Effect of Automated Online Counseling on Clinical Outcomes and Quality of Life Among Adolescents With Acne Vulgaris: A Randomized Clinical Trial

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**Importance**
Effective patient education is necessary for treating patients with acne vulgaris. Automated online counseling simulates face-to-face encounters and may be a useful tool to deliver education.

**Objective**
To compare the effectiveness of a standard educational website with that of an automated-counseling website in improving clinical outcomes and quality of life among adolescents with acne.

**Design, Setting, and Participants**
Randomized clinical trial conducted between March 27, 2014, and June 27, 2014, including a 12-week follow-up in a local inner-city high school. Ninety-eight students aged at least 13 years with mild to moderate acne were eligible for participation. A per-protocol analysis of the evaluable population was conducted on clinical outcome data.

**Interventions**
Participants viewed either a standard educational website or an automated-counseling website.

**Main Outcomes and Measures**
The primary outcome was the total acne lesion count. Secondary measures included the Children's Dermatology Life Quality Index (CDLQI) scores and general skin care behavior.

**Results**
Forty-nine participants were randomized to each group. At baseline, the mean (SD) total acne lesion count was not significantly different between the standard-website group and the automated-counseling-website group (21.33 [10.81] vs 25.33 [12.45]; P = .10). Improvement in the mean (SD) acne lesion count was not significantly different between the standard-website group and the automated-counseling-website group (0.20 [9.26] vs 3.90 [12.19]; P = .10). The mean (SD) improvement in CDLQI score for the standard-website group was not significantly different from that of the automated-counseling-website group (0.17 [2.64] vs 0.39 [2.94]; P = .71). After 12 weeks, a greater proportion of participants in the automated-counseling-website group maintained or adopted a recommended anti-acne skin care routine compared with the standard-website group (43% vs 22%; P = .03).

**Conclusions and Relevance**
Internet-based acne education using automated counseling was not superior to standard-website education in improving acne severity and quality of life. However, a greater proportion of participants who viewed the automated-counseling website reported having maintained or adopted a recommended anti-acne skin care regimen.

**Trial Registration**
clinicaltrials.gov Identifier: NCT02031718
Acne vulgaris is a chronic inflammatory skin disease with high prevalence among adolescents. In addition to pharmacotherapy, an important part of managing acne includes patient education. Patient education has been shown to increase knowledge and promote behavioral changes. However, the effect of patient education on clinical outcomes is not well characterized in dermatology publications, to our knowledge. Determining what comprises effective acne education can significantly affect patient care and outcomes.

Dermatology-specific patient educational materials have primarily conveyed information using traditional media, such as printed materials. Alternative multimedia, such as the Internet and digital video, can also be used to deliver educational content. For instance, video was effective in promoting sunscreen use and increasing sunscreen knowledge among high school students. In addition, adolescents who viewed computerized audiovisual information had greater long-term gains in acne knowledge compared with those who received written handouts. Patient education using alternative media may be superior to using traditional media in improving knowledge, promoting changes in behavior, and affecting clinical outcomes.

We developed an educational website on acne that incorporated automated online counseling. Automated online counseling uses virtual counselors to simulate face-to-face clinical encounters. Virtual counselors are commonly developed using computer-based techniques, such as digital video or computer animation. Sessions are conversational and structured around questions asked by the virtual counselor. Patients “respond” to questions by choosing among a multiple-choice list of possible answers. In turn, the virtual counselor automatically provides feedback or guidance that is dependent on the patient’s responses. Previous studies have reported that automated counseling may be effective in promoting certain behaviors, such as increasing physical activity and improving dietary habits. Integrating automated online counseling with acne education is novel and can enhance future care of such patients.

We conducted a randomized clinical trial to compare the effectiveness of automated online counseling vs standard Internet-based education on improving clinical outcomes and quality of life among high school students. We hypothesized that those randomized to receive automated online counseling would exhibit greater improvement in acne severity and quality of life. This investigation builds on prior work from our research group that has shown that automated online counseling produces greater improvement in participant knowledge compared with standard website education.

Methods

Study Design and Participants
This randomized clinical trial was conducted among students from a high school located in Northern California. Student participation was entirely voluntary. We received parental or guardian consent and participant assent for all patients. The study was approved by the institutional review board of the University of California, Davis. The full study protocol can be found in the trial protocol in the Supplement.

Participants were required to be at least 13 years of age, have a diagnosis of active mild to moderate acne, speak English, be able to hear and view the educational videos, and have access to a computer with an Internet connection. We excluded students who were currently using prescription acne treatment.

Study Schedule
Following confirmation of diagnosis and informed consent and assent, participants completed a questionnaire to assess baseline demographics and current skin care behaviors as well as the Children’s Dermatology Life Quality Index (CDLQI) to assess patients’ quality of life. Study staff (W.T.) then took a series of 3 standardized photographs of each patient that included the forehead and bilateral cheeks. All participants then received a one-on-one tutorial on how to log on to the password-protected website to which they were randomly assigned (Figure 1). Participants also received weekly email reminders to access online content.

After 12 weeks, study staff (W.T.) obtained follow-up photographs of the same facial regions assessed at baseline. Participants then completed a final questionnaire to assess changes in quality of life and skin care behavior.

Description of Educational Websites
Two educational websites were developed for this study (both are at http://projectclearskin.wix.com/project-clear-skin). The first was a standard educational website that contained information regarding the pathogenesis of acne, suggestions on preventing acne, over-the-counter acne medications, and prescription acne medications. In addition, the website included...
an evidence-based guide on building an anti-acne skin care routine using over-the-counter products.

The second website contained information identical to that on the standard educational website but was enhanced with automated counseling. The virtual counselor was developed using prerecorded digital videos. Similar to previous studies, participants interfaced with an Internet-based platform and interacted with the virtual counselor by choosing from a multiple-choice list of responses (Figure 2). The Transtheoretical Model guided the development of the automated online counseling sessions. This model describes how patients progress through a series of cognitive stages (precontemplation, contemplation, preparation, action, and maintenance) during intentional behavioral change. In addition, the model emphasizes the provision of guidance that is matched to a patient’s readiness to practice a new behavior. For example, the virtual counselor for this study provided more education and described the pros and cons of using anti-acne products for individuals who have not yet started such a regimen (ie, participants in the precontemplation stage). In contrast, individuals who have started using anti-acne products (ie, participants in the action or maintenance stage) were given positive feedback to help maintain newly adopted behavior. Moreover, the virtual counselor screened for and provided practical solutions to common adverse effects of using anti-acne skin care products (eg, dry irritated skin).

Assessment of Acne
The primary outcome of the study was the change in the total acne lesion count between baseline and the 12-week follow-up visit. A study rater who was blinded to the randomization allocation was trained to count the number of inflammatory and noninflammatory acne lesions in a 9-cm² area on each of the 3 standardized digital photographs taken for every participant. The number of acne lesions in each 9-cm² area was summed to calculate a total acne lesion score. The rater was blinded to subject randomization and visit number.

Assessment of Quality of Life
Acne-related effects on quality of life were assessed using the CDLQI, a well-validated measure that assesses the effects of a disease on various domains of daily life. The scores range from 0 to 30, with higher scores indicating a greater effect on quality of life.

Assessment of Skin Care Behavior
We asked participants to choose from among the following answers to best describe their current anti-acne skin care habits: (1) I haven’t thought about starting a skin care routine; (2) I’m thinking about starting a skin care routine; (3) I have a skin care routine in mind and I’m planning on buying skin care supplies soon; (4) I just started a skin care routine (in the past 6 months); and (5) I already have a skin care routine (for more than 6 months). This question was recoded as a binary variable to better define participants who did not have a skin care routine (answers 1-3) and those who did (answers 4 and 5).

Sample Size and Randomization
Participants were randomized in a 1:1 nonstratified randomization scheme. Sequentially numbered, opaque sealed envelopes were used for allocation concealment. With a total sample size of 88 participants, the study had 80% power to detect a minimal clinically significant difference of 15 acne lesions between study groups, assuming a standard deviation of 25 and 2-tailed α of .05. We then assumed a dropout rate of approximately 10%, which increased our total sample to 98 participants.

Statistical Analysis
All statistical analyses were conducted using SPSS, version 20.0 (IBM). An unpaired t test was used to analyze continuous variables for between-group comparisons and a paired t test was used for within-group comparisons. Fisher exact or χ² tests were used for categorical variables. A per-protocol analysis of the evaluable population was conducted on the outcome data.
For all statistical analyses, 2-tailed tests were conducted and $P < .05$ was considered statistically significant.

**Results**

A total of 98 high school students were enrolled starting March 27, 2014, and participated in the study through June 27, 2014. Enrolled participants were aged between 14 and 19 years. Ninety-five of the 98 enrolled participants (97%) completed the study (Figure 1). Baseline demographic data are presented in Table 1. Clinical outcome data are summarized in Table 2 and Table 3. Participants accessed the standard website and the automated counseling website with similar frequency (mean [SD], 4.63 [2.67] vs 5.31 [3.18] times for 12 weeks; $P = .26$).

**Acne Lesion Count**

The standard-website group and the automated-counseling-website group had similar total acne lesion counts at baseline (mean [SD], 21.33 [10.81] vs 25.33 [12.45] lesions per person; $P = .10$) (Table 2). Within-group analysis showed that the standard-website group had a nonsignificant decrease in the mean (SD) total acne lesion count after 12 weeks (21.13 [14.42] lesions) compared with baseline ($P = .89$). However, the automated-counseling-website group showed a significant decrease in mean (SD) total acne lesions (21.43 [10.69] lesions) from baseline ($P = .03$).

Between-group analysis revealed a greater mean (SD) improvement in total acne lesions in the automated-counseling-website group (3.90 [12.19] lesions) compared with the standard-website group (0.20 [9.26] lesions); however, this difference was not statistically significant ($P = .10$) (Table 3).

**Quality of Life**

The standard-website group and the automated-counseling-website group had similar baseline CDLQI scores (mean [SD] score, 2.72 [3.19] vs 2.69 [3.28]; $P = .97$) (Table 2). Within-group analysis showed that the mean (SD) CDLQI score of the standard-website group did not significantly change after the 12-week follow-up period (2.69 [3.28]) compared with baseline ($P = .66$). Similarly, the automated-counseling-website group reported a mean (SD) CDLQI score of 2.31 (2.99) that was not significantly different from baseline ($P = .36$).

Between-group comparison showed that the mean (SD) improvement in CDLQI score was not significantly different between the standard-website and automated-counseling-website groups (0.17 [2.64] vs 0.39 [2.94]; $P = .71$) (Table 3).

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Table 1. Baseline Demographic Characteristics of Participants Randomized to the Standard Website and the Automated-Counseling Website

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Standard Website (n = 49)*</th>
<th>Automated-Counseling Website (n = 49)*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>16.10 (1.70)</td>
<td>16.30 (1.47)</td>
<td>.53</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>29 (59)</td>
<td>30 (61)</td>
<td>.84</td>
</tr>
<tr>
<td>Male</td>
<td>20 (41)</td>
<td>19 (39)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>7 (14)</td>
<td>10 (20)</td>
<td>.61</td>
</tr>
<tr>
<td>African American</td>
<td>9 (18)</td>
<td>8 (16)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>24 (49)</td>
<td>26 (53)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>9 (18)</td>
<td>5 (10)</td>
<td></td>
</tr>
<tr>
<td>Currently have an anti-acne skin care routine</td>
<td></td>
<td></td>
<td>.83</td>
</tr>
<tr>
<td>No</td>
<td>33 (67)</td>
<td>35 (71)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>16 (33)</td>
<td>14 (29)</td>
<td></td>
</tr>
</tbody>
</table>

* Values are presented as the number (percentage) of patients unless otherwise indicated. Percentages may not total to 100 owing to rounding.

Table 2. Mean Total Acne Lesion Count and CDLQI Scores

<table>
<thead>
<tr>
<th>Type of Evaluation</th>
<th>Standard Website (n = 46)*</th>
<th>Automated-Counseling Website (n = 49)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>12-wk Follow-up</td>
<td>P Value (Within Group)*</td>
</tr>
<tr>
<td>Total No. of acne lesions, mean (SD)</td>
<td>21.33 (10.81)</td>
<td>21.13 (14.42)</td>
<td>.89</td>
</tr>
<tr>
<td>CDLQI score, mean (SD)</td>
<td>2.72 (3.19)</td>
<td>2.54 (2.78)</td>
<td>.66</td>
</tr>
</tbody>
</table>

Abbreviation: CDLQI, Children's Dermatology Life Quality Index.

* Three participants were lost to follow-up.

* $P$ value when comparing baseline values with 12-week follow-up results (within-group results).

* $P$ value when comparing results between groups. Baseline significance is followed by significance at the 12-week follow-up (in parentheses).
Skin Care Behavior

The study groups had similar proportions of participants who endorsed having a skin care routine at baseline ($\chi^2 = 0.001; P = .98$). At the 12-week follow-up, a higher proportion of the automated-counseling-website group endorsed having maintained or adopted a skin care regimen compared with the standard-website group (43% vs 22%; $\chi^2 = 4.81; P = .03$).

Table 3. Comparison of Change in Total Acne Lesion Count, CDLQI Score, and Skin Care Behavior

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Standard Website (n = 46)*</th>
<th>Automated-Counseling Website (n = 49)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of acne lesions, change in mean (SD)$^b$</td>
<td>0.20 (9.26)</td>
<td>3.90 (12.19)</td>
<td>.10</td>
</tr>
<tr>
<td>CDLQI score, change in mean (SD)$^b$</td>
<td>0.17 (2.64)</td>
<td>0.39 (2.94)</td>
<td>.71</td>
</tr>
<tr>
<td>Maintained or recently adopted an anti-acne skin care routine, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>36 (78)</td>
<td>28 (57)</td>
<td>.03</td>
</tr>
<tr>
<td>Yes</td>
<td>10 (22)</td>
<td>21 (43)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: CDLQI, Children’s Dermatology Life Quality Index.

* Three participants were lost to follow-up.

A positive number signifies an improvement from the baseline.

Discussion

Acne is prevalent among adolescents and is associated with significant psychosocial burden. Despite this, evidence of what comprises effective educational methods for patients with acne is lacking. In this study, we integrated Internet-based acne education and automated counseling for several reasons. First, alternative health communication formats (eg, the Internet) may be superior to traditional media (eg, written pamphlets) in delivering patient education. Online content by youth suggested that Internet-based educational methods for patients with acne and its treatments. In turn, improved understanding may lead to greater treatment adherence and clinical outcomes.

The results of this study should be interpreted in the context of the study design. Currently, the CDLQI is only validated for patients between 4 and 16 years of age. To preserve the study power, all participants completed the CDLQI questionnaire to be able to compare results among the participants. Therefore, the effect of automated online counseling on adult dermatologic quality of life was not assessed in this study. In addition, the use of skin care products was based on self-report. As such, there may be potential for recall bias.

Conclusions

Patient education is an essential component of disease management and can be delivered through various formats and media. Evidence is lacking regarding what constitutes effective education for patients with acne and how such information can be delivered. Using the Internet to deliver patient education about acne is advantageous because it is easily disseminated and accessible and has high acceptability among adolescents. Internet-based education using automated counseling appears to be an effective tool for promoting skin care behavior in adolescents with acne. The long-term effect on clinical outcomes can be explored in future studies.
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Tuong, Armstrong.

Critical revision of the manuscript for important intellectual content: All authors.

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Tuong.

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REFERENCES


