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The therapeutic effect of teeth whitening

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ABSTRACT

Introduction: A beautiful smile is associated with health, self-confidence and youth. Studies show in this context that at least 50% of the population is dissatisfied with the color of their teeth. Demand for teeth whitening products and procedures is increasing accordingly. This paper investigates the effect of teeth whitening on self-confidence, anxiety and depression.

Materials & Methods: Thirty subjects completed a questionnaire measuring self-esteem, using the Multidimensional Self-Esteem Scale and the State-Trait Anxiety-Depression Inventory, both before and two weeks after in-office tooth bleaching treatment with 34-37%-strength whitening gels. We also ascertained information on participants' subjective perceptions of their attractiveness and the extent of their social contacts in work settings.

Results: Teeth whitening procedures increased body-related self-esteem ($p = .0195$) and social self-esteem ($p = .001$). Further, anxiety ($p = .006$) and current anxiety state ($p = .001$) decreased in individuals as a result of teeth whitening. We also noted an improvement in current states of depression ($p = .001$).

Keywords: Tooth bleaching**,** Teeth Whitening, Smile, Dental Health, Self-confidence

I. INTRODUCTION

Studies show that, while children laugh up to 400 times a day, the average adult enjoys only 15 laughs daily (Deutsche Presse-Agentur, 2010). One factor which may play its part in reducing the frequency of laughter is the occurrence of oral health complaints, which have been found to negatively impact quality of life in 15% of adults (Sanders et al., 2009). Dentofacial appearance has an impact on self-confidence and enjoyment of life (Frejman et al., 2012). Healthy teeth contribute to an attractive smile, which in turn leads to greater self-confidence and self-esteem (Van der Geld et al., 2007). Tooth misalignment may even result in depression (Ekuni et al., 2011). Demand for teeth whitening products and procedures is accordingly on the rise (Tschackert, 2015). The purpose of this study is to ascertain whether people achieve higher self-esteem through teeth whitening and whether the procedure has an effect on existing symptoms of depression or anxiety disorder.

Current state of research

Xiao et al. (2007) found that half of China's urban population (48.9%) suffered from tooth staining, and 52.6% were unhappy with the color of their teeth. Dissatisfaction increased with the severity of the discoloration. The results of a study from Saudi Arabia on 1129 subjects showed that 63.6% were not satisfied with the color of their teeth (Ahmed et al., 2017). The dental industry promotes teeth whitening procedures that appear to promise a beautiful smile and increased success at work and in relationships (Maio, 2009). Researchers have found that exposure to television and internet content in which physical attractiveness played a role exerted a positive effect on people's willingness to undergo professional teeth whitening (Werdin, 2018). Photographs with brighter teeth are judged more positively (Höfel et al., 2007). A study by Kershaw et al. (2008) noted more negative judgments on the four personality categories of social skills, intellectual ability, psychological adjustment, and relationship satisfaction in response to images of individuals with decayed teeth, and more positive ratings for images showing people with whitened teeth. Bersezio et al. (2018) recorded a positive influence of teeth whitening on patients' psychosocial affect after three months of bleaching treatment, and Fernandéz et al. (2017) likewise found positive effects on psychosocial wellbeing from teeth whitening. Hafidh (2019) found that tooth color was one of the major components of individuals' dissatisfaction with themselves: 61.8% of participants did not feel confident enough about their teeth, 50.4% were not satisfied with their smiles, and 80.5% wanted esthetic treatment in this area. Many of the participants in this study (72.5%) indicated that social media had a major impact on self-esteem relating to the appearance of their teeth (Hafidh, 2019).

II. MATERIALS AND METHODS

The work took place as a longitudinal study in a pre-post design in collaboration with

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several dental practices; we further recruited subjects from social media (Facebook and Instagram) and teeth bleaching portals. All subjects were treated with the in-office bleaching method, with gels featuring a 34-37% concentration of carbamide peroxide. The subjects received a questionnaire the day before the bleaching treatment and again two weeks thereafter. The control group (who did not undergo teeth whitening) also received a questionnaire. In addition to gender, age, marital status, and occupation, we recorded information on the number of social contacts our subjects had, their self-confidence, levels of depression and anxiety, and their personal assessment of their attractiveness. The questionnaire also included items specific to teeth whitening treatment: both the experimental group and control group received questions on expectations of the procedure, on the habit of smiling or not smiling, and on whether or not to show one's teeth when smiling, while the post-test for the experimental group additionally incorporated questions on whether their expectations of the treatment had been fulfilled, how intense the pain had been, and whether they perceived any changes in their behaviors around smiling and laughing since undergoing the procedure.

Our questionnaire used items drawn from the Multidimensional Self-Worth Scale (Schütz et al., 2016), a German-language adaptation of the Multidimensional Self-Concept Scale (Fleming & Courtney, 1984) based on the hierarchical multidimensional model proposed by Shavelson, Hubner, and Stantion (Dickhäuser, 2019). The Multidimensional Self-Worth Scale consists of a total of 32 items assigned to six subscales (emotional self-esteem; social self-esteem confidence in contact; social self-esteem in handling criticism; performance-related self-esteem; self-esteem in physical attractiveness; self-esteem athleticism). The parent scales were the social and body self-esteem scales. Further, we asked participants to complete the State-Trait Anxiety-Depression Inventory (STADI) (Laux et al., 2013), which records anxiety, with the components "excitement" and "apprehension," and depression, with the components "euthymia" and "dysthymia," as states and traits. The first part of the Inventory measures subjects' current state as regards anxiety and depression, the second part their tendency to experience anxiety and depression over the long term.

Questions

We drew on the findings of previous work in this area to formulate the following research questions: 1. Does teeth whitening significantly increase people's self-esteem? 2. Does teeth whitening significantly reduce depression scores and thus have a therapeutic effect? 3. Does teeth whitening significantly reduce anxiety levels and thus have a therapeutic effect? 4. Does teeth whitening have different effects on women than on men? 5. Does teeth whitening show greater positive effects in older people or in younger people? 6. Do people who have a job entailing large amounts of contact with other people have their teeth whitened significantly more often than people with few social contacts at work? 7. Is teeth whitening undergone more often by people without a partner than by people with a partner? 8. Do people who do not personally consider themselves attractive undertake teeth whitening more frequently than do people who do consider themselves attractive?

Sample

We collected complete pre- and post-data from N=30 German patients who had undergone teeth whitening, of whom 17 were women (56.7%) and 13 were men (43.3%); the mean age was 34.03±12.4 years. We then compared these data with data from a control group of N=109, of whom 79 were women (72.5%) and 30 men (27.5%), with a mean age of 25.63±9.1 years. In the experimental group, 11 (36.7%) were married, one person (3.3%) was widowed, one (3.3%) was separated, one (3.3%) was divorced, seven (23.3%) were in a committed relationship, and nine (30%) were single. 3 subjects (10%) indicated that they had no encounters at all with other people in the course of a working day, 5 subjects (16.7%) had few encounters (1-3 people), 6 subjects (20%) had a moderate number of encounters (4-10), and 16 subjects (53.3%) had a large number of encounters (more than 10 in a typical working day). All data refer to subjects' activities before the coronavirus pandemic. Five participants (16.7%) had already had a teeth whitening treatment prior to their involvement in the study.

III. RESULTS

In both the pre- and post-measurement, we asked participants whether they tended to show their teeth when they smiled (see Figure 1). Figure 2 depicts percentage frequencies for participants' assessment of their own attractiveness ("Do you find yourself attractive?").

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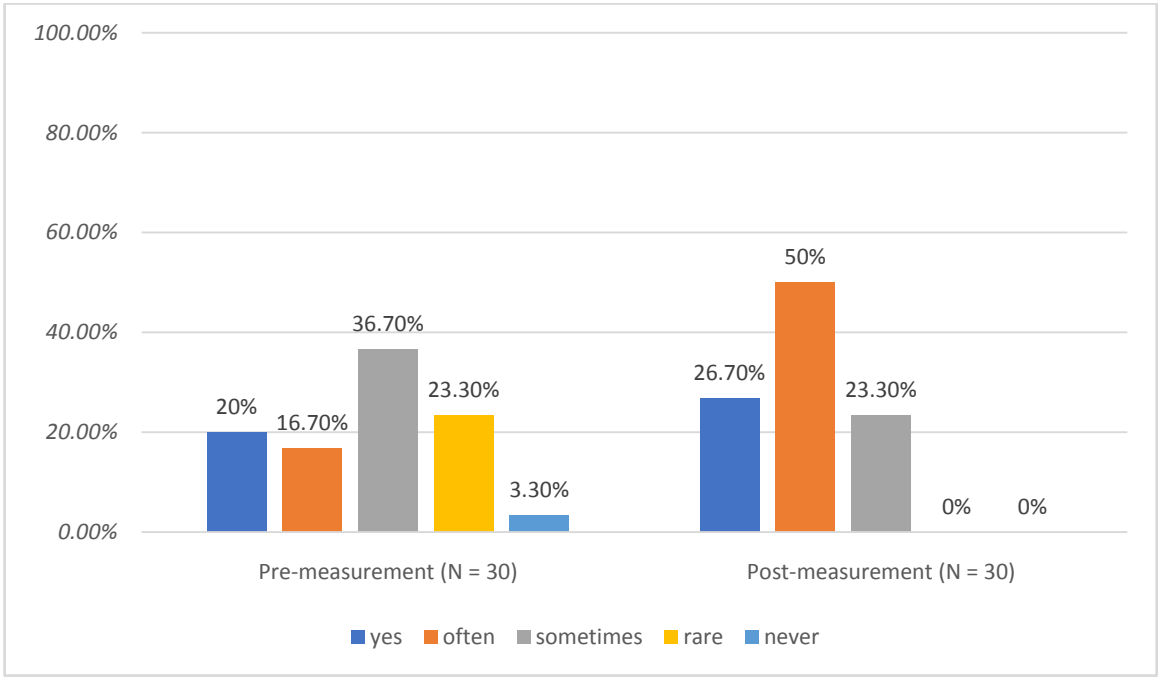

Figure 1: Percentage frequencies of participants' habit of showing their teeth when smiling, for the pre- and post-measurement respectively

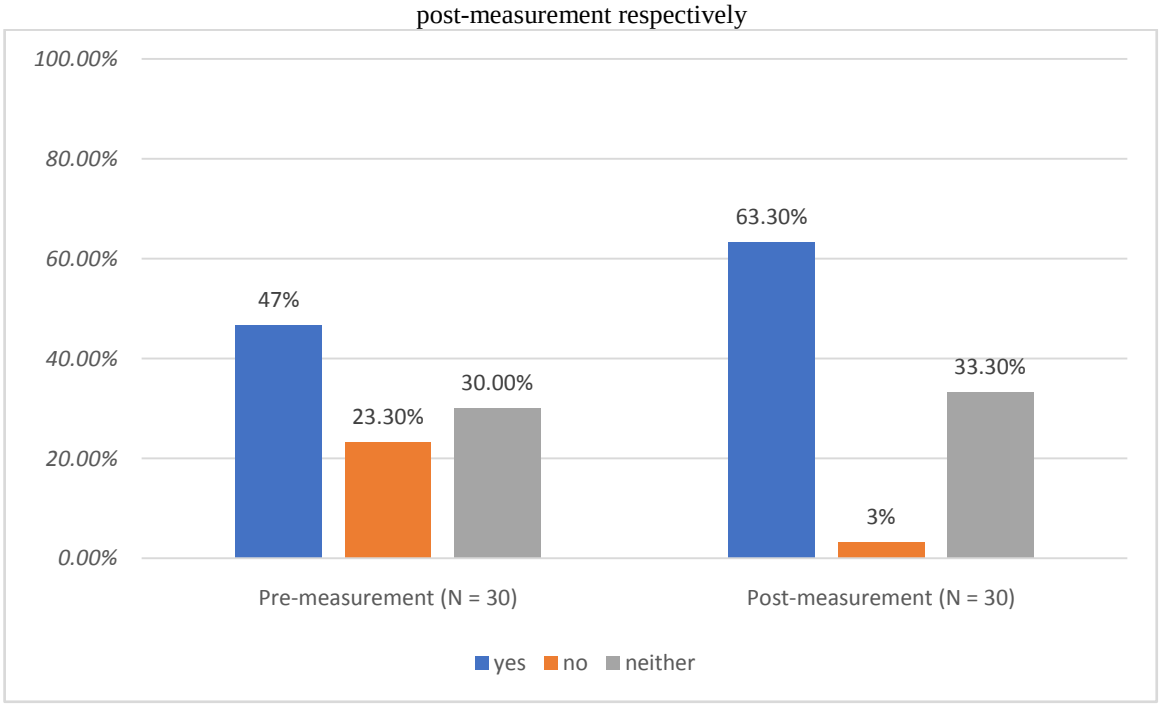

Figure 2: Percentage frequencies for participants' subjective ratings of their own attractiveness, for the pre- and post-measurement respectively

12 people (40%) were very satisfied (10 points on a scale of 0 to 10) with the results of their teeth whitening procedure. 4 participants (13.3%) awarded nine points and 3 (10%) gave eight; 8 participants (26.7%) awarded seven, 2 (6.7%) gave six points and 1 person (3.3%) awarded five points. No respondent rated their satisfaction with their teeth whitening treatment lower than five points. Twenty-nine people (96.7%) would have their teeth whitened again and only one person (3.3%) indicated that they would only "maybe" consider doing so.

We conducted statistical testing of the hypotheses, examining in each case whether the data were

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normally distributed (Kolmogorov-Smirnov test). If normal distribution was present, parametric tests were performed (mostly one-sided t-tests); otherwise, we used non-parametric tests (e.g. Wilcoxon).

A dependent-samples t-test was performed for the first hypothesis, "Teeth whitening significantly increases people's self-confidence." Table 1 shows the results.

Table 1: t-test for dependent samples with the parent scales of the MSWS (H1)

Variable	M	SD	t	p
Pre-measurement: social self-esteem	40.73	9.13		
Post-measurement: social self-esteem	49.80	9.65	-3.41	.001**
Pre-measurement: body-related self-esteem	37.13	8.58		
Post-measurement: body-related self-esteem	41.63	8.12	-2.16	.0195*

M = mean; SD = standard deviation; t = t-value; p= p-value; Cl [95%]; one-tailed test

There was a strongly significant difference between the pre- and post-measurement, indicating that individuals possess higher social and body self-esteem after teeth whitening treatment. For the second research hypothesis, "Tooth whitening significantly reduces depression scores and thus has a therapeutic effect," we performed a one-tailed t-test for dependent samples, which, as expected, revealed only a small, non-significant decrease in trait depression (21.37±4.06 to 20.50 ±4.13; p=0.122). For the non-normally distributed "state depression," a Wilcoxon test showed that the ranks were very significantly different (t = 80.50; Z = -3.134; p = .001**) from each other on one-sided testing, that is, that current "state" depression was significantly lower at post-measurement than at pre-measurement. Teeth whitening thus appears to significantly change scores of current depression.

To investigate the third hypothesis, "Teeth whitening significantly decreases anxiety scores and thus has a therapeutic effect," we compared scores on the trait anxiety and state anxiety scales attained in the pre- and post-measurement. Trait anxiety decreased significantly from 27.7±6.48 to 23.37±5.64 (p=0.006); we did not expect this finding, because trait anxiety is persistent by definition. As the "state" anxiety scores were not normally distributed, we ran a Wilcoxon test, which gave a highly significant result (p=0.001) indicating that subjects had perceived a reduction in both persistent anxiety and current anxiety after teeth whitening.

The fourth hypothesis examined whether female subjects differed from male subjects (see Tables 2 and 3).

Table 2: t-test for dependent samples for female subjects

Variable	M	SD	T	p
Pre-measurement: body-related self-esteem	36.00	10.12		
Post-measurement: body-related self-esteem	39.00	7.14	-1.046	.155
Pre-measurement: social self-esteem	40.76	10.41		
Post-measurement: social self-esteem	49.00	9.58	-2.175	.023*
Pre-measurement: trait depression	20.59	3.99		
Post-measurement: trait depression	21.00	4.00	-0.404	.345
Pre-measurement: state	21.53	5.29		

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depression				
Post-measurement: state depression	18.24	5.80	2.054	.028*
Pre-measurement: trait anxiety	27.41	7.13		
Post-measurement: trait anxiety	22.88	6.81	2.022	.031*

M = mean; SD = standard deviation; t = t value; p= p value; *p < .05; Cl [95%]; one-tailed test

Table 3: t-test for dependent samples for male subjects

Variable	M	SD	T	p
Pre-measurement: body-related self-esteem	8.62	6.09		
Post-measurement: body-related self-esteem	45.08	8.29	-2.12	.028*
Pre-measurement: social self-esteem	40.69	7.55		
Post-measurement: social self-esteem	50.85	10.04	-2.69	.01*
Pre-measurement: trait depression	22.38	4.07		
Post-measurement: trait depression	19.85	4.38	2.95	.006**
Pre-measurement: state depression	22.85	5.18		
Post-measurement: state depression	17.31	4.82	4.14	.001**
Pre-measurement: trait anxiety	27.54	5.1		
Post-measurement: trait anxiety	24.00	3.79	1.71	.056

M = mean; SD = standard deviation; t = t value; p= p value; *p < .05; **p < .01; Cl [95%]; one-tailed test

The results presented in Tables 2 and 3 enabled calculation of effect sizes (Cohen's d) for female and male subjects. These are shown in Table 4.

Table 4: Cohen´s d effect size in female and male subjects

		Gender	
	Variable	**Female**	**Male**
Cohen‘s d	Body-related self-esteem	|-0.59|	|-1.70|
	Social self-esteem	|-2.86|	|-2.17|
	Trait depression	|-2.05|	|2.22|
	State depression	|1.96|	|4.13|
	Trait anxiety	|1.74|	|1.14|

Note: Cohen's d: effect size from pre-measurement to post-measurement; |0.2| and higher = weak effect; |0.5| and higher = medium effect; |0.8| and higher = strong effect

It is clear from the results that there are medium and strong effects. Larger effects tend to be observable in male than in female participants, who experience larger effects in relation to trait

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anxiety and social self-esteem only. We ran a Wilcoxon test on state anxiety in order to fully test the hypothesis; a highly significant difference emerged (t = 18.50; Z = -2.748; p =.003**). A significant difference was also apparent in relation to male subjects (t = 7.50; Z = -2.477; p =.013*). Both groups saw strong effects (r = .67 for female and r = .69 for male respondents) (Cohen, 1988). The findings indicate overall that men tend to experience greater changes in self-esteem, depression and anxiety levels as a result of teeth whitening than do women.

To test the fifth hypothesis, "Teeth whitening shows significantly greater positive effects in older people than in younger people," we compared results for younger (under 40 years of age) and older subjects (40 years of age and older). Thus defined, there were a total of 22 “younger” and eight “older” participants. A dependent samples t-test was performed. The results show that younger subjects tend to have larger effects in the three variables than older subjects (see Table 5, Table 6, and Table 7).

Table 5: t-test for dependent samples in younger subjects (N=22)

Variable	M	SD	T	p
Pre-measurement: body-related self-esteem	36.73	8.11		
Post-measurement: body-related self-esteem	43.14	7.68	-2.645	.008**
Pre-measurement: social self-esteem	40.59	9.41		
Post-measurement: social self-esteem	51.05	9.98	-3.152	.003**
Pre-measurement: trait anxiety	27.27	6.42		
Post-measurement: trait anxiety	22.50	5.89	2.628	.008**

M = mean; SD = standard deviation; t = t value; p= p value; **p < .01; Cl [95%]; one-tailed test

Table 6: t-test for dependent samples in older subjects (N=8).

Variable	M	SD	t	p
Pre-measurement: body-related self-esteem	38.25	10.28		
Post-measurement: body-related self-esteem	37.50	8.35	.204	.422
Pre-measurement: social self-esteem	41.13	8.92		
Post-measurement: social self-esteem	46.38	8.29	-1.301	.117
Pre-measurement: trait anxiety	28.00	7.09		
Post-measurement: trait anxiety	25.75	4.33	.775	.232

One-tailed test; Cl [95%]; M = mean; SD = standard deviation; t = t-value; p= p-value

Table 7: Cohen´s d effect size in younger and older subjects

		Age	
	Variable	Young	Old
Cohen‘s d	Body-related self-esteem	|-3.48|	|0.18|
	Social self-esteem	|-4.45|	|-2.15|
	Trait anxiety	|2.64|	|0.56|

Calculation of the effect size r shows that younger subjects tend to experience medium to strong effects for "state anxiety" (r = .78) and "trait depression" (r = .30), and larger positive effects than do older participants (r = .22 and r = .004 respectively). Only for "state depression" do we

witness a greater positive effect in older respondents (r = .69) than in younger ones (r = .52).

The next hypothesis examines whether there is a relationship between numbers of social contacts in an individual's working life and their likelihood of undergoing teeth whitening ("People who have a job involving large amounts of contact with other people are significantly more likely to have their teeth whitened than people whose jobs involve little contact with others"). In this context, we used a control group whose members had not had any teeth whitening treatment at all and applied a chi-square test which did not lead to any significant result ($\chi 2=0.91$, $\phi= 0.93$, $p=0.34$).

For the hypothesis "Teeth whitening is undergone significantly more often by people without a partner than by people with a partner", we compared single people (N=13) with individuals in committed relationships (N= 17) using a chi-square test, which also failed to yield a significant result ($\chi 2=0.181$, $\phi= 0.04$, $p=0.336$).

The final hypothesis tests whether subjects who consider themselves to be unattractive are more likely to seek teeth whitening treatment than subjects who consider themselves attractive. Once again, we used a chi-square test to test the variables "attractiveness" and "frequency of teeth whitening treatment" for dependence. No significant correlation was found between subjectively assessed attractiveness and the frequency of teeth whitening treatment ($\chi 2=2.304$, $\phi= 0.153$, $p=0.065$).

IV. DISCUSSION

The findings of this study indicate that, after teeth whitening, the individuals in our sample experienced strengthened social and body-related self-esteem, feeling more confident in contact with other people in their social environment. Teeth whitening also appears to make individuals feel more physically attractive and more athletic. This result complements previous findings such as those made by Kershaw et al. (2008) on the influence of teeth whitening on social perceptions of individuals; those who had undergone teeth whitening were judged to be more socially competent, more intellectually capable, and psychologically better-adjusted. Our study further found that respondents' current state of depression (state anxiety) improved after teeth whitening, but trait depression, as a long-lasting personality dimension, did not. By contrast, both state and trait anxiety improved after teeth whitening.

In exploring the gender-specific effect of teeth whitening on the variables of self-esteem, anxiety and depression, we observed a greater positive effect of teeth whitening on men's body-related self-esteem, state and trait depression scores, and state anxiety than we noted in women. , while female participants showed higher improvements in trait anxiety and social self-esteem (i.e., coping with criticism and confidence in interactions with others). It is of interest in this context to note the finding of Al-Saleh et al. (2018) that female students were much more dissatisfied with their smiles than their male counterparts; our findings appear to support this observed tendency in female research subjects to exhibit self-critical self-perceptions. It is possible that males are more likely to be positive about change, which might explain our finding in relation to body-related self-esteem and gender; the study appears to indicate that women are less likely to draw an improved self-perception from one intervention, such as teeth whitening. It is reasonable to assume that women conform much more strictly than men to their own ideal image of themselves, but also to social norms and social influences. Above all, there is often an unconscious competition between women, which may stand in the way of their positive self-perceptions and make it difficult for them to perceive positive change because they are still not "perfect." Age is also a factor in differences we found. Younger individuals (under 40) appear more likely to benefit psychologically from a cosmetic procedure – in this case teeth whitening – than are older people (40 and over). This may be because younger adults place more emphasis on conforming to ideal images of themselves. The smaller effect in the older age group may relate to the generally weaker influence of the social environment on this population; younger individuals are often more likely to seek to adapt to their social environment and therefore may be more open to altering their appearance (Kovacevic Pavicic et al., 2019).

There was no correlation between the number of social contacts respondents reported typically having at work and their willingness to have their teeth whitened. Our study did not ascertain information on the extent of interactions in personal life and cannot therefore identify the role of a desire to look more attractive in that context. Similarly, willingness to undergo teeth whitening was independent of whether or not respondents were in a committed relationship. Our hypothesis, which our work did not bear out, was that people without a committed relationship would be more willing to have their teeth whitened in order to improve their chances of finding a partner. Similarly, we found that willingness to have teeth whitening was independent of a person's subjective

perception of their attractiveness. We would caution here that the difference in size between the experimental and the control groups may have influenced this finding.

The post-measurement in our study took place just two weeks after treatment, a very short time interval. Fernandéz et al. (2017) investigated the effect of teeth whitening after nine months, finding a stable improvement in psychosocial wellbeing subsequent to the procedure.

V. CONCLUSIONS

The study found that teeth whitening treatment reduces individuals' current state of anxiety and has a positive effect on their self-esteem. The low level of side effects and risks associated with teeth whitening, and its relatively uncomplicated course as compared to major esthetic procedures such as breast augmentation, may make it a suitable, low-threshold support for the self-esteem of highly insecure individuals who struggle with self-confidence.

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