Contents lists available at www.innovativejournal.in

INTERNATIONAL JOURNAL OF NURSING DIDACTICS

homepage: http://innovativejournal.in/ijnd/index.php/ijnd

Development of Critical Appraisal Tool for Cross- Sectional Studies (CAT-CSS)

Rasha A. Mohamed, Amel I. Ahmed, Sahar M. Soliman

Faculty of Nursing, Mansoura University

Abstract: Appraisal of research quality is important issues in interpreting primary research. Tools for assessing quality in clinical trials and other research study designs are well described. However, less attention has been given to similar tools for cross-sectional studies. ***Aim of the study:*** The study aimed to develop a critical appraisal tool that includes the criteria appropriate for criticizing cross-sectional study design (CAT-CSS).***Research Design:*** Delphi survey technique was used as an iterative multistage process. ***Subjects and sampling:*** A Delphi panel of (15) academic staff members was established by using of non- probability purposive sampling technique. ***Setting:*** The study took place at the Faculty of Nursing, Mansoura University during the period from June 2016 to January 2017.***Survey tools:*** Tools were designed to assess study content validity and face validity of the developed appraisal tool. ***Results:*** Concerning face validity of CAT-CSS, all academic staff members (n=15) found the tool was scientifically worthy, easy to apply, presented in logical sequence, specific, unambiguous and valid for prevalence data. Concerning criterion validity, there were significant positive correlations between scores of the study validity section's domains and its overall quality scores.

Conclusion: CAT-CSS showed acceptable level of content, face and criterion validity as well as it was accepted statistical reliability.
Recommendations: Disseminating CAT-CSS for further testing specially for construct validity.

Keywords: CAT-CSS, Appraisal- tool, Cross Sectional Studies

INTRODUCTION

Utilization of research findings is a crucial health professional's related issue in the provision of health care based on evidence[1, 2]. Research findings that are driven from certain study design would be used to answer specific type of question. Several questions in health sciences find their answers in observational study designs[3].Cross-sectional studydesign is observational descriptive design that investigates the prevalence of diseases. It gathers information from a sample of questions made to participants on a particular topic[4,5].The accuracy of prevalence studies is the central element that firmly guides and influences the decision-making in planning health services. This planning includes resources allocation and prioritization of public health initiatives according to the burden of diseases. Accuracy of prevalence studies also is a base for monitoring and evaluating the changes of diseasetrends over time[5,6,7,8,9].While utilization of research findings is crucial issue in the provision of health care. policy makers and healthcare professionals still face rapid increase in the number of published papers to decide on evidence-based actions[1,2]. Therefore, healthcare professionals should have the ability to select the high- quality papers through using of critical appraisal skills[1, 10].

Critical appraisal is a process, which is systematic in natureand is used by clinicians and researchers to examine the methodological quality of research. Moreover, critical appraisal guides and tools are used to assist in determining whether research findings are relevant to a specific clinical or research context[11].The most important component of critical appraisal is the assessment of the strategic methodological features of the study design, the appropriateness of the used statistical analysis and relevance of the results to the clinical situation of the reader[12].Critical appraisal tool (CAT) is required to enable the reader to rate and qualify the scientific paper on the research methods and conclusion[13].There is standard CAT for all study designs such as cohort, diagnostic and randomized control trails. On the other hand, there is no standard CAT for cross sectional study design that covers all the important keys of this design[8].Bearing in mind that cross sectional and survey's studies, represent 32% of the published papers in a highly impact nursing journals including "Journal of Community Health Nursing" and "Public Health Nursing"[15]. To address this gap in current knowledge, the primary aim of the current study was to develop a critical appraisal tool that includes appropriate criteria for criticizing cross-sectional study design.

MATERIAL AND METHODS

Research design:

Delphi survey technique was used in designing the methodological frame of this study according to the "Guideline for the Delphi Survey 2000"[16]. Delphi survey was described as an iterative multistage process that designed to obtain consensus on the opinions from "experts" through a series of structured questionnaires throughout a series of rounds. These "experts" would complete the questionnaires anonymously.

Research questions:

1. What are the components of critical appraisal tool for cross-sectional studies?

2. Is the developed critical appraisal tool for cross-sectional studies applicable?

Subjects and sampling:

A Delphi panel was established by using of non- probability purposive sampling technique. The Delphi panel composed of (15)academic staff members. The inclusion criteria for selecting academic staff members based on having experience in quantitative research methods specifically the cross-sectional research designs. Academic staff members were assistant professors and professors in community health nursing and public health sciences. The selection of participants and their number were decided according to **Day J and Bobeva M (2005)[17]**, who stated that useful results could be obtained from small size, homogeneous groups of 10-15 experts.

Setting:

This study was carried out at Faculty of Nursing, Mansoura University during the period from June 2016 to January 2017.

Survey tools:

The tools of the current study were designed to assess essential study validity types of which are content validity and face validity.

Content validity five- point rating scale:

This scale was developed to assess the content validity of the cross- sectional studies' critical appraisal tool (CAT-CSS), by obtaining the academic staff members' responses regarding the components of the developed CAT-CSS. The rating scale ranged from 1= not at all important to 5= extremely important. A free- text field was added for each item to encourage feedback and suggestions. A final question was asked for any more general comments.

Face validity-testing checklist:

Face validity testing checklist composed of (8) criteria that test the ease of use, logical sequence of CAT-CS Scriteria and timeliness (i.e. consumed time to complete the appraisal tool) of the developed CAT-CSS.

Development of the CAT-CSS

The current CAT-CSS was developed throughout the following steps:

Step 1: Reviewing of related literatures:

Searching different bibliographic databases was conducted for identifying criteria of cross- sectional study design and tracking down literatures about any existing critical appraisal tools that examining cross- sectional studies (**Box 1**). Searching generated five critical appraisal tools (**Box 2**).

Box 1: List of searched networks, websites, and organizations

▪ Scottish Intercollegiate Guidelines Network (SIGN) ▪ Gates Foundation ▪ Cochrane Collaboration ▪ Medical Research Council UK (MRC) ▪ Grades of Recommendation, Assessment, Development, and Evaluation guidelines (GRADE) for rating quality of evidence and grading strength of recommendations in health care	▪ Strengthening the reporting of observational studies in epidemiology (STROBE) ▪ International Centre for Allied Health Evidence ▪ Centre for Evidence-Based Medicine ▪ Health Protection Agency (HPA) UK ▪ National Institutes of Health ▪ The Joanna Briggs Institute

Box 2: The tracked down critical appraisal checklists

▪ The STROBE (v4) checklist[18].   ▪ The Joanna Briggs Institute's Descriptive/Case series critical appraisal tool[19].   ▪ Quality Assessment Tool for Quantitative Studies[20].   ▪ Critical Appraisal of a Questionnaire Study[21].

Step 2: Statingcriteria of the first draft of the CAT-CSS

On the highlight of the tracked down criteria of cross-sectional study design and identified critical appraisal tools, the researchers stated the criteria of the first draft of the CAT-CSS.

Step 3: Conducting Delphi Survey

Before conducting the survey, the identified academic staff members were invited to participate in the Delphi survey. Written information statements was provided to explain the purpose of the study and the expected time of the survey and what exactly they would be asked to do during the survey.

The Delphi survey was conducted throughout three sequential rounds. Each round was conducted throughout one week, in which opinions of participants were collected. The interval between each round is 14 days. The working group (the three researchers of the current study) was working on analysis of the collected data from the previous round. According to the discussion, conclusion and the analyzed data, the working group developed the modified

form of the CAT-CSS to be rated in the next round. One-day discussion workshop was conducted after the third round to revise the final version of the CAT-CSS. The workshop involvedthe15academic staff members and the working group.

Round one:

In round one, the first draft of the CAT-CSS that was composed of 67 criteria was structured in the form of content validity five-point rating scale. The first draft of CAT-CSS was distributed to the academic staff members at their workplaces. They were asked to rate their response regarding each item of the CAT-CSS to explore the importance of each criterion. They were asked also to write their suggestions in the free- text fields. The distributed CAT-CSS forms were collected after a week and responses were analyzed. The data analysis of the first round indicated reallocation of some criteria, and deletion of other criteria of the CAT-CSS. The working group decided the deletion of a criterion on the basis of level of agreement of participants. A criterion was included into the CAT-CSS if all participants

showed consensus for inclusion by ratingitas 4 or 5 on the 5-points scale. A criterion was assumed unclear if all participants rated it as 3 and most of them commented on it. A criterion was excluded if all participants rated it 2 or less. Based on the content analysis of this round the CAT-CSS was modified in a form of validity five-points rating scale. Then it was used as the survey checklist for the second round of data collection.

Round two:

The second draft of CAT-CSS was distributed to the academic staff members to review and rat eeach item on the five-points rating scale. Once again, the working group analyzed the rating response and summarized the collected information in a form of validity five-points rating scale that was used in the third round.

Round three:

During round three, the modified CAT-CSS was distributed again to the academic staff members for further rating of each criterion. Then the working group made the final modification based on the analysis of the third round.

Discussion workshop:

A one-day workshop was conducted to finalize the CAT-CSS. The working group with the academic staff members worked on clarification of the final form of the CAT-CSS. This workshop provided a final opportunity for respondents to revise their judgments.

Step 4: Piloting the CAT-CSS:

The CAT-CSS was trialed by the 15academic staff members. Eleven cross- sectional studies were submitted to academic staff members to be appraised by using the CAT-CSS. The academic staff members were asked to evaluate the application of the CAT-CSS by using the pre developed face validity- testing checklist.

Data analysis:

A descriptive analys is and frequencies were used in this study to illustrate the content and face validity of the CAT-CSS. Kendall's tau B rank correlation coefficients were used to study the criterion validity of the CAT-CSS.

Reliability analysis was used to study the properties of the CAT-CSS and the relationships between individual criteria in the scale. Cronbach Alpha model was used to test the internal consistency of the CAT-CSS domains. Intra class correlation coefficient was used to compute inter-rater reliability estimates, which estimate the consistency or agreement of appraisers in relation to each domain. SPSS version 20 was used for all statistical analysis.

Ethical considerations:

Ethical considerations are not required for this work.

RESULTS

Content validity was tested throughout the three rounds of the Delphi survey, in which academic staff members evaluated the content of the CAT-CSS. The pre- determined criteria of the cross sectional critical appraisal tool (CAT-CSS) started with 67criteria that were arranged in 5 sections. Those sections were: study identification, internal validity, external validity, conclusion, and overall quality of the

study. The internal and external validity sections concerned with there search methodological framework. These sections were composed of19domains. Academic staff members rated this version of CAT-CSS in round one. They rated 31criteria (4 or 5), while 36criteria were rated whether (3 or less) on the 5- points scale (Table 1 and 2). Comments of the academic staff members' in round one were analyzed to reveal that the CAT-CSS was generally fragmented (Box 3). The first comment was to integrate the internal and external validity sections under the theme of "study validity". They mentioned that introduction criteria need more clarification and to be gathered with the abstract part. Criteria in the aim part were required to be more specific according to the SMART. Research question part was composed of three criteria, one of them omitted and the other two criteria were clarified. Academic staff members suggested gathering of the aim and research question into one part. The suggested criteria in the study design part required defragmentation and more clarification. Two criteria regarding to study setting and study time- frame were added to the study design part. The other four criteria were clarified to this section. Criteria of sampling, data collection, discussion, and references domains were clarified and rearranged. Based on the comments of academic staff members and discussion of the working group, it was decided to use rubric scoring to ensure the objectivity in the CAT-CSS. The rubric scoring was approved to be used for scoring CAT-CSS's domains. A domain would be considered poor if an apprised article accomplished less than 50% of the its mentioned criteria, good if 50% to 65% of the a domain mentioned criteria were accomplished, and excellent if more than 65% of a domain mentioned criteria were accomplished in an apprised article.

The refined CAT-CSS form that included 58criteria was distributed in the second round of the Delphi survey to be rated again on the 5- points scale. Academic staff members rated 12 criteria less than 4. The introduction and study design domains were approved completely, while other domains required some modifications. Some of the 12criteria that were rated less than 4, reallocated within the different domains and/ or modified, while other criteria were newly added according to comments analysis. Then the refined CAT-CSS involved 46criteria as shown in table (2). Table 3 shows that CAT-CS Scriteria scored less than 4 were 36 in the first round and declined to 12 in the second round.

Final structure of the CAT-CSS:

The third round and workshop discussion indicated the final form of the CAT-CSS. The final CAT-CSS composed of four main sections, namely the study identification section, study validity section, conclusion section, and overall quality scoring of the study. The skeleton of the CAT-CSS is the "study validity section". This section was composed of nine domains with total number of 50criteria (Table 4). These sections were built on the sequence of a scientific article structure. The abstract and introduction part included 6criteria, while the aim and research question/part included 4criteria. Regarding to the methodological framework, it composed of study design/ setting and timeframe section which included 5 criteria , sampling 10 criteria and data collection 10 criteria. The results part included 6criteria.Discussion, conclusion, and recommendations part included 7criteria. The references part included

2criteria.Each domain of the CAT-CSS was scored by using of the illustrated rubric scoring in the CAT-CSS form. The overall quality scoring of the study to be calculated as percentage of the total covered criteria mentioned throughout the "study validity" section.

Table 1: CAT-CSScriteria with ratings of high agreement (4 or 5) by academic staff members in the first Delphi round

CAT-CSS Domains of Study validity section	CAT-CSS Criteria
Abstract of the study	1. Presented in an informative and balanced summary of what was done and what was found
Introduction	2. Sufficient explanation of the scientific background was provided
Aim	3. Clearly stated 4. Is descriptive
Research questions	5. Adequate description of study question/s 6. Type of question/s correspond to study design
Methodological framework	
Study design	7. Presented clearly 8. Is appropriate to address the aim of the study 9. Description of the setting or locations 10. The time frame for the study is illustrated 11. The expected timeline for each study stage is given
Sampling	12. The methods of sample selection is clearly described 13. Selected randomly 14. Sample size estimates have been performed 15. Sample size seems feasible (taking into account resources/ prevalence of disease/ study population,etc...) 16. Description/specification of inclusion criteria 17. Description/specification of exclusion criteria
Data collection	18. The methods for data collection are described for each of the variables collected (where, by who and when) 19. Well-designed data collection tool 20. The procedures for the pilot test described
Results	21. The results are explicit 22. Adequate and objective description of the results 23. Present characteristics of study participants (e.g demographic, clinical, social) 24. Confidence intervals for prevalence estimates and P value for comparison of subgroups 25. The tables and figures adequate, clear and appropriately titled 26. The study mention if negative results, results of no effect/difference will be considered for publication
Discussion	28. The results are summarized and discussed in relation to the original research questions 29. The researcher have discussed the credibility of their results
References	30. References included relevant 31. References are adequate

Box 3: Comment analysis of academic staff members about the structure and components of the CAT-CSS

Rounds	Comments
Round 1	**CSSCAT Sections and domains** Internal and external validity domains gathered under the theme of ***"study validity"*** Aim and research questions collected in one them Abstract and introduction gathered under one them Study design companied with the study setting and timeframe Data collection gathered with ethical issues Discussion, conclusion and recommendations collected under one them **Introduction** Needs more clarification **Aim** Required to be more specific according to the SMART **Research questions** Requires more clarification **Study design** Study design section required defragmentation and more clarification **Sampling, Data collection, Discussion and References** Needs clarifications and rearrangement **Fund** To be excluded from the scoring system **Scoring system** Using of rubric
Round 2	**Clarifications and reallocation of some criteria**

Table 2: CAT-CSScriteria with ratings of high agreement (4 or 5) by all teams in second Delphi round

CAT-CSS Domains of Study validity section	CAT-CSS Criteria
Abstract and Introduction of the study	1. Abstract is presented in an informative and balanced summary of what was done and what was found. 2. Sufficient scientific background information on the topic 3. Introduction is focused, relevant, in logical fashion and justifiable to the research question. 4. Introduction is zoomed into regional or national perspective if applicable 5. Introduction is ended with the objectives (aim) of the study. 6. Burden of disease/ condition is quantified.
Aim and Research questions	7. Aim is clearly stated**.** 8. Aim is SMART: Specific, Measurable, Achievable, Resourced (within the project budget) and Time Bound. 9. Question/s of study is adequately described. 10. Type of question/s is corresponded to the study design**.**
Methodological framework	
Study Design / Setting And Timeframe	11. Study design is clearly presented. 12. Study design is justified. 13. Study design is appropriate to address the aim of the study**.** 14. Study setting or locations are described. 15. Study timeframe is clearly illustrated. 16. Study timeframe seems appropriate**.**
Sampling	17. Sample is selected and representative of reference population. 18. The methods of sample selection is clearly described. 19. Sample is selected randomly. 20. Specific description of inclusion criteria 21. Specific description of exclusion criteria. 22. Sample size estimates have been performed. 23. Sample size seems feasible (taking into account resources/ prevalence of disease/ study population, etc...). 24. A highly participation level.　　　　　Response rate: (　　).
Data collection	25. The methods for data collection are described for each of the variables collected (where, by who and when). 26. Data collection tool is tested for its reliability. 27. The study specifies who are the data collectors and their background. 28. Identification of the sources of data 29. Exposure factor/s identified: Number: (　) 30. Outcome/s ascertained:Number: (　) 31. Potential confounding factors are measured accurately. 32. Ethical approval been obtained if appropriate. 33. Informed consent is obtained**.**
Results	34. The results are explicit. 35. Characteristics of study participants (e.g. demographic, clinical, and social) are presented. 36. Exposure variables are associated with outcome variables. 37. Confidence intervals for prevalence estimates and P value for comparison of subgroups are measured. 38. The tables and figures are adequate, clear and appropriately titled. 39. The study mentions if negative results, results of no effect/difference will be considered for publication.
Discussion	40. The results are summarized and discussed in relation to the original research questions. 41. The researcher has discussed the credibility of their results. 42. There is adequate discussion of the evidence against the researchers' arguments. 43. Discusses of the contribution the study makes to existing body of knowledge.
References	44. References are accurate. 45. References are relevant. 46. References are adequate.

Table 3: Number of CAT-CSScriteria with ratings of low agreement (< 4) by academic staff members in Delphi during first and second Delphi rounds

CAT-CSS domains of study validity section	First round	Second round
Introduction	1. The literature review presented in a clear and logical fashion	
Aim of the study	2. Give an indication of the magnitude of the problem in a particular population	1. Aim is descriptive.
Research question	3. Specify type of question/s---	
Time frame	4. Reasonably sufficient to see an association between exposure and outcome if it existed	
Sample	5. Selected from the whole population 6. Sample size justified 7. The chosen power adequate for the study question	2. A relatively large number of respondents 3. Withdrawals (during study) are reported, explained, and reasonable
Ethical approval	8. Ethical approval been obtained if appropriate 9. Informed consent obtained	
Data collection	10. The study specify who are the interviewers/data collectors and their background 11. Data collection tool is pilot tested 12. Identification of the sources of data 13. Formal observation involving interviews or questionnaires	4. Potential confounding factors are measured accurately . 5. Well-designed data collection tool. 6. Submission of data collection tool to jury for ensuring validity The procedures for the pilot test are described.

		7. Valid and reliable measurement of exposure variables
		8. Valid and reliable measurement of outcome variables
		9. Appropriate statistical analysis be stated and referenced. Odds ratio: ( ) Absolute risks and relative risks: ( ) Chi-square test: ( )
		10. Analyses of subgroups and interactions, and sensitivity analyses. Specify the study statistical measures--------------
Outcome and exposure variables	14. Exposure factor/s : Number: 15. Outcome/s ascertained: Number: 16. Clear measurement of exposure variables 17. Valid and reliable measurement of exposure variables 18. Valid and reliable measurement of outcome variables 19. Exposure variables are associated with outcome variables 20. Measurement at one specific time point 21. Potential confounding factors are measured accurately	
Response rates	22. A highly participation level 23. response rate-------- 24. Withdrawals (during study) are reported, explained, and reasonable 25. Measures were made to contact non-responders	
Results	26. The results suggest a more rigorous study is needed. 27. The authors mention how the study results will be used, i.e. potential implications for actions. 28. The study results likely to contribute to the existing evidence base	11. Adequate and objective description of the results.
Discussion	29. The discussion is biased 30. There is adequate discussion of the evidence for the researchers' arguments. 31. Discussed clearly, taking into account sources of potential bias	12. Limitations of the study are discussed, taking into account sources of potential bias or imprecision
References	32. References are consistent.	
Limitation	33. Discussed clearly, taking into account sources of potential bias or imprecision	
External Validity	34. Sample is representative of reference population 35. The subjects covered in the study could be sufficiently different from your population to cause concern 36. Your local setting is likely to differ much from that of the study	

Table 4: Component of the final CAT-CSS after confirmation in the third Delphi round

CAT-CSS domains of study validity section	CAT-CSScriteria
Abstract and Introduction of the study	1. Abstract is presented in an informative and balanced summary of what was done and what was found. 2. Sufficient scientific background information on the topic. 3. Introduction is focused, relevant, in logical fashion and justifiable to the research question. 4. Burden of disease/ condition is quantified to magnify the magnitude of the problem in a particular population. 5. Introduction is zoomed into regional or national perspective if applicable. 6. Introduction is ended with the aim of the study.
Aim and Research questions	7. Aim is descriptive and clearly stated. 8. Aim is SMART: Specific, Measurable, Achievable, Resourced (within the project budget), and Time Bound. 9. Question/s of study is adequately described. 10. Type of research question/s is corresponded to the study design.
Methodological framework	
Study Design/ Setting and Timeframe	11. Study design is clearly presented. 12. Study design is reasonably justified. 13. Study setting or a location is described. 14. Study timeframe is clearly illustrated. 15. Study timeframe seems appropriate.
Sampling	16. Sample is selected and representative of reference population. 17. The methods of sample selection are clearly described. 18. Appropriate sample technique is used with ensured randomization. 19. Specific description of inclusion criteria. 20. Specific description of exclusion criteria. 21. Sample size estimates have been performed. 22. Sample size seems feasible (taking into account resources/ prevalence of disease/ study population, etc...). 23. The chosen level of precision, confidence limit, and variability) estimated proportion of an attribute that is present in the population) are adequate for the study question. 24. A highly participation level. Response rate: ( ). 25. The subjects covered in the study could be sufficiently similar from your population to cause concern.
Data collection and ethical issues	26. The methods for data collection are described for each of the variables collected (where, by who and when). 27. Content and face validity of the tools are well described. 28. Data collection tools are tested for its reliability. 29. The study specifies who are the data collectors and their background. 30. Exposure factor/s identified: Number:( )

31. Outcome/s ascertained   Number:( )
32. Exposure and outcomes are measured at one specific point in time.
33. Potential confounding factors are measured accurately.
34. Measures were made to contact non-responders.
35. Ethical issues mentioned clearly (if appropriate).

Results

36. The results are adequately, objectively, and explicitly described.
37. Characteristics of study participants (e.g. demographic, clinical, and social, professional or occupational) are presented.
38. Exposure variables are associated with outcome variables.
39. Tables and figures are adequate, clear, and appropriately titled.
40. Appropriate statistical analysis be used: Specify the study statistical measures ( ).
41. The study mentions if negative results or results of no effect/difference are considered for publication.

Discussion/ Conclusion And Recommendations

42. The results are summarized and discussed in relation to the original research questions.
43. The researcher has discussed the credibility of their results.
44. There is adequate discussion of the evidence for the researchers' arguments.
45. Limitations of the study are discussed, taking into account sources of potential bias or imprecision.
46. Discussion shows the contribution of the study to the body of knowledge and existing evidence base.
47. The results suggest a more rigorous study is needed.
48. The authors mention how the study results will be used, i.e. potential implications for actions.

References

49. References are adequate and relevant to the study topic.
50. References are up-to-date.

Face validity:

Tables 6 and 7 illustrate the face validity of the CAT-CSS as revealed by the feedback of the appraisers. A total number of 11cross sectional research articles were apprised with the CAT-CSS. All academic staff members (n=15) found that the developed tool was scientifically worthy, easy to apply, presented in logical sequence, and valid for prevalence data.

Most of appraisers (93.3%) found the CAT-CSS was specific and unambiguous, as well as they strongly recommended the CAT-CSS for appraising cross-sectional studies (Table 5).The mean consumed time for appraisal was ($B\pm S.D =24.3\pm5.3$ min) for the first paper and ($B\pm S.D =10.8\pm1.24$ min) for the final/11th paper (Table 6).

Table5: Feedback of appraisers about CAT-CSS application

Items	Number of appraisers = (15)			
	Strongly agree		Agree	
	no	%	no	%
The CAT-CSS is scientifically worthy	15	100	0	0
The CAT-CSS domains are easy to apply	15	100	0	0
The CAT-CSScriteria are presented in logical sequence	13	86.7	2	13.3
The CAT-CSScriteria are valid for prevalence data	15	100	0	0
The CAT-CSS is specific and unambiguous	14	93.3	1	6.7
The CAT-CSStimeliness is suitable	14	93.3	1	6.7
Strong recommendation for CAT-CSS use	14	93.3	1	6.7

Table 6: Mean of consumed time by academic staff members for appraising papers by CAT-CSS

Appraised papers	Mean of consumed time/ minutes $\overline{X}\pm S.D$
Paper 1	24.3±5.3
Paper 2	21±6
Paper 3	16.6±6.72
Paper 4	12.6±3.19
Paper 5	11±2.80
Paper 6	11.2±1.57
Paper 7	11.4±1.45
Paper 8	11.4±1.40
Paper 9	11.6±1.59
Paper 10	11.2±1.33
Paper 11	10.8±1.24
Papers from 5- 11	11.2 ±1.5

Criterion validity:

Kendall's tau B rank correlation coefficient between the domain scores of the "study validity" section and overall quality score of the CAT-CSS were highly significant (p ≤

0.05). These significant positive correlations between scores of the study validity section's domains and its overall quality scores are providing evidence of criterion validity (Table 7).

Table 7: Correlation of domain scores of CAT-CSS with its overall assessment

CAT-CSS domains of study validity section	Correlation with overall assessment	
	Correlation coefficient	P
Abstract and Introduction of the Study	0.66	0.000
Aim and Research Questions	0.23	0.002
Study Design / Setting and Timeframe	0.26	0.000
Sampling	0.30	0.000
Data Collection and Ethical Issues	0.203	0.006
Results	0.56	0.000
Discussion /Conclusion And Recommendations	0.35	0.000
References	0.57	0.000

Reliability:

Table (8) shows the analysis of reliability of individual domain, which indicated internal consistency, ranged between 0.76 and 0.97 as indicated by Chronbach α. Table (9) also shows the interclass correlations (ICC) for each CAT-CSS domain. A high degree of reliability was found between 15 appraisers' scores in all domains including the overall assessment scores. The average of raters' scores ICC was ranged from 0.7 to 0.95 which significantly differs from the single rater ICC that ranged from 0.26 to 0.67.

Table 8: Internal reliability and intraclass correlation

CAT-CSS domains of study validity section	Single rater Intraclass correlation (95% CI)	Average of raters Intraclass correlation (95% CI)	Chronbachα
Abstract and Introduction	0.67 (0.61- 0.74)	0.95 (0.94- 0.96)	0.95
Aim and Research Questions	0.56 (0.36- 0.80)	0.95 (0.92- 0.98)	0.95
Study Design / Setting and Timeframe	0.72 (0.53- 0.89)	0.97 (0.94- 0.99)	0.97
Sampling	0.67 (0.48- 0.86)	0.7 (0.93- 0.99)	0.97
Data Collection and Ethical Issues	0.59 (0.39- 0.82)	0.95 (0.90- 0.98)	0.95
Results	0.17 (0.06- 0.45)	0.76 (0.49- 0.92)	0.76
Discussion /Conclusion and Recommendations	0.58 (0.38- 0.82)	0.95 (0.90- 0.98)	0.95
References	0.57 (0.37- 0.81)	0.65 (0.98- 0.98)	0.95
Overall assessment	0.26 (0.11- 0.5)	0.84 (0.66- 0.95)	0.84

DISCUSSION

Cross- sectional studies are primarily used to report about prevalence and exposure at one point of time. It is widely used because it is highly feasible and has seldom-ethical difficulties[22,23].It is important for healthcare professionals to evaluate the reliability, validity, and applicability of research article to determine if its results are strong enough to be used in clinical practice or not. The critical appraisal skills will enable healthcare providers to decide the level of validity, reliability, and applicability of a research article [24].

Several critical appraisal tools were developed to apprise systematic reviews of cross- sectional studies. However, the current study developed an appraisal tool specifically for primary cross sectional studies that was tested for validity and reliability. The working group decided to focus on the cross-sectional study design that is most widely used in the observational descriptive research. The current study results found that the cross- sectional critical appraisal tool(CAT-CSS) is reliable and valid when used to evaluate several cross- sectional studies by different appraisers. The content validity of the CAT-CSS was tested throughout the Delphi survey, which revealed a consensus among academic staff members and working group on the content of the CAT-CSS. The current critical appraisal tool depends on rubric scoring of each domain in addition to the quantitative overall quality assessment. This is in agreement with**Pieper, Mathes, & Eikermann, 2014[25]** who recommended that a summary score would enable the reader to decide on the level of the research article.

The face validity test revealed that most of appraisers found the CAT-CSS is unambiguous critical appraisal tool. The appraisers strongly recommended the use of CAT-CSS in appraising cross- sectional studies. The indicated level of agreement about the CAT-CSS was the same agreement level that reported by Munn and his colleagues 2014.They stated that their developed critical appraisal tool for systematic reviews addressing questions of prevalence was well accepted by the users**[8]**.

The results of the current study indicated a highly significant criterion validity of the CAT-CSS. Most of the CAT-CSScriteria of the study validity section showed a high reliability by using Chronbach α. Moreover, there was a high significant reliability of these domains among the 15 appraisers. The CAT-CSS is a reliable tool for evaluating the quality of cross- sectional study design. **Lucas et al., 2013[26],** reported that a developed quality appraisal tool for studies of diagnostic reliability showed moderate to high reliability of its criteria. Moreover, the results of reliability of the AGREE instruments indicated that the it was reliable based on the significant agreement of appraisers who tested

the instrument**[27]**.Finally, the current results achieved the recommendation of **Sanderson, Tatt, & Higgins, 2007 [28],**who stated that the tools for assessing research quality should be rigorously developed, valid, reliable, and easy to use. In addition, a study done by **Bennett et al., 2011[29]** highlighted the need forawell-developed guideline for survey research structure that ensure valid survey results.

CONCLUSION AND RECOMMENDATIONS

This study concluded that The CAT-CSS was developed rigorously and showed acceptable level of content, face, and criterion validity as well as are liability level. Face validity revealed that the CAT-CSS was unambiguous, and easy to use.

The study recommended that:

1. CAT-CSS to be disseminated on wider scale for using and construct validity testing.

2. CAT-CSS would be used asa guide for the researchers when conducting cross- sectional studies.

3. CAT-CSS would ensure judgment consistency about cross- sectional studies among researchers from diverse backgrounds and perspectives when appraising published articles on cross-sectional studies

Appendix: Supplementary data

REFERENCES

[1]. Greenhalgh, T., 2010. How to Read a Paper: The Basics of Evidence-based Medicine. 4th ed., Wiley-Blackwell.

[2]. Polit, D.F., & Beck, C.T., 2012. Nursing Research: Generating and Assessing Evidence for Nursing Practice. 9th ed., Wolters Kluwer Health, Philadelphia.

[3]. Glasziou, P., Vandenbroucke, J., Chalmers, I., Glasziou, P., Vandenbroucke, J., & Chalmers, I. (2004). Assessing the quality of research Assessing the quality of research. http://doi.org/10.1136/bmj.328.7430.39

[4]. Sackett, D.L., Richardson, W.S., Rosemberg, W.S., Rosenberg, W., Haynes, B. R., (2010). Evidence-Based Medicine: How to practice and teach EBM. Churchill Livingstone.

[5]. Guyatt, G., Meade, M.O., Cook, D.J., Rennie, D. (2014). Users' Guides to the Medical Literature: A Manual for Evidence-based Clinical Practice, 3rd ed. New York.

[6]. Spencer, F. A., Iorio, A., You, J., Murad, M. H., Schünemann, H. J., Vandvik, P. O., ... Guyatt, G. H. (2012). Uncertainties in baseline risk estimates and confidence in treatment effects. *BMJ (Online)*, *345*(7885), [e7401]. DOI: 10.1136/bmj.e7401

[7]. Harder, T. (2014). Some notes on critical appraisal of prevalence studiesComment on: "The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence," 3(5), 289–290. http://doi.org/10.15171/ijhpm.2014.99

[8]. Munn, Z., Moola, S., Riitano, D., & Lisy, K. (2014). The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence, 3(x), 1–6. http://doi.org/10.15171/ijhpm.2014.71

[9]. The Joanna Briggs Institute. Reviewer's Manual. Australia: The Joanna Briggs Institute; 2014.

http://joannabriggs.org/research/critical-appraisal-tools.html

[10]. Glasziou, P. P. (2008). In clinical practice. Editorial, 189(2).

[11]. Straus, Sh., Glasziou, P., Richardson W. S., & Haynes, B. R., (2011) Evidence-Based Medicine. How to Practice and Teach It., 4th ed., Churchill Livingstone.

[12]. Young, J. M., & Solomon, M. J. (2009). How to critically appraise an article, 6(2). http://doi.org/10.1038/ncpgasthep1331

[13]. Crowe, M., & Sheppard, L. (2011). A general critical appraisal tool: An evaluation of construct validity. International Journal of Nursing Studies, 48(12), 1505–1516. http://doi.org/10.1016/j.ijnurstu.2011.06.004

[14]. Munn, Z., Moola, S., Riitano, D., & Lisy, K. (2014). Original Article The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence, 3(x), 1–6. http://doi.org/10.15171/ijhpm.2014.71

[15]. Association of Community Health Nursing Educators (ACHNE) Research Committee. (2010). Research priorities for public health nursing. Public Health Nursing, 27, 1, 94-100.

[16]. Hasson, F., Keeney, S. and Mckenna, H., (2000). Research guidelines for the Delphi survey technique. Journal of Advanced Nursing 32(4), p.1008-1015

[17]. Day J and Bobeva M., (2005). A Generic Toolkit for the Successful Management of Delphi Studies. The Electronic Journal of Business Research Methodology 3 2, pp 103-116. www.ejbrm.com

[18]. Elm, E. Von, Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, C., & Vandenbroucke, J. P. (2007). Policy and practice The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement : guidelines for reporting observational studies, *45120*(November), 867–872. http://doi.org/10.2471/BLT.

[19]. The Joanna Briggs Institute, (2016). The Joanna Briggs Institute critical appraisal tool for use I JBI systematic review. Checklist for analytical cross-sectional studies. http://joannabriggs.org/research/critical-appraisal-tools.html

[20]. National Collaborating Centre for Methods and Tools (2008). Quality Assessment Tool for Quantitative Studies. Hamilton, ON: McMaster University. (Updated 13 April, 2010) Retrieved fromhttp://www.nccmt.ca/resources/search/14.

[21]. Critical appraisal questions for a survey. Center for evidence- based management. Retrieved from https://www.cebma.org/wp-content/.../Critical-Appraisal-Questions-for-a Survey.pdf accessed at Jun 2016.

[22]. Roever, L. (2016). Evidence Based Medicine and Practice, 1(2), 1–2. http://doi.org/10.4172/ebmp.

[23]. Mann, C. J. (2012). Observational research methods — Cohort studies , cross sectional studies , and case – control studies ´thodes des e ´ tudes d ' observation – Etudes de cohorte , Me ´ tudes transversales , e ´ moins e. African Journal of Emergency Medicine, 2(1), 38–46.

http://doi.org/10.1016/j.afjem.2011.12.004

[24]. Facchiano, L., Practitioner, F. N., Snyder, C. H., & Practitioner, F. N. (2012). Evidence-based practice for the busy nurse practitioner : Part one : Relevance to clinical practice and clinical inquiry process, 24, 579–586. http://doi.org/10.1111/j.1745-7599.2012.00748.

[25]. Pieper, D., Mathes, T., & Eikermann, M. (2014). Impact of choice of quality appraisal tool for systematic reviews in overviews, 7(1), 72–78. http://doi.org/10.1111/jebm.12097

[26]. Lucas, N., Moran, R., Lucas, N., Macaskill, P., Irwig, L., Moran, R., … Bogduk, N. (2013). The reliability of a quality appraisal tool for studies of diagnostic reliability (QAREL) The reliability of a quality appraisal tool for studies of diagnostic reliability (QAREL). BMC Medical Research Methodology, 13(1), 1. http://doi.org/10.1186/1471-2288-13-111

[27]. Macdermid, J. C., Brooks, D., Solway, S., Switzer-, S., Brosseau, L., & Graham, I. D. (2005). Reliability and validity of the AGREE instrument used by physical therapists in assessment of clinical practice guidelines, 12, 1–12. http://doi.org/10.1186/1472-6963-5-18

[28]. Sanderson, S., Tatt, I. D., & Higgins, J. P. T. (2007). Tools for assessing quality and susceptibility to bias in observational studies in epidemiology : a systematic review and annotated bibliography, (April), 666–676. http://doi.org/10.1093/ije/dym018

[29]. Bennett, C., Khangura, S., Brehaut, J. C., Graham, I. D., Moher, D., Potter, B. K., & Grimshaw, J. M. (2011). Reporting Guidelines for Survey Research : An Analysis of Published Guidance and Reporting Practices, 8(8), 1–11. http://doi.org/10.1371/journal.pmed.1001069

Appendix

Critical Appraisal Tool for Cross-Sectional Studies (CAT-CSS)Appraiser Guide

Purpose of the tool: critically appraise cross-sectional study design.

Who can use the tool?

The CAT-CSS tool is intended to be used by the scientific researchers and educators who is interested in enhancing their critical appraisal skills of cross-sectional studies.

Instructions for use

This information is intended to help users to understand the issues and concepts addressed by the criteria.

Please read the following instructions carefully before using the CAT-CSS.

I- Study identification section

This section is concerning study author/s, title of the article, journal, volume, year of publicationand funding.

II- Study validity section

   This section was composed of nine domains with total number of 50 criteria**.**

1. Abstract and introduction of the study (items 1-6)
2. Aim and question/s of the study (items 7-10)
3. Study design/ setting and timeframe (items 11-15)
4. Sampling (items 16-25)
5. Data collection and ethical issues (items 26-35)
6. Results (items 36-41)
7. Discussion/ conclusion and recommendations (items 42-48)
8. References (items 49-50)

For each criterion, document the appropriate response, according to how you think it is addressed:

Poor: if less than 50% of the mentioned criteria is found in the appraisal checklist

Good: if 50% to 65% of the mentioned criteria is found in the appraisal checklist

Excellent: if more than 65% of the mentioned criteria is found in the appraisal checklist

III- Conclusion, strengths, and limitations/weaknesses of the study section

This section is concerning study conclusion**,** strengths, and limitations/weaknesses.

IV- Overall quality scoring of the study section

This section is to be calculated as percentage of the total covered criteria mentioned throughout the "study validity" section. The overall quality of the study is rated on the rubric scale as the same as the domains of the study validity section.

Critical Appraisal Tool for Cross-Sectional Studies (CAT-CSS)

Appraiser: --- **Date:** ---

Section (I) Study Identification
Author(s) and Affiliation(s):---
Title of the article: --
Journal:---
Volume, year of publication and page numbers: ---

FUNDING
1. Identification of the source of funding Yes ( ) No ( )
2. Identification of the role of funders   Yes ( ) No ( )
3. Declarations of conflict of interest   Yes ( ) No( )

Section (II) Study Validity
For each criterion, document the appropriate response, according to how you think it is addressed:
Poor: if less than 50% of the mentioned criteria is found in the appraisal checklist
Good: if 50% to 65% of the mentioned criteria is found in the appraisal checklist
Excellent: if more than 65% of the mentioned criteria is found in the appraisal checklist

ABSTRACT AND INTRODUCTION OF THE STUDY
1. Abstract is presented in an informative and balanced summary of what was done and what was found.
2. Sufficient scientific background information on the topic.
3. Introduction is focused, relevant, in logical fashion and justifiable to the research question.
4. Burden of disease/ condition is quantified to magnify the magnitude of the problem in a particular population
5. Introduction is zoomed into regional or national perspective if applicable.
6. Introduction is ended with the aim of the study.

Abstract and introduction	Poor	Good	Excellent
Number of criteria: (6)	< 3 criteria	3-4 criteria	> 4 criteria
	No. of covered criteria: (n=)	No. of covered criteria: (n=)	No. of covered criteria: (n=)

AIM AND QUESTION/S OF THE STUDY
1. Aim is descriptive and clearly stated**.**
2. Aim is SMART: Specific, Measurable, Achievable, Resourced (within the project budget) and Time Bound.
3. Question/s of study is adequately described.
4. Type of research question/s is corresponded to the study design**.**

Aim and question/s of the study	Poor	Good	Excellent
	<2 criteria	2-3 criteria	> 3 criteria
Number of criteria: (4)	No. of covered criteria: (n=)	No. of covered criteria: (n=)	No. of covered criteria: (n=)

METHODS

STUDY DESIGN/ SETTING AND TIMEFRAME
1. Study design is clearly presented.
2. Study design is justified.
3. Study setting or a location is described.
4. Study timeframe is clearly illustrated.
5. Study timeframe seems appropriate**.**

Study design/ setting and timeframe	Poor	Good	Excellent
	< 3 criteria	3-4 criteria	> 4 criteria
Number of criteria: (5)	No. of covered criteria: (n=)	No. of covered criteria: (n=)	No. of covered criteria: (n=)

SAMPLING

1. Sample is selected and representative of reference population.
2. The methods of sample selection are clearly described.
3. Appropriate sample technique is used with ensured randomization.
4. Specific description of inclusion criteria.
5. Specific description of exclusion criteria.
6. Sample size estimates have been performed.
7. Sample size seems feasible (taking into account resources/ prevalence of disease/ study population, etc...).
8. The chosen level of precision, confidence limit, and variability) estimated proportion of an attribute that is present in the population) are adequate for the study question.
9. A highly participation level.   Response rate: (   ).
10. The subjects covered in the study could be sufficiently similar from your population to cause concern.

Sample selection	Poor	Good	Excellent
	<5 criteria	5-6 criteria	> 6 criteria
Number of criteria: (10)	No. of covered criteria: (n=)	No. of covered criteria: (n=)	No. of covered criteria: (n=)

DATA COLLECTION and ETHICAL ISSUES
1. The methods for data collection are described for each of the variables collected (where, by who and when).
2. Content and face validity of the tools are well described
3. Data collection tools are tested for its reliability.
4. The study specifies who are the data collectors and their background.
5. Exposure factor/s is/are identified: Number: ( )
6. Outcome/s is/are ascertained: Number: ( )
7. Exposure and outcomes are measured at one specific point in time.
8. Potential confounding factors are measured accurately.
9. Measures were made to contact non-responders
10. Ethical issues are mentioned clearly (if appropriate).

Data collection/ethical approval and statistical analysis	Poor	Good	Excellent
	< 5 criteria	5-6 criteria	> 6 criteria
Number of criteria: (10)	No. of covered criteria: (n=)	No. of covered criteria: (n=)	No. of covered criteria: (n=)

RESULTS
1. The results are adequately, objectively, and explicitly described.
2. Characteristics of study participants (e.g. demographic, clinical, and social) are presented.
3. Exposure variables are associated with outcome variables.
4. Tables and figures are adequate, clear, and appropriately titled.
5. Appropriate statistical analysis be used: Specify the study statistical measures--
6. The study mentions if negative results or results of no effect/difference are considered for publication.

Results Number of criteria: (6)	**Poor** **< 3 criteria** No. of covered criteria: (n=)	**Good** **3-4 criteria** No. of covered criteria: (n=)	**Excellent** **> 4 criteria** No. of covered criteria: (n=)

DISCUSSION/CONCLUSION AND RECOMMENDATIONS
1. The results are summarized and discussed in relation to the original research questions.
2. The researcher has discussed the credibility of their results.
3. There is adequate discussion of the evidence for the researchers' arguments.
4. Limitations of the study are discussed, taking into account sources of potential bias or imprecision.
5. Discussion shows the contribution of the study to the body of knowledge and existing evidence base.
6. The results suggest a more rigorous study is needed.
7. The authors mention how the study results will be used, i.e. potential implications for actions.

Discussion/ conclusion and recommendations Number of criteria: (7)	**Poor** **< 4 criteria** No. of covered criteria: (n=)	**Good** **4-5 criteria** No. of covered criteria: (n=)	**Excellent** **> 5 criteria** No. of covered criteria: (n=)

REFERENCES
1. References are adequate and relevant to the study topic.
2. References are up-to-date.

References Number of criteria: (4)	**Poor** **< 2 criteria** No. of covered criteria: (n=)	**Good** **2-3 criteria** No. of covered criteria: (n=)	**Excellent** **> 3 criteria** No. of covered criteria: (n=)

Section (III) Conclusions of the study			
Author/s conclusions:			
Strengths of the study:			
Limitations/Weaknesses of the study:			

Section (V) Overall Quality Scoring of the Study
No. of covered criteria: (n=)/ 50 × 100=

Number of criteria: (50)	**Poor** **< 25 criteria** No. of covered criteria: (n=)	**Good** **22– 32 criteria** No. of covered criteria: (n=)	**Excellent** **> 32 criteria** No. of covered criteria: (n=)
Comments:			