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ORIGINAL ARTICLE

Body mass index and self-care behaviors related to oral health–related quality of life in patients with oral squamous cell carcinoma within three months posttreatment

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Abstract

Purpose Oral dysfunction is a common adverse event of treatment and may affect oral health–related quality of life (OHRQoL). This study aimed to identify factors associated with OHRQoL in patients with oral squamous cell carcinoma (OSCC) within the first three months posttreatment.

Methods This cross-sectional study examined OSCC patients who received treatment from the outpatient radiation department of a single cancer center in northern Taiwan. Demographic and clinical characteristics were recorded, and patients were assessed using the Self-Care Behaviors Scale (SCB), Oral Health Impact Profile (OHIP), and Karnofsky Performance Status (KPS) questionnaires.

Results Among 148 OSCC patients, 11.5% reported being underweight and 70.3% reported normal weight. The most common self-care factors associated with adverse effects were decreased appetite and fatigue. Psychological disability, functional limitation, and physical pain were the most negative OHRQoL factors. Poor OHRQoL was associated with more severe adverse effects after self-care behaviors, using feeding tubes during treatment, and having BMI less than 25, which together explained 33.5% of the variance in OHRQoL.

Conclusions The severity of adverse effects after self-care behaviors and using feeding tubes during treatment strongly influenced overall OHRQoL and seven specific dimensions of OHRQoL.

Keywords Oral squamous cell carcinoma · Treatment modality · Body mass index · Oral symptoms · Patient report outcome · Health-related quality of life

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Introduction

Cancer is a leading cause of morbidity and mortality in populations around the world, including in Taiwan [1]. In Taiwan, oral cavity cancer has become the fourth most common cancer among males, and oral squamous cell carcinoma (OSCC) is the most common type of oral cavity cancer [2]. Betel quid chewing is regarded as a major carcinogen for OSCC and it is more likely to affect the oral mucosa and oral health than other factors [3, 4]. More than 55% of those diagnosed with OSCC are diagnosed at stages III and IV, and surgery combined with chemotherapy, radiation therapy (RT), or concurrent chemoradiation therapy (CCRT) is the major treatment for advanced-stage OSCC [2, 5]. Mucosal toxicities are reported to be the most acute adverse effect and may extend to several months after completing treatment [6], while also having a negative impact on oral health–related quality of life (OHRQoL) [7, 8].

Patients receiving chemotherapy, RT, or CCRT may experience oral mucosal injury such as mucositis during

and after treatment, which can present as erythema, ulceration, and pain [9, 10]. Approximately 1.3–88.3% of OSCC patients and 23.3–36.2% of nasopharyngeal cancer (NPC) patients who received the CCRT regimen reported oral mucosal toxicities, which develop 2–3 weeks following treatment and may persist for up to 8 weeks [11–13]. Symptoms of mucosal toxicities (e.g., mouth pain, dry mouth, change in taste, difficulty eating, difficulty drinking, difficulty swallowing, difficulty speaking) may cause weight loss [14], malnutrition [15], and reduce OHRQoL [16, 17].

Body mass index (BMI) reflects the nutritional status in patients treated for OSCC. Weight loss occurs in 1.8–44.2% of head and neck cancer patients, weight loss more than 5% may occur during RT, and loss of at least 10% of body weight may be noted at 9 months postdiagnosis. Several studies showed that lower BMI was associated with increased mortality risk and poorer OHRQoL [18, 19]. Self-care behavior refers to an individual's ability to promote and maintain health, prevent disease, and to cope with a health problem or illness [20]. Studies have demonstrated that patients' oral healthcare behavior can reduce oral mucosal toxicities [21]. Also, whether or not patients perform a certain behavior may play an important role in reducing the severity of oral adverse effects [22, 23]. Poor oral self-care behaviors and more mucosal problems together lead to worse OHRQoL [24].

OHRQoL is a multidimensional construct that reflects individually perceived oral health problems and its impact on general health includes physical, psychological, and social aspects, as well as the experience of discomfort [25]. In that study, OHRQoL decreased significantly from pre-surgery to 1-month postsurgery, and increased from 1-month postsurgery to 3-month postsurgery. Poorer OHRQoL is associated with lower BMI [26], more oral dysfunction (dysphagia, xerostomia, trismus, or temporomandibular pain) [26–29], advanced stages [27, 29], reduced physical function [27], and poor social-emotional function [27]. Although previous studies have explored these issues, most research has focused on patients who survived head and neck cancer (HNC) [26–29], data from Western countries [27–30], and postoperative OHRQoL [26, 30]. Few studies have explored symptom distress [31, 32] and oral healthcare needs [32] during treatment and the early posttreatment period in Taiwan. Clinical observation indicates that patients' self-care behaviors and nutritional status affect oral health, an issue that has not received sufficient attention to date. Therefore, the purposes of this study were to (1) assess OSCC patients' levels of BMI, self-care behaviors associated with adverse effects, and OHRQoL and to (2) identify factors associated with OHRQoL among OSCC patients within the first three months posttreatment.

Methods

Design and sample

This study was conducted using a cross-sectional, descriptive, and correlational design. Consecutive sampling was used to recruit subjects from the outpatient radiation department of a single cancer center in northern Taiwan between August 2018 and July 2019. The inclusion criteria were (1) patients aged 20 years or older; (2) newly diagnosed with OSCC; (3) who received surgery, chemotherapy, radiotherapy (RT), or chemoradiotherapy (CCRT); and (4) who had completed their initial treatment within the last three months. Patients with mental disorders, an unstable systemic disease (active infection or other underlying disease), recurrent OSCC, or physical performance less than 60 on the Karnofsky Performance Status Scale (KPS) [33] were excluded.

Ethical considerations

Ethical approval was obtained from the Institutional Review Board of the medical center (Number: 104-8655B). Following a detailed explanation of the study and its procedures, subjects who agreed to participate were asked to provide signed informed consent before data collection.

Data collection

After completing treatment, all included patients regularly visited the outpatient radiation department at intervals determined by the primary physician. During one visit, a well-trained research nurse assisted the patients with completing the questionnaires followed by physical examination of mucosal toxicities, which took around 10–15 min. The research nurse had more than 10 years' cancer care experience of OSCC patients and was trained by a radiation oncologist with expertise in the radiotherapy and mucosal toxicities therapies of OSCC. The training included information about the concept of mucosal toxicities, procedures for administration and scoring of mucosal toxicities measurements, and details of the questionnaire. Satisfactory inter-rater reliability was reported in the pilot study.

Measures

Self-Care Behaviors Scale

The Self-Care Behaviors Scale (SCB) was used to assess patients' self-care activities associated with adverse effects [34]. The SCB consists of two self-reported subscales: a diary of the performance of self-care behaviors associated with adverse effects (22 items), and patients' perceptions of the severity of adverse effects (22 items). Each subscale contains five

domains: fatigue (4 items), sleeping difficulty (2 items), nausea (10 items), decreased appetite (4 items), and change in food taste/smell (2 items) [34]. In the subscale that rates the diary of performance of self-care behaviors associated with adverse effects, each completed item was assigned a score of 1 and the items not completed were assigned a score of 0. In the subscale that rates patients' perceptions of the severity of adverse effects, each item was rated on a scale of 0–5 (not used = 0, used but no relief = 1, used with some relief = 2, used with moderate relief = 3, used with quite a bit of relief = 4, and used with complete relief = 5), with a higher score indicating more relief of adverse effects [34]. Several previous studies have demonstrated satisfactory psychometric properties for this scale [34, 35]. Cronbach's α for the SCB used in this study was 0.95.

Oral Health Impact Profile

impact of oral conditions on quality of life were assessed using the Oral Health Impact Profile (OHIP) [36]. This 14-item scale has seven subscales: functional limitation (2 items), physical pain (2 items), psychological discomfort (2 items), physical disability (2 items), psychological disability (2 items), social disability (2 items), and handicap (2 items). Each item is scored on a scale of 0 to 4, with a higher score indicating more negative impacts and a lower OHRQoL [35]. The OHIP has been widely used to assess oral health–related QOL in head and neck cancer related studies [28, 29]. A Chinese language translation of the scale [37] was used and satisfactory psychometric properties were reported in previous studies [38]. Cronbach's alpha for the OHIP data was 0.86.

Radiation Therapy Oncology Group Assessment Scale 2.0

The Radiation Therapy Oncology Group (RTOG) Assessment Scale was developed by the US National Cancer Institute (NCI) and is widely use in severity grading scale for adverse events in cancer therapy [39]. Severity of mucosal toxicity of therapeutic regimens is measured in five grades: Grade 0, none; Grade I, erythema of the mucosa; Grade II, patchy pseudomembranous reaction (patches generally ≤ 1.5 cm in diameter and non-contiguous); Grade III, confluent pseudomembranous reaction (contiguous patches generally > 1.5 cm in diameter); Grade IV, necrosis or deep ulceration; and may include bleeding not induced by minor trauma or abrasion [32]. The RTOG has been widely used and demonstrated to be reliable in mucositis due to radiation therapy [40]. The inter-rater reliability for this study was 0.98 between the research nurse and the oncologist who provided training to the research nurse.

Karnofsky Performance Status Scale

The Karnofsky Performance Status Scale (KPS) was used to assess performance status [33]. The KPS is an 11-point scale with scores ranging from normal function (100%) to expired (0%). In Taiwan, the KPS has been widely used in clinical cancer studies to assess a cancer patient's level of physical performance [31, 32]. An inter-observer reliability coefficient of 0.98 was reported in the present study.

Demographic and clinical characteristics

The demographic data included age, sex, employment after diagnosis, marital status, educational level, and religion. Clinical characteristics included cancer subsite, cancer stage, medical treatment, and radiation dose.

Data analysis

Data were analyzed statistically using SPSS, version 21.0 for Windows (IBM Corp., Armonk, NY, USA). Demographic characteristics, clinical characteristics, BMI, self-care behaviors for adverse effects, and OHRQoL were analyzed using descriptive statistics (frequency distribution, percentage, means, and standard deviations). One-way ANOVA was used to measure the differences in patients' mean age between BMI classifications (underweight, normal, and overweight). Multiple regression analysis was conducted to identify factors associated with OHRQoL. The independent variables included cancer stage (early vs. advanced), tumor location (others vs. tongue), adjuvant therapy (CT or RT vs. CCRT), feeding tube during treatment (no vs. yes), body mass index (≥ 25 kg/m^2 vs. < 25 kg/m^2), and the severity of adverse effects after self-care behaviors (sum score of the subscale for perceived severity of each adverse effect).

Results

Patient characteristics

Of 153 eligible patients who were recruited initially, 5 declined to participate because they had no time or interest. The response rate was 96.7%. A total of 148 OSCC patients were recruited into this study. Patients' average age was 52.55 (SE = 0.78) years, no statistically significant differences were found in age between BMI classifications (underweight, normal, and overweight), which normalizes age given that adults and elderly patients were included [35]. The majority were male (n = 137, 92.6%), unemployed (n = 93, 62.8%), married (n = 122, 82.4%), and had a senior high school education (n = 52, 35.1%), and most patients held Buddhist/Taoist religious beliefs (n = 130, 87.8%). Most common cancer sites were the buccal mucosa (n = 51, 34.5%)

and tongue ($n = 55$, 37.2%); a majority of patients had advanced-stage cancer ($n = 114$, 77.0%) and had received surgery with CCRT ($n = 86$, 58.0%). After treatment, a majority of patients had mucosal toxicities at grade 0 ($n = 137$, 92.6%). The mean total radiotherapy dose was 6575.26 cGy (SD = 41.28, range: 6000 to 8400), and all patients had satisfactory KPS scores (70 to 100) (Table 1).

Patients' performance of self-care behaviors and perceived severity of adverse effects

The top seven items reported by patients who performed self-care behaviors for adverse effects were "took naps" ($n = 46$, 31.1%), "made an extra effort to eat" ($n = 33$, 22.3%), "ate high-protein foods" ($n = 33$, 22.3%), "cleaned mouth and

Table 1 Demographic and clinical characteristics of patients ($N = 148$)

Variable	Number (%)	Mean (SE)	Range	*F*	*p*
Age (years)		52.55 (0.78)	32–73	0.847	0.431
Underweight	17 (11.5)	53.71 (2.47)			
Normal	104 (70.3)	52.90 (0.89)			
Overweight	27 (18.2)	50.48 (2.03)			
Sex					
Male	137 (92.6)				
Female	11 (7.4)				
Occupation					
Unemployed	93 (62.8)				
Employed	55 (37.2)				
Marital status					
Unmarried	26 (17.6)				
Married	122 (82.4)				
Education level					
None	2 (1.4)				
Elementary	42 (28.4)				
Junior high	40 (27.0)				
Senior high	52 (35.1)				
College and above	12 (8.1)				
Religion					
None	14 (9.5)				
Buddhism/Taoism	130 (87.8)				
Christianity/Catholicism	4 (2.7)				
Sub-site					
Lip	4 (2.7)				
Buccal mucosa	51 (34.5)				
Oral tongue	55 (37.2)				
Gingivae	25 (16.9)				
Mouth floor	6 (4.1)				
Hard palate	6 (4.1)				
Retromolar	1 (0.7)				
Cancer stage					
Early stage	34 (23.0)				
Advanced stage	114 (77.0)				
Medical treatment					
Surgery + RT	40 (27.0)				
Surgery + CT	4 (2.7)				
Surgery + CCRT	86 (58.0)				
RT	8 (5.4)				
CCRT	10 (8.7)				
Radiotherapy, total dose, cGy		6575.26 (41.28)	6000–8400		
Grade of mucosal toxicity					
0	137 (92.6)				
1	9 (6.1)				
2	1 (0.7)				
3	1 (0.7)				
4	0 (0)				
KPS score (level)		85.74 (0.45)	70–90		
90 to 100	89 (60.1)				
80 to 90	55 (37.2)				
70 to 80	4 (2.7)				

SD, standard deviation; *RT*, radiotherapy; *CT*, chemotherapy; *CCRT*, combined chemotherapy and radiotherapy; *KPS*, Karnofsky performance score

teeth more often" (n = 30, 20.3%), "ate less" (n = 28, 18.9%), "ate more frequently" (n = 27, 18.2%), and "went to bed earlier than usual" (n = 16, 10.8%). Among these items, patients' perceived severity of adverse effects was associated with "took naps" (mean = 0.40, SE = 0.05), "made an extra effort to eat" (mean = 0.30, SE = 0.05), "ate high-protein foods" (mean = 0.31, SE = 0.06), "cleaned mouth and teeth more often" (mean = 0.25, SE = 0.05), "ate less" (mean = 0.26, SE = 0.05), "ate more frequently" (mean = 0.29, SE = 0.06), and "went to bed earlier than usual" (mean = 0.13, SE = 0.03) (Table 2).

Levels of BMI, severity of adverse effects after self-care behaviors, and OHRQoL

According to BMI classification [41], 18.2% (n = 27) of patients were overweight, 70.3% (n = 104) had normal weight, and 11.5% (n = 17) were underweight. The score for overall mean severity of adverse effects after self-care behaviors was 2.55 (SE = 0.55); the top three items indicating severity of adverse effects after self-care behaviors were "decreased appetite" (mean = 1.12, SE = 0.20), "fatigue" (mean = 0.69, SE = 0.12), and "change in food taste/smell" (mean = 0.38, SE = 0.07). The overall mean OHIP score was 13.94 (SE = 0.66), and OHIP subscales with the highest levels were "psychological disability" (mean = 3.81, SE = 0.19), "functional limitation" (mean = 2.93, SE = 0.12), and "physical pain" (mean = 2.70, SE = 0.13) (Table 3).

Factors associated with OHRQoL

Multiple regression analysis identified factors that were significantly and independently associated with OHRQoL and seven dimensions of OHRQoL (Table 3). Patients who had more severity of adverse effects after self-care behaviors (β = 0.461), who used feeding tubes during treatment (β = 0.284), and who had BMI less than 25 (β = − 0.174) were more likely to have worse overall OHRQoL. These 3 factors explained 33.5% of the total variance in overall OHRQoL.

Functional limitations were more severe in patients who had more severity of adverse effects after self-care behaviors (β = 0.371), who used feeding tubes during treatment (β = 0.216), and who had BMI less than 25 (β = − 0.171), which together explained 21.6% of the total variance in functional limitation. Greater pain was associated with using feeding tubes during treatment (β = 0.19) and more severity of adverse effects after self-care behaviors (β = 0.213), which together explained 8.2% of the total variance in pain. Patients who had higher levels of severity of adverse effects after self-care behaviors (β = 0.332), used feeding tubes during treatment (β = 0.214), had BMI less than 25 (β = − 0.256), and received CCRT had more severe psychological discomfort (β = − 0.203), which together explained 26.7% of the total variance in psychological discomfort. Greater physical disability was associated with more severity of adverse effects after self-care behaviors (β = 0.314) and using feeding tubes during treatment (β = 0.267), which together explained 16.1% of the total variance in physical disability. Patients who had more severity of adverse effects after self-care behaviors (β = 0.410), received CCRT (β = − 0.225), those whose tumor location was the tongue (β = − 0.195), and who used feeding tubes during treatment (β = 0.169) were more likely to have severe psychological disability. These 4 factors explained 29.3% of the total variance in psychological disability. Greater social disability was associated with more severity of adverse effects after self-care behaviors (β = 0.386) and were underweight BMI (β = − 0.156), which together explained 18.5% of the total variance in social disability. Patients who had more

Table 2 Patient-performed self-care behaviors and perceived severity of adverse effects (N = 148)

Self-care behavior	Domain	Perform self-care behaviors for adverse effects subscale Number (%)	Perceived severity of adverse effects subscale Mean (SE)
1. Took naps	Fatigue	46 (31.1)	0.40 (0.05)
18. Made an extra effort to eat	Decreased appetite	33 (22.3)	0.30 (0.05)
19. Ate high-protein foods	Decreased appetite	33 (22.3)	0.31 (0.06)
21. Cleaned mouth and teeth more often	Change in food taste/smell	30 (20.3)	0.25 (0.05)
17. Ate less	Decreased appetite	28 (18.9)	0.26 (0.05)
20. Ate more frequently	Decreased appetite	27 (18.2)	0.29 (0.06)
2. Went to bed earlier than usual	Fatigue	16 (10.8)	0.13 (0.03)

Perform self-care behaviors for adverse effects subscale, "no" indicating patients did not perform self-care behaviors of adverse effects, and "yes" indicating patients have performed self-care behaviors of adverse effects

Perceived severity of adverse effects subscale, each item rated on a scale of 0–5 (not used = 0, used but no relief = 1, used with some relief = 2, used with moderate relief = 3, used with quite a bit of relief = 4, and used with complete relief = 5)

severity of adverse effects after self-care behaviors ($\beta = 0.344$) were more likely to have severe handicap, which explained 11.3% of the total variance in handicap.

The severity of adverse effects after self-care behaviors was the most robust factor associated with overall OHRQoL and with all individual domains of OHRQoL. The use of feeding tubes during treatment was another potential factor significantly associated with OHRQoL and all individual domains of OHRQoL, except for social disability and handicap (Table 4).

Discussion

In the present study, 11.5% of patients were classified as underweight and 70.3% as having normal BMI, which are similar results shown for populations in previous studies. Lee et al. [42] reported that HNC patients' body weight decreased 3.09 kg before RT to 1 month after initiating RT, 1.72 kg from 1 month after initiating RT to completion of RT, and 1.04 kg from completing RT to 1 month posttreatment. Pai et al. [43] found that the mean weight loss of head and neck cancer (HNC) patients during RT was 3.4 kg, and 39.4% of patients had weight loss of more than 5% during RT. Nutrition supplementation is important during and after treatment, so providing nutrition education and instruction for diet preparation may help to prevent weight loss.

The present study examined OSCC patients at three months or earlier after the end of treatment. The level of OHRQoL among subjects in this study was lower than that of another recent study [29]. This difference may be due to the different times after completion of treatment, namely, the study of Soldera et al. [29] recorded OHRQoL at more than three months posttreatment, but subjects in the present study were evaluated within three months after treatment. Perhaps the mucosal adverse effects of treatment lasted for several months after completing treatment. Healthcare providers are well advised to continue assessment of oral function and provide timely symptom management and nutrition counseling.

Results of the present study showed that decreased appetite and fatigue were the most common associated with severity of adverse effects after self-care behaviors in OSCC patients within the first three months posttreatment. These results are consistent with those of previous studies [44, 45], which reported that surgical procedures and RT damaged the oral anatomy and mucosa leading to oral dysfunction (e.g., oral mucositis, dysphagia, xerostomia, trismus, and communication dysfunction) and psychological problems (e.g., anxiety, irritability, and depression), and also increased sleep disturbances, leading to fatigue. Therefore, enhanced oral hygiene, avoidance of irritating foods, education and relaxation training, and

Table 3 Scores for body mass index, severity of adverse effects after self-care behaviors, and oral health–related quality of life ($N = 148$)

Variable	Mean/*N*	SE/%	Range/$\times^2$	Theoretical scoring range/*p*
Body mass index (BMI)			5.638	0.06
- Underweight	17	11.5		
- Normal	104	70.3		
- Overweight	27	18.2		
Severity of adverse effects after self-care behaviors (SCB)	2.55	0.55	0–74	0–88
- Fatigue	0.69	0.12	0–12	0–16
- Sleeping difficulty	0.09	0.05	0–6	0–8
- Nausea	0.28	0.24	0–35	0–40
- Decreased appetite	1.12	0.20	0–14	0–16
- Change in food taste/smell	0.38	0.07	0–4	0–8
Oral health–related quality of life (OHIP)	13.94	0.66	2–38	0–56
- Functional limitation	2.93	0.12	0–8	0–8
- Physical pain	2.70	0.13	0–8	0–8
- Psychological discomfort	3.12	0.18	0–4	0–8
- Physical disability	2.27	0.14	0–4	0–8
- Psychological disability	1.84	0.15	0–8	0–8
- Social disability	1.62	0.15	0–8	0–8
- Handicap	0.40	0.09	0–6	0–8

SCB, self-care behaviors, theoretical scoring range 0–88; *OHIP*, Oral Health Impact Profile, theoretical scoring range 0–56

Table 4 Factors significantly associated with overall oral health–related quality of life and seven aspects of oral health–related quality of life based on multiple regression analysis ($N = 148$)

Domains of resilience	Predictive variable	Adjusted R^2	Beta	F	p	95% CI	
						Lower	Upper
Overall oral health–related QOL (OHIP)	Severity of adverse effects after self-care behaviors	0.335	0.461	25.684	0.001	0.527	0.965
	Feeding tube during treatment (no vs. yes)		0.284		0.001	0.175	0.485
	Body mass index (≥ 25 kg/m^2 vs. < 25 kg/m^2)		− 0.174		0.012	− 0.059	− 0.007
	Constant				0.001	0.840	1.997
Functional limitation (OHIP)	Severity of adverse effects after self-care behaviors	0.216	0.371	14.515	0.001	0.478	1.107
	Feeding tube during treatment (no vs. yes)		0.216		0.004	0.109	0.555
	Body mass index (≥ 25 kg/m^2 vs. < 25 kg/m^2)		− 0.171		0.024	− 0.080	− 0.006
	Constant				0.001	1.257	2.918
Pain (OHIP)	Feeding tube during treatment (no vs. yes)	0.082	0.219	7.604	0.006	0.099	0.591
	Severity of adverse effects after self-care behaviors		0.213		0.008	0.126	0.812
	Constant				0.001	0.931	1.280
Psychological discomfort (OHIP)	Severity of adverse effects after self-care behaviors	0.267	0.332	14.374	0.001	0.486	1.217
	Feeding tube during treatment (no vs. yes)		0.214		0.003	0.135	0.656
	Body mass index (≥ 25 kg/m^2 vs. < 25 kg/m^2)		− 0.256		0.001	− 0.121	− 0.034
	Adjuvant therapy (CT or RT vs. CCRT)		− 0.203		0.005	− 0.710	− 0.126
	Constant				0.001	1.542	3.588
Physical disability (OHIP)	Severity of adverse effects after self-care behaviors	0.161	0.314	15.137	0.001	0.551	1.550
	Feeding tube during treatment (no vs. yes)		0.267		0.001	0.284	1.002
	Constant				0.001	0.978	1.487
Psychological disability (OHIP)	Severity of adverse effects after self-care behaviors	0.293	0.410	16.211	0.001	0.637	1.278
	Adjuvant therapy (CT or RT vs. CCRT)		− 0.225		0.002	− 0.681	− 0.163
	Tumor location (others vs. tongue)		− 0.195		0.006	− 0.569	− 0.097
	Feeding tube during treatment (no vs. yes)		0.169		0.017	0.051	1.518
	Constant				0.001	1.043	1.601
Social disability (OHIP)	Severity of adverse effects after self-care behaviors	0.185	0.386	17.733	0.001	0.429	0.973
	Body mass index (≥ 25 kg/m^2 vs. < 25 kg/m^2)		− 0.156		0.041	− 0.065	− 0.001
	Constant				0.012	0.203	1.639
Handicap (OHIP)	Severity of adverse effects after self-care behaviors	0.113	0.344	19.658	0.001	0.301	0.784
	Constant				0.122	− 0.022	0.180

OHIP, Oral Health Impact Profile

Input independent variable: covariates included cancer stage (early vs. advanced), tumor location (others vs. tongue), adjuvant therapy (CT or RT vs. CCRT), feeding tube during treatment (no vs. yes), body mass index (≥ 25 kg/m^2 vs. < 25 kg/m^2), and severity of adverse effects after self-care behaviors (continuous score, using the sum score of the perceived severity of each adverse effect subscale)

providing psychological support during and after treatment can help patients promote appetite and relieve fatigue.

Patients in the present study reported that certain factors had a high impact on OHRQoL dimensions, especially "psychological discomfort" and "functional limitation." Prior studies of HNC patients who received chemotherapy, RT, or CCRT indicated that the greatest concern was related to function limitations, physical pain, and physical disability [28, 29]. Differences between the results of the present study and prior studies may be due to the inclusion of oral cavity cancer patients in this study. A prior study of oral cancer patients also indicated that depression was highest at 1 month posttreatment and 3 months after discharge [46]. Since the majority of our subjects were male with OSCC, those who had betel nut chewing habits for a long time before diagnosis were more likely to have potential psychological difficulties [47]. A synergistic effect on depression was likely caused by suddenly stopping the substance abuse, having a cancer diagnosed, undergoing adverse effects of treatment, experiencing economic problems, and other factors. During the posttreatment period, providers should be aware that patients experience such changes in psychological status, resulting in ineffective self-care behaviors that may contribute to worsening OHRQoL.

Results of the present study indicated that patients who had more severity of adverse effects after self-care behaviors and who used feeding tubes during treatment were more likely to have worse overall OHRQoL and individual dimensions of OHRQoL. More than four-fifths of our patients were at an advanced stage and received multimodal treatment (such as radical resection combined with reconstruction combined with RT or CCRT), and these patients may experience a greater number of oral symptoms, less appetite, and more physical and psychosocial distress [9, 11]. Accordingly, it is very important for healthcare providers to assess oral function during the removal of a feeding tube to initiate an oral intake period, providing information to assist the caregivers in preparing individual diets for patients, including items such as personal preferences, food texture, nutritional ingredients, and need for accessory appliances (such as blender, food scissors, and soft sauce bottle) in order to stimulate the appetite and enhance physical fitness to cope with adverse effects posttreatment.

No statistically significant associations were found between patients' cancer stage, tumor location, and adjuvant therapy and overall OHRQoL. These results did not support our research assumption [21–24]. Results of the present study showed that when the patients' tumor location was the tongue, they were more likely to have psychological disability, and those who received CCRT had more psychological comfort. These findings may reflect that the tumor location and type of adjuvant therapy did not affect oral health, except in the psychological dimension. According to clinical observation, advanced OSCC patients treated with radical resection combined with reconstruction were admitted into the intensive care unit during the acute postoperative period; this situation may alarm patients, cause a greater physical burden and psychological distress, and result in poor nutritional intake and negative oral health self-care. Our findings suggest that healthcare providers should be aware of patients' mental outlook and provide appropriate care for their needs.

Limitations

This study had several limitations. First, the present study examined OSCC patients in the first three months posttreatment using cross-sectional design, which may limit the interpretation of results. Longitudinal or long-term follow-up studies are needed to identify factors associated with OHRQoL. Second, we examined self-care behaviors associated with adverse effects based on self-reported information, and this lack of objective assessment may limit generalization of the results. Therefore, objective assessment should be used in future studies to more accurately and completely identify self-care behaviors associated with adverse effects. Finally, patients' initial (pre-cancer or pre-treatment) oral function and dental condition variables were not studied here, which may have affected the evaluation of OHRQoL. Further studies are needed to determine the correlation between initial oral function, dental condition, and OHRQoL.

Conclusions

Psychological disability, functional limitation, and physical pain are the strongest factors affecting OHRQoL. OSCC patients who had more severity of adverse effects after self-care behaviors, who used a feeding tubes during treatment, and those with BMI less than 25 were more likely to have worse overall OHRQoL.

Clinical implications

The results of this study provide a reference for clinical assessment of self-care behaviors associated with adverse effects and factors associated with OHRQoL in OSCC patients within the first three months posttreatment. Regarding clinical practical care on the basis of our study results, healthcare providers should identify and assess the mental health status and self-care needs of OSCC patients with advanced-stage cancer and whose tumor location was the tongue, and design individualized psychological supportive care programs to improve the psychological status and self-care skills of these patients in order to manage treatment-related adverse effects.

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Compliance with ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of Wisconsin Health Sciences IRB (Number: 104-8655B) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Ferlay J, Colombet M, Soerjomataram I, Mathers C, Parkin DM, Piñeros M, Znaor A, Bray F (2019) Estimating the global cancer incidence and mortality in 2018: GLOBOCAN sources and methods. Int J Cancer 144:1941–1953
2. Taiwan cancer registry. 2016 annual report. Available from: http://crs.cph.ntu.edu.tw/. Accessed 7 April 2020
3. Lee YA, Li S, Chen Y et al (2019) Tobacco smoking, alcohol drinking, betel quid chewing, and the risk of head and neck cancer

in an East Asian population. Head Neck 41:92–102. https://doi.org/10.1002/hed.25383
4. Lee CY, Lu B, Shieh TY, Chang YY (2016) Patterns of betel quid, cigarette, and alcohol use, and their correlates with betel quid cessation in a male inmate population. Subst Use Misuse 51:471–478
5. National Comprehensive Cancer Network (NCCN) (2020) NCCN guidelines for treatment of cancer by site-head and neck cancers treatment. Available from: https://www.nccn.org/professionals/physician_gls/pdf/head-and-neck.pdf Accessed 7 April 2020
6. Epstein JB, Villines D, Epstein GL, Smutzer G (2020) Oral examination findings, taste and smell testing during and following head and neck cancer therapy. Support Care Cancer 28:4305–4311. https://doi.org/10.1007/s00520-019-05232-y
7. Chang JS, Lo HI, Wong TY, Huang CC, Lee WT, Tsai ST, Chen KC, Yen CJ, Wu YH, Hsueh WT, Yang MW, Wu SY, Chang KY, Chang JY, Ou CY, Wang YH, Weng YL, Yang HC, Wang FT, Lin CL, Huang JS, Hsiao JR (2013) Investigating the association between oral hygiene and head and neck cancer. Oral Oncol 49:1010–1017. https://doi.org/10.1016/j.oraloncology.2013.07.004
8. Gondivkar SM, Gadbail AR, Gondivkar RS, Sarode SC, Sarode GS, Patil S (2018) Impact of oral potentially malignant disorders on quality of life: a systematic review. Future Oncol 14:995–1010. https://doi.org/10.2217/fon-2017-0577
9. Chen SC (2019) Oral dysfunction in patients with head and neck cancer: a systematic review. J Nurs Res 27:e39. https://doi.org/10.1097/jnr.0000000000000363
10. Sonis ST, Elting LS, Keefe D, Peterson DE, Schubert M, Hauer-Jensen M, Bekele BN, Raber-Durlacher J, Donnelly JP, Rubenstein EB, for the Mucositis Study Section of the Multinational Association of Supportive Care in Cancer and the International Society for Oral Oncology (2004) Perspectives on cancer therapy-induced mucosal injury: pathogenesis, measurement, epidemiology, and consequences for patients. Cancer 100:1995–2025. https://doi.org/10.1002/cncr.20162
11. Chen SC, Lai YH, Liao CT, Lin CC, Chang JTC (2010) Changes of symptom and depression in oral cavity cancer patients receiving radiation therapy. Oral Oncol 46:509–513. https://doi.org/10.1016/j.oraloncology.2010.02.024
12. Tan T, Lim WT, Fong KW, Cheah SL, Soong YL, Ang MK, Ng QS, Tan D, Ong WS, Tan SH, Yip C, Quah D, Soo KC, Wee J (2015) Concurrent chemo-radiation with or without induction gemcitabine, carboplatin, and paclitaxel: a randomized, phase 2/3 trial in locally advanced nasopharyngeal carcinoma. Int J Radiat Oncol Biol Phys 91:952–960
13. Wu F, Wang R, Lu H, Wei B, Feng G, Li G, Liu M, Yan H, Zhu J, Zhang Y, Hu K (2014) Concurrent chemoradiotherapy in locoregionally advanced nasopharyngeal carcinoma: treatment outcomes of a prospective, multicentric clinical study. Radiother Oncol 112:106–111
14. Kim SH, Oh SA, Yea JW, Park JW (2019) Prospective assessment of inter- or intra-fractional variation according to body weight or volume change in patients with head and neck cancer undergoing radiotherapy. PLoS One 14:e0216655. https://doi.org/10.1371/journal.pone.0216655 eCollection 2019
15. Findlay M, Rankin NM, Bauer J, Collett G, Shaw T, White K (2020) Completely and utterly flummoxed and out of my depth: patient and caregiver experiences during and after treatment for head and neck cancer-a qualitative evaluation of barriers and facilitators to best-practice nutrition care. Support Care Cancer. https://doi.org/10.1007/s00520-020-05386-0
16. Karimi AM, Gairola M, Ahlawat P, Tandon S, Pal M, Sachdeva N, Sharief MI, Dobriyal K (2019) Health-related quality of life assessment for head-and-neck cancer patients during and at 3 months after radiotherapy - a prospective, analytical questionnaire-based study. Natl J Maxillofac Surg 10:134–140. https://doi.org/10.4103/njms.NJMS_92_18
17. Meier JK, Schuderer JG, Zeman F et al (2019) Health-related quality of life: a retrospective study on local vs. microvascular reconstruction in patients with oral cancer. BMC Oral Health 19:62. https://doi.org/10.1186/s12903-019-0760-2
18. Jin S, Lu Q, Jin S, Zhang L, Cui H, Li H (2018) Relationship between subjective taste alteration and weight loss in head and neck cancer patients treated with radiotherapy: a longitudinal study. Eur J Oncol Nurs 37:43–50. https://doi.org/10.1016/j.ejon.2018.10.003
19. Lønbro S, Petersen GB, Andersen JR, Johansen J (2016) Prediction of critical weight loss during radiation treatment in head and neck cancer patients is dependent on BMI. Support Care Cancer 24:2101–2109. https://doi.org/10.1007/s00520-015-2999-8
20. World Health Organization, Regional Office for South-East Asia (2014) Self care for health. WHO Regional Office for South-East Asia. Available from: https://apps.who.int/iris/handle/10665/205887 Accessed 7 Aug 2020
21. Hong CHL, Gueiros LA, Fulton JS et al (2019) Systematic review of basic oral care for the management of oral mucositis in cancer patients and clinical practice guidelines. Support Care Cancer 27:3949–3967. https://doi.org/10.1007/s00520-019-04848-4
22. Kawashita Y, Soutome S, Umeda M, Saito T (2020) Oral management strategies for radiotherapy of head and neck cancer. Jpn Dent Sci Rev 56:62–67. https://doi.org/10.1016/j.jdsr.2020.02.001
23. Morais MO, Martins AFL, de Jesus APG, de Sousa Neto SS, da Costa AWF, Pereira CH, Oton-Leite AF, de Freitas NMA, Leles CR, Mendonça EF (2020) A prospective study on oral adverse effects in head and neck cancer patients submitted to a preventive oral care protocol [published online ahead of print, 2020 Jan 3]. Support Care Cancer 28:4263–4273. https://doi.org/10.1007/s00520-019-05283-1
24. Oku S, Iyota K, Mizutani S, Otsuki S, Kubo K, Yamada S, Kobayashi Y, Kashiwazaki H (2020) The association of oral function with oral health-related quality of life in university students: a cross-sectional pilot study. Int J Environ Res Public Health 17:E4863. https://doi.org/10.3390/ijerph17134863
25. Bennadi D, Reddy CV (2013) Oral health related quality of life. J Int Soc Prev Community Dent 3:1–6. https://doi.org/10.4103/2231-0762.115700
26. Tashimo Y, Ihara Y, Yuasa K et al (2019) Acute stage longitudinal change of quality of life from pre- to 3 months after surgical treatment in head and neck cancer patients. Asian Pac J Cancer Prev 20:3129–3136. https://doi.org/10.31557/APJCP.2019.20.10.3129
27. Bonzanini LIL, Soldera EB, Ortigara GB, Schulz RE, Antoniazzi RP, Ardenghi TM, Ferrazzo KL (2020) Clinical and sociodemographic factors that affect the quality of life of survivors of head and neck cancer. Support Care Cancer 28:1941–1950. https://doi.org/10.1007/s00520-019-05008-4
28. de Melo NB, de Sousa VM, Bernardino ÍM, de Melo DP, Gomes DQC, Bento PM (2019) Oral health related quality of life and determinant factors in patients with head and neck cancer. Med Oral Patol Oral Cir Bucal 24:e281–e289. https://doi.org/10.4317/medoral.22670
29. Soldera EB, Ortigara GB, Bonzanini LIL, Schulz RE, Danesi CC, Antoniazzi RP, Linhares Ferrazzo K (2020) Clinical and sociodemographic factors associated with oral health-related quality of life in survivors of head and neck cancer. Head Neck 42:886–897. https://doi.org/10.1002/hed.26063
30. Buurman DJM, Speksnijder CM, de Groot RJ et al (2020) Mastication in maxillectomy patients: a comparison between reconstructed maxillae and implant supported obturators: a cross-sectional study [published online ahead of print, 2020 Jul 2]. J Oral Rehabil 47:1171–1177. https://doi.org/10.1111/joor.13043
31. Chen SC, Lai YH, Huang BS, Lin CY, Fan KH, Chang JTC (2015) Changes and predictors of radiation-induced oral mucositis in patients with oral cavity cancer during active treatment. Eur J Oncol Nurs 19:214–219. https://doi.org/10.1016/j.ejon.2014.12.001

32. Chen SC, Lai YH, Liao CT, Chang JTC, Lin CY, Fan KH, Huang BS (2013) Supportive care needs in newly diagnosed oral cavity cancer patients receiving radiation therapy. Psychooncology 22: 1220–1228. https://doi.org/10.1002/pon.3126
33. Karnofsky DA, Abelmann WH, Craver LF, Burchenal JH (1948) The use of the nitrogen mustards in the palliative treatment of carcinoma with particular reference to bronchogenic. Cancer 1:634–656
34. Nail LM, Jones LS, Greene D et al (1911) Oncol Nurs Forum 18: 883–887
35. Wong PC, Dodd MJ, Miaskowski C et al (2006) Mucositis pain induced by radiation therapy: prevalence, severity, and use of self-care behaviors. J Pain Symptom Manag 32:23–37
36. Slade GD (1997) Derivation and validation of a short-form oral health impact profile. Community Dent Oral Epidemiol 25:284–290
37. Wong M, Lo E, McMillan AS (2002) Validation of a Chinese version of the oral health impact profile (OHIP). Community Dent Oral Epidemiol 30:423–430
38. Sun L, Wong HM, McGrath CPJ (2020) A cohort study of factors that influence oral health-related quality of life from age 12 to 18 in Hong Kong. Health Qual Life Outcomes 18:65. https://doi.org/10.1186/s12955-020-01317-z
39. National Cancer Institute. Common Toxicity Criteria. Version 2.0. (1999). Available from: https://ctep.cancer.gov/protocoldevelopment/electronic_applications/docs/ctcv20_4-30-992.pdf
40. Köstler WJ, Hejna M, Wenzel C, Zielinski CC (2001) Oral mucositis complicating chemotherapy and/or radiotherapy: options for prevention and treatment. CA Cancer J Clin 51:290–315. https://doi.org/10.3322/canjclin.51.5.290
41. World Health Organization. Body mass index – BMI. Available from: http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi Accessed 7 April 2020
42. Lee SC, Wang TJ, Chu PY (2019) Predictors of weight loss during and after radiotherapy in patients with head and neck cancer: a longitudinal study. Eur J Oncol Nurs 39:98–104. https://doi.org/10.1016/j.ejon.2019.02.004
43. Pai PC, Chuang CC, Tseng CK, Tsang NM, Chang KP, Yen TC, Liao CT, Hong JH, Chang JTC (2012) Impact of pretreatment body mass index on patients with head-and-neck cancer treated with radiation. Int J Radiat Oncol Biol Phys 83:e93–e100. https://doi.org/10.1016/j.ijrobp.2011.11.071
44. Gunn GB, Mendoza TR, Fuller CD, Gning I, Frank SJ, Beadle BM, Hanna EY, Lu C, Cleeland CS, Rosenthal DI (2013) High symptom burden prior to radiation therapy for head and neck cancer: a patient-reported outcomes study. Head Neck 35:1490–1498. https://doi.org/10.1002/hed.23181
45. Wulff-Burchfield E, Dietrich MS, Ridner S, Murphy BA (2019) Late systemic symptoms in head and neck cancer survivors. Support Care Cancer 27:2893–2902. https://doi.org/10.1007/s00520-018-4577-3
46. Kumar K, Kumar S, Mehrotra D, Tiwari SC, Kumar V, Khandpur S, Dwivedi RC (2018) Prospective evaluation of psychological burden in patients with oral cancer. Br J Oral Maxillofac Surg 56: 918–924. https://doi.org/10.1016/j.bjoms.2018.09.004
47. Yen HY, Chen PH, Ko YC, Chiang SK, Chang YYC, Shiah YJ (2018) Betel quid chewing, personality and mood: Betel quid chewing associated with low extraversion and negative mood. Subst Use Misuse 53:1782–1787. https://doi.org/10.1080/10826084.2018.1432652

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