

Online interventions for alcohol consumption among adolescents: A systematic literature review

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Abstract

Adolescence is characterized by challenges that may lead to risky behaviors, such as alcohol consumption. Online interventions can be beneficial in reducing harm associated with alcohol use. This article aimed to conduct a systematic literature review on online interventions for alcohol use among adolescents. The search was conducted using the descriptors "alcohol," "adolescent," and "web-based intervention" in Portuguese, English, and Spanish, covering the period from 2018 to 2024. The CAPES Portal was used to access the following databases: PubMed, DOAJ, Web of Science, Elsevier ScienceDirect, Journals@Ovid Complete, SpringerLink Journals, Wiley Online Library, Sage Premier Journal Collection, HighWire Press (Free Journals), Education Resources Information Center, Taylor & Francis Online, American Academy of Pediatrics, and BMJ Open Access Journals. The sample comprised eight articles, with most publications originating from the United States and Europe. The interventions primarily addressed psychoeducation on alcohol use, personalized feedback on consumption, motivational strategies, and consumption reduction strategies. The included studies demonstrated good methodological quality and led to the conclusion that online interventions targeted at adolescents show favorable outcomes in reducing alcohol consumption.

Keywords: alcohol, adolescent, web-based intervention, systematic review

1 Introduction

When considering the field of health, it is essential to recognize that the challenges associated with adolescence can influence how young people engage in risky situations. One behavior potentially linked to negative health outcomes among adolescents is alcohol consumption. According to 2021 data from the Brazilian Institute of Geography and Statistics (IBGE), 63.3% of young people aged 13 to 17 have consumed alcohol. Moreover, 34.6% of these individuals reported consuming alcohol before the age of 14, which is alarming given that substance use during adolescence may impair brain function, causing cognitive deficits that can affect quality of life [1, 2]. Attention to harmful alcohol consumption becomes even more significant when considering the association between alcohol use and adverse outcomes, such as risky sexual behavior, exposure to traffic accidents, and suicide.

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Concerns regarding the potential risks of alcohol consumption among young people go beyond the assumption that banning alcohol use is a sufficient solution. On the contrary, evidence suggests that even in countries where alcohol sales to adolescents are legally prohibited, such restrictions alone are insufficient to prevent access to alcohol among this age group [1]. Therefore, it is crucial that alcohol abuse prevention initiatives targeting adolescents address the complexity of the issue, emphasizing the collaboration of various stakeholders and the development of youth skills to mitigate negative outcomes associated with drinking during this life stage.

One emerging approach to health interventions involves the use of technology. Regarding alcohol use, recent studies have demonstrated evidence supporting the effectiveness of web-based interventions in reducing weekly, excessive, and overall alcohol consumption among adults [3]. Considering the adolescent population, online health interventions targeting alcohol use hold considerable promise, as adolescents generally exhibit a strong interest in online activities. Thus, it is essential to identify and describe the nature of these interventions currently being implemented. This article aims to conduct a systematic literature review to identify and describe online interventions for alcohol consumption directed at adolescents published over the past six years.

2 Method

This systematic review was conducted following the criteria established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [4]. The search was conducted in October 2024 through the CAPES Portal. The following databases were consulted: PubMed, DOAJ, Web of Science, Elsevier ScienceDirect, Journals@Ovid Complete, SpringerLink Journals, Wiley Online Library, Sage Premier Journal Collection, HighWire Press (Free Journals), Education Resources Information Center, Taylor & Francis Online, American Academy of Pediatrics, and BMJ Open Access Journals. The descriptors Alcohol AND Adolescent AND Web-based intervention, defined according to the DeCS/MeSH terms, were used in Portuguese, English, and Spanish.

Regarding the inclusion criteria, empirical studies published between 2018 and 2024, written in Portuguese, English, or Spanish, were selected if they included the descriptors in their titles and abstracts and described an online intervention for alcohol use targeted at adolescents. Interventions focused on both prevention and treatment were included. Adolescence was defined as the age range between 12 and 18 years, based on the Statute of the Child and Adolescent (Estatuto da Criança e do Adolescente – ECA) [5]. Exclusion criteria included theoretical studies, reviews, interventions focused on other substances or general mental health, and articles with samples exceeding 18 years of age. The inclusion criteria were based on the SPIDER model (Sample, Phenomenon of Interest, Design, Evaluation, and Research type), a standardized strategy used to define objectives and inclusion criteria in systematic reviews.

To organize the data for analysis, the Zotero platform was used. Initially, duplicate articles were removed, followed by a screening of titles and abstracts to evaluate studies based on the established inclusion and exclusion criteria. For full-text reading and data extraction, an Excel spreadsheet was created to categorize the following variables: year of publication, lan-

guage, country of origin, publication journal, keywords, primary and secondary objectives, study design, target audience, sample size, intervention description, outcomes assessed, instruments used, results obtained, and study limitations. Two researchers independently conducted these procedures. At the end of this phase, additional studies were excluded due to non-compliance with the inclusion criteria.

The final sample articles were compared in terms of their objectives, methodological procedures, intervention stages, and results. Descriptive data related to the included studies were also analyzed. To evaluate the potential risk of bias, a critical analysis of the methodological aspects and possible conflicts of interest was conducted. The methodological quality of the studies was assessed using the Mixed Methods Appraisal Tool (MMAT) [6]. Two researchers independently evaluated the final sample articles according to the criteria for the corresponding category, resolving disagreements by consensus. The articles were analyzed descriptively without assigning scores for the fulfillment of evaluation criteria, and no studies were excluded during this phase.

3 Results and general discussion

3.1 Characteristics of the studies

The electronic search in the CAPES Portal yielded 154 articles. After checking and removing duplicates, 151 studies remained. Screening titles and abstracts according to the inclusion and exclusion criteria reduced this number to 32 articles, which were then read in full. Subsequently, 20 studies were excluded for not meeting the inclusion criteria, and 4 were excluded due to lack of access to the complete publication, resulting in 8 eligible articles for the review (Figure 1).

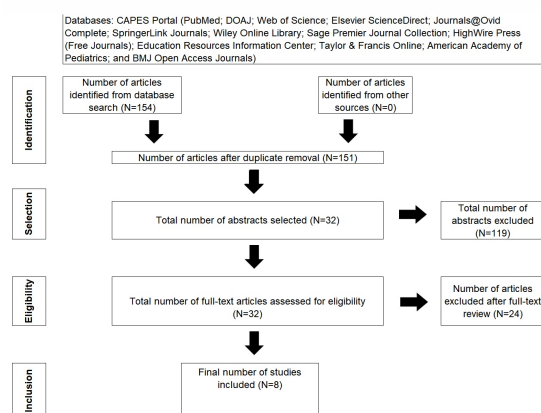


Figure 1: PRISMA Flowchart

In terms of publication years, 2020 had the highest frequency of publications, with three studies. Most research was conducted in the United States (50%), while the remaining studies originated from Germany, Hong Kong, Spain, and England, each accounting for

12.5% of the publications. All included articles were published in English. Despite the importance of the research presented, there is a notable absence of studies involving Latin American adolescents, which is concerning given data indicating early and often excessive alcohol consumption among youth in Latin America [1, 7]. Furthermore, socioeconomic differences between the Global North and South highlight the necessity of considering social determinants of health when analyzing adolescent alcohol consumption across these diverse contexts, especially considering the multifactorial nature of alcohol use among adolescents [8].

Regarding methodological design, 75% of the studies conducted quantitative analyses, 12.5% used qualitative methods, and 12.5% combined both quantitative and qualitative methods. As for the instruments used, there was some variability in the choice for measuring issues related to alcohol consumption. Some studies opted only for asking questions about the topic [9, 10], while others used well-established instruments on the subject. Figure 2 presents the latter, along with the references to the articles in which they were cited. The study by Tinner and colleagues did not use any alcohol consumption measurement instruments, as the study's objective did not require such measurements [11].

Reference	Instrument
Diestelkamp et al., 2019	AUDIT-C, CRAFFT, Drinking Motive Questionnaire-Revised Short Form (DMQ-R SF), Rutgers Alcohol Problem Index (RAPI), The Brief Readiness to Change Drinking Algorithm
Doumas et al., 2020a	Brief Comprehensive Effects of Alcohol Questionnaire, Protective Behavioral Strategies Scale-20 (PBSS-20), Quantity/Frequency/Peak (modified QFP)
Doumas et al., 2020b	Daily Drinking Questionnaire (DDQ), Quantity/Frequency/Peak (modified QFP)
Doumas & Esp, 2019	RAPI
Hausheer et al., 2018	QFP (modified)

Figure 2: Instruments Used

3.2 Objectives of the studies and characteristics of the interventions

In general, the studies focused on describing online interventions for alcohol consumption among adolescents. The study by Diestelkamp and colleagues involved a sample of 1,076 German students, ranging from 6th to 13th grade, with risky alcohol use [12]. The goal was to conduct a pilot test to assess the feasibility and acceptability of a user-centered text message intervention, with individualized instructions and feedback regarding drinking intentions and actual alcohol use. To this end, two models were combined: the Prowise model is a single-session intervention with just one module, while the TIP program involves sending text messages two days a week for a 12-week period after the Prowise intervention. The experimental group received both programs combined, while three other groups received,

respectively, only the Prowise intervention; unstructured text messages; and only psychoeducation about alcohol use. To increase participants' motivation, the study also involved the use of a decisional balance, which is an exercise aimed at reflecting on the advantages and disadvantages of drinking.

Focusing on high school seniors, the studies by Doumas and Esp [13], Doumas and colleagues [14], and Doumas and colleagues [15] aimed at analyzing the implementation of the eCHECKUP TO GO program [16], which lasts 30 minutes. The objectives were, respectively: to examine the effectiveness of the program in reducing alcohol-related consequences among students (105 participants; mean age = 17.14 years); to replicate and expand research investigating sex differences in the program's effectiveness, both in addressing risk factors and in increasing protective strategies (311 participants; mean age = 17.14 years); and to assess sex differences in the program's acceptability, short-term alcohol consumption, and the relationship between this consumption and the program's acceptability (135 participants; ages 15 to 18). The relevance of investigating sex differences in alcohol consumption is highlighted, as although alcohol use has historically been higher among males, there has been a growing increase in the number of girls and women drinking excessively compared to boys and men [17]. Given that adolescent consumption patterns tend to be associated with such behavior in adulthood, early recognition of this issue is justified to mitigate future negative effects [7].

The study by Ho and colleagues [9] aimed to implement an online intervention in which a quiz game designed to reduce alcohol consumption was compared with a conventional health education approach. The program lasted a total of 30 days and was based on the Elaboration Likelihood Model (ELM) for persuasion, which posits that attitude changes through a process of deliberate thinking lead to stronger and more lasting changes. The sample consisted of students aged 12 to 15, with 4,294 adolescents in the intervention group and 3,498 in the control group. Given that this was the only study among the selected ones with data from the Asian continent, the relevance of such a large sample size for obtaining data on this population is emphasized.

The study by Lima-Serrano and colleagues [10] is a pilot study aimed at describing, implementing, evaluating, and testing the effectiveness of the Alerta Álcool program, which focuses on reducing binge drinking patterns among adolescents through a computer-based intervention. The sample was estimated to require 1,230 students aged 16 to 18. The program consists of six sessions of variable duration, during which goals related to alcohol consumption are established. The intervention is based on the I-Change model, which focuses on behavior change across the pre-motivational (awareness), motivational (motivation), and post-motivational (action) phases.

The study by Hausheer and colleagues [18] included a sample that, in addition to adolescents, also involved other individuals deemed relevant for conducting interventions related to alcohol consumption among young people. In this regard, they aimed to evaluate the eCHECKUP TO GO intervention, both when applied alone and when combined with the "Talk. They Listen to You" program [19], which is aimed at parents. The sample consisted of 205 students aged 13 to 16.

To consider the opinions of individuals actively involved with adolescents, the article by Tinner and colleagues [11] aimed to develop the Rethink Alcohol intervention [20], which consists of four main themes: monitoring consumption, information about alcohol, guidance

for less harmful drinking, and presenting real-life scenarios. The opinions of young people (N=20; aged 14 to 18), teachers (N=3), and youth workers (N=6) were explored regarding the content, design, and usability of the intervention. The strategy of incorporating feedback from family members and youth professionals in developing tasks for this audience is promising for the quality of these actions, as when working with adolescents, it is important to establish support networks with significant adults to promote youth health.

Figure 3 presents a compilation of the main information regarding the interventions, including the content of each module, session, or theme of the actions and their duration.

Intervention	Modules
Prowise (Diestelkamp et al., 2019)	Single session: Includes personalized feedback on consumption patterns, providing information about health risks. The feedback is normatively tailored, considering gender and age, and evaluates blood alcohol concentration (BAC) and associated health risks. Finally, a summary and feedback are provided to strengthen motivation stop drinking, including a decisional balance and strategies to identify and manage risky situations.
TIP (Diestelkamp, et al., 2019)	Includes two modules. The first module focuses on potential risk situations and strategies to manage them. The second module addresses days when alcohol consumption occurred.
eCHECKUP TO GO (Doulas et al., 2020a; Doulas & Esp, 2019; Doulas et al., 2020b; Hausheer et al., 2018)	Single session: Assesses demographic characteristics and consumption patterns. It provides personalized feedback with information on the quantity and frequency of drinking, a personal BAC (blood alcohol concentration) chart, and the caloric equivalence of alcohol in terms of cheeseburgers. Additionally, it offers feedback on consumption risks and strategies that can be used to help change drinking behavior.
Quiz Game Intervention (Ho et al., 2021)	Involves answering questions about alcohol use. Correct answers are scored, and participants are ranked according to their accuracy. Top-ranking participants receive gift cards.
Alerta Alcool (Lima-Serrano et al., 2018)	The first session involves initial assessments of alcohol consumption. The following two sessions present common alcohol use scenarios, providing questions, personalized messages, and management strategies for these situations. The fourth session introduces an abstinence challenge until the next meeting, where the challenge is evaluated. Finally, the sixth session conducts a final assessment of the program.
Rethink Alcohol (Tinner, et al., 2020)	A reality check is conducted, involving questions about perceptions of drinking, followed by an assessment of alcohol consumption. Subsequently, information about alcohol is provided, including legal regulations and health risks, along with guidelines for safer drinking. Finally, real-life drinking scenarios are presented, with different behavioral options to consider.

Figure 3: Intervention Modules

Online interventions can be classified into three different types: self-guided (the user follows the content without professional support); guided (there is contact with a professional through electronic communication); and hybrid (a combination of self-guided and guided components). All the articles selected for this review involved self-guided interventions, although 12.5% offered the possibility of contacting a professional in case of difficulties in carrying out the self-guided intervention [14]. This type of intervention presents considerable advantages, as it allows simultaneous access for multiple patients, can be reused, and offers broader reach by overcoming geographic and temporal barriers. Furthermore, because they are quicker and less costly, these interventions are useful for identifying and addressing at-risk users, especially those who are not actively seeking specific help, which is often the

case for adolescents [21]. The number of sessions or modules, as well as the duration of the interventions, varied considerably, ranging from single-session interventions to those with eight different modules. It is worth noting that, according to the literature in the field, studies suggest that the duration and extent of interventions are not always related to their effectiveness [22].

Only one of the interventions targeted at-risk users [12], while the others focused on adolescents in general, regardless of their consumption patterns. This indicates a concern in the studies with universal prevention, highlighting the importance of such actions in identifying at-risk users and reducing consumption overall, particularly due to the potential risks associated with early use.

It is also worth highlighting some important elements addressed in the interventions. First, it is noteworthy that 25% of the studies involved psychoeducation about alcohol use [9, 11]. Sharing information about alcohol consumption and its effects on the body stands out as one of the main strategies for reducing alcohol abuse among adolescents. This is because, by understanding adolescence as a phase of experimentation and risk exposure, knowledge about the real effects and potential consequences of alcohol consumption aids in making more informed decisions regarding the contexts and forms of use, as well as demystifying socially shared beliefs about this substance [23]. Additionally, 25% of the interventions focused on identifying risk situations for consumption [10, 12], while sharing strategies for reducing use and managing risk situations was present in 87.5% of the studies [10, 11, 12, 13, 14, 15, 18].

Furthermore, 62.5% of the studies involved sharing personalized normative feedback on alcohol consumption, comparing data collected during initial assessments of each participant with their peers and describing the results and the impact of alcohol use [12, 13, 14, 15, 18]. This strategy is significant because it enables adolescents to become more aware of their consumption patterns, which can foster critical thinking about alcohol use and subsequently lead to reduced consumption, especially when combined with decreased availability and accessibility of alcohol [24].

Regarding the theoretical basis used, 62.5% of the interventions were grounded in Motivational Interviewing [12, 13, 14, 15, 18], a counseling method aimed at enhancing patients' motivation for behavior change. This approach has demonstrated efficacy in modifying various health behaviors [25]. Concerning alcohol consumption, Steele and colleagues [26] review of 22 articles indicated that this method is effective in reducing alcohol use patterns among adolescents. Motivational Interviewing is increasingly being employed in online interventions, as highlighted in the present review, with studies emphasizing its acceptability and potential to induce behavior change [25].

Another significantly utilized approach was Social Norms, present in 50% of the studies [13, 14, 15, 18], which emphasizes that misperceptions about peer alcohol consumption and permissiveness contribute to problematic alcohol-related behaviors. The literature indicates that Social Norms-based interventions can reduce alcohol consumption by correcting these misperceptions [27]. Finally, Tinner and colleagues [11] also based their intervention on Social Norms approaches, as well as Social Cognitive Theory and the Social Influence Model, which is particularly relevant given the role of social norms and environmental factors in reducing alcohol use and related harms [24].

3.3 Results of the interventions

Two of the included studies did not present results [10, 12]. Tinner and colleagues [11] did not report results related to alcohol consumption but focused on the development of an intervention. A prototype intervention was created based on the literature and consultations with young people. Subsequently, interviews were conducted to revise the prototype and finalize the intervention. The analysis of these interviews indicated that the Rethink Alcohol intervention could be usable and informative for young people, address behavioral determinants, and influence perceptions of alcohol-related risks, provided it uses a professional and consistent design, concise text messages clarifying potential risks, interactive and audiovisual components, and reliable information.

The remaining studies, regarding alcohol consumption, presented at least one favorable outcome post-intervention. Dumas and colleagues [14], in a controlled-group study, reported that 30 days after the intervention, there was a significant reduction in perceptions of peer consumption and gender-specific peer consumption, as well as in positive expectations regarding alcohol use and overall consumption. Significant reductions in perceptions of peer drunkenness and drinking frequency were found only among women. No significant differences were found in the use of protective behavioral strategies. Dumas & Esp [13], also in a controlled-group study, found a significant reduction in alcohol-related consequences among high-risk drinking adolescents in the intervention group at the 30-day and 6-month follow-ups (large effect size). Dumas and colleagues [15], in a study without a control group, reported that the intervention had a significant and large overall effect in reducing the frequency and quantity of weekly alcohol consumption. Ho and colleagues [9] found that the intervention group showed significant improvements compared to the control group regarding drinking days, alcohol-related problems, and knowledge about alcohol, which were maintained at follow-up assessments. Finally, Hausheer and colleagues [18] demonstrated that the intervention significantly reduced drinking frequency only among women and found no differences between the group receiving only the eCHECKUP TO GO intervention and the group receiving it combined with the "Talk. They Hear You." program.

These results point to the effectiveness of online alcohol interventions targeting adolescents, which is supported by the literature in the field. Hadjistavropoulos and colleagues [28] highlighted that self-guided interventions are effective in reducing alcohol consumption, although they have smaller effects compared to guided interventions. Smedslund and colleagues [21], in a systematic review evaluating brief computerized interventions for at-risk youth, emphasized that these interventions have moderate evidence of reducing risky consumption among young people. In a scoping review on alcohol prevention interventions for adolescents, Rosa and colleagues [29] found that most internet-based programs yield positive outcomes. Finally, McDermott and colleagues [30] provided evidence that digital interventions offer health and social benefits through the moderation of alcohol consumption.

Despite the favorable results found in the literature and in the present review, it is important to highlight the findings of the meta-analysis conducted by McDermott and colleagues [30], which aimed to investigate the quality and strength of evidence from systematic reviews on digital interventions aimed at young people. The analysis revealed that the studies were highly heterogeneous and generally lacked methodological robustness, particularly regarding the efficacy and consistency of the data, limiting conclusions about the effectiveness of

the programs. Moreover, the authors emphasize the need to update reviews on this topic, especially due to the rapidly evolving field of technology and digital interventions, requiring more recent analyses. This gap was also highlighted in other reviews [29], and the present study aims to address it.

4 Study limitations

For a more in-depth analysis of the study limitations, the MMAT tool was used. The assessment of methodological quality was compromised in two articles [10, 12], as these were descriptions of research protocols. However, since both provided detailed descriptions of the proposed interventions, the studies were retained in the sample as they were considered relevant to the central objective of the present review.

In this regard, 62.5% of the studies were randomized controlled trials [9, 12, 13, 14, 18]. Of these, only 40% provided a detailed description of the randomization process [9, 12], allowing the inference that it was conducted appropriately. Additionally, 40% presented comparable baseline samples [9, 13], while another 40% aimed to statistically correct the differences found [14, 18]. Regarding the results, 80% of the studies provided complete data, as they had retention rates equal to or greater than 84% of the initial sample [9, 13, 14, 18]. Only 20% of the studies explicitly stated that the evaluators were blinded to the type of intervention provided [12]. In the other studies, this condition was inferred, as the data were obtained through self-reports. Finally, 80% of the studies indicated that participants adhered to the proposed intervention, reporting retention rates equal to or greater than 84% of the sample.

The study conducted by Doumas and colleagues [15] adopted a quasi-experimental design without sample randomization. The analysis according to the MMAT categories indicated that the participants were representative of the target population, with the inclusion and exclusion criteria well justified, and the power calculation favorable for the proposed analyses. Additionally, the use of validated and appropriate instruments to answer the research questions supports that the measures were adequate in relation to the results found and the intervention employed, as well as that the results presented complete data, since the study had a retention rate of 91.1% of the sample. Confounding factors were considered both in the research design and in the data analysis, with outliers identified and adjusted prior to the analyses. It was possible to infer that the intervention was implemented as planned, since the study reported no contamination in the process that could have affected the results.

The study by Tinner and colleagues [11] was the only one to exclusively employ a qualitative methodology. This research met all the quality criteria proposed by the MMAT tool for this category of study. In this regard, it is understood that the qualitative approach was appropriate to answer the research question, with the proper use of the methodology to address this issue. Furthermore, the article analysis allowed for the conclusion that the findings were appropriately derived and interpreted in accordance with the data found, with the process carried out in a coherent manner considering the data source, collection, analysis, and interpretation.

Finally, the work by Lima-Serrano and colleagues [10] employed mixed methods, con-

ducting both a focus group and a randomized clinical trial. The use of this methodology was justifiable, as it allowed the intervention to be designed from the perspective of the target audience and, subsequently, to assess the program's effectiveness. In this way, it is understood that the different components of the study were indeed integrated to answer the research question, although the lack of results prevents inferring whether this integration will be appropriately interpreted or if divergences and inconsistencies will be adequately addressed. Moreover, it is not possible to state whether all quality criteria for both qualitative and quantitative methodologies will be adopted. However, it is known that the schools were not blinded to the study due to field-specific characteristics, which is considered a limitation of the research.

In general, the articles included in this review used relevant methodological criteria for the proposed analyses, indicating good study quality, which aligns with the findings in the meta-analysis by McDermott and colleagues [30]. Additionally, a significant portion of the articles (75%) assessed differences between pre- and post-test results, and 68.75% included a control group. Given the importance of conducting research with higher methodological rigor for evidence-based practice, it is understood that analyses comparing a control group and pre- and post-test results, as well as sample randomization, contribute to obtaining more accurate results. However, the relevance of more detailed methodological reporting by the studies is emphasized, particularly regarding the randomization process and the evaluation of interventions by the target audience, in order to enhance the descriptive quality of the data and allow for greater scientific community knowledge about the processes employed in the research.

5 Final considerations

This article aimed to conduct a systematic review of online interventions for alcohol use involving adolescents, in order to understand what types of interventions exist, the elements present in these interventions, and the results they present. From the searches, 8 studies were found and analyzed. The analyses indicated that the development of this type of intervention is concentrated in the United States and European countries, with a need to expand studies to other countries experiencing alcohol use-related issues, particularly Latin American countries such as Brazil. Moreover, the interventions developed are primarily based on motivational interviewing, but also on models such as the social norms approach, social cognitive theory, the I-Change Model, and the Elaboration Likelihood Model. Overall, the studies showed positive results regarding the reduction of alcohol consumption, highlighting the effectiveness of this type of intervention. Additionally, some studies suggest the acceptability of these interventions and a correlation between reduced consumption and variables such as healthcare living costs and quality of life.

This review presented some limitations. First, only one descriptor was used for online interventions, which may have limited the searches, as other terms exist that describe such actions. However, to address this, descriptors from DeCS/MeSH were used. Additionally, four articles that seemingly met the inclusion criteria were excluded due to being unavailable in full. Nevertheless, thorough analyses of the included studies were conducted to provide an initial overview of the targeted interventions.

Finally, it is important to emphasize that this review contributed to the knowledge and analysis of existing alcohol use interventions with adolescents, their main elements and theoretical foundations, as well as other relevant characteristics, whose understanding enables the development of robust new interventions in different contexts. Furthermore, the analysis of the study designs and results provided evidence of the effectiveness of these interventions, which is crucial to consider when aiming to replicate them.

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