

Development and Validation of a Self-Administered Screening Test for Betel Quid Use Disorders in Betel Quid Chewers in Hunan, China

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Introduction: Processed betel quid product chewing is a public health problem in areca non-plant areas in China. However, there is no valid instrument to screen for betel quid use disorder (BQUD) in mainland China. We developed a self-administered screening test for betel quid use disorders (SST-BQUD) and tested its reliability and validity in a sample of betel quid chewers (BQCers) in Hunan, China.

Methods: Items of SST-BQUD were selected from the test results of an item pool, which includes 52 questions related to the psychosocial and behavioral presentations of BQUD. All participants, in a self-administered manner, completed the item pool. A subsample completed the re-test one week later. Two psychiatrists interviewed all participants to ascertain the presence of BQUD. The receiver Operating Characteristic curve was used to determine the best cut-off value to discriminate BQUD.

Results: One hundred and twelve BQCers were recruited. Based on the statistical analysis of receiver operating characteristic (ROC) curves, 14 yes/no questions were selected for SST-BQUD. As indicated by Cronbach's α coefficient, the internal consistency was 0.876. The area under the curve of SST-BQUD was 0.881, representing a satisfactory diagnostic value. The one-week re-test reliability test was 0.771 ($P < 0.001$), suggesting good stability over time. The optimal cut-off score for BQUD screening was six, with a sensitivity of 0.921 and a specificity of 0.716, implying the satisfactory accuracy of SST-BQUD to screen for BQUD.

Conclusion: The standard version of SST-BQUD consists of 14 items. The total score of SST-BQUD was the sum of affirmative answers, with higher scores denoting a more severe BQUD symptom. If one answered six or more times "yes" to these 14 questions, they can be classified with BQUD. The SST-BQUD is a valid screening method for BQUD among BQCers in betel quid processed area.

Keywords: betel quid use disorders, screener, development, validity, diagnostic test

Introduction

Betel quid is the fourth most popular addictive substance in the world, following tobacco, alcohol, and caffeine.¹ In 2020, the output of areca nut in the major producing areas in China was almost eight times that of 20 years ago.² The effects of Betel quid chewing (BQC) are described as pleasurable and generally stimulating, inducing a sense of well-being, euphoria, heightened alertness, a warm sensation throughout the body, and an increased capacity to work.³ So, it causes drivers, labor workers, and adolescents to chew betel quid. In recent years, the current prevalence rates of BQC in Hunan China were 73.9% in drivers, 52.7% in labor workers, 49.7% in senior middle school students, 47.2% in secondary

vocational school students, 40.8% in junior middle school students, 31.8% in pupils.⁴⁻⁶ The proportion of men chewing betel quid is significantly higher than that of women.⁷

The areca nut is classified as a Group 1 human carcinogen.⁸ Evidence has shown that BQC is associated with an increased risk of many adverse health outcomes, including oral submucous fibrosis, oral cancers, chronic kidney disease, coronary artery disease, and premature deaths.⁹⁻¹¹ The risk of oral and pharyngeal cancer increased with increasing daily amount and duration (years) of chewing betel quid.¹² As of 2016, BQC caused close to 25,000 cases of oral cancer in Hunan, China, resulting in about ¥5 billion in accumulated financial loss.¹³ Therefore, BQC has been a significant public health challenge in China, particularly in China's southern regions, with the custom of BQC.¹⁴

Empirical data suggest that despite increasing awareness of the health risk of BQC and having suffered from oral diseases, the betel quid chewers (BQCers) still chew betel quid.^{15,16} Relieving fatigue, betel addiction, and social needs (exchanging packaged betel areca products in social situations is etiquette in some parts of southern China) are commonly reported reasons for using betel quid in China.¹⁵ In terms of prevention and intervention programs for betel quid cessation, it is essential to identify whether a chewer has a betel quid use disorder (BQUD) that is defined by the inability to control the use of betel quid despite harmful consequences. Unfortunately, due to inadequate mental health services resources, psychiatric assessment by mental health workers is not feasible for large-scale population-based intervention programs. In response to that, a brief, reliable and valid self-report measure for screening for and assessing the severity of BQUD helps address this issue.

Until now, Chinese researchers have developed some self-rating scales to screen for BQUD: the Self-report Screening Test for Areca-quid Abuser (SSTAA), Betel Quid Dependence Instrument (BQDI), and Betel Quid Dependence Scale (BQDS).¹⁷⁻¹⁹ However, these scales are designed for BQCers in fresh areca nuts use areas. Due to their short shelf life, fresh areca nuts are only available in the tropical regions of their origin. Inland China consumers prefer chewing processed betel quid products, consisting of dried areca nuts, spices, sugar, and rosewater or other additives that are manufactured industrially and marketed commercially.²⁰ In traditional Chinese medicine, dried areca nut is recommended for improving digestion and maintaining good health. Areca nuts are often exchanged as gifts, perceived as a token of love or friendship in China. The exchange of processed betel quid on social occasions has become a local social etiquette.²⁰ Due to the different areca-cultural and ingredients of popular betel quid, these available scales may not be applicable for screening BQUD in areca non-plant areas. A particular version of the betel quid screening test is necessary for clinical practice.

Based on previous works and the urgent need for contemporary screening tests, we developed the Self-administered Screening Test for BQUD (SST-BQUD). Further, we tested its reliability and validity among a sample of BQCers in Hunan, China.

Methods

Participants

From November to December 2010, we recruited a convenience sample of BQCers from Hengyang, China. Hengyang is an extensive inland municipality in Hunan province. In 2018–19, the overall prevalence of BQC in Hengyang residents was as high as 27.4%.⁵ Based on the findings from our pilot study, the prevalence of BQUD in BQCers was 30%, the response rate was 80%, and the sensitivity and specificity of the SST-BQUD were 80% and 80%, respectively. A total sample size of 104, including 35 BQCers with BQUD, was obtained by using the formula for estimating the sample size for a diagnostic test, which achieved 91% power to detect a change in sensitivity from 0.5 to 0.8 using a two-sided binomial test and 100% power to detect a change in specificity from 0.5 to 0.8 using a two-sided binomial test. The target significance level is 0.05.

Adults 18 or older who reported “often chewing betel quid” and voluntarily participated in this study were recruited from local communities. Written informed consent was collected from all participants. There was no pre-existing relationship between participants and investigators. The study was approved by the Institutional Review Board of Peking University Sixth Hospital (No.2010-50). All procedures were tightly followed the guidelines of the Declaration of Helsinki.

Instruments and Procedures

After informing the authors with verbal permission, researchers introduced the initial screening test used to develop the Self-report Screening Test for Areca quid Abusers (SSTAA)¹⁷ as our item pool. There were a total of 52 yes/no questions in the initial screening test, which were developed based on the diagnostic criteria for substance use disorders in SCAN (Schedules for Clinical Assessment in Neuropsychiatry),²¹ ICD-10 (Clinical descriptions and diagnostic guidelines: The ICD-10 Classification of Mental and Behavioral disorder),²² and DSM-IV (Diagnostic and Statistical Manual of Mental disorders).²³ These questions included: (1) the onset age and frequency (4 questions); (2) subjective craving and feeling (7 questions); (3) social problems due to betel quid chewing (7 questions); (4) physical problems due to betel quid chewing (11 questions); (5) oral symptoms (4 questions); (6) psychological and abstinence-related problems (12 questions); (7) the motivation and capacity to abstain (7 questions).¹⁷ This simplified Chinese item pool was further pilot-tested, and necessary modifications were made to ensure cultural appropriateness and clarity. The item pool was completed by all participants in a self-administered manner. In addition, trained investigators were arranged to read questions for people having difficulties completing the questionnaire.

To ascertain the presence of BQUD, all participants were interviewed with Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID-I) by two experienced psychiatrists trained before the formal study and blinded to the test results of the item pool. We define individuals with BQUD as users of betel quid who met the diagnostic criteria for substance use disorders of DSM-IV by SCID-I. To examine the re-test reliability, a subsample of the BQCers were invited to complete the item pool again one week after the first administration.

Statistical Analysis

The statistical analysis strategy aims to identify a set of screening questions that can best discriminate participants with and without BQUD. The Chi-square test was used to compare the proportions of affirmative answers to item pool questions between participants with and without DSM-IV BQUD. Items with statistically significant differences consisted of the preliminary version of the SST-BQUD. In the reliability analysis, we deleted items with corrected item-total correlation coefficients <0.30 , and the final version of SST-BQUD was generated.

Cronbach's α coefficient was calculated to assess the internal consistency of SST-BQUD. Pearson correlation coefficient of the total scores between the first and second administrations was used to evaluate the re-test reliability. The Receiver Operating Characteristic (ROC) curve was used to determine the best cut-off value to discriminate BQUD. Corresponding area under the curve (AUC), sensitivity, specificity, and Youden's index were also calculated. SPSS software version 22.0 was used to analyze the data. All tests were two-tailed, and the significance level was $P < 0.05$.

Results

Sample Characteristics

In total, 112 BQCers completed the item pool, and 32 BQCers completed the re-test of SST-BQUD one week later. The mean age of the 112 BQCers was 33.7 years (range: 19–57, standard deviation [SD]: 8.4), and 107 (95.5%) were male. The average length of chewing was 91.2 months (range: 6–336, SD: 67.3), and the frequency of chewing was 5.9 per week (range: 1–7, SD: 1.9). Of the 112 BQCers, 38 BQCers met the DSM-IV criteria for BQUD. Demographic data regarding BQCers are shown in [Table 1](#). The consumption of betel quid between the groups with or without BQUD is compared in [Table 2](#).

The Development of SST-BQUD

Chi-square test results showed that BQCers with and without BQUD differed significantly in 15 items ($\chi^2=4.149-23.076$, $P \leq 0.023$). After removing an item with a corrected item-total correlation coefficient of 0.299, 14 items were retained and consisted of the standard version of SST-BQUD ([Table 3](#)). Six items are about subjective craving and feeling, five are about social problems due to betel quid chewing, one item on physical problems due to betel acid chewing, one item on oral problems due to betel quid chewing, and one item on psychological and abstinence-related problems. The total score of SST-BQUD was the sum of affirmative answers, with higher scores denoting more severe BQUD symptoms.

Table 1 Demographic Data and Characteristics of BQCers

	BQCers (N=112)		
	n (%)	Mean (SD)	Range
Gender: male	95.5		
Age (years)		33.7±8.4	19–57
Length of chewing		91.2±67.3	6–336
Frequency of chewing (per week)		5.9±1.9	1–7

Table 2 Consumption of Betel Quid Between the Groups with or Without BQUD

	Mean ± SD		P-value
	BQUD	Non- BQUD	
Age (y)	35.34±8.73	33.23±9.08	0.219
Age of start chewing (y)	23.35±7.54	24.39±8.22	0.517
Number of betel quid per day	4.97±1.50	1.00±0.50	0.000
Years of betel quid chewing	12.24±7.09	9.39±7.53	0.057

Table 3 The Self-Administered Screening Test for Betel Quid Use Disorders: Items and Corrected Item-Total Correlation Coefficients

Number	Item	Corrected Item-Total Correlation Coefficient
1	Do you like chewing betel quid?	0.572
2	Do you feel cheerful and spiritual when you have betel quid?	0.496
3	Have you ever felt that you have to chew betel quid?	0.651
4	Have you ever tried to quit or cut down on betel quid but did not succeed?	0.611
5	Have you ever found that once you start chewing, you are unable to stop?	0.704
6	Do your family think your teeth bad-looking or unclean?	0.649
7	Do your friends think your teeth bad-looking or unclean?	0.582
8	Do your family express their dislike for your betel quid chewing?	0.481
9	Have you ever quarreled with family or friends because of chewing betel quid?	0.465
10	Do you feel troubled when you are on some occasions forbidding betel quid chewing (like on a train) or in some places that betel quid is unavailable (such as north China)?	0.597
11	Have you ever nonstop chewed betel quid one after one?	0.599
12	Does betel quid chewing have a bad influence on your health?	0.378
13	Have you ever suffered from the oral cavity ulcer pains but still kept on chewing betel quid?	0.353
14	When you out down on or completely get rid of betel quid, do you have headaches?	0.412

Note: The total score was the sum of affirmative answers, with higher scores denoting as more severe BQUD symptom.

Reliability of SST-BQUD

Corrected item-total correlation coefficients of the 14 items of SST-BQUD ranged between 0.353 and 0.704, with a mean of 0.539 (Table 3). The Cronbach's α coefficient was 0.876. The one-week re-test reliability test was 0.771 ($P < 0.001$).

Table 4 The Identification of Cut-Point for the Self-Administered Screening Test for Betel Quid Use Disorders

Cut-Off Score (Number of “Yes” Questions)	Sensitivity	Specificity	Youden's Index
0	1	0	0
1	1	0.162	0.162
2	1	0.27	0.27
3	1	0.351	0.351
4	1	0.432	0.432
5	1	0.608	0.608
6	0.921	0.716	0.637
7	0.816	0.797	0.613
8	0.763	0.797	0.56
9	0.737	0.797	0.534
10	0.632	0.892	0.524
11	0.447	0.932	0.379
12	0.211	0.959	0.17
13	0.079	0.973	0.052
14	0.053	0.973	0.026

Validity of SST-BQUD

The AUC of SST-BQUD was 0.881. As shown in Table 4, the highest Youden's index was achieved when the cut-point was set at 6, with a sensitivity of 0.921 and a specificity of 0.716. Hence, for the screening test SST-BQUD, if one answered six or more times “yes” to these 14 questions, they can be classified with BQUD.

Discussion

The practice of chewing processed dried areca nut products in areca non-plant areas in China is unique in the world.²⁰ Along with recent progress in food manufacturing industrialization, processed betel products have spread to nearly all areas of China. Betel nut-associated oral cancer cases also have been increasing rapidly in the past years in China.¹³ In 2019, the Ministry of Public Health of China presented the Healthy Oral Action Program (2019–2025), which focuses on the long-term oral health consequences of betel quid chewing and proposed targeted education and oral health examinations to promote early diagnosis and treatment of periodontal disease in areas where chewing betel quid is common.²⁴

Our study is the first work to provide a reliable and valid screener for BQUD that is more adaptive to areca non-plant areas. Items in SST-BQUD seem to be consistent with the clinical presentations of BQUD, suggesting good face validity. For example, item 2 reflects the feeling of euphoria that a BQCer has, item 3 measures the patient's craving for betel quid, item 10 measures the severity of psychological withdrawal symptoms, item 11 measures the presence of compulsive betel-taking behavior, and items 6–9 investigates social malfunction due to problematic betel quid use (Table 3). Because these items measure different aspects of BQUD and are specific to BQUD, it is reasonable to find a high internal consistency of SST-BQUD ($\alpha = 0.876$). The AUC value of 0.881 in our study represents the satisfactory diagnostic value of a screening test. Accordingly, the SST-BQUD has an excellent practical value for screening for BQUD. This may be explained by the comprehensive and specific items of SST-BQUD. The cut-off score of six SST-BQUD results in high sensitivity (0.921), while the corresponding specificity seems slightly low (0.716). Given the

deleterious outcomes of BQUD, it is acceptable to have a slightly over-inclusive criterion for BQUD screening. In sum, the high sensitivity and specificity imply the strong ability of SST-BQUD to apply to its target population. The one-week re-test reliability test of 0.771 also entails a fair level of reliability, which could be helpful for further studies in the future.

Researchers introduced the initial screening test used to develop SSTAA,¹⁷ which included 52 questions based on the SCAN, ICD-10, and DSM-IV. Despite the same item pool used, the standard version of SST-BQUD in our study is different from SSTAA. We speculated that this might be primarily due to the different areca-cultural and ingredients of popular betel quid. Secondly, methodological differences in screening the patients and their level of betel quid use disorder may also explain this difference in item selection. For example, the authors of SSTAA used the unstructured clinical interview to diagnose betel quid abuse, but our research team used a stricter instrument, SCID-I. Both SST-BQUD and SSTAA are developed for community BQCers as an instrument of self-administered screening. They both include several “subjective craving and feeling” questions, of which SST-BQUD has six questions, and SSTAA has five. From the information above, it can be assumed that the pool of entries designed in accordance with ICD-10 and DSM-IV in the Chinese-speaking region has similar good suitability for the subjective craving and feeling of betel nut chewing.

There are two differences between SST-BQUD and SSTAA.¹⁷ The first one is that some questions entered SST-BQUD but not SSTAA: four “social problems due to betel quid chewing”, one “subjective craving and feeling”, one “physical problems due to betel acid chewing”, one “oral problems due to betel quid chewing” and one “psychological and abstinence related problems”. Second, some questions which were in SSTAA did not enter SST-BQUD: “psychological and abstinence related problems” (2 questions), “oral problems due to betel quid drinking” (3 questions), “the motivation and capacity to abstinence” (1 question).

From the above two differences, it can be considered that item “social problems due to betel quid chewing” have a more significant impact on BQCers in areca non-plant areas, while item “oral problems due to betel quid chewing” have a greater impact on BQCers in areca plant areas. Betel quid chewing has social and cultural characteristics, such as being a method of interpersonal communication. Consumers chew fresh areca nuts in areca plant areas, which is less convenient in interpersonal communication than processed betel nuts. Inland provinces, on the other hand, have a habit of eating processed betel nuts which are easier to carry and exchange in social situations. Handing betel nut to each other when meeting even becomes an essential interpersonal communication behavior. Accordingly, among the millions of people who chew processed betel nut in areca non-plant areas, it would be better to use the screening questionnaire with items like “social problems due to betel quid chewing” for it better identifies the abusive behavior of chewers and better reflects the use of screening scale.

The current study has some limitations. Our survey was conducted in 2010. Times have changed, which may affect the application of this screener. However, there is no noticeable change in the use pattern of betel quid in areca non-plant areas, and the research methodology is not outdated. The SST-BQUD is still a valid screening instrument for BQUD, but it may need to be revised in future practice. The sample size was relatively small ($n=112$). The sample of BQCers was not randomly selected from communities, so the majority of participants were male, and the sample representativeness of our sample may be limited.

Despite the limitations stated above, our findings suggest that SST-BQUD is a reliable and valid scale for screening BQUD among BQCers in betel quid processed areas. Based on our experiences, in summary, the test can be completed by self-administered in five minutes, so it is also user-friendly. The SST-BQUD has excellent potential for public health research and intervention programs aiming at reducing betel quid use in the Chinese population.

Conclusion

The standard version of SST-BQUD consists of 14 items. The total score of SST-BQUD was the sum of affirmative answers, with higher scores denoting a more severe BQUD symptom. If one answered six or more times “yes” to these 14 questions, they can be classified with BQUD. The SST-BQUD is a valid screening method for BQUD among BQCers in betel quid processed areas.

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Disclosure

The authors report no conflicts of interest in this work.

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