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Development and Psychometric Evaluation of a Chinese Version of Auditory Hallucination Risk Assessment Scale in Patients with a Diagnosis of Schizophrenia

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Abstract

Aims and objectives: To develop a Chinese version of Auditory Hallucination Risk Assessment Scale and evaluate its psychometric properties.

Background: Auditory hallucination, a common symptom in schizophrenia, has the potential to cause harm to patients and the people around them. However, there has been a paucity of suitable instrument developed in Asian region that can comprehensively and reliably assess its risk and inform interventions.

Design: This study involved 2 stages, the development of the Auditory Hallucination Risk Assessment Scale (AHRAS) and testing the psychometric properties of AHRAS. We followed STROBE guidelines in reporting the study.

Methods: AHRAS items were developed based on Symptom Management Theory, systematic literature review and findings of a qualitative study on the experience of auditory hallucinations. The items were evaluated by content validity. AHRAS was then tested for construct validity, concurrent validity, predictive validity, internal consistency and test-retest reliability in a convenience sample of 156 patients with a diagnosis of schizophrenia.

Results: The final version of AHRAS has nine items. Two factors were extracted from AHRAS which explained 57.74 % of the total variance. The score of AHRAS was strongly

correlated with that of the Psychotic Symptom Rating Scales Auditory Hallucinations. Area under the curve was 0.90 for the overall AHRAS score. Sensitivity (86.5%) and specificity (80.0%) were maximal for a mean overall AHRAS score of 13.5, suggesting that this is an appropriate threshold for differentiation. Cronbach's alpha coefficient for internal consistency was 0.82 and intra-class correlation coefficient for test-retest reliability was 0.84.

Conclusions: AHRAS has good reliability and validity. It can be used in clinical settings in China and beyond to assess the risk of auditory hallucinations.

Relevance to clinical practice： AHRAS can serve as a tool for nurses and other healthcare professionals to identify patients with high-risk auditory hallucinations, monitor the changes of risk and inform nursing interventions.

Keywords: schizophrenia, auditory hallucination, risk assessment, scale, psychometric evaluation

Introduction

Despite regular use of neuroleptic medication, many patients with a diagnosis of schizophrenia still experience residual auditory hallucinations (Kane, 2007). Auditory hallucination is the core and most common symptom in many patients with a diagnosis of schizophrenia (Thomas et al., 2007). Patients who hear voices frequently, especially those with vicious content, suffer enormously from emotional trauma, such as low self-esteem and depression (Fannon et al., 2009; Ellett et al., 2017; Thomas, Mcleod, &Brewin, 2009). It contributes profoundly to extreme behaviors such as suicide. A study found that 76% of patients experienced unfriendly voices, 53% of patients had severe negative emotions, and 85% of patients could not distinguish real voices from auditory hallucinations (Phadke, 2015). It was reported that harmful or dangerous command hallucinations occurred in 48% of patients with mental illness, and 69% of patients in medium secure hospital units (Shawyer, Mackinnon, Farhall, Trauer,&Copolov, 2003). Harmful command hallucinations can directly lead to aggressive behaviors or self-mutilation (Barrowcliff, & Haddock, 2006; Shawyer, Mackinnon, Farhall, Trauer, &Copolov, 2003). Patients without an effective coping strategy

are more likely to harm themselves when inflicted with continual voices (Lee, Chong, Chan, & Sathyadevan, 2004). It is thus vitally important for healthcare professionals to conduct accurate and timely risk assessment of auditory hallucinations and to formulate interventions to decrease voice-related harm. In this paper, risk assessment refers to evaluating patients' odds of physically hurting themselves or others due to auditory hallucinations.

Background

Tools for assessing auditory hallucinations have been developed and can be categorized into different types. There are scales assessing overall mental health condition which include a category for hallucination assessment. The most well-known is the Positive and Negative Syndrome Scale (PANSS), where item P3 measures not only auditory hallucination but also other kinds of hallucinations such as olfactory hallucination. In addition, P3 emphasizes hallucinations' influence on patients' thoughts and behaviors regardless of the specific characteristics of hallucinations (e.g., pleasant or vicious) and patients' response (e.g., positive or negative emotional response). The PANSS has been widely used, but it could lead to inaccurate judgement of auditory hallucination risk. Since people experiencing pleasant auditory hallucinations can be classified as severe in P3 but have low risk of self-harm or harm to others. Many of the existing assessment tools involve the evaluation of physical characteristics of voices, including frequency, loudness, clarity, and location. Details vary across different scales. Some are brief (e.g., The Psychotic Symptom Rating Scales-Auditory Hallucinations [Telles-Correia et al.,2017], and Auditory Hallucinations Rating Scale [Hoffman et al., 2003]) while others are relatively extensive (e.g., Matsuzawa Assessment Schedule for Auditory Hallucinations [Hayashi, Igarashi, Suda, &Nakagawa, 2004]). Almost all these scales involve measuring other aspects of voices, such as origin of voices and voices' disruption to life, some of which have little to do with the risk of voices. There are scales focusing on specific aspects of voices. For example, the Beliefs about Voices Questionnaire-Revised (Chadwick, Lees, &Birchwood, 2000) is used to assess patients' belief about voices; the Voice and You Scale (Hayward, Denney, Vaughan,&Fowler, 2008)

is used to assess the relationship between those hearing voices and voices themselves; Responses to Auditory Hallucinations Questionnaire (Mann & Pakenham, 2006) is used to assess patients' responses to voices.

Thus far, to the best of the researchers' knowledge, there is no scale that comprehensively and solely assesses the risk of auditory hallucinations. The Unpleasant Voices Scale (UVS) (Gerlock, Buccheri, Buffum, Trygstad, & Dowling, 2010) was developed to assess voice-related risk, but it is very limited, covering only areas such as the frequency of unpleasant voices, harmful command voices, and patients' compliance; and does not accurately and comprehensively assess the risk. The Harm Command Safety Protocol's measurement is more concise, but only focuses on three components (patients' intent and plan to harm themselves or others, and history of doing harm) (Gerlock, Buccheri, Buffum, Trygstad, & Dowling, 2010).

Another issue is related to who should assess a patient's voice-related risk - patients, or healthcare professionals. We believe it should be patients. Although patients with severe mental illness may deny their mental problems, they can still feel the real disturbance of voices and, in most cases, are willing to actively report the voices they hear (Suryani, Welch, & Cox, 2013). Some patients may be reluctant to communicate with others due to their disease or personality factors. Self-rated scales address this problem because they do not involve patients in verbally communicating with others. They also consume less of a nurse's time. Finally, self-report questionnaires not only reflect information that is usually gathered with interviewer-rated instruments, but they also collect more personal, insightful information about patients' subjective experience (Kim et al., 2010; Jeong et al., 2017). Thus far, all the existing assessment tools for auditory hallucination are developed in western countries and validated with Caucasian populations. There may be cultural differences in Asian settings in relation to the perception of auditory hallucination risk.

Thus, the objectives of the study were to develop a self-rating tool, in Chinese language, for quick and accurate auditory hallucination risk assessment and conduct psychometric evaluation of this new tool.

Methods

Study design

This was a cross-sectional and observational survey designed to test the psychometric properties of a new tool Auditory Hallucination Risk Assessment Scale (AHRAS). We followed the Strengthening the Reporting of Observational Studies in Epidemiology Statement (STROBE) in reporting this study (See Supplementary File 1) (von Elm et al., 2014).

Settings

Four psychiatric hospitals in Shanghai, China.

Development of the AHRAS

Item generation

The AHRAS was developed based on the concepts of Symptom Management Theory (SMT). SMT addresses symptom experience, symptom management strategies, and outcomes (Dodd et al., 2001). It is important to understand patients' experience of auditory hallucination and to manage its risk. Thus, we used the framework of the symptom experience (perception, evaluation, and response) in SMT to determine and organize the components of AHRAS.

The items of AHRAS were generated from a systematic review of existing auditory hallucination assessment tools and prior voices risk-related studies, as well as from a qualitative study on the experience of auditory hallucinations in patients with a diagnosis of schizophrenia (Hoffman et al., 2003; Gerlock, Buccheri, Buffum, Trygstad & Dowling, 2010;Haddock, McCarron, Tarrier, & Faragher,1999; Wang & Shi, 2019). The research team which consisted of experienced psychiatric nurses, psychiatrists and graduate students generated the items. The original AHRAS consisted of 12 items. Four items (frequency, duration, loudness and realness) were related to patients' perception of auditory hallucinations; two items (unfriendly content and its proportion) were related to patients'

evaluation on auditory hallucinations; and six items (degree of anger, frequency of anger, degree of distress, degree of tolerance, patients' control of voices, history of obeying voices leading to self-harm or harming others) were related to patients' response to auditory hallucinations.

Content validity

Two rounds of expert panel consultation (Hsu & Sanford, 2007) were conducted with the aim to test the content validity and to make cultural and wording adjustments. A total of 16 experts were involved. They were psychiatrists, psychiatric nurses, and psychiatric academics. Most of them have master' s degree or above. AHRAS was sent to them by email. They rated their degree of agreement for each item as: agree, revision needed, or disagree, and provided comments on the items for further revision. The importance of each item was then rated quantitatively from 1-5 respectively representing: not important, less important, moderately important, important, very important. Finally, the experts were invited to complete a rating form which assessed their degree of authority on the evaluated items (Cr). Ca represents experts' judgment criteria for the items, including theoretical analysis, practical experience, literature review and intuition. Experts chose the degree of reliance on each criterion when judging the items. The degree of reliance is from high to low. For the "theoretical analysis", it was assigned 0.3,0.2,0.1; for the "practical experience", it was assigned 0.5,0.4,0.3; for the "literature review"and "intuition", they were both assigned 0.1,0.1,0.1. Ca is the total degrees of these four criteria. Cs represents experts' familiarity with the items, ranging from "very familiar" to "unfamiliar", and assigning from "0.9" to "0.1". Cr is measured using the following formula: Cr=(Ca+Cs)/2(Hu et al., 2019). In the process of statistical analysis, Cr greater than 0.7 is considered acceptable (Tan et al.,2007). The mean importance score of each item should be greater than 4, otherwise the item will be deleted (Hu et al., 2017). CV is the variation degree of experts' opinions about the items and is the standard deviation divided by the mean. CV of each item should be less than 20 %, otherwise the item will be deleted (Hu et al., 2017).

In round one, the expert panel provided 50 comments and 25 of them were adopted after

discussion among the research team. The results showed that Cr was between 0.75–0.95 and the mean importance score of each item was 4.31–5.00. Both met the above-mentioned criteria for Cr and importance score. The item "In the previous one week, how often did voices arouse your anger?" was deleted because its CV was greater than 20% (22.2%).

The revised AHRAS was sent to all experts again for further comments. Round two returned 22 comments with 11 of them adopted. All items met the criteria. In this round, two items were added: number of voices, and share voices with family members or medical staff. After this round, the AHRAS has a total of 13 items which are categorized into three dimensions. Perception dimension included frequency, duration, loudness and number of voices. Evaluation dimension included realness, unfriendly content and its proportion. Response dimension included degree of anger, degree of distress, degree of tolerance, patients' control of voices, history of obeying voices leading to self-harm or harming others, share voices with family members or medical staff.

The Psychometric Evaluation of the AHRAS

Participants

From March to July of 2019, in-patients with auditory hallucinations were recruited from four psychiatric hospitals in Shanghai by convenience sampling. Inclusion criteria were: in-patients who have a diagnosis of schizophrenia by their attending psychiatrists according to International Classification of Diseases, Tenth Edition (ICD-10) criteria; the existence of auditory hallucinations one week before the survey; having abilities to read, write and communicate in Chinese; being able to provide informed consent. Exclusion criteria were: severe intellectual disability, and severe violent or self-harm tendency.

Sample size

The sample size was calculated based on 10 participants per item (Kline, 2005). Thus 130 participants should be sufficient. Taking into account of drop out and incomplete questionnaires, a total of 162 patients were invited to participate in the study. Finally, 156 patients were included in the study analysis as 4 patients refused to continue with the questionnaires during the process, and 2 patients were interrupted by family visit thus could

not complete the questionnaires.

Instruments

AHRAS contains 13 items with three dimensions: perception, evaluation, and response. Each item is rated on a 5-point Likert scale from 0-4 with higher scores indicating higher risk.

The Psychotic Symptom Rating Scales-Auditory Hallucinations (PSYRATS-AH) was used to test the concurrent validity of AHRAS. It is a 4-factor scale used to measure the severity of auditory hallucinations and contains 11 items (Telles-Correia et al.,2017). Factor one includes amount and degree of negative content, amount and intensity of distress, disruption to life. Factor two includes frequency and duration of auditory hallucinations. Factor three includes loudness and controllability. Factor four includes location and origin of voices. Each item is rated on a Likert scale from 0-4 with higher scores indicating more severe auditory hallucinations.

Data collection

The student researcher (first author) was a student studying her master programme in a tertiary psychiatric hospital. She had access to hospitalized in-patients in the study venues. The head nurses of the hospitals introduced the researchers to eligible patients according to inclusion and exclusion criteria. The student researcher met with individual potential participants, provided them with information and the participant information sheet, explained the study to them in details, and allowed them to ask questions. Those who agreed to participate signed the informed consent. The student researcher distributed the AHRAS to patients, which was completed by patients themselves. One of the team members who is a psychiatric nurse and professionally trained to conduct face to face structured interviews with patients, administered the PSYRATS-AH. She read the items and recorded participants' response on the questionnaire. The data collection of two researchers was conducted at different time of a day in a quiet and private room in the wards.

A test-retest of AHRAS was conducted six to eight days after the first test to a smaller subgroup of the participants (n=36) who were available and willing to do the retest.

Statistical analysis

SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) was used. CR value was used to delete items that could not well distinguish high-risk participants from low-risk ones. The AHRAS score of 156 patients was ranked from high to low. The upper and lower 27 % of patients were regarded as group A and group B respectively. Then the means of each item were compared between groups using independent sample t-test, items without statistical significance ($p>0.05$) were deleted (Zhu et al., 2019). Next, item-total correlation coefficient was used to delete items that had minor relations (0.4 or lower) to the total scores of AHRAS (Reinius et al., 2017). Finally, according to the results of exploratory factor analysis (EFA), we deleted items with less than a 0.5 loading value (Parker & Waller, 2017).

The Cronbach's alpha coefficients for the entire scale and different factors were calculated, those items that were no lower than 0.5 were accepted (Dullie, Meland, Hetlevik, Mildestvedt & Gjesdal, 2018). The intra-class correlation coefficient (ICC) was calculated between the first test and retest of AHRAS. Different values represented different levels of reliability (0–0.2, poor; 0.3–0.4, fair; 0.5–0.6, moderate; 0.7–0.8, strong; and >0.8, excellent) (Potkin et al., 2016).

Pearson correlation test was conducted among total mean scores of each factor and the AHRAS total mean scores. Good correlations across factor scores indicate that factors are measuring similar but distinct sub-constructs while good correlations between factor scores and AHRAS total scores mean that the factors and the composite scores are measuring the same construct (Feng et al., 2020).

In terms of concurrent validity, Pearson correlation test was conducted between AHRAS and PSYRATS-AH. For predictive validity, we defined a score of PSYRATS-AH greater than or equal to 22 as high voice-related risk and a score less than 22 as low voice-related risk. We used receiver operating characteristics (ROC) analysis to determine the cut-off score that optimizes classification.

Ethical considerations

This study was approved by the ethics committee of the Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine (reference no: 2017-36R). Written informed consent was obtained from the participants. The participants were informed of all study details. Their participation was voluntary, and they had the right to withdraw from the study at any time. Whether they participated or not would have no implication to the services that they received. The information that they provided would be kept confidential and their names would not be associated with any of the data or study report.

Results

Study participants

A total of 156 patients participated in this study. More than one-half of the participants were unmarried (n=91, 58.3%). There were almost equal number of male (n=69, 44.2 %) and female participants (n=87, 55.8 %). More than half of the participants (n=100, 64.1%) had a junior or senior high school of education. More than one-third of the participants (n=64, 41%) had a history of violence. However, most participants had no insight into their mental illness (n=97, 62.2%). The participants' characteristics are presented in Table 1.

Item analysis

After comparing the means of each item between group A (42 participants with the highest AHRAS scores) and group B (42 participants with the lowest AHRAS scores), item 13 "In the previous one week, did you actively tell your family members or medical staff about the voices?" showed no statistical significance ($t=-1.37$, $p=0.174$), and was deleted (Zhu et al., 2019). Table 2 presents the CR value of all items in the AHRAS. After the analysis of item-total correlation coefficients, another three items were deleted for their low correlations with the total scores of AHRAS (0.4 or lower). They were item 4 "In the previous one week, how many voices did you hear every time generally?" ($r=0.38$, $p<0.001$), item 5 "In the previous one week, to what extent did you think the voices were real?"($r=0.36$, $p<0.001$), and item 12 "In the previous one year, did you follow command voices to harm yourself or others?" ($r=0.31$, $p<0.001$). After this procedure, 9 items were left in AHRAS.

They were frequency, duration and loudness in perception dimension; unfriendly content and its proportion in evaluation dimension; and degree of anger, degree of distress, degree of tolerance, patients' control of voices in response dimension.

Construct validity

Construct validity was assessed by EFA as well as correlations across factor scores. The Kaiser-Meyer-Olkin test for sampling adequacy was 0.83, indicating that the items of this scale were sufficiently correlated to conduct a factor analysis (Stuart, Sartorius, Liinamaa, & Images Study Group,2014). EFA was conducted using the principal component method of extraction followed by varimax rotation. All the variables had a 0.5 or greater loading value and thus, were retained. The scree plot indicated that among the nine components of AHRAS, only two of them had eigenvalues that were greater than 1(Figure 1). Table 3 presents the specific eigenvalues and variance contribution rate of each component of AHRAS. The AHRAS consisted of two factors, accounting for 57.74% of the total variance. One factor was "subjective feelings", including unfriendly content and its proportion, degree of anger, degree of distress, and degree of tolerance. The other was "objective characteristics", including frequency, duration, loudness and patients' control of voices (Table 4). The Pearson correlation coefficient of the two factors was 0.43 ($p<0.001$), which was moderate correlation. The correlation coefficients between factor scores and the AHRAS total scores were 0.89 ($p<0.001$) and 0.79 ($p<0.001$), respectively which were considered strong correlation (Cohen,1992).

Concurrent validity

The total score of AHRAS has strong positive correlation with that of PSYRATS-AH ($r= 0.85$, $p<0.001$). All factors of PSYRATS-AH (except factor 4) have significant correlation with factors in AHRAS (Table 5).

Predictive validity

According to the classification of PSYRATS-AH score, there were 96 patients who had

high voice-related risk and 60 patients who had low voice-related risk. The area under the curve was then calculated and the best cut-off score was determined by Youden index (sensitivity + specificity - 1) (Dong et al., 2020). The results showed that the area under the curve was 0.90, the standard error was 0.03, and the 95% confidence interval was 0.85-0.95 ($p<0.001$). When the total score of AHRAS was 13.5, Youden index was the largest, which was 0.67. In such case, the sensitivity was 86.5%, and the specificity was 80.0%. Therefore, the critical value of AHRAS was 14. Scores that were higher than or equal to 14 indicated existing high risk of auditory hallucination (95 cases), and scores that were lower than 14 indicated low risk of auditory hallucination (61 cases). The ROC curve of AHRAS is presented in Figure 2.

Reliability

The Cronbach's alpha coefficient of each factor was 0.83 and 0.69 respectively and was 0.82 for the whole scale which indicated good internal consistency. The test-retest ICC of the total scale was 0.84, which indicated that the scale has excellent stability over six to eight days.

Discussion

This paper reported the development and psychometric evaluation of AHRAS. To the best of our knowledge, the study is the first of its kind in China and Asian region. The AHRAS was developed based on the theoretical framework of SMT and current evidence from a qualitative study and systematic review. The AHRAS was tested through a rigorous process. It demonstrated good validity and reliability.

However, the 2-factor structure extracted from EFA in the study was not the same as the 3-dimension structure based on the framework of symptom experience in SMT which included perception (frequency, duration, loudness), evaluation (unfriendly content and its proportion) and response (degree of anger, degree of distress, degree of tolerance, patients' control of voices). The item "patients' control of voices" was incorporated into the original perception dimension to construct factor 2 (objective characteristics). The remaining items of response dimension were combined with items in the evaluation dimension to form factor

1(subjective feelings). Although the distribution of items changed, each item still reflects patients' perception of, evaluation on or response to voices. Thus, compared with previous instruments, the newly developed AHRAS improved the accuracy of predicting risk. The results of EFA also indicated that we could consider voice-related risk from two rather than three dimensions (perception, evaluation and response), namely patients' subjective feelings and objective characteristics related to voices.

Concurrent validity analysis found that the total score of AHRAS was highly correlated with that of PSYRATS-AH, which can be partially explained by several items they share. Likewise, factor 1 of AHRAS (subjective feelings) was closely related to factor 1 of PSYRATS-AH (emotion characteristics and disruption) which integrated negative content, negative content proportion and distress into one factor (Telles-Correia et al., 2017). However, correlations between all factors of AHRAS and factor 4 of PSYRATS-AH were not significant, which meant that the risk of voices was not related to the location and origin of voices. PSYRATS-AH served as the item source of AHRAS and the tool to test its concurrent validity. However, they aim at different aspects of auditory hallucinations. The PSYRATS-AH focuses on symptom severity assessment, the AHRAS is for risk assessment. They have something in common but also have their unique consideration in item selection. Those hearing pleasant voices can be rated as serious in PSYRATS-AH, but less risky in AHRAS. The methods of evaluation are also different.

AHRAS, as a self-rating tool, could be more acceptable to patients, especially for those who are unwilling to verbally communicate with others on voices due to personality or disease factors. It could acquire more accurate data. Patients can complete AHRAS themselves and even write down more personal feelings. Accurate assessment could contribute to better quality of care.

As for predictive validity, the current study showed that the area under the curve was 0.90 (95% confidence interval was 0.85-0.95), indicating that the diagnostic efficiency of AHRAS was good. The positive predictive value of AHRAS was 88.9% and the negative predictive value was 82.2%, which meant AHRAS could recognize high-risk patients with auditory hallucinations and has low probability of diagnostic errors. The Cronbach's alpha coefficient of AHRAS was 0.82, indicating that AHRAS has good internal consistency. In

addition, the test-retest ICC (0.84) of AHRAS indicated that the scale was stable over time.

In the development of the items for AHRAS, we combined the auditory hallucination experience of Chinese patients with a diagnosis of schizophrenia as well as experts' opinions which took into account of the characteristics of Chinese patients. The final version of AHRAS contains nine items. It is brief and comprehensive, thus easy to administer in clinical settings. The AHRAS will be a good addition to the existing tools in assessing the risk of auditory hallucination in Chinese patients.

Limitations

Many psychiatric diseases have symptoms of auditory hallucination (Shinn et al., 2012). This study only included participants with a diagnosis of schizophrenia. Thus, the study results may not be able to generalize to patients with other diagnoses. In addition, this study was conducted in Shanghai. The results may not be able to be generalized to other areas of China, thus further studies are needed.

Conclusion

The AHRAS is a brief, reliable and valid tool that has been culturally adapted to assess voice-related risk of Chinese patients with a diagnosis of schizophrenia. The AHRAS contributes to improving auditory hallucination risk assessment. It is an addition to the available assessment tools of auditory hallucination. It is a new clinical tool that can be applied in clinical settings in China and beyond. Further researches should focus on examining the feasibility of applying AHRAS to patients who do not have a diagnosis of schizophrenia but are suffered from auditory hallucinations, and patients in other geographic areas in China outside Shanghai.

Relevance to clinical practice

Patients with high risk of auditory hallucinations can be identified by AHRAS which can inform nurses of specific aspects of risk, such as subjective feelings (e.g., distress, anger) and objective characteristics (e.g., lack of control methods). Prompt interventions can be taken by

nurses to reduce voice-related risk. In addition, AHRAS can also be used to monitor the changing risk of auditory hallucinations when patients are under treatment.

Impact Statement

AHRAS is a brief, comprehensive and useful tool for psychiatric nurses to identify patients with high-risk auditory hallucinations.

The results of AHRAS can inform healthcare professionals of specific voice-related risk and help to formulate corresponding interventions to reduce risk.

References

Barrowcliff, A.L., ＆Haddock, G. (2006). The relationship between command hallucinations and factors of compliance: a critical review of the literature. Journal of Forensic Psychiatry and Psychology,17(2),266-298. doi:10.1080/14789940500485078

Chadwick, P., Lees, S., ＆Birchwood, M. (2000). The revised Beliefs About Voices Questionnaire (BAVQ-R). British Journal of Psychiatry,177,229-232. doi:10.1192/bjp.177.3.229

Cheung, P., Schweitzer, I., Crowley, K., ＆Tuckwell, V. (1997). Violence in schizophrenia: role of hallucinations and delusions. Schizophrenia Research,26(2-3),181-190. doi:10.1016/s0920-9964(97)00049-2

Cohen, J. (1992). A power primer. Psychological Bulletin, 112(1),155-159. doi: 10.1037//0033-2909.112.1.155

Dodd, M., Janson, S., Facione, N., Faucett, J., Froelicher, E.S., Humphreys, J., …Taylor, D. (2001). Advancing the science of symptom management. Journal of Advanced Nursing, 33(5),668-676. doi: 10.1046/j.1365-2648.2001.01697.x

Dong, W., Liu, X., Zhu, S., Lu, D., Cai, K., Cai, R., …Li, M. (2020). Selection and optimization of nutritional risk screening tools for esophageal cancer patients in China. Nutrition Research and Practice, 14(1),20-24. doi: 10.4162/nrp.2020.14.1.20

Dullie, L., Meland, E., Hetlevik, Ø., Mildestvedt, T., ＆Gjesdal, S. (2018). Development and validation of a Malawian version of the primary care assessment tool. BMC Family Practice,19(1),63. doi: 10.1186/s12875-018-0763-0

Ellett, L., Luzon, O., Birchwood, M., Abbas, Z., Harris, A., ＆Chadwick, P. (2017). Distress, omnipotence, and responsibility beliefs in command hallucinations. British Journal of Clinical Psychology,56(3),303-309. doi:10.1111/bjc.12139

Fannon, D., Hayward, P., Thompson, N., Green, N., Surguladze, S., ＆Wykes, T. (2009). The self or the voice? Relative contributions of self-esteem and voice appraisal in persistent auditory hallucinations. Schizophrenia Research, 112(1-3),174-180. doi:10.1016/j.schres.2009.03.031

Feng, J., Li, Y., Sun, Y., Wang, L., Qi, W., Wang, K.T., ＆Xue, Y. (2020). The Chinese Spiritual Coping Scale: Development and Initial Psychometric Evaluation. Journal of Religion and Health, [Epub ahead of print]. doi: 10.1007/s10943-019-00970-z.

Gerlock, A.A., Buccheri, R., Buffum, M.D., Trygstad, L., ＆Dowling, G.A. (2010). Responding to Command Hallucinations to Harm: the unpleasant voices scale and harm command safety protocol. Journal of Psychosocial Nursing and Mental Health Services,48(5),26-33. doi: 10.3928/02793695-20100304-03

Haddock, G., McCarron, J., Tarrier, N., ＆Faragher, E.B. (1999). Scales to measure dimensions of hallucinations and delusions: the psychotic symptom rating scales (PSYRATS). Psychological Medicine,29(4),879-889. doi:10.1017/s0033291799008661

Hayashi, N., Igarashi, Y., Suda, K., ＆Nakagawa, S. (2004). Phenomenological features of auditory hallucinations and their symptomatological relevance. Psychiatry and Clinical Neurosciences,58(6),651-659. doi: 10.1111/j.1440-1819.2004.01316.x

Hayward, M., Denney, J., Vaughan, S., &Fowler, D. (2008). The voice and you: development and psychometric evaluation of a measure of relationships with voices. Clinical Psychology&Psychotherapy,15(1),45-52. doi:10.1002/cpp.561

Hoffman, R.E., Hawkins, K.A., Gueorguieva, R., Boutros, N.N., Rachid, F., Carroll, K., & Krystal, J.H. (2003). Transcranial magnetic stimulation of left temporoparietal cortex and medication-resistant auditory hallucinations. Archives of General Psychiatry, 60(1),49-56. doi:10.1001/archpsyc.60.1.49

Hsu, C., &Sanford, B. (2007). The Delphi technique: making sense of consensus. Practical Assessment, Research & Evaluation,12,1-8.

Hu, J., Fallacaro, M.D., Jiang, L., Wu, J., Jiang, H., Shi, Z., &Ruan, H. (2017). IFNA approved Chinese Anaesthesia Nurse Education Program: A Delphi method. Nurse Education Today,56,6-12. doi: 10.1016/j.nedt.2017.05.017

Hu, Q., Qin, Z., Zhan, M., Wu, B., Chen, Z., &Xu, T. (2019). Development of a trigger tool for the detection of adverse drug events in Chinese geriatric inpatients using the Delphi method. International Journal of Clinical Pharmacy,41(5),1174-1183. doi:10.1007/s11096-019-00871-x

Jeong, S.H., Chung, I., Jung, H.Y., Hwang, S.S., Kim, S.H., Youn, T., ...Kim, Y.S. (2017). Comparison of clinician-rated and self-report insight in Korean patients with schizophrenia using VAGUS insight scale. Psychiatry Research, 258,93-100. doi: 10.1016/j.psychres.2017.10.003

Junginger, J., &Frame, C.L. (1985). Self-report of the frequency and phenomenology of verbal hallucinations. Journal of Nervous and Mental Disease,173(3),149-155. doi:10.1097/00005053-198503000-00003

Kane, J.M. (2007). Treatment resistant schizophrenic patients. Journal of Clinical Psychiatry,57(suppl9),35-40.

Kasper, M.E., Rogers, R., &Adams, P.A. (1996). Dangerousness and command hallucinations: an investigation of psychotic inpatients. Bulletin of the American Academy of Psychiatry and the Law,24(2),219-224.

Kim, S.H., Jung, H.Y., Hwang, S.S., Chang, J.S., Kim, Y., Ahn, Y.M., &Kim, Y.S. (2010). The usefulness of a self-report questionnaire measuring auditory verbal hallucinations.

Progress in Neuro-Psychopharmacology & Biological Psychiatry,34(6),968-973. doi: 10.1016/j.pnpbp.2010.05.005

Kline, R.B. (2005). Principles and practice of structural equation modeling (2nd ed.). New York: Guilford Press.

Parker, Z. J., &Waller, G. (2017). Development and Validation of the Negative Attitudes towards CBT Scale. Behavioural and Cognitive Psychotherapy,45(6),629-646. doi: 10.1017/S1352465817000170

Lee, T.M., Chong, S.A., Chan, Y.H., &Sathyadevan, G. (2004). Command hallucinations among Asian patients with schizophrenia. Canadian Journal of Psychiatry, 49(12), 838-842. doi:10.1177/070674370404901207

Mann, B., &Pakenham, K.I. (2006). Development of a measure to assess coping for auditory hallucinations. Australian Journal of Psychology,52(2),93-100. doi：10.1080/00049530600730450

Ngooi, B.X., Packer, T.L., Warner, G., Kephart, G., Koh, K.W.L., Wong, R.C.C., &Lim, S.P. (2018). How adults with cardiac conditions in Singapore understand the Patient Activation Measure (PAM-13) items: a cognitive interviewing study. Disability and Rehabilitation,40(5),587-596. doi:10.1080/09638288.2016.1261413

Phadke, I. (2015). Hallucinations in Patients with Schizophrenia Attending a Tertiary Psychiatry Hospital (translated from يد راجعون الذين الـ فصام مرضى في الهلوسات الـ ثالث المسيتوى من مسد تشد في). The Arab Journal of Psychiatry,26(1), 68-73.

Potkin, S.G., Bugarski-Kirola, D., Edgar, C.J., Soliman, S., Le Scouiller, S., Kunovac, J., …Garibaldi, G.M. (2016). Psychometric evaluation of the Work Readiness Questionnaire in schizophrenia. CNS Spectrums, 21(2),199-206. doi: 10.1017/S1092852914000352

Reinius, M., Wettergren, L., Wiklander, M., Svedhem, V., Ekström, A.M., &Eriksson, L.E. (2017). Development of a 12-item short version of the HIV stigma scale. Health and Quality of Life Outcomes,15(1),115. doi: 10.1186/s12955-017-0691-z

Shawyer, F., Mackinnon, A., Farhall, J., Trauer, T., &Copolov, D. (2003). Command Hallucinations and Violence: Implications for Detention and Treatment. Psychiatry Psychology and Law, 10(1),97-107. doi: 10.1375/pplt.2003.10.1.97

Shinn, A.K., Pfaff, D., Young, S., Lewandowski, K.E., Cohen, B.M., &Öngür, D. (2012). Auditory hallucinations in a cross-diagnostic sample of psychotic disorder patients: a descriptive, cross-sectional study. Comprehensive Psychiatry,53(6),718-726. doi: 10.1016/j.comppsych.2011.11.003

Stuart, H., Sartorius, N., Liinamaa, T., &Images Study Group. (2014). Images Study Group The images of psychiatry scale: development, factor structure, and reliability. BMC Psychiatry,14,337. doi: 10.1186/s12888-014-0337-1

Suryani, S., Welch, A., &Cox, L. (2013). The phenomena of auditory hallucination as described by Indonesian people living with schizophrenia. Archives of Psychiatric Nursing,27(6),312-318. doi: 10.1016/j.apnu.2013.08.001

Tan, H., Ping, W., Yang, T., Li, S., Liu, A., Zhou, J., …Sun, Z. (2007). The synthetic evaluation model for analysis of flooding hazards. European Journal of Public Health, 17(2),206-210. doi:10.1093/eurpub/ckl067

Telles-Correia, D., Barbosa-Rocha, N., Gama-Marques, J., Moreira, A.L., Alves-Moreira, C., Saraiva, S., … Haddock, G. (2017). Validation of the Portuguese version of the Psychotic Symptom Rating Scales (PSYRATS). Actas Espanolas de Psiquiatria, 45(2),56-61.

Thomas, P., Mathur, P., Gottesman, I.I., Nagpal, R., Nimgaonkar, V.L., &Deshpande, S.N. (2007). Correlates of hallucinations in schizophrenia: A cross-cultural evaluation. Schizophrenia Research,92(1-3),41-49. doi:10.1016/j.schres.2007.01.017

Thomas, N., Mcleod, H.J., &Brewin, C.R. (2009). Interpersonal complementarity in responses to auditory hallucinations in psychosis. British Journal of Clinical Psychology,48(4),411-424. doi:10.1348/014466509X411937

von Elm, E., Altman, D.G., Egger, M., Pocock, S.J., Gøtzsche, P.C., Vandenbroucke, J.P., & STROBE Initiative. (2014). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. International Journal of Surgery, 12(12),1495-1499. doi: 10.1016/j.ijsu.2014.07.013

Wang, X.X., &Shi, Z.Y. (2019). Study on the lived experience of auditory hallucinations in stable inpatients with a diagnosis of schizophrenia. Manuscript submitted for publication.

Zhu, Y., Zhan, Y.C., Zhu, J.M., Huang, L., Zhang, L., Zhang, M., &Li, B.K. (2019). The development and psychometric validation of a Chinese empathy motivation scale. Journal of Clinical Nursing, 28(13-14), 2599-2612. doi: 10.1111/jocn.14846

Tables

Table 1. Participants characteristics (n=156)

Item	Mean (SD)	N (%)
Illness Duration(year)	15.47 (12.84)	
Age	39.61 (15.78)	
Sex		

Male	69 (44.2)
Female	87 (55.8)
Marital Status	
Unmarried	91 (58.3)
Married	45 (28.8)
Divorced	15 (9.6)
Widow/Widower	3 (1.9)
Other status	2 (1.3)
Education Level	
Primary school or lower	9 (5.8)
Junior high school	29 (18.6)
Senior high school	71 (45.5)
Junior college	18 (11.5)
University or above	29 (18.6)
Disease Insight	
No	97 (62.2)
Partial	53 (34.0)
Complete	6 (3.8)
Violence History	
No	92 (59.0)
Yes	64 (41.0)
Family History	
No	115 (73.7)
Yes	41 (26.3)
MECT	
No	88 (56.4)
Yes	68 (43.6)
Occupation	
No	74 (47.4)

Yes	36 (23.1)
Retired	28 (17.9)
Student	18 (11.5)

Note. MECT, Modified Electra Convulsive Therapy.

Table 2. The CR value of items in AHRAS

Item	Upper27% patients (Mean±SD)	Lower27% patients (Mean±SD)	t	p
Frequency	3.26±1.08	1.69±0.81	-7.53	<0.001
Duration	2.98±1.39	0.76±0.98	-8.44	<0.001
Loudness	2.55±1.02	1.05±0.82	-7.42	<0.001
Number of voices	1.98±1.22	0.57±0.94	-5.91	<0.001
Realness	3.21±0.90	2.26±1.34	-3.82	<0.001
Unfriendly content	3.07±0.81	0.67±1.12	-11.29	<0.001
The proportion of unfriendly content	3.17±0.91	0.69±0.84	-12.97	<0.001
Degree of anger	2.29±1.37	0.31±0.52	-8.76	<0.001
Degree of distress	2.69±1.20	0.43±0.55	-11.12	<0.001
Degree of tolerance	2.86±1.14	1.19±0.74	-7.95	<0.001
Patients' control of voices	3.19±1.13	1.52±1.52	-5.71	<0.001
Compliant history of harmful command voices	0.98±1.41	0.29±0.67	-2.87	0.006
Share voices with family members or medical staff	2.90±1.28	2.50±1.42	-1.37	0.174

Note. AHRAS, Auditory Hallucination Risk Assessment Scale.

Table 3. Eigenvalues and variance contribution rate of each component of AHRAS

Component	Eigenvalue	Variance (%)	Cumulative variance (%)
1	3.77	41.84	41.84
2	1.43	15.90	57.74
3	0.81	8.98	66.72
4	0.71	7.87	74.59
5	0.67	7.40	82.00
6	0.55	6.09	88.09
7	0.39	4.37	92.45
8	0.37	4.12	96.57
9	0.31	3.43	100.00

Note. AHRAS, Auditory Hallucination Risk Assessment Scale.

Table 4. The exploratory factor analysis of AHRAS

Item	Factor1	Factor2	Extracted Communalities
1.In the previous one week, how often did the voices appear in an average level? 0.Voices appeared less than once a week 1.Voices appeared at least once a week 2.Voices appeared at least once a day 3.Voices appeared at least once an hour 4.Voices appeared continuously or almost continuously, or were interrupted for a few seconds or minutes.	0.14	**0.81**	0.68
2.In the previous one week, how long did the voices last every time in an average level?		**0.85**	0.73

0.Voices lasted for a few seconds at a time 1.Voices lasted for several minutes to half an hour at a time 2.Voices lasted for more than half an hour but less than 1 hour at a time 3.Voices lasted for several hours at a time 4.Voices were not interrupted or interrupted for a few seconds or minutes			
3.In the previous one week, how loud were the voices you heard in an average level? 0.Voices were too light to hear 1.Voices were audible 2.Voices were moderate 3.Voices were loud 4.Voices were noisy	0.36	**0.53**	0.41
4.In the previous one week, what unfriendly content did the voices contain? (if more than one option below matches you, choose the larger number) 0.There was nothing unfriendly in voices 1.Voices commented on others, not on me 2.Voices told me what I should not do or how to do something 3.Voices insulted me, spoke ill of me or threatened to hurt me or my family members 4.Voices commanded me to hurt myself, others or the surrounding environment	**0.78**		0.61
5.In the previous one week, among all the voices you heard, what was the proportion of	**0.80**	0.20	0.68

unfriendly voices? 0. no unfriendly content 1.< 10% of the content was unfriendly 2.< 50% of the content was unfriendly 3. 50% - 80% of the content was unfriendly 4. > 80% of the content was unfriendly			
6.In the previous one week, to what extent did the voices arouse your anger generally? 0.Voices did not make me angry 1.Voices made me a little angry 2.Voices made me moderately angry 3.Voices made me very angry 4.Voices made me extremely angry	**0.78**	0.15	0.63
7.In the previous one week, to what extent did the voices distress you generally? 0.Voices did not distress me 1.Voices distressed me a little 2.Voices distressed me moderately 3.Voices distressed me a lot 4.Voices distressed me extremely	**0.77**	0.18	0.62
8.In the previous one week, to what extent could you endure the voices? 0. I enjoyed voices 1. I could live in peace with voices 2. I could barely stand voices, but I hoped it would disappear soon 3.I could not stand voices 4.I could not stand voices at all	**0.63**	0.26	0.46
9.In the previous one week, how well could you	0.17	**0.59**	0.38

control the voices?					
0.I could always banish or ignore voices easily					
1.I could reduce or ignore voices most of the time					
2.I could reduce or ignore voices for about half the time					
3.I could occasionally reduce or ignore voices					
4.I could not do anything to reduce or ignore voices					

Note. Bold values represent successfully loading (>0.5) onto the factor.

AHRAS, Auditory Hallucination Risk Assessment Scale.

Table 5. Pearson correlations between AHRAS and PSYRATS-AH(n=156)

AHRAS	PSYRATS-AH				
	Factor 1	Factor 2	Factor 3	Factor 4	Total score
Factor 1	0.88 (p<0.001)	0.30 (p<0.001)	0.28 (p<0.001)	0.11 (p=0.190)	0.80 (p<0.001)
Factor 2	0.34 (p<0.001)	0.85 (p<0.001)	0.52 (p<0.001)	0.08 (p=0.343)	0.62 (p<0.001)
Total score	0.77 (p<0.001)	0.63 (p<0.001)	0.45 (p<0.001)	0.11 (p=0.173)	0.85 (p<0.001)

Note. AHRAS, Auditory Hallucination Risk Assessment Scale.

PSYRATS-AH, Psychotic Symptom Rating Scales-Auditory Hallucinations.

Figure 1. The scree plot of AHRAS

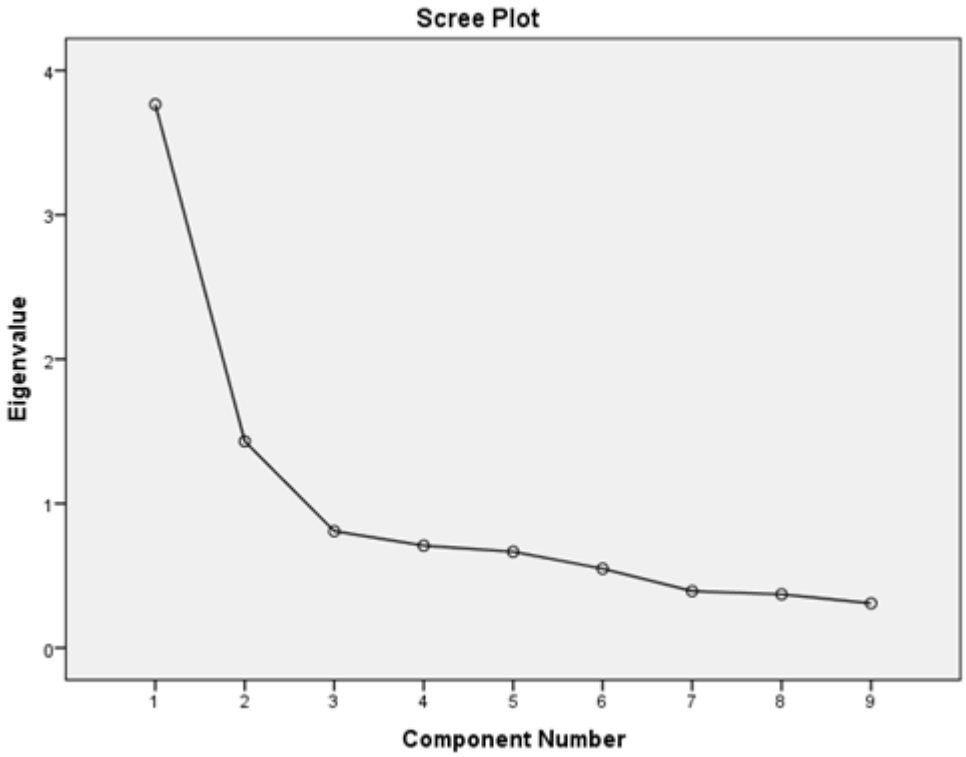
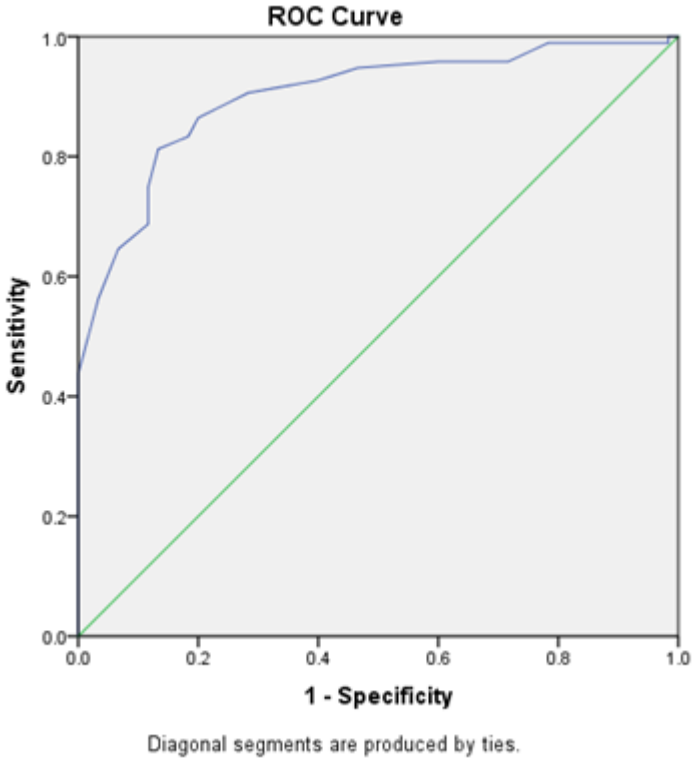


Figure 2. The ROC curve of AHRAS



Note. The area under the curve was 0.90.