Original Article

The quality of evidence on nutrition intervention published in Chinese journals: an assessment of meta-analyses on vitamin interventions

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Background and Objectives: The quality of meta-analyses (MAs) on nutrition intervention in mainland China remains uninvestigated. To assess the quality of the evidence regarding nutrition intervention in mainland China, we used vitamin intervention as an example to assess the overall methodological and reporting qualities of MAs on nutrition interventions published in Chinese journals. **Methods and Study Design:** A cross-sectional study on MAs of vitamin interventions was performed. Four Chinese databases were searched from inception through September 2016 for all MAs of vitamin intervention. A Measurement Tool to Assess Systematic Reviews (AMSTAR) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statements were used to assess methodological and reporting qualities, respectively. **Results:** A total of 43 MAs of vitamin interventions were included, but none of the studies had been updated. These reviews mainly focused on the effects of interventions involving vitamin D, B vitamins and vitamin E, and the most studied condition was "Endocrine, Nutritional and Metabolic diseases," such as diabetes, obesity, and nutritional rickets. The median AMSTAR score was 6 (0-7), and median PRISMA score was 18 (3-24). No study provided an 'a priori' design, a list of excluded studies, or a statement on conflict of interest, and less than 50.0% of included MAs stated the publication status and performed an adequate structure summary. **Conclusions:** The quality of the included MAs was disappointing regarding some items, and some lower quality reviews should be updated. Future MAs should improve on reporting conflicts of interest, harm, and publication bias.

Key Words: systematic review, meta-analyses, vitamin, methodological quality, reporting quality

INTRODUCTION

Dietary supplements of essential vitamins are important when nutritional requirements are not met through diet alone. Nevertheless, the safety and efficacy of vitamin supplementation remains vigorously debated given that potential deleterious effects of excessive intake have been identified for vitamins.[1] For example, the United States Preventive Service Task Force (USPSTF) reported that individual supplements of folic acid and vitamins C, D and E were conducive to cancer and cardiovascular disease in nutrient-sufficient adults.[2]

Meta-analysis (MAs) is considered the best method to summarize high-quality evidence on the efficacy and safety of various therapies. However, biased results from MAs can mislead clinical medical decision making, so it is important to assess the methodological and reporting quality of MAs. The Assessing of Multiple Systematic Reviews (AMSTAR), a new instrument for evaluating MAs, was developed in 2007.[3] The full version is available the AMSTAR official website.[4] The tool consists of 11 items and is reliable and valid for assessing the methodological quality of MAs.[5] The AMSTAR score has been adopted by a number of research and health technology assessment groups, such as the Canadian Agency for Drugs and Technologies in Health and the Cochrane Effective Practice and Organization of Care Group.[6] The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement differs from the AMSTAR checklists. PRISMA is an evolution of the Quality of Reporting of Meta-analyses (QUPRPM) guideline for assessing the reporting quality of MAs.[7] There are 27 specific items in the PRISMA Statement, which encompass all aspects of an article and ensure the transpar-

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ent and complete reporting of MAs.[8]

In the past ten years, MAs of vitamin interventions were published continually in China, with the aim of providing trustworthy evidence for clinicians and policy makers to judge the risks, benefits, and harms associated with vitamin interventions. However, the quality of MAs on vitamin interventions published in Chinese journals is unclear.

Using a cross-sectional study design, the present study aimed to (1) summarize the characteristics of MAs of vitamin interventions published in Chinese journals, (2) assess their methodological quality by AMSTAR statements, and (3) evaluate their reporting quality by PRISMA checklists. The results of this review will provide an overview of MAs in the field of vitamin interventions published in Chinese and lead to suggestions for future quality improvements.

METHODS

Data sources and searches

Comprehensive searches were performed in the following four Chinese electronic databases: 1. China National Knowledge Infrastructure database (CNKI, 1979 to September 2016); 2. China Biology Medicine database (CBM, 1978 to September 2016); 3. VIP database (VIP, 1989 to September 2016); and 4. Wanfang database (Wanfang, 1998 to September 2016). These databases are comprehensive databases, with the exception of CBM, which is focused on Medicine. These databases include both English and Chinese journals, but English journals are less represented. The main search terms used were "systematic review," "meta-analysis," "meta-analyses," "vitamin," "vitamins," "folic acid," "pantothenic acid," "biotin," and "nicotinic acid." We also searched Chinese synonyms of the above search terms and the references of all included reviews.

Inclusion and exclusion criteria

MAs of vitamin interventions published in Chinese journals were included in this review. Reviews were considered eligible for inclusion if the terms meta-analyses or systematic review were included in the titles or abstracts. Studies in which a systematic review had been undertaken were also eligible for inclusion. There was no limitation on the study population and clinical setting. The methodologies of MAs, surveys, historical reviews, narrative reviews, and case reports with extensive literature reviews were excluded. Articles without titles and abstracts in English were also excluded.

Study selection and data extraction

Two authors (YHN, JXZ) independently screened the titles, abstracts and full texts of potentially relevant articles. Disagreements were resolved by discussion or with reference to a third author (YL). Full-text articles were obtained for each potentially relevant study. Data on patients, methods, interventions, outcomes and results were extracted by two reviewers (YHN, JXZ) independently using a data extraction form. Missing data were obtained from the authors whenever possible. The medical conditions that were the subjects of the included MAs were classified by the International statistical Classification of

Table 1. The International Statistical Classification of Diseases (10th revision, ICD-10)

The items of ICD-10	Examples
Certain infectious and parasitic diseases	Tuberculosis, viral hepatitis, etc.
Neoplasms	Benign neoplasms, malignant breast tumor, etc.
Disease of the blood and blood-forming organs and certain disorders involving the immune mechanism	Nutritional anemias, hemolytic anemias, etc.
Endocrine, nutritional and metabolic diseases	Diabetes mellitus, malnutrition, etc.
Mental and behavioral disorders	Mood disorders, mental retardation, etc.
Diseases of the nervous system	Nerve, nerve root and plexus disorders, extrapyramidal and movement disorders, etc.
Diseases of the eye and adnexa system	Disorders of lens, glaucoma, etc.
Diseases of the ear and mastoid process	Disease of inner ear, diseases of external ear, etc.
Disease of the circulatory system	Acute rheumatic fever, hypertensive diseases, etc.
Disease of the respiratory system	Influenza and pneumonia, chronic lower respiratory diseases, etc.
Disease of the digestive system	Diseases of appendix, hernia, etc.
Disease of the skin and subcutaneous tissue	Bullous disorders, urticarial and erythema, etc.
Disease of the musculoskeletal system and connective tissue	Osteoarthritis, spondylopathies, etc.
Diseases of the genitourinary system	Glomerular diseases, urolithiasis, etc.
Pregnancy, childbirth and the puperium	Pregnancy with abortive outcome, supervision of high risk pregnancy, etc.
Certain conditions originating in the perinatal period	Birth trauma, abnormal findings on neonatal screening, etc.
Congenital malformations, deformations and chromosomal abnormalities	Congenital malformations of the respiratory system, cleft lip and cleft palate, etc.
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	Abnormal tumor markers, general symptoms and signs, etc.
Injury, poisoning and certain other consequences of external causes	Injures to the head, injures to the neck, etc.
External causes of morbidity	Accidents, assault, etc.
Factors influencing health status and contact with health services	Blood type, body mass index, etc.

Diseases (10th revision, ICD-10) (Table 1).

Assessment of methodological and reporting quality

The methodological quality of the included MAs was evaluated using the AMSTAR instrument. Each AMSTAR item is rated with "yes"=1, "no" =0, "cannot answer"=0, or "not available"=0. The reporting quality of the included reviews was assessed according to the level of compliance with the PRISMA checklists. The PRISMA is a list of 27 items corresponding to each part of the review, including title, abstract, introduction, methods, results, discussion, conclusion, and funding. Each item is rated as "adequate"=1, "inadequate"=0 or "no description"=0. The reviewers received the same training on the use of PRISMA and the AMSTRA tools. Two reviewers (YHN, JXZ) assessed each MA blindly and independently, and disagreements were discussed or resolved by asking a third reviewer (YL).

Data analysis

The characteristics and the AMSTAR and PRISMA results for each review were entered into a spreadsheet (Microsoft Excel 2013, Microsoft Corporation, Washington) and analyzed by statistical software SPSS (version 19.0, SPSS Inc, Chicago). Descriptive statistical analyses of the characteristics of the included reviews were undertaken.

RESULTS

Review searching and selection

The search strategy identified 1,158 records of potential interest. After screening the titles and abstracts, 1,054 reviews were excluded for duplication or for describing non-vitamin interventions or non-MA studies. Upon full-text review, 61 reviews were excluded according to exclusion criteria, and only 43 studies were eligible for quality assessment and full data extraction (Figure 1).

Study characteristics

Lists of the included MAs and the characteristics of these included reviews are provided in Tables 2 and 3. The included MAs were obtained from 34 Chinese journals, and 16 (37.2%) of them were cited by the Chinese Science Citation Database (CSCD). The impact factor of the journals ranged from 0.198 to 1.99, with a median of 0.681. Most of the included studies (90.7%) were published after 2009. The number of authors ranged from 1 to 8, and the median was 4. The frequency of citations for each MA ranged from 0 to 37, and greater than half (51.2%) of the MAs had not been cited. The most common vitamin interventions were vitamin D (32.6%), B vitamins (27.9%) and vitamin E (20.9%). Studies on vitamin D focused on "Endocrine, Nutritional, and Metabolic Diseases", "Diseases of Genitourinary System", "Diseases of the Circulatory System", "Certain Infectious and Parasitic Diseases" and "Neoplasms". Studies on B vitamins focused on "Diseases of the Circulatory System", "Endocrine, Nutritional, and Metabolic Diseases", "Certain conditions originating in the Prenatal Period", "Diseases of Genitourinary System", "Neoplasms" and "Safety of medication". Studies on vitamin E were related to "Diseases of the

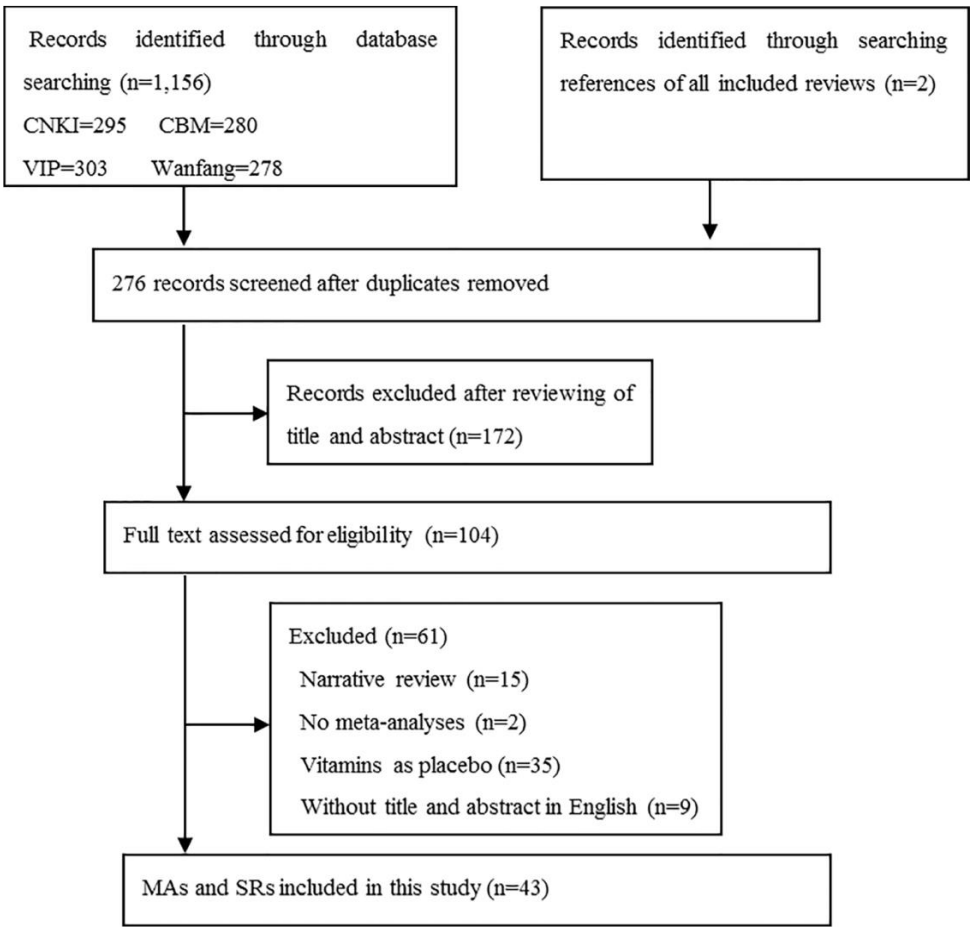

Figure 1. A flowchart of the articles identified, included, and excluded.

Table 2. A list of the included MAs

No.	Study ID	The targeted condition	Exposures	Outcomes
1	Jia HY, 2005[9]	Diabetic peripheral neuropathy	Methylcobalamin	Effective
2	Jian MZ, 2009[10]	Neural tube defects	Folic acid	Effective
3	Wu J, 2009 [11]	Allergic rhinitis	Vitamin E or the n-3 polyunsaturated free fatty acid	Effective
4	Zhang C, 2009[12]	Cardiovascular and cerebrovascular disease	B Vitamins	Ineffective
5	Wang ZX, 2010[13]	Iron nutritional status	Iron in combination with vitamin A	Effective
6	Li J, 2010[14]	Prostate cancer	Vitamin E	Ineffective
7	Xiao YM, 2010[15]	Bone loss in renal transplant patients	Vitamin D	Effective
8	Cao GL, 2011[16]	Alzheimer disease	Antioxidant vitamin (vitamin C and E)	Ineffective
9	Du J, 2011[17]	Stroke	Vitamin E	Effective (ischemic stroke)
10	Mou JJ, 2011[18]	Tuberculosis	Vitamin D as adjuvant treatment	Ineffective
11	Tu JF, 2011[19]	Pneumonia in children	Vitamin A	Effective
12	Zhao R, 2012[20]	Neonatal scleredema	Compound danshen injection combined with vitamin E	Effective
13	Zhong JH, 2012[21]	Hepatocellular carcinoma after surgery	Vitamin K_2 analogs	Effective
14	Gao W, 2013[22]	Type 2 diabetes mellitus	Vitamin D	Effective
15	Liu YR, 2013[23]	Incidences of twin pregnancy	Folic acid	Ineffective
16	Su YJ, 2013[24]	Female breast cancer	Vitamin C	Ineffective
17	Tang ST, 2013[25]	Falls in elderly people	Vitamin D	Effective
18	Zhang N, 2013[26]	Blood pressure	Vitamin D	Ineffective
19	Ding H, 2014[27]	Hypocalcemia in patients with total thyroidectomy	Calcium and Vitamin D supplements	Effective
20	Kou GN, 2014[28]	Obesity	Vitamin D	Effective
21	Li MC, 2014[29]	Stroke	Folic acid	Effective
22	Luo WP, 2014[30]	The growth of children under five years old	Iron and folic acid	Ineffective
23	Luo JY, 2014[31]	Nonalcoholic fatty liver disease	Vitamin E	Ineffective
24	Wang M, 2014[32]	Serum phosphate level in dialysis patients	Nicotinic acid and nicotinamide	Effective
25	Wang Z, 2014[33]	Hemodialysis patients with secondary hyperparathyroidism	Paricalcitol	Effective
26	Wu BS, 2014[34]	Birth defects	Multivitamin	Effective
27	Yu J, 2014[35]	Nutritional rickets	Combined therapy vitamin D with calcium	Effective
28	Zhang N, 2014[36]	Endothelial cell function in patients with homocysteine	Folic acid	Effective
29	He L, 2015[37]	Type 2 diabetes	Vitamin D_3	Effective
30	Lan X, 2015[38]	Cardio-cerebrovascular diseases	Vitamin E	Ineffective
31	Qiu S, 2015[39]	H-hypertension	Folic acid + routine treatment	Effective
32	Wei ZG, 2015[40]	Gastrointestinal tumors in elder	Folic Acid	Ineffective
33	Xiang J, 2015[41]	Prostate cancer	Vitamin D	Effective
34	Xu J, 2015[42]	The safety of large doses of vitamin C	Vitamin C + routine treatment	Safe
35	Ting Y, 2015[43]	Type 2 diabetes mellitus	Vitamin D	Effective
36	Chen M, 2016[44]	Safety of medication	Vitamin B-6	Unsafe
37	Lan X, 2016[45]	Cardiovascular disease mortality and all-cause mortality	Vitamin E	Ineffective
38	Lan X, 2016[46]	Cardio-cerebrovascular diseases	Folic acid, vitamin B-12 and B-6	Ineffective
39	Li WH, 2016[47]	Unexplained male infertility	Vitamin E	Effective
40	Wang DM, 2016[48]	Chronic obstructive pulmonary disease (COPD)	Vitamin D + routine treatment	Effective
41	Wang X, 2016[49]	Myocardial infarction	Vitamin E	Ineffective
42	Wei XC, 2016[50]	Chemotherapy-induced peripheral neuropathy in cancer patients	Vitamins	Effective
43	Zhang YB, 2016[51]	Gestational diabetes mellitus	Vitamin D	Effective

Table 3. Characteristics of the included systematic reviews (N=43)

Category	Characteristic	Number (%)
Year of publication	2005-2009	4 (9.30)
	2010-2016	39 (90.7)
Median number of authors (range)		4 (1-8)
Intervention	Vitamin A	2 (4.70)
	B vitamins	12 (27.9)
	Vitamin C	2 (4.70)
	Vitamin D	14 (32.6)
	Vitamin E	9 (20.9)
	Vitamin E	1 (2.30)
	Multivitamins	3 (7.00)
Condition focused on in the review	Endocrine, nutritional, and metabolic diseases	12 (27.9)
	Diseases of the circulatory system	9 (20.9)
	Neoplasms	5 (11.6)
	Diseases of the genitourinary system	5 (11.6)
	Others	12 (27.9)
Median impact factor of the journal in which the MA was published (range)		0.68 (0.20-1.99)
Median number of searched databases in the MA (range)		6 (2-11)
Median number of included primary studies (range)		10 (1-30)
Median number of participants in the included primary studies (range)		1247 (193-400,058)
Reported harm of the intervention	Yes	18 (41.9)
	No	25 (58.1)
Eligibility criteria based on the language of the publication	Included English publications only	17 (39.5)
	English and Chinese	22 (51.2)
	No language limitations	2 (4.70)
	Language criteria not reported	17 (39.5)
Included a PRISMA-like flow diagram	Yes	16 (37.2)
	No	27 (62.8)
Tools for assessing risk of bias of primary studies	Cochrane risk of bias tool	25 (58.1)
	Jadad scale	13 (30.2)
	Others	2 (4.7)
	Not reported	3 (7.00)
Funding location of the MA	Not reported	25 (58.1)
	Stated	0 (0)
	National	6 (14.0)
	Provincial	4 (9.30)
	Municipal	2 (4.70)
	Pharmaceutical company sponsored	5 (11.6)
	Others	1 (2.30)
Update of a previous review	Yes	0 (0)
	No	43 (100)
Indexed in CSCD	Yes	16 (37.2)
	No	27 (62.8)
Cited	Yes	21(48.8)
	No	22 (51.2)

CSCD: Chinese Science Citation Database.

Circulatory System", "Diseases of the Respiratory System", "Neoplasms", "Certain conditions originating in the Prenatal Period", "Diseases of the Digestive System" and "Diseases of Genitourinary System". Among the included studies, 18 stud-ies reported harm of the intervention, and 25 studies did not report adverse events.

Methodological quality

The average AMSTAR score was 6.10±1.20 out of 11, and the mean adherence rate to the AMSTAR checklist was 55.2%, demonstrating a lower middle level of methodological quality. The top 3 poorest adherence rates among all the AMSTAR checklist items were for items requiring providing an 'a priori' design (item 1, 0%), demanding a list of the studies reviewed (item 5, 0%) and stating the conflict of interest (item 11, 0%) (Figure 2). Then, the item requiring stating the status of publication (grey literature) exhibited the next lowest adherence rate. A few reviews (7.00%) included "the status of publication" as an inclusive criterion, but the search details were not provided. In contrast, some items had a higher adherence rate, such as using appropriate methods to combine the findings of studies (97.7%), providing the characteristics of the included studies (95.3%), and assessing and documenting the scientific quality of the included studies (93.0%).

Reporting quality

The average PRISMA score was 18.1±3.80 out of 27, and the mean adherence rate to the PRISMA checklist was 66.9%, demonstrating a middle class of reporting quality. In the title, the terms "meta-analyses" or "systematic

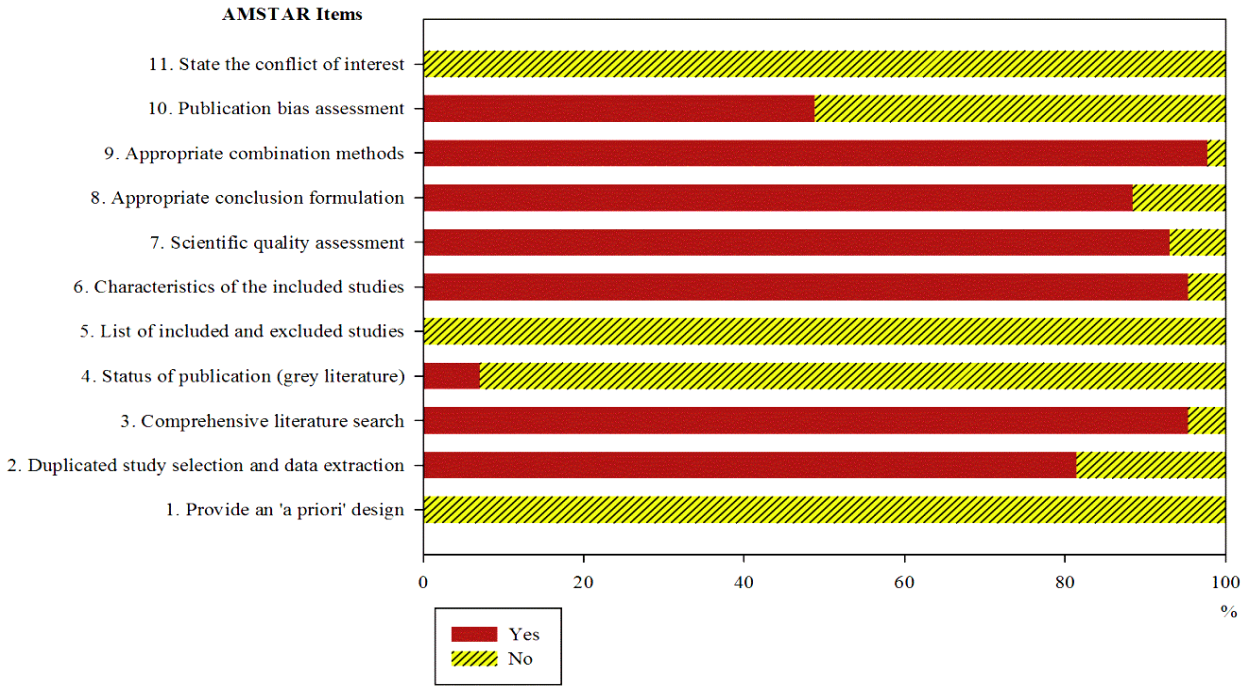

Figure 2. Individual items of and adherence to the AMSTAR checklist

review" were used in most of the included studies, but none of them reported a comprehensive structured summary or registration number (Figure 3). Among the introduction, greater than half (76.7%) adequately described the rationale; however, only 51.2% of the reviews provided a description of objectives. In methods, the item requiring a protocol and registration information was the one with the poorest adherence rate (item 5) followed by the item assessing the search (item 8). None of the reviews provided a protocol and registration information, and only 4 (9.30%) reviews presented the full electronic search strategy for at least one major database. However, the majority of the included studies provided the eligibility criteria, information sources, risks of bias in individual studies, summary measures, and synthesis of results. Regarding the results, the item focusing on the risk of bias across studies had the lowest adherence rate, and only 12 (27.9%) reviews used a flowchart. Regarding the dis-

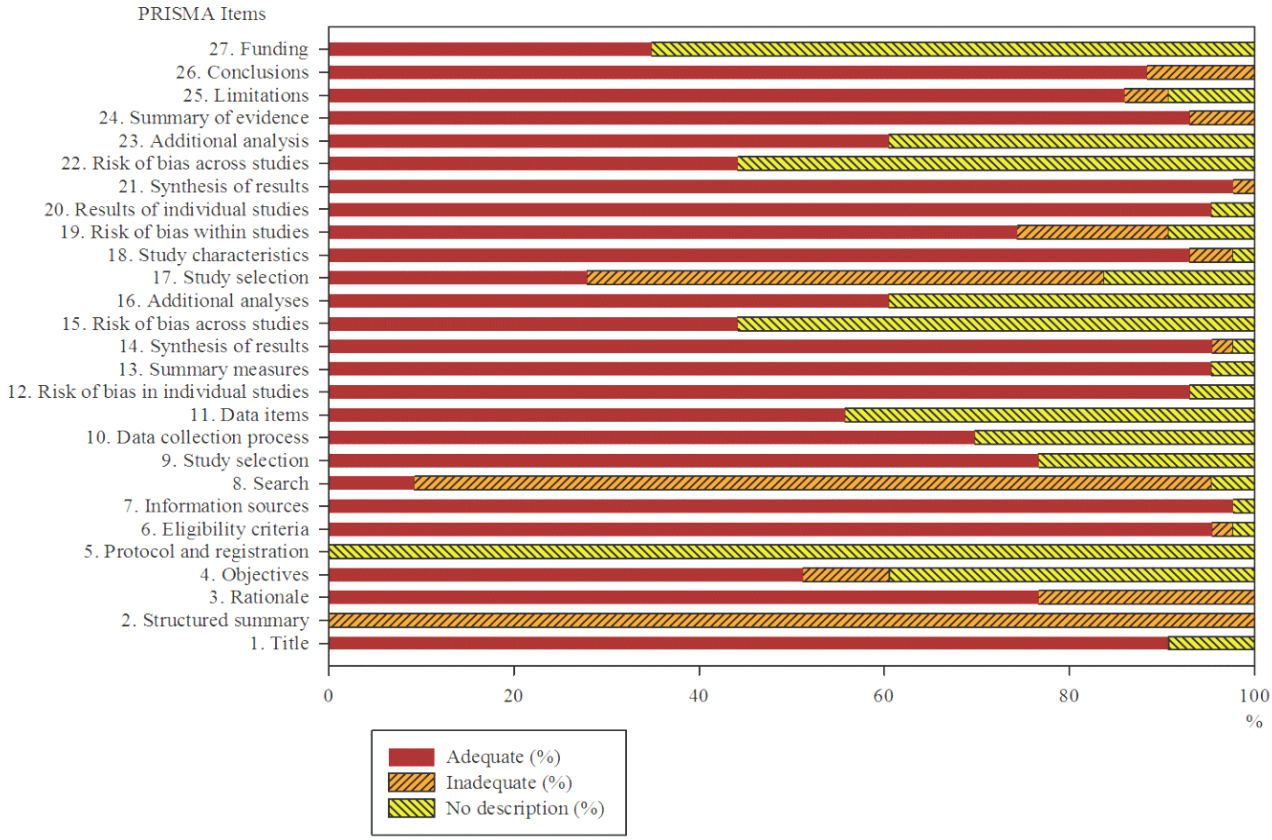

Figure 3. Individual items of and adherence to the PRISMA checklist.

Table 4. List of 9 high-quality systematic reviews and their total AMSTRA and PRISMA scores

No.	Study ID	Review title	AMSTAR Score	PRISMA Score
1	Jia HY,2005[9]	Effects of methylcobalamin in on diabetic peripheral neuropathy: a system review	7	21
21	Li MC, 2014[29]	Effect of folic acid supplementation on stroke prevention: a meta-analysis	7	21
22	Luo WP, 2014[30]	Effect of iron supplement on the growth of children under five years old: a meta-analysis of randomized controlled trials	7	24
31	Qiu S, 2015[39]	System analysis of antihypertensive drugs combined with folic acid in the treatment of H-hypertension for stroke prevention	7	20
32	Wei ZG, 2015[40]	Efficacy of folic acid in the Prevention of Gastrointestinal Tumors in Elder: a meta-analysis	7	21
34	Xu J, 2015[42]	Systematic review on the safety of large dose of vitamin C treatment for related diseases	7	19
37	Lan X, 2016[45]	Effect of vitamin E supplementation on cardiovascular disease mortality and all-cause deaths: a meta-analysis of randomized controlled trials	7	24
38	Lan X, 2016[46]	Meta-analysis on effect of combined supplementation of folic acid, vitamin B-12 and B-6 On risk of cardio-cerebrovascular diseases in randomized control trials	7	20
40	Wang DM, 2016[48]	Meta analysis on application value of vitamin D in treatment of COPD	7	19

cussion, all items had a higher adherence rate. Regarding funding, 15 reviews stated the funding for the MA itself, but no review reported the funding sources for all included primary studies. Moreover, MAs of interventions should place equal emphasis on harm and efficacy. In this study, harmful effects of interventions were also underreported in the sampled MAs.

The overall quality of the sampled MAs

The mean adherence rate of all items in the AMSTAR tool was 55.2%, indicating a moderate methodological quality. The mean adherence rate for all items in PRISMA was 66.9%, indicating moderate quality. Nine reviews had higher PRISMA and AMSTAR scores, of which the AMSTAR score was greater than the average AMSTAR score (6.10) and the PRISMA score was greater than the average PRISMA score (18.1) (Table 4).

DISCUSSION

Nutrition recommendations and guidelines based on MAs are very important tools for nutritional therapy.[52] MAs could minimize bias through rigorous processes and provide evidence for policy makers and clinicians to judge benefits, harms and risks associated with interventions. However, the quality of MAs on nutrition intervention in mainland China remains uninvestigated. Given the large number of MAs published on nutrition intervention, we chose MAs of vitamin intervention to represent the quality in the nutrition intervention field in mainland China. To our knowledge, the present study is the first quality assessment of nutrition interventions published in Chinese journals. The present findings may help nutritionists, clinicians and policy makers to understand better the methodological and reporting strengths and weaknesses of MAs on vitamin interventions published in Chinese journals.

Methodological quality

Poor methodological quality of MAs can cause biased conclusions. Our study included 43 MAs published in Chinese journals and found that the methodological quality was poor. In particular, this study found that all the examined studies lack an 'a priori' design, a list of excluded studies, and a statement on conflicts of interest. An 'a priori' design is required, and the research question and inclusion criteria should be ascertained before conducting a review, according to the AMSTAR checklist. Zhang et al[53] also found that none of the nursing intervention reviews published in Chinese journals provided an 'a priori' design. A possible explanation for this problem was an omission in paper writing rather than that all the studies lacked an a priori design. Because of the limitations on paper length in Chinese journals, all the included MAs failed to provide a list of excluded studies, which may increase the risk of selective reporting and cause bias.[54] Zhang et al[55] found that only 4.50% of meta-analyses of observational studies published in Chinese journals stated conflicts of interest. However, funding sources may influence the quality and outcome of MAs.[56] Therefore, the statement on conflicts of interest is essential information for readers to make an informed assessment of the findings.

Furthermore, less than 10.0% of the included MAs stated the publication status, and most of the included studies did not refer to the grey literature and the status of publication in their inclusion criteria. This limitation may affect the comprehensiveness of literature retrieval and may cause crosscurrent of the intervention effect. Focusing on the status of publications and locating unpublished data are key steps for performing a comprehensive literature search of studies published in Chinese journals. Additionally, less than 50.0% of the included MAs assessed publication bias, which may cause bias in MAs.

Interestingly, the other six AMSTAR items (2, 3, 6, 7, 8 and 9) were reported in greater than 80.0% of the total reports, which improved the methodological quality of the included MAs. An appropriate method to combine the findings of included studies is a key procedure for formulating exact conclusions. Statistical errors were present in greater than half of the MAs on nursing interventions published in Chinese journals.[53] However, fewer statistical errors were noted among the MAs included in the present study. Most of the included MAs reported the

assessment of homogeneity and explored the reasons for heterogeneity.

Reporting quality

The PRISMA Group recommends using PRISMA checklists to improve the reporting quality of MAs. The checklists focus on fair reporting of research processes and findings.[8] This study demonstrated some flaws in the compliance of MAs with the PRISMA checklists. Ma et al[57] also demonstrated that the rate of compliance with the PRISMA guidelines was low in many Chinese systematic reviews (SRs).

A protocol could pre-specify the objectives and methods of MAs, but none of the included MAs included a protocol or registration information. This finding is consistent with the results of quality assessment reviews in other medical specialties in mainland China.[53,57] This finding may be attributed to the fact that most MAs with a registration in the Cochrane collaboration or other platforms were published in international journals. In addition, a pre-designed protocol is typically not requested by Chinese journals.

Moreover, the item regarding providing a structured abstract was the second poorest item among the MAs included in this study. All the included studies included structured summaries, but most of them were inadequate and not performed according to international standards for abstract reporting. In addition, greater than 50.0% of the included MAs were weak in stating funding and the risk of bias across studies. These findings were similar to those of previous studies.[53,58,59] Given that the risk of bias across studies may affect the results of the cumulative evidence, this study advises authors to describe potential biases across studies. The PRISMA checklists indicate that authors should state any funding they received to perform the reviews or state if the review was not funded.[8] Similarly, the PRISMA guidelines also require that authors of MAs should describe limitations in the review process and provide rational advice for future research in the discussion of MAs;[60] however, these features were not adequately addressed in the included reviews. We anticipate that MAs performed according to reporting guidelines would improve the reporting quality.

Main findings

According to the assessment of methodological and reporting quality, 9 high-quality reviews were included in this meta-analysis. Six of the reviews focused on summarizing the effects of B vitamin interventions, one focused on vitamin C, one focused on vitamin D, and one focused on vitamin E. For B vitamins, methylcobalamin appeared to be a safe and effective treatment for diabetic peripheral neuropathy.[1] In addition, folic acid alone or combined with vitamin B-6 and B-12 reduced the risk of stroke,[21,31,38] but folic acid supplement did not effectively reduce the incidence of gastrointestinal tumors in elderly individuals.[32] In addition, iron combined with folic acid supplementation did not affect the growth of children significantly.[22] Xu et al[34] conducted a systematic review on the safety of a large dose of vitamin C in the treatment of related diseases, and the results stated that large doses of vitamin C were safe, but adverse reactions related to the digestive system should be noted. Vitamin D supplementation could improve pulmonary function and health status, reduce clinical symptoms and increase the level of serum 25(OH)D.[40] The other MA stated that vitamin E supplementation might not significantly reduce cardiovascular disease mortality and the all-cause death rate.[37]

Safety

For any health intervention, accurate knowledge of both benefits and harms is needed. Less than 10.0% of MAs assessed adverse events as the primary outcomes.[61] Improving reporting of adverse events in systematic reviews is an important step towards a balanced assessment of an intervention.[62] In our study, only 41.9% of the included MAs reported harmful effects of the intervention. MAs often compound poor reporting of harms in primary studies by failing to report or inadequately reporting harms.[63] Hence, we suggest that the primary study should note the adverse events associated with the intervention.

Strengths and limitations

A quality assessment provides a general idea of how reliable the MAs are in some domains. To our knowledge, this study is the first to assess the quality of evidence on nutrition intervention published in Chinese journals. The results of this study could provide some information for authors and editors to improve the quality of MAs on vitamin intervention. There are some limitations in our study. First, this study included MAs of vitamin interventions published only in Chinese journals. Second, this analysis is based on the content that the authors reported. Hence, some methodological and reporting shortfalls, rather than incompletely performed MAs, may lead to the omission of important details from the reports. Third, we have not provided a list of the excluded articles and details of the included MAs, which was beyond the scope of this article. Fourth, the MAs without an English title/abstract, which could not be searched or understood by non-Chinese speaking readers, were excluded in this study. Finally, the present study only included articles focused on vitamin intervention. The quality of MAs concerning other nutrients should be investigated in further studies.

Conclusions

The present study provides a comprehensive assessment of a large sample of MAs of vitamin intervention published in Chinese journals. The effective treatment of methylcobalamin on diabetic peripheral neuropathy and the preventive effects of folic acid on stroke have been demonstrated by MAs with higher methodological and reporting quality. However, the quality of MAs regarding vitamin interventions should be improved, and an update of the included reviews is necessary to increase the value of the existing MAs. This study strongly recommends that authors and editors use the methodological and reporting guidelines for improving the quality of MAs.

AUTHOR DISCLOSURES

The authors declare that they have no conflicts of interest.

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REFERENCES

1. Rautiainen S, Manson JE, Lichtenstein AH, Sesso HD. Dietary supplements and disease prevention - a global overview. Nat Rev Endocrinol. 2016;12:407-20. doi: 10. 1038/nrendo.2016.54.
2. Fortmann SP, Burda BU, Senger CA, Lin JS, Whitlock EP. Vitamin and mineral supplements in the primary prevention of cardiovascular disease and cancer: an updated systematic evidence review for the U.S. Preventive Services Task Force. Ann Intern Med. 2013;159:824-34. doi: 10.7326/0003-4819-159-12-201312170-00729.
3. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, Porter AC, Tuqwell P, Moher D, Bouter LM. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol. 2007;7:10. doi: 10.1186/1471-2288-7-10.
4. AMSTAR official website. [cited 2016/11/09]; Available from: amstar.ca.
5. Shea BJ, Hamel C, Wells GA, Bouter LM, Kristjansson E, Grimshaw J, Henry DA, Boers M. AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. J Clin Epidemiol. 2009;62:1013-20. doi: 10.1016/j.jclinepi.2008.10.009.
6. Ho RS, Wu X, Yuan J, Liu S, Lai X, Wong SY, Chung VC. Methodological quality of meta-analyses on treatments for chronic obstructive pulmonary disease: a cross-sectional study using the AMSTAR (Assessing the Methodological Quality of Systematic Reviews) tool. NPJ Prim Care Respir Med. 2015; 25:14102. doi: 10.1038/npipcrm.2014.102.
7. Moher D, Liberati A, Tetzlaff J, Alman DG, PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. J Clin Epidemiol. 2009;62: 1006-12. doi: 10.1016/j.jclinepi.2009.06.005.
8. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. J Clin Epidemiol. 2009;62:e1-34. doi: 10.1016/j.jclinepi. 2009.06.006.
9. Jia HY, Tian HM, Wei D. Effects of methylcobalam in on diabetic peripheral neuropathy: a system review. Chinese Journal of Evidence-Based Medicine. 2005;5:609-18.
10. Jian MZ, Wang JT, Sun HK. Meta-analysis of effects of intervention with folic acid on neural tube defects. Journal of Hygiene Research. 2009;38:682-4. (In Chinese)
11. Wu J, Zhang P, Zhou B, Kuang JL, Guo L. A meta-analysis on the study of the correlation between allergic rhinitis and food factors. Journal of Hainan Medical College. 2009;15: 423-8. (In Chinese)
12. Zhang C, Zhu HL. Effect of B vitamins supplementation on cardiovascular and cerebrovascular diseases by lowering plasma homocysteine concentration: a meta-analysis. Chinese Journal of Evidence-Based Medicine. 2009;9:55-62. (In Chinese)
13. Fan P, Wang FL, Du Z, Wang ZX. A meta-analysis: effect of improving iron nutritional status with the supplementation of iron alone and in combination with vitamin A. Chinese Preventive Medicine. 2010;11:1213-7. (In Chinese)
14. Li J, Hou Z. Whether vitamin E supplements can decrease the risk of prostate cancer: meta-analysis. Journal of Clinical Rehabilitative Tissue Engineering Research. 2010;14:5177-80. (In Chinese)
15. Xiao YM, Wang XD, Xie ZY, Wu K, Xie LB, Lu YP. Systematic review on vitamin D preventing and treating bore loss in renal transplant patients. Chinese Journal of Organ Transplantation. 2010;31:602-6. (In Chinese)
16. Cao GL, Han QY, Xiao M, Ding J. A meta-analysis on relationship between antioxidant vitamin supplement and risk of Alzheimer disease. Jiangsu MediCal Journal. 2011;37:36-8. (In Chinese)
17. Du J, Xu GY. Vitamin E and stroke risk: A systematic review. Chinese General Practice. 2011;14:3657-9. (In Chinese)
18. Mou JJ, Yang M, Liu RM, Zhou JX, Tang Y. Vitamin D as adjuvant treatment with tuberculosis: a systematic review. China Pharmacy. 2011;22:2658-60. (In Chinese)
19. Tu JF. A meta-analysis on vitamin A supplements in the treatment of pneumonia inchildren. China Medical Herald. 2011;8:30-3. (In Chinese)
20. Zhao R, Xiao XY, Ren J. A systematic review of compound danshen injection combined with vitamin E in the treatment of neonatal scleredema. China Pharmacy. 2012;23:1501-4. (In Chinese)
21. Zhong JH, Li LQ, You XM, Xiang BD, Ma L, Gong WF. Oral vitamin K2 analogs for hepatocellular carcinoma after surgery: a meta-analysis. World Chinese Journal of Digestology. 2012;20:2420-6. (In Chinese)
22. Gao W, Chen DW, Liu GJ, Ran XW. Efficacy and safety of vitamin D for type 2 diabetes mellitus: a systematic review. National Medical Journal of China. 2013;93:1401-6. (In Chinese)
23. Liu YR, Liu XR, Qi HB. Effects of periconceptional folic acid supplementation on incidences of twin pregnancy: A meta-analysis. Journal of Chongqing Medical University. 2013;38: 1121-4. (In Chinese)
24. Su YJ, Ding H. Evidence based research on vitamin C supplementation for preventing female breast cancer. Journal of Modern Medicine & Health. 2013;29:826-9.
25. Tang ST, Zhang Q, Tang HQ, Sun YH. The effect of vitamin D on falls: a meta-analysis. Chinese Journal of Osteoporosis and Bone Mineral Research. 2013;6:64-9. (In Chinese)
26. Zhang N, Xu XJ, Zhu LS. Effects of vitamin D supplement on blood pressure: a systematic review. Chinese Journal of Evidence-Based Medicine. 2013;13:86-92. (In Chinese)
27. Ding H, Xiao EL, Wang YG. Oral calcium and vitamin D supplements can prevent hypocalcemia in patients with total thyroidectomy: A meta-analysis. The Journal of Evidence-Based Medicine. 2014;14: 116-22. (In Chinese)
28. Kou GN, Guo LY, Wu HC, Zhang Y, Zhang D. Meta-analysis of the effect of vitamin D supplementation on obesity. Journal of Southwest University (Natural Science Edition). 2014; 36:42-6. (In Chinese)
29. Li MC, Wang LJ, Cheng QT, Cao XY, Guo JY. Effect of folic acid supplementation on stroke prevention: A meta-analysis. Chinese Journal of General Practitioners. 2014;13:188-92. (In Chinese)
30. Luo WP, Lu MS, Zhong X, Zhang CX. Effect of iron supplement on the growth of children under five years old: A meta-analysis of randomized controlled trials. Acta Nutrimenta Sinica. 2014;36:229-35.
31. Luo JY, Zhang LT, Lu MX, Liu YL, Xiao P. Systematic review of metformin versus vitamin E in treatment of nonalcoholic fatty liver disease. Journal of Clinical Hepatoloty. 2014;30: 1319-24. (In Chinese)
32. Wang M, He H, Liu D, Hu JM, Guo Y. Effect of nicotinic acid and nicotinamide on serum phosphate level in dialysis patients: a systematic review. Chinese Journal of Blood Purification. 2014;3:146-51. (In Chinese)

33. Wang Z, Jiang AL, Wei F, Chen HY. Efficacy of paricalcitol therapy for hemodialysis patients with secondary hyperparathyroidism: a meta-analysis. Chinese Journal of Blood Purification. 2014;3:129-33. (In Chinese)
34. Wu BS, Geng JS, Huang Y, Chen YY. Evaluation of protective effect of multivitamin on birth defects. Maternal and Child Health Care of China. 2014;29:2298-300. (In Chinese)
35. Yu J, Li WG, Li YN, Jiang L, Tao ZB, Li XJ, Zhao FL, Xie J. Meta-analysis of the efficacy of combined therapy vitamin D with calcium in nutritional rickets. International Journal of pediatrics. 2014;41:548-54. (In Chinese)
36. Zhang N, Tang QZ, Li FF, Yang Z. The efficacy of folic acid on improving endothelial cell function in the treatment of patients with homocysteine: a meta-analysis. Chinese Journal of Difficult and Complicated Cases. 2014;13:840-3. (In Chinese)
37. He L, Yi X, Lin M, Zhao TY, Li MS, Gao P. Renal protective role of active vitamin D3 supplement in patients with type 2 diabetes: A meta-analysis. Journal of Clinical Nephrology. 2015;15:201-7. (In Chinese)
38. Lan X, Dang SN, Zhao YL, Qu PF, Mi BB, Yan H. No significant effect of vitamin E supplement on cardio-cerebrovascular diseases: a meta-analysis of randomized controlled trials. Chinese Journal of Public health. 2015; 31:1497-501. (In Chinese)
39. Qiu S, Yang B, Ping HQ, Wang H, Zhou SF. System analysis of antihypertensive drugs combined with folic acid in the treatment of H-hypertension for stroke prevention. Chinese Journal of Cardiovascular Research. 2015;13:723-6. (In Chinese)
40. Wei ZG, Wei FX, Luo YK, Wang GN, Zhang YW, Zhang HH, Zhang YC. Efficacy of folic acid in the prevention of gastrointestinal tumors in elder: a meta-analysis. China Pharmacy. 2015;26:3815-8. (In Chinese)
41. Xiang J, Bian CD, Huang SS, Wu DL. Vitamin D in the treatment of prostate cancer: a meta-analysis. Chinese Journal of Clinical Medicine. 2015;22:528-30. (In Chinese)
42. Xu J, Liu JM, Fu L, Wang B, Zhao WJ, Wang HL, Gao MQ. Systematic review on the safety of large dose of vitamin C treatment for related diseases. China Pharmacy. 2015;26: 1229-33. (In Chinese)
43. Ye T, Tu WP, Xu GS. Efficacy and safety of vitamin D for type 2 diabetes mellitus: a systematic review. China Journal of Modern Medicine. 2015;25:59-65. (In Chinese)
44. Chen M, Zhang LL, Quan SY, Hu ZQ. Safety of medication of vitamin B-6: a systematic review. Chinese Pharmaceutical Journal. 2016;51:65-9. (In Chinese)
45. Lan X, Dang SN, Zhao YL, Qu PF, Ming BB, Yan H. Effect of vitamin E supplementation on cardiovascular disease mortality and all-cause deaths: a meta-analysis of randomized controlled trials. Chinese Preventive Medicine. 2016;17:504-8. (In Chinese)
46. Lan X, Dang SN, Zhao YL, Yan H, Yan H. Meta-analysis on effect of combined supplementation of folic acid, vitamin B-12 and B-6 on risk of cardio-cerebrovascular diseases in randomized control trials. Chinese Journal of Epidemiology. 2016;37:1028-34. (In Chinese)
47. Li WH, Liu XR, Hu XL. Meta-analysis on vitamin E for treating unexplained male infertility. Journal of Modern Medicine & Health. 2016;32:178-84. (In Chinese)
48. Wang DM, Zhou XD. Meta analysis on application value of vitamin D in treatment of COPD. Journal of Modern Medicine & Health. 2016;32:1146-9. (In Chinese)
49. Wang X, Zhou J, Tang YX, Niu XW, Li M. Meta-analysis of vitamin E supplement on preventive effect of myocardial infarction. Chinese Journal of General Practice. 2016;14: 893-6. (In Chinese)
50. Wei XC, Zhu LQ, Wang CG, Deng Q, Li X. Meta-analysis of the efficacy and safety of vitamins in preventing chemotherapy-induced peripheral neuropathy in cancer patients. Chinese Jouranl of Modern Applied Pharmacy. 2016;33:476-84. (In Chinese)
51. Zhong YB, Long PP, Zhang L, Miao ZL, Yan R, Zhai JY. Systematic review of vitamin D treatment on gestational diabetes mellitus. Modern Preventive Medicine. 2016;43: 2571-6. (In Chinese)
52. Chung M, Lau J. Evidence-based approach to inform clinical nutrition practice. World Rev Nutr Diet. 2015;111:1-6. doi: 10.1159/000362289.
53. Zhang J, Wang J, Han L, Zhang F, Cao J, Ma Y. Epidemiology, quality, and reporting characteristics of systematic reviews and meta-analyses of nursing interventions published in Chinese journals. Nurs Outlook. 2015;63:446-55.e4. doi: 10.1016/ j.outlook. 2014.11.020.
54. Zhu Y, Fan L, Zhang H, Wang M, Mei X, Hou J, Shi Z, Shuai Y, Shen Y. Is the best evidence good enough: Quality assessment and factor analysis of meta-analyses on depression. PLoS One. 2016;11:e0157808. doi: 10.1371/ journal.pone.0157808.
55. Zhang ZW, Cheng J, Liu Z, Ma JC, Li JL, Wang J, Yang KH. Epidemiology, quality and reporting characteristics of meta-analyses of observational studies published in Chinese journals. BMJ Open. 2015;5:e008066. doi: 10.1136/bmj open-2015-008066.
56. Barnes DE, Bero LA. Why review articles on the health effects of passive smoking reach different conclusions. JAMA. 1998;279:1566-70.
57. Ma B, Qi GQ, Lin XT, Wang T, Chen ZM, Yang KH. Epidemiology, quality, and reporting characteristics of systematic reviews of acupuncture interventions published in Chinese journals. J Altern Complement Med. 2012;18:813-7. doi: 10.1089 /acm.2011.0274.
58. Zhao X, Zhen Z, Guo J, Zhao T, Ye R, Guo Y, Chen H, Lian F, Tong X. Assessment of the reporting quality of placebo-controlled randomized trials on the treatment of type 3 diabetes with traditional Chinese medicine in mainland China: a PRISMA- compliant systematic review. Medicine (Baltimore). 2016;95:e2522. doi: 10.1097/MD.0000000000 002522.
59. Ma B, Guo J, Qi G, Li H, Peng J, Zhang Y, Ding Y, Yang K. Epidemicology, quality and reporting characteristics of systematic reviews of traditional Chinese medicine interventions published in Chinese journals. PLoS One. 2011; 6:e20185. doi: 10.1371/ journal.Pone.0020185.
60. Minelli C, Thompson JR, Abrams KR, Thakkinstian A, Attia J. The quality of meta-analyses of genetic association studies: a review with recommendations. Am J Epidemiol. 2009; 170:1333-43. doi: 10.1093/aje/kwp350.
61. Zorzela L, Loke YK, Iannidis JP, Golder S, Santaguida P, Altman DG, Moher D, Vohar S, PRISMAHarms Group. PRISMA harms checklist: improving harms reporting in systematic reviews. BMJ. 2016;352:i157. doi: 10.1136/bmj. i157.
62. Zorzela L, Golder S, Liu Y, Pilkington K, Hartling L, Joffe A, Loke Y, Vohra S. Quality of reporting in systematic reviews of adverse events: systematic review. BMJ. 2014;348:f7668. doi: 10.1136/bmj.f7668.
63. Golder S, Loke YK, Zorzela L. Some improvements are apparent in identifying adverse effects in systematic reviews from 1994 to 2011. J Clin Epidemiol. 2013;66:253-60. doi: 10.1016/j.jclinepi.2012.09.013.