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Latent Structure and Reliability Analysis of the Measure of Body Apperception: Cross-Validation for Head and Neck Cancer Patients

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Abstract

Purpose—Cancer and its treatments are associated with psychological distress that can negatively impact self-perception, psychosocial functioning, and quality of life. Patients with Head and neck cancers (HNC) are particularly susceptible to psychological distress. This study involved a cross-validation of the Measure of Body Apperception (MBA) for HNC patients.

Methods—One hundred twenty-two English-fluent HNC patients between 20 and 88 years of age completed the MBA on a Likert scale ranging from “1=Disagree” to “4=Agree”. We assessed the latent structure and internal consistency reliability of the MBA using Principal Components Analysis (PCA) and Cronbach's coefficient alpha (α), respectively. We determined convergent and divergent validities of the MBA using correlations with the Hospital Anxiety and Depression Scale (HADS), observer disfigurement rating, and patients' clinical and demographic variables.

Results—The PCA revealed a coherent set of items that explained 38% of the variance. The Keiser-Meyer-Olkin measure of sampling adequacy was .73 and the Bartlett's Test of Sphericity

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was statistically significant ($\chi^2(28) = 253.64; p < .001$), confirming the suitability of the data for dimension reduction analysis. The MBA had good internal consistency reliability ($\alpha = .77$) and demonstrated adequate convergent and divergent validities based on statistically significant moderate correlations with the HADS ($p < .01$) and observer rating of disfigurement ($p < .026$), and non-statistically significant correlations with patients' clinical and demographic variables: tumor location, age at diagnosis, and birth place (all $p_s > .05$).

Conclusions—The MBA is a valid and reliable screening measure of body apperception for HNC patients.

Keywords

Head and Neck Cancer; Psychological Distress; Body Apperception; Psychometrics; Measurement Development; Cancer Control; Symptom Management; Quality of life

INTRODUCTION

Incidence of head and neck cancer (HNC) is estimated to account for approximately 5% (57,080 males and 23,420 females) of all new cancers in the United States for the year 2012 [1]. HNC includes a category of biologically analogous malignant tumors that may start from various tissue types and subregions within the head and neck (e.g., oral cavity, salivary glands, nasal fossa, paranasal sinuses, pharynx, larynx, and cervical lymph nodes in the upper part of the neck). Usually, most HNC begins from squamous epithelium as squamous cell carcinomas, in either keratinized tissue or non-keratinized mucosa of the head and neck (i.e., mucosal lining of the oral and nasal cavities, throat, ears, and surface layer of the tongue). Even though regional cervical lymphatic metastases are common in HNC, distant (e.g., lung and liver) metastases may also occur [2–4].

The etiology of HNC is commonly attributed to environmental, lifestyle, or behavioral risk factors such as tobacco use, alcohol consumption, chemical or ultra violet light exposure, genetics and family history, and diseases such as the human papilloma virus [5–9]. Albeit generally characterized as biologically aggressive, squamous cell carcinomas of the head and neck can be highly curable if detected and treated early [2]. Treatments of HNC include surgery, radiation therapy, chemotherapy, or combined treatment modalities (e.g., chemotherapy plus radiation therapy) based on clinical parameters such as the cancer stage (e.g., early versus late stage) [2].

Cancer and cancer treatments are associated with psychological distress that can impact mental and emotional processes, self-perception, social functioning, and overall quality of life [10, 11]. HNC and its treatments, especially surgery and radiotherapy, generally result in disfigurement [12,13]. Consequently, HNC patients are particularly susceptible to disease and treatment-related psychological distress (e.g., anxiety and depression) and difficulties with self-perception, self-concept, self-acceptance, social cognition, and interpersonal interactions [10, 13–17].

The importance of other people in our social world to how we come to understand and perceive ourselves, as well as the dynamics of various aspects of our interpersonal

relationships are long established [18-21]. Disease and treatment-related disfigurement have serious implications for psychological adjustment and psychosocial functioning for HNC patients [22]. In fact, previous studies have suggested that appearance and self-perception are central factors that can negatively influence individuals' participation in routine activities of daily psychosocial functioning and their overall social experience [22-23].

Reliable assessment of cancer and cancer treatment-related psychosocial distress is a *sine qua non* to the development and testing of interventions to facilitate effective coping and improve quality of life for HNC patients. We reviewed other measures currently available in the medical literature such as the Head and Neck Survey and the Derriford Appearance Scale [24-26]. We found that these measures were either too specific or too long, and not particularly related to HNC. The purpose of the present study was to cross-validate the Measure of Body Apperception (MBA) for HNC patients [27]. The MBA is short and easy to administer and score; which would make it precisely suitable for time constraint clinical oncology settings. Additionally, the MBA could be utilized as a brief screening measure to facilitate the evaluation of HNC patients' self-perception within the context of their disease and its treatments, as well as their HNC-related physical, emotional, and psychosocial sequelae.

MATERIALS AND METHODS

Participants

The present sample included 122 English-fluent adult HNC patients between 20 and 88 years of age who provided demographic data and completed the MBA and HADS. Patients were recruited from the HNC clinic of the Sylvester Comprehensive Cancer Center (SCCC) at the University of Miami School of Medicine (UMSM). Data were collected from April 2011 to June 2011 as part of a larger study on psychological distress and quality of life for HNC patients. On average, time since treatment for study participants was 39 months (minimum = 12 months; maximum = 204 months). The Protocol Review Committee of the SCCC and the Medical Science Internal Review Board (IRB) of the UMSM approved this study protocol. All patients read and provided signed informed consent forms to indicate their decision to participate voluntarily in this study without any coercion.

Eligibility and inclusion Criteria

Participants in the present study: 1) were established patients with the SCCC UMSM who had a scheduled follow-up visit pending; 2) had completed their treatments more than 12 months prior to the scheduled medical visit at the HNC clinic; and 3) were adults 18 years of age or older at the time of study enrollment.

Procedures

Participants were asked to complete study questionnaires after registering for their scheduled medical appointment at the HNC clinic. A research associate recruited patients at the HNC clinic at SCCC. We had a very high response rate of approximately 94%. Specifically, of the 160 patients approached, a total of 150 accepted our invitation to participate in this study. The present sample included 122 patients who provided complete data on all questionnaires

in English. Patients were instructed that this study would take place in a private office in the HNC clinic either before or after seeing their doctors. A member of this research team was available to answer any question and provide assistance to study participants as needed. The average time for completing the study questionnaires was 30 minutes. Patients were informed that a member of this research team would also rate their appearance and the degree of visibility of the cancer and treatment-related changes (e.g., scars and missing bone/skin) in their face and neck regions. The research team member did not physically examine or touch any patient. Patients were also told that pertinent information about the dates and specifics of their cancer types, histology, and treatments would be abstracted from their medical records. All patients were informed of their rights to refuse to participate or stop participation in this study at any time. Participation in this study did not delay patients' scheduled medical appointments. We did not provide any incentive to patients for their participation in the present study.

Measures

All the measures included in this study had appropriate psychometric indices (i.e., adequate validity and reliability). Additionally, these measures have been previously utilized in cancer control and symptom management research [27-28].

Socio-demographic Characteristics—Socio-demographic characteristics were assessed using questionnaire items that asked about patients' age, sex, race-ethnicity, education, employment status, income, marital status, place of birth, and primary language.

The Measure of Body Apperception (MBA)—is an 8-item measure (plus 2-filler items) designed to assess investment in and concern about body apperception in breast cancer patients. Initial validation of the MBA revealed a multidimensional or 2-factor measure that explained 52.2% of the variance. Test-retest of the MBA revealed a correlation of $r = 0.75$ for each subscale over a period of four weeks [27]. Participants responded to items of the MBA on a 4-point Likert scale that ranged from "1=Disagree" to "4=Agree". A total scale score was calculated by summing all the items of the MBA. A higher score indicated a stronger agreement with the MBA. The reasons for using the MBA were: 1) to test whether the factor structure found with breast cancer during the initial psychometric validation of the measure would be replicated with HNC patients and 2) we needed a brief screening measure of body apperception that could be used with HNC patients. We revised the MBA to include gender-neutral items that were more appropriate for the present HNC sample. However, we did not add any new item.

The Hospital Anxiety and Depression Scale (HADS)—is a 14-item self-assessment measure designed to evaluate psychological distress (i.e., anxiety and depression) in non-psychiatric inpatient hospital settings [28]. In order to increase the probability of response accuracy, patients were instructed to respond to each item of the HADS with immediacy. Patients were also asked to indicate how items of the HADS described their feelings. Response options for items of the HADS were based on a 4-point Likert scale that ranged from "0=Not at all" to "3=Most of the time".

Statistical Analysis

Dimensionality analysis of the MBA—We evaluated the latent structure and psychometric properties of the MBA using the IBM PASW version 18, a statistical software package for Microsoft Windows (SPSS Inc., Chicago, IL). We determined the suitability of the data for dimension reduction analysis based on the following criteria: 1) examination of the correlation matrix for correlations of 0.30 and above; 2) the size of the sample that supported the calculation of reliable coefficients of correlation; 3) the Principal Components Analysis (PCA) solution that contained many high variables markers, which could support stable and reliable estimates of correlation coefficients with an even smaller sample size; 4) the Kaiser-Meyer-Olkin value (KMO) index of sampling adequacy, and 5) the Bartlett's test of sphericity [29–36].

We conducted a PCA to reduce the data to a minimum number of components that could facilitate a more precise data interpretation. We initially conducted the PCA without any rotation in order to facilitate the extraction and examination of meaningful components based on eigenvalues and screeplot criteria. This approach was expected to provide a more accurate description of the latent structure of the MBA. We also evaluated the screeplot of eigenvalues to help determine the number of components to retain. Then, we re-conducted the PCA with both VARIMAX and Direct Oblimin rotations of the initial factor solution [29].

Measurement reliability analysis—We conducted a scale reliability assessment to determine the degree to which items of the MBA formed a coherent set that assessed the same underlying construct of body apperception. We also calculated a Cronbach's coefficient alpha to determine the internal consistency of the MBA.

Convergence and Divergence Analysis—We used correlation analyses to establish convergent and divergent or discriminant characteristics of the MBA with the HADS and with patients' clinical and socio-demographic characteristics of patients in the present sample. We used the HADS to establish convergent validity because we thought the underlying construct of body apperception or self-perception might be closely related to the construct of psychological distress (e.g., anxiety and depression) [37–38]. Likewise, we used demographic variables (e.g., age at cancer diagnosis and tumor location) to establish divergent or discriminant validity of the MBA because we thought the construct of body apperception is different from the underlying concept these demographic variables are expected to measure.

RESULTS

Participants

The mean age of patients in the present study was 63 years, (range: 20 to 88 years; standard deviation = 13.5). Sixty-seven percent of the sample was under 65 years of age at the time of diagnosis. The present sample was predominantly White (73%). The majority of the patients (69.7%) were male, and 64.8% were married. Additionally, 68% of the patients were born in the United States, and the other 32% were foreign born mostly from Latin America, and the

Caribbean (e.g., Cuba, Haiti, Dominican Republic, Jamaica, Puerto Rico, Nicaragua, and Peru). These patients reported varied educational achievement and employment statuses (See Table 1).

Factorability and Testing of the Latent Structure of the MBA

Factorability of the MBA—The correlation matrix of the MBA had many coefficients of 0.30 and higher. The results of the analysis showed that the Keiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.73, which exceeded the recommended 0.60 [32, 33]. The Bartlett's Test of Sphericity was also statistically significant ($\chi^2(28) = 253.64; p < 0.001$) [34]. The correlation coefficients of the correlation matrix, the sample size, the KMO, and the Bartlett's Test of Sphericity supported the suitability of the data for dimension reduction analysis [29–36].

Dimensionality and Construct Validity Analysis—The initial unrotated PCA revealed the presence of two components with eigenvalues (λ_s) greater than 1 (i.e., $\lambda_1 = 3.0$ and $\lambda_2 = 1.347$), which explained 54.37% of the cumulative variance (Table 2). Additionally, the component matrix showed that approximately 87.5% ($N = 7$) of the items loaded on the first component and 3 items (including 2 items with cross-components loadings) loaded on the second component. Based on Cattell's screeplot test and eigenvalue criteria, we only retained one component for further investigation [32]. The exclusion of the second component was also based on recommendation to exclude components defined by just 1 or 2 variables because these components tend to be unstable and difficult to interpret [29]. Further, the item “*It's important to me to look my best at all time*” was excluded even though this item had a loading of .684 on the second component. The item “*Completely apart from the pain, I'd have trouble giving myself an injection because it would mean forcing a needle into an undamaged part of my body*” had a loading of .356 (or $\approx .4$, which is acceptable) and was retained within the first component. Removing this item would have only increased the scale's alpha from .77 to .78. We then repeated the PCA with all items restricted to a single component solution (i.e., 7 of the 8 items), which revealed an eigenvalue of 3.003 that explained 38% of the variance. Subsequent manipulations of the component solution using both VARIMAX and Direct Oblimin rotations did not produce a maximized sum of the variances of the squared loadings that would increase interpretability of the data [36]. Results of the PCA showed that the items of the MBA formed a one-dimensional and coherent set that assessed the construct of body apperception (Table 3).

MBA – Reliability, Convergent and Divergent Validities

Scale Reliability Assessment—Results of the scale reliability assessment using Cronbach's coefficient alpha for the 7 items showed that the MBA had good internal consistency reliability ($\alpha = 0.77$) based on standardized items of this measure. We performed an item-by-item analysis to determine if deleting items would improve the scale's Cronbach's coefficient alpha. The results showed that the plausible improvement, however, would not considerably improve the scale total statistics as the items form a coherent and reliable set that measure our construct of interest. The scale reliability assessment analysis supported the use of the MBA as a reliable tool for assessing physical self-perception for HNC cancer patients (Table 4) [32].

Convergent and Divergent Validity—The MBA demonstrated appropriate face validity and adequate convergent and divergent validities as indicated by statistically significant moderate correlations with the HADS (Pearson's $r = 0.29$ to 0.40 ; $p < 0.01$) and observer rating of disfigurement (Pearson's $r = 0.20$; $p < 0.026$), and non-statistically significant correlations with patients' clinical and demographic variables: tumor location, age at diagnosis, and place of birth (all $p_s > 0.05$).

DISCUSSION

The MBA is a brief measure that is easy to administer and score. The MBA was initially developed and validated for use with breast cancer patients. The initial validation of the MBA showed a two-factor solution that assessed Concern About Body Integrity and Concern About Appearance [27]. However, results of the PCA in the present study revealed a psychometrically valid one-dimensional structure for the MBA that can be used for assessing body apperception in HNC patients. Specifically, the latent structure and reliability analysis of the MBA revealed a parsimonious and reliable one-component solution. We decided to retain a single component since components defined by just 1 or 2 variables tend to be largely unstable and difficult to interpret [29]. The item “*It's important to me to look my best at all time*” was excluded, despite a loading of .684 on the second component that included two few variables. The item “*Completely apart from the pain, I'd have trouble giving myself an injection because it would mean forcing a needle into an undamaged part of my body*” had a loading of .356 ($\approx .4$, which is acceptable) and was retained within the first component. Removing this item would have only increased the scale Cronbach coefficient alpha from .77 to .78. Overall, the degree to which the items of the MBA formed a coherent set that assessed the underlying construct of patients' body apperception was demonstrated by the high internal consistency reliability of this measure.

A limitation of the present study is that we did not assess the responsiveness of the MBA to change and/or how well this measure matches clinical impression. Specifically, we do not know how well the MBA will capture differences in treatment and psychosocial outcomes among HNC patients. We also used cross-sectional data to determine the applicability of the MBA for HNC cancer patients. Nevertheless, the focus of the present study was on the psychometric validation of the MBA for HNC patients. The results showed good psychometric indices that would support the use of the MBA in similar cancer populations. Future longitudinal studies should test whether the MBA can summarize treatment and psychosocial outcomes.

Additionally plausible limitations are as follow: Seventy percent of patients were men and the MBA accounted for 38% of the variance in body apperception for the present sample. Follow-up studies should also test the generalizability of the MBA across gender, identify factors that account for the unexplained portion of the variance in self-reported body apperception, and assess the degree to which the MBA matches clinical impression. Further, study participants were told that a research team member would rate their appearance and the degree of visibility of change to their faces and necks. We found a statistically significant moderate correlation between the MBA and observer rating of disfigurement. However, we did not assess the impact of knowledge of being assessed on participants'

responses to the MBA. Thus, we do not know how knowledge of being assessed and response outcome on the MBA may be related. Future longitudinal studies are needed to more systematically examine the relationship between knowledge of being evaluated for disfigurement and HNC patients' responses on the MBA.

Despite the aforementioned limitations, the results showed that the items of the MBA constitute a coherent set that assessed body apperception for HNC patients. An added strength of the present study is that the cross-validation sample of the MBA for HNC included participants from diverse racial-ethnic and socio-demographic backgrounds. Future studies should determine the predictive validity of the MBA for HNC and HNC treatment-related outcomes from longitudinal perspectives. In summary, the MBA is a valid and internally consistent measure that can be used to facilitate the assessment of body apperception, and to inform the development and testing of interventions to help HNC patients manage their psychosocial distress and improve their quality of life. The MBA could also be used as a validated screening tool to assess HNC patients' body apperception following surgery.

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