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ORIGINAL PAPER

Impact of a primary care intervention on smoking, drinking, diet, weight, sun exposure, and work risk in families with cancer experience

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Abstract
Background Modifying multiple behavior risks is a promising approach to reduce cancer risk. Primary prevention advices of the European Code against Cancer were included in an educational intervention (EI) using social cognitive theories for motivating families with cancer experiences to adopt six cancer prevention behaviors.
Methods A randomized clinical controlled trial recruited 3,031 patients from Primary Care among cancer patients' relatives. The experimental group (EG) received four EI, one EI every six months, focused on tobacco, alcohol, diet, weight, sun and work, and based on social cognitive models. The impact of the first three EI was calculated measuring at baseline and 18 months later: (a) The percentage of people with each risk behavior; (b) The score reached in a Total Cancer Behavioral Risk (TCBR) indicator; (c) The Odds Ratios at the post-test.
Results Five risk behaviors decreased significantly more ($p < 0.01$) in the EG than in the CG: Smoking (OR = 0.662), drinking (OR = 0.504), diet (OR = 0.542), weight (OR = 0.698), and sun (OR = 0.389). The TCBR indicator also decreased an average of nearly 5 points (28.42 vs. 23.82), significantly more ($p < 0.001$) in the EG.
Conclusion Families with cancer experiences changed five cancer risk behaviors when approached in Primary Care with interventions based on social cognitive models.

Keywords Evaluation studies · Neoplasms: prevention and control · Education of patients · Risk reduction of multiple behavior · Primary prevention · Primary care · Health education

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Introduction

The highest cancer mortality rates in Spain appear in the Principality of Asturias, a northern region of around 1,100,000 inhabitants, with cancer crude mortality rates of 417 per 100,000 in males and 215 per 100,000 in women. These rates in Cantabria, another northern region, are 343 per 100,000 in males and 171 per 100,000 in women [1]. Deaths from cancer are 27.31% of the total (33.64 in men and 20.56 in women) and 28.61 of the total (34.86 in men and 21.64 in women) in Asturias and Cantabria, respectively

[2]. Most prevalent tumors could potentially be prevented by educative interventions because they have been linked to sun, diet, and smoking among others.

The European Code against Cancer (ECC) was established in 1987 due to a background of increasing cancer incidence and death rates, particularly in men, virtually worldwide. The ECC was revised in 1994 [3] and 2003 [4]. A target to reduce cancer mortality in Europe by 15% by the year 2000 was set. The current ECC is included in Table 1.

A recent study [5] shows that only Finland and Austria achieved reductions of 15% in cancer mortality. Cancer control seems to be failing in Spain, Portugal, and Greece. Rodríguez and Gutiérrez-Fisac [6] evaluated the fulfillment of the aim in Spain and found out that the mortality from cancer had increased 8 percentage points instead of decreasing, probably due, in part, to an insufficient preventive effort.

These data imply increasing the number of interventions focusing on the prevention of cancer and the diffusion of the ECC in Spain for the general public and for high-risk patients, above all in genetically predisposed individuals [7]. The identification of particular at-risk populations is increasingly possible [8], as can be persons with a family history of cancer. This article will address the latter group, because studies suggest that they may be more motivated to adopt preventive behaviors [9–12].

The primary prevention behaviors proposed by the ECC can be studied by means of psychosocial models that try to explain human behavior. We used a model that integrates insights of various theories, the A.S.E. Model [13–15], which has been applied to analyze various health behaviors [16–21] but not yet for studying multiple behavior changes.

Table 1 Primary prevention advice of the European Code against Cancer (third version) (Boyle et al. 2003a)

Many aspects of general health can be improved, and many cancer deaths prevented, if we adopt healthier lifestyles:

1. Do not smoke; if you smoke, stop doing so. If you fail to stop, do not smoke in the presence of non-smokers.
2. Avoid obesity.
3. Undertake some brisk, physical activity every day.[a]
4. Increase your daily intake and variety of vegetables and fruits: eat at least five servings daily. Limit your intake of foods containing fats from animal sources.
5. If you drink alcohol, whether beer, wine, or spirits, moderate your consumption to two drinks per day if you are a man or one drink per day if you are a woman.
6. Care must be taken to avoid excessive sun exposure. It is specifically important to protect children and adolescents. For individuals who have a tendency to burn in the sun active protective measures must be taken throughout life.
7. Apply strictly regulations aimed at preventing any exposure to known cancer-causing substances. Follow all health and safety instructions on substances which may cause cancer. Follow advice of National Radiation Protection Offices.

[a] Not included in this study

The A.S.E. Model (now denominated the I-Change Model) incorporates elements from Fishbein-Ajzen [22], Bandura [23] and Prochaska and DiClemente's [24] theories. It establishes that behavior is associated with three psychosocial determinants (attitude, social influence, and self-efficacy), through intention. An experimental design permits the effect of these determinants on behavior and its changes to be controlled.

Multiple health behavior change has been recognized of great importance and is recommended to increase efficiency [25–28], but there are only a few studies that test the efficacy of multiple lifestyle approaches [29–32]. Our study seems to be the only one that focuses on six risk factors included in the ECC within the Primary Care setting for families susceptible to primary prevention and, in this sense, is an advance on previous research.

Changing behaviors and evaluating changes due to an intervention is not easy [33]. The investigators usually report low enrollment rates [34], but methods to involve many people (telephone, mailing of written material, etc.) have some limitations [35, 36]. Furthermore, two-way interactions are likely more motivational [37]. Professionals in Primary Care can implement complex face-to-face interventions and evaluate them trying to overcome limitations.

This study has three aims: (1) To evaluate the impact of an educational intervention (EI) developed in Primary Care, on six preventive behaviors, among cancer risk families. (2) To measure the impact on a Total Cancer Behavioral Risk (TCBR) indicator. (3) To analyze the A.S.E. determinants as predictors of the six risk behaviors.

Methods

Subjects

Patients were recruited in 2001–2002, among those attending primary care centers in Asturias and Cantabria, two regions in the north of Spain that have the highest cancer incidence and mortality rates in our country [1]. The selection criteria were: age between 15 and 50 years and having a first or second-degree relative, dead or alive, affected by cancer, because this population increases the efficiency of the interventions [9, 11]. Patients who were willing to participate were asked to give their informed consent. People under 18 were included if they wished to participate and if their parents gave informed consent. The patients were given their next appointment (six months later) at the clinics, and were reminded by telephone up to a

maximum of three times. The University's review board approved the study. Twenty-four trained doctor–nurse units from 14 primary care centers took part.

Design

A randomized clinical controlled trial was designed. Patients were randomly assigned to the experimental (EG) and the control group (CG). The EG received a tailored educational intervention and the CG the usual care.

Intervention

The intervention used principles of health counseling that tailored the content of the information to the motivational stage of the respondent [38, 39]. It emphasized the advantages of the ECC preventive behaviors among precontemplative and contemplative patients, following Prochaska and Di Clemente's stages of change classification [40]. A prior qualitative investigation [41] provided a list of the advantages and disadvantages of following the ECC advice (see example in Fig 1) perceived by the target population. A question classified the patients into five stages of change to tailor the EI. Persons motivated to change received information on how to cope with barriers to change (self-efficacy enhancing information) and skills to be able to change. When advisable, they were sent to specific preventive programs (Fig 1). Persons in action and maintenance were encouraged to continue to adopt their healthy behavior. A booklet and poster were used as reinforcement materials. Four individual face-to-face interventions were implemented in Primary Care centers, once every six months, during 2002–2003. The fourth intervention was carried out both in the EG and CG only for professional ethical reasons just after the post-test evaluation. Our study evaluates the impact of the first three interventions after a six-month follow-up. All respondents filled in a validated self-administered questionnaire [41].

Questionnaire

The questionnaire was completed at baseline (pre-test) and 18 months later and assessed outcomes and confounders (Table 2). Help was given by health care workers if the patients had questions.

Outcome variables

The primary prevention behaviors of cancer were measured in two ways: each behavior independently and dichotomically (risk/no risk); all the risk behaviors together, by means of the synthetic variable called *Total Cancer Behavioral Risk* (TCBR) indicator. Sample size was calculated to detect at least a variation pre–post in the TCBR = 1.5 points ($\alpha = 0.05$; $\beta = 0.10$; estimated drop-outs = 20%).

Smoking and risk drinking, sun exposure and work were assessed by specific and dichotomus questions (Table 2). *Body Mass Index* was objectively measured by the doctors or nurses. *Risk Diet* was calculated by a Food Frequency Questionnaire [42] that included six theoretically protection foods and seven risk foods, frequently consumed in the region. It was estimated that there was a diet risk if the quotient between the annual frequency of consumption of protection food (PFCYF) and risk food (RFCYF) was less than 0.90. This indicator was validated by prediction, using the diet history of the patient, carried out by nutrition experts, as an external criterion.

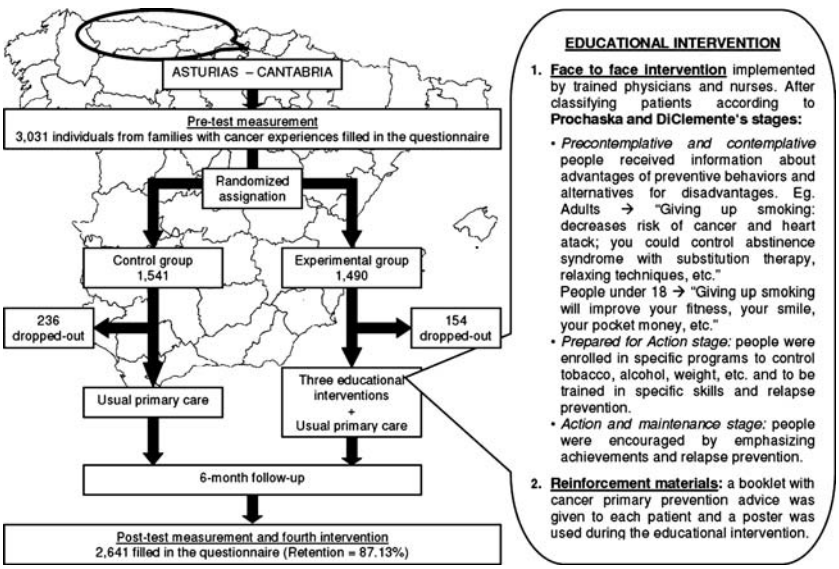

Fig. 1 Flow diagram and characteristics of the educational intervention

Table 2 Variables included in the study, measurement scales and codes for regression analyses

Outcome variables:

Cancer risk behavior

Smoking in the last seven days any quantity of tobacco, cigarettes or cigars (0 = NO; 1 = YES).

Risk drinking[a]: (0 = NO; 1 = YES)

Risk sun exposure—without protection: (0 = NO ; 1 = YES)

Risk work—without protection: (0 = NO; 1 = YES)

Risk weight: (0 = BMI ≤ 25; 1 = BMI > 25)

Risk diet: 0 = [(PFCYF/RFCYF) ≥ 0.90]; 1 = [(PFCYF/RFCYF) < 0.90].

Total cancer behavioral risk (TCBR). From 0 to 74 points according to Doll and Peto's percentage estimation on cancer mortality.

Smoking: 30 risk points.

Drink[a] more than three rations of wine per day, two if female (30 g of pure alcohol for males and 20 g for females) or the equivalent in alcohol in other drinks (a glass of spirits *or* a cocktail *or half* a liter of beer): 3 risk points.

Diet: The sum of the scores obtained in the six behaviors included: 0–30 total risk points.

- Does not consume any service of fresh fruit per day: 5 points.
- Does not consume any service of fresh vegetables per day: 5 points.
- Does not consume stewed vegetables at least three times per week: 5 points.
- Does not consume stewed pulses at least twice per week: 5 points.
- Does not consume wholemeal bread (or wholemeal cereals) at least five times per week: 5 points
- Has a value of <0.90 in the food frequency questionnaire on dividing the annual frequency of the protection foods by the annual frequency of risk foods: 5 points.

Weight: Has a BMI > 25: 5 points.

Exposure to the sun: does not follow the preventive advice 2 points.

Exposure at work: Does not follow *all* the protection rules with toxic products in the workplace (use of masks, gloves, clothes, cleanliness of hands, ventilation, etc.) 4 points.

Psychosocial determinants in the A.S.E. model (Cronbach α of the scales between 0.80 and 0.93)

Attitude: 63 items scored from –2 to +2 (the highest value corresponds to the most preventive attitude toward cancer). Average score of the 63 attitude items in the scale.

Social Influence: 10 items scored from 0 to 3 (the highest value corresponds to the most positive social influence for the prevention of cancer). Average score of the 10 items in the scale.

Self-efficacy: From 0 = Feels incapable of following any of the 6 preventive pieces of advice in the ECC to 1 = Feels capable of following the six pieces of advice in the ECC.

Intention: From 0 = Has no intention of following any of the six pieces of advice to 1 = Has the intention of following the six pieces of advice.

Family history of cancer

Number of first- and second-degree relatives with cancer: From 1 to 10

Deaths from cancer in the family: 0 = NO deaths; 1 = YES.

Time from last cancer death (years): From 1 to 26.

Study variables

Assignation to the study group: 0 = Control Group (CG); 1 = Experimental Group (EG).

Professional help to answer any question in the questionnaire: 0 = No help requested; 1 = Some help requested

Drop-out: 0 = NO; 1 = YES

Socio-demographic

Age in years: From 15 to 50.

Gender: 0 = Male; 1 = Female

Level of education: 0 = Primary; 1 = secondary/university (Dummy variables)

Region: 0 = Asturias, 1 = Cantabria

Internet at home: 0 = NO; 1 = YES.

Statistical analyses

Data analysis included basic descriptive statistics (Table 3). In order to study the comparability of EG and CG, Chi-square and Student's *t*-test were used. Drop-out analyses were performed using logistic regression analysis (backward method) with social demographic factors, study variables (included in Table 2), family history of cancer, attitudes, social influences, self-efficacy, intention, and behaviors. Behaviors at the pre- and post-test were analyzed calculating and comparing the percentages. The Chi-square test was used to detect significant differences between groups and a logistic regression to control the status at baseline when comparing EG and CG at the post-test (Table 4). To assess the impact of the program on TCBR the average values of TCBR were also compared in the EG and CG, using *t*-tests.

Multiple linear regression analyses (backward method) were run to analyze predictors of TCBR at the post-test (Table 5) using a similar method as described for the drop-out analysis.

The effects of various factors—including experimental condition and A.S.E. determinants—on risk behaviors at the post-test (Table 6) were analyzed using several logistic regressions in which the baseline covariables already mentioned, served as potential explanatory variables in the model.

All analyses were performed using SPSS, version 12.0 (SPSS Inc., Chicago, IL, USA).

Results

Sample characteristics

A total of 3,031 patients filled in the questionnaire at the pre-test, while 169 (5%) refused, mainly men ($p < 0.01$), due to lack of time owing to workload. At baseline patients were randomly assigned to the EG ($n = 1.490$; 49.1%) and CG ($n = 1.541$; 50.9%). No significant differences were found ($p > 0.1$) in socio-demographic and family history variables between groups, at pre-test.

Table 3 Descriptive statistics: socio-demographic, family history, and characteristics of the study variables at post-test

	Experimental group	Control group	*p* (two-tailed)
Socio-demographic variables *n*, %, average and 95% CI or median			
n	1,336	1,305	
% of drop-outs	10.3	15.4	<0.001
Average age [95% CI]	35.74 [35.24–36.24]	35.19 [34.68–35.71]	0.134
Gender			
% of women	72.7	70.8	0.284
% of men	27.3	29.2	0.284
Level of education			
% Primary	31.2	31.6	0.842
% Secondary	39.4	40.3	0.623
% University	29.4	28.1	0.462
Cancer family history			
Number of relatives with cancer			
Average [95% CI]	1.92 [1.85–1.99]	1.81 [1.75–1.87]	0.18
State of survival			
% alive	13.7	15.4	0.214
% dead	67.3	67.4	0.937
% alive and dead	19	17.2	0.217
Average years since last death [95% CI]	5.86 [5.64–6.08]	5.74 [5.52–5.97]	0.463
Characteristics of the study variables			
Professional help in answering questionnaire			
Yes	22.5	20.5	0.212
No	77.5	79.5	0.212
Interventions carried out			
Average [95% CI]		3.74 [3.71–3.77]	
Median		4	

Table 4 Percentage comparison and significant differences between the pre-test and post-test

Variable		% Pre-test	% Post-test	Point prevalence (% risk people changing behavior)	*p* (two-tailed)
Smokers	EG	42.6	35.4	16.91[a]	<0.001
	CG	41.5	38.3	7.71[a]	0.1
		$p = 0.55$	$p = 0.001$		
	Total	42	36.8		
Risk drinkers	EG	10.1	4.9	51.48[a]	<0.001
	CG	10	8.3	17.00[a]	0.13
		$p = 0.90$	$p < 0.001$		
	Total	10	6.6		
Risk diet	EG	26	18.1	30.38[a]	<0.001
	CG	24	24.1	0.41[b]	0.96
		$p = 0.22$	$p < 0.001$		
	Total	25	21.1		
Risk weight	EG	45.6	44.2	3.07[a]	0.45
	CG	45.6	47.5	4.16[b]	0.32
		$p = 0.99$	$p = 0.006$		
	Total	45.6	45.8		
Risk sun exposure	EG	16.5	5.4	67.27[a]	<0.001
	CG	15.7	11.3	28.02[a]	0.001
		$p = 0.56$	$p < 0.001$		
	Total	16.1	8.3		
Risk work	EG	2.4	1.3	45.83[a]	0.03
	CG	3.7	1.5	59.45[a]	<0.001
		$p = 0.05$	$p = 0.91$		
	Total	3	1.4		

[a] Risk reduction

[b] Risk increasing

Table 5 Total cancer behavioral risk at the post-test: variables with significant association in the multiple regression analysis

	Unstandardized coefficients		Standardized coefficients	*t*	Sig.	95% CI	
	B	Std. Error	*β*		*p*	Min	Max
(Constant)	14.995	1.683		8.91	<0.001	11.695	18.295
Assignation to the EG	–3.202	0.448	–0.091	–7.14	<0.001	–4.081	–2.322
Gender (Female)	–1.57	0.505	–0.04	–3.11	0.002	–2.56	–0.58
Age	–0.064	0.024	–0.034	–2.614	0.009	–0.112	–0.016
Level of education (University studies)	–1.325	0.51	–0.034	–2.6	0.009	–2.324	–0.326
Mean Attitude	–2.438	0.787	–0.046	–3.096	0.002	–3.982	–0.894
Mean social influence	2.909	1.101	0.035	2.643	0.008	0.75	5.067
Mean self-efficacy	–3.059	1.342	–0.033	–2.28	0.023	–5.69	–0.428
TCBR at the pre-test	0.692	0.015	0.692	45.253	<0.001	0.662	0.722

Dependent variable: Total cancer behavioral risk (TCBR) at the post-test (0–74 points). Independent variables: Assignation to the EG/CG, region, gender, age (years), level of education, internet at home, help in answering, number of first- and second-degree relatives with cancer, deaths by cancer in the family, time since last cancer death (years), attitude, social influence, self-efficacy, intention and TCBR at the pre-test

Table 6 Risk Behaviors at the post-test: variables with significant association in the logistic regression analyses

	Behavior at post-test					
	Smoking	Risk drinking	Risk diet	Risk weight (BMI)	Risk sun exposure	Risk work
	OR [95% CI]					
Experimental group	0.662**	0.504***	0.542***	0.698**	0.389***	
	[0.513–0.854]	[0.351–0.723]	[0.425–0.691]	[0.528–0.921]	[0.283–0.534]	
Age			0.966***	1.018*	0.979*	
			[0.953–0.979]	[1.002–1.034]	[0.963–0.996]	
Female gender		0.257***	0.615***	0.628**	0.578***	0.306**
		[0.179–0.37]	[0.474–0.798]	[0.462–0.852]	[0.419–0.798]	[0.144–0.648]
Region (Cantabria)			0.676**	0.673**		
			[0.518–0.881]	[0.5–0.906]		
Level of education	(a)	(a)				(b)
a: University	0.686**	1.536*				2.076*
b: Secondary	[0.515–0.912]	[1.049–2.248]				[1.027–4.196]
Internet at home						0.287*
						[0.099–0.833]
Cancer deaths				0.63*		
				[0.415–0.956]		
Attitude Pre-test	0.549**	0.385**	0.568**	0.576*		
	[0.36–0.836]	[0.214–0.695]	[0.369–0.874]	[0.367–0.902]		
Self-efficacy pre-test			0.305***		0.282**	
			[0.156–0.593]		[0.128–0.621]	
Smoking pre-test	68.341***		1.314*			
	[51.231–91.166]		[1.013–1.704]			
Risk drinking pre-test		11.295***			1.734**	
		[7.851–16.25]			[1.167–2.576]	
Risk BMI pre-test			0.966*	3.039***		
			[0.936–0.996]	[2.762–3.345]		
Risk sun exposure at pre-test		1.781**			6.287***	2.744**
		[1.202–2.641]			[4.589–8.613]	[1.336–5.639]
Risk work at pre-test					2.089*	13.971***
					[1.112–3.89]	[6.36–30.688]
Risk diet at pre-test			6.147***[4.774–7.913]			

Dependent variables: Each one of the six risk behaviors alone. Independent variables: Assignation to the EG/CC, age (years), gender, region, level of education, internet at home, help in answering, number of first- and second-degree relatives with cancer, deaths by cancer in the family, time since last cancer death (years), attitude, social influence, self-efficacy, intention, and risk behaviors at the pre-test

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

The average age of our sample was approximately 35 years and consisted mainly of women. Only 3% of the sample was under 18. Most of our respondents had at least a secondary education; had between one and two relatives affected by cancer; the average time since the last death ranged between five and six years. Of the 1,273 smokers (42% of the full sample) 17.14% were in pre-contemplation, 68.57% in contemplation, and 14.29% in preparation. Of the 303 risk drinkers (10% of the full sample), 23%, 52%, and 25%, respectively. Of the 758 people at risk diet (25% of the full sample), 24.8%, 62.8%, and 12.4%, respectively. Of the 1,382 people at risk weight (45.6% of the full sample), 6.36%, 49.56%, and 44.08%, respectively. Of the 488 people at risk for sun exposure (16.1% of the full sample), 13.66%, 39.75%, and 46.59%, respectively. Finally, of the 92 people at risk work (3% of the full sample), 10%, 46.67%, and 43.33%, respectively.

The post-test questionnaire was filled in by 2,641 people: 1,336 (50.60%) patients in the EG and 1,305 (49.4%) in the CG. A total of 12.87% of the people at baseline were

drop-outs. Table 3 shows averages and percentages of the individual characteristics of the socio-demographic, family history of cancer and study variables at post-test. No significant differences were found ($p \geq 0.13$ in all variables).

Drop-out analyses

A total of 390 patients dropped-out in the post-test: 39.48% of the EG and 60.51% of the CG. Logistic regression analysis revealed that drop-outs were more likely to be younger (age OR = 0.96; 95% CI: 0.94–0.99) and had slightly higher cancer risk scores as assessed by the TCBR (OR = 1.027; 95% CI: 1.014–1.040).

Effect of EI on isolated risk behaviors and on TCBR

Table 4 summarizes the differences between study groups. The percentage of people with risk behaviors decreased significantly in all the behaviors in the EG, except risk weight. The percentages of people with risk behavior at the post-test were significantly lower in the EG than in the CG, with one exception: cancer risk at work. The EI had the greatest effect on reducing sun exposure risk.

Furthermore, the TCBR dropped significantly in the EG from 28.42 (pre-test) to 23.82 (post-test) ($p < 0.001$); a smaller change was also noted in the CG (Fig 2).

Table 5 shows the final model of *multiple linear regression*. First, the intervention was successful in reducing the TCBR. Controlling all the variables, those that are significantly associated with and reduce the TCBR in the post-test allows the following low-risk profile to be drawn: a woman from the EG, with university studies, high self-efficacy, and preventive attitude toward cancer. The older they are the less TCBR. The rest of controlled variables failed to be retained in this model. The highest standardized β coefficients were: belonging to the EG (–0.09), followed by the average attitude and gender. On the contrary, social influence and the TCBR score in the pre-test were associated with a higher TCBR in post-test.

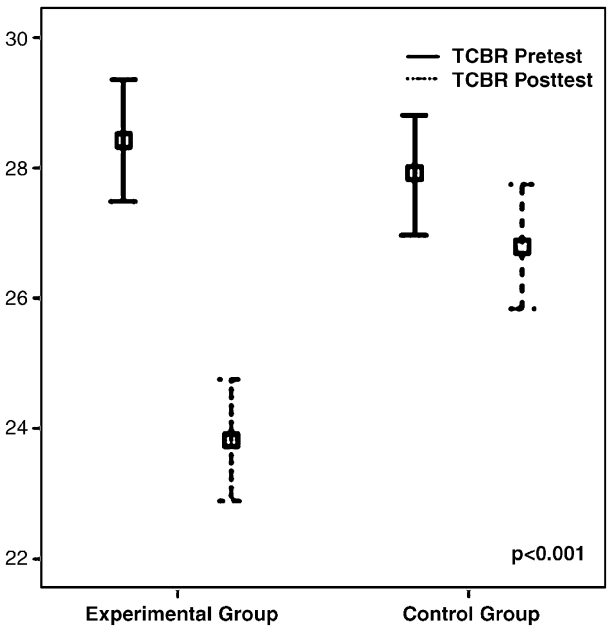

Fig. 2 Total cancer behavioral risk: comparison between groups at the pre-test/post-test (mean and 95% CI)

Predictors of cancer risk behaviors

The outcomes of the various *logistic regression analyses* are shown in Table 6, and they permit the predictors of the six cancer risk behaviors at the post-test to be identified. The EI was successful for all behaviors but risk work: belonging to the EG reduced five out of six risk behaviors at the post-test. The ORs range between 0.389 and 0.698. After controlling for potential confounders, the results show that the intervention was effective above all in reducing risks related to sun exposure, excessive drinking, and unhealthy diet. The explained variance ranges from 23.6% (for risk work) to 78.7% (for risk weight).

Discussion

Our purpose was to test the efficacy of an intervention for families with cancer experiences, focusing on primary prevention behaviors as advised by the European Code against Cancer. We found significant changes in five out of six cancer risk behaviors and in the total cancer risk score.

The intervention was successful in reducing the percentage of people with risk behaviors. The greatest effect was achieved for behaviors related to tanning, alcohol consumption, and nutrition, which decreased between approximately 67% and 30%, respectively. The only comparable intervention study that we have found also showed effects on three cancer primary prevention behaviors simultaneously [31]. Prochaska detected significant treatment effects for smoking, diet, and sun exposure after 24-month follow-up with interventions contact on primary care patients. The improvement percentages were very similar to ours. But their criterion for sampling did not include having relatives affected by cancer, so our results are not exactly comparable. This intervention had great impact on sun exposure, as we also found.

Our control group also reduced, but to a lesser extent, their risks as other authors found [43–45]; this could be due to concomitant programs, the educational effect of filling—in the questionnaire or contamination among patients. But the multivariate analyses clarify the effect of the EI on

the EG, controlling the rest of the variables. The logistic regression analysis showed the efficacy of the intervention for behaviors related to tanning, alcohol, diet, tobacco, and weight. Having a favorable attitude toward cancer prevention in the pre-test was associated with the risk reduction in the behaviors related to tobacco, diet, weight, and above all the alcohol intake. Self-efficacy at baseline was more related to influencing diet and, above all, sun exposure. In different studies self-efficacy has been shown to be one of the best predictors of behaviors [46], including diet behavior [47]. For this reason interventions should be focused on removing barriers and providing skills to increase self-efficacy. As expected, engaging in risk behaviors at baseline increased the risk of engaging in similar behaviors at post-test, with the highest risks for addictive behaviors, smoking, and alcohol use.

Furthermore, the total cancer behavioral risk score (TCBR) also showed an average reduction of almost 5 points in the experimental group, a reduction that was found to be significant in the regression analysis. Other factors related to lowering overall risk scores were demographic characteristics, such as being older, a woman, and having university studies, findings also found by other researchers [48–50]. Again, the scores of the A.S.E. determinants in the pre-test were associated with the reduction of the TCBR, especially attitude and self-efficacy. Both had demonstrated their influence on preventive behavior considered separately [16–20], but in the present study they also show their association with a global indicator of cancer behavioral risk, decreasing it.

An interesting finding was that the cancer family history characteristics (number of relatives with cancer, survival and time from the last death due to cancer) had very little influence on the efficacy of the intervention. Some authors suggested that interventions may be more effective for persons with a family cancer risk history [9–11, 49, 51]. An explanation for our findings may be that we addressed persons who all had a certain cancer risk history. It is conceivable that this overall risk was more significant than specific details on the type and history of cancer risk.

Our sample had an over-representation of women like other studies [52, 53] for several reasons: women attend Primary Care centers more often than men do [54, 55] and are more favorable to cancer prevention, primary [14, 56, 57] and secondary [58, 59].

Study limitations and strengths

First, the drop-outs had a slightly higher cancer risk at baseline, which could have influenced the results also slightly increasing the impact. However, losing more patients among those at maximum risk is normal in intervention studies [60]. Second, we arbitrarily used one indicator to measure the TCBR. Nevertheless our indicator has been sensitive enough to detect a reduction of almost 5 points in the cancer risk of the experimental group. This reduction is consistent with the one also detected in the percentage of patients with risk behaviors after the intervention, and therefore seems valid and reliable. Third, our over-representation of females hinders the generalization of the results to males.

Finally, despite the limitations, the strength of our study is that significant changes were achieved in our population of families with cancer experience. However, our results were obtained after six-months of follow-up since the third intervention. It is known that time can decrease the effect of Health Education interventions, and so the National Health System should include systematic and periodic interventions to prevent cancer in the Primary Care protocols, as the centers involved in this research promised to do after the efficacy of the EI was demonstrated.

Future research is needed to foster the enrollment of more men in similar studies and to determine what motivates multiple health behavior changes in patients without family risks. It is also necessary to study the optimum periodicity of the interventions that maintain the effect by means of long-term follow-up studied.

Conclusion

A protocolized intervention reduced cancer behavioral risk in five out of six behaviors related to cancer in relatives of cancer patients. The intervention was feasible and well accepted in Primary Care centers.

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