Research

Vital Tooth Whitening Effects On Oral Health–Related Quality Of Life in Older Adults

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Introduction

Vital tooth bleaching, the act of using hydrogen peroxide or carbamide peroxide to whiten teeth, is the most commonly requested cosmetic dental procedure in the U.S.[1] The American Academy of Cosmetic Dentistry's survey on cosmetic procedures performed from 2005 to 2006 showed a 57% increase in tooth whitening.[2] Capitalizing on consumer interest, dental practices are marketing as specialists in cosmetic or aesthetic dentistry. Since 97% of cosmetic dental practices reported profits from tooth whitening in 2006, determining the effects of whitening on oral health–related quality of life (OHRQOL) is important to investigate.[2] OHRQOL is the absence of negative impacts of oral conditions on social life, and a positive sense of dentofacial self–confidence.[3] Quality of life research in relation to dental aesthetics has thus far focused mainly on university students, and no published research was found that focused on the effects of vital tooth bleaching on quality of life in an older adult population.

The Centers for Disease Control and Prevention (CDC) estimate the population ages 50 to 85 and older will reach approximately 3 billion by year 2030.[4] A trip to the dentist can be discouraging due to access barriers such as transportation, cost and dissatisfaction with the way their teeth look, feel or function.[5] The American Academy of Cosmetic Dentistry reported that adults 51

Abstract

Purpose: The purpose of this study was to determine if vital tooth whitening affects oral health–related quality of life (OHRQOL) in adults age 50 years and older, and if tooth whitening causes increased participation in social activities.

Methods: Using a 2 group, single blind, randomized, pre–test, multiple post–test design, 62 participants were enrolled. The experimental group used a whitening product twice daily for 3 weeks. The control group used no whitening products. The Oral Health Impact Profile (OHIP) served as the pre– and post–test measure. The OHIP measures OHRQOL on 7 subscales: functional factors, psychological disabilities, psychological discomforts, physical disabilities, social disabilities, handicaps and physical pain. Additional questions measured the subjects' social activities at baseline, 3 weeks and 3 months. Data from 53 participants, who completed the study, were analyzed using paired t–tests and ANOVA at p=0.05.

Results: Statistical significance was observed for the OHIP physical pain subscale (p=0.0029) and the handicap subscale (p=0.05). Pre– to post–test means of the physical pain subscale increased in the experimental group (4.84 to 7.10), suggesting a lower OHRQOL, most likely related to tooth sensitivity experienced by the experimental group. Means from pre– to post–test of the handicap subscale (1.96 to 1.19) reveal that the experimental group reported an improved OHRQOL and felt they were more willing to work. Repeated measures ANOVA and Tukey's post–hoc tests revealed that the experimental group reported significantly less (p=0.04) social activities at the 3 month post–test (3.92 to 3.45). No statistically significant between–group differences were observed in the overall OHIP score for functional factors, psychological disabilities, psychological discomforts, physical disabilities and social disabilities.

Conclusion: Results indicate that vital tooth whitening does not improve overall OHRQOL in older adults.

Keywords: Tooth whitening, middle aged, oral health related quality of life (OHRQOL), Oral Health Impact Profile (OHIP)

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years of age and older partook in 34% of cosmetic dentistry procedures in 2006.[2] Since tooth whitening is noninvasive and relatively inexpensive, it is important to examine its impact on quality of life in an older population. Higher quality of life from a whiter and brighter smile might lead to increased dental visits and increased concern for the health of the oral cavity. In the present study, data were collected on older adults via the Oral Health Impact Profile (OHIP) and compared to research on OHRQOL and tooth whitening on college–age students.

Table I: OHIP Subscales

OHIP Subscales	Assessment
Functional limitation	Feeling as if problems with the teeth affect overall appearance
Physical pain	Experiencing headaches due to problems with the teeth or tooth sensitivity
Psychological discomfort	Feelings of worry or self–consciousness due to problems with the teeth
Physical disability	Experiencing a reduced ability to eat and avoidance of smiling due to problems with the teeth
Psychological disability	Feelings of depression and embarrassment because of problems with the teeth
Social disability	Avoiding social situations and inability to get along with others due to problems with the teeth
Handicap	Feeling of reduced ability to work due to problems with the teeth

Attractiveness and its Effects on Self Consciousness

Physical attractiveness, in particular facial appearance, has been shown to be significant to body image and self consciousness.[6] Teeth are a predominant facial feature and play an important role in overall physical attractiveness. Dissatisfaction with how one's own teeth look may result in loss of eye contact and anxiety.[6] Following the placement of anterior composite restorations, individuals who were previously dissatisfied with the appearance of their teeth had increased self–esteem and reported feeling more comfortable in social scenarios as evidenced by the Body–Esteem Questionnaire.[6]

Research suggests that society judges based on appearance even when other personality traits or abilities are known.[7] The most important factor in assessing one's self–image is acceptance and perceptions from peer groups.[7] Based on appearance alone, older adults are often deemed feeble, unstable and less flexible individuals.[7] A meta–anayltic and theoretical review on attractiveness found that adults who thought of themselves as physically attractive self–reported as healthier and more efficient.[8] Attractiveness was also found to be significant within the work and school environment.[8] Researchers concluded that facial attractiveness has an effect on self–consciousness, as attractive adults were found to have higher self–confidence and self–esteem.[8]

Older Adults and OHRQOL

Researchers found that physical health has profound quality of life implications.[9] Being social is important for overall general health and increased quality of life in older adults. Physical pain associated with dental diseases and disorders, and feelings of embarrassment from unattractive teeth, can decrease social interaction in older adults, thereby decreasing quality of life.[10] In a research study by Ekanayke et al, 235 participants 60 years of age and older underwent oral examinations and were interviewed on socio–demographic data, perceived oral health status, perceived need for dental care, dental visiting pattern and psychosocial impact of oral disorders on well–being and quality of life.[11] This study demonstrated that OHIP data was useful for determining how older adults view their own oral health status.[11]

Effects of Tooth Whitening on OHRQOL

McGrath and colleagues studied whitening effects in 87 college–aged individuals. At baseline, participants completed the OHIP, which assessed functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap (Table I).[12,13] Eight weeks after using whitening products, 63 participants returned for post–testing. Researchers found that the OHIP was "sensitive and responsive" to whiter teeth, meaning whiter teeth positively affected OHRQOL.[12] Of the 7 variables, the functional limitation subscale changed significantly after participants' teeth were whitened, meaning they reported less difficulty chewing and better overall appearance of their teeth.[12]

Slade et al explained the use of the OHIP in the measurement of quality of life based on 7 sub-

Table II: Research design

Pre–Test Measures Baseline	Treatment	Post–Test Measures Week 3	Post–Test Measures Three Months	Final Sample
Experimental Group • Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• Use of a tooth whitening product • Oral home-care instructions	• Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• Additional Questions Survey (AQS)	• Females: 10 • Males: 14 • Total: 24
Control Group • Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• No use of tooth whitening product • Oral home-care instructions	• Trubyte New Hue Vitality Scale • Tooth Color Satisfaction Scale (TCSS) • Oral Health Impact Profile (OHIP) • Additional Questions Survey (AQS)	• Additional Questions Survey (AQS) • Given tooth whitening product	• Females: 18 • Males: 11 • Total: 29
				• Total: n=53

scales in 64 dental patients, which showed validity and reliability.[13] Outcomes provide information to better understand the dimensions of OHRQOL and factors that encourage dental care seeking behaviors in older adults. This is due to the fact that OHIP reliability in the study performed by Slade et al was performed on 122 individuals over the age of 60.[13] The purpose of the present study was to determine if prescription strength at–home tooth whitening lead to self–reported tooth color satisfaction, improved overall OHRQOL and lead to increased social activities in older adults.

Methods and Materials

Research Design

A 2 group, single blind, randomized, pre–test, multiple post–test design was used for the present study (Table II). Sixty–two participants 50 years of age and older were enrolled and randomly assigned to 1 of 2 groups by research assistants. A total of 53 participants completed the study (Table II). Clinicians collecting data were unaware of participant group status, since the participants were assigned a number after being randomly assigned to a group. Research assistants informed participants not to discuss treatment with clinicians. Since the control group did not utilize a whitening product and the experimental group did, both groups were aware of their status within the study. The whitening product used, (Crest Whitening Supreme® 14%; Procter & Gamble, Cincinnati, Ohio) has demonstrated safety and effectiveness.[14,15]

Sample Description, Selection and Enrollment

The convenience sample of 62 adults 50 years of age and older were enrolled from the Hampton Roads area of Virginia. This sample size was chosen to obtain at least 30 participants in each group for use of parametric statistics. Participants had to be in good general health, possess the cognitive ability and physical dexterity to perform daily oral care, have at least 8 natural anterior teeth free from composite restorations, crowns, veneers, full or partial dentures and endodontic treatment, and refrain from using any over–the–counter tooth whitening products for the duration of the study. Exclusion criteria included visible calculus deposits on labial or lingual surfaces of anterior teeth covering more than one third, severe tooth sensitivity or professional whitening within the past 3 years. Exclusion and inclusion criteria were determined through a researcher–conducted screening process.

Procedures and Materials

Tooth color assessments using the Tooth Color Shade Guide (TCSG) on teeth numbers 6 through 11 and 22 through 27 were measured at the middle third and recorded. The TCSG consisted of 12 shades numbered from 1 to 12, with 1 being the lightest and 12 being the darkest (Trubyte New Hue Vitality Scale®, Dentsply International, York, Penn).

Data Collection Instruments

Tooth color satisfaction, measured with the Tooth

Color Satisfaction Scale (TCSS), asked the question "How satisfied are you with the color of your teeth?" Responses ranged from very satisfied (5 points), satisfied (4 points), neither satisfied nor dissatisfied (3 points), dissatisfied (2 points) and very dissatisfied (1 point). Calibration for measuring tooth color was conducted prior to study initiation. Test–retest data were analyzed using percentages and both intra–rater reliability (examiner 1=100%, examiner 2=90%) and inter–rater reliability (99.44%) were considered excellent.

OHRQOL measured the frequency of dental–related problems utilizing a reference period of 1 month and a 5 point Likert scale: very often (5 points), fairly often (4 points), occasionally (3 points), hardly ever (2 points), never (1 point), don't know and not applicable.[13] Questions with responses of don't know and not applicable were not included in the analysis. The instrument yields an interval scale of 0 to 196 for overall quality of life – the lower the score, the higher the OHRQOL since the OHIP weights negative factors. OHIP measured overall quality of life and its 7 subscales: functional factors (0 to 36), psychological disability (0 to 24), psychological discomfort (0 to 20), physical disability (0 to 36), social disability (0 to 20), handicap (0 to 36) and the feeling of pain or discomfort (0 to 36). The OHIP is "one of the most comprehensive measures of OHRQOL," and determined the primary endpoints of whether or not overall quality of life and it's 7 subscales increased within the experimental group, demonstrating that whiter teeth positively impacted quality of life.[12]

The number of self–reported social activities for older adults measured by a researcher–created Additional Question Survey (AQS) asked, "How many social activities (with a group or with one other person) did you participate in over the past two weeks?" Responses ranged from none (1 point), 1 to 2 (2 points), 3 to 4 (3 points), 5 to 6 (4 points) and 7 or more (5 points).

Protection of Human Subjects

The University's institutional review board approved the protocol for protection of human participants. All participants were informed verbally and in writing of the potential risks, benefits, procedures, protection of subject rights and the risk–benefit ratio, and signed informed consent.

Table III: Pre–test to Post–test Tooth Color Satisfaction

	Degrees of Freedom	Sums of Squares	Mean Squares	F–Statistic	p–Value
Pre–Test Scores	1	0.10	0.10	0.20	0.66
Error	51	25.79	0.51		
Corrected Total	52	25.89			
Post–Test Scores	1	39.57	39.57	50.05	<0.0001
Error	48	37.95	0.79		
Corrected Total	49	77.52			

Statistical Analysis

Data were entered into Microsoft Excel software, and SAS statistical analysis software. Pre– and post–test scores measuring tooth color change as a result of the whitening treatment in the experimental group were also included. Between group differences were analyzed using analysis of variance (ANOVA) for tooth color and tooth color satisfaction, while scores from the OHIP measure were analyzed using the paired t–test. Two–way analysis of variance determined the differences between the pre– and the post–test for each group. To correlate tooth color satisfaction with the overall score, regression analysis was used. This also determined if tooth color satisfaction scores affected overall OHRQOL within groups. For the additional question, repeated measures ANOVA and post–hoc comparisons with Tukey's test were performed.

Results

A 36.8% improvement in tooth color for the experimental group was found over 3 weeks. TCSS analysis revealed that older adults in this group were significantly more satisfied with the color of their teeth than those in the control group. At baseline, individual groups were equivalent in the satisfaction of their tooth color. Post–test scores in tooth color satisfaction for the experimental group increased significantly from 2.29 to 4.36, suggesting that persons who had their teeth whitened became more satisfied. Data revealed that individuals who received the whitening treatment showed significant increases in tooth color satisfaction (Table III).

OHRQOL analysis revealed no statistically significant difference in the experimental group compared with the control group after the whitening treatment. Paired t–test results for the control group using the log scores of the difference from pre– to post–test showed no statistically significant improvement in overall quality of life (t–val-
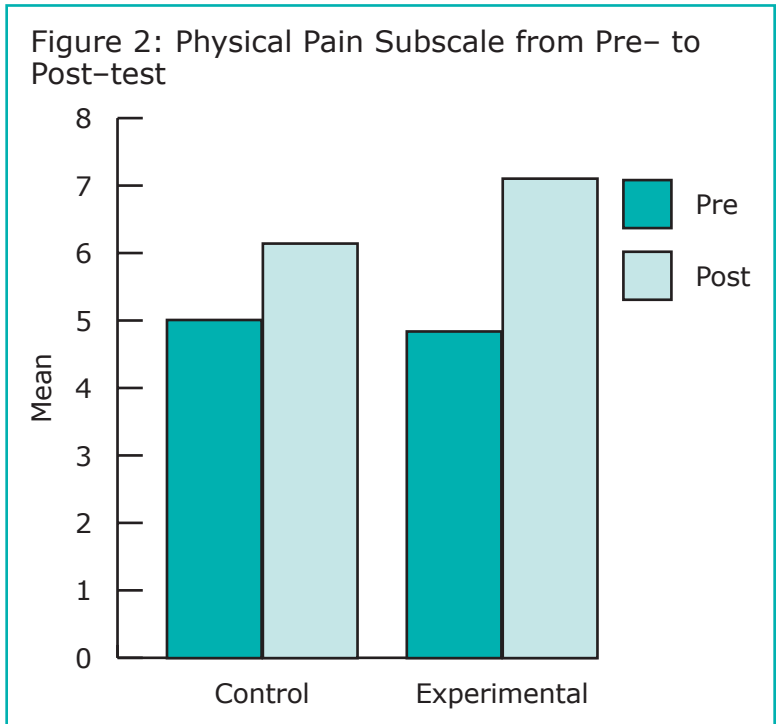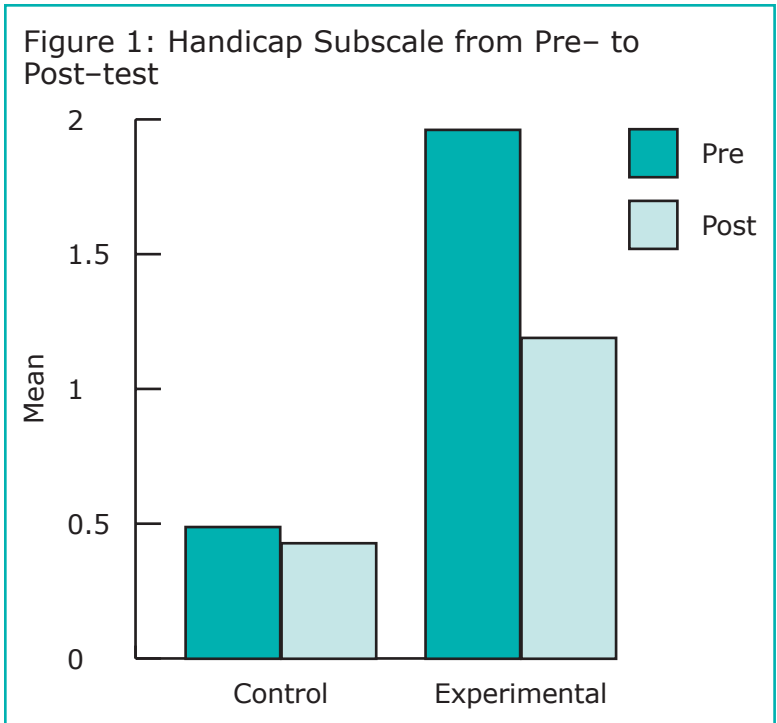
ue=−1.10, df=28, p−value=0.28). Paired t−test results for the whitening group showed no statistically significant difference (t−value=1.27, df=23, p−value=0.22). The overall quality of life difference score from pre− to post−test was 0.96 (n=24). At baseline, the control group had a slightly higher OHRQOL (18.14 and 20.67). Tooth whitening did not influence overall quality of life.

Statistical significance was not observed for the OHIP functional factors, psychological disabilities, psychological discomforts, physical disabilities and social disabilities subscales. Analysis of the handicap subscale of the OHIP revealed that older adults in the experimental group became statistically more willing to work due to a perceived increase in health compared to the control group. Paired t−test results for the experimental group showed a statistically significant improvement in the handicap subscale from pre− to post−test (p=0.05). No statistically significant difference occurred when the handicap subscale OHIP pre− and post−test means for the control group were analyzed (p=0.63, Figure 1). Baseline comparisons made for the handicap subscale revealed a statistically significant difference between the experimental group and the control group (p=0.03), suggesting that the 2 groups had varying handicap subscale results.

Analysis of the physical pain subscale of the OHIP revealed significantly more physical pain in the experimental group, since a statistically significant change for the worse (more pain was experienced) was shown (p=0.0029). No statistically significant change occurred in the control group (p=0.08, Figure 2). Baseline comparisons for the experimental group showed initial group equivalency (p=0.90).

Analysis of the number of social activities participated in over the past 2 weeks revealed a significant difference among older adults in the experimental group as measured by the AQS. Repeated measures of ANOVA showed no statistically significant interaction between treatment group and time, indicating the profiles of the means were parallel (p=0.95, Figure 3). Statistically significant differences were observed between groups (p=0.04) and between time (p=0.01), and both groups changed similarly.

A post−hoc test (Tukey's test) was conducted

Figure 1: Handicap Subscale from Pre− to Post−test

Figure 2: Physical Pain Subscale from Pre− to Post−test

to identify the significant time periods from the group differences. When comparing the control and experimental group from baseline to 3 weeks (p=0.40) and baseline to 3 months (p=0.21), no significant changes were found. Significance was found when comparing the control and experimental group means from 3 week to 3 months (p=0.01). Although still higher than the control group, the experimental group experienced slightly less social activities from post−testing at 3 weeks to 3 months.

Relationships among tooth color satisfaction scores and overall OHIP scores were analyzed using regression analysis. At baseline, the control group showed no statistically significant correlation (p=0.93) in overall OHIP and tooth color satisfaction scores. As the tooth color satisfaction scores increased, the overall OHIP scores stayed about the same. Moreover, there was no statistically significant relationship (p=0.56) among the control group's tooth color satisfaction and overall OHIP scores at the 3 week post–test. Even though results were not significant, the control group demonstrated that within 3 weeks, tooth color satisfaction increased and OHRQOL increased (OHIP scores decreased). Correlations between the experimental group tooth color satisfaction and overall OHIP scores at baseline showed a statistically significant relationship (p=0.01). As tooth color satisfaction increased, OHRQOL increased (OHIP scores decreased).

At 3 weeks the experimental group revealed a statistically significant correlation between tooth color satisfaction and overall OHIP (p=0.01). As seen in Figure 4, tooth color satisfaction increased and OHIP scores significantly decreased (higher OHRQOL). An increase in the satisfaction of one's teeth demonstrated a significant correlation with higher quality of life.

When accounting for the pre– and post–test differences of the experimental group, no statistically significant correlation occurred between the overall OHIP score and tooth color satisfaction (p=0.48). Tooth color satisfaction increased significantly in the experimental group over 3 weeks.

Discussion

In general, all participants were low on the OHIP scale indicating a high quality of life at baseline. Tooth whitening positively changed older adults' perceptions of their teeth and they became more satisfied with their tooth color. The results were similar to McGrath et al, where over half of participants reported being more satisfied with the color of their teeth after tooth whitening.[12]

Overall oral–health related quality of life was not changed as a result of tooth whitening, which contrasts McGrath et al where overall OHIP results improved significantly after tooth whitening.[12] These overt differences might be explained due to the fact that the control group demonstrated a higher overall OHIP result than the experimental group. Although not statistically significant, the experimental group had a lower OHRQOL, while the

Figure 3: Average Social Activities Scores of Control and Experimental and Time at Baseline, 3 Weeks and 3 Months
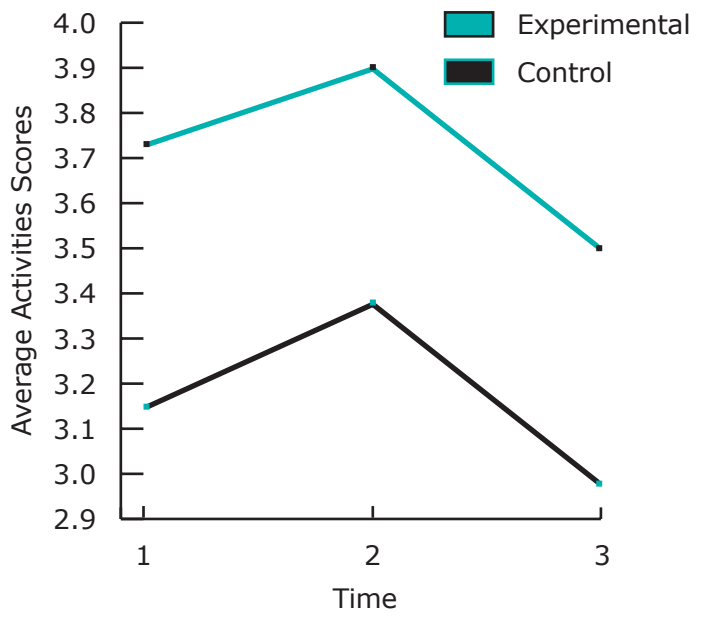
control group showed higher OHRQOL. Reasons for this could be due to the statistically significant decrease in OHRQOL for the physical pain sub-scale of the OHIP within the experimental group. The control group also showed a statistically non–significant increased mean score (lower OHRQOL), but the increase shown in the experimental group was much higher, unlike McGrath et al.[12] This increase in pain is most likely attributed to the tooth sensitivity that is common with whitening procedures. The functional factors subscale of the OHIP showed no statistically significant differences, therefore, those who whitened their teeth did not report increased confidence in their appearance. This is unlike McGrath et al, where significance was concluded for the functional limitation subscale.[12] The psychological disability subscale of the OHIP yielded no statistically significant difference from pre– to post–test in the experimental group. The control group showed improved OHRQOL for the psychological disability subscale, but this was not statistically significant. This may be attributed to a history threat, where the control group participants absorbed information regarding tooth whitening during the 3 week period and related this to the questionnaire. The physical disability subscale revealed that participants did not experience an increased ability to perform daily oral hygiene or to smile. Initial group equivalence was established, yet the control group experienced a greater decrease in the mean score from OHIP pre– to post–test (2.16 to 1.34) and showed a higher OHRQOL for the subscale (p=0.09). This is most likely due

Figure 4: Relationship Between Tooth Color Satisfaction and Overall OHIP Scores for the Experimental at Three–week Post–test
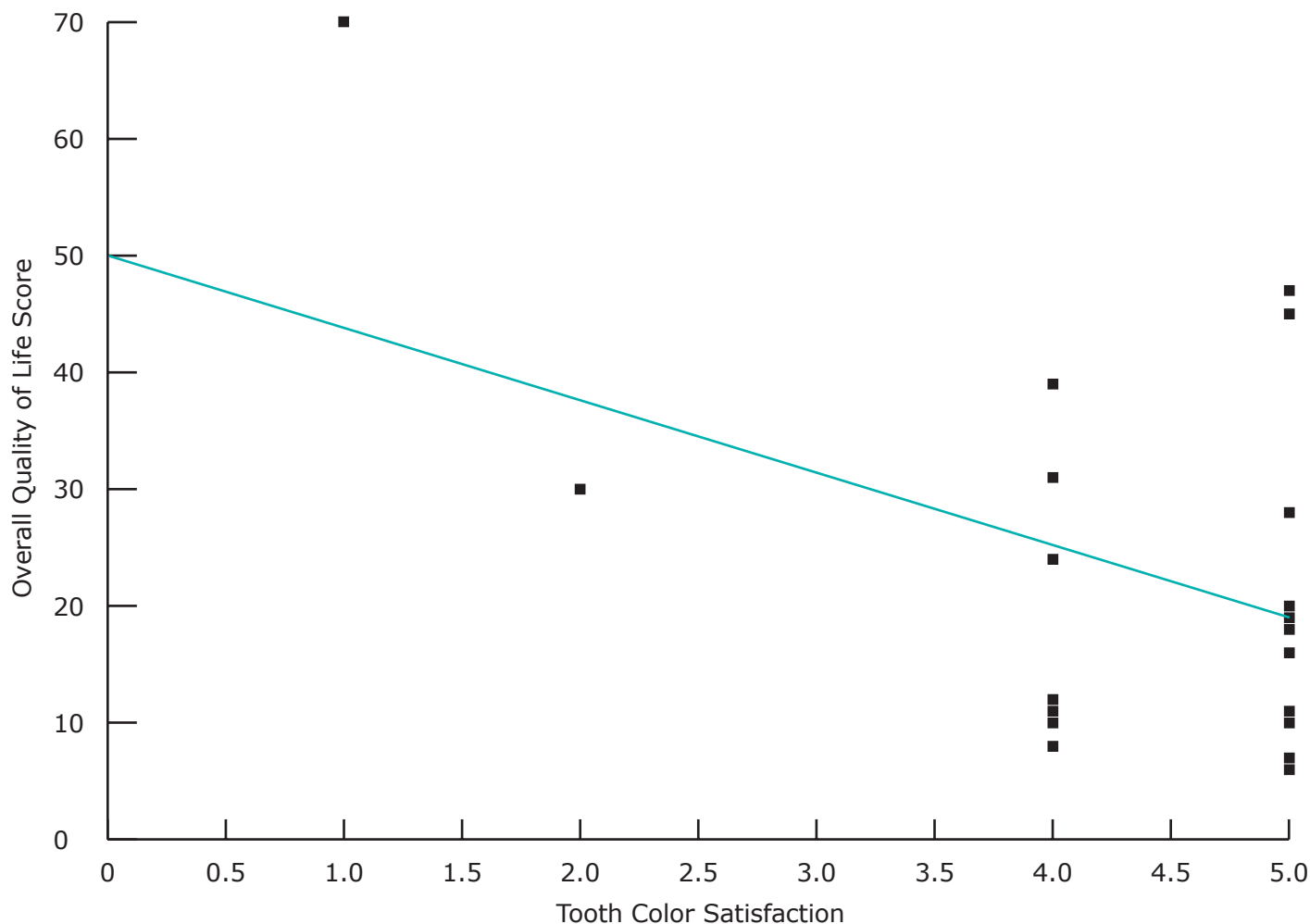
to the fact that participants were not disabled and were competent in performing daily oral hygiene to begin with.

Future studies should assess tooth color scores at baseline, then assign them to matched groups based on their pre–test score. This would give researchers initial group equivalency and a more precise assessment of a change in quality of life than was possible presently. The short–form OHIP (OHIP–14), used in the study done by Ekanayke et al may have had more room for error and has been shown to be equivalent to the 49 item questionnaire used in the present study.[11,16,17] Larger sample sizes, as well as random selection of samples, would allow future researchers to generalize results to a broader older adult population. As demonstrated by the present study and existing literature, the older adult population is interested in their tooth color. Future studies are recommended to further address psychosocial change in older adults associated with tooth whitening using larger sample sizes, a placebo, random selection and stratification.

Conclusion

Based on the outcomes of this study, the following is reported:

- The older adults who whitened their teeth experienced an increased satisfaction with their tooth color as evidenced by the TCSS
- Tooth whitening was not associated with improvements in overall OHRQOL, or its functional factors, psychological disabilities, psychological discomforts, physical disabilities and social disabilities subscales
- Tooth whitening did affect the handicap subscale, which demonstrated that persons who experienced tooth whitening were more willing to work due to a perceived increase in health
- Tooth whitening did affect the physical pain subscale, which demonstrated a lower OHRQOL for participants
- Older adults who whitened their teeth reported fewer social activities 3 months after the initial post–testing
- Regression analysis relating tooth color satis-

faction with overall OHRQOL revealed a significant correlation between tooth color satisfaction and overall OHIP for the experimental group

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Acknowledgments

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