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Comparing the Effectiveness of Automated Online Counseling to Standard Web-Based Education on Improving Acne Knowledge: A Randomized Controlled Trial

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Abstract

Background—Evidence regarding what comprises effective education for acne vulgaris patients is lacking. Internet-based education may improve patient knowledge of this condition.

Objectives—Our objective was to compare the effectiveness of standard web-based education and an automated counseling website in improving acne knowledge.

Design—In a randomized trial, participants visited either a standard website or an automated counseling website to learn about acne. Multiple-choice questions were administered at baseline and after 12 weeks to assess change in acne knowledge.

Results—A total of 97 high school students were enrolled, and 95 completed the study. The standard website group had a significant increase in knowledge from baseline (3.61 ± 1.22) to 12-week follow-up (5.46 ± 1.31 , $p < 0.001$). Similarly, the automated counseling website group had a significant increase in knowledge between both time points (3.53 ± 1.50 vs. 6.49 ± 1.06 , $p < 0.001$). After 12 weeks, mean improvement in knowledge was higher in the automated counseling group (2.96 ± 1.85) than in the standard website group (1.85 ± 1.46 , $d = 0.67$, $p = 0.002$). The number of website visits was positively correlated with improvement in knowledge in both groups. Finally, the automated counseling website group rated their educational material more useful ($p = 0.004$) and more enjoyable to view ($p = 0.003$) than did the standard website group.

Limitations—This study is limited to adolescents with mild-to-moderate acne vulgaris.

Conclusion—Internet-based patient education appears to be an effective method of improving acne knowledge among adolescents.

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Conflict of interest Mr. William Tuong has no relevant conflicts of interest to declare. Dr. Audrey S. Wang has no relevant conflicts of interest to declare. Dr. April W. Armstrong has no relevant conflicts of interest to declare.

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1 Introduction

Acne is a common skin disease amongst adolescents and can significantly impact psychological and social functioning [1]. Previous studies also indicate that patients may have several misconceptions of acne, including the natural course of the disease, etiology, and duration of therapy [2, 3]. Despite this, evidence regarding the best means of delivering education on acne is lacking.

Improving patient knowledge about acne may have important implications on treatment adherence and outcomes. Patients who believe they have a poor understanding of acne and its treatments may be less likely to be compliant with acne treatments [4]. Moreover, evidence suggests that non-adherence has been associated with acne treatment failure [5]. Thus, effective patient education may improve knowledge, thereby leading to improved compliance and better treatment effect.

Patient education can be delivered through various formats and media [6]. However, alternative forms of patient education, such as internet-based information, may be superior to traditional methods (e.g., written pamphlets) in improving patient knowledge [6–9]. In addition, web-based technologies may be an effective tool in delivering health information amongst adolescents, given the rising rates of Internet utilization and access of online content in this population [10].

For our primary study, we created two educational websites to teach adolescents about acne. One website provided information in a standard fashion with text, diagrams, and images. In contrast, the other more interactive website incorporated automated online counseling, which uses virtual counselors to simulate face-to-face conversations. Virtual counselors are commonly developed using computer-generated images or digital video. When the virtual counselor asks a question, patients answer by choosing from a list of possible responses. In turn, the virtual counselor provides feedback that is tailored to the responses of the patient. Although studies in other areas of medicine have used automated online counseling to promote certain preventive behaviors [11, 12], the application of such technology in the field of dermatology is novel.

One of our aims for this paper was to evaluate the effectiveness of the two educational websites in enhancing acne knowledge. We hypothesized that subjects randomized to receive education via the automated counseling website would demonstrate a greater increase in acne knowledge than would those receiving standard website education.

2 Methods

2.1 Study Procedures and Participants

We conducted a randomized trial amongst high school students. The study protocol was approved by the Institutional Review Board at the University of California, Davis. The clinicaltrials.gov registration number is NCT02031718. For all participants, we obtained written parental/guardian informed consent and participant assent.

Participants were required to meet several eligibility criteria. Specifically, students were eligible if they were least 13 years of age, had been diagnosed as having mild to moderate acne, spoke English, were able to hear and view the educational videos, and had access to a computer with an Internet connection. We excluded students reporting current use of any prescription acne treatments.

Randomization occurred in a simple, 1:1, non-stratified randomization scheme. Randomization sequences were concealed within opaque, sequentially numbered envelopes until interventions were assigned. After randomization to either the standard website education group or the automated counseling website group, participants had one-on-one time with research staff to receive instructions on how to access the password-protected website.

2.2 Standard Educational Website

The standard website used images, diagrams, and text to deliver educational content. Educational topics included causes of acne, strategies to prevent exacerbation of acne, over-the-counter and prescription acne treatments, common side effects of acne treatments, and the duration that acne treatments should be used before improvement is typically noticeable. It also provided an evidence-based guide on building an anti-acne skincare routine with over-the-counter products.

2.3 Automated Counseling Website

The virtual counselor for this study provided educational information on topics identical to those on the standard website. He also reminded participants to review different sections of the educational website and provided links to content. An actor was digitally recorded for the online counseling sessions. Participants engaged with the virtual counselor through a platform similar to those used in prior studies [11, 12]. Specifically, participants responded to the virtual counselor's questions by choosing among a list of response choices (Fig. 1). Each participant response was linked to a specific online video of the online counselor. For instance, the counselor would discuss strategies to care for skin irritation secondary to anti-acne treatments if the participant responded affirmatively to a question screening for this side effect.

The dialog system used by the virtual counselor was based on a model used by Bickmore et al. [11] that describes how conversations progress in a step-wise fashion. In particular, the dialog system was constructed around a conversational hierarchy that included the initiation of dialog (greeting the participant), conducting the core part of acne education and anti-acne skin care counseling, and closing the conversation (saying farewell to the participant). An excerpt is outlined in Fig. 2.

2.4 Scales and Measures

The primary outcome was change in acne knowledge between baseline and 12-week follow-up. Acne knowledge was assessed using an identical set of eight multiple-choice questions (Electronic Supplementary Material 1) that have been pre-tested in a prior study [13]. The topics covered by the knowledge test include causes of acne, meaning of specific acne

terminology, side effects of medications, and typical duration of acne treatment. Website usage was assessed by asking participants how many times they accessed the website to which they were randomly assigned.

We used three measures to evaluate participant satisfaction with the educational websites: (1) evaluation of usefulness of the websites, (2) presentation quality of information, and (3) how much participants enjoyed using the websites. Each measure was assessed on a 10-point scale (1 indicating the lowest level of satisfaction and 10 indicating the highest level of satisfaction on that specific dimension). For example, usefulness of the educational material was measured by asking, “Please rate the usefulness of the educational material on a scale of 1 to 10, with 1 being least useful and 10 being most useful.” Presentation quality and enjoyment were measured with similar questions. These questions have been pre-tested in a prior study [8].

2.5 Statistical Analysis

Data were analyzed using SPSS 20.0 software (IBM Corp, Armonk, NY, USA). Paired *t* tests were used to assess for within-group changes in acne knowledge, whereas unpaired *t* tests were used to analyze between-group differences. Chi-squared or Fisher’s exact tests were used for categorical data. A Pearson product–moment correlation coefficient was conducted to assess the relationship between website usage and improvement in knowledge. Cohen’s *d* size effect is provided for between-group comparisons (independent samples). Tests were two-tailed, and $p < 0.05$ was considered statistically significant.

3 Results

In total, 97 participants enrolled in the study; 49 were randomized to the automated counseling website group, and 48 were randomized to the standard website group. Two participants in the standard website group were lost to follow-up (i.e., they were absent from school on the days we conducted follow-up assessments). In sum, 95 participants completed the study, resulting in a 98 % completion rate. Baseline characteristics were not significantly different between study groups and are summarized in Table 1.

3.1 Change in Knowledge

Acne knowledge scores for both study groups are summarized in Table 2. At baseline, the standard website group (3.61 ± 1.22) and the automated counseling website group (3.53 ± 1.50) had similar mean acne knowledge scores at baseline ($d = 0.06$, $p = 0.782$). Within-group analysis revealed that the mean knowledge score for the standard website group was significantly different at the 12-week follow-up time point (5.46 ± 1.31) compared with baseline ($p < 0.001$). Similarly, the mean knowledge score for the automated counseling website group was significantly different at the 12-week follow-up period (6.49 ± 1.06) compared with baseline ($p < 0.001$).

Between-group analysis showed that the mean change in acne knowledge was significantly different between the standard website group (1.85 ± 1.46) and the automated counseling website group (2.96 ± 1.85 , $d = 0.67$, $p = 0.002$), favoring the latter.

3.2 Website Usage and Acne Knowledge

The standard website group visited their online site 4.63 ± 2.67 mean times over 12 weeks, and the automated counseling website group visited their online site 5.31 ± 3.18 mean times ($d = 0.23$, $p = 0.264$). Within the standard website group, there was a significant positive correlation between the number of times the website was accessed and improvement in acne knowledge ($r = 0.305$, $n = 46$, $p = 0.040$). Likewise, there was a significant positive correlation between these two variables in the automated counseling website group ($r = 0.655$, $n = 49$, $p < 0.001$). Scatterplots summarize the results (Fig. 3a, b).

3.3 Participant Satisfaction

The automated counseling website group rated the usefulness of their material 7.22 ± 1.56 , which was significantly higher than the standard website rating of 6.33 ± 1.43 ($d = 0.59$, $p = 0.004$). Furthermore, the automated counseling group gave a significantly higher enjoyment rating to their material (7.45 ± 1.49) compared with the standard website group (6.43 ± 1.78 , $d = 0.62$, $p = 0.003$). The automated counseling group and standard website group rated the presentation quality of their material similarly (7.55 ± 1.34 vs. 6.98 ± 1.65 , respectively; $d = 0.38$, $p = 0.066$).

4 Discussion

Rising trends in internet utilization among youth, and the positive results of prior automated counseling interventions, indicated a novel way of educating adolescents about acne [10–12]. Several studies have indicated that alternative formats of patient education may be superior to traditional methods in improving patient knowledge [6–9]. Armstrong et al. [9] reported that online video education was more effective than written pamphlets in improving atopic dermatitis skincare knowledge. Moreover, participants randomized to the video education group had significantly improved disease severity than the pamphlet group [9].

For this study, we sought to compare the effectiveness of a standard educational website with that of an automated counseling website in improving acne knowledge. At the end of the 12-week study period, mean acne knowledge scores significantly increased in both study groups. Additionally, between-group analysis revealed that the automated counseling website group had a mean improvement in knowledge that was significantly greater than the standard website group. Our findings corroborate results of other studies that have evaluated how increasing the interactivity of health information enhances the effectiveness of patient education [7]. In particular, interactive multimedia programs may improve acquisition of knowledge among younger patients [7]. For this study, the automated counseling sessions increased the interactivity of website content by engaging participants in ‘conversations’ and reminding them to review different sections of the website.

In both study groups, improvement in knowledge was positively correlated with the number of times a participant accessed the website. Repetition and frequent exposure to information has been shown to improve the acquisition and retention of knowledge [14]. A prior study comparing the effect of video-based education with that of a written pamphlet found that participants reviewed the video more often and had significantly higher knowledge and

improved sun-protection behavior [8]. Encouraging patients to revisit information may be a simple yet effective technique in improving knowledge.

Our study findings must be interpreted within the context of certain limitations. The number of times participants accessed the website was based on self-report. As such, there may be risk for recall bias. Additionally, despite absence of validated acne vulgaris knowledge questionnaires, the multiple-choice items used for this study were pre-tested in a separate study [13].

To date, evidence regarding the effect of acne-specific patient education is lacking. Effective means of delivering patient education on acne is important given its high prevalence and potential impact on psychosocial well being [1]. This study demonstrates that an interactive automated online counseling website was significantly more effective than standard web-based education in improving acne knowledge among adolescents.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Points

Evidence regarding what comprises effective education for acne vulgaris patients is lacking.

After 12 weeks, mean improvement in knowledge was higher in the automated counseling group than in the standard website group.

The number of times a participant logged on to the website was positively correlated with improvement in knowledge in both groups.

Fig. 1.
Screenshot of automated counseling website on acne education

C: Hi. Thanks for visiting today. Are you ready to learn about acne today? GREETING
P: Yes, I am.
...
C: What did you want to learn about today? EDUCATION
P: I want to learn about starting an anti-acne skin care regimen.
C: Great. It includes three important parts: 1) a facial cleanser, 2) an over-the-counter
acne treatment, and 3) a non-comedogenic facial moisturizer. Non-comedogenic
means it is less likely to clog your pores, and thus less likely to contribute to breakouts.
...
C: Have you been experiencing any side effects from having an anti-acne regimen? ASSESSMENT
P: No, I have not.
...
C: That's it for this week. Please visit back next week and I'll check in with you to see how CLOSING
things have been going. Remember that there's a lot you can do to achieve clearer skin.
See you soon!

Fig. 2.
Sample excerpt of automated counseling session (*C* precedes counselor utterances, *P*
precedes participant utterances)

Fig. 3.

a Scatterplot of number of times logged on and change in acne knowledge of standard website group. **b** Scatterplot of number of times logged on and change in acne knowledge of automated counseling website group

Table 1

Baseline demographic factors of participants randomized to the standard website and the automated counseling website

	Standard website (n = 48)	Automated counseling website (n = 49)	p
Age	16.10 ± 1.72	16.31 ± 1.47	0.535
Sex			
Female	28 (58)	30 (61)	0.772
Male	20 (42)	19 (39)	
Ethnicity			
White	6 (12)	10 (20)	0.294
Non-White	42 (88)	39 (80)	

Data are presented as mean ± standard deviation or number of cases (%)

Table 2

Acne knowledge between participants randomized to the standard website and automated counseling website

	Baseline			12-week follow-up			Change from baseline to 12-week follow-up^a		
	Standard website	Automated counseling website	<i>p</i> (between-groups)	Standard website	Automated counseling website	<i>p</i> (between-groups)	Standard website	Automated counseling website	<i>p</i> (between-groups)
Acne knowledge	3.61 ± 1.22	3.53 ± 1.50	0.782	5.46 ± 1.31	6.49 ± 1.06	<0.001	1.85 ± 1.46	2.96 ± 1.85	0.002

Data are presented as mean ± standard deviation

^aPositive values represent greater improvement in knowledge