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RESEARCH PAPER

A Mobile Application for Mexican Youth Alcohol Interventions: A Formative Evaluation

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Abstract

Risky alcohol consumption and binge drinking among Mexican youth represent significant public health issues. In this work, we present SofIA, a mobile application designed to monitor and intervene in the alcohol consumption patterns of Mexican youth. We designed a naturalistic, formative study intended to obtain feedback on SofIA. This study aimed to assess the usability and effectiveness of the application using the System Usability Scale (SUS) and the Chatbot Usability Questionnaire (CUQ). Our results indicate a moderate level of usability with suggestions for targeted improvements to enhance user experience and application efficacy. This study provides insights into the design of mobile apps for public health interventions for youth alcohol misuse, highlighting the need for further research to optimize these digital tools.

Keywords:

Alcohol Consumption; Mobile Sensing; Chatbot; Usability Testing; Text-Based Interventions; User Involvement.

1 Introduction

Risky alcohol consumption among Mexican youth and young adults represents significant public health issues with extensive consequences. This behavior is notably typical among Mexican adolescents and young adults, substantially contributing to various health and social problems. Data from 2018 shows that about 18.2% of Mexico's population aged 15 and older have engaged in binge drinking. Among regular drinkers in this age group, 42.5% reported binge drinking [20]. Additionally, the National Survey of Drug Use in Students in Mexico (Encuesta Nacional de Consumo de Drogas en Estudiantes, ENCODE) from 2016-2017 reveals that 53.3% of the population aged 18-65 reported alcohol consumption in the previous year, and 22.1% admitted to binge drinking within the previous month [15].

Addressing alcohol consumption among youth requires innovative and effective strategies. Technology has emerged as a powerful tool in public health interventions recently. The increasing use of smartphones and mobile applications provides a unique opportunity to reach young people who may be at risk of alcohol misuse. Mobile interventions can offer personalized and immediate support, making them a valuable resource in efforts to reduce harmful drinking behaviors. These digital tools can deliver real-time feedback, monitor consumption patterns, and provide educational resources, helping to foster healthier habits among young users [7, 11].

Mobile interventions for alcohol misuse have shown promise in various studies. For instance, applications designed to assist individuals in tracking their drinking habits, setting goals, and accessing support networks have effectively reduced alcohol consumption [5, 8, 19]. These interventions can benefit youth, who are often more comfortable with technology and may prefer the anonymity and convenience of digital tools over traditional face-to-face interactions. Moreover, mobile applications can be tailored to individual needs, providing a more personalized approach to treatment and prevention [4, 10].

The motivation for this study stems from the need to explore innovative solutions to tackle the growing issue of alcohol misuse among Mexican youth. In this work, we present the results of a formative evaluation of a mobile application to monitor and intervene in youth alcohol consumption. We focused on assessing the usability and effectiveness of the mobile app and an integrated chatbot. This work also presents user feedback obtained from the field study, which is used to refine and improve the application, ensuring it meets the needs of its target audience. This preliminary study provides valuable insights into the potential of mobile interventions in public health. It also contributes to the development of more effective strategies to address alcohol-related harm among Mexican youth.

2 Mobile Interventions for Alcohol Consumption Problems

In recent years, mobile interventions have emerged as a promising approach to addressing alcohol consumption problems [5,8]. These interventions leverage the ubiquity of smartphones and mobile applications to deliver personalized, immediate support to individuals struggling with alcohol misuse. Mobile interventions can include features such as self-monitoring, goal setting,

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educational resources, and reminders, all of which can be tailored to the user's specific needs. Studies have shown that these digital tools can complement traditional treatment methods by providing continuous support and facilitating behavioral changes outside clinical settings [11].

One significant advantage of mobile interventions is their ability to reach a broad audience, including populations needing access to conventional treatment services. For instance, young people, often early adopters of technology, may find mobile apps more engaging and less stigmatizing than face-to-face therapy sessions. Mobile applications can offer anonymity and privacy, which are particularly important for individuals who might be reluctant to seek help due to the stigma associated with alcohol misuse. This accessibility can increase engagement and adherence to treatment protocols [7, 14].

Moreover, mobile interventions can provide real-time data and feedback, which can be critical for timely interventions. For example, apps can track drinking patterns, monitor mood and triggers, and alert users when they are at risk of relapse. This quick and timely feedback provided by the application allows for proactive management of alcohol consumption and can help users develop healthier habits over time. Additionally, mobile apps can integrate with other technologies, such as wearables and biosensors, to provide comprehensive monitoring and personalized feedback, enhancing their effectiveness [6].

Integrating chatbots and mobile interventions in health care, particularly for substance use, has shown promising usability and user experience results [3, 5, 8, 12]. Research indicates that chatbots can offer immediate and accessible support for mental health, including substance use disorders. Fully automated conversational agents have the potential to provide mental health support [12], highlighting the importance of ethical considerations and user-centered design to enhance engagement and effectiveness. Moreover, a study investigated the feasibility, usability, and acceptability of the MobileCoach-Teen app for preventing risky drinking behavior among adolescents, reinforcing the applicability of mobile interventions in addressing substance use issues were ratings of usability, acceptability, and digital working alliance with the app were positive [3]. Also, it has been reported that smartphone applications significantly support recovery from alcoholism through continuous monitoring and support [7], further validating the role of mobile technology in healthcare interventions [7]. Although these are valuable cases, it is unclear whether similar results would be obtained with Mexican youth.

Integrating mobile interventions with traditional treatment methods can improve outcomes by providing a continuous support system. Conventional nonpharmacological treatments, such as counseling and support groups, often require regular attendance and can be limited by geographic and time constraints. On the other hand, mobile apps are available 24/7 and can offer support whenever and wherever needed. This constant availability can help maintain motivation and engagement, reduce the likelihood of relapse, and support long-term recovery [13]. By bridging the gap between clinical sessions and everyday life, mobile interventions can make alcohol misuse treatment more dynamic and responsive to individual needs [17].

3 SofIA: A Mobile Application and Chatbot for Alcohol Interventions

The SofIA mobile application and chatbot aims to provide a comprehensive tool for tracking and managing alcohol consumption among young adults. This mobile application, designed for Android devices, incorporates a chatbot feature to enhance user interaction and support. Through real-time notifications and personalized interventions, SofIA assists users in identifying risky behaviors and offers strategies to mitigate them. This section will delve into the key functionalities of the SofIA app, the integration of chatbot interactions, and the overall user experience.

3.1 Functional Requirements for the Mobile Application and Chatbot

To develop effective intervention strategies, brainstorming sessions were held with three professional therapists who lead substance abuse intervention programs at a public institute in Northwest Mexico. These discussions highlighted the importance of incorporating informal language, positive reinforcement techniques, and explicitly referencing family within the intervention design. Additionally, the methodology for analyzing these brainstorming sessions involved a detailed process of identifying and categorizing functional requirements based on recurring themes and therapist input. The insights from these sessions guided the formulation of the following functional requirements.

First, the system should incorporate informal language that aligns with the cultural and social characteristics of the target population. In the context of young people from Northwest Mexico, this means understanding and using the local language and colloquialisms that resonate with them. Youth in this region often communicate using a blend of Spanish and regional slang, which reflects their local cultural identity and social dynamics. By adopting this informal language, the intervention can foster a sense of familiarity and relatability, making the messages more engaging and effective.

Secondly, the system should utilize messages with positive connotations, avoiding threats or negative undertones, especially when addressing young people. This approach is crucial in fostering a supportive and encouraging environment, which is particularly important for youth. Positive messaging helps build trust and motivate young individuals to engage with the intervention and positively change their behavior. In the context of youth interventions, using positive connotations means framing messages to highlight the benefits of healthy behaviors rather than the consequences of risky ones. For example, instead of saying, "*Avoid drinking to prevent negative health outcomes,*" a more effective message would be, "*Staying sober helps you stay healthy and achieve your goals.*" This shift in focus from negative to positive reinforces the idea that making good choices leads to tangible benefits, which can be more motivating for young people [1].

Lastly, the system should include references to family or community in the messages. For people in Mexico, family and community are central aspects of their lives and cultural identity. The intervention can become more relevant and impactful for the target audience by incorporating references to these critical social structures. Family and community ties play a significant role in the daily lives of Mexican youth, providing support, guidance, and a sense of belonging [18]. By acknowledging these connections in the intervention messages, the system can tap into existing sources of motivation and influence. For example, messages emphasizing how positive behavior changes can benefit their family or strengthen community bonds will likely resonate more deeply with young people. Statements like "*By making healthy choices, you set a good example for your siblings*" or "*Staying sober helps you be a*

positive force in your community" can create a powerful emotional connection and enhance the personal relevance of the intervention.

3.2 The SofIA Mobile Application and Chatbot

This section details the development, features, and infrastructure of the SofIA mobile application and chatbot, highlighting its innovative approach to providing real-time interventions and support.

- **The SofIA mobile application:** It was developed for Android using Kotlin in the Android Studio IDE[1]. Serving as the primary interface for users, the application collects data associated with risky alcohol drinking locations among Mexican youth. A key feature is its use of the Google Maps API for geolocation, enabling real-time interaction with locations identified as risky drinking spots. Also, it includes text-based interventions that are delivered to the user through notifications when interacting with a high-risk location. Additionally, users can click on these notifications to access the chatbot on Telegram, providing further support and information. The application ensures secure data processing and storage through a cloud-based infrastructure, offering robust and reliable performance.
- **Backend infrastructure:** The backend infrastructure of the application is built on Firebase[2]. Firebase supports pattern recognition, such as user interaction analysis, behavioral data storage, and real-time feedback, allowing for the timely identification of risky drinking locations and behaviors. It provides essential services such as data storage, authentication, and real-time database updates, which are integral for efficient data processing and analysis. Firebase's robust capabilities ensure the application can handle real-time data management and complexities of user interaction.
- **Chatbot:** The application also includes an integrated Telegram chatbot, developed using Python, which provides personalized follow-ups on interventions. The chatbot engages users through text-based instant messages specifically tailored to resonate with Mexican youth, such as informal language, positive connotations, and the inclusion of family or community references, enhancing user interaction and offering additional support and guidance. We used OpenAI technology (GPT-3.5 Turbo) to further refine the chatbot's engagement, making them more suitable and relatable for the target demographic. This customization helps ensure that the messages are appropriate, such as using informal and positive language, thereby increasing the likelihood of successful intervention.

Figure 1 shows a screenshot of the mobile application SofIA for mobile interventions. The figure shows a map where participants must mark their alcohol-risky locations (Red mark on the map). The application then sends text-based notifications when the user is nearby or interacts with the area. The participant can decide to interact with the notification message, where the chatbot can provide a follow-up on the intervention.

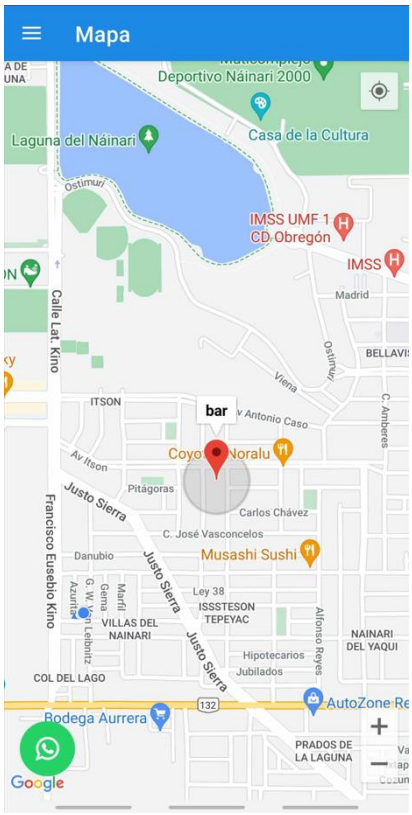

Figure 1. Risky Alcohol Location Feature

Figure 2 illustrates an interaction between the SofIA chatbot component and a user in Telegram. This screenshot demonstrates how the chatbot engages with the user by providing personalized recommendations and strategies for managing alcohol consumption based on the recommendations given by our therapists. The interaction showcases the chatbot's ability to deliver relevant information and support, guiding the user through various options and advice tailored to the population's needs.

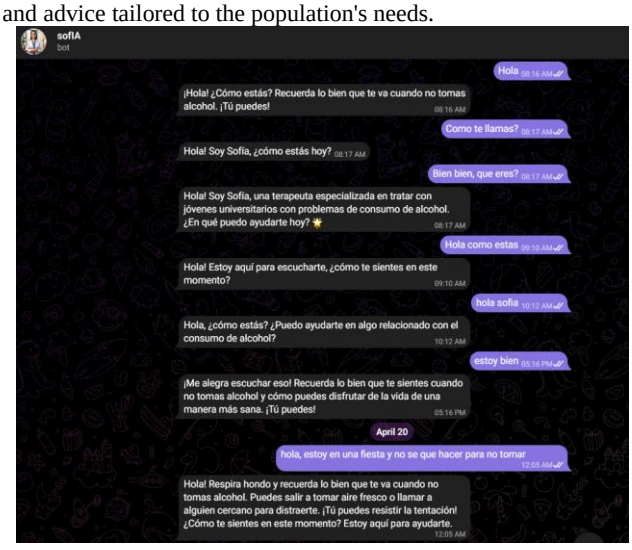

Figure 2. SofIA chatbot example

[1] https://developer.android.com/

[2] https://firebase.google.com/

By combining these technologies, the mobile application not only tracks and analyzes alcohol consumption patterns but also provides real-time support and intervention through its chatbot, making it a comprehensive tool for addressing risky drinking behaviors among Mexican youth.

4 Methodology

We designed a formative evaluation aimed at enhancing the usability of the application. The methodology employed in this study was inspired by the A/B tests used with functional systems. We utilized a between-subjects design, with participants divided into three conditions: a group with the app and a chatbot featuring individualized interventions (C1), a group with the app and a chatbot with no personalized interventions (C2), and a control group with the app but no chatbot (the chatbot was disabled for this group) (C3). Participants were divided evenly across the groups without any special assignment process. However, non-Android users, who required an Android device to interact with the app, were given the option to join the group they preferred.

Our dependent variables were (1) usability scores, which were assessed through the System Usability Scale (SUS) [2], and (2) chatbot usability, which was evaluated using the Chatbot Usability Questionnaire (CUQ) [9].

4.1 Participants

The study involved 21 participants (four female, one undisclosed gender) aged 20 to 22. Recruitment took place at a university in Northwest Mexico. Our participants were distributed across three groups, with group 1 (C1) consisting of 11 participants, group 2 (C2) of 5 participants, and group 3 (C3) of 5 participants. Group 1 had more participants because students without an Android smartphone (who owned iPhones) were paired with those with an Android device. These pairs were asked to interact with the app independently using their partner's smartphone. Most of these pairings used C1 of the app.

We asked our participants to share their alcohol consumption patterns such as frequency, quantity, and the consequences of drinking. Alcohol consumption was measured using the Alcohol Use Disorders Identification Test (AUDIT) [16], a 10-item questionnaire that assesses alcohol consumption, drinking behaviors, and alcohol-related problems. Participants' responses provide a total score that categorizes them into different risk levels for alcohol-related disorders, ranging from low risk to high risk. This measure allowed us to identify the varying levels of alcohol consumption among participants and how these levels might influence their interaction with the SofIA application.

4.2 Procedure

The procedure commenced with an introduction session where participants were familiarized with the application and its functionalities. Over the course of one week, we asked participants to use the application to monitor and regulate their alcohol consumption by identifying and interacting with risky alcohol drinking locations. We selected a one-week period as we believed it provided enough time for participants to engage with the app and assess usability while keeping the study manageable. Post-study assessments were conducted using the AUDIT to measure alcohol consumption levels. Lastly, participants were asked to submit a written report providing recommendations and suggestions for the application and the chatbot.

4.3 Data collection

For the purposes of this study, our data collection encompassed the digital administration of the SUS and CUQ surveys through Google Forms. These surveys were designed to gauge user satisfaction with the application and assess the usability of the integrated chatbots. The study aimed to comprehensively evaluate the application's usability and associated chatbot features by incorporating subjective and objective measures. No data were analyzed from the user interacting with the chatbot or the app.

4.4 Data analysis

The survey data were analyzed using standardized statistical data analysis tests using the IBM SPSS software.

As mentioned, the usability of SofIA was assessed using the System Usability Scale (SUS). The SUS is a widely used tool for evaluating the usability of a system, consisting of 10 items that provide a composite score reflecting the user's overall satisfaction with the application's usability. Answers were formatted using a 5-point Likert scale, with 1 indicating 'strongly disagree' and 5 indicating 'strongly agree'. After participants used the application for one week, they completed the SUS questionnaire. The resulting scores were analyzed using an Analysis of Variance (ANOVA) to determine if there were significant differences in usability scores between different groups of participants.

The usability of the chatbot integrated into the SofIA application was measured using the Chatbot Usability Questionnaire (CUQ). The CUQ is similar to the SUS but is specifically designed to evaluate the usability of chatbots. It includes 16 items, with an equal number of positive and negative statements about the chatbot's performance and user interaction. Answers were also formatted using a 5-point Likert scale, with 1 indicating 'strongly disagree' and 5 indicating 'strongly agree'. Participants who interacted with the chatbot completed the CUQ, and the scores were analyzed using an independent samples t-test. This statistical test was used to compare the usability scores of the two conditions of the chatbot to identify any significant differences in usability scores.

5 Results

The average SUS score on a scale of 100 was 62.5 among the 21 participants, using the evaluation method described by [2]. The highest score obtained was 92.5, and the lowest was 27.5. The average SUS score differed among the application conditions: C1 had an average score of 70 (SD = 19.33), C2 had an average score of 54.5 (SD = 17.98), and C3 had an average score of 54 (SD = 15.87). An analysis of variance was conducted to determine if there were significant differences between the mean SUS scores of the different conditions. The results showed no significant difference between the means of the conditions (t=1.938, df=2, p=.173).

Participants generally provided positive feedback regarding interactions with the chatbots (C1 with personalized interventions and C2 without personalized interventions). They noted that the chatbot in C1 performed as expected, functioning like a therapist and providing relevant information, while the chatbot in C2 was appreciated for its flexibility, allowing broader conversation topics. The average CUQ score on a scale of 100 was 63.6 (SD = 13.07 from 10 participants who interacted with both chatbot conditions (C2 N=7, C3 N=3), applying the evaluation method described by [9]. The highest score obtained was 75.0, and the lowest was 35.9. The average CUQ score differed between the chatbot conditions: C1 had an average score of 62.1, and C2 had an average score of 67.2. The results indicated no significant difference between the means (t=-.547, df=8, p=.599).

Most participants found the application easy to use and navigate. However, a notable point was that while the majority found the application user-friendly, they suggested that the usability instructions would be more helpful if placed in a more accessible location. Participants responded positively to the application's aesthetics and the arrangement of visual elements. Nonetheless, we identified opportunities for improvement, such as making text fields and taskbar functionalities more intuitive. The application was deemed accessible for most users, although there were noted deficiencies in its adaptability for individuals with visual impairments. Participants praised the consistency in design and the feedback provided by the application, which contributed positively to the overall user experience.

6 Design Feedback

The participants' usability and user experience feedback indicated that most found the SofIA application easy to use and navigate. However, a notable suggestion was that the application would be more user-friendly if the usage instructions were placed in a more accessible location. For instance, one participant suggested, "The application would be easier to interact with if the usage instructions were placed in a more accessible location." Another echoed this sentiment: "*Having the instructions easier to find would definitely improve my experience with the app*."

As mentioned before, participants reacted positively to the application's user interface (UI) design. Despite this, some areas were identified for improvement to make the interface more intuitive, such as enhancing text fields in the register section (Figure 3) and taskbar functionalities (i.e., usage instructions in the main screen).

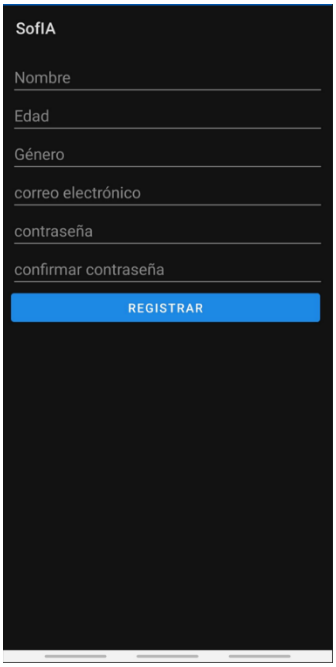

Figure 3. Original text fields of the SofIA app register section

In terms of accessibility, the application was generally accessible to most users, but some deficiencies were noted concerning its adaptability for individuals with visual impairments. For instance, participants mentioned that some fonts and text fields were too small and difficult to understand. Participants also praised the consistent design and effective feedback mechanisms as significant strengths that enhanced user satisfaction.

Based on the average SUS score and the variability of the responses, a deeper analysis of the user feedback is necessary to identify specific areas of the application that require improvement. Participants noted that the font size and text fields should be larger for better readability. They also recommended that the usage instructions be more precise and easily accessible. Additionally, the chatbot interaction should be more intuitive, and overall accessibility should be enhanced to support visually impaired users.

Both chatbot conditions (C1 and C2) have similar performance in terms of usability but still have room for improvement. For instance, some participants suggested that the chatbot's responses should be more accurate and contextually relevant, enhancing the intuitiveness of interactions. Additionally, the chatbot should offer more flexible conversational options to cater to diverse user needs.

It is crucial to prioritize the areas that received lower ratings, such as font size, text fields, clarity and accessibility of usage instructions, intuitiveness of chatbot interactions, and overall accessibility for visual impairments. The app's font size and text fields should be increased to address these areas, and usage instructions should be prominently displayed and simplified. Integrating both a video tutorial and written instructions could enhance clarity. Furthermore, the chatbot interface should be made more intuitive to access, and additional accessibility features should be incorporated to support better visually impaired users, such as larger fonts and more precise instructions. User feedback should guide these iterative changes to the design and functionality of the application and chatbot.

7 Discussion

The overall study provided valuable insights into the usability and user experience of the SofIA mobile application. The SUS questionnaire responses revealed that the 21 participants gave the application an average score of 62.5 out of 100, indicating a moderately positive perception. However, the wide range of scores, from 27.5 to 92.5, highlights both positive aspects and areas requiring improvement in the user experience. While some parts of the application received high ratings, others need enhancement. Despite these areas for improvement, the results suggest that the application has promising potential to meet user needs.

Based on the results obtained from the Chatbot Usability Questionnaire (CUQ), participants generally rated the chatbot's usability with an average score of 63.6 out of 100, suggesting a moderately positive perception. Although there was variability in the scores, ranging from 35.9 to 75.0, both conditions of the chatbot showed similar average scores. The independent samples t-test revealed no significant differences between the C1 and C2 mean scores, indicating that both conditions perform similarly in usability. These findings suggest that while the chatbot has positive aspects regarding usability, areas for improvement could be addressed in future iterations to optimize the user experience further.

One of our study's significant limitations was that most participants, specifically 19 out of 21, were categorized at the lowest risk level of alcohol consumption among the four possible levels classified by the AUDIT results. Additionally, non-Android users were paired with Android users to ensure they could interact with the app, which may have influenced the study dynamics and the participants' experience. This distribution could explain the moderately average SUS score, as users with lower risk levels might have found the application more straightforward and less critical regarding intervention needs. In contrast, only one participant fell into group 2 and another into group 3, indicating higher risk levels. This variation in participant risk levels

underscores the importance of considering user demographics and risk profiles when evaluating application usability and effectiveness. Also, it suggests that future iterations of the application should tailor features to meet the diverse needs of users across different risk levels, ensuring a more comprehensive and satisfactory user experience.

Lastly, given that our participants in C1 and C2 conditions perform similarly in terms of usability, a detailed analysis of the CUQ feedback is recommended to identify specific areas of the user experience that need enhancement. Furthermore, conducting additional user tests to validate the implemented improvements and transparently communicating any changes made to the chatbot based on received feedback is essential. These actions can significantly contribute to optimizing the chatbot's usability and enhancing the user experience in future interactions.

8 Conclusion

The preliminary approach to the SofIA mobile application has provided valuable insights into its usability and user experience, highlighting strengths and improvement areas. The average SUS score of 62.5 indicates a moderately positive perception, though the wide range of individual scores suggests variability in user satisfaction. Most participants found the application easy to use but identified areas that require enhancement, such as the placement of usage instructions and the intuitiveness of specific interface elements. The feedback on the chatbots was generally positive, with users appreciating both the functionality and flexibility offered by the different conditions, although the CUQ scores indicated room for further refinement.

These findings underscore the importance of tailoring the application to meet better its users' diverse needs, particularly those with varying risk levels, as indicated by the AUDIT scores. Moving forward, it is crucial to prioritize improvements based on user feedback, focusing on enhancing the intuitiveness and accessibility of the application. By continually iterating on the design and functionality, SofIA can become a more effective and user-friendly tool for managing alcohol consumption. Future research should validate these improvements and further explore how demographic and risk profile variations impact user experience and usability.

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