Reliability and validity study of Sino-nasal outcome test 22 (Thai version) in chronic rhinosinusitis

Jate Lumyongsatien 1*, Waralak Yangsakul 1, Chaweewan Bunnag 1, Claire Hopkins 2 and Pongsakorn Tantilipikorn 1

Abstract

Background: Chronic rhinosinusitis (CRS) is one of common health conditions that affects patients’ health-related quality of life. Our purpose is to assess the reliability and validity of Thai-version of Sino-Nasal Outcome Test 22 in chronic rhinosinusitis.

Methods: Permission for translation of SNOT-22 from English language to Thai language was obtained from the developer. The translation process was done based on the international standard of translation method. A total of 80 subjects were recruited into the study and divided into two groups comprising of 50 patients with chronic rhinosinusitis and 30 healthy volunteers. Cronbach’s α and Intraclass correlation coefficient were evaluated for its reliability. Validity test was evaluated against VAS score, SF-36 (Thai version) questionnaire and CT scan (based on Lund-Mackay score). Responsiveness was assessed between pre-operative and post-operative scores in 34 patients.

Results: The Thai version of SNOT-22 showed good reliability according to high value of Cronbach’s α coefficient (r = 0.929) and intraclass correlation coefficient (r = 0.935). It also showed good validity by its ability to differentiate the patients with chronic rhinosinusitis from normal (p < 0.001), and different severity of symptoms (p < 0.05). In addition, the SNOT-22 Thai version also showed good responsiveness when compared between pre-operative and post-operative scores (p < 0.001) and also well-performed in effect size calculation (1.37).

Conclusion: We demonstrated that Thai-version of SNOT-22 has good reliability and validity, suitable for evaluation of chronic rhinosinusitis symptoms together with severity of the disease and response to treatment.

Trial registration: Thai clinical trials registry TCTR20170320003. Date of registration 20/03/2017 (retrospectively registered).

Keywords: Chronic disease, Language, Quality of life, Reproducibility of results, Sinusitis, Surveys and questionnaires, Translations

Background

Chronic rhinosinusitis (CRS) is a common chronic condition affecting significant portion of population. It has been showed that CRS affects 5–15% of the general population both in Europe and the United states [1]. Using general measurement of quality of life (QOL) questionnaire, CRS has been found to affect patient’s QOL not less than other conditions such as congestive heart failure, angina, chronic obstructive lung disease and back pain [2]. Although the general questionnaire, such as SF-36 was demonstrated to be useful in assessment of CRS patient’s QOL, disease-specific questionnaire may be more suitable to evaluate many aspects of the disease [3].

SNOT-20 (Sino-Nasal Outcome test) is one of the widely used disease-specific questionnaire for CRS. It contains 20 questions of CRS-related symptoms/QOL and has been demonstrated for its validity and reliability [4]. However, SNOT –20 lacks 2 important symptoms that commonly found in sinonasal disease i.e. nasal obstruction and loss of sense of smell and taste [5, 6]. SNOT-22 is a modification of SNOT-20 with 2 additional items addressing nasal obstruction and smell/taste problem [6]. The validity and reliability of SNOT-22 was well established.
แบบประเมินอาการทางอุตสาหะกีฬา (SNOT-22)

ตัวเลือกนี้เป็นการต้องการของโรคภูมิและไข้บิดมาแบบและผลกระทบที่เกิดขึ้นกับสังคมหรือครอบครัวที่ทำผ่านไปในคุณภาพชีวิตของผู้ที่มีโรคทางระบบทางเดินหายใจ ยกเว้นความยั่งยืนที่มีความส่วนตัวของโรค ที่มีผลต่อสุขภาพและมีผลต่อกำลังงานที่สำคัญในชีวิตประจำวัน โดยโปรดให้คะแนนแต่ละปัญหาของข้อความตามที่เกิดขึ้นในขั้วของคุณภาพชีวิตที่ผ่านมา คะแนนที่ผ่านมาดูดดีที่สุดก็ได้ 0 และมีผลต่อกำลังงานที่สำคัญในชีวิตประจำวัน

| เลข | ข้อความ | ไม่มีปัญหา | มีปัญหา ย่อยหยาบ | มีปัญหา ย่อยละเอียด | มีปัญหา บกพร่องมาก | มีปัญหา บกพร่องมากขึ้น | มีปัญหา รุนแรงมาก | ข้อคิด | ลำดับที่สุด |
|-----|--------|-------------|-----------------|-----------------|----------------|----------------|----------------|--------|-----------|
| 1   | ไม่สบายตัว | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 2   | อาการติดจมูก | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 3   | น้ำยาไหล | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 4   | ไข้ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 5   | น้ำยาเหลือง孵蛋 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 6   | น้ำยาเหนื่อย | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 7   | น้ำยาเหนื่อย | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 8   | น้ำยาติดจมูก | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 9   | น้ำยาเหนื่อย | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 10  | ความทุกข์ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 11  | ความทุกข์ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 12  | ประสิทธิภาพการหายใจ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 13  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 14  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 15  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 16  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 17  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 18  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 19  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 20  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 21  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
| 22  | ความสามารถ | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 | 0 1 2 3 4 5 |
In the present time, SNOT-22 is widely used for evaluation of sinonasal diseases and has been translated and re-validated from original English version into several languages, including Chinese, Portuguese, Greek and French [7–10].

According to its popularity and usefulness, the aim of this study is to translate SNOT-22 into Thai version and make a validation of Thai language questionnaire in Thai CRS patients.

Methods

The study was approved by Siriraj institutional review board of Human Research Protection Unit of Faculty of Medicine, Siriraj hospital, Mahidol university. Permission for translation was obtained from the owners of the questionnaire (Piccirillo JF, Hopkins C). Initial translation of SNOT-22 from English to Thai language was made by two Thai native speakers with good academic background in English from Chulalongkorn and Mahidol universities. Backward translation from Thai to English language was performed by an English native speaker with fluency in Thai. Content of Thai-version questionnaire was evaluated to be correct and had the same meaning as in original questionnaire by two rhinologists in our department. Ten volunteers of normal population were collected to check that the questionnaire could be understood (Fig. 1).

All subjects were over 18-year-old and could read and write Thai. Diagnosis of CRS was based on diagnostic criteria of European Position Paper on Rhinosinusitis and Nasal Polyps 2012 [1]. Questionnaire completion was divided into 3 visits. The first visit questionnaire was completed both in CRS and normal group at the first day of enrollment. The second and third visit questionnaire were completed only in CRS group. The second visit questionnaire was completed at 2 weeks after first visit. The third questionnaire, which completed only in CRS patients who underwent sinus surgery, was done 12 weeks after the operation. Pre-operative CT scan of paranasal sinuses and Lund-Mackay score [11] record was done in every operated case. Visual analog scale (VAS) of sino-nasal symptoms and SF-36 score (Thai version) [12] was recorded in all subjects.

Statistical analysis was performed using SPSS program version 18.0 for Windows (SPSS Inc., Chicago, IL, USA). Internal consistency was analyzed by calculating Cronbach’s α. Test-retest reliability was calculated by comparing SNOT-22 between first and second visit (2 weeks interval without change in CRS treatment) using intra-class correlation coefficient. Validity was calculated by comparing SNOT-22 score between CRS and normal group using independent sample T-test. Correlation between SNOT-22 score and SF-36 score/Lund-Mackay score was analyzed by calculating Pearson correlation coefficient. By using VAS, the CRS group was divided into 3 subgroups according to VAS score (mild 0–4, moderate >4–8 and severe >8–10) and SNOT-22 score between 3 subgroups was compared by one-way ANOVA. Responsiveness and sensitivity to change was analyzed by comparing pre/post-operative SNOT-22 score in patients who underwent sinus surgery. Magnitude of treatment effect from surgery was determined by calculating effect size.

Results

A total of 80 subjects, 30 normal volunteers and 50 CRS patients, were recruited. Subjects’ demographic data was shown in Table 1.

Mean score of SNOT-22 in CRS group was 50.36 ± 20.67 and in normal group was 7.70 ± 7.39. Mean score of VAS in CRS group and normal subject were 5.83 ± 2.58 and 0.00 ± 0.00 respectively (Table 2).

Table 1 Demographic data

|               | Normal | CRS  |
|---------------|--------|------|
| Total number  | 30     | 50   |
| Mean age in years (±SD) | 46.43 (±11.138) | 51.84(±14.818) |
| Male          | 17     | 24   |
| Female        | 13     | 26   |

Table 2 VAS and SNOT-22 score

|               | Normal | CRS  |
|---------------|--------|------|
| VAS           | 0.00 ± 0.00 | 5.83 ± 2.58 |
| SNOT-22 score | 7.70 ± 7.39 | 50.36 ± 20.67 |

Table 3 SF-36 and Lund-Mackay score of CRS group

|               | Mean ± SD |
|---------------|-----------|
| SF-36         |           |
| Physical      | 58.10 ± 21.64 |
| Role physical | 46.50 ± 41.35 |
| Bodily pain   | 54.04 ± 24.53 |
| General health| 39.82 ± 16.81 |
| Vitality      | 53.30 ± 15.31 |
| Social function| 59.00 ± 23.39 |
| Role emotional| 33.99 ± 38.97 |
| Mental health | 60.60 ± 13.93 |
| Lund-Mackay score | 12.03 ± 6.90 |

Table 4 Cronbach’s α, Intraclass correlation coefficient and SNOT-22 in normal and diseased groups

|               | Cronbach’s α | Intraclass correlation coefficient |
|---------------|--------------|-----------------------------------|
| SNOT-22 score | 0.929        | 0.935                             |
| Score in CRS group | 0.929 | Score in normal group | p-value |
| SNOT-22 score | 0.929        | 0.935                             |
| Score in CRS group | 0.929 | Score in normal group | p-value |

<0.001
2.58 and 0.00 ± 0.00 respectively (Table 2). Mean Lund-Mackay score of CT scan of paranasal sinuses in CRS group was 12.03 ± 6.90. Mean value of SF-36 and Lund-Mackay score in CRS group was shown in Table 3. Internal consistency and test-retest reliability of the questionnaire were analyzed, by calculating Cronbach’s α and intraclass correlation coefficient respectively. By using independent sample T-test comparing SNOT-22 score between normal and CRS group, Validity of the questionnaire was obtained. The results were shown in Table 4.

CRS patients were divided into 3 groups, according to VAS (mild 0–4, moderate >4–8 and severe >8). SNOT-22 score between groups were analyzed by one-way ANOVA. The difference of the SNOT-score between groups was statistically significant and was shown in Table 5.

SF-36 and Lund-Mackay score were compared with SNOT-22 score by Pearson correlation test. SF-36 was correlated to SNOT-22 in some domains. There was no correlation between Lund-Mackay and SNOT-22 score (Table 6).

Responsiveness/sensitivity to change was analyzed SNOT-22 score and VAS in 34 patients who underwent surgical treatment using paired-sample T-test. The effect size was calculated from change in SNOT-22 score. The result was shown in Table 7.

### Discussion

Chronic Rhinosinusitis is a common chronic disease that has substantial effect on quality of life of the patients. Accurate evaluation of QOL is the crucial part both in treatment and research aspects. There are many kinds of questionnaire that have been used and studied. SNOT-22 is a short, easy to do and validated questionnaire for evaluation of QOL of the CRS patients that recommended to use in literatures [1, 13].

In our study, we demonstrate that Thai-version, as in original English version, of SNOT-22 is a valid and reliable tool for assessment of CRS patients. The questionnaire itself can differentiate CRS patient from normal population (50.36 ± 20.67 vs 7.70 ± 7.39 p < 0.001). Moreover, among CRS patients with different severity according to VAS, SNOT-22 score was significantly different between severity groups. This result can be translated that the questionnaire can be used to stratify the severity of the CRS patients. The internal consistency and reliability over time are solid, giving calculated Cronbach’s α and intraclass correlation coefficient 0.929 and 0.935 respectively. In CRS patients who underwent surgery of the paranasal sinuses, SNOT-22 score showed significant reduction at 3 months after surgery (50.62 ± 20.01 vs 28.97 ± 15.69 p < 0.001). This result implies that the questionnaire has very good responsiveness to treatment.

As expected, SNOT-22 Thai version is not correlated well with SF-36 and has no correlation with Lund-Mackay scoring of CT scan of PNS. This result is in the same line with previous study that SF-36 is a general questionnaire about patient’s health status not specific to CRS symptoms and patient’s CRS symptoms are not correlated with severity of the CT scan [10, 14].

There was a study of validity and reliability of Thai-language SNOT-22 published in January 2017 by Numthavaj et al. showing that Thai SNOT-22 is valid and reliable in Thai CRS patients [15]. Even though the results regarding validity and reliability are not

### Table 5 SNOT-22 score between groups in CRS

| VAS      | Mild n=8 | Moderate n=25 | Severe n=17 |
|----------|----------|---------------|--------------|
| SNOT-22 score | 37.13 ± 21.59 | 45.52 ± 19.74 | 63.71 ± 14.39 |

Mild vs Moderate group p = 0.004
Moderate vs Severe p = 0.008

### Table 6 Correlation between SNOT-22 and SF-36/Lund-Mackay score

| SF-36                  | r       | p-value |
|------------------------|---------|---------|
| Physical function      | −0.372  | 0.008   |
| Role physical          | −0.489  | <0.001  |
| Bodily pain            | −0.484  | <0.001  |
| General health         | −0.435  | 0.002   |
| Vitality               | −0.217  | 0.130   |
| Social function        | −0.531  | <0.001  |
| Role emotional         | −0.321  | 0.023   |
| Mental health          | −0.224  | 0.118   |
| Lund-Mackay score      | 0.062   | 0.727   |

### Table 7 Pre/post-operative change in SNOT-22 and VAS

|                | Pre-operative (mean ± SD) | Post-operative (mean ± SD) | p-value | effect size |
|----------------|---------------------------|----------------------------|---------|-------------|
| SNOT-22 score  | 50.62 ± 20.01             | 28.97 ± 15.69              | <0.001  | 1.37        |
| VAS            | 6.24 ± 2.03               | 3.51 ± 2.47               | <0.001  |             |
different between the previous and the present study, we provide more data which were not demonstrated in the previous research. Those are the data analysis compared SNOT-22 with SF-36/ Lund-Mackay score, SNOT-22 score in normal control compared with CRS patients. Moreover, we also demonstrate that the Thai-language SNOT-22 questionnaire has good responsiveness/sensitivity to change, which has not been analyzed before.

This study has its strength in the terms of the reliability and validity. The discrimination power of SNOT-22 Thai version can be shown statistically by the change of scoring after surgical intervention. Nevertheless, the minimal clinically important difference (MCID) should be further studied in order to determine it discrimination power in the clinical practice. The limitation in our research is we did not study CRS with polyps and CRS without polyps separately. If there was difference between groups, our study results would be changed to some extent.

Conclusion
SNOT-22 Thai version shows good reliability and validity as its original version. It can be utilized as the validated questionnaire for outcome measurement for CRS. As the SNOT-22 is the most accepted validated questionnaire for CRS, the utilization of SNOT-22 Thai version can be implemented for multi-national research purpose.

Abbreviations
CRS: Chronic rhinosinusitis; MCID: Minimal clinically important difference; QOL: Quality of life; SF-36: 36-item Short form health survey; SNOT-22: Sino-nasal outcome test 22; VAS: Visual analog scale

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Availability of data and materials
The datasets generated and/or analysed during the current study are not publicly available in order to maintain patient anonymity, but are available from the corresponding author on reasonable request.

Author’s contributions
JL: study design, data collection, data analysis, manuscript writing. WY: data collection, data analysis, manuscript writing. CB: data analysis. CH: data analysis. PT: study design, data collection, data analysis, manuscript writing. All authors read and approved the final manuscript.

Authors’ information
Jate Lumyongsatien is a lecturer in department of otorhinolaryngology head and neck surgery, faculty of medicine Siriraj hospital, Mahidol university. Waralak Yangakul, at the time of research conduct, was an ENT resident in department of otorhinolaryngology head and neck surgery, faculty of medicine Siriraj hospital, Mahidol university. Chaweewan Bunnag is a professor in department of otorhinolaryngology head and neck surgery, faculty of medicine Siriraj hospital, Mahidol university. Claire Hopkins is a professor and consultant ENT and skull base surgeon at Guys and St Thomas’ Hospital, London, UK. Pongsakorn Tamtilipikorn is an associate professor in department of otorhinolaryngology head and neck surgery, faculty of medicine Siriraj hospital, Mahidol university.

Ethics approval and consent to participate
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Written informed consent was obtained from all participants. This study was approved by Siriraj institutional review board (approval no. Si 487/2014).

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Author details
1Department of Otorhinolaryngology Head and Neck Surgery, Faculty of medicine Siriraj hospital, Mahidol university, 2 Thanon Arun Amarin, Khwaeng Siriraj, Khet Bangkok Noi, Bangkok 10700, Thailand. 2DM Guys and St Thomas’ Hospital, ENT Department, Great Maze Pond, London SE1 9RT, UK.

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