




# Stigma, depression, and anxiety among patients with head and neck cancer

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Received: 17 June 2021 / Accepted: 7 September 2021 / Published online: 17 September 2021  
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## Abstract

**Purpose** Patients with head and neck cancer (HNC) are vulnerable to psychiatric comorbidities, particularly anxiety and depression, and also suffer from cancer stigma. This study aimed to comprehensively compare HNC patients' stigma, depression, and anxiety, and elucidate the underlying relationships among them.

**Methods** This cross-sectional study recruited inpatients with HNC from a medical center. Measurements included a psychiatric diagnostic interview, the Shame and Stigma Scale (SSS), the Hamilton Anxiety Rating Scale (HAM-A), the Hamilton Depression Rating Scale (HAM-D), the Explanatory Model Interview Catalogue (EMIC), and stressors of HNC patients. Structural equation modeling was used to establish models of potential mechanisms.

**Results** Those patients having stressors of worry about health ( $t = 5.21, p < 0.001$ ), worry about job ( $t = 2.73, p = 0.007$ ), worry about family ( $t = 2.25, p = 0.026$ ), or worry about economic problems ( $t = 2.09, p = 0.038$ ) showed significantly higher SSS score than those having no such stressor. The SSS total score was significantly correlated with HAM-A ( $r = 0.509, p < 0.001$ ), HAM-D ( $r = 0.521, p < 0.001$ ), and EMIC ( $r = 0.532, p < 0.001$ ) scores. Structural equation modeling was used to propose the possible effect of stigma on anxiety ( $\beta = 0.51, p < 0.001$ ), and then the possible effect of anxiety on depression ( $\beta = 0.90, p < 0.001$ ).

**Conclusion** Stigma is significantly correlated with anxiety and depression and might in HNC patients. Proper identification of comorbidities and a reduction of stigma should be advised in mental health efforts among patients with HNC.

**Keywords** Stigma · Anxiety · Depression · Head and neck cancer

## Introduction

Head and neck cancer (HNC) includes malignancies in the oral cavity, oropharynx, hypopharynx, and larynx. HNC incidences and mortality rates vary by geographical locations, with a pattern of clustering in certain high-risk

regions, such as South and Southeast Asia, including Taiwan [1, 2]. Previous studies have shown that HNC patients suffer significantly from psychological distress [3], and often from comorbid psychiatric disorders [4]. Around 33% of HNC patients were estimated to have depression and/or anxiety [5]. Compared to general population, HNC

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patients had more than three-fold higher risks of both having depressive disorder [4] and attempting suicide [6]. HNC patients' suicide attempt rate was also higher than that of patients with other types of cancer [6]. In addition to depression, anxiety symptoms are also common in cancer patients [7].

Both cancer and mental disorder are highly stigmatized illnesses [8, 9]. Moreover, since HNC is linked to avoidable lifestyle risks and visible disfigurement, it is regarded as one of the most stigmatized cancer types [10, 11]. Along the treatment course, HNC patients may experience a variety of psychological impacts related to stigma, due to disfigurement, body-image alteration, sexual dysfunction, and devalued social identity [11–13]. Stigmatization affects patients' help-seeking intentions and could lead to delayed medical intervention [9, 14].

Studies conducted on the topic of the associations between cancer stigma and depression/anxiety are almost all limited to samples of mixed cancer diagnoses or lung cancer patients. Data specifically related to HNC patients on this topic are scant. Cancer survivors who had or experienced cancer stigma were 2.5 times more likely to have depression than patients with positive attitudes [15]. Lung cancer stigma was found to have strong relationships with anxiety, depression, symptoms severity, and quality of life [16]. Another study, also on lung cancer patients, reported that greater stigma and shame were related to poorer outcomes in psychological distress and quality of life [17]. Only one investigation focused on oral cancer patients, and found that levels of perceived stress and social isolation due to stigma were identified to be predictors of anxiety symptoms and depressive symptoms [18]. Thus, a comprehensive assessment of HNC patients' stigma, depression, and anxiety, and the underlying relationships between stigma, depression, and anxiety, is warranted.

In sum, recognizing and dealing with stigma is challenging, particularly for HNC patients who are prone to comorbid psychiatric illnesses. Due to the lack of useful and brief tools to assess stigma in HNC patients in the past, there have been few studies measuring their stigma level, much less together with their depression and anxiety levels. In 2013, Kissane, et al. developed a reliable and valid instrument, the Shame and Stigma Scale (SSS), for measuring HNC patients' shame and stigma level [19]. Our research team translated the SSS into Chinese and demonstrated its validity and reliability among HNC patients in Taiwan [20]. In the present study, utilizing this validated stigma measurement tool, we aimed to compare the stigma, depression, and anxiety of HNC patients, and elucidate the relationships among the three.

## Methods

### Study design and participants

All procedures performed in studies involving human participants were in accordance with the Declaration of Helsinki (1964) and its later amendments or comparable ethical standards. The current research was approved by the Institutional Review Board at Chang Gung Memorial Hospital (IRB No. 201601843A3).

This study used a cross-sectional design with consecutive sampling in a medical center in southern Taiwan that consists of 2754 beds and provides services to 5000 cancer patients per year. Participants were recruited from the ear, nose, and throat (ENT) ward between April 2018 and January 2019. All participants satisfied the following eligibility criteria: (1) diagnosed with HNC (newly diagnosed or relapsed), and (2) able to understand the study procedure and complete the questionnaires. Exclusion criteria were as follows: (1) patients with a prior cancer diagnosis other than HNC, (2) patients with dementia or severe cognitive impairment, and (3) patients who were too weak to complete the questionnaire or interviews.

### Measures

#### Mini-International Neuropsychiatric Interview (MINI)

The MINI is a short but accurate structured psychiatric interview designed to generate psychiatric diagnoses in epidemiological studies for researchers, or outcome tracking in clinical settings for clinicians. Approximately 15–20 min are needed to complete this interview [21].

#### Shame and Stigma Scale (SSS)

The SSS was first developed by Kissane, in English, to assess HNC patients' shame and stigma. It was shown to have satisfactory reliability and validity (Cronbach's  $\alpha = 0.94$ ) [19]. In our previous work, we translated the SSS into a Chinese version and confirmed it to be a reliable and valid tool in a sample of patients with HNC in Taiwan (Cronbach's  $\alpha = 0.85$ ) [20]. The Chinese version of the SSS consists of 20 items, and the following five factors: Shame with Appearance, Regret, Social/Speech Concern, and Sense of Stigma [20]. The subjects were asked to indicate whether each item has been experienced and how frequently on a Likert-like scale with scoring from 0 to 4 points (ranging from *never* to *all the time*). After items 1, 4, 7, and 20 are reverse coded, the higher scores on all items consistently suggested greater degree of shame/stigma. A total score can be obtained by summing all responses, with a range of 0 to 80.

### Hamilton Depression Rating Scale (HAM-D)

Depression level was assessed with the HAM-D. The HAM-D is a long-standing and widely used tool to probe a subject's mood, feelings of guilt, suicide ideation, insomnia, agitation or retardation, anxiety, weight loss, and somatic symptoms in clinical and research settings [22]. The Chinese version of the 17-item HAM-D had been verified to be reliable and valid. The score ranges from 0 to 52 [23]. It usually takes 15–20 min for a researcher to complete this questionnaire.

### Hamilton Anxiety Rating Scale (HAM-A)

The HAM-A is among the first and most widely used instruments for measuring the severity of anxiety symptoms [24]. It is a clinician-rated questionnaire that consists 14 items measuring both psychic anxiety and somatic anxiety [24]. The reliability and concurrent validity of the HAM-A and its subscales have been proved to be sufficient [25]. Each item is scored on a basic numeric scoring of 0 (not present) to 4 (severe), with the total score ranging from 0 to 56 [26].

### Explanatory Model Interview Catalogue (EMIC)

The EMIC is an anthropologically based, culturally sensitive, semi-structured interview schedule that addresses a wide range of concepts relevant to the psychosocial impact of illness through combining quantitative and qualitative approaches [27]. The EMIC has been widely applied across a variety conditions and cultures, focusing on patients' illness behavior and stigma [28–30]. In this study, the stigma assessment of EMIC was adapted, consisting of 12 items with covering the various aspects of perceived stigma, including concerns about disclosure, diminished self-esteem, social rejection, and impact on marriage. Sample items are *If possible, would you prefer to keep people from knowing about this problem?*, and *Do you think less of yourself because of this problem?* Each question was scored as 3 for *yes*, 2 for *possibly*, 1 for *uncertain*, and 0 for *no* as quantitative component, and details in prose were maintained as qualitative component that preserves the narrative context.

### Study procedures

After explaining the study aims and providing the details of the procedures, eligible patients who agreed to participate signed an informed consent document and were enrolled in the study. A senior psychiatrist (Dr. Y. Lee) performed a structured interview to identify the psychiatric diagnoses according to the MINI, and rated patient anxiety and depression levels according to the HAM-A and HAM-D,

respectively. A psychiatrist (Dr. Tseng) and a research assistant utilized the SSS to evaluate the participants' stigma. The participants' clinical and demographic data, stressors, EMIC data (quantitative component and qualitative component) were collected and documented by a trained research assistant. The stressor items were derived and modified from the List of Threatening Life Experiences Questionnaire [31, 32]. The stressor items applied in this study include worry about health, worry about job, worry about family, worry about economic problems, worry about legal problem, and worry about relationships. Each stressor item was dichotomized into presence or absence.

### Data analyses

We used the Statistical Package for the Social Sciences (SPSS), version 25, to analyze descriptive and inferential statistics. Descriptive statistics were used to report the sample's sociodemographic background, substance use, prevalence of psychiatric comorbidity, and mean HAM-A, HAM-D, EMIC, and SSS scores. To identify the patients' stressors relevant to stigma, we dichotomized each stressor item (present/absence) among the HNC patients, and a *t* test was calculated for each stressor item with the SSS total score. We used the Pearson product moment correlation to estimate the relationships between the SSS total score and subscales and the HAM-A, HAM-D, and EMIC in patients with HNC. Bonferroni correction was applied to adjust multiple comparisons. Further, structural equation modeling (SEM), a statistical method to assess directional influences among variables in cross-sectional studies [33], was then utilized to establish models of potential mechanisms among the SSS, HAM-A, and HAM-D. The SEM statistical program was analyzed using SPSS Amos 24.0. Based on the *t*-test, power = 0.8,  $p < 0.05$ , effect size = 0.5, the minimum sample size was calculated to be 128. Regarding Pearson correlation, power = 0.8,  $p < 0.05$ , and effect size = 0.3, the minimum sample size was calculated to be 84. Finally, we exhibit patients' narrative prose that contain experiences about stigma, stressor, or emotional distress to complement the quantitative findings.

## Results

### Sample Characteristics

There were 172 HNC patients who were eligible, and 19 patients declined to participate (15 males and 4 females). In total, 153 patients with HNC were successfully recruited and completed the measurements. Most of them were male (95.4%). The mean age was  $56.9 \pm 9.4$  years. Their mean education level was  $10.4 \pm 3.1$  years; 67.3%

were married, and 51.6% were currently employed. Construction and manufacturing work was the most common employment among our HNC patients (46.8%), followed by business (17.7%), freelance (13.9%), and agriculture (12.7%). In addition, 81.0% of the patients consumed alcohol, 88.9% were ever-smokers, and 84.3% were betel-nut chewers. The average HAM-D, HAM-A, EMIC, and SSS scores were  $7.3 \pm 5.3$ ,  $7.3 \pm 4.7$ ,  $4.8 \pm 3.8$ , and  $17.5 \pm 12.2$ , respectively. Cronbach's  $\alpha$  of the HAM-D, HAM-A, EMIC, and SSS were 0.898, 0.815, 0.688, and 0.845, respectively.

About 69.3% of the participants had at least one psychiatric diagnosis. The most prevalent psychiatric comorbidities were depressive disorders (31.4%), followed by alcohol dependence (20.9%), adjustment disorder (14.4%), and insomnia disorder (7.8%). Among the depressive disorders, major depressive disorder (14.4%) was the most prevalent, followed by depressive disorder not otherwise specified (NOS) (13.7%), and dysthymia (3.3%) (Table 1).

## Stressors and Stigma

We probed the patients' stressors by providing multiple categories with a binomial model, and further examined the association between the SSS total score and the stressor categories (Table 2). It is worth noting that those patients having stressors of worry about health ( $t = 5.21$ ,  $p < 0.001$ ), worry about job ( $t = 2.73$ ,  $p = 0.007$ ), worry about family ( $t = 2.25$ ,  $p = 0.026$ ), or worry about economic problems ( $t = 2.09$ ,  $p = 0.038$ ), showed significantly higher SSS score than those having no such stressor. A significant trend of higher SSS was found in those having stressors of worry about legal problem ( $t = 1.92$ ,  $p = 0.056$ ). There was no significant association between worry about relationships and SSS score.

## Correlations between stigma, depression, and anxiety

Pearson product moment correlations of the SSS total and subscales with the HAM-A, HAM-D, and EMIC scores were performed. After Bonferroni correction was used to adjust for multiple testing, the SSS total score was significantly correlated with the HAM-A ( $r = 0.509$ ,  $p < 0.001$ ), HAM-D ( $r = 0.521$ ,  $p < 0.001$ ), and EMIC ( $r = 0.532$ ,  $p < 0.001$ ) scores, which indicated that the more shame and stigma the HNC patients perceived, the more anxiety and depression they suffered (Table 3). In addition, most of the subscales of the SSS (Shame with Appearance, Social/Speech Concerns, Sense of Stigma)

**Table 1** Demographic and clinical characteristics of participants (n=153)

Demographic and clinical variables	N (%) or Mean $\pm$ SD
Gender	
Male	146 (95.4%)
Female	7 (4.6%)
Age, years, mean	56.9 $\pm$ 9.4
Education (years)	
Elementary school ( $\leq 6$ )	23 (15.0%)
High school ( $\leq 12$ )	117 (76.5%)
College or above ( $> 12$ )	13 (8.5%)
Education years, mean	10.4 $\pm$ 3.1
Marital status	
Unmarried	50 (32.7%)
Married	103 (67.3%)
Employment	79 (51.6%)
Construction and manufacturing	37 (46.8%)
Business	14 (17.7%)
Freelance	11 (13.9%)
Agriculture	10 (12.7%)
Others*	5 (6.3%)
Civil, military, and educational services	2 (2.5%)
Unemployed	74 (48.4%)
Cancer diagnosis	
Newly diagnosed	87 (56.9%)
Relapsed	66 (43.1%)
Time since diagnosis (months)	18.92 ( $\pm 38.55$ )
Cancer Stage	
Early	56 (37.6%)
Advanced	93 (62.4%)
Substance use	
Alcohol	124 (81.0%)
Tobacco	136 (88.9%)
Betel-nut	129 (84.3%)
Measurements	
HAM-D	7.3 $\pm$ 5.3
HAM-A	7.3 $\pm$ 4.7
EMIC	4.8 $\pm$ 3.8
SSS	17.5 $\pm$ 12.2
Suicide history	4 (2.6%)
Psychiatric diagnosis	
Depressive disorders	48 (31.4%)
Major depressive disorder	22 (14.4%)
Depressive disorder NOS	21 (13.7%)
Dysthymia	5 (3.3%)
Alcohol dependence	32 (20.9%)
Adjustment disorder	22 (14.4%)
Insomnia disorder	12 (7.8%)
Anxiety disorder NOS	2 (1.3%)
Bipolar II disorder	1 (0.7%)
No psychiatric disorder	47 (30.7%)

*HAM-D* Hamilton Depression Rating Scale; *HAM-A* Hamilton Anxiety Scale; *EMIC* Explanatory Model Interview Catalogue; *SSS* Shame and Stigma Scale. Depressive disorder *NOS* Depressive disorder not otherwise specified; Anxiety disorder *NOS* Anxiety disorder not otherwise specified. Others\*: service industry, gardening, information industry, aquaculture, taxi service. Time since diagnosis (7 days to 222 months)

**Table 2** Comparison of stressors with the Shame and Stigma Scale

	SSS total	<i>t</i> test	<i>p</i> value
Worry about health		5.21	<0.001
Yes ( <i>N</i> =97)	20.6 ± 13.6		
No ( <i>N</i> =56)	12.1 ± 6.6		
Worry about job		2.73	<0.01
Yes ( <i>N</i> =25)	23.5 ± 11.3		
No ( <i>N</i> =128)	16.3 ± 12.1		
Worry about family		2.25	<0.05
Yes ( <i>N</i> =45)	20.9 ± 12.4		
No ( <i>N</i> =108)	16.1 ± 11.9		
Worry about economic problems		2.09	<0.05
Yes ( <i>N</i> =44)	20.7 ± 12.2		
No ( <i>N</i> =109)	16.2 ± 12.0		
Worry about legal problems		1.92	0.06
Yes ( <i>N</i> =4)	29.0 ± 20.9		
No ( <i>N</i> =149)	17.2 ± 11.9		
Worry about relationships		-1.54	0.13
Yes ( <i>N</i> =6)	10.0 ± 5.3		
No ( <i>N</i> =147)	17.8 ± 12.3		

SSSShame and Stigma Scale

were positively correlated with anxiety and depression ( $r = 0.337$ – $0.443$ , all  $p < 0.001$ ). Self-discrimination subscale reached correlation with anxiety and depression, but its significance did not survive after Bonferroni correction.

**Table 3** Pearson product moment correlations ( $n = 153$ ) of the Shame and Stigma Scale total and subscales with HAM-A, HAM-D, and EMIC

		HAM-A	HAM-D	EMIC
SSS Total score	<i>r</i>	0.509***	0.521***	0.532***
	<i>N</i>	153	153	153
Shame with appearance	<i>r</i>	0.413***	0.433***	0.315**
	<i>N</i>	153	153	153
Regret	<i>r</i>	0.339***	0.337***	0.203
	<i>N</i>	153	153	153
Social/speech concerns	<i>r</i>	0.360***	0.371***	0.356***
	<i>N</i>	153	153	153
Self-discrimination	<i>r</i>	0.196	0.218	0.551***
	<i>N</i>	153	153	153
Sense of stigma	<i>r</i>	0.393***	0.367***	0.516***
	<i>N</i>	153	153	153

HAM-A=Hamilton Anxiety Rating Scale; HAM-D=Hamilton Depression Rating Scale; EMIC=Explanatory Model Interview Catalogue; SSS=Shame and Stigma Scale. Bonferroni correction was used to adjust for multiple testing in the correlation matrix

( $p$  value  $\times 18$ ). Significant correlation remains after Bonferroni correction (Notes: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ )

## Structural equation modeling (SEM) of the SSS, HAM-A, and HAM-D

Using SEM, we observed that stigma severity was significantly linked with anxiety severity ( $\beta = 0.51$ ,  $p < 0.001$ ); and further, anxiety severity was significantly linked with depression severity ( $\beta = 0.90$ ,  $p < 0.001$ ) in patients with HNC (Fig. 1).

## Qualitative data

In qualitative data, HNC patients disclosed their lived experience of suffering from stigma, stressor, and emotional distress. The two cases below are examples:

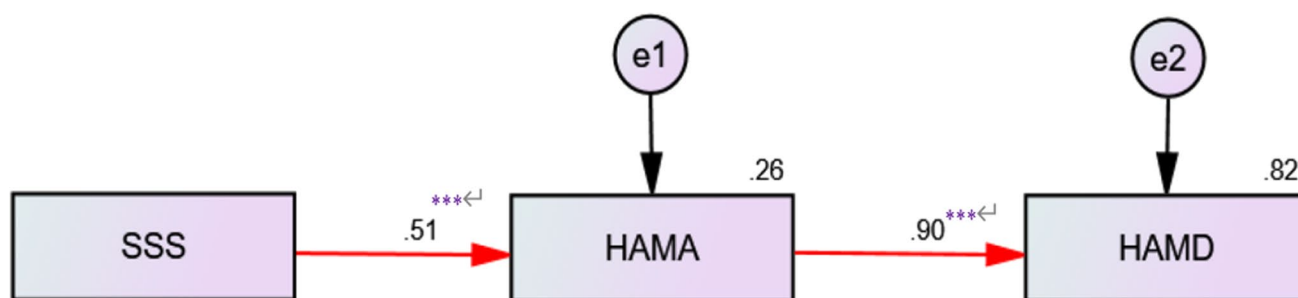
Mr. A was a 50-year-old male HNC patient, who also had psychiatric diagnosis of depressive disorder NOS. As answering to stigma-related questions, he said “I don’t want to let others know about my situation, because they may look down on me or say something bad”; “My parents don’t want others to know my situation, either. They are afraid of being talked about behind their back, as well”; “My wife worries about being judged harshly.”

Mr. B was a 73-year-old male HNC patient comorbid with major depressive disorder. He described his most troubling distress as “I am worried about having communication problems with others because of my poor hearing, so I am afraid of talking with people.” As answering to stigma-related questions, he said “The only thing I care about is to go back to work as soon as possible. People may say something about me, so I am afraid of letting people know my current situation”; “Being unable to work makes me feel useless.”

## Discussion

In the present study, using structured interviews to obtain the psychiatric diagnoses, the prevalence of psychiatric comorbidities (at least one psychiatric disorder) was estimated to be as high as 69.3% among HNC patients. Even though it is believed that HNC patients are more likely to suffer from psychiatric illnesses, the prevalence rates vary widely across studies. Depressive disorders were ranked as the most prevalent comorbidity, with a prevalence of 31.4% in our sample, which is consistent with a previous review article that reported that 15–50% of HNC patients had depression [34].

In our sample, substance use (current and former use) rates were found to be very high: 88.9% for smoking, 81.0% for alcohol use, and 84.3% for betel-nut use; 20.9% of the participants were diagnosed with alcohol dependence. A systematic review concluded that substance use rates ranged from 2 to 35% among cancer patients, with a median rate of 25.5% for alcohol [35]. The alcohol use rate ranged from 18 to 28% among HNC patients, using data from the USA [35]. These discrepancies may implicate the characteristic



**Fig. 1** Structural equation modeling of SSS, HAM-A, and HAM-D. Model summary: chi-square=4.201; df=1;  $p=0.04$ . The model fit: GFI=0.982; AGFI=0.893; RMSEA=0.145; AIC=14.201. Acronyms: HAM-A=Hamilton Anxiety Rating Scale; HAM-D=Ham-

ilton Depression Rating Scale; EMIC=Explanatory Model Interview; SSS=Shame and Stigma Scale. Notes: \* $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$

cultural background of the HNC population in Taiwan. Smoking, alcohol use, and betel-nut chewing were identified as major causes of cancer among HNC patients, and all these behaviors are commonly observed in Taiwanese males, resulting in an increasing HNC morbidity rate in this population [36, 37].

From the sociodemographic perspective, our sample comprised mostly males (95.4%), largely construction/manufacturing workers (46.8%), and half of them were currently unemployed (48.4%). It has been reported that socioeconomic inequality has causal interactions with depression and anxiety [38]. In a Taiwanese nationwide study, HNC patients who were primarily retired, unemployed, blue collar, and low income were reported to have a higher risk of depressive disorder, particularly higher than those who have white-collar jobs and higher income (> 20,000 NTD) [4].

In the current study, using an innovative approach, we attempted to explore HNC patients' stressors and their links to stigmatization. We found that some categories of stressors (health, job, family, and economic problems) were significantly associated with stigmatization. This result was supported by other studies [39]. In their study, Lebel et al. found that illness intrusiveness in meaningful life domains, such as work and intimate relationships, partially mediated the psychosocial impact of stigma on both distress and subjective well-being. In addition, the patients' narrative data complemented the quantitative analysis findings, providing a new perspective on their lived experiences, concerns, and explanations about their suffering.

However, we noticed a negative association ( $t = -1.54$ ,  $p = 0.13$ ) between worry about relationships and stigmatization, which indicated that patients who have no need to worry about relationships suffered from less stigmatization, though this did not reach a significant level. This could be a hint for further and larger studies to examine the hypothesis that intact relationships in a supportive system might be a protective factor for HNC patients' stigmatization.

Relative to past evidence, including our previous work (examining the concurrent validity between the SSS and HAM-A, HAM-D, and EMIC), findings from the present study confirmed that HNC patients with more stigmatization have more severe anxiety and depression [15, 20, 39, 40]. Next, using SEM analysis, our study further provided a possible causal model in which HNC patients' stigmatization might contribute to the development of anxiety, and then anxiety might contribute to the development of depression. The cause-effect relationships underlying the patients' stigmatization, anxiety, and depression have been barely explored in the past. SEM has been widely used in testing causal assumptions based on cross-sectional data of psychiatric disorders and associated factors [41, 42]. During the analysis, several causal assumptions based on the existing evidence were modeled, testing our dataset using SEM, and the best fit model was presented.

Numerous findings from earlier studies might support our model. One study followed up patients with newly diagnosed HNC for 6 months during the treatment course. They found that a high rate of anxiety developed before treatment, and steadily declined over time; the rate of depression was observed to be in a skewed pattern, increasing during the first 3 months and declining afterward [43]. Another longitudinal study indicated the predominant role of anxiety in diagnosis as a precursor to post-treatment major depressive disorder, suggesting the need for identification and prophylactic treatment of anxiety in HNC patients on diagnosis [44]. Furthermore, possible distress overlaps with anxiety and depression were also revealed in HNC patients, and included total distress, and emotional and social distress subscales [45]. Nonetheless, further longitudinal follow-up research is warranted to confirm the causality, and relevant confounding variables should be taken into considerations.

The strengths of this study were as follows. First, the psychiatric diagnosis was established via structured clinical interviews by psychiatrists. Furthermore, we chose

psychometrically sound instruments to quantify HNC stigma. And finally, SEM was used to propose the possible causal relationship between HNC patients' stigma, anxiety, and depression. This might be the first report providing a unified explanation of HNC patients' stigma, anxiety, and depression.

Still, numerous limitations should be mentioned. First, the causal assumptions proposed in this study should be cautiously interpreted due to the nature of the cross-sectional design. Next, as discussed earlier, the sample may be representative of Taiwanese HNC patients in terms of sociodemographic background; however, our patient sample may differ from patients in other countries or regions, thereby limiting the generalizability of the study findings. Furthermore, several possible confounders (e.g., tumor stage, age, sex) were not controlled in current study. Besides, for testing association of stressors with stigma, we chose SSS total score as the representative of stigma level; the associations between stressors and stigma subscales were not tested here, which might be an area for future investigation. Lastly, we did not conduct the qualitative analysis, the qualitative data served as a complement for quantitative findings only in this study. We may consider to extent this issue by applying qualitative analysis in future work.

## Conclusion

Combining clinical assessments and qualitative data, the present study provided a comprehensive understanding of and explanations for HNC patients' stigma, anxiety, and depression. The clinical implications suggested that (1) stressors of health, job, family, and economic problems were significantly associated with stigmatization; (2) more stigmatization correlated to more severe anxiety and depression; (3) the possible effect of stigma on anxiety, and then the possible effect of anxiety on depression. Proper identification and the reduction of stigma should be advised in mental health efforts dealing with patients with HNC.

**Authors' contributions** WTT drafted the manuscript. YL, CFH, and PYL designed the study. CYC, HCC, FMF, SHL, TLH, and MYC conducted the study. LY and WLJ performed data analysis. L-JW and YL critically revised the manuscript. All authors reviewed and approved the final manuscript.

**Funding** This study was supported by a grant from the Kaohsiung Chang Gung Memorial Hospital, Taiwan (Grant No. CMRPG8G1171). The funding agent had no role in the study design, study performance, and decision to submit the report.

**Data availability** The datasets analyzed during this study are available from the corresponding author on reasonable request.

## Declarations

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the Declaration of Helsinki (1964) and its later amendments or comparable ethical standards. The current research was approved by the Institutional Review Board at Chang Gung Memorial Hospital (IRB No. 201601843A3).

**Consent to participate** All patients had written the inform consents.

**Conflict of interest** All authors declare no conflicts of interest.

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