Research Article

The reliability and validity of Indian version of Chinese restaurant syndrome scale

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ABSTRACT

Background: Universally people relish and appreciate attractive foods from the restaurants. Chinese restaurant syndrome (CRS) includes nexus web of symptoms such as numbness at the back of neck which is gradually radiating to upper limbs, general weakness, and palpitation. Hence, developing a cost-effective tool to assess the CRS among general population was our key research priority. **Objective:** The aim of this study was to develop a self-administered scale to assess the CRS. **Materials and Methods:** This was a cross-sectional study for which parameters for assessing CRS were identified and reviewed by experts in the area of scale construction. Designed questionnaire was given to the 131 study subjects with objectives explained, triad of symptoms (chest pain, numbness, and burning sensation) were analyzed and the confidentiality of the data and results were been assured and a final scale including three domains including 25 item check-list was constructed. Data were analyzed for factor analysis, internal consistency (Cronbachα), test-retest reliability using SPSS v 22.0 software. **Results:** The reliability of the questionnaire was tested using Cronbach's alpha which was 0.91 and the intra class correlation coefficient was 0.90; 95% CI (0.898, 0.936), $P < 0.001$. The test-retest reliability was assessed showing r = 0.92. The Kaiser-Meyer-Olkin index was 0.60 for the adequacy of samples (Bartlett's test of sphericity was significant, df = 28, $P = 0.0001$). **Conclusion:** Although these symptoms are unpleasant, they get slowly unnoticed without treatment in short duration. As the student community is so familiar with junk food culture, craving for Pizza and fast food, an amendment have to be made in public health act and the existing prevention of food adulteration act act to be strictly implemented. Moreover, results of this study provide critical information in assisting clinicians treating individuals with appropriate syndrome.

KEY WORDS: Questionnaire; Chinese Restaurant Syndrome; Monosodium Glutamate; Reliability; Validity

INTRODUCTION

Universally people relish and appreciate attractive foods from the restaurants. Professor Kikunae Ikeda by serendipity invented flavor enhancer monosodium glutamate which has a long history of use in foods.[1,2] Monosodium glutamate is the prime ingredient for the tangy taste by activating the taste receptors on our tongue, especially "umami" receptors which amplifies the tangy flavor of these foods.[3,4] Nexus web of symptoms such as numbness at the back of neck which is gradually radiating to upper limbs, general weakness and palpitation was described by Dr. Kwok in 1986 and described as "Chinese restaurant syndrome" (CRS).[3] Existing literature reveals the CRS symptoms will aggravate in the pre-existing illness such as bronchial asthma, ischemic heart disease thereby contributing to cardiac arrhythmias, extreme rise or drop in blood pressure, tachycardia, and angina. A few studies have linked the effect of MSG on blood

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vessels because of vasoconstriction.[3] Those nexus web of symptoms occur within 15 to 30 min of eating foods with the high concentrations of MSG and usually fades away without treatment in about 2 h.[1] The prevention of food adulteration act (PFA) had recommended the average daily intake of MSG from 0.3 g to 1 g, but in a highly seasoned restaurant it is added as much as 5 g.[1,2]

Rationale

Extensive literature review reveals that there is no gold standard CRS questionnaire (CRSQ) which has been developed or validated for assessing symptoms of general population in India. Hence, developing a cost-effective tool to assess the CRS among general population was our key research priority. This study aims to develop a self-administered scale to assess the CRS and describes the reliability, validity of CRSQ. Operational definition of CRS is distinguished by triad of symptoms (chest pain, numbness, and burning sensation or flushing).[5-7]

MATERIALS AND METHODS

Construction of CRSQ comprised of two phases. First phase included construction of questionnaire. Based on the review of literature, different studies undertaken and with expert opinion from various fields (behavioral & social scientists, public health experts, and nutritionalist), we came with three broad categories in the construction of the CRSQ which were socio demographic characteristics, nutritional history, and symptom complex which are socially and culturally adaptable. Second phase comprised reliability and validity testing.

Defining Categories and Parameters under each Category of CRS Scale

The first category is socio-demographic variables with 18 parameters including anthropometric characteristics. It comprises age, address, type of family, religion, marital status, education, standard of living index (SLI), family history of diabetes, family history of hypertension, family history of both diabetes and hypertension, physical activity, known case of diabetes, known case of hypertension, waist circumference, hip circumference, weight in kg, height in meters, and any known health problems such as asthma, heart related problems. Socio-economic status was assessed using SLI which includes 11 items on housing details, basic amenities, ownership of land livestock, and durable goods. The scoring ranges 0-67 classified as low, medium, and high.[8] Physical activity of woman was computed-based on the international physical activity questionnaire.[9]

The second category includes nutritional with type of diet, homemade or outside food, do they have the habit of adding MSG in homemade food, if yes which all the food they have the habit of adding MSG which included 29 variety of dishes commonly consumed, frequency of visit per week to eleven restaurants which included both MSG and non-MSG using restaurants in and around the study area and also the number of times they tend to take food items per week from these restaurants which comprises 28 variety of dishes. We enquired from the food in charge of the respective restaurants in and around the geographical area of the study participants about the amount; usage of the additive substance in their foods and the confidentiality was maintained.

Third category includes nexus web of symptom complexes such as chest pain, flushing, sense of facial pressure, abnormal heart rhythm, decreased air entry into the lungs, light-headedness, burning or tingling sensation all over the body, vomiting, headache, numbness or burning in or around mouth, sweating, rapid heart rate, dizziness, tightness of jaw, nausea, and wheezing.

Trial of the Scale on Health Professionals

The scale was administered to the selected sample of medical students. A total of 131 students were selected, methodology, and its results are published elsewhere.[10] Each questionnaire took 10 min to administer and was done a week apart. The data were analyzed using SPSS v 17.0; descriptive statistics were presented as frequency (percentage) for categorical variables, mean standard deviation for continuous variables. Chi-square at 5% level of significance was used to find whether there was a statistically significant association between CRS and the recipes.

Scoring was done at two levels, scoring for nutritional history and symptom complex. The nutritional history has got two constructs- food frequency questionnaire (FFQ) and food hubs they visit frequently. The scores for these questions are categorized as 1-3 times/week as one, 3-5 times/week as two and more than five as three. Scoring of final part of the questionnaire, that is, CRS will be done for each symptom in the scale. Marked triad of symptoms such as chest pain, numbness or burning sensation in or around the mouth and flushing are given a score of five. Pre-eminent symptoms like sense of facial pressure, rapid heart rate, and abnormal heart rhythm are given a score of four. Symptoms such as light-headedness, tightness of jaw and burning or tingling sensation all over the body are given a score of three. Wheezing and decreased air entry into the lungs is given a score of two. Symptoms such as headache, sweating, dizziness, nausea, and vomiting are given a score of one. Composite score of the symptom complex sums up to 42. Grading of CRS as follows-mild (0-15), moderate (16-25), severe (26-35), and very severe (36-42). In total, each individual will have two scores on CRS: One score on nutritional history and other on nexus web of symptoms.

RESULTS

In total 105 items entered the final phase of CRSQ development. The reliability of the questionnaire was tested using Cronbach's alpha which was 0.91 and the intra class correlation coefficient was 0.90; 95% CI (0.898, 0.936) (P = 0.0001). Similarly, Cronbach's alpha and intra-class correlation coefficient for each domain are presented in Table 1. The test-retest reliability was assessed showing r = 0.92 (Pearson correlation coefficient). The scale was validated and reliability was established for the urban educated adults including medical graduates. The content validity was evaluated by the help of a team of expert specialists. In general, the assessment of reliability and validity showed that the whole questionnaire had an acceptable validity and reliability.

Factor analysis was performed to scrutinize the construct validity of the questionnaire. This was assessed for both the domains encompassing of nutritional history and CRS symptoms. The range of factors for each domain having Eigen value >1 were extracted for principal component analysis and its variance are shown in Tables 2 and 3. Figures 1 and 2 depict eight of those factors which show most of the variability. The Kaiser-Meyer-Olkin (KMO) index was 0.60 for the adequacy of samples (Bartlett's test of sphericity was significant, df = 28, P = 0.0001).

DISCUSSION

The whole questionnaire had an acceptable validity and reliability. The whole questionnaire has three categories. The first category has socio-demographic variables, second category includes nutritional history with type of diet, homemade or outside food and third category includes nexus web of symptoms. This study is unique in developing a questionnaire to assess the CRS complex. A valid and reliable questionnaire tool was framed in interpreting the symptom complex among medical students. With these search engines (PubMed, PubMed Central, Google Scholar, and Scopus) could not find any questionnaire in this field. Various studies have been carried out in this field by many people in finding out the relation of monosodium glutamate with CRS symptom complex.

The two most important and fundamental characteristics of any measurement procedure are reliability and validity and lie at the heart of competent and effective study.[11] In 2012, Kelishadi et al. designed a valid and reliable tool for assessing the determinants of underweight and overweight in children and adolescents.[12] In 2015, Fatihah et al. developed and validated a FFQ to assess habitual diets of multi-ethnic Malaysian children aged 7-12 years.[13] One of the study on validation ensures exploratory factor analysis basis of sample size estimation, recommending the sample size to range from 100 to 250.[14] Cronbach's alpha of the mobile phone problematic use scale was 0.91.[15] Reliability is measured in the form of internal consistency based on Cronbach's alpha having a level above ≥0.70.[14] The KMO measure of sampling adequacy provides an index (between 0 and 1). Mohammadi et al. reported KMO index for the validity and reliability of the Persian version of test of mobile phone dependency to be 0.94.[16] Nahvizadeh et al. designed a new questionnaire which determined the knowledge, attitude, and practice of high school students regarding addictive drugs and their associated causes.[17] Kerr et al. reported "possible CRS" in his medical school community to be 31%.[18]

This study has got few limitations such as there is no gold standard questionnaire in this field which fails to find the correlation of this questionnaire with standard. The amounts of MSG usage reported by the restaurants were subjective in nature and were not measured. Generalizability of this questionnaire to other sectors of the population is doubtful as the trial of this questionnaire was on urban educated medical

Table 1: Cronbach's alpha and ICC coefficient of CRSQ

Domain	Cronbach's alpha	ICC*	95% CI† for ICC*
Food frequency history	0.811	0.810	0.763-0.853
CRS symptoms	0.908	0.906	0.886-0.928

*ICC: Intra-class correlation †CI: Confidence interval, CRSQ: Chinese restaurant syndrome questionnaire

Table 2: Total variance explained for food items consumed from restaurants

Component	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	5.510	19.677	19.677	4.051	14.469	14.469
2	3.379	12.067	31.744	3.523	12.583	27.052
3	2.924	10.442	42.186	2.738	9.777	36.830
4	2.237	7.991	50.177	2.653	9.475	46.305
5	2.111	7.540	57.717	2.519	8.998	55.303
6	2.029	7.247	64.965	2.154	7.693	62.996
7	1.545	5.517	70.481	1.738	6.206	69.201
8	1.332	4.756	75.237	1.690	6.036	75.237

Extraction method: Principal component analysis

Table 3: Total variance explained for Chinese restaurant syndrome symptoms

Component	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.988	18.676	18.676	2.205	13.779	13.779
2	2.438	15.239	33.915	2.045	12.778	26.557
3	1.803	11.268	45.183	1.705	10.658	37.215
4	1.470	9.186	54.369	1.674	10.461	47.676
5	1.187	7.416	61.785	1.548	9.678	57.353
6	1.137	7.103	68.888	1.448	9.052	66.405
7	1.090	6.812	75.701	1.323	8.270	74.675
8	1.016	6.352	82.052	1.180	7.377	82.052

Extraction method: Principal component analysis

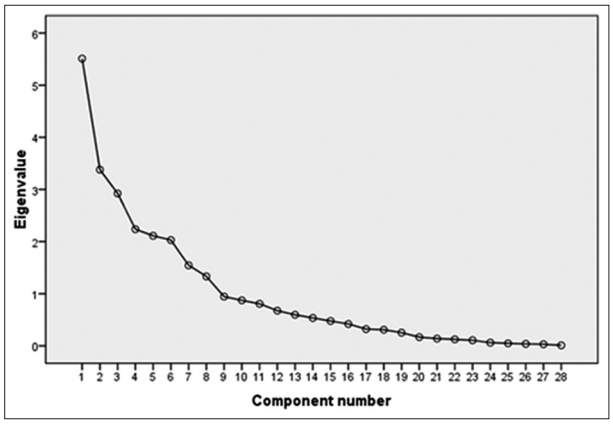

Figure 1: Scree plot for the food items consumed from restaurants

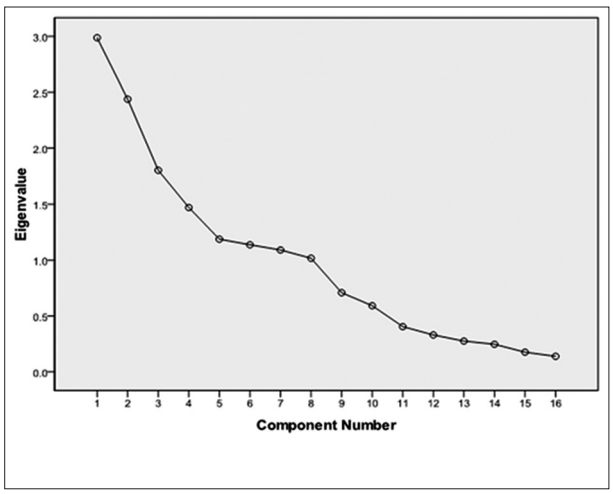

Figure 2: Scree plot for the Chinese restaurants syndrome symptoms

professionals. This gives a way for future research to find the cardio-respiratory changes following the intake of MSG added foods.

CONCLUSION

Although these symptoms are unpleasant, they get slowly unnoticed without treatment in short duration. As the student community is so familiar with junk food culture, craving for Pizza and fast food, an amendment has to be made in Public health act. It is suggested the existing PFA act has to be strictly implemented. Moreover, results of this study provide critical information in assisting clinicians treating individuals with appropriate syndrome.

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