Systematic review of the tools of oral and dental health literacy: Assessment of conceptual dimensions and psychometric properties

Mohtasham Ghaffari  
Shaheed Beheshti University of Medical Sciences

Sakineh Rakhshanderou  
Shaheed Beheshti University of Medical Sciences

Ali Ramezankhani  
Shaheed Beheshti University of Medical Sciences

Yadollah Mehrabi  
Shaheed Beheshti University of Medical Sciences

Ali Safari-Moradabadi  
(alisafari_31@yahoo.com)  
Shahid Beheshti University of Medical Sciences  
https://orcid.org/0000-0002-8310-5160

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Abstract

Background This article aims to provide a description of conceptual dimensions and psychometric properties of the tools of oral and dental health literacy. Methods Two authors in this study conducted electronic searches in the Medline (via PubMed), and Embase databases to find relevant articles from 1990 to present day. Evaluation of the tools was carried out in two parts; general evaluation of the tools using skills introduced by Sørensen et al., and qualitative assessment of psychometric properties using COSMIN checklist. Results After reviewing 1839 articles on oral and dental health literacy and evaluating 33 full text articles for eligibility, 21 articles entered the study. The sample size varied from 20 to 1405 subjects and the items of each tool ranged from 11 to 99 items. Of the 21 tools examined, 16 tools were evaluated for word recognition. For the studies examined, the evaluation of COSMIN scores was often fair or good. Of the 21 tools examined, 9 tools at least in one dimension were in the category of "poor", 19 tools were in the category of "fair", 20 tools were in the category of "good", and 4 tools were in the category of "excellent" in at least one dimension. Conclusion The findings of this study showed that some aspects of oral and dental health literacy are being ignored in the existing tools. Therefore, the authors of present study emphasize on the necessity to design and develop a comprehensive tool and take into account two characteristics of simplicity and briefness for international use.

Background

In the 21st century, health literacy (HL) has been introduced as a global issue and a priority in health[1, 2], and the World Health Organization has identified HL as one of the greatest determinants of health[3, 4]. One of the important topics in the field of health, is oral and dental health. Oral and dental health literacy is a subset of HL [5]. Using health literacy, the most common definition of oral health literacy (OHL) is "a degree of people's ability to obtain, process, and understand oral health information and make appropriate oral health decisions"[6]. Oral and dental health literacy skills are important for reducing oral health inequalities and promoting oral health information[7].

Some studies point to the link between low level of OHL and lack of using preventive or therapeutic services and also understanding of health information transferred by the health care providers[8, 9]. The American Dental Association has confirmed that limited HL is an obstacle to the prevention, diagnosis and treatment of oral and dental illness, and clear, accurate and effective communication is one of the essential skills for effective dental practice [10]. There is strong evidence about the economic costs associated with the low level of oral and dental health literacy[11, 12], and various studies have referred to the convergence between oral health and general health and the effects of poor oral health on quality of life[11, 13, 14]. So, there are many challenges in educating and helping people to obtain the necessary resources to make decision about oral and dental health. Clear communication in plain language about oral health and services will help to improve oral health[15]. On the other hand, level of knowledge about the importance of HL in oral and dental health has increased dramatically in recent years, and efforts have been made to integrate the concept of HL in oral health research [16-18].

Measuring oral and dental health literacy

The primary tool for OHL has been derived from the HL tools. For example, the tool of Rapid Estimate of Adult Literacy in Dentistry (REALD) is an adaptation of the Rapid Estimate of Adult Literacy in Medicine (REALM), [19]. Similar examples include the Test of Functional Health Literacy in Dentistry (ToFHLID), which has been adopted from the Test of Functional Health Literacy in Adults (ToFHLA), [20]. Primary tools received similar criticisms about the general health literacy versions because they were first the word recognition tools that did not actually measure oral and dental health literacy, but rather they measured the reading skills of oral health contents [21]. A wide range of similar tools has been designed to display, diagnose and measure OHL. However, there is currently no tool available as a gold standard for oral and dental health literacy. Due to the predicted increase in the number of adults in the world and the low level of oral and dental health literacy in this population, as well as the correlation between OHL and the probability of taking preventive interventions, it is vitally important to prioritize the accurate assessment of oral and dental health literacy.

So far, only one systematic review has been carried out to evaluate the oral and dental health literacy tools in 2013 [22], which examined the HL tools in general. Therefore, the present study intends to review and examine the HL tools in terms of dimensions and psychometric evaluation using the COSMIN checklist, by updating the study of Sørensen et al (1990 to present). We expect the findings of this study to be effective in identifying and selecting the most appropriate tool for various purposes.

Methods

We report this manuscript in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA statement) guideline [23] (Supplementary material 1).

Search strategy

A systematic library search was conducted by one of the authors (ASM) in consultation with a librarian across five electronic databases (CINAHL, Embase, PsycINFO, PubMed, and Scopus). Grey literature was searched from ProQuest Dissertations and Theses. The key words used in the search included; Oral, dental, Health, Literacy, tool, instrument, questionnaire, Psychometric, validity, reliability. Only peer-reviewed articles that were written in English were considered. The full search strategy for each database is provided in Supplementary material 2. A hand-search of relevant bibliographies was performed to identify potential studies that were excluded.

Studies that fulfilled the following criteria were included: (1) assessed one or more of the following psychometric properties: internal consistency, reliability, measurement error, content validity, face validity, structural validity, hypothesis testing, cross-cultural validity, criterion validity, or responsiveness; (2) all studies published between each database's inception and January 2019 that have been design, develop, or psychometric to measure oral and dental health literacy;
and (3) studies published in English language. Studies were excluded if they were (1) conference abstracts, systematic review and meta-analysis, and other studies that did not meet the inclusion criteria as well (2) psychometric property testing protocols.

Screening, Data extraction

Search strategies were performed by two trained authors (ASM and SR). The authors were the same at all stages of the study. In the first stage, titles and abstract of the articles were evaluated. In the second stage, the full text of the articles was independently reviewed by two authors. Differences in judgment were resolved through a consensus procedure. In this study, the End Note software was used to organize the references. Data extraction included author, year, target population, sample size, location of the study, complete instrument name, report, time management (min), number of questions and scales, and rating. One part of the data extraction is related to the process of qualitative evaluation of the tools which is discussed below. The searches conducted From February to April 12. The authors entered the data existed in the articles into Excel software based on the items in the data extraction section.

The process of qualitative evaluation of the tools entered into the study

We used two important factors to test the tools used in the study:

1) An overall assessment of a tool (using the skills introduced by Sørensen et al) in analyzing the content of studies in terms of the definitions of oral and dental health literacy. This process evaluates the tools based on different dimensions, including the reading dimension (basic skills for reading based on the International Student Assessment [PISA]), interactive dimension (the ability to communicate about health issues), perceptual dimension (the ability to extract meaning from information sources), and computational dimension (the ability to perform numeric tasks and mathematic operations). The remaining dimensions includes; information search (which requires the ability to find information on health for health management), performance (the ability to use and process, or act upon health information and informed decision), assessment (ability to filter, change and evaluate information), and responsibility (the ability to take responsibility and make decision on health and Health care). [22].

2) Qualitative assessment of methodology and psychometric properties. To evaluate the psychometric section, the COSMIN checklist (the consensus-based standards for the selection of health measurement instruments) was used [24]. This tool examines the quality of studies in 4 areas, 12 domains and 114 items. The 12 domains include; internal consistency, reliability, measurement error, content validity, structural validity, hypothesis testing, cross-cultural validity, criterion validity, responsiveness of theory methods (if applied), interpretability, and generalizability of the tool's properties.

All 114 items were evaluated according to the poor, fair, good, and excellent scale[25, 26]. Since there is no gold standard for the oral and dental health literacy tools[27], the domain of Criterion validity was not considered.

Results

Two authors screened 291 articles, and the full text of 33 articles. Finally, 21 articles had the criteria to enter the study (Figure 1).

The sample size varied from 20 to 1405 subjects and items per instrument ranged from 11 to 99. Most studies had examined the adult age group. A detailed description of the measurement tools is shown in Table 1. Of the 21 tools examined, 16 tools had evaluated the word recognition (short form or quick estimate) [28-47], and only one study had examined the "decision-making" dimension [42]. Dimensions of evaluation, responsibility and interaction had not been measured in any instrument (Table 2).

Methodological quality of the studies

The results of evaluation of COSMIN checklist are presented in Table 3. Also a summary of the quality of the domains examined on the basis of a checklist COSMIN for oral health assessment tools reported in the Supplementary material 3.

The results of methodological quality evaluation of the tools showed that, out of the 21 tools examined, 9 tools at least in one dimension were in the category of poor, which indicated the poor quality of that area[29, 31, 32, 34, 35, 38, 43-45, 48]. The results of tool review using the COSMIN checklist showed that, 19 studies at least in one dimension had a "fair" quality, which indicated the suspected methodological quality[28, 30, 31, 33-48]. Also, 20 and 4 articles at least in one dimension had a "good" [28-42, 44-48] and "excellent" [36, 45, 46, 48] quality, respectively.

Four tools, by examining seven domains, had paid the most attention to the domains in the psychometric section [36-38, 45, 46], and the two tools of ToFHLiD and OHLA-B had evaluated the minimum domains in the COSMIN checklist [39, 43].

In the area of internal consistency, all tools were evaluated except for three tools [30, 33, 39]. The range of Cronbach alpha score in the reviewed studies varied from 0.63 [43] to 0.91 [36]. The "adequate" criterion for this dimension was Cronbach's alpha of ≥ 0.70, which was obtained in other studies except for one study (43). In other studies, the standard range was obtained. Reliability was also investigated in 12 studies [30, 33, 36-38, 40, 42, 44-46, 48]. The most common statistical methods used to evaluate this domain were t-retest and ICC. Construct validity was also evaluated in 9 studies [29, 32, 34-38, 45, 46]. Confirmatory and exploratory factor analysis were the most common statistical methods used to determine structural validity. In this section, the factor analysis with total variance of more than 50% was considered as the adequate criterion. The measurement error, responsiveness, and interpretability domains were not investigated in any tool.
The results of present study showed that, the highest percentage of "excellent" and "good" quality was related to the area of internal consistency, the "fair" quality was related to the area of criterion validity, and the "poor" quality was related to the area of hypothesis testing.

**Discussion**

In this study, we attempted to examine tools that measure OHL. Based on the results of present study, the tools were different in terms of what concept of oral and dental health literacy they were measuring. They were also different in terms of items such as scoring, attention to the clinical or health dimension, target group, sample size related to the design and psychometry, and considering the dimensions of oral and dental health literacy.

Based on the results of present study, most oral and dental health literacy tools merely measure the primary skills of oral health including word recognition, reading comprehension, and computation. Based on what Sørensen et al. [22] have considered for a complete HL tool, there is still a considerable shortcoming in these tools in terms of the accurate measuring of oral and dental health literacy, despite many tools that are available in this regard. The lack of standardized measurement tool can greatly limit the ability to identify HL [49]. Therefore, designing and developing a credible and brief screening tool to determine HL can be beneficial.

Various approaches to literacy tools are among issues that contribute to the inadequacy of HL tools. In other words, the basis for design and development of HL tools (including oral and dental health literacy) is either theoretical or practical, but in practice, this indicator is not measured by a fixed or definite approach or concept. These differences lead to different outcomes and provide scholars and decision makers with a wide range of comparisons and conclusions.

In this study, we also found differences in the methodology, measurement and psychometry of oral and dental health literacy tools. The results showed that, there is no comprehensive tool to examine all dimensions of COSMIN checklist. None of the tools had examined or reported the areas of responsibility, measurement error, and interpretability.

Health measurement tools should consider two areas of validity and reliability to ensure the accuracy of diagnosis and compliance [24]. The results showed that most tools that examine validity and reliability, had a low or fair quality based on the COSMIN methodology. Therefore, considering the importance of HL tools, it is recommended to pay more attention to the psychometric evaluation of the tools. The risk of inappropriate evaluation and misdiagnosis can be affected by the use of a tool without a solid validity and reliability. The most important consequences of using such tools include the increased likelihood of misinterpretation and incorrect reporting of research results. Since oral and dental health literacy is very important both in the field of treatment and prevention, specific attention must be paid to the areas of validity and reliability when designing and developing a tool in order to reduce adverse outcomes, undesirable treatment planning and inappropriate allocation of resources, including the incorrect provision of preventive and restorative interventions. The results of this study can be used to help researchers select a desirable benchmark for their individual research goals. However, it should be noted that the psychometric properties of the tool should be re-implemented for every new setting, sample, or cultural context [50].

**Practice implications**

Since oral and dental health literacy tools are still being developed and designed, the relevant stakeholders including health professionals, treatment team and researchers are recommended to evaluate the tools available to synchronize them with the conceptual and scientific perspective related to their specialized goals. For an oral and dental health literacy tool that is tailored to the target group and the subject matter, it is vital to measure the domains of oral and dental health literacy.

In some cases, depending on the purpose of the research, rapid estimation tools can also be useful. In most cases however, functional tools can be more effective as they provide deeper knowledge on oral and dental health literacy of target group. Whenever possible, the use of comprehensive tools (gold standard) that can cover all aspects (including content and psychometry) are useful in acquiring a deep comparative knowledge on the dimensions of oral and dental health literacy or comparison with other tools.

**Study limitations**

One of the limitations of this study was that, only studies in English were included in the review. The COSMIN checklist could also be considered as another limitation of this study, as in this checklist, the validity of criteria requires a golden standard, and this is while that, there is currently no standardized tool for measuring oral and dental health literacy, and the existing studies on oral and dental health literacy are used to assess the validity of the criteria. Individual subjectivity can also play an important role in the search, data extraction and synthesis of results, so to prevent the bias, two authors were used to perform the above processes.

**Conclusion**

The findings of this study showed that some aspects of oral and dental health literacy are being ignored in the existing tools. On the other hand, some areas of psychometric evaluation of the tools are not being considered, which could jeopardize the credibility of existing tools. Other findings of this study include the deficiencies in the validation methodology of the tools. Therefore, the authors of present study emphasize on the necessity to design and develop a comprehensive tool and take into account two characteristics of simplicity and briefness for international use. Because it is only then that, the tool can be used to transform oral and dental health literacy into a comprehensive and usable index for monitoring the world's health system (in oral health).

**Abbreviations**
Declarations

Ethics approval and consent to participate

The proposal has been approved by the Ethics Committee of the School of Public Health & Neuroscience Research Centre in Shahid Beheshti University of Medical Sciences; Approval ID: IR.SBMU.PHNS.REC.1397.051 : Approval Date:2019-01-15).

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Competing interests

The authors have no conflicts of interest.

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Authors' contributions

MGH, SR, and ASM designed the study. ASM, YM and AR wrote the first draft. All authors contributed to writing, revising, and approved the final manuscript.

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### Tables

#### Table 1: Describing Details of Oral Health Literacy Tools

#### Table 2. Dimensions assessed in health literacy measures

#### Table 3 Results of Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) Checklist

- Studies that did not report information were ignored

### Figures
| (Richman et al., 2007) | REALD-99 | 2007 | North Carolina | Pronunciation | Adults: 18 to 64 years | Face-to-face | 99 | 102 | English | REALM Family | Objective | Sum score (0-99) |
|----------------------|----------|------|----------------|---------------|----------------------|-------------|-----|------|---------|-------------|-----------|-----------------|
| (Gong et al., 2007)  | ToFHLiD  | 2007 | North Carolina | Comprehension, Numeracy | Adults: 18 to 64 years | Face-to-face | 80 | 102 | English | TOFHLA Family | Objective | Weighted score (0-100) |
| (Lee, Rozier, Lee, Bender, & Ruiz, 2007) | REALD-30 | 2007 | North Carolina | Pronunciation | Adults: 18 to 64 years | Face-to-face | 30 | 202 | English | REALM Family | Objective | Sum score (0-30) |
| (Sabbahi, Lawrence, Limeback, & Rootman, 2009) | OHLI | 2009 | Toronto | Comprehension, Numeracy | Adults: 18 to 64 years | Paper and pencil, Face-to-face | 57 | 100 | English | TOFHLA Family | Objective | Possible range: 0-100 (comprehension score x 1.31, numeracy score x 2.63), with 0-59: inadequate HL, 60-74: marginal HL, and 75-100: adequate HL |
| (Macek et al., 2010) | CMOHK | 2010 | Baltimore | Pronunciation | Adults: aged 45-64 years | Face-to-face | 28 | 100 | - | REALM Family | Objective | CMOHK scores were divided into three categories. Scores from 0 to 11 represented "poor," 12-14 corresponded to "fair," and 15-23 represented "good" |
| (Atchison, Gironda, Messadi, & Der-Martirosian, 2010) | REALM-D | 2010 | USA | Comprehension, Pronunciation | Adults: 18 to 64 years | Face-to-face | 84 | 200 | English | REALM Family | Objective | Words pronounced correctly received a score of 1, and mispronounced or not attempted words received a score of 0. |
| (Stucky, Lee, Lee, & Rozier, 2011) | TS-REALD | 2011 | North Carolina | Pronunciation | Adults | Face-to-face | 11 | 1405 | English | REALM Family | Objective | Possible range: 0-9 (raw score). For interpretation, raw scores are transformed |
| (Wong et al., 2012) | HKREALD-30 | 2012 | Hong Kong | Comprehension, Numeracy | Adults: 18 to 64 years, Adolescents: 10 to 17 years | Paper and pencil, Face-to-face | 52 | 200 | Cantonese | REALM Family | Objective | Possible range: 0-52, ↑scores = ↑Oral HL |
| (J. Lee, Stucky, Rozier, Lee, & Zeldin, 2013) | OHLA-S | 2012 | North Carolina | Word recognition section and a comprehension | aged 18 or older but less than 80 years | Face-to-face | 24 | 405 | Spanish and English | REALM Family | Objective | Sum score (0-24) |
| Year | Country | Language | Instrument | Target Population | Mode | Language | Scoring | Notes |
|------|---------|----------|------------|-------------------|------|----------|---------|-------|
| 2013 | USA     | English  | REALMD-20  | least 18 years of age | Face-to-face | English | Objective | Sum score (0–20) |
| 2013 | Hong Kong | English | HKOHLAT-P | Adults: aged 45-64 years | Face-to-face | Hong Kong | TOFHLA Family | Self-reported | Total score range of 0–52, with higher scores indicating better functional OHL |
| 2013 | Australians | English | HeLD | Older Adults: 65+ years, Adults: 18 to 64 years, Adolescents: 10 to 17 years | Paper and pencil, Face-to-face | English | Self-reported | NR |
| 2013 | Tehran (Iran) | Persian | OHL-AQ | adults aged between 18 and 65 years | Face-to-face | Persian | TOFHLA Family | Self-reported | Possible range: 0-17 Inadequate, 0–9; marginal, 10–11; and adequate, 12-17. |
| 2014 | Saudi Arabia | Arabic | AREALD-30 | aged over 25 years | Face-to-face | Arabic | REALM Family | Objective | Sum score (0–30) |
| 2014 | Iran | Persian | IREALD-99 | Adults: 18 to 64 years | Face-to-face | Persian | REALM Family | Objective | Sum score (0-99) |
| 2015 | Brazilian | Brazilian-Portuguese | BREALD-20 | aged 18 to years 75 | Face-to-face | Brazilian-Portuguese | REALM Family | Objective | Sum score (0-30) |
| 2017 | Turkish | Turkish | TREALD-30 | Adults: 18 to 64 years | Face-to-face | Turkish | REALM Family | Objective | Sum score (0-30) |
| Study                                      | Year | Country | Language | Age Groups                  | Test Description                  | Objective | Objective Details                                      |
|-------------------------------------------|------|---------|----------|-----------------------------|-----------------------------------|-----------|--------------------------------------------------------|
| Cruvinel et al. (2017)                     | 2017 | Brazil  | Portuguese | Older Adults: 65+ years, Adults: 18 to 64 years | REALMD-20                          | NR        |                                                        |
| Bado, Ferreira, de Souza Barbosa, & Mialhe (2017) | 2017 | Brazil  | Portuguese | Adults | OHLA-B                          | Objective | Sum score (0-30)                                        |
| Cartes-Velásquez and Luengo-Machuca (2017)      | 2017 | Chile   | Spanish   | Adults: 18 to 64 years | OHLI-cl                           | Objective | Possible range: 0-100 (comprehension score x 1.31, numeracy score x 2.63), with 0-59: inadequate HL, 60-74: marginal HL, and 75-100: adequate HL |
| Cartes-Velásquez and Luengo-Machuca (2018)      | 2018 | Chile   | Spanish   | Adults: 18 to 64 years | Span-REALD-30                      | NR        |                                                        |

Figure 1
Flowchart of article selection
| Instrument | Literacy | Interaction | Pronunciation | Comprehension | Numeracy | Information seeking | Decision making/critical thinking | Evaluation | Responsibility |
|------------|----------|-------------|---------------|---------------|----------|----------------------|----------------------------------|------------|----------------|  
| REALD-99   | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| REALD-30   | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| ToFHLD     | Y        | N           | N             | Y             | Y        | Y                    | N                                | N          | N              |  
| OHLI       | Y        | N           | N             | Y             | Y        | Y                    | N                                | N          | N              |  
| CMOHK      | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| HKREALD-30 | Y        | N           | N             | Y             | Y        | Y                    | N                                | N          | N              |  
| OHLA-S     | Y        | N           | Y             | N             | Y        | Y                    | N                                | N          | N              |  
| REALMD-20  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| HOKHLAT-P  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| HeLD       | Y        | N           | Y             | Y             | Y        | N                    | N                                | N          | N              |  
| TS-REALD   | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| BREALD-20  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| TREALD-30  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| AREALD-30  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| REALMD-20  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| OHLA-B     | Y        | N           | Y             | Y             | N        | Y                    | N                                | N          | N              |  
| OHL-AQ     | Y        | N           | N             | Y             | Y        | Y                    | Y                                | N          | N              |  
| OHLI-cl    | Y        | N           | N             | Y             | Y        | Y                    | N                                | N          | N              |  
| Span-REALD-30 | Y   | N           | Y             | Y             | Y        | Y                    | N                                | N          | N              |  
| IREALD-99  | Y        | N           | Y             | N             | N        | N                    | N                                | N          | N              |  
| REALM-D    | Y        | N           | Y             | Y             | N        | Y                    | N                                | N          | N              |  

Y=YES  N=NO

**Supplementary Files**

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementarymaterial3.docx
- Supplementarymaterial1.doc
- Supplementarymaterial2.docx
| Study reference          | Assessment Tool | Internal consistency | Reliability | Measurement error | Content validity | Criterion validity | Construct validity | Hypothesis testing | Cross-cultural validity | Respon |
|-------------------------|-----------------|----------------------|-------------|-------------------|-----------------|-------------------|-------------------|---------------------|------------------------|--------|
| Richman et al (2007)    | REALD-99        | G                    | NI          | NI                | F               | G                 | NI                | NI                  | NI                     | 1      |
| Lee et al (2007)        | REALD-30        | G                    | NI          | NI                | Ni              | G                 | P                 | NI                  | NI                     | 1      |
| Gong et al (2007)       | ToFHLID         | P                    | NI          | NI                | F               | Ni                | NI                | NI                  | NI                     | 1      |
| Saizaliz et al (2009)   | OHLI            | G                    | F           | NI                | Ni              | G                 | F                 | Ni                  | Ni                     | 1      |
| Macek et al (2010)      | CMQIH           | NI                   | F           | NI                | G               | F                 | Ni                | Ni                  | Ni                     | 1      |
| Wong et al. (2012)      | HKREALD-30      | E                    | E           | Ni                | P               | G                 | G                 | F                  | F                     | 1      |
| Lee et al. (2012)       | OHLA-S          | F                    | NI          | NI                | G               | Ni                | Ni                | F                  | P                     | 1      |
| Gironda et al. (2013)   | REALMD-20       | G                    | NI          | NI                | P               | G                 | P                 | Ni                  | Ni                     | 1      |
| Wong et al. / Bridges et al (2013) | HKOHLAT-P | NI           | F           | Ni                | Ni              | F                 | Ni                | Ni                  | Ni                     | 1      |
| Jones et al. (2013)     | HeLD            | G                    | NI          | NI                | P               | F                 | F                 | F                  | Ni                     | 1      |
| Stucky et al. (2011)    | TS-REALD        | F                    | Ni          | Ni                | P               | F                 | G                 | P                  | Ni                     | 1      |
| Junkes et al. (2015)    | BREALD-20       | E                    | G           | Ni                | F               | G                 | G                 | F                  | G                     | 1      |
| Parker et al. (2017)    | TREALD-30       | G                    | G           | Ni                | Ni              | G                 | G                 | F                  | F                     | 1      |
| Tadakamadla et al. (2014) | AREALD-30    | G                    | F           | Ni                | G               | F                 | F                 | F                  | G                     | 1      |
| Cruvinel et al. (2017)  | REALMD-20       | G                    | F           | Ni                | Ni              | G                 | F                 | G                  | P                     | 1      |
| Bado et al. (2017)      | OHLA-B          | NI                   | NI          | Ni                | F               | Ni                | Ni                | Ni                  | G                     | 1      |
| Sistani et al. (2013)   | OHL-AQ          | F                    | G           | Ni                | G               | Ni                | Ni                | Ni                  | Ni                     | 1      |
| Cartes-Velasquez et al. | OHL-cl          | F                    | Ni          | Ni                | G               | F                 | Ni                | Ni                  | G                     | 1      |
| Cartes-Velasquez et al. | Span-REALD-30  | G                    | G           | Ni                | G               | F                 | Ni                | Ni                  | F                     | 1      |
| Pakpour et al.          | IREALD-99       | G                    | F           | Ni                | G               | F                 | Ni                | Ni                  | F                     | 1      |
| Atchison et al.         | REALM-D         | G                    | G           | Ni                | F               | E                 | Ni                | Ni                  | Ni                     | 1      |
| Frequency of studies in the every domain | 18 | 12 | 0 | 19 | 18 | 9 | 8 | 10 |        |

| Frequency and percentage of studies based on quality classification | Excellent | Good | Fair | Poor | No information |
|-------------------------------------------------|-----------|-----|------|------|----------------|
| Excellent                                       | (11.11)   | 0   | 0    | 1    | 0             |
| Good                                            | (61.11)   | 5   | 11   | 11   | 6             |
| Fair                                            | (22.22)   | 0   | 4    | 4    | 2             |
| Poor                                            | (5.55)    | 1   | 0    | 4    | 2             |

Frequency of studies in the domain: 18, 12, 0, 19, 18, 9, 8, 10.