancer	Yes	5 (6.76%)	14 (18.92%)	0.034	3,220 [1.096–9.464]

Table 3. Multivariate Logistic Regression Analysis of Factors Associated with Breast Cancer Risk

Variable	Category	Adjusted OR (95% CI)	p-value
Physical activity level	Low	1	—
	Moderate	0.34 (0.15–0.81)	0.014
	High	0.17 (0.06–0.46)	<0.001
Sedentary time (hours/day)	≤ 4	1	—
	5–7	0.39 (0.16–0.98)	0.044
	≥ 8	1	0.077
Perceived stress (PSS)	Low	1	—
	Moderate	2.48 (1.13–5.33)	0.023
	High	4.07 (1.68–9.86)	0.002
Family history of breast cancer	Yes	3.22 (1.10–9.46)	0.034
Hormonal contraception use	Yes	1.95 (1.01–3.77)	0.048
Employment status	Unemployed	1	—
	Employed/other	0.41 (0.17–0.99)	0.047

Model adjusted for age, educational level, socioeconomic status, physical activity, sedentary behavior, perceived stress, family history of breast cancer, and hormonal contraception.

data in a context where epidemiological evidence remains limited.

In this study, participants with a BMI of 30 kg/m² or higher were much more common among cases than controls, and obesity was associated with a nearly fourfold increase in breast cancer risk compared to normal-weight individuals. In contrast, being overweight (BMI 25–29.9 kg/m²) did not show a statistically significant association, suggesting that the impact of excess adiposity may become clinically relevant primarily at the level of obesity.

These findings align with a large body of epidemiological evidence identifying obesity as a well-established risk factor for several cancers, particularly hormone-dependent malignancies like breast cancer [12]. Adipose tissue is not just a passive energy store but an active endocrine organ that contributes to carcinogenesis through various biological pathways [13]. In postmenopausal women, adipose tissue is the primary site of estrogen production through the aromatization of androgens, leading to prolonged estrogen exposure that may promote tumor initiation and progression [14]. Additionally, obesity is linked to chronic low-grade inflammation, hyperinsulinemia, insulin resistance, and elevated levels of insulin-like growth factors, all of which can enhance cellular proliferation and inhibit apoptosis [15].

The lack of a significant association for overweight individuals may be due to variability within this group, where metabolic risk profiles differ widely. It is also possible that the relatively small sample size limited the statistical power to detect more modest associations. However, the clear gradient observed for obesity supports the idea of a dose-response relationship between adiposity and cancer risk, as seen in larger cohort studies [16].

In contrast, there is a strong inverse association between physical activity and breast cancer risk. Women with moderate to high physical activity levels had a significantly lower risk of breast cancer, even after accounting for sociodemographic, reproductive, and behavioral factors. This protective effect aligns

with previous international studies, which suggest that regular physical activity lowers breast cancer risk through mechanisms such as regulating sex hormone levels, improving insulin sensitivity, reducing chronic inflammation, and enhancing immune surveillance.

Physical activity is associated with a lower risk of breast cancer, while sedentary behavior and perceived stress increase the risk. Women with high stress levels have a significantly greater risk than those with low stress. A family history of breast cancer and hormonal contraceptive use are also linked to higher risk. These findings highlight the need to encourage physical activity, reduce sedentary behavior, and manage psychological stress as part of breast cancer prevention strategies for Moroccan women [17].

Regarding sedentary behavior raises the risk of breast cancer, particularly for women who are sedentary for long periods each day. Although this association weakens after considering other factors, it suggests that sedentary behavior is a distinct risk factor, independent of a lack of physical activity [4, 6]. Sitting for long periods can disrupt metabolism, trigger low-grade inflammation, and interfere with insulin signaling, all of which may contribute to the development of breast cancer [4]. These results highlight the importance of addressing not only physical activity promotion but also sedentary behavior reduction in breast cancer prevention strategies.

With regard to psychological stress the study found a strong link between high perceived stress and an increased risk of breast cancer. Even after considering lifestyle and reproductive factors, the connection remained significant, indicating that stress may independently contribute to the risk. Chronic psychological stress can affect breast cancer risk by disrupting the body's stress response system, increasing cortisol levels, suppressing the immune system, and creating a pro-inflammatory environment that may support tumor growth [7]. The link between stress and cancer is complex, but these results highlight the need to consider psychosocial factors in cancer prevention and call for more research through long-term studies.

Beyond lifestyle habits, biological and hormonal factors play a decisive role in cancer risk. As seen in previous studies, a family history of breast cancer increases the risk, likely due to genetic factors. Hormonal contraceptive use was also associated with a higher risk, supporting the idea that long-term exposure to external hormones may contribute to breast cancer development [18].

In contrast, women with one to three pregnancies had a lower risk of breast cancer compared to those with more pregnancies. This aligns with earlier research suggesting that reproductive factors can influence lifetime estrogen exposure and breast tissue development [19].

In terms of socioeconomic determinants, our analysis underscores the impact of social vulnerability on health. The high rates of unemployment and low socioeconomic status among those with breast cancer highlight social vulnerability. While these factors were mainly treated as confounders, their link to breast cancer risk might stem from indirect effects like limited healthcare access, lower health literacy, unhealthy lifestyle choices, and increased psychosocial stress [18].

Strengths and limitations

There are some limitations to consider. The case-control design may introduce recall bias, particularly for self-reported physical activity and stress levels. Although the sample size is adequate to identify significant associations, it limits more detailed analyses, such as those by menopausal status [18, 20-21].

Clinical and public health implications

Despite these limitations, the findings have important implications for clinical and public health. They highlight the importance of promoting physical activity, reducing sedentary habits, and managing psychological stress as part of breast cancer prevention efforts. In low- and middle-income countries like Morocco, integrating lifestyle and psychosocial interventions into primary healthcare and cancer prevention programs could provide a cost-effective way to reduce the breast cancer burden.

In conclusion, this study shows that modifiable lifestyle and psychosocial factors play a significant role in breast cancer risk among Moroccan women. Higher physical activity levels were associated with a lower risk, while sedentary behavior, high stress, a family history of breast cancer, and hormonal contraceptive use increased the risk. These findings underscore the need to include physical activity promotion, sedentary behavior reduction, and psychosocial support in breast cancer prevention strategies. In low- and middle-income settings like Morocco, culturally tailored lifestyle and stress-management programs could be crucial in addressing the growing burden of breast cancer.

Author Contribution Statement

HK: Conceptualization, methodology, formal analysis. HA: Data curation, supervision, Writing. AE: Data collection. MM: Supervision. NZ: Supervision, Writing original draft. All authors have read and agreed to the

published version of the manuscript.

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Approval

If it was approved by any scientific Body/ if it is part of an approved student thesis

Ethical Declaration

This study was approved by the local ethics committee (University Mohammed V, Faculty of Medicine and Pharmacy of Rabat, Morocco, reference number CERB: 80/23).

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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