A Meta-Analysis of the Relationship Among Impaired Taste and Treatment, Treatment Type, and Tumor Site in Head and Neck Cancer Treatment Survivors

Laura McLaughlin, RN, PhD, OCN®, and Suzanne Mahon, RN, DNSc, AOCN®, APNG

Problem Identification: To understand how taste impairment caused by head and neck cancer treatment changes over time or varies with treatment site or type.

Literature Search: Ovid MEDLINE® database was searched for reports of health-related quality of life (HRQOL) in head and neck cancer treatment survivors (HNCTS), which included taste function in a HRQOL instrument from 1946–2013. Eligible studies compared taste scores from baseline to post-treatment, using two treatment types or two cancer sites.

Data Evaluation: 247 reports were identified; 19 were suitable for meta-analysis.

Data Analysis: A series of dichotomous meta-analyses were conducted using comprehensive meta-analysis software.

Presentation of Findings: Taste scores were statistically significantly worse after treatment; the summary effect for the standard measure difference between pretreatment and post-treatment taste scores was 0.353 ($p < 0.001$). Patients treated with radiation therapy (RT) reported statistically significant worse taste function post-treatment than those who received no RT; the summary effect for the standard mean differences in taste scores was 0.77 ($p = 0.001$). Differences in tumor site were not significant.

Implications for Nursing: Taste dysfunction is a long-term complication for HNCTS, and nurses should screen survivors for this sensory dysfunction.

Key Words: head/neck malignancies; quality of life; radiation therapy; biostatistics; late effects of cancer treatment

ONF, 41(3), E194–E202. doi:10.1188/14.ONF.E194-E202

Since the 1980s, the incidence of base of tongue and tonsil cancers has steadily increased in the United States (Marur, D'Souza, Westra, & Forastiere, 2010; Sturgis & Cinciripini, 2007). As many as 60% of these oropharyngeal tumors are human papilloma virus (HPV)-related head and neck cancers, which tend to be diagnosed at younger ages (often before age 45) and respond better to treatment (Marur et al., 2010; Sturgis & Cinciripini, 2007). Because of this, the pool of head and neck cancer survivors will continue to grow in the foreseeable future (Siegel & Jemal, 2013). About 185,000 head and neck cancer treatment survivors (HNCTS) exist, and that number is projected to rise to more than 232,000 by 2022 (Siegel et al., 2012). In addition, advancements in treatment technique such as intensity-modulated radiation therapy (IMRT) have improved long-term survival as well as functional outcome in HNCTS. The major consequences of head and neck cancer treatment previously were impaired swallowing, impaired speech, dry mouth, dysgeusia, and taste dysfunction (Baharvand, ShoalehSaadi, Barakian, & Moghaddam, 2013; Bornbaum et al., 2012). As nerve-sparing surgery and parotid-sparing radiation techniques improve functional outcomes for many patients (Chen et al., 2013; Loewen, Boliek, Harris, Seikaly, & Rieger, 2010), taste impairment may become a more recognized problem for long-term survivors.

Background

Head and neck cancer affects the anatomic structures from the mid-face to the neck. The organs of the head and neck work in harmony to accomplish the complex tasks involved in chewing, swallowing, breathing, and speaking. Air passes through the upper alimentary canal facilitating gas exchange with the respiratory track and allowing speech. Food in the form of liquid or solid begins the digestive process inside the mouth. The palatability and nutritional quality of food is biologically determined by sensory data that includes taste (Breslin & Spector, 2008; Coldwell et al., 2013). Because of the anatomic and physiologic characteristics of the head and neck organs, treatment for malignancy often results in the impairment of multiple actions that are vital to activities of everyday life and adequate nutrition.

Treatment for head and neck cancer may also result in a variety of long-term consequences that impair health-related quality of life (HRQOL) (Alicikus et al., 2009; Epstein & Murphy, 2010). These consequences include chronic neck and shoulder pain, mouth pain, dry mouth, impaired speech, difficulty with chewing and swallowing, and impairment of olfactory and taste sensations. Eating is imperative to survival, so healthcare practitioners need to focus their efforts on ensuring that patients are ingesting adequate calories to meet their metabolic demands. Those with swallowing impairments are at risk for life-threatening aspiration pneumonia, so tube feeding is not uncommon for patients with head and neck cancer with extensive disease to the throat (Airoldi et al., 2011; Gillespie, Brodsky, Day, Lee, & Martin-Harris, 2004). However, the return to oral feeding may be delayed by taste dysfunction–related appetite suppression. When taste is impaired, eating is not as enjoyable and appetite is diminished and so the occupation of eating is altered (McQuestion, Fitch, & Howell, 2011; Meyers & Ott, 2008). Sensory impairment of taste is negatively associated with overall HRQOL and head and neck cancer treatment results in taste dysfunction (Baharvand et al., 2013; Chasen & Bhargava, 2009). However, the extent to which taste impairment changes over time, or varies with treatment site or type, is not well understood.

One approach to addressing such knowledge gaps is meta-analysis. Meta-analysis is a systematic and replicable scientific process for evaluating the outcomes of published study reports. It allows the pooling of data from multiple, small, and often underpowered studies to increase the power and precision of the results. The data from multiple instruments may be compared in the same analysis as long as the instruments are all measuring attributes of the same outcome variable (Cooper, Hedges, & Valentine, 2009).

Table 1. Studies Identified for Meta-Analysis

Study	Time Post-Treatment	Years of Treatment	Sample
EORTC QLQ-H&N35			
Alicikus et al., 2009	Greater than 2 years	1991–2004	110 Turks; various sites and treatments
Birkhaug et al., 2002	Greater than 2 years	1992–1997	136 Norwegians; larynx cancer treated with surgery
Borggreven et al., 2007	6 months	1998–2001	80 Dutch; oral and oropharynx cancers
Bower et al., 2009	Greater than 2 years	Not reported	89 Chinese; various sites and treatments
Broglie et al., 2012	Greater than 2 years	2002–2007	98 Swiss; oropharynx cancer
Chen et al., 2013	Greater than 2 years	2007–2008	31 Chinese; various sites all treated with IMRT
Chung et al., 2010	Greater than 2 years	1996–2006	42 Koreans; early-stage tonsil cancer
Fang et al., 2010	Greater than 2 years	1995–2005	356 Taiwanese; nasopharynx cancer treated with RT
Hammerlid et al., 2001	Greater than 2 years	1993–1994	232 Swedes; various sites and treatments
Hanna et al., 2004	Greater than 2 years	Not reported	42 Americans; late-stage laryngeal cancer
Johansson et al., 2008	6 months	1998–2005	100 Swedes; laryngeal cancer
McMillan et al., 2006	12 months	2000–2003	32 Chinese; early-stage nasopharynx cancer
Pow et al., 2006	12 months	2000–2004	45 Chinese; nasopharynx cancer treated with RT
Singer et al., 2009	Greater than 2 years	Not reported	323 German; larynx cancer treated with surgery
Wan Leung et al., 2011	Greater than 2 years	Not reported	640 Taiwanese; various sites and treatments
UW-QOL			
Bekiroglu, 2011	Greater than 2 years	1995–2007	129 British; oral cavity cancer treated with RT
Biazevic et al., 2010	12 months	2006–2007	47 Brazilian; oral and oropharynx cancers treated with surgery
Lin et al., 2012	12 months	2008–2011	46 Americans; various sites and treatments
Mowry et al., 2006	6 months	Not reported	31 Americans; larynx and oropharynx cancers treated with chemoradiation

EORTC QLQ-H&N35—European Organisation for Research and Treatment of Cancer Head and Neck Cancer Module; IMRT—intensity-modulated radiation therapy; RT—radiation therapy; UW-QOL—University of Washington Quality of Life Questionnaire

Table 2. Meta-Analysis Procedures

Study	Pre- or Post-Treatment	Tumor Site	Treatment
EORTC QLQ-H&N35			
Alicikus et al., 2009		X	X
Birkhaug et al., 2002		X	
Borggreven et al., 2007	X		
Bower et al., 2009		X	
Broglie et al., 2012			X
Chen et al., 2013	X		
Chung et al., 2010			X
Fang et al., 2010			X
Hammerlid et al., 2001	X		
Hanna et al., 2004			X
Johansson et al., 2008	X		
McMillan et al., 2006	X		
Pow et al., 2006	X		X
Singer et al., 2009			X
Wan Leung et al., 2011		X	X
UW-QOL			
Bekiroglu, 2011			X
Biazevic et al., 2010	X		
Lin et al., 2012			X
Mowry et al., 2006		X	

EORTC QLQ-H&N35—European Organisation for Research and Treatment of Cancer Head and Neck Cancer Module; UW-QOL—University of Washington Quality of Life Questionnaire

Note. Marked columns determine what information was extracted from that study for the meta-analysis.

Instruments

To effectively and efficiently search the literature on taste dysfunction in HNCTS, a search for instruments that measure taste was conducted. The Health and Psychosocial Instruments (HAPI) database was searched and four instruments that measure taste in patients with head and neck cancer were identified. These instruments included The European Organisation for Research and Treatment of Cancer (EORTC) **Head and Neck Cancer Module (QLQ-H&N35)**, **University of Washington Quality of Life Questionnaire (UW-QOL)**, **MD Anderson Symptom Inventory Index-Head and Neck (MDASI-HN)**, and the **Radiation Therapy Oncology Group Common Terminology Criteria for Adverse Events (CTCAE)**.

A commonly used HRQOL instrument used for HNCTS, including items on sensory function (i.e., taste and smell), is the QLQ-H&N35. This instrument was developed by the EORTC and was designed to capture the HRQOL aspects specific to HNCTS. The QLQ-H&N35 is composed of seven scales (i.e., pain, swallowing, sense, speech, social eating, social contact, and sexuality) specifically designed to assess symptoms and complications commonly seen in HNCTS. The QLQ-H&N35 has been translated into 49 languages and is used as a standard instrument in measuring quality of life in HNCTS and takes about seven minutes to complete (Chaukar et al., 2005). This instrument is a symptom scale and a high score indicates a higher symptom burden. Reliability was assessed by use of Cronbach coefficient. The Cronbach coefficient for the senses subscale is reported to be 0.7 (Bjordal et al., 1999). The Pearson's correlation was greater than 0.41 for each subscale that supports item-convergent validity; none of the items correlated with other scales more than their own scales, which supports discriminant validity (Bjordal et al., 1999).

The UW-QOL questionnaire consists of 12 single questions, each having between three and six response options that are scaled from 0 (worst) to 100 (best) (Ghazali, Lowe, & Rogers, 2012). The questions address pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder movement, taste, saliva, mood, and anxiety. Another question asks patients to choose up to three of these domains that were most important to them in the previous week. Patients also were asked to state whether things had gotten worse, stayed the same, or improved over the last month for each UW-QOL domain. The UW-QOL has an overall internal consistency with a Cronbach alpha of 0.85. The test-retest reliability coefficient was 0.95 (Silveira et al., 2010; Weymuller, Alsarraf, Yueh, Deleyiannis, & Coltrera, 2001).

The MDASI-HN was designed to measure the burden of head and neck cancer treatment symptoms and the impact of those symptoms on daily life (Rosenthal et al., 2007). This instrument is composed of 13 general cancer symptom burden questions and nine items specific to head and neck cancer. The questionnaire can be completed in about seven minutes. The reliability coefficient for the head and neck–specific items was 0.83, and tasting food was among the most prevalent severe symptoms in the initial psychometric testing of the instrument (Rosenthal et al., 2007).

The CTCAE is a grading system for measuring treatment-related toxicities specific to radiation therapy in 28 different anatomical or physiological categories including

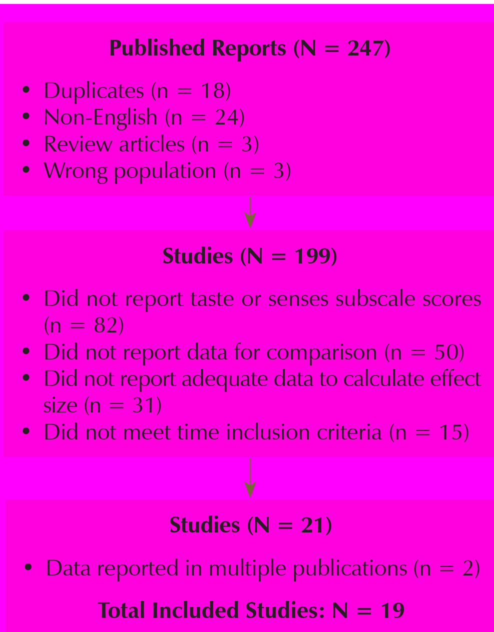

Figure 1. Study Inclusion Flowchart

taste (Palazzi et al., 2008). The grading system has been used to measure acute and long-term taste function (Büntzel et al., 2010). Events are graded on a scale from 0 (no adverse activity) to 5 (death related to the event). These criteria have been in use since 1998 (Palazzi et al., 2008).

Methods

Ovid MEDLINE® was searched for articles from 1946 to 2013 to identify potential studies that included reports of taste function scores in HNCTS suitable for meta-analysis. A search of the term QLQ-H&N35.mp yielded 131 items. The term UW-QOL.mp yielded 95 studies. Searching CTCAE.mp and MDASI-HN.mp produced 16 and 5 items, respectively.

Study Selection

Published research reports of studies conducted in HNCTS measuring HRQOL using all four instruments were reviewed. Studies were included if a taste score or subscale score was reported, participants included patients with head and neck cancer, and taste was assessed at least six months after the completion of all treatment. Eligible studies compared taste scores in the following ways: baseline compared to post-treatment, two treatment types, or two cancer sites. Cross-sectional studies of post-treatment taste function would have been included if a healthy control group was included for comparison with the HNCTS, but no such studies were identified in the search.

The stated purpose of all of the identified studies was to report overall HRQOL, not the taste or senses subscale, so no study reported information on taste in the manuscript abstract. Therefore, it was necessary to review each study report to determine its eligibility for inclusion in the meta-analysis. The database searches were downloaded into a Microsoft Word® file and printed out. Detailed field notes on study eligibility were recorded on this document. This preliminary process was conducted by the principal investigator alone and each document was evaluated twice to ensure that all eligible studies were included. To ensure accuracy, the co-author independently reviewed every 10th report in the sampling frame and no discrepancies were found (see Table 1).

Data Coding and Extraction

Prior to data extraction, a coding book was developed to capture the outcome of interest and to identify the potential comparison groups. Accurate and adequate description of the meta-analysis sample also is dependent on careful coding of individual study population characteristics. Data were extracted from the identified studies and recorded on data collection sheets based on a code book developed prior to data extraction, but was refined during this highly iterative process.

Table 3. Sample Characteristics (N = 2,651)

Characteristic	$\bar{X}$	
Age (years)	57.5	
Characteristic	**n**	**%**
Gender		
Male	2,068	78
Female	540	20
Not reported	43	2
Tumor site		
Pharynx	1,152	43
Larynx	762	29
Oral cavity	451	17
Paranasal	11	< 1
Other	269	10
Not reported	6	< 1
Stage		
I–II	908	34
III–IV	1,088	41
Not reported	655	25
Treatment		
Radiation	350	13
Surgery	100	4
Chemotherapy	9	< 1
Surgery and radiation	437	16
Surgery, radiation, and chemotherapy	22	1
Chemotherapy and radiation	158	6
Radiation with or without something else	1,319	50
Radiation with something else	91	3
Surgery with something else	6	< 1
Not reported	159	7

Note. Because of rounding, not all percentages total 100.

The two authors independently extracted data on study characteristics and estimates of effect size from each of the 19 identified studies. The initial coding process was conducted independently by each author. The authors then met to compare results and resolve disagreements. Differences were resolved by discussion among the authors until 100% agreement was achieved (Cooper et al., 2009).

The studies were described in terms of the county of origin, year of report, years of subject treatment, and research design. Subject description included demographic characteristics on age and gender, treatment type, tumor site, stage, and histology. Only one study was a randomized, controlled trial, and the rest were descriptive observational studies. Treatment modalities included conventional two-dimensional radiation therapy (2DRT), three-dimensional conformal therapy (3DRT), and IMRT.

Estimates of effect size of head and neck cancer therapy on taste dysfunction were extracted from each study. No estimates of incidence rates ratios from a normal comparison group were identified in any of the 19 research study reports. QLQ-H&N35 senses scores or UW-QOL taste scores comparing data on pre- and post-treatment, different treatment types, or different tumor sites were used to calculate effect size (see Table 2). About half of the studies reported sample size, mean taste scores, and standard deviations, which were used to calculate effect size (Alicikus et al., 2009; Biazevic et al., 2010; Bower et al., 2009; Chung et al., 2010; Fang et al., 2010; Hammerlid, Silander, Hornestam, & Sullivan, 2001; Johansson, Ryden, & Finizia, 2008; McMillan et al., 2006; Pow et al., 2006; Wan Leung et al., 2011). The others reported sample size, mean taste scores, and a p value for a t test (Bekiroglu et al., 2011; Birkhaug, Aarstad, Aarstad, & Olofsson, 2002; Borggreven et al., 2007; Broglie et al., 2013; Chen et al., 2013; Hanna et al., 2004; Lin, Starmer, & Gourin, 2012; Mowry, LoTempio, Sadeghi, Wang, & Wang, 2006; Singer et al., 2009).

Data Synthesis and Analysis

A descriptive meta-analysis was conducted using commercial software to calculate pooled effect sizes from multiple research studies. Comprehensive meta-analysis (CMA) software, version 2, was used to calculate a pooled incidence rates ratio for each of the eight meta-analyses. This software is ideally suited for meta-analysis because it accounts for different directions of data. For example, when using the QLQ-H&N35, a higher score indicates worse taste function and, in the UWQOL, a higher score indicates better taste function. CMA takes the data direction into account when calculating the effect size.

Statistical heterogeneity was qualified with the I and Q statistics. Cochran's Q is the usual statistic for testing the null hypothesis that all studies in a meta-analysis are homogeneous. However, a non-statistically significant Q value does not provide sufficient evidence for homogeneity, so I^2 may be examined to determine how much variation throughout studies is from heterogeneity (Higgins, Thompson, Deeks, & Altman, 2003). Publication bias was not assessed because all reports presented in this meta-analysis were published reports of research studies. No unpublished data, dissertation research, or conference presentation abstracts were identified in the literature search.

Results

Two hundred forty-seven reports were identified. Three reports were review articles and 18 appeared more than once in the search output. Twenty-four non-English reports were identified, but none were eligible for inclusion because the English-language abstracts did not report the required information. Three studies included patients without cancer. This left 199 reports potentially eligible for coding. Eighty-two studies did not report the taste or senses subscale score and were eliminated. The minimum required data for calculating an effect size is a sample size with mean and standard deviation, or a sample size, mean, and p value. Thirty-one studies did not report adequate information for the calculation of an effect size. An additional 50 reports were excluded because they did not include a comparison group. Fifteen studies did not meet the minimum time post-treatment required for inclusion. Twenty-one studies were available for coding, but two studies were excluded because the participants were represented in

Table 4. Pre- and Post-Treatment Type Statistics

			Standard Difference				
Group	Studies (N)	Participants (N)	$\bar{X}$	p	Q	p	I^2
Pre- versus post-treatment	6	545	0.35	< 0.001	10.6	0.1	43
RT versus no RT	3	197	0.77	0.001	8.09	0.02	75.3
2DRT versus IMRT	3	1,041	0.336	0.01	4.11	0.13	51.3

2DRT—two-dimensional radiation therapy; IMRT—intensity-modulated radiation therapy; RT—radiation therapy

Table 5. Treatment Site Statistics

Group	Studies (N)	Participants (N)	Standard Difference		Q	p	I^2
			$\bar{X}$	p			
Larynx versus all others	4	1,033	0.47	0.09	33.76	< 0.001	99.1
Larynx versus pharynx	4	661	0.13	0.5	6.92	0.08	56.6
Oral cavity versus all others	2	728	0.012	0.96	4.01	< 0.05	75.1
Oral cavity versus pharynx	2	580	0.18	0.06	0.42	0.52	–

multiple publications. In these cases, the most recent report was retained for meta-analysis (see Figure 1).

Effects of Treatment on Senses

The meta-analysis included data on 2,651 participants (see Table 3). As expected, the sample was predominantly young in age ($\bar{X}$ = 57.5 years, SD = 6.8) and 78% male, keeping with known demographic data regarding patients with head and neck cancer (Siegel & Jemal, 2013). The sample was highly heterogeneous in terms of country, tumor site, and therapy. Half of the studies did not report tumor stage. Because the studies were conducted in a variety of settings and timeframes, and participants varied widely in disease and treatments types, the random effects model was chosen for data analysis. Heterogeneity testing, as described in this article, was used to support this investigator-driven decision (Higgins et al., 2003).

Taste Change After Treatment

Taste scores for studies that reported both pretreatment and post-treatment scores were included in this meta-analysis. Although the Q value was non-significant (Q = 10.6, df = 6, p = 0.1), I^2 indicated that 43% of the variation across studies was because of heterogeneity. In the six studies with 545 participants, the summary effect for the standard measure difference between pretreatment and post-treatment taste scores was 0.353 (p < 0.001). This finding represents a statistically significant difference in the effect of head and neck cancer treatment on taste function among participants at least six months post-therapy (see Table 4).

Taste and Treatment Type

The random effects model was used to analyze the standard differences in mean taste scores based on treatment type. Three studies comparing groups of HNC treatment survivors treated with radiation compared with those who received no radiation therapy were evaluable for meta-analysis. Heterogeneity testing supported the decision to use the random effects model to analyze post-treatment mean taste scores among the 550 HNCTS (Q = 8.1, df = 2, p = 0.02). A large treatment effect was observed. The standardized mean difference between those treated with radiation compared to those without was 0.77 (p = 0.001). Patients treated with radiation reported statistically significant worse taste function post treatment than those who did not receive radiation therapy.

To further illustrate the relationship between radiation therapy and taste dysfunction, a meta-analysis of post-treatment taste scores was conducted on data from studies that reported post-treatment taste scores comparing those treated with conventional 2DRT with those treated with IMRT. Although Q was not significant (p = 0.13), I^2 indicated that 51% of the variation in taste scores was because of heterogeneity, so the random effect model was used to calculate the pooled treatment effect from the 498 participants. A moderate and statistically significant treatment effect was observed. The standardized difference in mean taste scores for those treated with 2DRT compared to those treated with IMRT was 0.336 (p < 0.05).

Taste and Treatment Site

A total of six published reports provided data on taste score comparisons based on treatment. Four different dichotomous meta-analyses were conducted and none demonstrated statistically significant standardized differences in mean taste scores based on treatment site. The results are presented in Table 5. Four studies that compared taste scores among those treated for laryngeal cancer to other types of cancer were available for meta-analysis. Of the 1,033 HNCTS, 305 had been treated for laryngeal cancer and 728 for other cancers of the head and neck. The standardized difference in mean taste scores was 0.472, but this difference was not statically significant (p = 0.09). Testing revealed a highly heterogeneous sample (Q = 33.8, df = 3, p < 0.001), and I^2 showed that 91% of the variation across studies was because of sample heterogeneity.

Discussion

The statistically significant treatment effect observed for the comparisons between pre- and post-treatment taste scores and radiation therapy versus no radiation therapy were expected findings. In addition, the

Knowledge Translation

Assessment of health-related quality of life should include questions on taste function in head and neck cancer treatment survivors.

The relationship between radiation therapy and taste may be influenced by older treatment techniques.

Tumor site is a poor predictor of taste function problems.

moderate, but statistically significant, treatment effect observed between those treated with conventional radiation therapy and IMRT was also expected. This finding was expected because modern radiation therapy techniques are more precise in their ability to target tumor and spare normal tissue (Chen et al., 2013; Gupta et al., 2012; Pow et al., 2006).

The lack of significant relationship between taste dysfunction and tumor site illustrates the pervasive nature of taste dysfunction in HNCTS. No statistically significant differences were observed for any of the four dichotomous comparisons. Multiple nerves transmit taste sensation data, and so treatment to any region of the mid-face to the base of the chest may result in impaired taste sensory function (McLaughlin, 2013; McLaughlin & Mahon, 2012; Nguyen, Reyland, & Barlow, 2012). Nurses must consider all patients with head and neck cancer at risk for taste dysfunction and expect severe dysfunction among long-term survivors who were treated with less precise techniques, including conventional 2DRT (Broglie et al., 2013; Wan Leung et al., 2011).

The findings of this study are limited by a number of factors. This was an exploratory meta-analysis and was conducted within a limited time period, so the database search terms were intentionally limited. A more exhaustive search using broader terms and multiple databases may yield different results. In addition, the sample of usable studies was small, so post-hoc moderator analysis was not possible. Advanced tumor stage and multi-modality treatment may be predictors of more severe taste dysfunction, but these comparisons were not possible given the available data.

Implications for Future Research

The process of coding for meta-analysis is iterative and this project produced a good working code book and data collection sheet, which may be used in future expanded meta-analysis projects. Both the QLQ-H&N35 and the UWQOL include items on pain and dry mouth, so future meta-analysis on oral sensory complaints would be helpful. In addition, meta-analysis on the small and inconsistent body of literature on dysgeusia, a persistent bitter or metallic taste, would help illuminate trends in this phenomena.

This study illustrates the problem of underreporting of statistical data in research reports. Thirty-one studies were excluded from this meta-analysis because the authors did not report the minimum information necessary to calculate an effect size. When preparing scientific manuscripts, investigators should report sample sizes and standard deviations along with means and should report the statistic along with a p value. This minimal standard of reporting statistical results in scientific publications is necessary for critical appraisal of study findings before implementing research-based recommendations into practice.

Implications for Nursing

The current study illustrates that taste dysfunction is an underappreciated late effect of head and neck cancer therapy. Of the 199 published reports of studies that measured taste, only 117 reported any data on the taste or senses subscale. Taste is one of five primary senses that humans use to interpret the physical world. When taste is impaired, appetite is diminished. Humans eat to satisfy food cravings driven by pleasure derived from taste sensations. The loss of taste function is distressing for HNTCS and is associated with decreased HRQOL because food also has emotional and cultural significance. When taste is altered by head and neck cancer treatment, HRQOL is compromised because both nutrition and emotional well-being are affected.

This meta-analysis identified many studies that consistently used standardized measures to evaluate HRQOL in head and neck cancer treatment survivors. These tools are readily available for both research and clinical practice. Nurses who care for patients with head and neck cancer need to take direct steps to systematically evaluate late treatment effects including taste dysfunction using these symptoms and function measurement tools.

Conclusion

Meta-analysis was an effective way to systematically review the literature on HRQOL instruments, which measure taste dysfunction in HNCTS. The process also afforded the opportunity to become familiar with the various HRQOL instruments that have been developed to evaluate the long-term health outcomes of people living with head and neck cancer. With shrinking research budgets, nurses can use meta-analysis as one approach to address clinical questions and identify areas that truly warrant additional clinical research with human participants.

Laura McLaughlin, RN, PhD, OCN®, is an assistant professor, and Suzanne Mahon, RN, DNSc, AOCN®, APNG, is an adjunct professor, both in the School of Nursing at Saint Louis University in Missouri. This project was conducted in partial fulfillment of a Career Development Award from ONS Foundation awarded to McLaughlin. McLaughlin can be reached at lashmann@slu.edu, with copy to editor at ONFEditor@ons.org. (Submitted September 2013. Accepted for publication November 25, 2013.)

References

Airoldi, M., Garzaro, M., Raimondo, L., Pecorari, G., Giordano, C., Varetto, A., . . . Torta, R. (2011). Functional and psychological evaluation after flap reconstruction plus radiotherapy in oral cancer. *Head and Neck, 33,* 458–468. doi:10.1002/hed.21471

Alicikus, Z.A., Akman, F., Ataman, O.U., Dag, N., Orcin, E., Bakis, B., & Kinay, M. (2009). Importance of patient, tumour and treatment related factors on quality of life in head and neck cancer patients after definitive treatment. *European Archives of Oto-Rhino-Laryngology, 266,* 1461–1468. doi:10.1007/s00405-008-0889-0

Baharvand, M., ShoalehSaadi, N., Barakian, R., & Moghaddam, E.J. (2013). Taste alteration and impact on quality of life after head and neck radiotherapy. *Journal of Oral Pathology and Medicine, 42,* 106–112. doi:10.1111/j.1600-0714.2012.01200.x

Bekiroglu, F., Ghazali, N., Laycock, R., Katre, C., Lowe, D., & Rogers, S.N. (2011). Adjuvant radiotherapy and health-related quality of life of patients at intermediate risk of recurrence following primary surgery for oral squamous cell carcinoma. *Oral Oncology, 47,* 967–973. doi:10.1016/j.oraloncology.2011.07.003

Biazevic, M.G., Antunes, J.L., Togni, J., de Andrade, F.P., de Carvalho, M.B., & Wünsch-Filho, V. (2010). Survival and quality of life of patients with oral and oropharyngeal cancer at 1-year follow-up of tumor resection. *Journal of Applied Oral Science, 18,* 279–284.

Birkhaug, E.J., Aarstad, H.J., Aarstad, A.K., & Olofsson, J. (2002). Relation between mood, social support and the quality of life in patients with laryngectomies. *European Archives of Oto-Rhino-Laryngology, 259,* 197–204.

Bjordal, K., Hammerlid, E., Ahlner-Elmqvist, M., de Graeff, A., Boysen, M., Evensen, J.F., . . . Kaasa, S. (1999). Quality of life in head and neck cancer patients: Validation of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-H&N35. *Journal of Clinical Oncology, 17,* 1008–1019.

Borggreven, P.A., Aaronson, N.K., Verdonck-de Leeuw, I.M., Muller, M.J., Heiligers, M.L., Bree, R., . . . Leemans, C.R. (2007). Quality of life after surgical treatment for oral and oropharyngeal cancer: A prospective longitudinal assessment of patients reconstructed by a microvascular flap. *Oral Oncology, 43,* 1034–1042.

Bornbaum, C.C., Fung, K., Franklin, J.H., Nichols, A., Yoo, J., & Doyle, P.C. (2012). A descriptive analysis of the relationship between quality of life and distress in individuals with head and neck cancer. *Supportive Care in Cancer, 20,* 2157–2165.

Bower, W.F., Vlantis, A.C., Chung, T.M., Cheung, S.K., Bjordal, K., & van Hasselt, C.A. (2009). Quality of life in head and neck cancer patients after surgical resection: Translation into Cantonese and validation of the EORTC QLQ-H&N35. *Acta Oto-Laryngologica, 129,* 779–785. doi:10.1080/00016480802398970

Breslin, P.A., & Spector, A.C. (2008). Mammalian taste perception. *Current Biology, 18,* R148–R155. doi:10.1016/j.cub.2007.12.017

Broglie, M.A., Soltermann, A., Haile, S.R., Röösli, C., Huber, G.F., Schmid, S., & Stoeckli, S.J. (2013). Quality of life of oropharyngeal cancer patients with respect to treatment strategy and p16-positivity. *Laryngoscope, 123,* 164–170. doi:10.1002/lary.23622

Büntzel, J., Riesenbeck, D., Glatzel, M., Berndt-Skorka, R., Riedel, T., Mucke, R., . . . Micke, O. (2010). Limited effects of selenium substitution in the prevention of radiation-associated toxicities. Results of a randomized study in head and neck cancer patients. *Anticancer Research, 30,* 1829–1832.

Chasen, M.R., & Bhargava, R. (2009). A descriptive review of the factors contributing to nutritional compromise in patients with head and neck cancer. *Supportive Care in Cancer, 17,* 1345–1351. doi:10.1007/s00520-009-0684-5

Chaukar, D.A., Das, A.K., Deshpande, M.S., Pai, P.S., Pathak, K.A., Chaturvedi, P., . . . D'Cruz, A.K. (2005). Quality of life of head and neck cancer patient: Validation of the European Organization for Research and Treatment of Cancer QLQ-C30 and European Organization for Research and Treatment of Cancer QLQ-H&N 35 in Indian patients. *Indian Journal of Cancer,* 42, 178–184.

Chen, W.C., Lai, C.H., Lee, T.F., Hung, C.H., Liu, K.C., Tsai, M.F., . . . Chen, M.F. (2013). Scintigraphic assessment of salivary function after intensity-modulated radiotherapy for head and neck cancer: Correlations with parotid dose and quality of life. *Oral Oncology, 49,* 42–48. doi:10.1016/j.oraloncology.2012.07.004

Chung, M.K., Son, Y.I., Cho, J.K., So, Y.K., Woo, S.H., Jeong, H.S., & Baek, C.H. (2010). Therapeutic options in patients with early T stage and advanced N stage of tonsillar squamous cell carcinomas. *Otolaryngology–Head and Neck Surgery, 143,* 808–814.

Coldwell, S.E., Mennella, J.A., Duffy, V.B., Pelchat, M.L., Griffith, J.W., Smutzer, G., . . . Hoffman, H.J. (2013). Gustation assessment using the NIH Toolbox. *Neurology, 80*(Suppl. 3), S20–S24. doi:10.1212/WNL.0b013e3182872e38

Cooper, H., Hedges, L.V., & Valentine, F.C. (2009). *The handbook of research synthesis and meta-analysis* (2nd ed.). New York, NY: Russell Sage Foundation.

Epstein, J.B., & Murphy, B.A. (2010). Late effects of cancer and cancer therapy on oral health and quality of life. *Journal of the Massachusetts Dental Society, 59*(3), 22–27.

Fang, F.M., Tsai, W.L., Lee, T.F., Liao, K.C., Chen, H.C., & Hsu, H.C. (2010). Multivariate analysis of quality of life outcome for nasopharyngeal carcinoma patients after treatment. *Radiotherapy and Oncology, 97,* 263–269. doi:10.1016/j.radonc.2010.05.022

Ghazali, N., Lowe, D., & Rogers, S.N. (2012). Enhanced patient reported outcome measurement suitable for head and neck cancer follow-up clinics. *Head and Neck Oncology, 4,* 32.

Gillespie, M.B., Brodsky, M.B., Day, T.A., Lee, F.S., & Martin-Harris, B. (2004). Swallowing-related quality of life after head and neck cancer treatment. *Laryngoscope, 114,* 1362–1367.

Gupta, T., Agarwal, J., Jain, S., Phurailatpam, R., Kannan, S., Ghosh-Laskar, S., . . . D'Cruz, A. (2012). Three-dimensional conformal radiotherapy (3D-CRT) versus intensity modulated radiation therapy (IMRT) in squamous cell carcinoma of the head and neck: A randomized controlled trial. *Radiotherapy and Oncology, 104,* 343–348. doi:10.1016/j.radonc.2012.07.001

Hammerlid, E., Silander, E., Hornestam, L., & Sullivan, M. (2001). Health-related quality of life three years after diagnosis of head and neck cancer–A longitudinal study. *Head and Neck, 23,* 113–125. doi:10.1002/1097-0347(200102)23:2<113::AID-HED1006>3.0.CO;2-W

Hanna, E., Sherman, A., Cash, D., Adams, D., Vural, E., Fan, C.Y., & Suen, J.Y. (2004). Quality of life for patients following total laryngectomy vs chemoradiation for laryngeal preservation. *Otolaryngology–Head and Neck Surgery, 130,* 875–879. doi:10.1001/archotol.130.7.875

Higgins, J.P.T., Thompson, S.G., Deeks, J.J., & Altman, D.G. (2003). Measuring inconsistency in meta-analyses. *BMJ, 327,* 557–560.

Johansson, M., Ryden, A., & Finizia, C. (2008). Self evaluation of communication experiences after laryngeal cancer–A longitudinal questionnaire study in patients with laryngeal cancer. *BMC Cancer, 8,* 80. doi:10.1186/1471-2407-8-80

Lin, B.M., Starmer, H.M., & Gourin, C.G. (2012). The relationship between depressive symptoms, quality of life, and swallowing function in head and neck cancer patients 1 year after definitive therapy. *Laryngoscope, 122,* 1518–1525. doi:10.1002/lary.23312

Loewen, I.J., Boliek, C.A., Harris, J., Seikaly, H., & Rieger, J.M. (2010). Oral sensation and function: A comparison of patients with innervated radial forearm free flap reconstruction to healthy matched controls. *Head and Neck, 32,* 85–95. doi:10.1002/hed.21155

Marur, S., D'Souza, G., Westra, W.H., & Forastiere, A.A. (2010). HPV-associated head and neck cancer: A virus-related cancer epidemic. *Lancet Oncology, 11,* 781–789. doi:10.1016/s1470-2045(10)70017-6

McLaughlin, L. (2013). Taste dysfunction in head and neck cancer survivors [Online exclusive]. *Oncology Nursing Forum, 40,* E4–E13. doi:10.1007/s00520-009-0684-5

McLaughlin, L., & Mahon, S.M. (2012). Understanding taste dysfunction in patients with cancer. *Clinical Journal of Oncology Nursing, 16,* 171–178. doi:10.1188/12.CJON.171-178

McMillan, A.S., Pow, E.H.N., Kwong, D.L.W., Wong, M.C.M., Sham, J.S.T., Leung, L.H.T., & Leung, W.K. (2006). Preservation of quality of life after intensity-modulated radiotherapy for early-stage nasopharyngeal carcinoma: Results of a prospective longitudinal study. *Head and Neck, 28,* 712–722. doi:10.1002/hed.20378

McQuestion, M., Fitch, M., & Howell, D. (2011). The changed meaning of food: Physical, social and emotional loss for patients having received radiation treatment for head and neck cancer. *European Journal of Oncology Nursing, 15,* 145–151. doi:10.1016/j.ejon.2010.07.006

Meyers, S., & Ott, M.J. (2008). Mindful eating as a clinical intervention for survivors of head and neck cancer: Interdisciplinary collaboration and strategies to improve oral intake. *Topics in Clinical Nutrition, 23,* 340–346. doi:10.1097/01.TIN.0000341346.50589.9e

Mowry, S.E., LoTempio, M.M., Sadeghi, A., Wang, K.H., & Wang, M.B. (2006). Quality of life outcomes in laryngeal and oropharyngeal cancer patients after chemoradiation. *Otolaryngology–Head and Neck Surgery, 135,* 565–570. doi:10.1016/j.otohns.2006.06.1266

Nguyen, H.M., Reyland, M.E., & Barlow, L.A. (2012). Mechanisms of taste bud cell loss after head and neck irradiation. *Journal of Neuroscience, 32,* 3474–3484. doi:10.1523/jneurosci.4167-11.2012

Palazzi, M., Tomatis, S., Orlandi, E., Guzzo, M., Sangalli, C., Potepan, P., . . . Olmi, P. (2008). Effects of treatment intensification on acute local toxicity during radiotherapy for head and neck cancer: Prospective observational study validating CTCAE, version 3.0, scoring system. *International Journal of Radiation Oncology, Biology, Physics, 70,* 330–337. doi:10.1016/j.ijrobp.2007.06.022

Pow, E.H.N., Kwong, D.L.W., McMillan, A.S., Wong, M.C.M., Sham, J.S.T., Leung, L.H.T., & Leung, W.K. (2006). Xerostomia and quality of life after intensity-modulated radiotherapy vs. conventional radiotherapy for early-stage nasopharyngeal carcinoma: Initial report on a randomized controlled clinical trial. *International Journal of Radiation Oncology, Biology, Physics, 66,* 981–991.

Rosenthal, D.I., Mendoza, T.R., Chambers, M.S., Asper, J.A., Gning, I., Kies, M.S., . . . Cleeland, C.S. (2007). Measuring head and neck cancer symptom burden: The development and validation of the M.D. Anderson symptom inventory, head and neck module. *Head and Neck, 29,* 923–931.

Siegel, R., DeSantis, C., Virgo, K., Stein, K., Mariotto, A., Smith, T., . . . Ward, E. (2012). Cancer treatment and survivorship statistics, 2012. *CA: Cancer Journal for Clinicians, 62,* 220–241. doi:10.3322/caac.21149

Siegel, R., & Jemal, A. (2013). Cancer facts and figures 2013. Retrieved from http://www.cancer.org/research/cancerfactsfigures/cancerfactsfigures/cancer-facts-figures-2013

Silveira, A.P., Goncalves, J., Sequeira, T., Ribeiro, C., Lopes, C., Monteiro, E., & Pimentel, F.L. (2010). Patient reported outcomes in head and neck cancer: selecting instruments for quality of life integration in clinical protocols. *Head and Neck Oncology, 2,* 32.

Singer, S., Wollbruck, D., Wulke, C., Dietz, A., Klemm, E., Oeken, J., . . . Schwarz, R. (2009). Validation of the EORTC QLQ-C30 and EORTC QLQ-H&N35 in patients with laryngeal cancer after surgery. *Head and Neck, 31,* 64–76. doi:10.1002/hed.20938

Sturgis, E.M., & Cinciripini, P.M. (2007). Trends in head and neck cancer incidence in relation to smoking prevalence: An emerging epidemic of human papillomavirus-associated cancers? *Cancer, 110,* 1429–1435. doi:10.1002/cncr.22963

Wan Leung, S., Lee, T.F., Chien, C.Y., Chao, P.J., Tsai, W.L., & Fang, F.M. (2011). Health-related quality of life in 640 head and neck cancer survivors after radiotherapy using EORTC QLQ-C30 and QLQ-H&N35 questionnaires. *BMC Cancer, 11,* 128. doi:10.1186/1471-2407-11-128

Weymuller, E.A., Jr., Alsarraf, R., Yueh, B., Deleyiannis, F.W., & Coltrera, M.D. (2001). Analysis of the performance characteristics of the University of Washington Quality of Life instrument and its modification (UW-QOL-R). *Otolaryngology–Head and Neck Surgery, 127,* 489–493. doi:10.1001/archotol.127.5.489