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Factor Analysis in Assessing the Research Methodology Quality of Systematic Reviews

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Abstract

Introduction: Many high quality systematic reviews available from medical journals, data bases and other electronic sources differ in quality and provide different answers to the same question. The literature recommended the use of a checklist type approach, which exceeds many of the problems associated with measurements. *Aim:* This study proposes to identify in a checklist type approach the most commonly used factors (from a methodological point of view) in assessing the quality of systematic reviews, and then mirror the actual stage of medical writing. We want to analyze the factors' occurrence and / or their development in the text and in the abstract of systematic reviews published in 2011. *Methods:* The present study randomly selected only free full text systematic reviews published in 2011, systematic reviews found in Pubmed and in Cochrane Database. The most commonly used factors were identified in PRISMA statement and quality measurement tools. *Results:* The evaluated systematic reviews mentioned or developed several of the factors studied. Only 78% of the papers surveyed have used the correct IMRAD format and 59% of them have mentioned the sample size used. The correspondence between the content of the paper and its abstract is summarized in the proportion of 54.63% and 51.85% for the two sets of factors, and it can lead to scarce appreciation of the article provided that only abstracts are read. *Conclusions:* Researchers do not properly take into consideration scientific articles and assessment tools used for quality evaluation. They should place more value over methodological factors which help assess systematic review quality, while journals form the only party who can enforce quality standards in medical writing.

Keywords: Review; Systematic; Methodology; Quality; Assessment.

Introduction

Usually used as a way to sum up research evidences, systematic reviews have taken over gradually the narrative reviews and the experts' comments. Systematic reviews try to bring the same level of rigor in assessing research evidences as the one that should be used in producing those evidences. This type of review should be clear, structured and replicable, if necessary. High quality reviews attempt to: identify all the relevant evidence (published and unpublished), select the studies and reports to be included in the review, evaluate the quality of each study or report, impartially synthetize the results presented in individual studies or reports, interpret the findings and present a balance and impartial summary of the findings, taking into consideration any flaws or errors in the

studied elements.

Many high quality peer-review systematic reviews are available from medical journals, data bases and other electronic sources. However, despite the care with which these reviews are compiled and published, they may differ in quality, and provide different answers to the same question [1].

As science evolves once with the accumulation of new research, new medical interventions, initially considered to be effective and safe, may prove to be ineffective or harmful, or vice-versa [2]. As a result, systematic reports users should be critical and carefully check the quality and methodological essays available [3].

Evaluation of systematic essays regarding the potential sources of error has resulted in numerous studies in which different individual factors were taken as such, for example, a recent methodological research has highlighted the potential importance of publication language and publication bias in systematic reports [4]. West et al. have identified more than 109 measurements, checklists and other guidance documents for conducting risk assessments of bias when carrying out systematic reports [5]. The most often evaluated subject in the whole scientific literature was the use of risk assessment scores for systematic errors in reports [6]. Other authors recommend the use of a checklist type approach, which exceeds many of the problems associated with measurements [6,7]. The abstract is an important aspect in assessing the overall quality of a systematic review. It is recommended that the abstract should be structured and it should be established the extent to which an abstract reflects the information in the article [8].

This study proposes to identify in a checklist type approach the most commonly used factors (from a methodological point of view) in assessing the quality of systematic reviews and, thus, mirror the actual stage of medical writing. We want to analyze the factors' occurrence and / or their development in the text and in the abstract of systematic reviews published in 2011. The Pubmed database provides 45,656 papers published in 2011, of which only 4,253 are available with free text. Systematic reviews published in the Cochrane Database were chosen because of the renowned rigorous structure and of the free text availability. It offers 1747 essays published in 2011.

Material and Method

The most commonly found factors, which show publication's quality from a methodological point of view, are split into two groups: the researchers' ability to collect properly and correctly data according to methodology ("Accurate Data Collection") and data accuracy for medical writing ("Accuracy of Medical Writing Issues") [4-7].

In the category of "Accurate Data Collection" were chosen following criteria: mentioning the medical literature searching (which were the targeted databases), presenting the search strategies used, mentioning sampling methodology, commenting the sample size, indicating the number of patients analyzed statistically in systematic papers, mentioning the data collection method used, specifying the number of reviewers involved in the study, presenting inclusion and exclusion criteria specific for its topic, indicating systematic errors avoidance and assessing the validity of the selected papers. To assess the "Accuracy of Medical Writing Issues" have been pursued: respecting the IMRAD format for writing the systematic review content (observe if the chapters were written mentioning the headings Introduction, Materials and methods, Results, Discussions and Conclusion), properly combining the findings of relevant studies (depending on the presentation of inclusion/exclusion criteria, declaration of articles' validity and systematic error avoidance) and data supporting the conclusions made by the author (observe if the author's conclusions are based on the results found).

In order to determine how well systematic reviews' abstracts reflect the information contained in the text, the display of factors (belonging to the two groups mentioned above) was counted and thus, grading was made.

We intend apply this set of factors on a set of systematic reviews to determine the level of their methodological standpoint. From all the articles available in Pubmed and Cochrane we limited our research and included only systematic reviews published in 2011. We excluded those not meeting the criteria to be considered systematic reviews and those which did not present free full text.

Random selection of reviews was made by picking one or two systematic reviews found on a result pages after applying the strategy "**Limits Activated:** only items with links to free full text, Systematic Reviews, published in the last 1 year". Reference to these texts can be found at [16-37].

For statistical analysis of data obtained from systematic reviews' evaluation included in the study, the programs used are Excel and EpiInfo. Descriptive statistical techniques and statistical tests (Chi-Squared, Fischer) were used. Although the Chi-Squared test showed the existence of statistically significant differences between observed and theoretical distribution for two qualitative variables (example: $p = 0.002$), if one of the contingency table cells was less than 5 we preferred using the Fischer test instead.

Results

15 papers published in Pubmed and 12 systematic reviews published in Cochrane were randomly selected and then analyzed. The evaluated systematic reviews mentioned or developed several of the criteria studied.

Each systematic review stated that there were two assessors for selected articles and disputes were resolved with the help of a third evaluator. All systematic reviews have pointed out where to search the medical literature and which information search strategies were used. All articles mentioned sampling methodology, mentioned data collection method used, applied inclusion criteria specific for its topic and avoided systematic errors. Good quality (validity) of articles included in the all systematic reviews' research was reported. Analyzing the evaluated studies, 59% of them mentioned the sample size used (95% Confidence Limits for PRESENT 38.8% 77.6%). Figure 1 shows that only 78% of the papers surveyed have used the correct IMRAD format (95% Confidence Limits for YES 57.7%-91.4%).

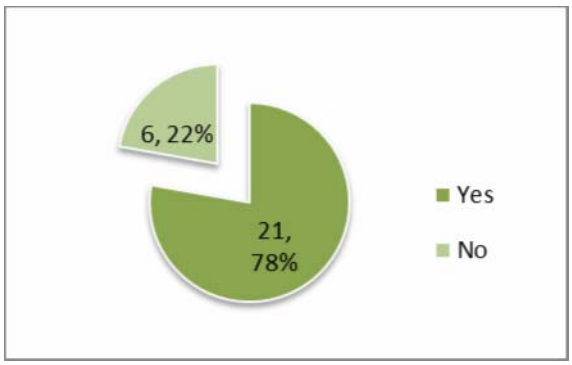

Figure 1. Distribution of systematic reviews which follow the IMRAD format

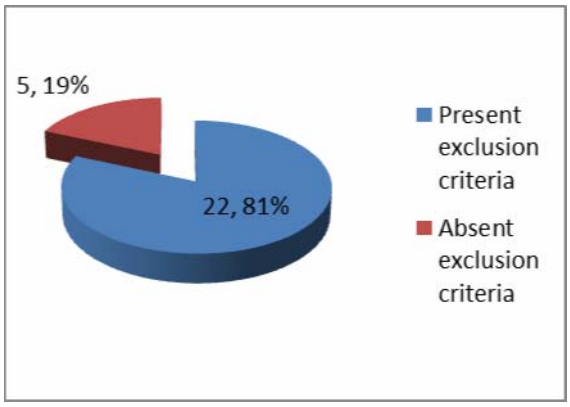

Figure 2. Distribution of systematic reviews which present the exclusion criteria

Approximately 70% reviews (95% Confidence Limits for YES 46.0%-83.5%) correctly combine the results of relevant studies, and 96% (95% Confidence Limits for YES 81.0%-99.9%)of them use data to support the author's conclusions. Exclusion criteria are lacking in 19% of cases (95% Confidence Limits for NO 6.3%-38.1%), while 96% of reports have said to avoid systematic errors.

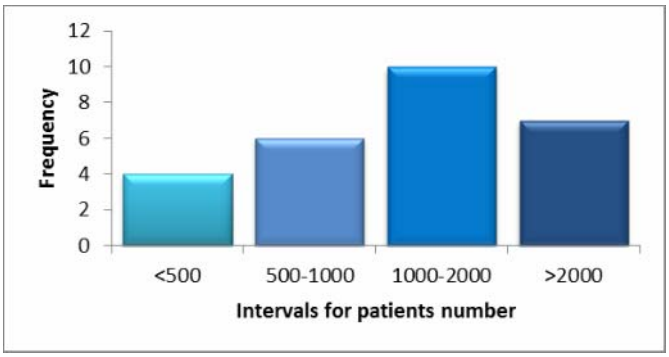

Figure 3. Patients' distribution in evaluated systematic papers

The number of patients analyzed statistically in systematic papers varies between 200 and 848019.

Table 1. Factor distribution according to its occurrence in the evaluated systematic reviews

Factors	Number of factors	Percentage (%)
Present in 100% of evaluated Systematic reviews	6	42.86
Present in 96% of evaluated Systematic reviews	3	21.4
Present in 55%-85% of evaluated Systematic reviews	5	35.7
Total	14	10

Table 1 shows that only 6 factors from the evaluated groups were found in every systematic review.

The correspondence between the content of the paper and its abstract is summarized in the proportion of 54.63% of "Accuracy of Medical Writing Issues" criteria present in the abstract, while aspects of "Accurate Data Collection" analysis are summarized in the proportion of 51.85%.

Relationships between grouped indicators in "Accurate Data Collection" and analysis of the "Accuracy of Medical Writing Issues" were evaluated.

Table 2. Relationship between "Correct Combining the Proper Results of Relevant Studies" and "Sample Size Specification"

		Combining correctly the proper results of relevant studies		
		YES	NO	TOTAL
Specifies the size of samples	YES	7	9	16
	NO	11	0	11
	TOTAL	18	9	27

Using statistical Fisher test p-value = 0.002 was found for the relationship between "Sample Size Specification" and "Combining Correctly the Proper Results of Relevant Studies".

Table 3. Relationship between the "Combining Correctly the Proper Results Of Relevant Studies" and "Reference to the Exclusion Criteria"

		Combining correctly the proper results of relevant studies		
		YES	NO	TOTAL
Specifies the exclusion criteria	YES	18	4	22
	NO	0	5	5
	TOTAL	18	9	27

According to Table 3, Fisher statistical test was used to assess the relationship between the presentation of the Reference To The Exclusion Criteria and Correct Combining The Proper Results Of Relevant Studies, and p = 0.001.

Table 4. Relationship between "Data Supports the Author's Conclusions" and "Avoidance of Systematic Errors in the Study"

		Data supports the author's conclusions		
		YES	NO	TOTAL
Avoidance of systematic errors in the study	YES	26	0	26
	NO	0	1	1
	TOTAL	26	1	27

The link between "Avoidance of Systematic Errors in the Study" and "Data Supports of the Author's Conclusions" has been evaluated with the help of Fisher's exact test, p is equal to 0.037.

Discussion

Following the conducted analysis, it was observed that not all indicators, considered suitable to achieve quality assessment and writing a systematic review, have been described or were at least mentioned.

Although the IMRAD format is very popular in writing research articles and has a clear structure to present items of research [9], it was not correctly applied in the text or has not been used, denoting researchers lack of information on the methodological accuracy in medical writing and, last but not least, shows no rigor imposed by journals where such reports were published.

Although all authors presented the search strategies and databases they have used to identify articles for use in developing systematic essays, only some of them informed on the exclusion criteria and the sample size studied. For 41% of systematic papers the number of patients analyzed statistically has to be looked for in tables and graphics.

Avoiding systematic errors is an issue that helps determining the validity of an article, but 4% of surveyed papers do not specify if this was taken into account.

A partial presentation in the abstract of issues that help determining the quality and rigor of research can mislead readers. It was noted that only half of the indicators presented in the content of the reports are listed in abstracts, which does not appropriately reflect the quality of research itself. This can lead to underestimation of the quality of the essay if it is not entirely read by researchers and clinicians. The development of richly detailed abstracts is highly recommended for establishing the quality level essential for reviews. Another recommendation is aimed at the readers to run through the entire systematic review text if the abstract is close to the expected quality.

There is a statistically significant relation between mentioning the sample size and the correct combination of relevant studies (Fisher: $p < 0.05$).

There is a statistically significant connection between the presentation of the exclusion criteria and the correct combination of relevant studies (Fisher: $p < 0.05$).

There is a statistically significant connection between the study's avoiding systematic errors and the author's conclusions supported by data (Fisher: $p < 0.05$).

Conclusions

Although many scientific articles and assessment tools suggested different sets of indicators, measurements and checklists for evaluating the systematic review's quality and proved their efficiency, researchers do not take them into consideration. Only 42.86% of the most commonly used criteria in quality assessment were present in the text of all reviews. The correspondence between the content of the paper and its abstract is summarized in the proportion of 54.63% and 51.85% for the two sets of factors, and it can lead to scarce appreciation of the article provided that

only abstracts are read. Researcher should place more value over methodological factors which help assess article quality, while journals form the only party who can enforce quality standards in medical writing. Sample size and exclusion criteria are related to the presentation of the correctly combined results of relevant studies. Another relation was established between errors evasion in systematic reviews and the author's conclusions supported by data.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Moher D, Soeken K, Sampson M, Ben Perot L, Berman B. Assessing the quality of reports of systematic reviews in pediatric complementary and alternative medicine. BMC Pediatr 2002;2:3. Available from: URL: http://www.biomedcentral.com/1471-2431/2/3
2. Chalmers I, Enkin M, Keirse MJ. Preparing and updating systematic reviews of randomized controlled trials of health care.Milbank Q 1993;71(3):411-37.
3. Jadad AR, Moher M, Browman GP, Booker L, Sigouin C, Fuentes M, et al. Systematic reviews and meta-analyses on treatment of asthma: critical evaluation. BMJ 2000;320:537-40.
4. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Medical Research Methodology 2007;7:10. Available from: URL: http://www.biomedcentral.com/1471-2288/7/10.
5. Systems to Rate the Strength of Scientific Evidence [online] [accessed September 2011] Evidence Report/Technology Assessment 2002;47. Available from: URL: http://archive.ahrq.gov/clinic/epcsums/strengthsum.pdf.
6. Herbison P, Hay-Smith J, Gillespie WJ. Adjustment of meta-analyses on the basis of quality scores should be abandoned. Journal of Clinical Epidemiology 2006;59(12):1249-56.
7. Jüni P,Witschi A, Bloch R, EggerM. The hazards of scoring the quality of clinical trials for meta-analysis. JAMA 1999;282(11):1054-60.
8. Taddio A, Pain T, Fassos FF, Boon H, Ilersich AL, Einarson TR. Quality of nonstructured and structured abstracts of original research articles in the British Medical Journal, the Canadian Medical Association Journal and the Journal of the American Medical Association. CMAJ 1994;150(10):1611-5.
9. Finnish Institutions Research Paper (Hopkins). Department of Translation Studies, University of Tampere. The IMRAD Research Paper Format [online]. 2011 [accessed November 2011]. Available from: URL: http://www.uta.fi/FAST/FIN/RESEARCH/imrad.html
10. Karr AF, Sanil AP, Bank DL. Data quality: A statistical perspective. Statistical Methodology 2006;3:137-73.
11. Morissette K, Tricco AC, Horsley T, Chen MH, Moher D. Blinded versus unblinded assessments of risk of bias in studies included in a systematic review. The Cochrane Library 2011;7:9. Available from: URL: http://onlinelibrary.wiley.com/doi/10.1002/14651858.MR000025.pub2/full
12. Moher D, Tsertsvadze A, Tricco A, EcclesM, Grimshaw J, SampsonM, et al. When and how to update systematic reviews. Cochrane Database Syst Rev. 2008 Jan 23;(1):MR000023. Available from: URL: http://onlinelibrary.wiley.com/doi/10.1002/14651858.MR000023.pub3/full
13. Hemingway P, Brereton N. What is a systematic review? Evidence based medicine. 2nd Edition. Hayward Medical Communications; 2009.
14. Patriota AG, Lemontea AJ, de Castro M. Influence diagnostics in a multivariate normal regression model with general parameterization. Statistical Methodology 2010;7(6):644-54.
15. Knobloch K, Yoon U, Vogt PM. Preferred reporting items for systematic reviews and meta-analyses (PRISMA)statement and publication bias. J Craniomaxillofac Surg 2011;39(2):91-2.

16. Zhang W. Evidence-based medicine methodology-systematic reviews and meta-analyses. Osteoarthritis and Cartilage 2007;15(Supplement C): C5.
17. Littell JH. Evidence-based or biased? The quality of published reviews of evidence-based practices. Children and Youth Services Review 2008;30:1299-1317.
18. De Vito C, Manzoli L, Marzuillo C, Anastasi D, Boccia A, Villari P. A systematic review evaluating the potential for bias and the methodological quality of meta-analyses in vaccinology. Vaccine 2007;25(52):8794-806.
19. Pluye P, Gagnon MP, Griffiths F, Johnson-Lafleur J. A scoring system for appraising mixed methods research, and concomitantly appraising qualitative, quantitative and mixed methods primary studies in Mixed Studies Reviews. Int J Nurs Stud 2009;46(4):529-46.
20. LiberatiA, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JPA, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions:explanation and elaboration. PLOS Medicine 2009;6(7). Available from: URL: http://www.plosmedicine.org/article/info:doi/10.1371/journal.pmed.1000100
21. Robinson N, Lorenc A, Liao X. The evidence for Shiatsu: a systematic review of Shiatsu and acupressure. BMC Complement Altern Med 2011;11:88. Available from: URL: http://www.biomedcentral.com/1472-6882/11/88.
22. Tanentsapf I, Heitmann BL, Adegboye A. Systematic review of clinical trials on dietary interventions to prevent excessive weight gain during pregnancy among normal weight, overweight and obese women. BMC Pregnancy Childbirth 2011;11:81. Available from: URL: http://www.biomedcentral.com/1471-2393/11/81.
23. Zainuldin R, Mackey MG, Alison JA. Optimal intensity and type of leg exercise training for people with chronic obstructive pulmonary disease. Cochrane Database Syst Rev. 2011;11:CD008008.
24. Schwingshackl L, Strasser B, Hoffmann G. Effects of Monounsaturated Fatty Acids on Glycaemic Control in Patients with Abnormal Glucose Metabolism: A Systematic Review and Meta-Analysis. Ann Nutr Metab 2011;58(4):290-6.
25. Parantainen A, Verbeek JH, Lavoie MC, Pahwa M. Blunt versus sharp suture needles for preventing percutaneous exposure incidents in surgical staff. Cochrane Database Syst Rev. 2011 Nov 9;11:CD009170.
26. Rosti-Otajärvi EM, Hämäläinen PI. Neuropsychological rehabilitation for multiple sclerosis. Cochrane Database Syst Rev 2011;11:CD009131.
27. Anderson O, Boshier P, Hanna G. Interventions designed to prevent healthcare bed-related injuries in patients. Cochrane Database Syst Rev 2011;11:CD008931.
28. Richards BL, Whittle SL, Buchbinder R. Antidepressants for pain management in rheumatoid arthritis. Cochrane Database Syst Rev 2011;11:CD008920.
29. Mujezinovic F, Alfirevic Z. Analgesia for amniocentesis or chorionic villus sampling. Cochrane Database Syst Rev 2011;11:CD008580.
30. Rees K, Stowe R, Patel S, Ives N, Breen K, Ben-Shlomo Y, et al. Anti-hypertensive drugs as disease-modifying agents for Parkinson's disease: evidence from observational studies and clinical trials. Cochrane Database Syst Rev 2011;11:CD008535.
31. Khan S, Heussler H, McGuire T, Dakin C, Pache D, Cooper D, et al. Melatonin for non-respiratory sleep disorders in visually impaired children. Cochrane Database Syst Rev 2011;11:CD008473.
32. Rees K, Stowe R, Patel S, Ives N, Breen K, Clarke CE, et al. Helicobacter pylori eradication for Parkinson's disease. Cochrane Database Syst Rev 2011;11:CD008453.
33. da Silva EMK, Strufaldi MWL, Andriolo RB, Silva LA. Enzyme replacement therapy with idursulfase for mucopolysaccharidosis type II (Hunter syndrome). Cochrane Database Syst Rev 2011;11:CD008185.
34. Liabsuetrakul T, Peeyananjarassri K. Mechanical dilatation of the cervix at non-labour caesarean section for reducing postoperative morbidity. Cochrane Database Syst Rev 2011;11:CD008019.
35. Ilic D, Forbes KM, Hassed C. Lycopene for the prevention of prostate cancer. Cochrane Database Syst Rev 2011;11:CD008007.

36. Faurschou A, Olesen AB, Leonardi-Bee J, Haedersdal M. Lasers or light sources for treating port-wine stains. Cochrane Database Syst Rev 2011;11:CD007152.
37. Adhikary SD, Thiruvenkatarajan V, Babu KS, Tharyan P. The effects of anaesthetic agents on cortical mapping during neurosurgical procedures involving eloquent areas of the brain. Cochrane Database Syst Rev 2011;11:CD006679.