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OBSERVATIONAL STUDY

Observational study on Lifestyle Behaviours and Nutrition in individuals undergoing genetic counseling for breast or colorectal cancer risk

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Findings:

This paper investigate modifiable lifestyle behaviors among individuals at increased risk of breast/colorectal cancer, in order to gain insights on their educational needs.

ABSTRACT

BACKGROUND. Healthy lifestyles are associated with cancer risk reduction. Individuals with hereditary cancer syndromes may be motivated to adopt health-protective behaviours.

OBJECTIVE. This study explored lifestyle behaviours associated to cancer risk reduction among individuals undergoing breast or colorectal cancer familial risk assessment.

METHOD. A cross-sectional survey was performed through a self-administered questionnaire, including: the Italian validated Medi-Lite and the International Physical Activity validated questionnaires (to assess adherence to the Mediterranean Diet and Physical activity), items on cancer risk perception, lifestyle and surveillance.

RESULTS. Forty-two women and eight men (age: 19-80 years) responded; 19 were affected by breast cancer, four by colorectal cancer, 27 were unaffected but had a family history of breast (n=23) or colorectal (n=4) cancer. The majority perceived their general lifestyle as moderately healthy. However, 16 (32%) were current or former smokers, 37 (74%) drank alcohol and 18 (36%) were overweight or obese; 21 (42%) showed low adherence to Mediterranean diet and seven (14%) reported low exercise. Adherence to Mediterranean diet was generally low (Medi-Lite score: 8.8±2.6): a low adherence was significantly more frequent in participants of lower education level (67%), compared to those with high education level (17%; p=0.044). Participants at higher cancer risk were significantly more likely to smoke: 63% of those at high risk, 40% at intermediate risk and 14% at standard risk were current or former smokers (p<0.05).

CONCLUSION. These findings suggest a need for raising awareness on the role of the lifestyle in cancer risk modulation among individuals at increased familial risk.

KEYWORDS: *Familial cancer risk, Lifestyle behaviours, Mediterranean diet, physical activity, genetic counselling*

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STUDIO OSSERVAZIONALE

Studio osservazionale su stile di vita e nutrizione in individui sottoposti a consulenza genetica per valutare il rischio di carcinoma della mammella o del colon-retto

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Riscontri:

Questo studio esamina i comportamenti di stile di vita modificabili tra gli individui a rischio aumentato di cancro al seno/colorettale, al fine di ottenere informazioni sulle loro necessità educative.

ABSTRACT

BACKGROUND. Stili di vita sani riducono il rischio di tumore; individui con predisposizione ereditaria oncologica dovrebbero essere motivati verso comportamenti protettivi.

OBIETTIVO. Esaminare gli stili di vita associati a riduzione del rischio oncologico in individui sottoposti a valutazione del rischio familiare di tumore al seno o al colon-retto.

METODI. È stata condotta un'indagine trasversale mediante questionario auto-somministrato, comprendente: questionario Medi-Lite validato in italiano, questionario Internazionale validato sull'Attività Fisica (per valutare aderenza alla dieta mediterranea e attività fisica), domande su percezione del rischio oncologico, stile di vita e sorveglianza.

RISULTATI. Hanno partecipato 42 donne e otto uomini (età: 19-80 anni); 19 con carcinoma mammario, quattro con carcinoma colorettale, 27 sani con storia familiare di tali tumori. La maggioranza percepiva il proprio stile di vita come piuttosto sano. Tuttavia, 16 (32%) erano fumatori attuali o ex-fumatori, 37 (74%) consumavano alcol e 18 (36%) erano sovrappeso od obesi; 21 (42%) presentavano bassa aderenza alla dieta mediterranea e sette (14%) riportavano scarsa attività fisica. L'aderenza alla dieta mediterranea è risultata generalmente bassa (Medi-Lite: 8.8±2.6); una bassa aderenza era più frequente in coloro con bassa scolarità (67%) rispetto a coloro con alto livello di istruzione (17%; p=0.044). I partecipanti a maggior rischio oncologico erano più propensi al fumo: 63% di coloro a rischio elevato, 40% a rischio intermedio e 14% a rischio standard erano fumatori attuali o ex-fumatori ($p<0.05$).

CONCLUSIONE. Lo studio suggerisce la necessità di aumentare la consapevolezza sull'importanza dello stile di vita nella modulazione del rischio oncologico in individui con rischio familiare elevato.

KEYWORDS: *Rischio familiare tumore, Comportamenti di vita, Dieta mediterranea, Attività fisica, Consulenza genetica*

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INTRODUCTION

A strong link between unhealthy lifestyles and several diseases, including cancer, is well-established; appropriate nutrition and regular physical activity have been shown to reduce risk of cancer development and/or progression [1]. Drinking alcohol, being overweight or obese and not doing enough physical activity is associated with an increased risk for Breast Cancer (BC) [2]. Similarly, risk factors for Colorectal Cancer (CRC) include a diet rich in red and processed meat and poor in foods containing fiber and wholegrains, being overweight or obese, not doing enough physical activity (colon cancer only), drinking alcohol and smoking tobacco [2].
Observational studies show that both BC and CRC risks are lowered by intentional weight loss [3,4] and data from bariatric surgery show that large weight losses in females are associated with a 42% reduction in overall cancer risk [5]. In the Women's Health Initiative study, undertaking healthy behaviors (higher physical activity, low alcohol intake and appropriate body weight) was beneficial for BC risk reduction in postmenopausal women and the degree of this benefit was the same for women with or without a family history of BC [6]. Literature data suggest that simple behavior changes could have a relevant impact on BC prevention, with increasing evidence that adopting a healthy lifestyle may be particularly significant for women who have inherited a genetic predisposition [7]. Individuals with a family history of CRC experienced a higher increase of the risk of developing to cancer based on alcohol consumption than those with no family history [8]. In addition, among patients with Lynch Syndrome, those obese showed a significantly greater CRC risk than underweight and normal-weight individuals [RR 2.41(95 % CI, 1.22 to 4.85)], and CRC risk increased by 7% for each 1-kg/m2 increase in body mass index [9].

Given the body of evidence that lifestyle changes are effective in reducing cancer risk, it is crucial that people who are at higher risk of cancer due to an inherited predisposition or a family history of the disease include lifestyle changes in their risk-reducing programs. However, it is not clear how to pursue this goal. A recent Cochrane review has highlighted that communicating DNA based risk estimates does not lead to changes in health behavior [10]. The UK National Institute for Clinical and Health Excellence (NICE) guidelines on familial BC recommend that a lifestyle information leaflet is provided (NICE 2013), but this is unclear whether it may result in significant changes. per se.
The aim of this explorative study was to investigate modifiable lifestyle behaviors among individuals at increased risk of breast/colorectal cancer, in order to gain insights on their educational needs, if any, and to inform incorporation of specific counseling during cancer risk assessment.

MATERIALS AND METHODS

Study design

Exploratory cross-sectional survey.

Setting

Participants were recruited among those referred to cancer genetic counseling at the IRCCS University Hospital St.Orsola of Bologna, (Italy) on the basis of a family history of cancer, in the framework of the regional program for Hereditary Breast Ovarian Cancer [11,12] or of the Hospital-based multidisciplinary paths for colorectal cancer treatment and prevention. Patients newly referred for BC/CRC genetic counseling to the family cancer clinic at IRCCS University Hospital St.Orsola of Bologna (Italy) from October 2020 and March 2021 were mailed the questionnaire prior to their appointment and asked to return it when they attended the first counseling appointment, if consenting to participate.

Genetic Counseling Protocol

The procedure of genetic counseling and testing followed the standard of care. Each genetic counseling session was performed by a clinical geneticist and, whenever possible, a genetic nurse; counseling sessions length was approximately 40 minutes on average. Prior to the visit, cancer diagnoses in the family members were confirmed through medical records (provided by patients or sent by referring physicians). The process of genetic counseling included a first counseling with detailed family history collection and genetic risk assessment performed. The genetic counseling process included a review of the family history of cancer, the cancer risk estimation, the possibility of genetic testing and the available surveillance programs. When the genetic test was appropriate, education provided about the possible results and implications of specific testing and discussion of the options for risk management; and post-test counseling for disclosure of test results, clinical interpretation and management plans. All patients received a written summary after counseling.

Participants

The study inclusion criteria required that each participant: (1) was over 18 years of age, (2) was referred for cancer genetic counseling, (3) was diagnosed with or was at family risk of: breast or colon cancer; (4) was able to give informed consent, and (5) was able to speak Italian fluently.

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Data collection

A self-administered questionnaire was designed by a nutritionist (DF), a geneticist (DT), and a genetic nurse (LG). The clinician and the genetic nurse were not aware of the answers during the genetic counseling sessions.

Measurements

The questionnaire was mainly based on existing scales and included 35 items subdivided into six distinct sections.

The first section (items 1-7) included questions about socio-demographic information, height and weight. The latter were used to calculate the BMI and classify as follows: underweight (BMI≤18.5), normal-weight (18.5 < BMI < 25), overweight (25 ≤BMI < 30) and obese (BMI ≥30).

The second section (items 8-11) included four questions extracted from a questionnaire developed for a previous study (manuscript submitted): a question about the history of cancer and questions on how people estimate their risk of developing cancer, stated either as a percentage, and using a six-point category rating scale (unlikely = 1, no doubt = 6), and compared to that of other persons of the same age and gender on a five-point scale (much lower = 1, much higher = 5).

In the third section (items 12-13), people were asked if they thought that surveillance would be changed after cancer genetic counseling and their compliance to surveillance using a five-point category rating scale (Not at all=1, Extremely=5).

In the fourth section (items 14-17), questions concerned perceived lifestyle behaviors, smoking status and alcohol intake. Concerning lifestyle behaviors, respondents were asked whether they considered themselves to have a healthy lifestyle, on a five-point category rating scale from 'very healthy lifestyle' to 'very unhealthy lifestyle'.

Smoking status was assessed asking the number of cigarettes smoked (by current smokers) or, for former smokers, how long before they have stopped.

Alcohol Intake was estimated using a seven-days recall questionnaire to indicate how many drinks (beer/wine/fortified wine or spirits) they had consumed over the previous seven days.

The fifth section (item 18-26), contained the Italian validated Medi-Lite score, developed to measure adherence to the Mediterranean Diet [13].

Overall, nine food categories were considered: for food groups typical of the Mediterranean Diet (fruit, vegetables, cereals, legumes and fish), a value of two was assigned to the highest category of consumption, one for the middle category and zero for the lowest category. Conversely, for food groups not typical of the Mediterranean Diet (meat and processed meat products, dairy products), a value of two was assigned for the lowest category, one for the middle category and zero for the highest category of consumption. The regular consume of alcohol and olive oil was assessed.

The final score was obtained by summing these items and it varies from 0 (low adherence) to 18 (high adherence).

Assuming that a higher Medi-Lite adherence score would indicate a better adherence, the score was classified as follows: low adherence (0-8), intermediate adherence (9-11) and high adherence (12–18).

The last section (item 27-35) consisted of the Italian validated short form International Physical Activity Questionnaire (IPAQ) [14]. The IPAQ assesses walking, activities of moderate and vigorous intensity as estimates of frequency (days per week) and duration (time per day). Data from IPAQs were analyzed using the research tool, developed by Dr Hoi Lun Cheng, according to which the physical activity was classified as low, intermediate or high [15].

For each participant, a pre-counseling family history score and a post-counseling cancer risk level were assessed. To define the "weight" of the personal and /or family history about cancer the following parameters were considered: the number, the degree of kinship with and the age of affected family members; in addition, for those families where a pathogenetic variant had been identified, the a priori probability of having inherited it. To this aim available models were adapted: for BC, an adapted version of the primary questionnaire of the Hereditary Breast and Ovarian Cancer protocol of the Emilia-Romagna region [11,12] was used.

For colorectal cancer, the score table proposed by Wong et. al [16] was adapted (Supplementary File; Table S1, Table S2).

Once the cumulative scores had been obtained, the family risk score was assigned as follows: low (< 2.5), intermediate (2.5-5.0) and high (>5). Cancer risk after post-counseling assessment was classified as follows: a risk level one represents a risk of cancer comparable to the general population (individuals who did not inherited a known family pathogenetic variant or individuals with likely sporadic cases among relatives), a risk level two represents an intermediate risk (multiple family members with the same cancer type, without features suggesting inherited predisposition) and a risk level three represents a high cancer risk (individuals carrying a cancer predisposing genetic variant or empirical risk at least three times the population risk).

Data Analysis

Data were entered anonymously into a dedicated database and were analyzed by using the statistical package IBM-SPSS Statistics (Ver. 27 for Windows). Means, standard deviation (SD), ranges and frequencies were used as descriptive statistics. The Pearson chi-squared test was applied to nominal variables, the Fisher's exact test was used for dichotomous variables, and the sample size adequacy assumption was violated. The independent t test and ANOVA one-way were used to analyze the differences between group means, and post hoc tests were also performed where appropriate. Two-tailed p values <0.05 were considered statistically significant.

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Ethics compliance statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethical Board of Hospital S.Orsola-Malpighi, Bologna, Italy (685/2020/Oss/AOUBo, 19th September 2020). All participants were informed about the purpose and the methods of the study via a participant information sheet. They were informed that they were free to decide to participate or not and they did not have to give a reason if they declined. Informed consent was obtained from all subjects involved in the study. The authors did not receive support from any organization for the submitted work.

RESULTS

Participants characteristics

Fifty individuals were enrolled in the study; their demographic data are shown in Table 1.

Participants ranged in age from 19 to 80 years at the time of counseling. Among responders, 23 (46.0%) had received a cancer diagnosis: 19 of BC and four of CRC, while 27 (54.0%) were unaffected but had a family history of BC (n=23) or CRC (n=4). Family history scores ranged from one to eight. After cancer genetic assessment, 22 participants were allocated to risk level one, 20 to risk level two, and eight to risk level three.

Table 1. Features of participants

SAMPLE CHARACTERISTICS		ALL n(%)
Age at questionnaire (years) *Mean ± SD*		49.5±14.7
Gender (N=50)		
	Male	8 (16.0)
	Female	42 (84.0)
Education (N = 50)		
	Primary school/Lower secondary school	12 (24.0)
	Upper secondary school	26 (52.0)
	University degree/Postgraduate degree	12 (24.0)
Daily work (N=50)		
	Paid employment	32 (64.0)
	Student	4 (8.0)
	Homeworker/Unemployed	8 (16.0)
	Retired	6 (12.0)
Marital status (N=50)		
	Single (never married)	15 (30.0)
	Divorced/ Widowed	28 (56.0)
	Married/ Living with a partner	7 (14.0)

Risk perception and attitudes toward surveillance

Before genetic counseling, participants estimated their risk of developing cancer as high as 42.7% on average (SD: 22.1%; range: 0-80%); when expressing the risk by words, the majority (62.5%; n=30) rated their own risk of cancer as 'possible' (point four on an increasing six-point verbal scale). When patients were asked to compare their own risk of developing cancer with that of an individual of same age and gender in the general population, 44.2% (n=19) of patients answered it was 'higher' (Supplementary File, Table S3).

Among 48 responders, 40 (83.3%) defined themselves as moderately/very confident with the surveillance. Eighteen individuals (40.0%) thought that surveillance would change after cancer genetic counseling, while 24 (53.3%) stated that they did not know whether surveillance would be changed.

Lifestyle

Thirty-five of 50 respondents (70.0%) perceived their general lifestyle to be moderately healthy, 9 (18.0%) very healthy and 6 (12%) poorly healthy. Participants thinking that having a healthy lifestyle is very/extremely influential in reducing the risk of developing cancer were a minority (n=21; 42.0%). Among responders, 34 (69.4%) were never smokers, 11 (22.4%) were current smokers, and four (8.2%) were former smokers. Of the 11 current smokers, cigarettes per days ranged from 1 to 40 (11.6±11.2). The four former smokers had quitted from one to 20 years earlier. Concerning alcohol intake, 13 (26.0%) did not drink at all, and 37 (74.0%) drank alcohol: of those, 37 (74.0%) drank beer, 36 (72.0%) wine and 33 (66.0%) fortified wine or spirits. The BMI was available for 41 participants and was 24.95±6.79 kg/m2 an average: 5 (10.0%) were underweight, 18 (36.0%) normal-weight, 11 (22.0%) overweight and 7 (14.0%) obese.

As shown in Table 2, participants with higher cancer risk level were significantly more likely to smoke: 63% of those at high risk, 40% of those at intermediate risk and 14% of those at standard risk were current or former smokers ($p<0.05$). However, those with high family history score/cancer risk score were significantly less likely to be overweight/obese (33.3% versus 66.7%; $p<0.05$). No significant associations were found with other features.

Responses to lifestyle items are shown in Supplementary File (Table S4, Table S5).

Adherence to the Mediterranean Diet

Reported intake of each food component included in the Medi-Lite questionnaire is shown in Supplementary File (Figure S1). Optimal consumption was reported for olive oil by 37 (74.0%), for meat and processed meat by 24 participants (48.0%) and for milk and dairy products by 23 (46.0%). A lower rate of optimal consu-

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Table 2. Features of participants compared to Medi-Lite score, IPAQ score, weight status, alcohol and smoke

SAMPLE CHARACTERISTICS	Medi-Lite			IPAQ			Weight status				Alcohol		Smoke	
	Low	Intermediate	High	Low	Intermediate	High	Underweight	Normal	Overweight	Obese	Yes	No	Yes	No
Age at questionnaire *Mean ± SD* (years)	50.9±13.1	50.7±16.4	43.6±14.5	54.7±15.6	45.7±14.1	48.7±11.8	45.6±21.5	45.2±16.2	56.3±12.0	55.1±10.6	50.4±13.8	47.1±17.5	54.7±14.2	47.1±14.6
Gender	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Male	4 (50.0)	3 (37.5)	1 (12.5)	0	6 (75.0)	2 (25.0)	1 (14.3)	4 (57.1)	2 (28.6)	0	6 (75.0)	2 (25.0)	3 (37.5)	5 (62.5)
Female	17 (40.5)	17 (40.5)	8 (19.0)	7 (16.7)	18 (42.9)	17 (40.5)	4 (11.8)	14 (41.2)	9 (26.5)	7 (20.6)	31 (73.8)	11 (26.2)	13 (31.0)	29 (69.0)
Education														
Primary school/ Lower secondary school	8 (66.7)*	4 (33.3)*	0*	1 (8.3)	5 (41.7)	6 (50.0)	1 (10.0)	4 (40.0)	2 (20.0)	3 (30.0)	9 (75.0)	3 (25.0)	5 (41.7)	7 (58.3)
Upper secondary school	11 (42.3)*	8 (30.8)*	7 (26.9)*	6 (23.1)	12 (46.2)	8 (30.8)	3 (13.0)	11 (47.8)	7 (30.4)	2 (8.7)	21 (80.8)	5 (19.2)	10 (38.5)	16 (61.5)
University degree/ Postgraduate degree	2 (16.7)*	8 (66.7)*	2 (16.7)*	0	7 (58.3)	5 (41.7)	1 (12.5)	3 (37.5)	2 (25.0)	2 (25.0)	7 (58.3)	5 (41.7)	1 (8.3)	11 (91.7)
Daily work														
Paid employment	13 (40.6)	13 (40.6)	6 (18.8)	5 (15.6)	18 (53.3)	9 (28.1)	2 (8.0)	13 (52.0)	7 (28.0)	3 (12.0)	26 (81.3)	6 (18.8)	11 (34.4)	21 (65.6)
Student	1 (25.0)	2 (50.0)	1 (25.0)	0	3 (75.0)	1 (25.0)	0	2 (100.0)	0	0	2 (50.0)	2 (50.0)	0	4 (100.0)
Homemaker/Unemployed	4 (50.0)	2 (25.0)	2 (25.0)	1 (12.5)	2 (25.0)	5 (62.5)	2 (25.0)	2 (25.0)	2 (25.0)	2 (25.0)	5 (62.5)	3 (37.5)	3 (37.5)	5 (62.5)
Retired	3 (50.0)	3 (50.0)	0	1 (16.7)	1 (17.7)	4 (66.7)	1 (16.7)	1 (16.7)	2 (33.3)	2 (33.3)	4 (66.7)	2 (33.3)	2 (33.3)	4 (66.7)
Personal history of cancer														
Yes	11 (40.7)	10 (37.0)	6 (22.2)	3 (13.0)	10 (43.5)	10 (43.5)	1 (5.6)	7 (38.9)	7 (38.9)	3 (16.7)	16 (69.6)	7 (30.4)	7 (30.4)	16 (69.6)
No	10 (43.5)	10 (43.5)	3 (13.0)	4 (14.8)	14 (51.9)	9 (33.3)	4 (17.4)	11 (47.8)	4 (17.4)	4 (17.4)	21 (77.8)	6 (22.2)	9 (33.3)	18 (66.7)
Marital status														
Single (never married)	6 (40.0)	6 (40.0)	3 (20.0)	2 (26.7)	9 (39.3)	4 (57.1)	2 (16.7)	7 (58.3)	1 (8.3)	2 (16.7)	10 (66.7)	5 (33.3)	4 (26.7)	11 (73.3)
Divorced/ Widowed	11 (39.3)	12 (42.9)	5 (17.9)	3 (60.0)	14 (50.0)	11 (14.3)	2 (9.1)	8 (36.4)	8 (36.4)	4 (18.2)	22 (78.6)	6 (21.4)	8 (28.6)	20 (71.4)
Married/ Living with a partner	4 (57.1)	2 (28.6)	1 (14.3)	2 (13.3)	1 (10.7)	4 (28.6)	1 (14.3)	3 (42.9)	2 (28.6)	1 (14.3)	5 (71.4)	2 (28.6)	4 (57.1)	3 (42.9)
Family history score														
Low	8 (38.1)	11 (52.4)	2 (9.5)	2 (12.5)	5 (31.3)	9 (56.3)	0*	3 (23.1)*	5 (38.5)*	5 (38.5)*	11 (68.8)	5 (31.3)	4 (25.0)	12 (75.0)
Intermediate	8 (40.0)	11 (55.0)	1 (5.0)	5 (16.7)	16 (53.3)	9 (30.0)	4 (16.0)*	15 (60.0)*	4 (16.0)*	2 (8.0)*	22 (59.5)	8 (26.7)	10 (33.3)	20 (66.7)
High	0	8 (88.9)	1 (11.1)	0	3 (75.0)	1 (25.0)	1 (33.3)*	0*	2 (66.7)*	0*	4 (100.0)	0	2 (50.0)	2 (50.0)
Cancer risk level														
Risk level 1	10 (47.6)	8 (38.1)	3 (14.3)	2 (9.1)	12 (54.5)	8 (36.4)	2 (11.8)	7 (41.2)	4 (23.5)	4 (23.5)	14 (63.6)	8 (36.4)	3 (13.6)*	19 (86.4)*
Risk level 2	9 (45.0)	7 (35.0)	4 (20.0)	4 (20.0)	11 (50.0)	5 (25.0)	1 (6.3)	8 (50.0)	4 (25.0)	3 (18.8)	17 (85.0)	3 (15.0)	8 (40.0)*	12 (60.0)*
Risk level 3	3 (33.3)	5 (55.6)	1 (11.1)	1 (12.5)	1 (12.5)	6 (75.0)	2 (25.0)	3 (37.5)	3 (37.5)	0	6 (75.0)	2 (25.0)	5 (62.5)*	3 (37.5)*

*p<.05

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mption was observed for cereals (n=12, 24.0%), fruit (n=11, 22.0%), vegetables (n=6, 12.0%), legumes (n=5, 10.0%), fish (n=5, 10.0%) and alcohol (n=3; 7.9%). Overall, the mean adherence to the Mediterranean diet, calculated through the Medi-Lite score, in our population was 8.8±2.6 (range: 4-13). More detailed, 21 (42.0%) had a low adherence to Mediterranean diet, 20 (40.0%) an intermediate adherence, and nine (18.0%) a high adherence. Education level appeared to influence the adherence, as low adherence was reported by 66.7% (n=8) of participants of lower education level, by 42.3% (n=11) of those with intermediate education level and by 16.7% (n=2) of those with high education level (p=0.044). No correlations were found with other socio-demographic features. A high family history score, unlike the cancer risk level and having had cancer, was associated with high or intermediate adherence (11.1% and 88.9% respectively). No differences were observed by smoking and drinking habits. High adherence was associated with a lower mean BMI (22.1±3.1) if compared to intermediate adherence (23.3±3.9) and low adherence (27.7±8.9) (p=0.041). Those who considered their lifestyle as moderately/very healthy showed an average adherence to Medi-Lite slightly higher than those reporting an averagely healthy lifestyle (9.7±2.6 versus 8.0±2.0, ns). The adherence score based on different demographic characteristics is shown in Table 2.

Physical activity

Physical activity, as assessed using IPAQ, was classifies as moderate in 48.0% (n=24), as high in 38.0% (n=19) and as low in 14.0% (n=7) of participants. On average, vigorous physical activities were performed on 1.10±1.61 days per week, moderate activities on 2.21±2.10 days per week and walking at least 10 minutes on 4.42±2.41 days per week. Among those reporting walking, 6 (18.0%) described their step as vigorous, 27 (54.0%) as moderate, and 14 (28.0%) as slow. No correlations were found with socio-demographic features, or smoking and drinking habits (Table 2).

Answers to the questions relating single activity/time spent sitting of the IPAQ are shown in Supplementary File (Table S6).

DISCUSSION

This exploratory cross-sectional survey of patients who underwent cancer genetic counseling at our Medical Genetic Unit aimed at a preliminary investigation of modifiable lifestyle behaviors among individuals at increased risk of breast/colorectal cancer. Indeed, recommendations for cancer risk management mainly involve increased surveillance and, for carriers of specific inherited cancer syndromes, risk-reducing surgeries, while lifestyle and diet interventions are inconsistently suggested. Generally, a healthy lifestyle is estimated to reduce the risk of cancer by up one-third [16]: behaviors that can reduce risk of cancer include not being overweight, eating a diet rich in whole grains, non-starchy vegetables and fruit and beans, and consuming limited amount of red meat and little, if any, processed meat, avoiding alcohol, being physically active every day, and limiting sedentary time [17]. For Mediterranean populations like Italians, one of the best indicators of diet quality is considered to be the adherence to the Mediterranean Diet [18,19], which has been recognized by UNESCO in 2012 as a cultural heritage of humanity [20]. This dietary pattern has been reported effective in reducing overall cancer mortality and preventing neurodegenerative diseases. cardiovascular diseases [21–23] and mental health conditions [24,25].

However, although some studies still show a good average adherence to the Mediterranean Diet in Italy [22, 26, 27], a progressive loss of adherence to this dietary model, associated to a 'westernization' of food habits, has been reported in several countries in the Mediterranean area [28, 29], including Italy [30–32], where a progressive and constant reduction over the years has been described both in Southern [33] and in Northern [34] areas.

Consistently, in our sample, the mean Medi-Lite adherence score was quite low (8.8±2.6). Participants reporting high adherence had a significantly lower mean BMI (22.1±3.1), if compared to intermediate adherence (23.3±3.9) and low adherence (27.7±8.9) (p=0.041), which is in line with recent data from a sample of 280 Italian individuals showing a significant association between the Medi-Lite adherence score and the clinical condition of obesity: the mean adherence score was 8.9±1.9 in patients with abdominal obesity, and 10.0±2.2 in those without abdominal obesity (p<0.001) [23].

An encouraging observation is that participants with a high family history score reported higher adherence to Mediterranean Diet than those with lower risk; unfortunately, individuals at high cancer risk reported more frequently smoking habits (63% of those at high risk, 40% of those at intermediate risk and 14% of those at standard risk; p<0.05). These data are difficult to interpret; whereas a healthy diet could suggest positive attitudes toward a healthy lifestyle in individuals with a family history of cancer, smoking habits in high-risk individuals seem to disconfirm this hypothesis. More in-depth studies on larger samples are needed to better assess awareness and behaviors in high-risk individuals.

Data on physical activity in our sample are reassuring, as the majority of respondents reported levels of exercise either moderate (48.0%) or high (38.0%), in line with larger samples of Italian individuals in which IPAQ-assessed levels of physical activity before COVID-19 quarantine were moderate in 35.2%-44% and high in 41.8%-50% [35,36].

Consistently with previous studies [22,23,37], we found a significant association between the adherence to the Mediterranean Diet and the education level (low adherence was reported by 66.7% of participants of lower education level, by 42.3% of those with intermediate education level and by 16.7% of those with high education level; p=0.044), More in general, the role of education in influencing eating habits is

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well established, with evidence indicating that the higher the education, the higher the nutritional knowledge and the individual awareness of the benefits of the Mediterranean Diet [38,39] and, more in general, supporting a positive association between education [40] or nutritional literacy [37,41,42] and health.

Study Limitation

The main limitations of this study are the small size and the heterogeneity of the sample and the use of self-administered questionnaires. Indeed, data were not objectively assessed and questionnaires are susceptible to reporting bias. Studies on a larger number of patients are needed before the results can be extended. However, our data provide insights into the modifiable lifestyle behaviors (smoking and alcohol habits, Medi-Lite adherence score, IPAQ score) among individuals at increased risk of breast/colorectal cancer, a largely unexplored area, and offer preliminary suggestions that may inform further studies.

Practice Implications

Our results show limited awareness of the relevance of lifestyle for cancer prevention, with only a minority of participants thinking that lifestyle has a relevant role in cancer risk reduction, thus highlighting a strong need for nutritional/lifestyle education. Unlike formal education, which cannot be regarded as a modifiable factor, nutrition literacy (individuals' knowledge and competencies that develop over the course of life) may represent a major outcome in the view of increasing the adoption of healthy lifestyles, which should be pursued through systematic nutritional health education approaches.
Therefore, in counseling individuals at increased risk of cancer, it should be taken into account that educational needs are not limited to Genetics; even if genetic counselors have little opportunity to discuss behavioral factors, as they normally see their patients only twice [43]. To this aim, lifestyle behaviors, based on evidence-based recommendations, should be offered by all health professionals involved in care for people with a high risk of cancer.

Research Recommendations

Future research should assess the actual long-term impact of promoting nutritional/lifestyle education at individuals at increased risk of cancer. In addition, future research should also focus on genetic counselors' knowledge of the impact of behavior on cancer risk to reinforce their competencies in this regard helping to support the needs of people at high risk of cancer.

CONCLUSION

In conclusion, the results of this cross-sectional survey of a group of patients referred to our Genetic Clinical Unit support a need for raising awareness on the role of the lifestyle in cancer risk modulation among counselees, possibly tailoring education according to their literacy.

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CONFLICT OF INTEREST

The authors have no relevant financial or non-financial interests to disclose.

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None.

ETHICS STATEMENT

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethical Board of Hospital S.Orsola-Malpighi, Bologna, Italy (685/2020/Oss/AOUBo, 19th September 2020). All participants were informed about the purpose and the methods of the study via a participant information sheet. They were informed that they were free to decide to participate or not and they did not have to give a reason if they declined. Informed consent was obtained from all subjects involved in the study. The authors did not receive support from any organization for the submitted work.

DATA AVAILABILITY STATEMENT

All data presented in this study, not yet publicly archived, shall be made available through the corresponding author on request.

AUTHOR CONTRIBUTIONS

Conceptualization, D.F., D.T. and L.G.; formal analysis, L.G. and D.T.; investigation, D.F. and L.G.; methodology, D.T. and L.G.; resources, L.G. and B.B.; supervision, D.T.; visualization, L.G.; writing—original draft preparation, L.G., and D.T.; writing—review and editing, L.G., and D.T. All authors have read and agreed to the published version of the manuscript.

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