

Cost-effectiveness and cost-utility analyses of a web-based computer-tailored intervention for prevention of binge drinking among Spanish adolescents

Ana Magdalena Vargas-Martínez¹  | Marta Lima-Serrano¹  | Marta Trapero-Bertran² 

¹Department of Nursing, Faculty of Nursing, Physiotherapy and Podiatry, University of Seville, Seville, Spain

²Department of Basic Sciences, University Institute for Patient Care, Universitat Internacional de Catalunya (UIC Barcelona), Barcelona, Spain

Correspondence

Marta Lima-Serrano, Department of Nursing, Faculty of Nursing, Physiotherapy and Podiatry, University of Seville, Seville, Spain.
Email: mlima@us.es

Funding information

Agència de Gestió d'Ajuts Universitaris i de Recerca, Grant/Award Number: SGR 2017-2019; Consejería de Salud y Bienestar Social, Junta de Andalucía, Grant/Award Number: PI-0031-2014; Secretaría de Estado de Investigación, Desarrollo e Innovación, Grant/Award Number: ECO2017-83771-C3-3-R; Consejería de Salud de la Junta de Andalucía, Grant/Award Number: PI-0012-2017

Abstract

Background: Binge drinking (BD) among adolescents is a public health concern worldwide. This study assessed the cost-effectiveness and cost-utility of a web-based computer-tailored intervention to prevent BD in adolescence.

Methods: The sample was drawn from a study evaluating the *Alerta Alcohol* program. The population consisted of adolescents 15 to 19 years of age. Data were recorded at baseline (January to February 2016) and after 4 months (May to June 2017) and were used to estimate costs and health outcomes, as measured by the number of BD occasions and quality-adjusted life years (QALYs). Incremental cost-effectiveness and cost-utility ratios were calculated from National Health Service (NHS) and societal perspectives and for a time horizon of 4 months. A multivariate deterministic sensitivity analysis of best/worst scenarios by subgroups was used to account for uncertainty.

Results: The cost of reducing BD occasions by one per month was €16.63 from the NHS perspective, which from the societal perspective resulted in savings of €7986.37. From the societal perspective, the intervention resulted in an incremental cost of €71.05 per QALY gained from the NHS perspective and this was dominant, resulting in savings of €34,126.64 per QALY gained in comparison with the control group. Subgroup analyses showed that the intervention was dominant for girls from both the perspectives and for individuals 17 years or older from the NHS perspective.

Conclusions: Computer-tailored feedback is a cost-effective way to reduce BD and increase QALYs among adolescents. However, long-term follow-up is needed to evaluate more fully changes in both BD and health-related quality of life.

KEYWORDS

adolescents, alcohol, binge drinking, cost-effectiveness, cost-utility, Spain

Trial registration number ([ClinicalTrials.gov](https://clinicaltrials.gov)): NCT03288896

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial](https://creativecommons.org/licenses/by-nc/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2023 The Authors. *Alcohol: Clinical & Experimental Research* published by Wiley Periodicals LLC on behalf of Research Society on Alcohol.

INTRODUCTION

Globally, alcohol was responsible for 17.6% of all injury deaths and 7.2% of all premature mortality in 2016 (World Health Organization [WHO], 2018). Worldwide, this proportion was highest among people 20 to 39 years of age (13.5%) (WHO, 2018). Europe was the region with the highest proportions of deaths attributable to alcohol consumption in all age groups, with the highest percentage (27%) occurring among people 25 to 29 years of age and over 15% occurring among adolescents 15 to 19 years of age (WHO, 2018).

Moreover, young people tend to consume larger amounts of alcohol per occasion than adults (Substance Abuse and Mental Health Administration [SAMHSA], 2018). Heavy episodic drinking (HED; defined as drinking five or more drinks, 60 or more grams of pure alcohol, on at least one occasion at least once per month) among young people aged 15 to 19 years is particularly prevalent in Europe (24.1%, WHO, 2018). Despite reductions in HED among adolescents (15 to 19 years old) in Europe from 2000 (35.1%) to 2016 (24.1%), according to the WHO *Global Status Report on Alcohol and Health 2018*, levels of consumption remain dangerously high, and HED among adolescents continues to be a major public health concern (WHO, 2018).

"Binge drinking" (BD), another term for HED, has been defined as consuming five or more standard drinks per occasion for men and four or more drinks for women on the same occasion (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2019). In the countries and regions of Europe and North America, prevalence of BD increases sharply in adolescence and peaks in early adulthood (around the age of 20 to 25) reaching almost 40% (Kuntsche & Gmel, 2013). Subsequently, prevalence rates decrease with age. Surveys on drug and alcohol use among adolescents in secondary education in Spain (ESTUDES, 2016 to 2017) have shown high prevalence of BD among adolescents aged 14 to 18 (31.7%) (Delegación del Gobierno para el Plan Nacional sobre Drogas [National Plan on Drugs], 2018).

In particular, literature on the economic consequences (healthcare and nonhealthcare costs) of BD is scarce. In the European Union, alcohol-attributable costs were estimated at €125 billion in 2003 (Anderson & Baumberg, 2006). We did not find any studies related specifically to costs associated with BD and underage drinking in Europe. However, previous work has shown that youth drinkers are at greater risk of involvement in violence, low educational attainment, and low college expectations, putting a financial burden on the criminal justice system and the education sector (Drost et al., 2016; Waterman et al., 2019). In addition to these consequences, Böckerman et al. (2017) discovered a negative association between BD and months of employment, and subsequently with long-term adverse labor market outcomes. The foregoing suggests a need to intervene to change young people's behavior in relation to BD. A variety of interventions have been developed to tackle this public health issue, but those aimed at preventing BD specifically are scarce (Anderson-Carpenter et al., 2016; Foxcroft &

Tsertsvadze, 2011; Hanewinkel et al., 2017; MacArthur et al., 2015). Khadjesari et al. (2011), in a systematic review about the effects of computer-based interventions aimed at reducing alcohol consumption, concluded that these types of interventions are more effective than minimally active comparator groups (such as generic nontailored information or educational materials, assessment-only) not only at reducing alcohol consumption in both student and nonstudent adult populations but also at reducing the binge frequency in student populations. Among the advantages of this type of computer-based intervention that could be highlighted are the scalability of a public health intervention, the delivery of an individualized approach, increased access to the program, flexibility of use, and the low cost per additional user (Copeland & Martin, 2004; Linke et al., 2007; Murray, 2009). In addition, the other advantages of online intervention over face-to-face intervention for alcohol abuse described in the literature include convenience, easy access, anonymity (given the stigma surrounding alcohol abuse), and ongoing availability (Murray et al., 2013). Tait and Christensen (2010) found that web and brief face-to-face interventions aimed at alcohol-related problems had an almost equivalent effect, but web interventions offer the advantage that they can be applied to a much larger proportion of the target population.

Many international and national interventions have sought to prevent alcohol use among adolescents, but neither their cost-effectiveness has seldom been assessed, nor has the efficiency of the interventions been evaluated (Alayli-Goebbels et al., 2014; Drost et al., 2016; Sumnall et al., 2017). Among these studies, the study by Drost et al. (2016), which assesses the efficiency of the intervention (Jander et al., 2014) and on which our study is based in Dutch population, found that computer-tailored intervention could be a cost-effective measure to target alcohol consumption in adolescence. This intervention is based on the I-change model (de Vries, 2017; de Vries et al., 2005). In the context of budget constraints, it seems important to study the cost-effectiveness of interventions to better inform health decision-making. In particular, there is a need to evaluate the cost-effectiveness of different interventions that are being, or could be, implemented to tackle the problem of BD among adolescents. In addition, WHO set as a priority goal to make efforts aimed at reducing BD in populations, particularly among young people (WHO, 2018).

The aim of the current study is to analyze the cost-effectiveness and utility of *Alerta Alcohol*, a web-based, computer-tailored intervention to prevent BD among adolescents 15 to 19 years of age in Andalusia, Spain. We compare the *Alerta Alcohol* program to the absence of any intervention. This program, adapted from previously described Dutch program known as *Alcohol Alert*, is a web-based, computer-tailored intervention that addresses the cognitive (e.g., knowledge and risk perception) and motivational factors (e.g., attitude, social influence, and self-efficacy) related to alcohol consumption and BD in adolescents. Furthermore, we provide plans to avoid these risky behaviors (for more information about the study design, see Lima-Serrano et al. (2018) and Tables S1 and S2).

MATERIALS AND METHODS

The structure of this section has been developed following the ISPOR RCT-CEA Task Force Report (Ramsey et al., 2005) for economic evaluations based on a clinical trial. The study adhered to the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) for economic evaluations.

Trial-related issues

The sample was part of a two-arm cluster randomized controlled trial, with one intervention group and one waiting-list control group, which evaluated an intervention aimed at reducing BD among adolescents (15 to 19 years of age) in Andalusian secondary schools through a web-based computer-tailored program known as *Alerta Alcohol*. A total of 1247 adolescents from 15 public high schools were assessed at baseline (January to February 2017) and 612 adolescents at 4-month follow-up (May to June 2017). However, because the collection of cost data began later in time, complete data were only available on effectiveness and costs for 367 adolescents that were included in this economic evaluation analysis. A detailed description on the pattern of missing data and characteristics of the intervention and control group is provided in a previously published article (Vargas-Martínez et al., 2019).

Figure S1 shows a flowchart with the number of participants at baseline and follow-up according to Consolidated Standards of Reporting Trials (CONSORT).

Alerta Alcohol program provided feedback through preventive messages and personalized information about the benefits of not consuming alcohol, with the aim of reducing positive attitudes about and excessive consumption of alcohol, while assessing social influences and self-efficacy. The tailored messages were based on the I-change model, which integrates elements of various models of social cognition and self-regulation, such as Ajzen's Theory of Planned Behaviour, Bandura's Social Cognitive Theory, and Prochaska's Transtheoretical Model, the Health Belief Model and Implementation and Goal setting theories, and assumes that behavior is the result of the individual's intentions, action plans, and abilities (de Vries, 2017; de Vries et al., 2005). This intervention comprised six sessions. In initial session or first session, participants completed a baseline questionnaire, which elicited information on demographics, alcohol use behaviors, mediator variables such as motivational determinants (attitude, social influences, and self-efficacy), and cost measures (healthcare and nonhealthcare costs) (more details in Section 2.2). This initial session was followed by the second and third sessions and a 1- to 2-week period between sessions, which comprise a short story in which the main character wakes up after an evening in which he/she consumed alcohol excessively and does not remember what happened. Those stories take place at home (Session 2), at celebrations (Session 2), and in public places (Session 3). Under these scenarios, questions and tailored messages are offered. In the fourth session, adolescents could accept the challenge of not consuming

excessive alcohol at an upcoming event, and in the fifth session, the response to the challenge is evaluated. Finally, a sixth session, scheduled 4 months after the first session, was conducted to evaluate the intervention. The follow-up questionnaire included the same items as the baseline questionnaire, barring the demographic variables. The control group received only the baseline questionnaire and a follow-up questionnaire (Sessions 1 and 6) without receiving any active intervention in between.

Data for the economic study

A cluster randomized controlled trial-based economic evaluation was carried out along the *Alerta Alcohol* study (Lima-Serrano et al., 2018). Both the baseline and follow-up questionnaires comprised several sections (demographics; alcohol use behaviors; motivational determinants such as attitude, social influences, and self-efficacy; and cost measures such as healthcare and nonhealthcare costs) as mentioned above, which were validated and cross-culturally adapted to Spanish prior to the development of this study (Jander et al., 2014; Lima-Serrano et al., 2017). In addition, these questionnaires include the EQ-5D-5L questionnaire validated in Spain by Garcia-Gordillo et al. (2016). The questionnaires were completed during class in computer classrooms through the intervention website (<http://institucional.us.es/alertalcohol/>), where each student created a user account. The students were advised by a research technician and under the supervision of a professor. Thus, the economic evaluation was performed with patient-level data extracted from the trial.

The two sets of estimates (from Spanish Health System and societal perspective) are presented separately and differentiated. Table 1 shows details of the data required for evaluating costs and health outcomes.

More details are given below of the data/variables and costs used in this study.

First, we used the reduction in the number of BD occasions over the last 30 days and gains in the number of quality-adjusted life years (QALYs) to assess the primary health outcome or effects of *Alerta Alcohol* program. The results of the primary analysis of the program's effects on the quality of life and alcohol consumption were published before the economic evaluation (Vargas-Martínez et al., 2019).

Independent variables related to alcohol use were collected, such as family (father, mother, and siblings) alcohol consumption, family BD, peer alcohol consumption, and peer BD frequencies. These as well as other variables related to risk perception and mediator variables, such as motivational determinants (attitude, social influences, and self-efficacy), are part of the five scales used to measure the determinants of BD in Spanish adolescents, which were validated by Lima-Serrano et al. (2017).

The QALYs gained were calculated according to the difference between the adolescent's answers to the EQ-5D-5L questionnaire at two different time points (baseline and 4-month follow-up) assuming a linear change in QALY. We considered the adult version of the EQ-5D-5L that assesses one's health-related quality of life (HRQoL),

TABLE 1 Parameters for conducting the analysis (€2017); data are only for subjects included in the economic evaluation ($n = 367$)

Type of cost	Intervention group ($n = 210$)						Control group ($n = 157$)					
	Preintervention			Postintervention			Preintervention			Postintervention		
	n	Mean (SD) (€2017)	Min to max	n	Mean (SD) (€2017)	Min to max	n	Mean (SD) (€2017)	Min to max	n	Mean (SD) (€2017)	Min to max
Outcome measures												
Number of BD occasions	210	1.08 (1.86)	0 to 10	210	0.97 (1.81)	0 to 10	157	1.17 (2.08)	0 to 10	157	1.11 (2.24)	0 to 10
EQ utility index	190	0.94 (0.10)	0 to 1	175	0.96 (0.09)	0 to 1	135	0.92 (0.15)	0 to 1	144	0.94 (0.12)	0 to 1
Direct healthcare costs (DHC) ^a												
Hospital stays due to binge drinking												
Yes							1	496 (.)	496 to 496	1	496 (.)	496 to 496
No	2	0	0	0	0	0	1	0	0	2	0	0
Hospital stays due to an alcohol-induced coma												
Yes	0	0	0	0	0	0	0	0	0	1	1827.37 (.)	1827.37 to 1827.37
No	2	0	0	0	0	0	2	0	0	1	0	0
Emergency visits due to binge drinking (BD; hospital)												
Yes	0	0	0	0	0	0	1	285.66 (.)	285.66 to 285.66	1	142.83 (.)	142.83 to 142.83
No	0	0	0	0	0	0	0	0	0	1	0	0
Emergency visits and observations due to an alcohol-induced coma (hospital)												
Yes	2	388.19 (0)	388.19 to 388.19	0	0	0	2	388.19 (0)	388.19 to 388.19	1	388.19 (0)	388.19 to 388.19
No	0	0	0	0	0	0	0	0	0	1	0	0
Emergency visits due to BD (primary healthcare center)												
Yes	2	48.68 (0)	48.68 to 48.68	1	48.68 (.)	48.68 to 48.68	0	0	0	0	0	0
No	0	0	0	0	0	0	0	0	0	1	0	0
Emergency visits and observations due to an alcohol-induced coma (primary healthcare center)												
Yes	2	109.41 (0)	109.41 to 109.41	1	109.41 (0)	109.41 to 109.41	0	0	0	0	0	0
No	0	0	0	0	0	0	1	0	0	1	0	0
Emergency medical transports due to BD												
Yes	1	310.14 (0)	310.14 to 310.14	1	310.14 (0)	310.14 to 310.14	0	0	0	2	775.35 (657.91)	310.14 to 1240.56
No	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 1 (Continued)

Type of cost	Intervention group (n = 210)				Control group (n = 157)			
	Preintervention		Postintervention		Preintervention		Postintervention	
	n	Mean (SD) (€2017)	Min to max	n	Mean (SD) (€2017)	Min to max	n	Mean (SD) (€2017)
Emergency medical transports due to an alcohol-induced coma								
Yes	2	361.49 (0)	361.49 to 361.49	1	361.49 (0)	361.49 to 361.49	1	361.49 (.)
No	0			0			0	
Total direct healthcare costs (NHS perspective)		1217.91			829.72			3991.23
Direct nonhealthcare costs (DNHC)								
Traffic accidents (injured but not hospitalized)								
Yes	5	13,724.08 (10,250.44)	6238.22 to 24,952.88	5	8733.51 (3416.81)	6238.22 to 12,476.44	4	23,393.33 (9357.33)
No	189			175			141	
Average amount spent per day to arrest one person	0			1	58.81 (0)	58.81 to 58.81	5	164.67 (120.52)
Average cost per student per missed class	2	97 (82.31)	38.8 to 155.2	4	77.6 (31.68)	38.8 to 116.4	5	108.64 (57.55)
Direct costs to the subject (DCS)								
Price of cigarettes per smoker								
Yes	41	51.98 (75.82)	3.6 to 360	38	100.33 (126.74)	3.6 to 504	18	70 (95.33)
No	149			145			124	
Price of shisha (tobacco) per smoker								
Yes	56	447.04 (558.64)	146.4 to 3367.2	46	359.63 (282.38)	146.4 to 1317.6	43	708.17 (994.44)
No	135			138			103	
Total direct nonhealthcare costs + direct costs to subject		14,320.1			9329.88			24,487.1
Societal perspective (DHC + DNHC + DCS)		15,538.01			10,159.6			28,478.33

Note: The minimum and maximum values are referred to in the observed range.

^aQuestions about direct healthcare costs were answered only by adolescents who were engaged in BD during the last month. In addition, in relation to the questions about visits to the emergency room or hospital stays, adolescents were first asked if they had gone to a health center in general. If they answered "no," they were not asked the subsequent questions about emergency services, hospital stays, and emergency transport. Moreover, this occurred in the case of arrests and absenteeism or missed classes. Therefore, the sample size "n" for some cost units is very small (i.e., "0," "1," "2" ...).

since it applies to subjects from the age of 15 (Rowen et al., 2020). In addition, there is no set value for EQ-5D-Y, and it interferes with the calculation of QALYs (de Vries et al., 2005). This index was calculated using the Spanish value set (García-Gordillo et al., 2016; Hernández et al., 2018; Martín-Fernández et al., 2018; Ramos-Goñi et al., 2018).

Information on demographics (gender, age, economic situation at home, weekly pocket money, and parents' educational level), alcohol use behaviors, other substances use, and mediator variables such as motivational determinants (attitude, social influences, and self-efficacy) were collected through a clinical trial using a questionnaire to make the two groups comparable (intervention and control groups).

Within demographics variables, the economic situation at home was obtained using the question "Of the following situations, which one would you identify with the most?" The response options were converted into a dummy variable, which indicated a value of 1 "good economic situation at home" and a value of 0 "other economic situation." This question was developed ad hoc and used in another study carried out by Lima-Serrano et al. (2015).

The weekly pocket money availability was asked by means of the question "How many Euros do you have per week to spend on yourself?" with five response options: €0, €1 to 10, €11 to 20, €21 to 30, and more than €30. Notwithstanding these amounts were recoded into three categories—0 €, 1 to 20 €, and more than 20 €—due to proportions of each response category. Similar recode was used in the study carried out by Díaz Geada et al. (2018). Later, for analyses, this variable was converted to a numerical variable using the mean of each response option.

The parents' educational level was calculated according to the number of schooling years after answering a question with the following response categories: "No study," "Primary studies," "High school/professional training," and "University."

As regards to use of other substances (cocaine, nonprescribed tranquilizers, sedatives or sleeping pills and prescribed tranquilizers, sedatives, or sleeping pills), although its frequency of consumption was measured through a self-reported question based on the ESTUDES' questionnaire (Delegación del Gobierno para el Plan Nacional sobre Drogas [National Plan on Drug], 2018), only costs of cigarettes and shishas could be obtained from literature review. Additionally, the other substance use was minimal except for the consumption of cigarettes, shishas or hookahs, and cannabis.

The following direct healthcare and nonhealthcare costs related to the *Alerta Alcohol* program and BD behavior were identified and measured: (1) intervention costs (i.e., initial start-up costs for setting up and installing a database and making it available-TailorBuilder, license fee per project-TailorBuilder, hosting costs for *Alerta Alcohol* project November 2016 to July 2017, research technician for 6 days), (2) direct healthcare costs (i.e., costs for services within the healthcare sector), (3) direct nonhealthcare costs (i.e., costs for services outside the healthcare sector), and (4) direct costs to the subject (e.g., costs associated with use of tobacco or other substances) (see Table 2 for more details).

To aid the comparative quantitative analysis, the mean unit and annual costs were converted to €2017 using country-specific

or country-group-specific inflation on average consumer prices. Literature reviews were carried out between 2016 and 2019 and, where necessary, international (Eurostat, Database of Abstracts of Reviews of Effects [DARE], Health Technology Assessment [HTA], National Institute for Health Research Economic Evaluation Database [NHS EED], PubMed) and national (Official Journal [*Boletín Oficial del Estado*], Health Council of Andalusia) databases were used to acquire data for the analysis.

Methods of analysis

Cluster randomization was used to select the sample, but not to conduct the analyses. This type of randomization is often used among health service researchers, particularly in health promotion trials among children where these are conducted within a school setting by randomizing whole schools and/or full classes to include a new health promotion intervention (Puffer et al., 2005). In addition, cluster randomization is useful to avoid "contamination" between students who receive the program and those who did not, understood as the fact that the intervention group shares information with the control group within the same school, thus resulting in a probable dilution bias (Puffer et al., 2005).

A descriptive analysis of the characteristics of the sample was carried out, and a Wilcoxon–Mann–Whitney test was used to compare the means of the scores between values of variables in the intervention group and control group in the pre- and postintervention period, and Pearson chi-squared test to compare the frequencies. The preintervention period is defined as the baseline period prior to the delivery of the program, and the postintervention period is considered the one after the development of the program; it means 4 months after the start of the intervention.

A cost-effectiveness analysis (CEA) and cost-utility analysis (CUA) were carried out to evaluate the efficiency of the *Alerta Alcohol* program compared with not engaging in any active intervention. The health outcomes were, for the CEA, the difference in mean number of BD occasions in the last 30 days in the postintervention (4 months after baseline) and preintervention (baseline) periods obtained through the aforementioned questionnaire and for the CUA, the difference in mean group QALYs obtained through the EQ utility index. In both analyses, CEA and CUA, the difference in costs between the intervention and control groups was divided by the difference in health outcomes between both groups, resulting in the incremental cost-effectiveness and cost-utility ratio (ICER and ICUR, respectively).

In more details, the outcome unit used for the CEA was measured in terms of reducing the number of BD occasions in the last 30 days by subgroups (gender, age, and available pocket money). Data referring to each subject's BD occasions, as well as the costs and all the measures used in the analyses of this study, were obtained from the main clinical trial. The impact of *Alerta Alcohol* program intervention on BD by those subgroups (gender, age, and pocket money) was analyzed using a two-part model using backward stepwise selection method to

TABLE 2 Use of resources and direct healthcare and nonhealthcare costs and direct costs to subject

Societal perspective	NHS perspective	Perspective-type of cost	Unit of measurement	Unit cost (€2017)	Source
	Intervention costs				
		Initial start-up costs for setting up and installing a database and making it available (TailorBuilder)		785.00	
		License fee per project (TailorBuilder)		2350.00	
		Hosting costs for the <i>Alerta Alcohol</i> project November 2016 to July 2017 (35 weeks)	Cost per week	10.00	
		Research technician (for 6 days)	Salary	225.50	
		Direct healthcare costs			
		Hospital stay due to BD	Average price per hospitalization/subject	490.73	Servicio Andaluz de Salud (2005)
		Hospital stay due to an alcohol-induced coma	Average price per hospitalization/subject	1827.37	
		Emergency hospital visit due to BD	Per consultation	142.83	
		Emergency hospital visit due to an alcohol-induced coma	Per consultation	388.19	
		Emergency primary healthcare center visit due to BD	Per consultation	48.68	
		Emergency primary healthcare center visit due to alcohol-induced coma	Per consultation	109.41	
		Emergency medical transport due to BD	Per trip or service	310.14	
		Emergency medical transport due to alcohol-induced coma	Per trip or service	361.49	
		Direct nonhealthcare costs			
		Traffic accident (injured but not hospitalized)	Per accident	6238.22	Dirección General de Tráfico (2016)
		Arrest of one person	Average amount spent per day	58.81	Aebi et al. (2016)
		Missed classes at school	Average cost per student per missed class	38.80	European Commission (n.d.)
		Direct costs to subject			
		Tobacco use (cigarettes)	Per pack of cigarettes	4.5	Agencia Estatal Boletín Oficial del Estado (2017b)
		Tobacco use (shisha)	Per unit	9.15	Agencia Estatal Boletín Oficial del Estado (2017a)

TABLE 3 Impact of the *Alerta alcohol* program intervention on BD through two-part model (marginal effects), by subgroup

Number of BD occasions	Gender		Age		Pocket money		
	Female	Male	<17 years	≥17 years	€0	€1 to 20	>€20
Intervention							
Period ^a	0.190 (0.25)	0.380 (0.26)	0.188 (0.15)	0.649 (0.37)*	0.599 (0.44)	0.153 (0.19)	0.142 (0.56)
Treated ^b	0.234 (0.18)	0.199 (0.16)	0.126 (0.14)	0.322 (0.21)	0.195 (0.27)	0.276 (0.14)*	-0.303 (0.45)
Intervention impact ^c	-0.190 (0.28)	-0.542 (0.29)*	-0.129 (0.20)	-1.076 (0.46)**	-0.583 (0.46)	-0.341 (0.23)	0.041 (0.76)
Adherence to intervention ^d	-0.138 (0.07)**	-0.055 (0.06)	-0.063 (0.06)	-0.134 (0.09)	-0.109 (0.12)	-0.126 (0.05)**	0.066 (0.20)
Socioeconomic							
Age	0.242 (0.06)***	0.277 (0.07)***	0.410 (0.08)***	0.134 (0.11)	0.068 (0.10)	0.314 (0.05)***	0.251 (0.13)*
Female ^e			0.045 (0.10)	0.182 (0.22)	0.173 (0.17)	-0.038 (0.11)	0.636 (0.45)
Spanish ^f	0.376 (0.37)	0.060 (0.54)	0.074 (0.33)	0.535 (0.39)	-0.375 (0.56)	0.847 (0.37)**	-0.692 (0.56)
Nuclear family composition ^g	-0.014 (0.12)	-0.223 (0.10)**	-0.089 (0.11)	-0.125 (0.13)	-0.031 (0.16)	-0.143 (0.08)*	-0.002 (0.25)
Mother's schooling years	-0.001 (0.00)	-0.004 (0.00)**	-0.003 (0.00)**	-0.000 (0.00)	0.003 (0.00)**	-0.004 (0.00)***	0.005 (0.01)
Good economic situation at home ^h	0.052 (0.10)	0.003 (0.11)	-0.010 (0.09)	0.049 (0.19)	-0.113 (0.21)	-0.011 (0.11)	0.245 (0.36)
Pocket money (weekly)	0.030 (0.01)***	0.011 (0.01)*	0.013 (0.01)**	0.039 (0.01)**			
Weekly day when the questionnaire was completed ⁱ	-0.522 (0.14)***	-0.073 (0.13)	-0.341 (0.10)***	-0.358 (0.21)*	-0.321 (0.22)	-0.299 (0.13)**	-0.022 (0.40)
Completed questionnaire close to local events	0.005 (0.01)	-0.008 (0.01)	-0.010 (0.00)	-0.000 (0.01)	0.001 (0.01)	-0.003 (0.01)	-0.001 (0.02)
Family model							
Family alcohol consumption ^j	0.525 (0.09)***	0.455 (0.10)***	0.405 (0.09)***	0.697 (0.10)***	0.236 (0.23)	0.458 (0.06)***	0.816 (0.26)***
N	1322	1172	1552	942	288	1764	344
Wald χ^2	182.72	182.72	182.72	182.72	182.72	182.72	182.72
Log likelihood	-1432.04	-1432.04	-1432.04	-1432.04	-1432.04	-1432.04	-1432.04

Note: Average values and standard deviations are shown in brackets. ***, **, * and * represent a significance level of 1%, 5% and 10%, respectively; 1000 replications were used for bootstrapping analysis, and standard errors were clustered at classroom level.

^a1 = Postintervention period 1; 0 = Preintervention period.

^b1 = Intervention group; 0 = Control group.

^cThe product of the number of subjects who participated in the program and the difference in the number of BD occasions between the post- and preintervention periods.

^dAdherence to the intervention based on the number of sessions completed.

^e1 = female; 0 = male.

^f1 = Spanish; 0 = other nationality.

^g1 = nuclear family (father, mother and/or brother(s) and sister(s)); 0 = other.

^h1 = Good economic situation at home; 0 = other.

ⁱWeekly day when the questionnaire was completed (closeness to the last weekend): 1 = Completed the questionnaire on Wednesday, Thursday or Friday; 0 = Completed the questionnaire on Monday or Tuesday.

^jFamily alcohol consumption: 0 = Mother, father, and siblings do not binge drink; 1 = Mother, father, or siblings binge drink occasionally or more frequently; 2 = Two members of the family (mother, father, or siblings) binge drink occasionally or more frequently; 3 = Mother, father, and siblings binge drink occasionally or more frequently.

incorporate the covariates (Table 3). Specifically, the first part of the two-part model is estimated using a logit regression model, and the second part is specified as a generalized linear model panel regression. This model was used because of the presence of a large proportion of zero count observations (Mora et al., 2015), and it was carried out with the initial sample ($n = 1247$). Owing to the high desertion rate in the postintervention period, for the majority of variables in the follow-up questionnaire, we decided not to use multiple imputation and instead conducted the analysis with pairwise deletion. Despite the fact that the postintervention dropout rate was more than 50%, the use of multiple imputation methods was ruled out. As Rubin (1987) states, although this type of analysis generates good results even when desertion reaches 50%, others (Medina & Galván, 2007) do not recommend imputing data in which the desertion in one or more variables is greater than 20%, especially when the results support the design of public policies. An alternative to data imputation that mitigates data loss is the pairwise elimination technique, which uses all available cases in the data analysis procedure.

The covariates were selected after conducting correlation analyses. In addition, the backward stepwise selection method was used to obtain the most parsimonious model.

Cost-effectiveness and cost-utility analyses were carried out for three subgroups (defined by gender (female/male), age (<17 years of age/ ≥ 17 years of age), and weekly pocket money (€0/€120/>€20)) due to differences found in the literature in these subgroups (Crocamo et al., 2018; Drost et al., 2016; Jönsson, 2009; Nur et al., 2017). Uncertainty was studied through multivariate deterministic sensitivity analysis of best/worst scenarios by the same subgroups mentioned above. In this type of analysis, several parameters are modified and values that combine the parameters producing the best and worst cost-effectiveness ratios and the most optimistic and pessimistic scenarios are chosen to examine if the intervention is cost-effective in an extreme scenario. These values were chosen through the 95% confidence interval for the effectiveness measures used in the analyses (i.e., the number of BD occasions avoided over the last month and the number of QALYs gained) by each subgroup. The minimum value of the 95% confidence interval for both measures would constitute the worst scenario and the maximum the best.

The main outputs used in this analysis were the ICER and ICUR. We used the cost-utility threshold for Spain of €21,000 to €24,000 per QALY (Vallejo-Torres et al., 2016).

A time horizon of 4 months was evaluated, so no discount rate was applied because of the short time horizon. Subgroup analysis was carried out by age, gender, and availability of pocket money. All estimates were calculated from the Spanish National Health Service (NHS) perspective as well as from the societal perspective.

The analysis was conducted using Stata version 14.0 (StataCorp) and Microsoft Excel version 16.16.5.

Ethics approval

The study received approval from the Bioethics Committee of Andalusia (registration number: PI-0031-2014, 04 August 2015).

Written informed consent was obtained from parents and students prior to participation in the study. The questionnaires were self-completed by the adolescents and confidentiality was ensured.

RESULTS

Sample characteristics

In relation to socioeconomic characteristics, age at the beginning of intervention by group (intervention and control groups) and current job situation of the adolescent's father were statistically significant. In the baseline period, there were statistically significant differences in relation to the number of glasses of alcohol consumed in outdoor public places and siblings' BD frequency. In the postintervention period, there were statistically significant differences in relation to siblings' alcohol use frequency, adolescent's father BD frequency, and adolescent's shishas or hookahs use (see Table 4).

Table 1 also shows that total direct healthcare costs were lower in the intervention group (€829.72) than in the control group (€3991.23) at the 4-month follow-up point. This difference can be explained largely by the difference in cost of a reported hospital stay. While no hospital stay was reported by the intervention group before taking the *Alerta Alcohol* program (baseline period) or at a 4-month follow-up session, in the control group, a hospital stay owing to BD was reported in the baseline period, and two hospital stays were reported at the 4-month follow-up session. Total direct nonhealthcare costs were also lower in the intervention group (€9329.88) than in the control group (€24,487.1). This difference was mainly related to traffic accidents. Additionally, the number of BD occasions decreased and HRQoL increased in both groups, but the effect was greater in the intervention group than in the control group. The mean intervention cost calculated for all adolescents who received the program in the trial on which this study is based ($n = 712$) was of €5.26 per adolescent. An increase in number of adolescents receiving the program does not increase the intervention cost.

As shown in Table 3 through the variable "intervention impact," the program showed a statistically significant reduction in number of BD occasions of 1.076 between the baseline period and the follow-up period in the older group (≥ 17 years). Similarly, females and those who had available pocket money of between €1 and €20 showed greater adherence to the intervention and a reduction in number of BD occasions of 0.138 and 0.126, respectively.

Incremental cost-effectiveness and cost-utility ratios (ICERs and ICURs)

ICERs differed from both perspectives. Cost of reducing BD occasions by one per month was €16.63 from the NHS perspective. Notwithstanding, the intervention was dominant from the societal perspective resulting in savings of €7986.37 by one BD occasion averted per month. This cost savings is obtained by dividing the difference in total costs (–€278.12) by the difference in the

TABLE 4 Characteristics of the sample in the pre- and postintervention period by intervention or control group ($n = 367$)

	Preintervention		Postintervention	
	Intervention ($n = 210$)	Control ($n = 157$)	Intervention ($n = 210$)	Control ($n = 157$)
Numerical variables				
Socioeconomic				
Age at the beginning of the program	16.78 (0.96)	16.36 (0.84)***		
Family functionality: APGAR	1.69 (0.57)	1.70 (0.56)		
Years of schooling of the mother	11.32 (3.39)	11.73 (3.00)		
Years of schooling of the father	11.41 (3.15)	11.09 (3.26)		
Pocket money (weekly)	10.12 (8.82)	11.66 (9.76)		
HRQoL (EQ index value)	0.94 (0.10)	0.91 (0.17)*	0.96 (0.09)	0.94 (0.12)
Alcohol consumption				
Number of BD occasions	0.94 (1.67)	1.02 (1.93)	1.05 (2.25)	1.20 (2.78)
Frequency of alcohol use in public outdoor places (number of times a month)	1.42 (2.60)	0.98 (2.22)*	1.07 (2.30)	0.71 (1.81)
“...” at parties or celebrations (times a month)	1.46 (2.54)	1.77 (2.78)	1.27 (2.42)	1.37 (2.49)
“...” at home or at someone else's home (times a month)	0.98 (2.25)	1.23 (2.52)	0.63 (1.37)	0.85 (1.94)
Glasses of alcohol consumed in outdoor public places	1.86 (2.24)	1.07 (1.79)***	1.51 (2.27)	1.14 (2.35)
“...” at parties or celebrations	2.56 (2.75)	2.68 (2.76)	2.22 (2.37)	2.34 (2.98)
“...” at home or at someone else's home	1.33 (2.23)	1.56 (2.19)	1.10 (2.01)	1.35 (2.22)
Consumption of other substances				
Number of cigarettes a week	3.12 (11.37)	2.76 (11.87)	5.79 (19.51)	4.52 (14.8)
Number of shishas or hookahs a week	0.90 (2.48)	1.39 (3.31)	0.61 (1.43)	1.43 (4.27)**
Categorical variables				
Socioeconomic				
Being female (vs. male)	119 (56.67)	77 (49.05)		
Being Spanish (vs. no Spanish)	203 (96.67)	144 (92.90)		
Being Catholic (vs. another religion)	132 (62.86)	106 (67.52)		
No religion (vs. religion)	68 (32.38)	40 (25.48)		
Family composition: Nuclear	158 (75.24)	115 (73.25)		
Current job situation of the mother (yes)	129 (65.48)	91 (75.83)*		
Current job situation of the father (yes)	147 (83.05)	77 (70.0)***		
Good economic situation at home	92 (43.81)	74 (47.13)		
Economic difficulties at home	83 (39.52)	47 (29.94)*		
Completing the questionnaire later in the week	146 (69.52)	101 (64.33)		
Alcohol consumption				
Alcohol use over the last weekend [yes]	45 (21.43)	32 (20.38)	57 (27.14)	34 (21.66)
Mother consumes alcohol occasionally/more frequently	43 (20.48)	38 (24.20)	50 (23.81)	30 (19.11)
Father “...”	89 (42.38)	59 (37.58)	77 (36.67)	55 (35.03)
Siblings “...”	40 (19.05)	37 (23.57)	34 (16.19)	39 (24.84)**
Partner “...”	36 (17.14)	25 (15.92)	32 (15.24)	21 (13.38)
Friends “...”	180 (85.71)	128 (81.53)	158 (75.24)	118 (75.16)
Best friend “...”	137 (65.24)	89 (56.69)*	123 (58.57)	79 (50.32)
Mother binge drinks more frequently	7 (3.33)	9 (5.73)	10 (4.76)	8 (5.10)
Father “...”	32 (15.24)	25 (15.92)	34 (16.19)	14 (8.92)**
Siblings “...”	19 (9.05)	25 (15.92)**	22 (10.48)	16 (10.19)

TABLE 4 (Continued)

	Preintervention		Postintervention	
	Intervention (n = 210)	Control (n = 157)	Intervention (n = 210)	Control (n = 157)
Partner "..."	25 (11.90)	16 (10.19)	21 (10.0)	17 (10.83)
Friends "..."	151 (71.90)	102 (64.97)	134 (63.81)	95 (60.51)
Best friend "..."	100 (47.62)	60 (38.22)*	103 (49.05)	63 (40.13)*
Consumption of other substances				
Being a smoker or a tobacco user (cigarettes or shishas/hookahs)	85 (40.48)	57 (36.31)	76 (36.19)	61 (38.85)
Being a cannabis user	20 (9.52)	18 (11.46)	27 (12.86)	24 (15.92)
Prescribed tranquilizers, sedatives, or sleeping pills (yes)	5 (2.38)	6 (3.82)	10 (4.76)	9 (5.73)
Not prescribed tranquilizers, sedatives, or sleeping pills (yes)	5 (2.38)	6 (3.82)	6 (2.86)	8 (5.10)

Note: We show the average values and standard deviations in brackets for the numerical variables and frequencies and percentages in brackets for the categorical variables. ***, **, and * represent statistical significance at a 1%, 5%, and 10% level between the values of variables in the intervention and control groups in the pre- and postintervention periods (second and third columns, fourth and fifth columns, respectively).

effectiveness measure (0.0348), for the intervention group versus control group (see Table 5). Because there was a cost reduction in the intervention group at the 4-month follow-up, which did not occur in the control group, the difference yields a negative result, which generates monetary savings. Conversely, regarding the measure of effectiveness, there was a greater reduction in the monthly number of BD occasions in the intervention group than in the control group.

With regard to QALYs gained, the intervention was more expensive but also more effective (a difference of 0.0081 QALYs gained between intervention and control conditions), resulting in an incremental cost of €71.05 per QALY gained from the NHS perspective in comparison with the control condition. From the societal perspective, this intervention was dominant resulting in savings of €34,126.64 per QALY gained (see Table 5).

Subgroup and sensitivity analyses

For reduction in the number of BD occasions per month, the intervention was dominant for girls resulting in savings for both perspectives. Nonetheless, the intervention was not effective for boys. From the NHS perspective, the intervention was dominant only for girls that resulted in savings of €2163.6 per QALY gained; meanwhile, for boys, the intervention was cost-effective with an incremental cost of €2710.92 per QALY gained. An analysis by gender was carried out from both the perspectives, but the results did not change at decision level from the societal perspective when the effect measure used was QALY finding that the intervention was dominant for girls and boys, resulting in savings of €35,332.38 and €39,289.26 per QALY gained, respectively.

By age, the intervention was dominant from the NHS perspective for older adolescents (≥17 years of age), resulting in savings of €34.33 per BD occasion averted, and it could be cost-effective from the societal perspective. A difference was noted when the outcome measure used was QALY gained, finding that the intervention was cost-effective from NHS perspective with an incremental cost of

€213.64 per QALY gained and dominant from the societal perspective for younger adolescents (<17 years) with savings of €25,499.25 per QALY gained.

In relation to pocket money, the intervention proved more cost-effective for those who had no pocket money using both outcome measures, number of BD occasions averted, and QALYs gained. However, some differences were found in those who had a pocket money available between €1 and €20 and those who had more than €20. The *Alerta Alcohol* program was not cost-effective from both perspectives for QALYs for those who had a pocket money between €1 and €20 and for reducing the number of BD occasions for those who had a pocket money more than €20.

The best scenario showed that the intervention could be cost-effective in reducing the number of BD occasions from NHS perspective and dominant from the societal perspective. Regarding QALYs gained, the best scenario showed its cost-effectiveness from NHS perspective and its dominance from the societal perspective (see Table 5 and Figure S2).

DISCUSSION

To our knowledge, this study is the first to examine the cost-effectiveness and cost-utility of a web-based intervention carried out among adolescents with the aim of preventing BD in Spain. The intervention showed cost-effectiveness and cost-utility from both NHS and societal perspective, based on the BD occasions outcome measure and QALYs in comparison with no active intervention.

Regarding the type of intervention, in addition to studies that are already cited, the results of Donoghue et al.'s (2014) systematic review and meta-analysis indicate that an intervention based on electronic screening and brief intervention (eSBI) not only results in a significant reduction in weekly alcohol consumption during the intervention and control conditions in different follow-up periods, but it also has a lower implementation cost and wider accessibility

TABLE 5 ICERs and ICURs and multivariate deterministic sensitivity analysis of best/worst scenarios using the base data for the NHS (financier) and societal perspectives, with number of BD occasions in the last 30 days as the outcome variable (discount rate 0%)

Subgroups of the sample	NHS perspective						Societal perspective					
	Scenario	Incremental cost (£2017)	Incremental cost (£2017)	ICER (£2017)	Incremental effect (QALYs)	ICUR (£2017)	Incremental cost (£2017)	Incremental cost (£2017)	ICER (£2017)	Incremental effect (number of BD occasions less)	ICUR (£2017)	Incremental effect (QALYs)
Total sample	Best	0.58	0.2656	2.18	0.0336	17.21	-903.13	-903.13	D	0.2656	0.0336	D
	Base data	0.58	0.0348	16.63	0.0081	71.05	-278.12	-278.12	D	0.0348	0.0081	D
	Worst	0.58	-0.1959	d	-0.0173	-33.39	346.89	346.89	d	-0.1959	-0.0173	d
Female	Best	-23.25	0.5013	D	0.0484	D	-964.49	-964.49	D	0.3564	0.0358	D
	Base data	-23.25	0.1685	D	0.0108	D	-379.75	-379.75	D	0.1685	0.0108	D
	Worst	-23.25	-0.1641	141.69	-0.0269	-865.88	298.63	298.63	d	-0.1323	-0.0161	d
Male	Best	11.52	0.2079	55.37	0.0384	300.23	-392.05	-392.05	D	0.2079	0.0384	D
	Base data	11.52	-0.1293	d	0.0043	2710.92	-166.88	-166.88	D	-0.1293	0.0043	D
	Worst	11.52	-0.4666	d	-0.0297	d	58.28	58.28	d	-0.4666	-0.0297	d
<17 years old	Best	3.54	0.1714	20.68	0.0454	78.15	-888.46	-888.46	D	0.1714	0.0454	D
	Base data	3.54	-0.0482	d	0.0166	213.64	-423.01	-423.01	D	-0.0482	0.0166	D
	Worst	3.54	-0.2678	d	-0.0122	d	42.45	42.45	d	-0.2678	-0.0122	d
≥17 years old	Best	-10.40	0.8649	D	0.0248	D	-1078.73	-1078.73	D	0.8649	0.0248	D
	Base data	-10.40	0.3030	D	-0.0244	426.21	549.80	549.80	D	0.3030	-0.0244	d
	Worst	-10.40	-0.2589	40.18	-0.0736	141.26	2178.33	2178.33	d	-0.2589	-0.0736	d
Pocket money = €0	Best	5	1.1463	4.36	0.1344	37.19	-437.27	-437.27	D	1.1463	0.1344	D
	Base data	5	0.4650	10.75	0.0298	167.53	33.67	33.67	D	0.4650	0.0298	D
	Worst	5	-0.1921	d	-0.0747	d	504.61	504.61	d	-0.1921	-0.0747	d
Pocket money = €1 to 20	Best	9.86	0.3627	27.18	0.0212	464.12	-1186.30	-1186.30	D	0.3627	0.0212	D
	Base data	9.86	0.1024	96.26	-0.0074	d	-339.42	-339.42	D	0.1024	-0.0074	D
	Worst	9.86	-0.1591	d	-0.0360	d	507.46	507.46	d	-0.1591	-0.0360	d
Pocket money = >€20	Best	-40.24	0.8732	D	0.1352	D	-1199.01	-1199.01	D	0.8732	0.1352	D
	Base data	-40.24	-0.4454	90.37	0.0571	D	-270.34	-270.34	D	-0.4454	0.0571	D
	Worst	-40.24	-1.7639	22.82	-0.0210	1919.20	658.34	658.34	d	-1.7639	-0.0210	d

Note: "D" = Dominant; "d" = dominated. An intervention or program is considered "Dominant" when it is superior in effectiveness and its adoption involves fewer resources than its comparator. The opposite case would be one in which the new intervention or program to be evaluated is more expensive (i.e., it involves a greater sacrifice of resources) and less effective than its comparator; therefore, it would be an intervention "dominated" by the intervention with which it is being compared. "Base data" = mean the values observed in the sample; "Best scenario" = maximum value of 95% IC for effectiveness measures; "Worst scenario" = minimum value of 95% IC for effectiveness measures. The positive values for the "incremental effect" in relation to the number of BD occasions averted refer to a reduction in the number of BD occasions in the intervention group as regards control group; meanwhile, the negative values refer to an increase in the number of BD occasions. The positive values for the "incremental effect" in relation to QALYs refer to an increasing quality of life, while the negative values refer to a decreasing quality of life.

than conventional face-to-face SBI. The current widespread use of mobile and electronic technologies may increase the population with access to SBI, and the potential cost of delivery may be reduced because the main cost is incurred during the development of the intervention with limited additional costs being associated with its delivery (Linke et al., 2007). However, there is limited evidence about the cost-effectiveness of this type of Internet-based intervention (Ingels et al., 2013; Nelson, 2015; Suijkerbuijk et al., 2014). Future studies on the cost-effectiveness of health promotion and prevention for adolescents that include long-term assessments are recommended since the effect on behavior change is higher at long time, which could increase the savings of the accumulated costs of these interventions (Ahmad, 2005). The inferiority of the intervention for certain subgroups could be explained in part by the finding that baseline consumption for these subgroups was relatively low compared with that of their counterparts. For instance, the number of BD occasions in the baseline period for the female subgroup and older subgroup (17 years of age and older) was markedly higher than that for the male subgroup and younger subgroup (under 17 years of age). This fact is also discussed by Drost et al. (2016). The major incremental effect obtained by subgroups in terms of the number of BD occasions averted per month was for adolescents who had no weekly pocket money available, with a difference of 0.465 BD occasions averted per month more in the group that received the *Alerta Alcohol* program compared to adolescents who received no active intervention. This finding is consistent with the study of Crocamo et al. (2018) in which a high pocket money availability was a risk factor for young people in relation to the number of BD episodes. However, the major incremental effect obtained in relation to QALYs gained was for those who had a weekly pocket money of more than €20. In relation to this finding, Nur et al. (2017) found that young people who received an adequate amount of pocket money (understanding "adequate" similar to high) had a higher score in quality of life, specifically in mental health. Hence, this could explain a better general HRQoL. In addition, the small incremental effect in QALYs could be explained by the heterogeneity found in other studies among binge drinker young people (Bourdieu, 1979; Luquiens et al., 2018; Scott et al., 2017).

The findings of this study are similar to those of the *Alcohol Alert* study carried out by Drost et al. (2016), in which, from both perspectives, and particularly, the intervention was more cost-effective in reducing the number of BD occasions per month for older adolescents (aged 17 to 19 years of age) than for those who were younger than 17 years old.

Given the scarcity of literature related to economic evaluations of behavior change interventions, one of the main strengths of this study is the cost-effectiveness and cost-utility assessment, including both the NHS and societal perspectives (Onrust et al., 2016). It is known that the societal perspective is dominant over other perspectives (Byford & Raftery, 1998; Jönsson, 2009). Jönsson (2009) provided 10 arguments for taking a broad societal perspective in conducting HTA studies. Since regulatory decisions about the market authorization of new medical technologies are based on an

assessment of the societal benefits and risks, HTA studies should take the same perspective. Another argument is that adopting a payer perspective instead of a societal perspective may create a bias against investments aimed at improving health through health-care spending. Since it is widely accepted that economic evaluations should include all potential health effects, the costs should also be considered from a societal perspective. Another argument is that specific payer perspectives should be assessed within the societal perspective because it may thereby be possible to identify the most relevant perspective depending on the policy issue to be addressed. Furthermore, Jönsson (2009) proposed that a societal perspective promotes an informed public discussion and democratic decisions since it is the public that pays for and receives the benefits of new technologies and healthcare interventions. In addition, previous studies on the economic evaluation of similar programs, such as Drost et al. (2016), Ingels et al. (2013), and Sumnall et al. (2017), also chose the societal perspective. Nevertheless, both the choice of this perspective and the way in which it was implemented in the design of the study can be considered important strengths. Another strength of our study is the separate reporting of data for subgroups, since the impact of behavior change interventions might vary according to contextual factors, as noted by Das et al. (2016).

Notwithstanding these strengths, it is necessary to contextualize the results of this study by taking into account the study's limitations, the first being the low response rate in the follow-up period and, in relation to the cost questionnaire, the failure to include questions related to costs from the beginning of the study. The main cause of missing data for the follow-up questionnaire was early completion of classes by vocational training students (whose classes ended before those of the other participants). Moreover, the date for administering the postintervention questionnaire fell close to the final examination period in the schools involved, which made it difficult to ensure that all participants completed the questionnaire. It is known that high attrition rates are common in eHealth interventions (de Vries et al., 2012; Kohl et al., 2013). Another possible reason for this attrition could be the design of the intervention for the target population. The feedback to the adolescent in this program is provided through text messages that come from an avatar that each adolescent chooses when registering on the program's website, and this avatar accompanies them during all sessions. A review of the literature on computer-based interventions and prevention programs to reduce alcohol use among young people notes that few programs exploit the potential of technologies using elements of gamification, smartphones apps, or social media to complement the design of interventions such as the *Alerta Alcohol* program, which are based on a program personalized for the youth's individual demographic characteristics, risk factors, and vulnerabilities (Schinke & Schwinn, 2017). This fact indicates that the program design should be improved in future research. A possible explanation for the difference in the number of adolescents that comprise the intervention and control groups could be because of the fact that although 16 schools initially accepted the invitation to participate and were randomly assigned to either the intervention or control group, a school

in the control group did not start the baseline assessment and withdrew owing to logistical problems. Therefore, the study started with an inferior sample in this comparator group from the beginning.

A second limitation was that the data collected in the study came from self-reported questionnaires completed by the adolescents and may therefore have been affected by subjectivity. However, previous studies have found that self-reporting of risk behaviors among adolescents and young adults shows good reliability and validity (Brener et al., 2003; Harrison et al., 2007). In this line, a 4-month recall period after the start of program to assess the alcohol use could increase the recall bias as suggested by Cherpitel et al. (2018) in their study.

Another important limitation was that short-term behavior change assessments capture little benefit, so we would need to monitor the effect of this intervention in the long term. However, according to a review of economic evaluations of behavior change interventions (Alayli-Goebbels et al., 2014), only six studies had longer follow-up periods (up to 5 years). There are still very few studies regarding the long-term effectiveness of eHealth interventions in schools that are aimed at preventing unhealthy behaviors in general. Champion et al. (2019) highlighted the need for longer-term follow-up and future lines of research on the effects of these interventions during adolescence, especially for substance use. It is expected that a natural increase in its use will be found. Several scholars (Cremers et al., 2012; Schneider et al., 2013) have identified aspects of the content and design of web-based interventions that may improve their effects, for instance, using booster sessions to remind the core concepts emphasizing reminders for the sessions. After assessing the effectiveness of the Alcohol Alert program, improvements in the design related to gamification were proposed as well as the inclusion of booster sessions (Martinez-Montilla et al., 2020).

A limitation related to the number of participants who reported being admitted to a hospital is important due to the few events that occurred in this regard in the sample. A low number for the results of a variable could affect the accuracy of the outcomes. However, the data reported by the Hospital Emergency Indicators in Andalusia (Andalusian Plan on Drugs and Addictions, 2018) for 2017 (i.e., the year of data collection) indicated that 1277 people had a hospital emergency due to alcohol consumption; 11.7% of them, or 149 people, were between 15 and 19 years of age. In addition, of the total number of emergencies due to psychoactive substance use, 8% were admitted to a hospital, and of these emergencies, 2.8% were due to the exclusive consumption of alcohol. Therefore, the data regarding hospital stays in the sample population are similar to what was found in our study. This possible standard error associated with low outcome counts could be solved by considering the average number of days of a hospital stay, but such data were not available owing to a lack of responses.

Finally, in relation to known limitations related to economic evaluations based on clinical trials, using economic evaluation as a basis for decision making about the national reimbursement of health care technologies demands some specific analytical methods. For instance, this article has incorporated two perspectives, NHS and

societal, to consider a consistent perspective among what would be appropriate and the actual focus of decision makers. Although the time horizon considered in this analysis has been shorter than the appropriate 4 months, there is no robust evidence that this type of interventions has a direct impact on mortality. In addition, trial-based economic evaluations exhibit a difference between costs and benefits, which can be estimated in the trial, and those which are needed for decision making. It is true that the main problem is that economic evaluation based on single trials will invariably fail to reflect all the available evidence related to a particular decision problem. However, they have the advantage of reflecting an unbiased estimate of the relative treatment effect, reducing the risk of selection bias. In any case, trial-based economic evaluation is an important source of evidence, though future work should address this by using a decision-analytic model to meet full requirements for decision making (Petrou, 2012; Sculpher et al., 2006).

To conclude, computer-tailored feedback could be a cost-effective way to prevent BD in terms of reducing the number of BD occasions and increasing QALYs among adolescents. This intervention could be implemented at schools to all students to prevent alcohol consumption and especially BD, although it would be interesting to tailor the program to specific subgroups of this population that are at greater risk of being involved in BD. However, to capture major changes both in the reduction of number of BD occasions and in HRQoL and savings in healthcare costs due to a behavioral change intervention, long-term follow-up of the intervention would probably be required. Other countries could evaluate this type of program to design the public health policies targeting alcohol use among adolescents.

AUTHOR CONTRIBUTIONS

Conceptualization: Marta Lima-Serrano, Marta Trapero-Bertran and Ana Magdalena Vargas-Martínez. Formal Analysis: Ana Magdalena Vargas-Martínez and Marta Trapero-Bertran. Methodology: Marta Lima-Serrano, Marta Trapero-Bertran and Ana Magdalena Vargas-Martínez. Supervision: Marta Trapero-Bertran and Marta Lima-Serrano. Writing—Original Draft Preparation: Ana Magdalena Vargas-Martínez. Writing—Review & Editing: Marta Trapero-Bertran, Marta Lima-Serrano and Ana Magdalena Vargas-Martínez.

FUNDING INFORMATION

This study was prepared within the framework of the research project “Alerta Alcohol: design, validation and evaluation of the program of selective prevention of alcohol abuse in adolescents: web-based computer-tailored intervention” (PI-0031-2014) and financed by the Andalusian Public Foundation “Progress and Health” for the financing of research and innovation in the biomedical field and in the health sciences in Andalusia for the year 2014 (Health Counselling). The study received partial funding from the Spanish Ministry of Economy and Competitiveness (MINECO) under the program “PROYECTOS I+D+I RETOS”, the project: “Estilos de vida no saludables: herramientas para el análisis de políticas de salud” [Grant ECO2017-83771-C3-3-R]. Moreover, it has been partially

funded by the Agència de gestió d'Ajuts Universitaris i de Recerca (AGAUR) within the framework of the program "Suports a Grups de Recerca (SGR 2017-2019)", of the group: "Grup de Recerca en Avaluació de Polítiques Públiques", proceeding 2017 SGR 263. The funder had no influence in the conduct of this study or the drafting of this manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

ORCID

Ana Magdalena Vargas-Martínez  <https://orcid.org/0000-0001-8223-1109>

Marta Lima-Serrano  <https://orcid.org/0000-0003-3909-2718>

Marta Trapero-Bertran  <https://orcid.org/0000-0002-9233-1776>

REFERENCES

- Aebi, M.F., Tiago, M.M. & Burkhardt, C. (2016) *Space. Council of Europe Annual Penal Statistics: prison populations. Survey 2015*. Available from: http://wp.unil.ch/space/files/2017/04/SPACE_I_2015_Final_Report_161215_REV170425.pdf [Accessed 24th March 2019]. Strasbourg: Council of Europe I.
- Agencia Estatal Boletín Oficial del Estado. (2017a) *Resolución de 9 de junio de 2017, de la Presidencia del Comisionado para el Mercado de Tabacos*. Available from: <https://www.boe.es/boe/dias/2017/06/10/pdfs/BOE-A-2017-6584.pdf> [Accessed 16th April 2019].
- Agencia Estatal Boletín Oficial del Estado. (2017b) *Resolución de 24 de noviembre de 2017, de la Presidencia del Comisionado para el Mercado de Tabacos*. Available from: <https://www.boe.es/boe/dias/2017/11/25/pdfs/BOE-A-2017-13646.pdf> [Accessed 16th April 2019].
- Ahmad, S. (2005) Closing the youth access gap: the projected health benefits and cost savings of a national policy to raise the legal smoking age to 21 in the United States. *Health Policy*, 75, 74–84. Available from: <https://doi.org/10.1016/j.healthpol.2005.02.004>
- Alayli-Goebbels, A.F.G., Evers, S.M.A.A., Alexeeva, D., Ament, A.J.H.A., de Vries, N.K., Tilly, J.C. et al. (2014) A review of economic evaluations of behavior change interventions: setting an agenda for research methods and practice. *Journal of Public Health (Oxford, England)*, 36, 336–344. Available from: <https://doi.org/10.1093/pubmed/fdt080>
- Andalusian Plan on drugs and addictions [Plan andaluz sobre drogas y adicciones]. (2018) *Informe de resultados del Indicador Urgencias Hospitalarias relacionadas con el consumo de sustancias psicoactivas 2017*. Available from: https://www.juntadeandalucia.es/export/drupaljda/Informe_Urgencias_2017.pdf [Accessed 16th April 2019].
- Anderson, P. & Baumberg, B. (2006) *Alcohol in Europe*. London: Institute of Alcohol Studies.
- Anderson-Carpenter, K.D., Watson-Thompson, J., Chaney, L. & Jones, M. (2016) Reducing binge drinking in adolescents through implementation of the strategic prevention framework. *American Journal of Community Psychology*, 57, 36–46. Available from: <https://doi.org/10.1002/ajcp.12029>
- Böckerman, P., Hyytinen, A. & Maczulskij, T. (2017) Alcohol consumption and long-term labor market outcomes. *Health Economics*, 26, 275–291. Available from: <https://doi.org/10.1002/hec.3290>
- Bourdieu, P. (1979) *La Distinction: Critique sociale du jugement*. Paris: Les Éditions de minuit.
- Brener, N.D., Billy, J.O. & Grady, W.R. (2003) Assessment of factors affecting the validity of self-reported health risk behavior among adolescents: evidence from the scientific literature. *The Journal of Adolescent Health*, 33, 436–457. Available from: [https://doi.org/10.1016/S1054-139X\(03\)00052-1](https://doi.org/10.1016/S1054-139X(03)00052-1)
- Byford, S. & Raftery, J. (1998) Perspectives in economic evaluation. *BMJ*, 316, 1529–1530. Available from: <https://doi.org/10.1136/bmj.316.7143.1529>
- Champion, K.E., Parmenter, B., McGowan, C., Spring, B., Wafford, Q.E., Gardner, L.A. et al. (2019) Effectiveness of school-based ehealth interventions to prevent multiple lifestyle risk behaviours among adolescents: a systematic review and meta-analysis. *The Lancet Digital Health*, 1, e206–e221. Available from: [https://doi.org/10.1016/S2589-7500\(19\)30088-3](https://doi.org/10.1016/S2589-7500(19)30088-3)
- Cherpitel, C.J., Ye, Y., Stockwell, T., Vallance, K. & Chow, C. (2018) Recall bias across 7 days in self-reported alcohol consumption prior to injury among emergency department patients. *Drug and Alcohol Review*, 37, 382–388. Available from: <https://doi.org/10.1111/dar.12558>
- Copeland, J. & Martin, G. (2004) Web-based interventions for substance use disorders: a qualitative review. *Journal of Substance Abuse Treatment*, 26, 109–116.
- Creemers, H.P., Mercken, L., Oenema, A. & de Vries, H. (2012) A web-based computer-tailored smoking prevention programme for primary school children: intervention design and study protocol. *BMC Public Health*, 12, 277. Available from: <https://doi.org/10.1186/1471-2458-12-277>
- Crocamo, C., Bartoli, F., Montomoli, C. & Carrà, G. (2018) Predicting young adults binge drinking in nightlife scenes: an evaluation of the D-ARIANNA risk estimation model. *Journal of Addiction Medicine*, 12, 401–409. Available from: <https://doi.org/10.1097/ADM.0000000000000419>
- Das, J.K., Salam, R.A., Lassi, Z.S., Khan, M.N., Mahmood, W., Patel, V. et al. (2016) Interventions for adolescent mental health: an overview of systematic reviews. *The Journal of Adolescent Health*, 59, S49–S60. Available from: <https://doi.org/10.1016/j.jadohealth.2016.06.020>
- de Vries, H. (2017) An integrated approach for understanding health behavior; the I-change model as an example. *Psychology and Behavioral Science International Journal*, 2, 555585. Available from: <https://doi.org/10.19080/PBSIJ.2017.02.555585>
- de Vries, H., Lezwijn, J., Hol, M. & Honing, C. (2005) Skin cancer prevention: behavior and motives of Dutch adolescents. *European Journal of Cancer Prevention*, 14, 39–50. Available from: <https://doi.org/10.1097/00008469-200502000-00006>
- de Vries, H., Logister, M., Krekels, G., Klaasse, F., Servranckx, V. & van Osch, L. (2012) Internet based computer tailored feedback on sun-screen use. *Journal of Medical Internet Research*, 14, e48. Available from: <https://doi.org/10.2196/jmir.1902>
- Díaz Geadá, A., Busto Miramontes, A. & Caamaño Isorna, F. (2018) Consumo de alcohol, Tabaco y cannabis en adolescentes de una población multicultural (Burela, Lugo). *Adicciones*, 30, 264–270. Available from: <https://doi.org/10.20882/adicciones.915>
- Delegación del Gobierno para El Plan Nacional Sobre Drogas (National Plan on Drugs). (2018) *Encuesta sobre el uso de drogas en enseñanzas secundarias en España (ESTUDES) 2016–2017*. [Survey on the use of drugs in secondary education in Spain 2016–2017]. Madrid, España: Ministerio de Sanidad, Servicios Sociales e Igualdad.
- Dirección General de Tráfico. (2016) *Las principales cifras de la Siniestralidad Vial*. Available from: http://www.dgt.es/Galerias/seguridad-vial/estadisticas-e-indicadores/publicaciones/principales-cifras-siniestralidad/2017-1969_Las_principales_cifras_de_la_Siniestralidad_Vial_España_2016.PDF [Accessed 10th February 2019]. España.
- Donoghue, K., Patton, R., Phillips, T., Deluca, P. & Drummond, C. (2014) The effectiveness of electronic screening and brief intervention for reducing levels of alcohol consumption: a systematic review and meta-analysis. *Journal of Medical Internet Research*, 16, e142. Available from: <https://doi.org/10.2196/jmir.3193>

- Drost, R.M., Paulus, A.T.G., Jander, A.F., Mercken, L., de Vries, H., Ruwaard, D. et al. (2016) A web-based computer-tailored alcohol prevention program for adolescents: cost-effectiveness and intersectoral costs and benefits. *Journal of Medical Internet Research*, 18, e93. Available from: <https://doi.org/10.2196/jmir.5223>
- European Commission. (n.d.) Eurostat Education and training. Available from: <http://ec.europa.eu/eurostat/data/database>. Accessed 8th January 2019. Database.
- Foxcroft, D.R. & Tsertsvadze, A. (2011) Universal multi-component prevention programs for alcohol misuse in young people. *Cochrane Database of Systematic Reviews*, 9, CD009307. Available from: <https://doi.org/10.1002/14651858.CD009307>
- García-Gordillo, M.A., Aduar, J.C. & Olivares, P.R. (2016) Normative values of EQ-5D-5L: in a Spanish representative population sample from Spanish health survey, 2011. *Quality of Life Research*, 25, 1313–1321. Available from: <https://doi.org/10.1007/s11136-015-1164-7>
- Hanewinkel, R., Tomczyk, S., Goecke, M. & Isensee, B. (2017) Preventing binge drinking in adolescents. *Deutsches Ärzteblatt International*, 114, 280–287. Available from: <https://doi.org/10.3238/arztebl.2017.0280>
- Harrison, L.D., Martin, S.S. & Enev, T. (2007) *Comparing drug testing and self-report of drug use among youths and young adults in the general population*. (DHHS Publication No. SMA 07-4249, Methodology Series M-7). Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies.
- Hernandez, G., Garin, O., Pardo, Y., Vilagut, G., Pont, À., Suárez, M. et al. (2018) Validity of the EQ-5D-5L and reference norms for the Spanish population. *Quality of Life Research*, 27, 2337–2348. Available from: <https://doi.org/10.1007/s11136-018-1877-5>
- Ingels, J.B., Corso, P.S., Kogan, S.M. & Brody, G.H. (2013) Cost-effectiveness of the strong African American families-teen program: 1-year follow-up. *Drug and Alcohol Dependence*, 133, 556–561. Available from: <https://doi.org/10.1016/j.drugalcdep.2013.07.036>
- Jönsson, B. (2009) Ten arguments for a societal perspective in the economic evaluation of medical innovations. *The European Journal of Health Economics*, 10, 357–359. Available from: <https://doi.org/10.1007/s10198-009-0173-2>
- Jander, A., Crutzen, R., Mercken, L. & de Vries, H. (2014) A web-based computer-tailored game to reduce binge drinking among 16 to 18 year old Dutch adolescents: development and study protocol. *BMC Public Health*, 14, 1054. Available from: <https://doi.org/10.1186/1471-2458-14-1054>
- Khadjesari, Z., Murray, E., Hewitt, C., Hartley, S. & Godfrey, C. (2011) Can stand-alone computer-based interventions reduce alcohol consumption? A systematic review. *Addiction*, 106, 267–282. Available from: <https://doi.org/10.1111/j.1360-0443.2010.03214.x>
- Kohl, L.F., Crutzen, R. & de Vries, N.K. (2013) Online prevention aimed at lifestyle behaviors: a systematic review of reviews. *Journal of Medical Internet Research*, 15, e146. Available from: <https://doi.org/10.2196/jmir.2665>
- Kuntsche, E. & Gmel, G. (2013) Alcohol consumption in late adolescence and early adulthood – where is the problem? *Swiss Medical Weekly*, 143, w13826. Available from: <https://doi.org/10.4414/smw.2013.13826>
- Lima-Serrano, M., Guerra-Martín, M.D. & Lima-Rodríguez, J.S. (2015) Estilos de vida y factores asociados a la alimentación y la actividad física en adolescentes. *Nutrición Hospitalaria*, 32, 2838–2847. Available from: <https://doi.org/10.3305/nh.2015.32.6.9831>
- Lima-Serrano, M., Martínez-Montilla, J.M., Lima-Rodríguez, J.S., Mercken, L. & de Vries, H. (2018) Design, implementation and evaluation of a web-based computer-tailored intervention to prevent binge drinking in adolescents: study protocol. *BMC Public Health*, 18, 449. Available from: <https://doi.org/10.1186/s12889-018-5346-4>
- Lima-Serrano, M., Vargas-Martínez, A.M., Gil García, E., Martínez-Montilla, J.M., Lima Rodríguez, J.S. & De Vries, H. (2017) [Adaptation and validation of five scales to measure determinants of binge drinking in adolescents]. *Anales del Sistema Sanitario de Navarra*, 40, 221–236. Available from: <https://doi.org/10.23938/ASSN.0028>
- Linke, S., Murray, E., Butler, C. & Wallace, P. (2007) Internet-based interactive health intervention for the promotion of sensible drinking: patterns of use and potential impact on members of the general public. *Journal of Medical Internet Research*, 9, e10.
- Luquiens, A., Said, A.B., Sadik, H., Ferrer Sánchez Del Villar, E., Le Manach, A., Ambrosino, B. et al. (2018) Alcohol consumption, drinker identity, and quality of life among students: why there cannot be one prevention strategy for all. *Quality of Life Research*, 27, 2629–2637. Available from: <https://doi.org/10.1007/s11136-018-1923-3>
- MacArthur, G.J., Harrison, S., Caldwell, D.M., MacArthur, G.J., Harrison, S., Caldwell, D.M. et al. (2015) Peer-led interventions to prevent tobacco, alcohol and/or drug use among young people aged 11–21 years: a systematic review and meta-analysis. *Addiction*, 111, 391–407. Available from: <https://doi.org/10.1111/add.13224>
- Martín-Fernández, J., Ariza-Cardiel, G., Polentinos-Castro, E., Sanz-Cuesta, T., Sarria-Santamera, A. & del Cura-González, I. (2018) Explaining differences in perceived health-related quality of life: a study within the Spanish population. *Gaceta Sanitaria*, 32, 447–453. Available from: <https://doi.org/10.1016/j.gaceta.2017.05.016>
- Martínez-Montilla, J.M., Mercken, L., de Vries, H., Candel, M., Lima-Rodríguez, J.S. & Lima-Serrano, M. (2020) A web-based, computer-tailored intervention to reduce alcohol consumption and binge drinking among Spanish adolescents: cluster randomized controlled trial. *Journal of Medical Internet Research*, 22, e15438. Available from: <https://doi.org/10.2196/15438>
- Medina, F. & Galván, M. (2007). *Imputación de datos: teoría y práctica. [Data imputation: theory and practice]*. Statistics and Economic Projections Division. United Nations. https://repositorio.cepal.org/bitstream/handle/11362/4755/1/S0700590_es.pdf
- Mora, T., Gil, J. & Sicras-Mainar, A. (2015) The influence of obesity and overweight on medical costs: a panel data perspective. *The European Journal of Health Economics*, 16, 161–173. Available from: <https://doi.org/10.1007/s10198-014-0562-z>
- Murray, E. (2009) The role of internet-delivered interventions in self-care. In: Edwards, A. & Elwyn, G. (Eds.) *Shared decision making in health care. Achieving evidence-based patient choice*, 2nd edition. Oxford: Oxford University Press, pp. 223–230.
- Murray, E., Khadjesari, Z., Linke, S., Hunter, R. & Freemantle, N. (2013) Health on the web: randomised trial of work-based online screening and brief intervention for hazardous and harmful drinking. *BMC Public Health*, 13, 505. Available from: <https://doi.org/10.1186/1471-2458-13-505>
- National Institute on Alcohol Abuse and Alcoholism (NIAAA). (2019) *Drinking levels defined*. Available from: <https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking> [Accessed 20th May 2019].
- Nelson, J.P. (2015) Binge drinking and alcohol prices: a systematic review of age-related results from econometric studies, natural experiments and field studies. *Health Economics Review*, 5, 6. Available from: <https://doi.org/10.1186/s13561-014-0040-4>
- Nur, N., Kibik, A., Kılıç, E. & Sümer, H. (2017) Health-related quality of life and associated factors among undergraduate university students. *Oman Medical Journal*, 32, 329–334. Available from: <https://doi.org/10.5001/omj.2017.62>
- Orrust, S.A., Otten, R., Lammers, J. & Smit, F. (2016) School-based programs to reduce and prevent substance use in different age groups: what works for whom? Systematic review and meta-regression analysis. *Clinical Psychology Review*, 44, 45–59. Available from: <https://doi.org/10.1016/j.cpr.2015.11.002>

- Petrou, S. (2012) Rationale and methodology for trial-based economic evaluation. *The Clinical Investigator*, 2, 1191–1200. Available from: <https://doi.org/10.4155/cli.12.121>
- Puffer, S., Torgerson, D.J. & Watson, J. (2005) Cluster randomized controlled trials. *Journal of Evaluation in Clinical Practice*, 11, 479–483. Available from: <https://doi.org/10.1111/j.1365-2753.2005.00568.x>
- Ramos-Goñi, J.M., Craig, B.M., Oppe, M., Ramallo-Fariña, Y., Pinto-Prades, J.L., Luo, N. et al. (2018) Handling data quality issues to estimate the Spanish EQ-5D-5L value set using a hybrid interval regression approach. *Value in Health*, 21, 596–604. Available from: <https://doi.org/10.1016/j.jval.2017.10.023>
- Ramsey, S., Willke, R., Briggs, A., Brown, R., Buxton, M., Chawla, A. et al. (2005) Good research practices for cost-effectiveness analysis along-side clinical trials: the ISPOR RCT-CEA task force report: the ISPOR RCT-CEA task force report. *Value in Health*, 8, 521–533. Available from: <https://doi.org/10.1111/j.1524-4733.2005.00045.x>
- Rowen, D., Rivero-Arias, O., Devlin, N. & Ratcliffe, J. (2020) Review of valuation methods of preference-based measures of health for economic evaluation in child and adolescent populations: where are we now and where are we going? *Pharmacoeconomics*, 38, 325–340. Available from: <https://doi.org/10.1007/s40273-019-00873-7>
- Rubin, D.B. (1987). *Multiple Imputation for Nonresponse in Surveys*, Wiley Series in Probability and Statistics. John Wiley and Sons. <https://doi.org/10.1002/9780470316696>
- Schinke, S. & Schwinn, T.M. (2017) Computer-based prevention and intervention to reduce substance use in youth. *Current Addiction Reports*, 4, 410–421. Available from: <https://doi.org/10.1007/s40429-017-0171-x>
- Schneider, F., de Vries, H., Candel, M., van de Kar, A. & van Osch, L. (2013 January 31) Periodic email prompts to re-use an internet-delivered computer-tailored lifestyle program: influence of prompt content and timing. *Journal of Medical Internet Research*, 15, e23. Available from: <https://doi.org/10.2196/jmir.2151>
- Scott, S., Shucksmith, J., Baker, R. & Kaner, E. (2017) “Hidden habits”: a qualitative study of socio-ecological influences on drinking practices and social identity in mid-adolescence. *International Journal of Environmental Research and Public Health*, 14, 611. Available from: <https://doi.org/10.3390/ijerph14060611>
- Sculpher, M.J., Claxton, K., Drummond, M. & McCabe, C. (2006) Whither trial-based economic evaluation for health care decision making? *Health Economics*, 15, 677–687. Available from: <https://doi.org/10.1002/hec.1093>
- Servicio Andaluz de Salud. (2005) *Consejería de Salud y Familias: Precios públicos de servicios sanitarios prestados en el SSPA*. Available from: <http://www.juntadeandalucia.es/servicioandaluzdesalud/ordenpreciospublicos/default.asp> [Accessed 29th May 2019].
- Substance Abuse and Mental Health Services Administration (SAMHSA). (2018) U.S. Department of Health and Human Services (HHS): report to congress on the prevention and reduction of underage drinking. Available from: https://www.stopalcoholabuse.gov/media/ReportToCongress/2018/report_main/stop_act_rtc.pdf [Accessed 16th April 2019]
- Suijkerbuijk, A., Van Gils, P. & De Wit, G. (2014) *De kosteneffectiviteit van interventies gericht op verslaving aan alcohol en middelen*. Bilthoven: National Institute for Public Health and the Environment. Available from: http://www.rivm.nl/dsresource?objectid=rivmp:251950&type=org&disposition=inline&ns_nc=1 [Accessed 19th April 2019].
- Sumnall, H.A., Cole, J., Doherty, P., Foxcroft, D., Harvey, S., Murphy, L. et al. (2017) Steps towards alcohol misuse prevention program (STAMPP): a school-based and community-based cluster randomised controlled trial. *Public Health Research*, 5, 2. Available from: <https://doi.org/10.1136/bmjopen-2017-019722>
- Tait, R.J. & Christensen, H. (2010) Internet-based interventions for young people with problematic substance use: a systematic review. *The Medical Journal of Australia*, 192(S11), S15–S21. Available from: <https://doi.org/10.5694/j.1326-5377.2010.tb03687.x>
- Vallejo-Torres, L., Garcia-Lorenzo, B., Rivero-Arias, O., Pinto-Prades, J.L. & Serrano-Aguilar, P. (2016) *Disponibilidad a pagar de la sociedad española por un Año de Vida Ajustado por Calidad*. Madrid: Ministerio de Sanidad, Servicios Sociales e Igualdad. Servicio de Evaluación del Servicio Canario de la Salud. Informes de Evaluación de Tecnologías Sanitarias.
- Vargas-Martínez, A.M., Trapero-Bertran, M., Lima-Serrano, M., Anokye, N., Pokhrel, S. & Mora, T. (2019) Measuring the effects on quality of life and alcohol consumption of a program to reduce binge drinking in Spanish adolescents. *Drug and Alcohol Dependence*, 205, 107597. Available from: <https://doi.org/10.1016/j.drugalcdep.2019.107597>
- Waterman, E.A., Lee, K.D.M. & Edwards, K.M. (2019) Longitudinal associations of binge drinking with interpersonal violence among adolescents. *Journal of Youth and Adolescence*, 48, 1342–1352. Available from: <https://doi.org/10.1007/s10964-019-01035-w>
- World Health Organization (WHO). (2018) *Global status report on alcohol and health*. Geneva: World Health Organization.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Vargas-Martínez, A.M., Lima-Serrano, M. & Trapero-Bertran, M. (2023) Cost-effectiveness and cost-utility analyses of a web-based computer-tailored intervention for prevention of binge drinking among Spanish adolescents. *Alcohol: Clinical and Experimental Research*, 47, 319–335. Available from: <https://doi.org/10.1111/acer.14990>