Clinical Nutrition Open Science 55 (2024) 1–19

Contents lists available at ScienceDirect

Clinical Nutrition Open Science

journal homepage:
www.clinicalnutritionopenscience.com

Original Article

A nationwide cross-sectional study investigating adherence to the Mediterranean diet, smoking, alcohol and work habits, hormonal dynamics between breast cancer cases and healthy subjects

Luana Conte [a, b], Roberto Lupo [c], Alessia Lezzi [d], Vitandrea Paolo [e], Ivan Rubbi [f], Emanuele Rizzo [g], Maicol Carvello [h], Antonino Calabrò [i], Stefano Botti [j], Elisabetta De Matteis [k], Raffaella Massafra [l], Elsa Vitale [m], Giorgio De Nunzio [a, b, *]

[a] *Laboratory of Biomedical Physics and Environment, Department of Mathematics and Physics "E. De Giorgi", University of Salento, Lecce, Italy*
[b] *Laboratory of Advanced Data Analysis for Medicine (ADAM) at the Laboratory of Interdisciplinary Research Applied to Medicine, University of Salento and Local Health Authority, Lecce, Italy*
[c] *"San Giuseppe da Copertino" Hospital, Local Health Authority, Copertino, Lecce, Italy*
[d] *ANT Italia ONLUS Foundation (National Cancer Association), Lecce, Italy*
[e] *Freelance Nurse, Lecce, Italy*
[f] *School of Nursing, University of Bologna, Faenza, Italy*
[g] *Department of Biological and Environmental Sciences and Technologies, University of Salento, Lecce, Italy*
[h] *Community Hospital, Local Health Authority, Romagna, Italy*
[i] *"Nuovo Ospedale degli Infermi" Hospital, Local Health Authority, Biella, Italy*
[j] *Haematology Unit, Azienda USL-IRCCS, Reggio Emilia, Italy*
[k] *Oncological Screenings Unit, Local Health Authority of Lecce, Lecce, Italy*
[l] *Laboratorio di Biostatistica e Bioinformatica, IRCCS Istituto Tumori "Giovanni Paolo II", Bari, Italy*
[m] *Scientific Directorate, IRCCS Istituto Tumori "Giovanni Paolo II", Bari, Italy*

ARTICLE INFO

Article history:
Received 8 January 2024
Accepted 21 February 2024
Available online 24 February 2024

Keywords:
Breast cancer
Mediterranean diet

SUMMARY

Background & Aims: Despite substantial efforts in promoting prevention and the advancements in surgical and minimally invasive techniques, breast cancer remains a leading cause of mortality among women worldwide. Genetics and risk factors, including diet and lifestyle, play a critical role in determining the susceptibility to this neoplasm. The primary objective of this study is to investigate the pivotal role of adherence to the Mediterranean

* Corresponding author. Laboratory of Biomedical Physics and Environment, Department of Mathematics and Physics "E. De Giorgi", University of Salento, Lecce, Italy.
E-mail address: giorgio.denunzio@unisalento.it (G. De Nunzio).

https://doi.org/10.1016/j.nutos.2024.02.007

Smoking
Alcohol
Work habits
Hormonal dynamics

diet in breast cancer prevention. Additionally, we assessed differences in diet, Body Mass Index (BMI), smoking and alcohol habits, work shifts, exposure to environmental pollutants, and hormonal factors between patients with previously diagnosed breast cancer and healthy subjects.
Methods: The validated CREA questionnaire, alongside additional inquiries, was administered to the Italian population. Adherence to the Mediterranean diet was examined, and respondents were categorized into two groups: the general population and patients with a previous cancer diagnosis. Descriptive and inferential statistics were applied to assess all risk factors among these groups.
Results: Results revealed low adherence to the Mediterranean diet, particularly among less educated individuals, those engaged in 24-hour shift work, smokers, and those with a high BMI. Furthermore, significant differences in working time distribution, consumption of meat, milk, and alcohol, as well as significant differences in hormonal factors such as age of menarche and menopause, age of first pregnancy, number of children and abortions, breastfeeding time, and contraceptive use were observed between these groups.
Conclusions: These findings underscore the importance of targeted interventions and personalized strategies to address specific risk factors and enhance preventive measures for individuals at risk.

Introduction

Breast cancer is currently the most common cancer in women worldwide [1,2]. In Italy alone, with 55,700 new diagnoses in 2020 and 12,500 deaths expected in 2022, this cancer accounts for 30% of all cancers diagnosed in Italy [3]. Despite breast cancer awareness, public attention, and advances in breast imaging for early detection, the mortality rates from breast cancer persist at alarming levels worldwide, making it the foremost cause of death in Italy [3]. Early diagnosis, therefore, remains the most important tool to intervene in time. Cancer encompasses a diverse group of diseases characterized by aberrations in cellular genomics within a multifactorial etiological framework. Tumors, depending on their origin, are categorized as sporadic, familial, or inherited, with the latter constituting approximately 10% of all diagnoses [4]. Genetic factors, especially mutations in the BRCA-1 and BRCA-2 genes, present a lifetime risk of 65% and 40% respectively for breast cancer onset [3]. This can occur in that segment of the population with known genetic mutations predisposing to the development of tumours: while, in most cases, the disease is triggered by a progressive and random accumulation of multigenic mutations, sometimes it can be traced back to single driver mutations or monogenic alterations that can increase the likelihood of contracting a specific type of cancer during lifetime, compared to the general population. These are the hereditary-familial tumours possibly arising in individuals carrying a hereditary genetic variant, which is the primary cause of tumour development.

Beyond genetics, recent research has shown that 20–30% of new breast cancer diagnoses can be traced back to specific risk factors that either trigger or influence the malignant transformation of breast cells [5]. Factors such as the age, dietary habits and obesity, lifestyle choices such as smoking habits and high alcohol intake, stress, environmental pollution, hormonal changes, and prior breast-related conditions [3,6,15,7–14] all play a role in determining breast cancer risk. A notable observation is that as age progresses, the risk escalates, which is attributed to hormonal changes and to the accumulation of genetic errors in cellular DNA [3].

Lifestyle plays a crucial role in breast cancer prevention. Diet, physical exercise, and voluntary habits such as alcohol consumption and cigarette smoking are certainly the factors that can be targeted for a healthy lifestyle. The Mediterranean diet is confirmed as the best preventive dietary approach [15–19], although maintaining high adherence to the diet is not always achievable, often due to stressful work habits that involve night shifts, making it challenging to plan the life and, consequently, dietary choices.

Strongly related to the diet, obesity is certainly one of the most studied factors, given the strong correlation between body mass index (BMI) and survival from breast cancer [16]. Obesity is associated both with a higher risk of developing breast cancer, particularly in postmenopausal women, and with worse disease outcome in women of all ages [17]. Compared to non-obese women with breast cancer, obese women with breast cancer have a worse disease-free and overall survival despite appropriate local and systemic therapies [18].

Among the voluntary and undoubtedly avoidable risk factors, tobacco smoking represents another single risk factor, associated with the onset of about one in three tumours and as many as 17 types/sites of cancer, in addition to lung cancer [19]. In both sexes, smoking is the risk factor with the greatest impact, accounting for at least 43,000 annual cancer deaths. Passive smoking has also been recognized as responsible for deaths from various tumour sites, including breast cancer in women. At the same time, harmful and risky alcohol consumption also represents a significant public health problem, as it is responsible in Europe for about 4% of all deaths and about 5% of the years of life lost due to disability [19]. This has led many countries to adopt recommendations on alcohol consumption, suggesting caution [20].

Other risk factors are present only in women: hormonal dynamics, like early onset of menstruation, delayed menopausal status, lactation duration, number of abortions, use of oral contraceptives and hormone therapies, have also a strong effect on the risks of breast cancer [21–25].

Identifying women with exceptionally high risk is not only crucial for understanding the complex landscape of breast cancer but also pivotal in tailoring personalized preventive strategies [26,27]. Those identified with a heightened risk may be eligible for risk-reducing surgeries, such as prophylactic mastectomy or oophorectomy, as well as innovative preventive treatments.

The Mediterranean diet, acknowledged as a preventive dietary approach, is a key focus of our investigation, recognizing the challenges of maintaining high adherence. Our primary objective was to underscore the role of this dietary style and scrutinize disparities between two distinct groups: individuals in the general population and those with a history of breast cancer diagnosis. Within these cohorts, we explored various facets of their lifestyles, encompassing adherence to the Mediterranean diet, BMI, and voluntary behaviors such as alcohol consumption and smoking. Additionally, we examined potential risk factors such as workplace shifts and exposures to environmental pollutants. Hormonal influences, including age of menarche, age of menopause, age of first pregnancy, number of children, number of abortions, breastfeeding, and contraceptive use for women, were also assessed. The aim was to uncover any variations between the two groups and provide a nuanced understanding of how lifestyle and environmental factors may contribute to observed differences in breast cancer outcomes.

Methods

Design

Between March and September 2023, a survey was carried out targeting Italian subjects. Out of the approached population, 509 individuals chose to participate. This study utilized an anonymous digital questionnaire, hosted on the Google Drive platform, ensuring ease of access and data collection. The questionnaire was promoted and shared across various Facebook groups and Instagram pages. The study employed a virtual snowball sampling technique, continuing until the point of data saturation.

Survey instrument

The survey instrument was designed to capture a broad spectrum of information from the respondents, divided into six distinct sections.

The first section (7 questions), focusing on socio-demographic characteristics, gathered data on gender, geographical location within Italy, age, educational attainment, employment status, religious beliefs, and the population size of the respondent's town.

The second section (7 questions) delved into the work habits of the participants. It inquired if they were involved in healthcare professions, their distribution of work hours, years of work experience, and the total hours they work per week. This section also explored the regularity and sequence of their work shifts, providing insights into their work-life balance.

The third section (5 questions) aimed to understand the exposure of participants to various risk factors. Questions in this section revolved around whether they lived in a polluted city, their body weight, height, and the resultant Body Mass Index (BMI). Smoking habits, including the number of cigarettes smoked and the duration of smoking in years, were also part of this section.

The fourth section (9 questions) was dedicated to understand the adherence of participants to the Mediterranean diet. This was assessed using the validated CREA questionnaire composed of 9 questions, each corresponding to a specific food group that should be included in diet: fruits, vegetables, legumes, cereals, fish, meat and cold cuts, milk and its derivatives, olive oil, and alcohol. For each question, there are three possible answers, with each answer being assigned a score ranging from zero to two. Therefore, the total score a participant can achieve ranges from 0 to 18. By summing up the scores obtained from all the questions, participants are categorized into one of the four predefined bands, ranging from “not adequate" to “completely adequate".

The last section (7 questions) was exclusively for female participants. It collected data on specific female characteristics like the age of menarche, age of the first pregnancy, the number of pregnancies, children, and abortions, breastfeeding habits, and menopause details.

Ethical considerations

Approval was obtained from the Bioethical Committee of the University of Bologna (Protocol no. 0335844 on 14 November 2023). Participation to the survey was anonymous and obtained through informed consent by completing the questionnaire. The ethical characteristics of the study were set out in the questionnaire presentation. The questionnaire was designed in accordance with the principles of the Italian data protection authority (DPA). It was emphasized that participation was voluntary and that the participant could refuse participation in the protocol whenever they wished. Those who were interested in participating were given an informed consent form, which recalled the voluntary nature of participation, as well as the confidentiality and anonymous nature of the information. In addition, to ensure that the questionnaires were anonymous, participants' responses were deidentified.

Statistical analysis

Data from all the 509 respondents underwent thorough analysis using both descriptive and inferential statistical methods. To identify items associated with differences in behavior toward breast cancer, the subjects were divided into 2 groups: the first group represents the general population (Group A, $n = 465$) while the second group represents individuals who have or had breast cancer in the past (Group 2, $n = 44$).

Continuous variables, such as age, body weight, height, and BMI, were summarized using mean and standard deviation (SD). Categorical variables, including gender, geographical location, and employment status, were presented using frequencies and percentages.

The CREA questionnaire, designed to gauge adherence to the Mediterranean diet, underwent a thorough statistical analysis. Descriptive statistics for each CREA item response were computed for all respondents, as well as separately for Group A and Group B. These statistics captured metrics such as the item median, standard deviation, skewness, floor and ceiling effects, along with their respective 95% confidence intervals. The reliability of the CREA questionnaire was confirmed using Cronbach's alpha.

According to the CREA scores, participants were then stratified into four distinct groups each representing a different level of adherence to the Mediterranean diet (inadequate, poor, sufficient and

adequate diet). To understand the difference in dietary habits and their potential implications across these groups, an ANOVA (Analysis of Variance) was conducted.

Subsequently, a one-way ANOVA was employed to identify significant differences between the CREA scores and various socio-demographic and risk factors. For factors that were identified as significant in the ANOVA, a post-hoc analysis using the Tukey test was performed. This helped in identifying which groups significantly differed from each other and provided a deeper understanding of the variations within the data.

To assess the differences in responses between Group A and Group B, the Mann-Whitney test was employed. This analysis highlighted variations in various aspects such as socio-demographic characteristics, work habits, adherence to the Mediterranean diet, and exposure to risk factors between the two distinct groups.

All the statistical analyses were conducted using MATLAB software. A significance level of $P<0.05$ was used for all tests to ensure that the results were both robust and meaningful.

Results

Sample demographics and baseline characteristics

A total of 509 individuals participated in the study. Responses from all participants are detailed in Table 1, spanning Sections 1-6. Within this table, responses have also been categorized and presented separately for Group A (general population group) and Group B (tumour group).

Section 1 of Table 1 includes the socio-demographic characteristics of the participants. Of the total of respondents, 81% were females and the majority (47%) were aged between 21-30 years. It is worth noting that none of the participants in the cancer group were aged between 21-30 years, whereas this age group constituted 52% of the general population group. The cancer group had also a higher percentage of participants aged between 41-50 years (45%) compared to the general population group (16%). This observation aligns with the typical age range for cancer development, which is most commonly above 50.

The majority of the participants hailed from different regions of Italy: 27% from Northern Italy, 16% from Central Italy, 54% from Southern Italy, and 3% from the islands. When comparing the two groups, 32% of the cancer group hailed from Northern Italy, compared to 26% of the general population. Similarly, 41% of the cancer group were from Southern Italy, compared to 55% of the general population.

Most of the participants (32%) had completed higher secondary education, and 4% had a post-graduate qualifications. In the cancer group, 50% had completed higher secondary education, compared to 40% in the general population.

Fifty-five percent of the participants were either students or workers, while 44% were unemployed or retired. The cancer group had a higher percentage of public employees (27%) compared to the general population (29%). However, the general population had a higher percentage of students (35%) compared to the cancer group, where no students were reported. This is in line with the age of the Group B.

In terms of religious beliefs, the majority followed Christianity (69%) and 27% were atheists.

The participants also provided information about the population size of their cities: 35% lived in small cities with a population between 500-2,000, 24% in cities with 3,000-10,000 inhabitants, 22% in cities with 20,000-60,000 inhabitants, and 18% in cities with more than 60,000 inhabitants.

Questionnaire items

Sections 2 to 6 of Table 1 collect the responses to the questionnaire for all participants, with data further categorized and presented for both Group A and Group B. The study delved into various aspects of the participants' lives, including their work habits (Section 2), exposure to risk factors (Section 3), adherence to the Mediterranean diet (Section 4), and a specific questions for female participants (Section 5).

In our exploration of the professional lives of the respondents (Section 2), we found that a significant portion were not directly involved in the healthcare sector (47%). This revelation underscores the

Table 1
Responses to the questionnaire divided among subjects diagnosed with breast cancer (Group A, $n = 44$), subjects from the general population (Group B, $n = 65$), and total ($n = 509$).

	Group A subjects of the general population (n=465)	Group B subjects with cancer (n=44)	Total responders (n=509)
	N (%)	N (%)	N (%)
SECTION 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS			
Gender			
Female	367 (79)	43 (98)	410 (81)
Male	98 (21)	1 (2)	99 (19)
Geographic Area			
North Italy	123 (26)	14 (32)	137 (27)
Central Italy	72 (15)	10 (23)	82 (16)
Southern Italy	255 (55)	18 (41)	273 (54)
Islands	15 (3)	2 (5)	17 (3)
Age			
21–30	240 (52)	0	240 (47)
31–40	82 (18)	5 (11)	87 (17)
41–50	74 (16)	20 (45)	94 (18)
51–60	46 (10)	11 (25)	57 (11)
>60	23 (5)	8 (18)	31 (6)
Education Level			
Junior high school diploma	39 (8)	8 (18)	47 (9)
Higher Diploma	186 (40)	22 (50)	208 (41)
Graduate Diploma	16 (3)	2 (5)	18 (4)
Bachelor's Degree	142 (31)	2 (5)	144 (28)
Master's Degree	45 (10)	5 (11)	50 (10)
Postgraduate training	37 (8)	5 (10)	37 (7)
Employment status			
Public dependent	135 (29)	12 (27)	147 (29)
Private employee	80 (17)	13 (30)	93 ((18)
Worker	8 (2)	1 (2)	9 (2)
Housewife	21 (5)	5 (11)	26 (5)
Freelancer	33 (7)	6 (14)	39 (8)
Unemployed	11 (2)	2 (5)	13 (3)
Retired	15 (3)	5 (11)	20 (4)
Student	162 (35)	0	162 (32) 7 (3)
Religious belief			
Atheist	134 (29)	5 (11)	139 (27)
Christianity (Catholicism, Protestantism, Orthodoxy, etc.)	311 (67)	39 (89)	350 (69)
Eastern Religions (Buddhism, Shintoism, Caodaism, etc.)	1 (2)	0	3 (0)
Other	17 (4)	0	17 (3)
Number of inhabitants in your city			
500–2.000	114 (25)	4 (9)	54 (11)
3.000–10.000	177 (38)	15 (34)	192 (38)
20.000–60.000	124 (27)	13 (30)	137 (27)
>60.000	114 (25)	12 (27)	126 (25)
SECTION 2: WORK HABITS			
Carry out a profession in health care			
No	202 (43)	36 (82)	238 (47)
Yes	263 (57)	8 (18)	271 (53)
Distribution of working hours			
Full time	279 (60)	20 (45)	299 (59)
Part-time	68 (15)	15 (34)	83 (16)
I do not work	117 (25)	9 (20)	126 (25)
missing	1 (0)	0	1 (0)
Years of work experience			
1–5	153 (33)	4 (9)	157 (31)
6–10	38 (8)	1 (2)	39 (8)

Table 1 (*continued*)

	Group A subjects of the general population (n=465)	Group B subjects with cancer (n=44)	Total responders (n=509)
	N (%)	N (%)	N (%)
11–15	27 (6)	1 (2)	28 (5)
16–20	28 (6)	8 (18)	36 (7)
21–25	19 (4)	7 (16)	26 (5)
26–30	14 (3)	2 (5)	16 (3)
>30	22 (5)	4 (9)	26 (5)
No work experience	63 (14)	17 (39)	80 (16)
missing	101 (22)	0	101 (20)
Work shift			
Day shift	172 (37)	28 (64)	200 (39)
24-hour shift	178 (38)	7 (16)	185 (36)
I do not work	114 (25)	9 (20)	123 (24)
missing	1 (0)	0	1 (0)
Regularity of work shift			
Fixed shift that allows to plan personal life throughout the coming year	81 (17)	16 (36)	97 (19)
Fixed shift that allows to plan personal life throughout the coming month	127 (27)	5 (11)	132 (26)
Fixed shift that allows scheduling of private life throughout the coming week	60 (13)	5 (11)	65 (13)
I do not have a fixed shift	84 (18)	9 (20)	93 (18)
I do not work	113 (24)	9 (20)	122 (24)
Is the work shift sequence always regular?			
No	162 (35)	9 (20)	171 (34)
Yes	188 (40)	26 (59)	214 (42)
I do not work	114 (25)	9 (20)	123 (24)
missing	1 (0)	0	1 (0)
Hours of work per week			
<12	30 (6)	2 (5)	32 (6)
13–18	13 (3)	4 (9)	17 (3)
19–24	29 (6)	7 (16)	26 (7)
25–32	75 (16)	7 (16)	82 (16)
>32	207 (45)	7 (16)	222 (44)
I do not work	111 (24)	9 (20)	120 (24)
SECTION 3: RISK FACTORS			
Do you live in a polluted city?			
No	242 (52)	26 (59)	268 (53)
Yes	223 (48)	18 (41)	241 (47)
Indicates body weight (kg)			
Range	37.5–130	46–90	37.5–130
Media	66.01	65.84	65.99
STD	12.79	12.45	12.75
Indicates height (cm)			
Range	145–195	153–178	145–195
Media	166.06	164.79	165.93
STD	7.92	6.075	7.78
Body Mass Index (BMI)			
Range	17–39	18–35	17–39
Media	23.89	24.18	23.91
STD	3.94	4.21	3.96
Smoker			
No	276 (59)	26 (64)	304 (60)
Yes	140 (30)	7 (16)	147 (29)
Ex-smoker	46 (10)	9 (20)	55 (11)
missing	3 (1)	0	3 (1)
If you answered yes to the previous question, please indicate the number of daily cigarettes			
Range	1–30	1–30	1–30
Media	8.89	9.16	9.16
STD	6.27	6.38	6.38

(*continued on next page*)

Table 1 (*continued*)

	Group A subjects of the general population (n=465)	Group B subjects with cancer (n=44)	Total responders (n=509)
	N (%)	N (%)	N (%)
If you answered yes to the previous question, please indicate how many years you have been smoking			
Range	1–50	1–50	1–50
Media	11.60	11.9	11.97
STD	10.03	10.032	10.03
SECTION 4: ADHERENCE TO THE MEDITERRANEAN DIET (CREA QUESTIONNAIRE)			
Fruit consumption per day (1 portion of 150g)			
<1 portion	225 (48)	19 (43)	244 (48)
1-2 servings	202 (43)	19 (43)	221 (43)
>2 servings	34 (7)	6 (14)	40 (8)
missing	4 (1)	0	4 (1)
Vegetable consumption per day (1 portion of 100g)			
<1 portion	155 (33)	8 (18)	163 (32)
1–2.5 servings	258 (55)	28 (64)	286 (56)
>2.5 servings	49 (11)	8 (18)	57 (11)
missing	3 (1)		3 (1)
Consumption of Legumes per week (1 portion of 70g)			
<1 portion	220 (47)	17 (39)	237 (47)
1-2 servings	189 (41)	23 (52)	212 (42)
>2 servings	51 (11)	3 (7)	54 (11)
missing	5 (1)	1 (2)	6 (1)
Consumption of Cereals, excluding sweets, per day (1 serving of 130g)			
<1 portion	128 (28)	18 (41)	146 (29)
1–1.5 servings	223 (48)	17 (39)	240 (47)
>1.5 servings	111 (24)	9 (20)	120 (24)
missing	3 (1)		3 (1)
Fish consumption per week (1 portion of 100g)			
<1 portion	226 (49)	21 (48)	247 (49)
1–2.5 servings	202 (43)	22 (50)	224 (44)
>2.5 servings	29 (6)	1 (2)	30 (6)
missing	8 (2)		8 (2)
Consumption of Meat and Cured Meats (1 serving of 80g)			
<1 portion	121 (26)	12 (27)	133 (26)
1–1.5 servings	184 (40)	8 (18)	192 (38)
>1.5 servings	152 (33)	23 (52)	175 (34)
Missing	8 (2)	1 (2)	9 (2)
Consumption of Milk and Milk Derivatives (1 serving of 180g)			
<1 portion	144 (31)	15 (34)	159 (31)
1–1.5 servings	192 (41)	10 (23)	202 (40)
>1.5 servings	121 (26)	18 (41)	139 (27)
Missing	8 (2)	1 (2)	9 (2)
Consumption of Olive Oil			
Occasional	56 (12)	1 (2)	57 (11)
Frequent	115 (25)	11 (25)	126 (25)
Regular	292 (63)	32 (73)	324 (64)
Missing	2 (2)		2 (0)
1 alcoholic unit (AU) per day, equivalent to one glass of wine, one can of beer			
No consumption	245 (53)	34 (77)	279 (55)
<1 AU	170(37)	6 (14)	176 (35)
1-2 UA	47 (10)	4 (9)	51 (10)
Missing	3 (1)		3 (1)
SECTION 5: WOMEN'S SECTION			
Age of menarche			
Range	8–16	9–16	8–16
Media	12.24	12.55	12.27
STD	1.46	1.38	1.45
Number of pregnancies			
Range	0–6	0–3	1–6

Table 1 (*continued*)

	Group A subjects of the general population (n=465)	Group B subjects with cancer (n=44)	Total responders (n=509)
	N (%)	N (%)	N (%)
Media	0.68	1.54	2
STD	1.07	0.91	0.85
Age of first pregnancy			
Range	17–42	17–43	28–43
Media	28.03	28.52	28.06
STD	5.44	5.45	6.61
Numbers of children			
Range	1–6	1–6	X
Media	1.82	1.79	
STD	0.77	0.73	
Number of abortions			
Range	0–4	0–2	0–4
Media	0.20	0.37	0.22
STD	0.54	0.54	0.54
Did you breastfeed your children?			
No	269 (58)	18 (41)	287 (71)
Yes	90 (19)	24 (55)	114 (28)
missing	106 (23)	2 (5)	9 (2)
If you answered yes to the previous question, please indicate for how long			
Range	1–48	1–13	2–48
Media	9.40	6.47	9.25
STD	7.08	3.42	6.57
Are you in the age of menopause?			
No	273 (74)	8 (18)	281 (68)
Yes	50 (14)	20 (45)	70 (17)
Yes, induced by chemotherapy	3 (1)	14 (32)	17 (4)
Missing	41 (11)	1 (2)	42 (10)
Indicates the age of menopause			
Range	44–57	30–55	30–57
Media	50.32	45.58	48.81
STD	3.49	6.42	5.27
Contraceptives assumption			
No	276 (75)	39 (89)	315 (77)
Yes	71 (19)	1 (2)	72 (17)
missing	20 (5)	3 (7)	23 (6)

The table is divided into 5 sections. Section 1 pertains to socio-demographic characteristics; Section 2 investigates work habits; Section 3 includes exposure to risk factors; Section 4 concerns adherence to the Mediterranean diet assessed with the validated CREA questionnaire. Section 5 is a part dedicated only to women.

diverse backgrounds of the study's participants, ensuring that the insights garnered are not solely from a healthcare-centric viewpoint but offer a more comprehensive understanding of the broader population.

When it came to work distribution, a majority were engaged in full-time employment (59%) and work more than 32 hours per week (44%), while a small percentage worked part-time (16%) or were currently not working (25%). The diversity in their work experience was evident, with some just starting their careers, having 1–5 years of experience (31%), and others boasting more than 30 years in their respective fields (5%). The nature of their shifts varied, with a majority working during the day (39%), and a smaller portion working 24h shifts (36%). The predictability of their schedules also differed, with many enjoying a fixed routine, while others faced more erratic timetables. The data reveals a diverse range of work habits among the respondents. The varied work schedules and years of experience highlight the different lifestyles and commitments of the participants.

Section 3 delved into potential risk factors the respondents might be exposed to. A striking 47% of participants believed they lived in a polluted city, a perception that could have profound implications

for their health and well-being. This significant percentage underscores the growing concerns about environmental health hazards and their potential impact on individual and community health.

To gain a more comprehensive understanding of the respondents' health profiles, we further investigated their personal health metrics, gathering data on their body weight (mean: 65.99 kg, SD: 12.75), height (mean: 165.93 cm, SD:7.78), and Body Mass Index (BMI) (mean: 23.91, SD:3.96).

Smoking habits, a well-known health risk, were also explored. It was found that a majority were non-smokers (60%), while a considerable portion were active smokers (29%), and a smaller segment had quit smoking (11%). The varied BMI values, combined with the smoking habits, paint a diverse picture of the health profiles and risk exposures of the participants, emphasizing the multifaceted nature of health determinants in the studied population.

Section 4 assessed the respondents' adherence to the Mediterranean diet using the validated CREA questionnaire. This diet, rich in fruits, vegetables, whole grains, olive oil, and lean proteins, has been globally recognized for its potential in reducing the risk of chronic diseases and promoting overall well-being. Through the questionnaire, specific dietary habits were explored, encompassing consumption patterns of vegetables, fruits, cereals, legumes, fish, meat, milk and dairy products, olive oil, and even alcohol. Results are shown in the section "*CREA score analysis*".

Lastly, Section 5 was exclusively tailored for female participants, delving into specific aspects of their reproductive health and life stages. This section aimed to gather insights into the age of menarche, (mean:12.27 years, SD:1.45). It also explored the reproductive history of the respondents, capturing data on the number of pregnancies, (mean:2, SD:0.85), the age at which they had their first pregnancy, (mean:28.06 years, SD:6.61), and the number of children they had. Additionally, the section inquired about the number of abortions (mean:0.22, SD:0.54). Breastfeeding habits were also investigated, revealing that a significant 71% of the respondents had not breastfed their children. Menopause details were another focal point, with 68% of the participants not having reached menopause, 17% in menopause, and 4% having undergone chemotherapy-induced menopause. The average age of menopause was found to be 48.81 years (SD:5.27). This section provided a comprehensive understanding of the female reproductive lifecycle and its potential implications on health and well-being.

CREA score analysis

Figure 1 and Table 2 presents the descriptive statistics and characteristics of the score distributions for the entire CREA questionnaire. In accordance with the CREA guidelines, the respondents were stratified into four distinct groups based on their dietary adherence. The results are quite revealing: 8.5% of the respondents do not follow an adequate diet, 62% have a diet that is only marginally adequate, 37% maintain a sufficiently adequate diet, and a mere 0.8% adhere to a completely adequate diet. Figure 1 provides a detailed stratification of all the respondents (n=509) to the CREA questionnaire. This diversity in adherence levels underscores the importance of understanding individual dietary choices and their potential implications for health. While some closely follow the Mediterranean dietary guidelines, others diverge in various ways, emphasizing the significance of nutrition in wellness and disease prevention.

The descriptive statistics of the CREA questionnaire, as presented in Table 2, offer a comprehensive overview of the score distributions for all respondents. Specifically, the table delineates the data for the entire cohort and further breaks it down to compare Group A and Group B. This distinction allows for a nuanced understanding of dietary adherence patterns across different segments of the study population. On average, respondents achieved a score of 8.39, which is slightly below the midpoint of the potential score range. The median score is marginally higher at 9, suggesting that over half of the participants are leaning towards better adherence to the Mediterranean diet as per the CREA guidelines. When we break down the scores by group, the individuals from the general population (Group A) have an average score of 8.35, which is very close to the overall average. Their median score is 8, indicating a similar trend in adherence to the Mediterranean diet. In contrast, patients with tumors (Group B) have a slightly higher average score of 8.72 and a median of 9, suggesting that this group, on average, tends to adhere more closely to the Mediterranean diet recommendations.

It's noteworthy that a mere 0.98% of all the subjects scored at the lowest possible end of the scale, indicating very few instances of extremely poor adherence. On the other hand, only 0.19% achieved the

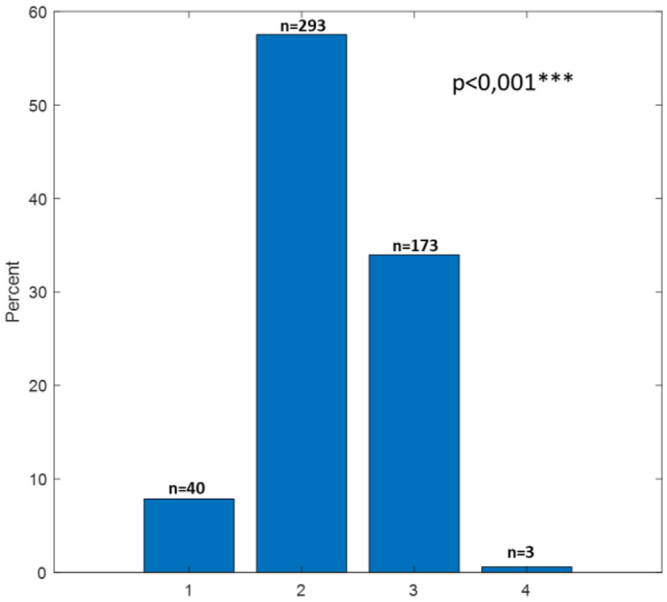

Figure 1. Results of the CREA questionnaire. BOX 1: inadequate diet for n=40 (8.5%); BOX 2: marginally adequate diet for n=293 (62%); BOX 3: sufficiently adequate diet for n=173 (37%); BOX 4: completely adequate diet for n=4 (0.8%). Missing = 39.

best possible score, showcasing that exemplary adherence to the diet, while present, is rare. Interestingly, Group A had a slightly higher percentage of individuals scoring at the floor (1.07%) compared to the overall respondents, and a marginally higher percentage at the ceiling (0.21%). In contrast, patients with tumors (Group B) exhibited a more pronounced floor effect with 4.54% of its members scoring at the lowest end, while 2.27% achieved the highest possible score, indicating a broader range of adherence levels within this group. The presence of a higher “floor" value in Group B suggests that a larger percentage of patients with tumors might not be following the Mediterranean diet as recommended or might have less healthy eating habits compared to individuals from the general population. This could reflect a range of factors, including a lack of awareness or resources to follow a balanced diet, or it might be influenced by disease-related factors, such as changes in appetite or food preferences following diagnosis or treatment. The presence of a higher “ceiling" value in Group B indicates that a larger percentage of patients with tumors strictly adhere to the Mediterranean diet or have very healthy eating habits. This could be the result of increased awareness or emphasis on nutrition and

Table 2
Comparative analysis of CREA questionnaire metrics for all respondents and between the general population (Group A) and patients with tumors (Group B).

CREA questionnaire	No. of items	Score range	Score (mean)	Median	% floor[a]	% ceiling[b]	Skewness	Cronbach's α[c]
Total respondents	9	0–18	8.39	9	0.98	0.19	-0.15	0.86
Group A – individuals of general popoulation			8.35	8	1.07	0.21	-0.12	
Group B – patients with tumours			8.72	9	4.54	2.27	-0.48	

The table presents the number of items, score range, mean and median scores, percentage of respondents at the floor and ceiling of the scoring range, skewness, and Cronbach's α for reliability assessment. Cronbach's alpha for all questionnaire was used to measure the scale' internal consistency reliability.
[a] Percentage of subjects with worst possible score.
[b] Percentage of subjects with best possible score.
[c] Measure of internal consistency.

health following a cancer diagnosis. Some patients might have adopted healthier eating habits as part of a holistic approach to managing their health and well-being during and after treatment.

The skewness value of -0.15 indicates a slight negative skew in the data distribution. This suggests that there are a few respondents who scored lower than the majority, pulling the mean score slightly below the median.

A pivotal aspect of any questionnaire is its reliability. The CREA questionnaire stands out with a strong internal consistency, as evidenced by a Cronbach's alpha value of 0.86. This high value indicates that the items in the questionnaire are closely related and provide consistent measurements.

To determine significant differences between the CREA scores across various socio-demographic and risk factors, a univariate analysis was performed. The results revealed that the educational level of the participants significantly influenced the CREA scores (P=0.01). Specifically, individuals with post-graduate training had the highest average score.

The ability to plan private life based on fixed shifts also played a role, showing a significant difference in CREA scores among different shift structures (P=0.04).

Furthermore, smoking status emerged as another significant factor. Non-smokers had a higher average CREA score compared to smokers and ex-smokers, with the difference being statistically significant (P=0.001). The number of cigarettes smoked daily was also associated with CREA scores. Those who smoked more than a pack daily had a considerably lower average score of 4.75±2.50 compared to those who smoked less than a pack, (P= 0.009). The duration of smoking was another influential factor. Individuals who had been smoking for more than 10 years had a lower average CREA score compared to those who had smoked for less than 10 years (P<0.001). Lastly, the BMI categories also showed significant differences in CREA scores (P=0.009). These results are shown in Table 3.

Table 3
Analysis of the CREA scores based on socio-demographic and risk factors using ANOVA.

Influencing factor	μ±SD	CREA F (*P*-value)
Socio-demographic factors		
Education Level		
Lower Middle School Diploma	7.28±3.08	**2.69 (0.01******)**
High School Diploma	8.30±2.74	
Bachelor's Degree	7.89±3.50	
Three-year Degree	8.50±2.73	
Master's Degree	8.78±2.60	
Postgraduate Training	10.00±2.92	
Work shift Structure		
Fixed shift that allows planning private life for the entire next year	7.91±2.96	**2.39 (0.04*****)**
Fixed shift that allows planning private life for the entire next month	8.70±2.68	
Fixed shift that allows planning private life for the entire next week	7.74±3.28	
I don't have a fixed shift	8.55±2.83	
Other risk factors		
Being a smoker		
No	8.71±2.83	**6.89 (0.001******)**
Yes	7.68±2.79	
Ex smoker	8.51±2.43	
Number of cigarettes smoked		
More than a pack	4.75±2.50	**6.85 (0.009******)**
Less than a pack	8.42±2.79	
Smoking duration		
More than 10 years	7.06±3.03	**13.36 (<0.001*******)**
Less than 10 years	8.54±2.75	
BMI		
Underweight	7.44±3.06	**3.85 (0.009*****)**
Normal weight	8.73±2.72	
Overweight	8.19±2.74	
Obese	7.91±2.76	

The table presents the mean and standard deviation (μ±SD) of the CREA scores for each factor, along with the F-statistic and its associated *P*-value. Statistical significance (highlighted by bold text) is denoted as follows: **P*<0.05; ***P*<0.01; ****P*<0.001; the same holds for Tables 4 and 5.

Following the ANOVA, a post-hoc analysis was conducted to delve deeper into the significant findings and pinpoint which groups exhibited the most pronounced statistical differences in adherence to the Mediterranean diet, as measured by the CREA score. The results of this analysis are presented in Table 4.

The comparison between individuals with postgraduate education and those with lower secondary education revealed a significant difference in adherence to the Mediterranean diet (P=0.009). Specifically, the difference in CREA scores ranged from 0.3268 to 3.9308. This suggests that individuals with higher educational qualifications might adhere more closely to the Mediterranean diet compared to those with lower educational levels.

A stark difference in adherence to the Mediterranean diet was observed between non-smokers and smokers (P<0.001), with a score difference ranging from 0.3771 to 1.6825. This underscores the potential impact of smoking habits on dietary choices and adherence, emphasizing the health implications of tobacco use in conjunction with dietary habits. In addition, when comparing individuals who smoke less than one pack to those who smoke more than one pack, a significant difference in adherence to the Mediterranean diet was found (P=0.008). The score difference ranged from 0.9224 to 6.4172, suggesting that the quantity of cigarettes consumed might influence dietary choices and adherence. A significant difference in adherence to the Mediterranean diet was also observed between individuals who have been smoking for less than 10 years and those who have been smoking for more than 10 years (P<0.001***). The score difference ranged from 0.6890 to 2.2810. This indicates that the duration of smoking might influence dietary habits, with long-term smokers potentially exhibiting different patterns of adherence to the Mediterranean diet compared to those who started smoking more recently.

Using the Mann Whitney test, differences in responses between respondents diagnosed with cancer (Group A, n=44) and subjects from the general population (Group B, n=465) were discerned (Table 5). In terms of socio-demographic characteristics, a significant difference was observed in gender between the two groups (P=0.002), age (P<0.001), employment status (P<0.001), and differences in religious beliefs (P=0.003).

When examining work habits, it was found that there was a highly significant difference in the profession in the healthcare sector between the two groups (P<0.001). The distribution of work hours and years of work experience also showed significant differences with P-values of 0.02 and 0.003, respectively. However, the number of hours worked per week did not differ significantly.

Regarding adherence to the Mediterranean diet, significant differences were found in the consumption of meat, milk, and alcohol between the two groups, with P-values of 0.002, 0.01, and 0.006, respectively.

In the category of exposure to risk factors, the size of the city's population and living in a polluted city did not show significant differences, with P-values of 0.86 and 0.28, respectively. The Body Mass Index (BMI) also did not differ significantly between the groups, with a P-value of 0.89. However, smoking habits showed a significant difference (P=0.01).

Lastly, for female-specific questions, several aspects of female reproductive health were explored. Highly significant differences were observed in the age of the first pregnancy, number of pregnancies, number of children, number of abortions, breastfeeding duration, and age of menopause, with all these factors having a P-value less than 0.001.

All these comparisons between the two groups revealed significant differences in various socio-demographic characteristics, work habits, dietary habits, and specific female reproductive health

Table 4
Post hoc analysis – Tukey test, followed ANOVA.

Dependent variable	Comparison		*P* value	Lower Bound	Upper Bound
Educational Level	Postgraduate Education	Lower Secondary education	**0.009****	0.3268	3.9308
Smoking habits	No	Yes	**<0.001*****	0.3771	1.6825
Number of cigarettes	<1 pack	>1 pack	**0.008****	0.9224	6.4172
Duration of smoking	<10 years	>10 years	**<0.001*****	0.6890	2.2810

Table 5
Comparison between respondents with a cancer diagnosis (Group A, n=44) and subjects from the general population (Group B, n=465).

Group A (n = 278), group B (n=43) comparison			
Variables		Z value	*P value*
Socio-demographic characteristics	Gender	3.0080	**0.002****
	Geographic Area	1.8411	**0.06**
	Age	-7.5256	**<0.001*****
	Education level	1.2612	0.20
	Employment status	3.9181	**<0.001*****
	Religious belief	-2.9441	**0.003****
Work habits	Profession in health care	4.8711	**<0.001*****
	Distribution of working time	2.3146	**0.02***
	Years of work experience	-2.9436	**0.003****
	Work hours per week	-1.4425	0.14
Adherence to the Mediterranean diet	Fruit consumption	-0.4670	0.64
	Vegetable consumption	0.4164	0.67
	Legumes consumption	1.5541	0.12
	Cereal consumption	-0.6914	0.48
	Fish consumption	1.0360	0.30
	Meat consumption	-2.9843	**0.002****
	Milk consumption	-2.5529	**0.01***
	Olive oil consumption	-0.9108	0.36
	Alcohol consumption	-2.7182	**0.006****
Exposure to risk factors	City inhabitants	0.0405	0.86
	Living in a polluted city	0.8934	0.28
	Body Mass Index (BMI)	-0.3094	0.89
	Smoker	2.5463	**0.01***
	Number of cigarettes per day	1.2048	0.22
	Smoking duration	1.1813	0.23
	Neck circumference	-0.8616	0.38
	For women		
	Age of menarche	-1.9749	**0.04***
	Age of first pregnancy	5.7399	**<0.001*****
	Number of pregnancies	-6.8709	**<0.001*****
	Number of children	-6.9528	**<0.001*****
	Number of abortions	-3.7866	**<0.001*****
	Breastfeeding of children	-0.6598	0.50
	Breastfeeding time	4.8246	**<0.001*****
	Being in menopause	1.8926	**0.05***
	Age of menopause	8.6676	**<0.001*****
	Contraceptives assumption	4.1952	**<0.001*****

Differences in responses between the two groups were assessed. A *P*-value <0.05 was considered statistically significant (*$P<0.05$; **$P<0.01$; ***$P<0.001$).

aspects. These findings underscore the importance of considering these factors when assessing the health and well-being of individuals with a cancer diagnosis compared to the general population.

Discussion

The primary aim of this study was to explore adherence to the Mediterranean diet and compare differences between two cohorts: individuals in the general population and those with a history of breast cancer diagnosis. Various aspects of lifestyle, including adherence to the Mediterranean diet and BMI, along with voluntary behaviors such as alcohol consumption and smoking, were examined. Additionally, an investigation into work patterns and exposure to risk factors, encompassing environmental pollution and hormonal influences, was conducted.

Respondents were divided into two groups: Group A, comprising the general population, and Group B, consisting of individuals with a previous cancer diagnosis. An initial demographic analysis revealed

that the patients in Group B were generally older, with an average age exceeding 41 years, in contrast to the general population group where more than half of the individuals were under 30 years old. Indeed, breast cancer typically affects individuals who are over 50 years old more frequently [28]. However, the incidence of breast cancer in recent decades has increased among individuals under the age of 40, which is below the age covered by the biennial screening offered for free by the National Health System to women aged 50 to 69 [29–31]. Subsequent studies and new healthcare interventions should ensure screenings for age groups below 50 years. Besides age, gender, geographic location, occupational status, and religious beliefs also showed statistically significant differences between the two analyzed groups. While gender is a well-known factor for the majority of affected individuals being women, religious beliefs might stem from specific traditions followed, such as limited or abstained meat consumption or prolonged fasting as potential religious practices. Geographic location, including differences between Northern and Southern Italy, has also been investigated in other studies [32].

Among the lifestyle factors investigated, the Mediterranean diet consistently proves to be the best in the world for preventive purposes year after year [33]. The CREA assessment on all cases shows that 8.5% do not follow a proper diet, 62% have a poorly adequate diet, 37% have a sufficiently adequate diet, and only 0.8% have a completely adequate diet. The results indicate that the majority of people fall into the intermediate levels, and very few adhere perfectly to the Mediterranean diet. This aligns with a recent study conducted on a sample of 2,869 adult Italians, revealing that only 13.3% reported a high adherence to the Mediterranean diet [33].

In our study, it also emerged that adherence to the Mediterranean diet is significantly associated with socio-demographic characteristics of the population. More educated individuals, non-smokers, and those with a normal weight exhibit higher adherence. These findings align with a recent study where it was revealed that more educated individuals, especially women and the elderly, demonstrated better adherence to the diet [33].

Adherence to the Mediterranean diet also appears to be influenced by cigarette smoking. It seems that being a smoker, especially for more than ten years and consuming over a pack a day, leads to a lower practice of the Mediterranean diet compared to non-smokers or those who have smoked for a shorter duration. This observation aligns with data reported in literature reviews [34]. Regardless of the Mediterranean diet, there is also a significant difference in smoking habits between the group with cancer and the general population group. Cigarette smoking is a well-known carcinogenic factor for the risk of developing breast cancer, especially among women who started smoking during adolescence, peri-menopausal period, or before their first childbirth, or those with a family history of the disease. [35]. Smoking is also associated with a higher rate of breast cancer recurrence after partial mastectomy and radiotherapy [36], compromising surgical outcomes and increasing the risk of post-operative complications in breast reconstruction procedures [37]. Providing support to breast cancer patients to quit smoking should be an intervention of utmost importance. This could not only reduce risks associated with radiotherapy but also decrease the development of mortality [38].

In terms of adherence to the Mediterranean diet, work habits also showed significant differences between the two groups. In our study, there is a notable difference between Group A and Group B regarding the distribution of 24-hour shift work, years of work experience, and being a healthcare professional. An example reported in the literature concerns the increased risk of breast cancer development among nurses working 24-hour shifts for 20 years or more [39]. One identified risk factor in this context involves the disrupted release of melatonin [40], which is normally released in the evening to promote sleep and may be suppressed in individuals who work during the evening and night hours. Some jobs, such as night shifts, make it challenging to plan one's life, including the ability to maintain a proper diet. Based on studies conducted on animals and limited evidence in humans, the alteration of the circadian rhythm was already classified by the AIRC in 2007 as a probable cancer-causing factor [41]. Changes in the circadian rhythm have indeed had a significant impact on the development of tumors and mechanisms that promote carcinogenesis.

Literature reviews and meta-analyses that have examined the association between the Mediterranean diet and the risk of breast cancer have reported conflicting data [42]. In our study, the assessment by CREA between the two groups has shown that both groups appear to adhere to the Mediterranean diet. However, within the cancer group, a subgroup (almost 5%) follows a diet quite different from the ‘ideal' one, while another subgroup (more than 2%) exhibits very high levels of

adherence to the diet. This may indicate a considerable degree of heterogeneity. Considering the observed protective factor of the Mediterranean diet, especially for menopausal women [33], inadequately balanced nutrition may have been one of the contributing factors to the onset of cancer or a loss of appetite post-diagnosis. On the other hand, complete adherence to the diet might suggest increased attention following diagnosis [42–45]. Diet adherence also varies among different Italian regions, aligning with studies available in the literature [32,33].

Notably, the consumption of meat, milk, and alcohol showed particular significance between the two groups under investigation. Alcohol or nitrosamines has been identified as ingredients associated with an increased risk of cancer [46]. Certainly, meat is undoubtedly an important source of protein, but its potential harm depends on both the quantities consumed and how certain components interact with the body. For example, the processing of meats for preservation and cooking methods can alter or generate new molecules that may increase the risk of developing cancer. No health condition is solely caused by the consumption of red meat. However, epidemiologists agree that individuals following diets rich in animal proteins, especially red and processed meats, have a higher risk of developing conditions such as diabetes, heart attacks, cardiovascular problems, obesity, and cancer. Regarding cancer, the risk increases, especially for gastrointestinal tumors like colorectal and stomach cancer, as well as for hormone-related cancers such as breast, prostate, and endometrial cancers. In 2015, the International Agency for Research on Cancer (IARC) in Lyon, an agency of the World Health Organization that evaluates and classifies the carcinogenicity of substances, classified red meat as probably carcinogenic (Group 2A in the IARC classification) and processed red meat (sausages and cold cuts) as definitely carcinogenic (Group 1 in the IARC classification).

Similarly, milk and dairy products are sources of valuable substances for the proper functioning of the body. Numerous studies on the link between dairy consumption and an increased risk of developing cancer have yielded contradictory results. The most up-to-date global analysis of available data on this topic has highlighted solid evidence supporting a protective effect of milk and dairy products against colorectal cancer [47]. Milk proteins are complete in terms of amino acid content and serve a wide range of functions, from defending against microorganisms to facilitating nutrient absorption. In some cases, they also act as growth factors, hormones, enzymes, and stimulants for the immune system. However, some molecules found in milk and its derivatives, in certain situations or when consumed in doses exceeding expert recommendations, can be harmful to health. This includes saturated fats, cholesterol, and certain factors that stimulate cell growth (the most well-known being IGF1), which are more abundant in individuals who consume these foods excessively [47].

No significant differences were observed in the consumption of fruits, vegetables, legumes, cereals, fish, and olive oil between Group A and Group B. Studies have demonstrated that around 30% of cancers can be prevented with a diet rich in foods containing polyphenols, n-3 fatty acids, or monounsaturated fatty acids. A recent study [48] shows that postmenopausal vegetarian women have a lower risk of developing breast cancer. Fruits, vegetables, legumes, and whole grains have a protective role against breast cancer, as well as colorectal cancer, lung cancer, stomach cancer, and other chronic conditions [49,50]. This is because the intestinal microbiota breaks down fiber into short-chain fatty acids, which helps maintain the proper function of the intestinal epithelium. Organic substances present in plants that give them color, flavor, and structure have potential anti-tumor effects and act synergistically with other bioactive substances by inhibiting signal transduction pathways, inducing apoptosis, and inhibiting the altered expression of oncogenes [51].

Lastly, significant differences between Group A and Group B were also found concerning hormonal factors such as age at menarche, age at first pregnancy, number of pregnancies and abortions, breastfeeding duration, menopausal status, and contraceptive use. These findings align with the most recent literature [21–25]. Having undergone three or more surgical or medical abortions and using two or more contraceptives had already been highlighted as factors leading to an increased risk of postmenopausal breast cancer [22]. Interestingly, fertile-age women using intrauterine devices (IUDs) as local contraceptives for more than 20 years tend to have a lower risk of breast cancer compared to other women of the same age [22]. Nevertheless, previous studies confirm that the use of oral contraceptives can significantly increase the risk of breast cancer, even though we must not overlook their benefits [23].

Our study, while providing valuable insights, has certain limitations that should be considered when interpreting the results. Firstly, the decision to conduct an online study introduces a potential

selection bias, as it may exclude individuals with limited computer literacy. This choice of study design could impact the generalizability of our findings, as the sample obtained may not be fully representative of the entire population.

Secondly, a broader limitation lies in the challenge of obtaining comprehensive genetic information within the general population. Genetic factors play a significant role in understanding breast cancer risk, yet our study lacks in-depth exploration in this area. The difficulty of collecting detailed genetic data on a large scale poses a constraint on the depth of insights we can provide regarding the interplay between genetics and lifestyle factors. Future research efforts could focus on addressing these limitations to enhance the robustness and applicability of findings in the broader context of breast cancer risk assessment.

Conclusions

Our investigation places a primary emphasis on adherence to the Mediterranean diet, recognizing its pivotal role in understanding risk factors crucial for effective breast cancer prevention. Delving into lifestyle factors, work habits, and exposure to environmental and hormonal influences, our study also offers a nuanced insight into the distinctions between individuals in the general population and those with a breast cancer history. This understanding of various risk factors is central to effective prevention. The recognition of women at high risk is not only crucial for navigating the intricate landscape of breast cancer but is also fundamental for tailoring personalized preventive strategies. This proactive approach aligns seamlessly with the evolving paradigm of precision medicine, emphasizing the tailoring of interventions based on an individual's genetic makeup, lifestyle choices, and specific risk factors. Ultimately, this emphasizes the critical role of risk comprehension in shaping effective preventive measures against breast cancer.

Author contributions

Luana Conte, Roberto Lupo, Emanuele Rizzo: Conceptualization, Methodology. Luana Conte, Roberto Lupo, Alessia Lezzi: Data curation, Writing- Original draft preparation. Luana Conte: Formal analysis. Luana Conte, Roberto Lupo, Vitandrea Paolo, Ivan Rubbi, Maicol Carvello, Antonino Calabrò, Stefano Botti: Visualization, Investigation. Elisabetta De Matteis, Raffaella Massafra, Elsa Vitale, Giorgio De Nunzio: Supervision. Giorgio De Nunzio: Validation.: Luana Conte, Giorgio De Nunzio: Writing-Reviewing and Editing.

Disclosure

The authors affiliated to the IRCCS Istituto Tumori “Giovanni Paolo II”, Bari are responsible for the views expressed in this article, which do not necessarily represent the Institute.

Funding

Open access funding provided by Università del Salento within the CRUI-CARE Agreement.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

References

[1] Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2018;68:394–424.

[2] Amuta AO, Mkuu RS, Jacobs W, Ejembi AZ. Influence of Cancer Worry on Four Cancer Related Health Protective Behaviors among a Nationally Representative Sample: Implications for Health Promotion Efforts. J Cancer Educ 2018;33:1002–10.

[3] AIOM-AIRTUM-Siapec-Iap. I numeri del cancro in Italia 2022. 2022. aiom.it/wp-content/uploads/2022/12/2022_AIOM_NDC-web.pdf. Available at: https://www.aiom.it/wp-content/uploads/2022/12/2022_AIOM_NDC-web.pdf. [Accessed 10 October 2023].
[4] Garutti M, Foffano L, Mazzeo R, Michelotti A, Da Ros L, Viel A, et al. Hereditary Cancer Syndromes: A Comprehensive Review with a Visual Tool. Genes (Basel) 2023;14:1025.
[5] Bucholc M, Łepecka-Klusek C, Pilewska A, Kanadys K. Ryzyko zachorowania na raka piersi w opinii kobiet. Ginekol Pol 2001;72. 1460–1456.
[6] Willett WC. Diet and Cancer. Oncologist 2000;5:393–404.
[7] Parida S, Sharma D. Microbial Alterations and Risk Factors of Breast Cancer: Connections and Mechanistic Insights. Cells 2020;9:1091.
[8] Hulka BS, Moorman PG. Breast cancer: hormones and other risk factors. Maturitas 2001;38:103–13. discussion 113-6.
[9] Eliassen AH, Colditz GA, Rosner B, Willett WC, Hankinson SE. Adult weight change and risk of postmenopausal breast cancer. JAMA 2006;296:193–201.
[10] Nichols HB, Trentham-Dietz A, Egan KM, Titus-Ernstoff L, Holmes MD, Bersch AJ, et al. Body Mass Index Before and After Breast Cancer Diagnosis: Associations with All-Cause, Breast Cancer, and Cardiovascular Disease Mortality. Cancer Epidemiol Biomarkers Prev 2009;18:1403–9.
[11] Rice S, Whitehead SA. Phytoestrogens and breast cancer –promoters or protectors? Endocr Relat Cancer 2006;13:995–1015.
[12] Alegre MM, Knowles MH, Robison RA, O'Neill KL. Mechanics behind Breast Cancer Prevention - Focus on Obesity, Exercise and Dietary Fat. Asian Pacific J Cancer Prev 2013;14:2207–12.
[13] Cheng I, Tseng C, Wu J, Yang J, Conroy SM, Shariff-Marco S, et al. Association between ambient air pollution and breast cancer risk: The multiethnic cohort study. Int J Cancer 2020;146:699–711.
[14] Kamińska M, Ciszewski T, Łopacka-Szatan K, Miotła P, Starosławska E. Breast cancer risk factors. Menopausal Rev 2015;3:196–202.
[15] Chiriac V-F, Baban A, Dumitrascu DL. Psychological stress and breast cancer incidence: a systematic review. Clujul Med 2018;91:18–26.
[16] Chan DSM, Vieira AR, Aune D, Bandera EV, Greenwood DC, McTiernan A, et al. Body mass index and survival in women with breast cancer-systematic literature review and meta-analysis of 82 follow-up studies. Ann Oncol Off J Eur Soc Med Oncol 2014;25:1901–14.
[17] Picon-Ruiz M, Morata-Tarifa C, Valle-Goffin JJ, Friedman ER, Slingerland JM. Obesity and adverse breast cancer risk and outcome: Mechanistic insights and strategies for intervention. CA Cancer J Clin 2017;67:378–97.
[18] Lee K, Kruper L, Dieli-Conwright CM, Mortimer JE. The Impact of Obesity on Breast Cancer Diagnosis and Treatment. Curr Oncol Rep 2019;21:41.
[19] Italian Ministry of Health Italian Ministry of Health. Piano Oncologico Nazionale: documento di pianificazione e indirizzo per la prevenzione e il contrasto del cancro 2023-2027. Available at: https://www.salute.gov.it/imgs/C_17_pubblicazioni_3291_allegato.pdf.
[20] Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria (CREA). 2018. Available at: https://www.crea.gov.it/documents/59764/0/LINEE-GUIDA+DEFINITIVO.pdf/28670db4-154c-0ecc-d187-1ee9db3b1c65?t=1576850671654.
[21] Kim S, Ko Y, Lee HJ, Lim J-E. Menopausal hormone therapy and the risk of breast cancer by histological type and race: a meta-analysis of randomized controlled trials and cohort studies. Breast Cancer Res Treat 2018;170:667–75.
[22] Yuan X, Yi F, Hou C, Lee H, Zhong X, Tao P, et al. Induced Abortion, Birth Control Methods, and Breast Cancer Risk: A Case-Control Study in China. J Epidemiol 2019;29:173–9.
[23] Fitzpatrick D, Pirie K, Reeves G, Green J, Beral V. Combined and progestagen-only hormonal contraceptives and breast cancer risk: A UK nested case-control study and meta-analysis. PLoS Med 2023;20:e1004188.
[24] Qiu R, Zhong Y, Hu M, Wu B. Breastfeeding and Reduced Risk of Breast Cancer: A Systematic Review and Meta-Analysis. Comput Math Methods Med 2022;2022:8500910.
[25] Menarche, menopause, and breast cancer risk: individual participant meta-analysis, including 118 964 women with breast cancer from 117 epidemiological studies. Lancet Oncol 2012;13:1141–51.
[26] Mammographic surveillance in women younger than 50 years who have a family history of breast cancer: tumour characteristics and projected effect on mortality in the prospective, single-arm, FH01 study. Lancet Oncol 2010;11:1127–34.
[27] Easton DF, Pharoah PDP, Antoniou AC, Tischkowitz M, Tavtigian SV, Nathanson KL, et al. Gene-Panel Sequencing and the Prediction of Breast-Cancer Risk. N Engl J Med 2015;372:2243–57.
[28] Sun Y-S, Zhao Z, Yang Z-N, Xu F, Lu H-J, Zhu Z-Y, et al. Risk Factors and Preventions of Breast Cancer. Int J Biol Sci 2017;13:1387–97.
[29] Ugai T, Sasamoto N, Lee H-Y, Ando M, Song M, Tamimi RM, et al. Is early-onset cancer an emerging global epidemic? Current evidence and future implications. Nat Rev Clin Oncol 2022;19:656–73.
[30] Conte L, De Nunzio G, Lupo R, Mieli M, Lezzi A, Vitale E, et al. Breast Cancer Prevention: The Key Role of Population Screening, Breast Self-Examination (BSE) and Technological Tools. Survey of Italian Women. J Cancer Educ 2023;38:1728–42.
[31] Paluch-Shimon S, Warner E. Breast cancer in young women. Curr Opin Support Palliat Care 2015;9:268–70.
[32] Cortesi L, Galli GR, Domati F, Conte L, Manca L, Berio MA, et al. Obesity in Postmenopausal Breast Cancer Patients: It Is Time to Improve Actions for a Healthier Lifestyle. The Results of a Comparison Between Two Italian Regions With Different "Presumed" Lifestyles. Front Oncol 2021;11. https://doi.org/10.3389/fonc.2021.769683.
[33] Aureli V, Rossi L. Nutrition Knowledge as a Driver of Adherence to the Mediterranean Diet in Italy. Front Nutr 2022;9:804865.
[34] Gaudet MM, Gapstur SM, Sun J, Diver WR, Hannan LM, Thun MJ. Active smoking and breast cancer risk: original cohort data and meta-analysis. J Natl Cancer Inst 2013;105:515–25.
[35] Jones ME, Schoemaker MJ, Wright LB, Ashworth A, Swerdlow AJ. Smoking and risk of breast cancer in the Generations Study cohort. Breast Cancer Res 2017;19:118.

[36] Bishop JD, Killelea BK, Chagpar AB, Horowitz NR, Lannin DR. Smoking and breast cancer recurrence after breast conservation therapy. Int J Breast Cancer 2014:327081. 2014.
[37] Padubidri AN, Yetman R, Browne E, Lucas A, Papay F, Larive B, et al. Complications of postmastectomy breast reconstructions in smokers, ex-smokers, and nonsmokers. Plast Reconstr Surg 2001;107:342–9. discussion 350-1.
[38] Taylor C, Correa C, Duane FK, Aznar MC, Anderson SJ, Bergh J, et al. Estimating the risks of breast cancer radiotherapy: evidence from modern radiation doses to the lungs and heart and from previous randomized Trials. J Clin Oncol 2017;35:1641–9.
[39] Cordina-Duverger E, Menegaux F, Popa A, Rabstein S, Harth V, Pesch B, et al. Night shift work and breast cancer: a pooled analysis of population-based case-control studies with complete work history. Eur J Epidemiol 2018;33:369–79.
[40] Hansen J. Night Shift Work and Risk of Breast Cancer. Curr Environ Heal Reports 2017;4:325–39.
[41] IARC working group on the identification of carcinogenic hazards to humans. 2020. Available at: https://www.iarc.who.int/news-events/iarc-monographs-volume-124-night-shift-work/. [Accessed 28 November 2023].
[42] González-Palacios Torres C, Barrios-Rodríguez R, Muñoz-Bravo C, Toledo E, Dierssen T, Jiménez-Moleón JJ. Mediterranean diet and risk of breast cancer: An umbrella review. Clin Nutr 2023;42:600–8.
[43] Castelló A, Pollán M, Buijsse B, Ruiz A, Casas AM, Baena-Cañada JM, et al. Spanish Mediterranean diet and other dietary patterns and breast cancer risk: case–control EpiGEICAM study. Br J Cancer 2014;111:1454–62.
[44] Turati F, Carioli G, Bravi F, Ferraroni M, Serraino D, Montella M, et al. Mediterranean Diet and Breast Cancer Risk. Nutrients 2018;10:326.
[45] Toledo E, Salas-Salvadó J, Donat-Vargas C, Buil-Cosiales P, Estruch R, Ros E, et al. Mediterranean Diet and Invasive Breast Cancer Risk Among Women at High Cardiovascular Risk in the PREDIMED Trial. JAMA Intern Med 2015;175:1752.
[46] De Cicco P, Catani MV, Gasperi V, Sibilano M, Quaglietta M, Savini I. Nutrition and Breast Cancer: A Literature Review on Prevention, Treatment and Recurrence. Nutrients 2019;11. https://doi.org/10.3390/nu11071514.
[47] (AIRC) AIR sul C. Latte e latticini aumentano il rischio di cancro?. 2020. Available at: https://www.airc.it/cancro/informazioni-tumori/corretta-informazione/latte-e-latticini-aumentano-il-rischio-di-cancro. [Accessed 26 November 2023].
[48] Watling CZ, Schmidt JA, Dunneram Y, Tong TYN, Kelly RK, Knuppel A, et al. Risk of cancer in regular and low meat-eaters, fish-eaters, and vegetarians: a prospective analysis of UK Biobank participants. BMC Med 2022;20:73.
[49] Toraldo DM, Conte L. Influence of the Lung Microbiota Dysbiosis in Chronic Obstructive Pulmonary Disease Exacerbations: The Controversial Use of Corticosteroid and Antibiotic Treatments and the Role of Eosinophils as a Disease Marker. J Clin Med Res 2019;11:667–75.
[50] Conte L, Toraldo DM. nutrients and dietary supplements influence the gut-lung microbiota axis in chronic obstructive pulmonary disease and exacerbations? Arch Med Sci 2020 May. https://doi.org/10.5114/aoms.2020.100589.
[51] Morze J, Danielewicz A, Przybyłowicz K, Zeng H, Hoffmann G, Schwingshackl L. An updated systematic review and meta-analysis on adherence to mediterranean diet and risk of cancer. Eur J Nutr 2021;60:1561–86.