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Impact of a web-based intervention supplemented with text messages to improve cancer prevention behaviors among adolescents: Results from a randomized controlled trial

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ABSTRACT

Objective. To assess the impact of a web-based intervention supplemented with text messages to reduce cancer risk linked with smoking, unhealthy diet, alcohol consumption, obesity, sedentary lifestyle and sun exposure.

Methods. A total of 2001 voluntary adolescents from Spain and Mexico were recruited between 2009 and 2012 and randomly assigned to: one control group and two experimental groups, which received exclusively the online intervention (experimental group 1) or the intervention supplemented with encouraging text messages (experimental group 2). The educational intervention was based on both: successful psychosocial models (i.e. A.S.E. and Transtheoretical model) and the school curriculum.

Results. After a 9-month follow-up, the prevalence of students who did not eat fruit was reduced significantly in all groups: experimental group 1 (−62.6%), experimental group 2 (−71.5%) and even the control group (−66.8%). Being overweight was only reduced in the experimental group 2 (−19.6%). The total cancer behavioral risk score, which ranged from 0 to 100 points (highest risk), was significantly reduced in the experimental group 1 (−3.5 points) and in the experimental group 2 (−5.3 points). The text-supplemented online intervention increased the probability of improving the post-test total cancer behavioral risk (OR = 1.62).

Conclusion. The web-based intervention supplemented with text messages had a positive global impact, but it lead to only minimal changes in risky behaviors. This intervention appears useful in controlling overweight adolescents.

Clinical trial registration number: ISRCTN27988779.

Introduction

Incidence of cancer in economically-developed countries has moderately decreased in the last few years. Even so, in the USA, 1 out of 2 men and more than 1 out of 3 women will develop a cancer in their lifetime (Siegel et al., 2012). According to GLOBOCAN estimations (Ferlay et al., 2010), age-adjusted incidence of cancer in Spain is lower than in the USA (241.4 vs 335.0 cases per 100,000). The same figure in Mexico is even reduced (128.4 cases). Notwithstanding that, cancer is also a major public health problem both in Spain and Mexico. Cancer is caused by the accumulation of genetic and epigenetic damage, which in turn is influenced by both internal and external factors (American Cancer Society, 2012). Peto (2011) has recently affirmed that if lifestyle risk factors are controlled, more than 40% of cancer diagnoses could be avoided — even in countries with an aging population. These include smoking, diet and overweight, among others.

Primary prevention is the only strategy capable of avoiding the disease. For this reason, prestigious institutions – such as the American Institute for Cancer Research (World Cancer Research Fund–American Institute for Cancer Research, 2007) and the European Code Against Cancer (Boyle et al., 2003) – have established clear recommendations aimed at controlling this disease.

Many studies have shown that preventing or modifying risk behaviors in adults is possible (López et al., 2007; Prochaska et al., 2005). However, the effectiveness of such strategies in adolescents has not yet been established. Even though, most risky behaviors are acquired in late childhood and consolidated during adolescence, making it an opportune time for prevention interventions (Holman et al., 2013). According to White et al. (2013), innovative approaches could be useful in designing multilevel evidence-based interventions. Modern communication media such as the Internet and cell phones represent important social media tools which should be utilized to improve young people's health. These have a high preventive capacity due to their widespread coverage and ease to adapt to adolescent codes. In a recent manuscript,

Abbreviations: TCBR, total cancer behavioral risk.

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Morse (2013) has even fought for including preventive patterns in the scholar environment. The author concludes that "coordinated collaboration between professionals in education and public health can better prepare our young people to be health literate and cancer-free". Interventions that combine both the Internet and the school context have achieved moderate success (Buendía Eisman et al., 2013; De Bourdeaudhuij et al., 2010; Hamel and Robbins, 2013). It is therefore essential to continue observing their impact.

In order to achieve behavior changes, it is necessary to know their underlying mechanisms (Carson et al., 2011; Glanz et al., 2008). Two psychosocial models aiming to explain behaviors have been successfully tested in previous programs — mainly when combined. These are the A.S.E. model (acronym of Attitude, Social influence and self-Efficacy) and the Prochaska and DiClemente's Transtheoretical model (López et al., 2007). They have been frequently used among adolescents to understand the role that the model's components (i.e. attitude, social influence and self-efficacy) play in the prediction of risk behaviors (Melbye et al., 2012; Vitória et al., 2011). However, their benefit for behavior change interventions remains unclear.

Advice to prevent cancer should be considered as a whole and in the context of a healthy lifestyle. Therefore, the aim of our study has been to assess the impact of a multiple educational intervention in reducing cancer risk associated with smoking, an unhealthy diet, alcohol consumption, obesity, and a sedentary lifestyle and sun exposure. Such interventions would be based on psychosocial models and be delivered through both the Internet and cell phone text messages.

Methods

Study and intervention design

This study assesses the impact of the PREVENCANADOL program, whose methods have been reported elsewhere (Lana et al., 2013 and Lana Pérez et al., 2013). Briefly, it was a randomized controlled trial (RCT), which was implemented on Spanish and Mexican adolescents attending school between 2009 and 2012. The program was supported by the educational authorities of Spain and Mexico and diffused among secondary education schools in both countries. Program information was sent by email to all teachers. Links and banners were placed on the main educational portals. Participation was voluntary, but most interested teachers encouraged their students to participate. Participants had to register with an alias in the program website and fill in a compulsory online questionnaire (pre-test). This form was based on one used in previous research, and adapted here for use in adolescents (López et al., 2007). Participants were randomly assigned to either the control group (CG) or experimental group (EG) using a computer program.

EG students had free access to all sections of the website, which was adapted to school curriculum and the features of each country (i.e. www.alertagrumete.com in Spain; www.alertagrumete.com.mx in Mexico). The website included several sections to learn how to prevent and treat main cancer risk behaviors using the theoretical framework of the A.S.E. model, that is: a) emphasizing advantages of following the recommendations and disadvantages of risk behaviors, b) creating a healthy online social environment and c) strengthening the skills to avoid risk behaviors. The section with the highest educational capacity contained problems or challenges that students had to solve. They were related both with subjects of their curriculum (e.g. Math, Literature or Science) and with the risk behavior prevention. The website also provided other services, such as expert dietetic advice after analyzing common homemade recipes and 24-hour food recalls, peer-starred educational videos, forums and chat lines to discuss cancer-related topics, documents and web links with selected information and online educational games. Moreover, adolescents who had provided a cell phone number received weekly text messages to encourage compliance with healthy behaviors. For instance, a text message focused on a healthy diet was the following: 'Don't be fooled! The best way to be pretty on the outside is by being pretty on the inside. Fruits and vegetables are your best makeup'. All behaviors were promoted equally. Consequently, the EG was formed by two EGs: EG1 (exclusively online) and EG2 (online intervention plus text messages). The described educational intervention lasted an entire academic year (9 months). After that, participants of both the CG and EG were required to complete another questionnaire (post-test assessment).

The study was approved by the Ethics Committee of Clinical Research (University Central Hospital of Asturias) and all participants gave their informed consent. The RCT complied with the principles of the Declaration of Helsinki and it was therefore included in an international register of clinical trials accepted by the World Health Organization (ISRCTN27988779).

Study variables

Main outcome: total cancer behavioral risk

In the questionnaire, students were directly asked about the presence of six cancer risk behaviors: smoking, unhealthy diet, alcohol consumption, obesity, sedentary lifestyle and sun exposure. Additionally, they were requested to classify their behaviors according to Prochaska and DiClemente's Stages of Change model (i.e. precontemplation, contemplation, preparation, action and maintenance). Students were considered to have a risky behavior if they provided an affirmative answer to direct questions or when they classified themselves in any of the first three stages. Weight was checked by self-reported BMI (Kg/m^2), whereas the dietetic behavior was assessed by a validated food frequency questionnaire (Martin-Moreno et al., 1993). This included two groups of food usually consumed in both Spain and Mexico. On the one hand, a group of theoretically risky foods, such as red meat (including pork and derivatives), sausage products (including bacon and pancetta), cream and pastries. On the other hand, a group of cancer protectors, such as fruit, fresh or stewed vegetables, legumes cooked without meat and whole grains. A synthetic indicator called total cancer behavioral risk (TCBR) was designed by adding up all of the risk points obtained for one or more risk behaviors. Points given by every risk behavior were calculated according to the Doll and Peto's estimations and to other more recent evidence (Doll and Peto, 1981; Peto, 2011). They read as follows: smoking regularly any amount of cigarettes = 35 points; eating less than five pieces of fruit and vegetables a day = 20 points; eating three or more fat pieces of food a day = 10 points; having a "frequency of cancer-protecting food/risky food" quotient <0.9 = 8 points; being obese or overweight = 15 or 10 points respectively; drinking excessively = 5 points; doing physical activity less than 360 min a week = 5 points; being in the sun without sunscreen = 2 points. Consequently, TCBR score ranged from 0 points (no risk) to 100 points (highest cancer behavioral risk).

Other variables

Other variables were also included due to their potential relationship with risk behaviors and TCBR score. In this respect, sociodemographic information was compiled: gender, age (12–16 years of age), country (Spain or Mexico), number of siblings (none, one, two, three, four or more), father's and mother's level of education (primary school, secondary school or university degree), family unit (parents, only father, only mother or with others) and weekly leisure expenditure (<3.0 €, between 3.0 and 5.9 € and ≥6.0 €) (1.0 € equals approximately 1.3 US $). Students were also required to provide their self-perceived health level (i.e. very good, good, regular, bad or very bad) and family history of cancer (i.e. number of first-degree and second-degree relatives suffering from any type of cancer).

Information about two academic variables was also required. The first one was the school grade, which is related to age (i.e. first, second or third), while the second one was self-reported academic level (i.e. very good, good, fair, bad or very bad). Finally, the questionnaire included the assessment of two behavior-determining factors that comply with the A.S.E. model. Firstly, the negative social influence from relatives (i.e. number of relatives with the risky behaviors highlighted in this study) and their peers (i.e. number of friends with risky behaviors). Secondly, the total self-efficacy score, which expresses the self-perceived capacity to comply with all preventive advice. It was measured using scale from 0 to 10 points, graded as "low <5", "medium = 5–9" and "high >9".

Statistical analysis

During the three academic years in which the program was active, 3855 students were involved. However, only 2001 (51.9%) completed and submitted the compulsory questionnaire and were consequently included in the RCT. The total sample was described in terms of proportions and using 95% confidence intervals (95%CI). Feature comparison of both study groups (CG and EG) was performed using the Pearson's χ^2 test, Z test (qualitative variables) and Mann–Whitney *U* test (quantitative variables). An exploratory data analysis which used a binary logistic regression allowed calculation of the adjusted odds ratio (OR) (95%CI), which best explains the probability of permanence in

the program until the post-test. McNemar's and Wicoxon's tests were employed to compare risky behavior prevalence and TCBR raw score between the pre- and the post-test. Differences between TCBR scores in the pre- and post-test were calculated. Negative post-test scores indicated a lower risk and therefore an improvement in the synthetic indicator. Generalized linear models were followed to find out the association between (a) differences between TCBR scores and (b) belonging to each of the study groups. In addition, a multinomial logistic regression was performed to obtain adjusted OR for the acquisition or giving up of risky behaviors from the pre-test to the post-test, according to the study groups. Lastly, binary logistic regressions were used to check if belonging to any of the two EG would increase the probability of having a lower post-test TCBR. Regression analyses were performed by using different adjustment models. In the last one, all possible effect-confusing variables were included: sociodemographic variables, health related variables, academic level, A.S.E. model's variables and pre-test TCBR score. Potential confounders were modeled with dummy terms. All the analyses were executed with the STATA software (v.11). Two-tailed p-values <0.05 were considered statistically significant.

Results

A total of 2001 adolescents took part in the RCT. 987 (49.3%) were assigned to the CG and 1014 (50.7%) to the EG (Fig. 1). Randomization produced comparable groups for almost all pre-test variables (Table 1). However, the EG mainly consisted of Spanish students in their first year of secondary education (12 or 13 years old) and with fewer relatives with risk behaviors. In addition, groups were also comparable regarding cancer risk behaviors at baseline, but in the CG there was a slightly higher prevalence of risks, which was only statistically significant in fatty food intake. Globally, an unhealthy diet and excessive sun exposure were the most prevalent risk behaviors among this adolescent cohort. No initial difference (p = 0.272) in the TCBR score was observed in both study groups, although it was slightly higher in the CG (18.8 points; 95%CI: 17.3–20.4) than in the EG (17.7 points; 95%CI: 16.5–19.0).

Post-test assessment was only performed in 737 adolescents (retention rate = 36.8%). 316 belonged to the CG (42.9%), 177 to the EG1 (24.0%) and 244 to the EG2 (33.1%) (Fig. 1). No data are available about the participation or post-intervention behavior change of the remaining students. The results of the multivariate analysis aimed at establishing the characteristics of the retained adolescents showed that students who completed the whole intervention had mainly the following features: they were EG students (OR = 2.4; 95%CI: 1.7–3.4), Mexicans (OR = 3.9; 95%CI: 2.1–7.2), whose mothers had university degrees (OR = 2.5; 95%CI: 1.1–6.3) and with a high self-efficacy (OR = 2.0; 95%CI: 1.1–3.6). On the other hand, being 15 or older (OR = 0.3; 95%CI: 0.1–0.6) and having relatives who smoke (OR = 0.7; 95%CI: 0.5–1.0) or friends (OR = 0.6; 95%CI: 0.3–0.9) decreased the probability of completing the program.

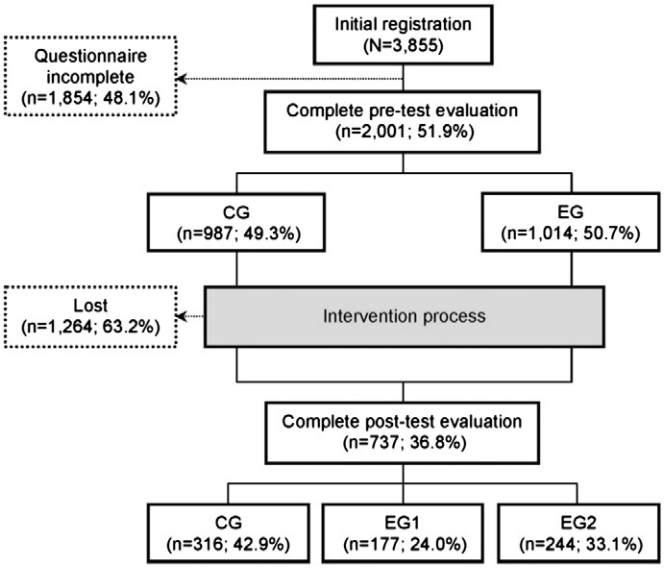

Fig. 1. Flow diagram of the RCT.

Table 1
Pre-test characteristics of the adolescents according to the study group (percentages and their 95%CI in brackets are reported).

	Total (N = 2001)	CG (n = 987)	EG (n = 1014)	p-Value
Country, Mexico	78.0 (76.2–79.8)	80.6 (78.0–82.9)	75.6 (72.8–78.1)	<0.01
Gender, girl	54.8 (52.6–57.0)	54.2 (51.0–57.3)	55.4 (52.3–58.5)	0.310
Age				<0.01
12 years	23.6 (21.8–25.6)	20.5 (17.9–23.0)	26.6 (23.6–29.2)	
13 years	40.6 (38.4–42.8)	42.7 (39.6–45.9)	38.5 (35.7–41.8)	
14 years	26.5 (24.6–28.5)	27.4 (24.5–30.2)	25.7 (23.2–28.8)	
15 years or more	9.2 (7.9–10.4)	9.4 (7.6–11.4)	9.2 (7.0–10.6)	
Grade				<0.001
First	41.0 (38.7–43.1)	37.0 (33.8–40.0)	45.5 (41.6–47.9)	
Second	41.4 (39.0–43.5)	47.3 (43.9–50.2)	35.0 (32.5–38.6)	
Third	17.6 (15.9–19.3)	15.7 (13.2–18.2)	19.5 (17.1–22.0)	
Academic level				0.756
Very good	21.5 (19.6–23.3)	21.4 (18.7–23.9)	21.5 (19.1–24.3)	
Good	47.2 (45.0–49.4)	47.0 (43.9–50.2)	47.3 (44.2–50.5)	
Fair	27.9 (25.9–29.9)	27.8 (24.9–30.6)	28.2 (25.2–30.9)	
Bad/very bad	3.4 (2.6–4.2)	3.8 (2.7–5.1)	2.9 (1.8–4.0)	
Living relatives				0.271
Both parents	78.9 (76.9–80.6)	78.5 (75.8–81.0)	80.1 (77.5–82.5)	
Only with mother	17.5 (15.3–18.7)	17.2 (15.0–19.8)	17.3 (15.0–19.8)	
Only with father	2.1 (1.3–2.6)	2.6 (1.8–3.8)	1.5 (0.9–2.5)	
With others	1.5 (0.8–1.9)	1.7 (1.0–2.7)	1.1 (0.6–2.0)	
Brothers or sisters				0.659
None	8.0 (6.8–9.2)	7.2 (5.6–8.9)	8.5 (6.9–10.5)	
One	37.6 (35.4–39.8)	38.9 (35.8–42.0)	36.5 (33.3–39.4)	
Two	37.3 (35.1–39.4)	36.3 (33.1–39.2)	37.9 (35.3–41.4)	
Three or more	17.0 (15.3–19.5)	16.7 (14.1–21.2)	17.1 (13.2–20.4)	
Father studies				0.211
Primary	6.9 (5.8–8.1)	7.7 (5.5–8.8)	6.0 (4.3–7.3)	
Secondary	43.5 (41.3–45.8)	42.0 (36.6–42.9)	45.1 (39.7–45.9)	
University	49.6 (47.3–51.9)	50.3 (44.4–50.8)	48.9 (42.4–48.7)	
Mother studies				0.061
Primary	6.4 (5.4–7.6)	7.6 (6.2–9.5)	5.2 (3.9–6.8)	
Secondary	39.7 (37.5–42.0)	37.6 (34.5–40.8)	41.8 (38.7–45.0)	
University	53.9 (51.6–56.2)	54.8 (51.6–58.0)	53.0 (49.8–56.2)	
Weekly expenditure				
2.9 € or less	42.2 (40.0–44.4)	42.6 (39.3–45.7)	41.7 (38.7–45.0)	0.451
3–5.9 €	26.0 (24.1–28.0)	24.8 (22.1–27.7)	27.3 (24.3–30.0)	
6 € or more	31.8 (29.7–33.9)	32.6 (29.6–35.6)	31.0 (28.1–33.9)	
Health status				0.566
Very good	40.4 (38.2–42.6)	39.6 (36.2–42.4)	41.4 (38.3–44.6)	
Good	38.2 (36.0–40.3)	39.5 (36.9–43.1)	36.5 (33.3–39.4)	
Fair	18.5 (16.7–20.2)	17.9 (15.3–20.2)	19.2 (16.7–21.7)	
Bad/very bad	3.0 (2.3–3.8)	3.1 (2.0–4.2)	2.9 (1.9–4.1)	
Cancer history, yes	30.1 (28.1–32.2)	30.9 (28.0–33.9)	29.3 (26.5–32.2)	0.430
Negative social influence[a]				
Family	6.9 (6.7–6.3)	7.3 (6.9–7.6)	6.7 (6.3–7.0)	<0.05
Peers	9.1 (8.7–9.4)	9.2 (8.7–9.7)	9.0 (8.5–9.5)	0.427
Self-efficacy[a]	6.8 (6.7–6.9)	6.7 (6.6–6.9)	6.8 (6.7–7.0)	0.190
Cancer risk behaviors				
Smoking	2.7 (1.9–3.5)	3.3 (2.1–4.5)	2.2 (1.2–3.2)	0.339
Not enough fruits	36.9 (4.6–39.2)	38.6 (35.3–41.9)	35.4 (32.2–38.6)	0.175
Not enough vegetables	35.0 (32.7–37.3)	33.3 (30.2–36.6)	36.5 (33.3–39.8)	0.169
Dietary fat	52.6 (50.2–55.0)	55.1 (51.7–58.5)	50.1 (46.8–53.5)	<0.05
Overweight/obesity	15.6 (13.9–17.4)	16.2 (13.7–18.7)	15.1 (12.7–17.5)	0.800
Alcohol	4.9 (3.9–5.9)	5.4 (3.9–7.0)	4.4 (3.0–5.8)	0.326
Sedentarism	27.8 (25.6–29.9)	28.1 (25.0–31.1)	27.5 (24.5–30.5)	0.317
Sun exposure	49.1 (46.8–51.5)	51.0 (47.6–54.4)	47.3 (44.0–50.7)	0.102

[a] For social influence and self-efficacy the mean scores (95% CI) are provided.

Table 2
Comparison of risk behaviors prevalence and percentage of change between the pre-test and post-test according study groups.

Cancer risk behaviors	CG (n = 316)			EG1 (n = 177)			EG2 (n = 244)		
	Pre-test	Post-test	Change	Pre-test	Post-test	Change	Pre-test	Post-test	Change
Smoking, %	1.5	0.7	−53.3	0.0	2.0	–	1.8	1.8	0
Not enough fruits, %	40.1	13.3	−66.8**	38.3	10.5	−62.6**	34.4	9.8	−71.5**
Not enough vegetables, %	26.6	29.7	11.7	41.6	32.9	−20.9	31.2	32.9	5.4
Dietary fat, %	53.6	49.0	−8.6	54.5	50.7	−7.0	49.1	44.4	−9.6
Overweight/obesity, %	16.1	17.1	6.2	14.3	17.7	23.8	14.3	11.5	−19.6*
Alcohol, %	1.8	3.1	72.2	0.6	2.6	333.3	2.2	5.8	163.6
Sedentarism, %	31.0	29.4	−5.2	31.8	27.6	−13.2	21.9	22.7	3.7
Sun exposure, %	50.7	53.5	5.5	49.3	49.3	0.0	46.9	47.1	0.4

* p-Value < 0.05.
** p-Value < 0.001.

The comparison of pre-test and post-test risky behavior prevalence is shown in Table 2. After taking part in the program, the percentage of EG2 students who don't consume sufficient fruit decreased by more than 70%. However, the same happened in the other groups. Prevalence of being overweight also decreased significantly (about 20%) in this group; while in the other ones it rose during the same period. Notwithstanding that, in all groups, alcohol intake was higher.

Mean TCBR scores were reduced in all groups of adolescents who finished the study (Fig. 2). Whereas in the EG1 it significantly dropped from 25.4 points (95%IC: 22.3–28.5) to 21.9 (95%IC: 19.7–24.0) and in the EG2 from 24.8 points (95%IC: 22.1–27.5) to 19.5 (95%IC: 17.0–21.9), in the CG it was not found to be significant as it fell from 22.9 points (95%IC: 20.8–25.0) to 21.8 (19.7–24.0). The mean TCBR score difference between the pre-test and the post-test was −3.5 points ($p = 0.049$) in the EG1 and −5.3 points ($p < 0.001$) in the EG2. These raw differences remain constant when adjusting for age or gender, though only in the EG2 (−5.35 points; $p = 0.048$).

As shown in Table 3, receiving the complete educational intervention (i.e. web-based supplemented with text messages) increased the probability of obtaining a lower post-test TCBR score by 50–60%. This happened even after controlling the effect of variables which had been transversely associated with a high pre-test TCBR score. In the same way, the adolescents assigned to the EG2 had more probability of giving up at least two behaviors than adolescents of the CG (OR = 1.70; $p = 0.038$) (Table 4).

Additional analyses were performed to check if the educational intervention had an isolated impact on each of the post-test risky behaviors. However, neither the web-based nor the text-supplemented intervention could improve these behaviors significantly. Adjusted ORs (95%CI), related to post-test risky behaviors, were as follows for the EG2 and the CG: smoking 1.0 (0.3–4.1), low fruit intake 0.8 (0.4–1.4), low vegetable intake 1.3 (0.7–1.5), excessive fat intake 1.0 (0.7–1.6), overweight 0.6 (0.3–1.0), alcohol consumption 1.1 (0.3–3.7), sedentary lifestyle 1.0 (0.6–1.6) and sun exposure 0.9 (0.6–1.3).

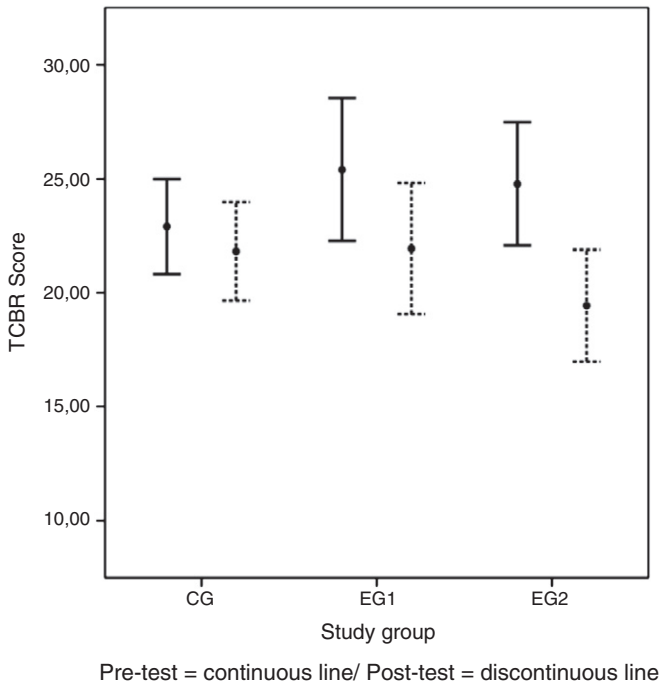

Fig. 2. Differences in the TCBR score between pre and post-test according to the study group.

Discussion

In designing the RCT, it was shown that the intervention complied with almost all scientifically-proven effectiveness requirements (Crutzen et al., 2008; Schneider et al., 2012 and Webb et al., 2010). These are: online questionnaires, suggestive interface, simple navigation, visit-encouraging reminders, periodic feedback, interactive and tailor-made activities, and competition rewards, among others. The intervention also complied with other desirable requirements, although they have not been accepted by general assent. These are: an attractive name and an appropriate website positioning on the major search engines (e.g. Google). It's also remarkable that almost all adolescents, both in Spain and in Mexico, had Internet access either at school or at home (Lana Perez et al., 2013). Nevertheless, drop-out rate was high. This may be since teachers did not have enough time or motivation to

Table 3
Probability of increase (p-value) of the TCBR score at the post-test.

	CG	EG1	EG2
Crude OR	1.00 (Ref.)	1.07 (0.740)	1.59 (0.009)
Adjusted ORs			
Model 1 (adjusted for sex and age)	1.00 (Ref.)	0.97 (0.892)	1.55 (0.016)
Model 2 (plus country)	1.00 (Ref.)	0.96 (0.851)	1.47 (0.037)
Model 3 (plus other sociodemographic variables[a])	1.00 (Ref.)	1.02 (0.924)	1.52 (0.030)
Model 4 (plus health related variables[b])	1.00 (Ref.)	0.99 (0.978)	1.51 (0.036)
Model 5 (plus academic level)	1.00 (Ref.)	1.13 (0.584)	1.55 (0.023)
Model 6 (plus A.S.E. model variables[c])	1.00 (Ref.)	1.18 (0.463)	1.63 (0.016)
Model 7 (plus basal TCBR)	1.00 (Ref.)	1.15 (0.588)	1.62 (0.032)

[a] Number of brothers, parents' academic level, living relatives and weekly expenditure.
[b] Health status and family history of cancer.
[c] Social influence (relatives and peers without risk behaviors) and total self-efficacy to follow the preventive recommendations.

Table 4
Adjusted OR[a] (p-value) of the change in cancer behaviors between pre- and post-test according to the study groups.

	CG	EG1	EG2
Acquisition 2 or more risky behaviors	1.00 (Ref.)	0.93 (0.235)	0.70 (0.758)
Acquisition 1 risky behavior	1.00 (Ref.)	1.17 (0.446)	0.82 (0.297)
Maintenance	1.00 (Ref.)	1.00 (Ref.)	1.00 (Ref.)
Giving-up 1 risky behaviors	1.00 (Ref.)	0.93 (0.728)	1.01 (0.952)
Giving-up 2 or more risky behaviors	1.00 (Ref.)	1.16 (0.648)	1.70 (0.038)

[a] Adjusted for the variables of Table 1: country, gender, age, grade, academic level, living relatives, brothers, parents' academic level, weekly expenditure, health status, family history of cancer, social influence and self-efficacy.

include this activity on their subject syllabus. It is also possible that students did not like the program website, in spite of the previous qualitative research performed to detect their likes and needs. In any case our primary aim was to assess the effectiveness of the intervention in a real setting and in real application conditions. So, in our opinion, the low retention rate cannot be considered a limitation itself. Moreover, the number of participants who completed the intervention was enough to assess its impact.

Generally, intervention programs aimed at changing adolescent behavior, which are accepted by their peers – such as drinking alcohol or smoking – do tend to have similar low retention rates as in this study (Paschall et al., 2011; Wangberg et al., 2011). The HELENA program (Maes et al., 2011), a famed web-based program which is similar to ours, was implemented in six European countries and obtained participation rates of about 50%. However, HELENA's results were assessed after three months, whereas our study was assessed after a whole academic year (around 9 months). According to Smit et al. (2012), an advantage of the low retention rate is that it allows performing a robust drop-out analysis, which can provide keys to improve retention in subsequent programs. In this respect, our study confirmed that behavioral intervention programs normally lose those participants who may need them most. This is therefore a common concern among researchers (Verheijden et al., 2007). In light of our results, programs wishing to minimize drop-out rate should focus on creating a website tailored the preferences of adolescents with a premature withdrawal risk; who are mainly older students with a poor self-efficacy, an unhealthy social influence and whose parents have a low educational level. It would be also interesting to perform a weighted randomization which assigns more students to the CG than to the EG, because withdrawals usually occur in the first study group. In addition, teenagers who frequently receive health counseling through different channels – as occurs in Spain – do not usually appreciate these kinds of initiatives. This may be due to the fact that they don't feel they need such advice and is in fact, one of the main reasons for withdrawal (Alff et al., 2012).

The risk of bias in our impact assessment was low because, as Carter et al. (2012) pointed out, bias occurs when pre-test differences between both groups and total students affect the result variables. In our study, neither risky behaviors nor their TCBR score varied.

After comparing pre-test and post-test risky behaviors, we can conclude that the program was modestly effective. The joint intervention on such a high number of behaviors could have diluted the advice we wanted to transmit to the students about each of them. Perhaps for that reason, the isolated impact was not so clear. A multiple intervention performed by Cullen et al. (2013) achieved only an improvement in vegetable consumption, but not other behaviors. Our program had only an isolated impact on being overweight. In EG2 post-test, it was reduced by 20%, whereas in the remaining groups it increased. Success in controlling BMI is vital given the widespread problem of overweight in western countries, which urgently needs addressing. Furthermore, it is a difficult risk factor to modify. Other web-based programs achieving short-term favorable effects regarding fruit and vegetable consumption could not reduce the adolescents' BMI (Ezendam et al., 2012). Even programs which also achieved increased physical activity levels could not reduce this index (Chen et al., 2011). Our analysis of homemade recipes and 24-hour recalls sent by students – services which have not been offered by other programs – could be the responsible factor of the positive impact on BMI. The key could also be the text-supplement, which is an affordable and well-tolerated measure (Woolford et al., 2010). On the other hand, fruit consumption was the behavior with the highest post-test improvement. Improvement rates were similar in all groups. Improvement in the CG behavior is not uncommon, since even the questionnaire used for collecting information can also have an educational value (Nichols et al., 2012). But if the intervention had been very efficient, differences between groups would have been even greater. Web-based interventions can achieve favorable changes in diet (Carlson et al., 2012; Chen et al., 2011; Ezendam et al., 2012), however, maintaining them for a long period of time would involve a higher involvement of the school environment as well as long-term feedback (Hamel and Robbins, 2013).

EG2's TCBR score decreased by approximately five points from pre-test to post-test measurements. An identical fall was reported by López et al. (2007) in a similar multi-behavior intervention program. However, their intervention was implemented in adults and without using current communication technology. In addition, only EG2 students might improve the post-test TCBR score. Furthermore, as the ORs were very consistent in different adjustment models, we consider that the web-based intervention supplemented with text messages was the real responsible factor of the TCBR score change. The traditional web-based intervention (EG1) had no positive impact either on the TCBR score or on the behaviors. For the invention's success text-supplementation (EG2) was needed. It is difficult to determine if text messages acted as an additional educational tool or as a memorandum for visiting the website, which apparently was their most effective use (Militello et al., 2012). In any case, text messages are cheap, user-friendly and well tolerated resources, which are accepted by the majority of adolescents (Greaney et al., 2012; Militello et al., 2012).

As far as we are aware, this is the first intervention which, on the one hand, attempts to improve simultaneously such a high number of risky adolescent behaviors, and on the other hand, is based on a tailor-made website, text messages and the school curriculum. Werch et al. (2011) executed a more successful multiple intervention in adolescents, however both studies are not comparable because Werch's did not utilize this kind of technology and their follow-up was shorter. In our study, the simultaneous intervention on six risk-related behaviors was a strong point since we looked for the highest efficiency. However, this made the program much more complex, and consequently achieving changes in isolated behaviors was more difficult. In addition, Lippke et al. (2012) showed that changing one behavior increases the probability of changing other related behaviors. In this respect, it is possible that the BMI improvement in some adolescents has taken place due to physical activity and diet recommendations. In addition, we are optimistic about the efficacy of the Internet and cell phones in adolescent cancer prevention, due to the global TCBR improvement.

Among the limitations of the study was a possible selection bias since involvement was a voluntary activity — the use of educational interventions must never be forced. However, it did not affect study groups differentially. An information bias could have also been possible where respondents may not have been sincere. This is an inherent bias to all surveys, and affects all study groups.

Conclusion

A complex educational intervention delivered through a customized website achieved a modest impact on cancer behavioral risk control when supplemented with text messages. The greatest positive impact was seen in the reduction of overweight prevalence.

Conflict of interest statement

The authors declare no conflict of interest. This study was funded by the Spanish Ministry of Health. The financial backer had no role in the study design or in the collection, analysis and interpretation of data. Both the writing of the manuscript and the decision to submit it for publication belong to the authors, who acted independently of the financial backer. All contributors had access to all data.

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