

# The Effect of Depression on Treatment Adherence Among a Sample of Saudi Patients Diagnosed with Acne Vulgaris

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**Purpose:** Acne vulgaris is an inflammatory disorder of the skin and is the most common dermatological disease, affecting all ages and races. Acne is known to be associated with depression. This study aimed to assess the impact of depression on patient adherence to acne vulgaris treatment using The Expectation Confirmation Theory (ECT).

**Patients and Methods:** This cross-sectional study was conducted with 204 patients with acne using four scales (depression, satisfaction, intention to adhere to acne medication, and control for confirmation). ECT scales were used to assess patient satisfaction and intention to adhere to medication. Demographic data were also collected, and descriptive and analytical statistical analyses were performed.

**Results:** A total of 204 questionnaires were completed. The mean age of the respondents was  $25 \pm 7.2$ . The majority were female; 167 (83.50%). Multiple linear regression analysis indicated a negative association between depression ( $\beta = -0.121$ ,  $p = 0.033$ ; 95% CI,  $-0.232$  to  $-0.009$ ) and satisfaction, when holding other variables constant, and the expected medication effect (confirmation) had a positive association with satisfaction ( $\beta = 0.334$ ,  $p < 0.001$ ; 95% CI,  $0.202$  to  $0.466$ ), keeping all other factors constant. Male sex was negatively associated with satisfaction ( $\beta = -2.388$ ,  $p = 0.015$ ; 95% CI  $-4.303$  to  $-0.473$ ), while keeping all other covariate constant. Residence in central provinces was a significant predictor of satisfaction ( $\beta = 2.562$ ,  $p = 0.004$ ; 95% CI,  $0.832$  to  $4.292$ ), when holding other factors constant. After conducting a simple linear regression, a positive significant association was found between adherence and satisfaction ( $\beta = 0.1713$ ; 95% CI,  $0.068$  to  $0.274$ ).

**Conclusion:** Adherence is the cornerstone for a successful treatment plan and prevention of relapse or treatment failure, and satisfaction is an essential indicator for improving health policies and implementing social service provisions.

**Keywords:** dermatological diseases, psychological disorder, intention, performance

## Introduction

Acne vulgaris is a common inflammatory dermatological skin disease that causes open and/or closed comedones (blackheads and whiteheads).<sup>1</sup> The etiology and pathogenic mechanism of acne is multifactorial, immune-mediated, and androgen triggered. The process of inflammation involves increased sebum production and follicular hyper-keratinization that is induced by androgenic hormones together with an increased colonization of *Propionibacterium acnes* in the inner layer of sebaceous glands. The inflammatory lesions by *Propionibacterium acnes*, known as *Bacillus acnes*, occur largely in areas that are rich in sebaceous glands, such as the

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chest, upper back, face, and shoulders.<sup>2</sup> The acne treatment goals are to decrease progression, duration, and recurrence of the number and severity of lesions, prevent scarring and hyperpigmentation, and improve appearance.<sup>3</sup>

According to the 2010 Global Burden of Disease Study, acne vulgaris is the eighth most prevalent skin condition.<sup>4</sup> Acne prevalence varies among nations and different age groups, with estimates of 35% to 100% of adolescents experiencing acne at least once.<sup>5</sup> Regarding sex, studies found that men had a higher prevalence (90%) than women (80%).<sup>6,7</sup> Bhate and Williams reported that acne prevalence was high among American teenagers (85%) and a high prevalence of acne among adolescent females was reported in most studies.<sup>8</sup> In Saudi Arabia, many studies have reported a high prevalence of acne among female adolescents. Despite the inconsistency in estimating the exact numbers of acne prevalence in the published studies it was generally high. In Riyadh city, acne vulgaris was shown to be common in about two-thirds of adolescent and young girls.<sup>9</sup> Despite this vast number, acne is neither dangerous nor harmful to the body.<sup>10,11</sup>

Dermatological disorders that alter the appearance and are not life-threatening, such as acne vulgaris, affect individuals' psychosocial status, daily activities, and relationships.<sup>12</sup> Acne impacts patients' physical and psychological image. It is one of more than the ten types of skin diseases that are closely related to psychological problems, which may be attributed to how patients deal with the disease.<sup>13</sup>

Depression is one of the most significant psychological impacts of acne. In a study done in Saudi Arabia, around 79.7% of acne patients suffered from depression with reportedly high depression levels (83.18%) among adolescents between the ages of 17 to 25 years, while it was 67.69% in people over the age of 25 years.<sup>14</sup> Depression is listed by the World Health Organization (WHO) as the single most significant factor contributing to global disability, as more than 300 million people worldwide suffer from it.<sup>15</sup>

Although depression can be influenced by different factors such as prior mental status or family history of depression, Acne may be correlated with anxiety, depressive symptoms, and body dissatisfaction, as in the study conducted by Gallitano in 2017.<sup>16</sup> Females are more likely to suffer than males from depressive disorders and anxiety related to stress and show different effects of stress compared to male.<sup>17</sup>

During 2020, a considerable amount of literature, including systematic reviews and meta-analyses, have reported psychiatric comorbidities of acne including depression and social risk.<sup>18,19</sup>

There is a significant link between patients' perceptions of met expectations and their satisfaction with their treatment.<sup>20</sup> Patient satisfaction is an essential predictor of maintenance of a relationship with the healthcare provider and adherence to a medication regimen.<sup>21</sup> In 1994, Halstead, Hartman, and Schmidt showed that prior to, during, or after consumption, consumer satisfaction is "a transaction-specific affective response resulting from the customer's comparison of product performance to some prepurchase standard".<sup>22</sup>

Since acne is a chronic disease that requires a long course of treatment,<sup>23</sup> poor treatment adherence is an expected challenging problem in international healthcare systems. A decline in psychosocial improvement may occur if the patient does not adhere to its medication, causing a substantial financial burden in addition to compromising patient safety. Adherence, concordance, and compliance are terms used in the literature to describe "the extent to which the patient's behavior corresponds with the advice given by the health care provider".<sup>24</sup> The WHO reports average medication compliance rates of just half of patients in developed countries.<sup>25</sup> The second term, concordance, which originated in English literature, places the patient at the center of the decision-making process. The term concentrates more on the target goal "the overall achievement of the treatment" and pays less attention to compliance.<sup>24</sup>

In the literature, compliance was the most common term until around 2003. The dominant relationship between the doctor and the patient was an authoritarian and asymmetrical relationship in which the doctor had the exclusive right to decide. The physicians' responsibility was to instruct, and the patients was to ensure that the prescribed regimen was followed to the letter.<sup>24</sup>

Poor treatment adherence is a critical problem for international healthcare providers, not only because of the risk to the patient's safety, but also because of the tremendous financial cost, and one main cause for the failure of a treatment plan is poor adherence to acne medication. Reports indicate that the cost of non-adherence to treatment is estimated to range from 100 to 290 billion dollars in the US, and approximately 1.48 billion dollars in Europe. Non-adherence is a significant cause of non-response to medication and is frequently mistaken for drug failure when

insufficient care is dedicated to evaluating patients' adherence to treatment. This incorrect assumption may lead physicians to unnecessarily modify the treatment or the medication dose. Hence, treatment adherence plays a crucial role in medical care outcomes.<sup>26</sup>

The main reason most acne patients did not initiate treatment was medication cost and insufficient insurance coverage.<sup>27,28</sup>

The multifactorial pathogenesis of the disease results in the use of multiple medications, which increases the cost and burden to acne patients. The poor outcomes of acne problems were due to poor medication adherence. Poor adherence is a significant problem for all medical disciplines, with an average adherence of only 24%.<sup>29</sup>

The expectation confirmation theory (ECT), also called the expectation disconfirmation theory, is a cognition-based theory devoted to interpreting post-adoption satisfaction based on perceived performance and expectations. The theory was built in the late nineteen-seventies and the beginning of the eighties and developed in two publications written by Oliver RL.<sup>30</sup> Customer satisfaction is vital in marketing research and is focused on post-acceptance and post-consumption expectation factors.<sup>31</sup> To better understand the theory in order to apply it to our study: when the consumer expectation is higher than the product performance, the confirmation is negative, and when the consumer expectation is lower than the product performance, the confirmation is positive. In contrast, simple confirmation would occur if the consumer expectation is equal to the product performance; therefore, post-product purchase satisfaction occurs when expectation coincides with product performance, which is the purpose of ECT theory.<sup>32</sup> In our study, ECT was used to understand the relationship between depression and treatment satisfaction when using acne vulgaris medications.

To the best of our knowledge, no previous study has evaluated the relationship between the variables mentioned above in acne patients in Saudi Arabia using expectation confirmation theory. Therefore, this study aimed to assess the impact of depression on patients' treatment adherence when using acne vulgaris medications and the impact of satisfaction on treatment adherence.

## Patients and Methods

### Study Design and Data Sources

This cross-sectional study was conducted using four scales (depression, satisfaction, intention to adhere to acne

medication, and controlling for confirmation) and demographics to determine the relationship between depression and treatment satisfaction among Saudi patients with acne vulgaris. The scales were first validated, and then self-administered using an online survey. This study was approved by the institutional review board (IRB) of the regional ethics committee in the Al-Qassim region (number 1442–185518). Data was collected between October 2020 and December 2020 from Saudi patients with acne vulgaris, and the sample size was calculated using the G\*Power software package (version 3.1.9). Several assumptions were made to calculate the required sample size: power = 0.95 alpha level = 0.05, predictor number = 15 and medium effect size = 0.15. The calculated necessary sample size was 199 participants, using these assumptions.

### Participants

The study was advertised by cards placed on card holders posted at dermatological clinics, and social media. The survey was directed only to patients with acne vulgaris. The cards had a participation invitation message and stated that donations of 10 SR (2.67 US dollars) for each completed survey would be placed by the research group on behalf of the participants. The questionnaire could be accessed in three ways. The first was by scanning the QR code using smartphones. The second involved typing in a short website address. The last way was to send an e-mail to the research team which would reply with a link to the questionnaire.

The self-administered questionnaire was uploaded to an online survey website (Google Forms), and the collected data were coded manually. Informed consent was obtained from each participant before commencing the survey. Participants received an informed consent form with a question regarding their agreement to participate in the survey when they click the link. The website redirected participants to the survey if they accepted to enroll. However, if they denied participation, they were thanked and directed to the end of the survey. Also, the consent form notified them that their participation was anonymous, voluntary, and would take 15 minutes to complete. The participants were free to stop at any time and for any reason.

### Survey Design

Convenience sampling techniques were used for data collection. All questionnaires were translated from English to

Arabic using the back-translation method.<sup>33</sup> The Patient Health Questionnaire-9 (PHQ-9) is a widely used, quick, efficient, self-administered, free access questionnaire to measure depression (9 items). The ECT scales were used to assess patients' satisfaction and intention to adhere to medication. The validity and reliability of the ECT scale have been reported to be adequate.<sup>34</sup> All questions were pilot-tested with 10 Saudi acne patients, and to verify their accuracy and understandability, they were asked to describe their understanding of the questionnaire using the think-aloud procedure.

## Variables

### Outcome variables

Measurement of their adherence to the acne medication(s) prescribed for them was based on the theory of planned behavior.<sup>35</sup> Furthermore, the ECT scale<sup>36</sup> was used to evaluate the satisfaction of patients. Participants were asked to indicate their level of satisfaction with using their acne medication(s) and satisfaction was measured on four seven-point semantic differential scales: 1—from extremely displeased to extremely pleased, 2—from extremely frustrated to extremely contented, 3—from extremely terrified to highly delighted, and 4—from highly dissatisfied to extremely satisfied.

### Independent Variables

The sociodemographic information of participants included sex, marital status, residency location, education level, employment status, insurance, chronic disease, skin type, and acne treatment. In addition, participants were asked to indicate the year of birth; income in Saudi Riyals (SAR; 3.75 Saudi Riyals = US\$1), and acne number as continuous variables, and ECT scales<sup>34</sup> were used to evaluate their expectations. Their expectation of the acne medication(s) prescribed for them was measured on a seven-point scale (1 = strongly disagree to 7 = strongly agree). The four items were used to measure the expectations. Participants were then asked to compare their experience after using the acne medication(s) to their initial expectation and indicate the perceived performance using a seven-point scale (1 = much worse than expected to 7 = much better than expected). The product of expectations and performance was confirmation. If the expectation was greater than the performance, the confirmation was negative, and vice versa.

The complications of acne vulgaris were psychological and physical and led to psychiatric diseases such as

depression in many previous studies that accompanied long-term patients.<sup>36</sup> Thus, the Patient Health questionnaire-9 was used to evaluate depression in Saudi patients with acne vulgaris who participated in this study. It is a pretested, validated, brief, self-administered, psychological screening instrument to measure depression, and contains nine questions scored 0–3, with 0 representing (not at all) and 3 (nearly every day). Thus, the total score range of the PHQ-9 was 0 to 27. The answer range was not difficult to extremely difficult.

## Statistical Analyses

Descriptive analyses were performed to explore the categorical and continuous demographics, depression, satisfaction, and intention to adhere to treatment. The univariate test was added to the multiple linear regression analysis of all independent variables with a p-value <0.05, to control for any statistically insignificant confounding variables.<sup>37,38</sup> All statistical analyses were conducted using Stata (version 16, StataCorp LLC., College Station, TX, USA).

## Results

A total of 204 surveys were completed. Descriptive categorical and continuous characteristics of the respondents are listed in Table 1. The mean age of the respondents was  $25 \pm 7.2$  years, and their average acne number was  $7.5 \pm 6.9$ . The participants included 167 women (83.50%) and 33 men (16.50%). Most participants were unmarried; 138 (69%) and from the central regions; 160 (80%).

Univariate and multivariate analyses were conducted to describe the association of covariates, such as demographics, with acne (eg, number of acne papules and depression) (Table 2). A simple linear regression analysis indicated a negative relationship between treatment satisfaction and depression ( $\beta = -0.179$ ; 95% CI,  $-0.297$  to  $-0.062$ ) with significance at  $p \leq 0.05$ , ie, depression negatively influences satisfaction. Further analysis showed a positive association in people who live in central regions ( $\beta = 2.525$ ; 95% CI,  $0.625$ – $4.424$ ). Overall, treatment satisfaction was not affected by education, income, or insurance. The association between treatment satisfaction and confirmation was interesting because confirmation is the relationship between performance and expectation. When confirmation became positive, satisfaction increased ( $\beta = 0.395$ ; 95% CI,  $0.264$ – $0.526$ ) and was statistically significant ( $P=0.008$ ). Males ( $\beta = -2.785$ ; 95% CI,  $-4.83$  to  $-0.74$ ) and employees or students ( $\beta = -2.171$ ; 95% CI,

**Table I** Continuous and Categorical Baseline Characteristics of the Participants

Characteristics	Number of Participants (n = 204)
Age (years), mean $\pm$ SD	25 $\pm$ 7.2
Income in SR, mean $\pm$ SD	14181.1 $\pm$ 11,798.5
Acne number, mean $\pm$ SD	7.5 $\pm$ 6.9
Sex	
Male, n (%)	33 (16.50)
Female, n (%)	167 (83.50)
Marital status	
Married, n (%)	62 (31)
Not married, n (%)	138 (69)
Residency Location	
Central regions, n (%)	160 (80)
Western regions, n (%)	9 (4.5)
South regions, n (%)	6 (3)
Eastern regions, n (%)	25 (12.50)
Education level	
Primary, n (%)	1 (0.50)
Secondary, n (%)	5 (2.50)
Higher secondary, n (%)	55 (27.50)
Graduated from college, n (%)	139 (69.5)
Employment status	
Student, n (%)	98 (49)
Employed, n (%)	35 (17.50)
Unemployed, n (%)	67 (33.50)
Insurance	
Yes, n (%)	45 (22.50)
No, n (%)	155 (77.50)
Chronic disease	
Yes, n (%)	13 (6.50)
No, n (%)	187 (93.50)
Skin Type	
Greasy, n (%)	62 (31)
Dry, n (%)	13 (6.50)
Mixed, n (%)	107 (53.50)
Normal, n (%)	14 (7)
Other, n (%)	4 (2)
Acne treatment	
On oral/topical prescription, n (%)	36 (18)
Using over-the-counter acne product, n (%)	45 (22.50)
Using a combination of acne prescription and over-the-counter product, n (%)	5 (2.50)
None, n (%)	114 (57)

**Abbreviations:** SD, standard deviation; n, number of participants; %, percentage of participants.

–3.78 to –0.563) were less satisfied with their acne vulgaris treatment.

Multiple linear regression analysis (Table 2) indicated a negative association between depression ( $\beta = -0.121$ ,  $p = 0.033$ ; 95% CI, –0.232 to –0.009) and satisfaction, when holding other variables constant. In addition, male sex showed a negative association with satisfaction ( $\beta = -2.387$ ,  $p = 0.015$ ; 95% CI, –4.302 to 0.472) when holding other variables constant. The expected medication effect (confirmation) was positively associated with satisfaction ( $\beta = 0.334$ ,  $p < 0.001$ ; 95% CI, 0.202–0.466), when holding other variables constant. Another linear regression was then conducted and found a positive relationship between satisfaction and residence location in the central regions ( $\beta = 2.561$ ,  $p = 0.004$ ; 95% CI, 0.831–4.291) (Table 2).

A simple linear regression analysis indicated a positive relationship between treatment adherence and satisfaction ( $\beta = 0.1713$ ; 95% CI, 0.06846 to 0.2742), with significance at  $p = 0.001$  (Table 3).

## Discussion

This study aimed to determine the relationship between depression and treatment adherence among Saudi patients with acne vulgaris. We found a negative relationship between treatment satisfaction and depression in the multivariate and univariate analyses. In addition, we found a positive relationship between treatment adherence and satisfaction.

Age wise the acne vulgaris typically starts around 12 to 14 years but tends to manifest earlier in female patients. The peak age for its severity is earlier in female patients (6 to 17 years) than in male patients (17 to 19 years).<sup>39</sup> In this study, the mean age was 25  $\pm$  7.2, the number of females was 167 (83.50%), more than males, and most participants were from the central regions; 160 (80%). In Saudi Arabia, many previous studies, in various regions, showed that females were more likely to have acne vulgaris than males, and that also occurred in other countries for several reasons. A 2020 study in Riyadh, the capital city of Saudi Arabia, showed a mean age of 22.4  $\pm$  4.4 and reported a higher prevalence of acne in females.<sup>10</sup> Another 2020 study in Hail, Saudi Arabia, reported that the majority of patients with acne were female (85%), and their age ranged from 10 to 35 years.<sup>39</sup> In addition, two studies



**Table 2** Univariate and Multivariate Linear Regression Analysis of Factors Associated with Treatment Satisfaction Among Acne Patients in Saudi Arabia

Independent Variable	Univariate Linear Regression Analysis			Multivariate Linear Regression Analysis		
	$\beta$	95% CI	p-value	$\beta$	95% CI	p-value
Depression	-0.179	-0.298 to -0.062	0.003*	-0.121	-0.233 to -0.009	0.033 *
Confirmation	0.396	0.265 to 0.527	<0.001*	0.334	0.202 to 0.466	<0.001*
Age	-0.099	-0.205 to 0.006	0.064			
Income in SAR/1000	0.047	-0.021 to 0.115	0.177			
Sex						
Male	-2.786	-4.831 to -0.741	0.008*	-2.388	-4.303 to -0.473	0.015 *
Female	Ref.			Ref.		
Residency location						
Central regions	2.525	0.626 to 4.424	0.009*	2.202*	0.511 to 3.895	0.011*
Other regions	Ref.			Ref.		
Education						
College level and higher	0.163	-1.515 to 1.841	0.848			
Below college level	Ref.					
Employment status						
Employee or student	-2.172	-3.78 to 0.563	0.008*			
Unemployed	Ref.					
Insurance						
Yes	0.929	-0.917 to 2.775	0.322			
No	Ref.					
Chronic disease						
Yes	1.839	-1.284 to 4.963	0.247			
No	Ref.					
Number of acne papules or pustules on half of the face	-0.116	-0.227 to 0.006	0.039*	2.562	0.832 to 4.292	0.004*

**Note:** p-value <0.05 indicated with asterisk.

**Abbreviations:**  $\beta$ , beta coefficient; 95% CI, 95% confidence interval; Ref, reference.

conducted in Jeddah among final year and first-year medical students found that the prevalence of acne vulgaris was high in females with a prevalence of 98% and 58.8%, respectively.<sup>40,41</sup> In Alexandria, an Egyptian study showed a higher prevalence among females, confirmed clinically, and their age ranged from 15 to 18 years with a mean age of  $16.31 \pm 0.725$ .<sup>42</sup> There are many reasons, connected to hormonal imbalances, that can affect female acne development, such as polycystic ovary syndrome where acne is one of the main symptoms.<sup>43</sup> Eighty percent of female acne patients have menstrual disturbances according to a study conducted in Makkah, western Saudi Arabia.<sup>44</sup> Most of the participants did not use any medication (57%).

Participants in this slice might have been affected either by the failure of acne treatment, or the severity level of acne. Then followed over-the-counter medications. Respondents here also, the level of acne is not severe or difficult to access health care system. Prescribed medications, either oral or topical medications, were used by 18% of the sample. This portion of patients might have had a good access to health care, or they were diagnosed with severe acne. The results of the current study provide a critical association that needs to be taken seriously. In Saudi Arabia, a limited number of studies have been conducted to address the factors associated with chronic diseases using ECT. Moreover, few studies in Saudi Arabia have discussed the

**Table 3** Univariate Linear Regression Analysis of Factors Associated with Treatment Adherence Among Acne Patients in Saudi Arabia

Independent Variable	$\beta$	95% CI	p-value
Satisfaction	0.171	0.068 to 0.274	0.001*
Age	0.041	-0.040 to 0.121	0.319
Income in SAR/1000	0.020	-0.031 to 0.072	0.443
Sex			
Male	0.625	-0.942 to 2.192	0.432
Female	Ref.		
Residency location			
Central regions	0.438	-1.017 to 1.892	0.554
Other regions	Ref.		
Education			
College level and more	0.488	-0.776 to 1.751	0.447
Less than college level	Ref.		
Employment status			
Employee or student	0.398	-0.835 to 1.630	0.525
Unemployed	Ref.		
Insurance			
Yes	0.771	-0.620 to 2.161	0.276
No	Ref.		
Chronic disease			
Yes	1.174	-1.183 to 3.531	0.327
No	Ref.		
Number of acne papules or pustules on half of the face	0.056	-0.027 to 0.139	0.184

**Note:** p-value <0.05 indicated with asterisk.

**Abbreviations:**  $\beta$ , beta coefficient; 95% CI, 95% confidence interval; Ref, reference.

psychological impact of acne on treatment satisfaction and adherence.<sup>8</sup>

The current study aimed to assess the impact of depression on patient satisfaction when using acne vulgaris medications. Furthermore, we explored the evidence available between treatment satisfaction and medication adherence between males and females.

To explain this association, we conducted two linear regressions. In the first, we assessed whether depression affects satisfaction and whether confirmation affects satisfaction. Since confirmation is the relationship between performance and expectation, when it becomes negative the satisfaction decreases. Second, we performed another linear regression and found an association between satisfaction and adherence.

The theory consists of four parts: expectations, performance, confirmation, and satisfaction. The expected

medication effect (confirmation) had a positive association with satisfaction, when holding other variables constant. Therefore, it can be assumed that when medication outperforms expectations (positive confirmation) post-purchase satisfaction will result. A diversity in acne treatment methods with a great result may explain the relatively good association between treatment satisfaction and confirmation. Confirmation and treatment satisfaction are two terms used interchangeably in a number of chronic diseases, such as hypertension<sup>45,46</sup> and asthma.<sup>47</sup> In 2019, a study conducted among 346 Saudi patients found a higher level of satisfaction among patients who were using oral than topical treatment.<sup>10</sup> The reason behind high treatment satisfaction level might be attributed to performance of the medication.

In the last decade, there has been growing interest in patient satisfaction.<sup>48,49</sup> The use of the life satisfaction indicator appears to be essential for determining its sensitivity over time to implement other health and social service provisions or improvements in health policies. Our study extends previous research on satisfaction outcomes by detailing how depression affects satisfaction with various factors.

This study produced results that corroborate the findings of a great deal of previous work in this field.<sup>50</sup> There was a clear relationship between depression and treatment satisfaction. Similar results were reported in a study that discussed the relationship between depression and treatment satisfaction among patients with type 2 diabetes.<sup>51</sup> The study showed that the relationship between depression and treatment satisfaction was significant, indicating that as depression increased, treatment satisfaction decreased. Increasing depressive symptoms are associated with lower patient satisfaction.<sup>52</sup> It is not surprising that researchers have found that people with acne often develop depression or anxiety.<sup>13,53</sup>

Our findings are consistent with studies that highlight the association between treatment satisfaction and adherence.<sup>55</sup> Patient preferences and attitudes have a powerful influence on the treatment of depression. These factors may explain the relatively good association between treatment satisfaction and adherence.<sup>29,55</sup> These findings further support the idea that treatment satisfaction is associated with better compliance.<sup>54</sup> These findings may help us understand the importance of adherence to acne medications.

The psychological effects of acne on patients can be considerable. Patients with clinical acne require medical therapy, either because of the severity or duration of their

disease. A cross-sectional study conducted to examine the associations between acne and depressive symptoms showed that acne was associated with an increased probability of depressive symptoms.<sup>56</sup>

The most unexpected association was that male sex showed a negative association with satisfaction. This could be because of psychological factors like less patience for treatment. These findings further support the idea of overall sex differences in many different areas.<sup>49,57</sup>

While men primarily have worse outbreaks than women, they are more satisfied than females. The same article also points out that women are usually much more negatively impacted by acne because it is such a visible disorder and has a deep psychological impact on so many. For example, it was associated with mild/moderate symptoms of depression and/or anxiety and impacted the ability to concentrate on work or school.<sup>58</sup>

Few studies have investigated the influence of sex on these associations. In this study, people who were more satisfied with their acne treatment were from the central regions. A possible explanation for these results may be the lack of adequate knowledge in other regions.<sup>11,14</sup> However, the observed difference between treatment satisfaction and education in this study was not significant. Another critical factor is our research from this region. This might be related to the availability and accessibility of acne treatment around the region. The availability of universities in this region has led to medical centers. In Riyadh, the capital city of Saudi Arabia, there are three prominent government medical colleges. In addition, many private colleges contribute to expanding knowledge in this region. Both temperature and humidity as environmental factors affect acne vulgaris,<sup>59</sup> and increased temperature and marked humidity might explain the results seen in the eastern and western regions of Saudi Arabia.

This study has many strengths, including a diverse population and validated survey tools, and covers many aspects.

We acknowledge several potential limitations of our study. First, as a challenge we faced, this study was undertaken in the Covid-19 pandemic period and more participants from dermatological clinics and secondary and higher secondary schools are necessary. Second, cross-sectional studies can establish association but cannot prove causality. Third, the responses from the online survey were based on self-reporting and lacked the necessary confirmation through clinical examination. Finally, further studies are needed to evaluate the study findings. The

possibility of generalization of study results may be limited by the number of participants (to similar types of populations).

A plan was developed to continue this project in the future to include more aspects of quality of life for patients with acne. The cost of medication treatment for acne is high.<sup>60</sup> Furthermore, adherence to acne medication is essential for good results, so a lack of adherence will not improve acne and would add more burden to the health care system. Improving depression will increase adherence through psychological strategies to decrease depression. Hence, this finding has important implications for developing educational programs for acne patients. Finally, interventional studies are required to confirm these results.

## Conclusion

This is the first study to evaluate the relationship between depression and treatment satisfaction among acne patients in Saudi Arabia and the effect of satisfaction on adherence. Medication adherence is the first step in a successful treatment plan and prevention of relapse or treatment failure. Overall, the findings of our study show a negative relationship between treatment satisfaction and male sex, and a positive association between satisfaction and central location residency. Our results found that satisfaction has positively influenced treatment adherence. Adherence to acne medication is essential for good results. Psychological strategies to decrease depression will improve adherence. Adherence improves treatment outcomes and decreases the economic burden on healthcare systems. Further research is needed to identify how to alleviate depression, since it lowers satisfaction and adherence.

## Abbreviations

ECT, Expectation Confirmation Theory; AV, Acne Vulgaris; al; PHQ-9, Patient Health Questionnaire-9; WHO, World Health Organization; Bl, Billion; SAR, Saudi Riyal; QR, Quick Response.

## Data Sharing Statement

The data that support the findings of this study are available from the corresponding author, Y.A., upon reasonable request.

## Ethics Approval and Informed Consent

This study was approved by the Qassim Region Research Ethics Committee (research number: 1442-185518). Also,



this research was conducted in accordance with the Declaration of Helsinki.

## Consent for Publication

Participants provided their consent for the findings of the study to be published.

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## Disclosure

The authors declare that they have no competing interests in this work.

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