

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

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Research article

Keywords: COSMIN, Psychometric, Oral Health Literacy, Dental Health Literacy

Posted Date: September 16th, 2019

DOI: <https://doi.org/10.21203/rs.2.14450/v1>

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Version of Record: A version of this preprint was published at BMC Oral Health on July 3rd, 2020. See the published version at <https://doi.org/10.1186/s12903-020-01170-y>.

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 Sornes 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.

Discussion The authors of this study emphasize on the necessity to design and develop a comprehensive tool and take into account two characteristics of simplicity and brevity 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).

Background

In the 21st century, health literacy has been introduced as a global issue and a priority in health [1, 2], and the World Health Organization has identified health literacy 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 health literacy [5]. Using health literacy, the most common definition of oral health literacy 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 oral health literacy 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 health literacy 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 health literacy in oral and dental health has increased dramatically in recent years, and efforts have been made to integrate the concept of health literacy in oral health research [16–18].

Measuring oral and dental health literacy

The primary tool for oral health literacy has been derived from the health literacy 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 oral health literacy. 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 oral health literacy 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 health literacy tools in general. Therefore, the present study intends to review and examine the health literacy tools in terms of dimensions and psychometric evaluation using the COSMIN checklist, by updating the study of Sorens 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

Search strategy

A systematic review of databases such as Medline (via PubMed), Embase, and PsycINFO led us to find the target articles. The key words used in the search included; health, health literacy, oral health, oral health literacy, instrument, questionnaire, measure, evaluation, screening, dentistry, dental, validity, reliability, development, and psychometry. The search was done in English languages with the operators of AND, NOT, and OR, which led us to find related articles.

In this study, all studies published from 1990 until now that have been design, develop, or psychometry to measure oral and dental health literacy were selected for the review.

Quality assessment

Quality assessment of the selected studies was performed using the 22-item “Strengthening the Reporting of Observational Studies in Epidemiology” (STROBE) checklist. The studies were classified as good (scores within the range of 17–22), medium (8–16) and poor (1–7) in terms of quality [23, 24].

Data extraction

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. 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 Surnes et al) in analyzing the content of studies in terms of the definitions of oral and dental health literacy. This tool 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 [25]. 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 [26, 27]. Since there is no gold standard for the oral and dental health literacy tools [28], the domain of validity was not considered a criterion.

Data collection and analysis

Search strategies were done by two authors. 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. In the event of disagreement, the third author reviewed the article and decided whether it has the merits to enter the study.

Results

In this study, the End Note software was used to organize the references. 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) [29–48], and only one study had examined the “decision-making” dimension [43]. 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*.

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 [30, 32, 33, 35, 36, 39, 44–46, 49]. 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 [29, 31, 32, 34–49]. Also, 20 and 4 articles at least in one dimension had a “good” [29–43, 45–49] and “excellent” [37, 46, 47, 49] quality, respectively.

Four tools, by examining seven domains, had paid the most attention to the domains in the psychometric section [37–39, 46, 47], and the two tools of ToFHLiD and OHLA-B had evaluated the minimum domains in the COSMIN checklist [40, 44].

In the area of internal consistency, all tools were evaluated except for three tools [31, 34, 40]. The range of Cronbach alpha score in the reviewed studies varied from 0.63 [44] to 0.91 [37]. 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 [31, 34, 37–39, 41, 43, 45–47, 49]. The most common statistical methods used to evaluate this domain were t-retest and ICC. Construct validity was also evaluated in 9 studies [30, 33, 35–39, 46, 47].

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

This study examined all tools that measure oral and dental health literacy. 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 Sorens et al. [22] have considered for a complete health literacy 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 health literacy [50]. Therefore, designing and developing a credible and brief screening tool to determine health literacy can be beneficial.

Various approaches to literacy tools are among issues that contribute to the inadequacy of health literacy tools. In other words, the basis for design and development of health literacy 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 [25]. 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 health literacy 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 [51].

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).

Declarations

Funding

This paper is part of PhD research project, which is supported by

Shahid Beheshti University of Medical Sciences, Tehran, Iran. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Ethics approval and consent to participate

The protocol 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.

Funding

This study is sponsored by Shahid Beheshti University of Medical Sciences in Tehran. The funding agencies had no role in the design of study, data collection and analysis, or presentation of the results.

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.

Acknowledgments

The authors would like to thank the research deputy of Shahid Beheshti University of Medical Sciences for their financial support.

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Tables

Table 1: Describing Details of Oral Health Literacy Tools

Author	Instrument	Year Publication	Setting	Characteristics			Psychometrics			Measure style	Ass
				Domains assessed	Validation sample population age	Modes of administration in validation study	Number of items	Sample size in validation study	Language of validated version		
Richman et al.,) (2007	REALD-99	2007	North Carolina	Pronunciation	Adults: 18 to 64 years	Face-to-face	99	102	English	REALM Family	OI
J. Y. 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	OI
Gong et al.,) (2007	ToFHLID	2007	North Carolina	Comprehension, Numeracy	Adults: 18 to 64 years	Face-to-face	80	102	English	TOFHLA Family	OI
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	OI
Macek et al.,) (2010	CMOHK	2010	Baltimore	Pronunciation	Adults: aged 45-64 years	Face-to-face	28	100	-	REALM Family	OI
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	OI
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	OI
Gironda, Der-) Martirosian, Messadi, Holtzman, & (Atchison, 2013	REALMD-20	2013	USA	Pronunciation	least 18 years of age	Face-to-face	20	200	English	REALM Family	OI

Bridges et al. (Wong et al., ,2013	HKOHLAT-P	2013	Hong Kong	Pronunciation	Adults:aged 45-64 years	Face-to-face	30	pairs 200 of paediatric dental patients	Hong Kong	TOFHLA Family	Self
Jones, Parker, Mills, Brennan, & (Jamieson, 2014	HeLD	2013	Australians	Comprehension, Numeracy	Older Adults: 65+ years, Adults: 18 to 64 years, Adolescents: 10 to 17 years	Paper and pencil, Face-to- face	29	209	English		Self
Stucky, Lee, Lee, (& Rozier, 2011	TS-REALD	2011	North Carolina	Pronunciation	Adults	Face-to-face	11	1405	English	REALM Family	Of
Junkes et al., (2015	BREALD-20	2015	Brazilian	Pronunciation	aged 18 to years 75	Face-to-face	30	258	Brazilian- Portuguese	REALM Family	Of
Peker, Köse, Güray, Uysal, & (Erdem, 2017	TREALD-30	2017	Turkish	Pronunciation	Adults: 18 to 64 years	Face-to-face	30	127	Turkish	REALM Family	Of
Tadakamadla et (al., 2014	AREALD-30	2014	Saudi Arabia	Pronunciation	aged over 25 years	Face-to-face	30	177	Arabic	REALM Family	Of
Cruvinel et al., (2017	REALMD-20	2017	Brazilian	Pronunciation	Older Adults: 65+ years, Adults: 18 to 64 years	Face-to-face	20	200	Portuguese	REALM Family	Of
Bado, Ferreira, de Souza Barbosa, & (Mialhe, 2017	OHLA-B	2017	Brazilian	Pronunciation and comprehension	Adults	Paper and pencil, Face-to- face	30	20	Portuguese	REALM Family	Of
(Naghbi Sistani, Montazeri, Yazdani, & Murtomaa, 2014)	OHL-AQ	2013	Tehran (Iran)	Reading comprehension, numeracy, literacy and decision making	adults aged between 18 and 65 years	Face-to-face	17	97	Persian	TOFHLA Family	Self
(Cartes-Velásquez and Luengo Machuca, 2017)	OHLI-cl	2017	Chilean	Comprehension, Numeracy, General	Adults: 18 to 64 years	Paper and pencil, Face-to- face	57	482	Spanish	-	Of

(Cartes-Velásquez and Luengo-Machucaa, 2018)	Span-REALD-30	2018	Chilean	Pronunciation, Numeracy, General, Comprehension	Adults: 18 to 64 years	Face-to-face	30	482	Spanish	-	Ol
(Pakpour, Lawson, Tadakamadla, Fridlund, & dentistry, 2016)	IREALD-99	2014	Iran	Pronunciation	Adults: 18 to 64 years	Face-to-face	99	421	Persian	REALM Family	Ol
(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	Ol

Table 2. Dimensions assessed in health literacy measures

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
ToFHLiD	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	Y	N	Y	N	N	N
REALMD-20	Y	N	Y	N	N	N	N	N	N
HKOHLAT-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				

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

Study reference	Assessment Tool	Internal consistency	Reliability	Measurement error	Content validity	Criterion validity	Construct validity	Hypothesis testing	Cross-cultural validity	Responsiveness	int					
Richman et al(2007)	REALD-99	G	NI	NI	F	G	NI	NI	NI	NI						
Lee et al(2007)	REALD-30	G	NI	NI	NI	G	P	NI	NI	NI						
Gong et al.(2007)	ToFHLiD	P	NI	NI	NI	F	NI	NI	NI	NI						
Sabbahi et al(2009)	OHLI	G	P	NI	G	F	NI	NI	NI	NI						
Macek et al(2010)	CMOHK	NI	F	NI	G	F	NI	NI	NI	NI						
Wong et al. (2012)	HKREALD-30	E	E	NI	P	G	G	F	F	NI						
Lee et al.(2012)	OHLA-S	F	NI	NI	G	NI	NI	F	P	NI						
Gironda et al.(2013)	REALMD-20	G	NI	NI	P	G	P	NI	NI	NI						
Wong et al. Bridges et al (2013)	HKOHLAT-P	NI	F	NI	G	F	NI	NI	NI	NI						
Jones et al.(2013)	HeLD	G	NI	NI	P	F	F	F	NI	NI						
Stucky et al.(2011)	TS-REALD	F	NI	NI	P	F	G	P	NI	NI						
Junkes et al(2015)	BREALD-20	E	G	NI	F	G	G	F	G	NI						
Parker et al.(2017)	TREALD-30	G	G	NI	G	G	F	F	E	NI						
Tadakamadla et al.(2014)	AREALD-30	G	F	NI	G	F	F	F	G	NI						
Crivinel et al.(2017)	REALMD-20	G	F	NI	G	F	G	P	G	NI						
Bado et al.(2017)	OHLA-B	NI	NI	NI	F	NI	NI	NI	G	NI						
Sistani et al.(2013)	OHL-AQ	F	G	NI	G	NI	NI	NI	NI	NI						
Cartes-Velasquez et al.	OHLI-cl	F	NI	NI	G	F	NI	NI	G	NI						
Cartes-Velasquez et al.	Span-REALD-30	G	G	NI	G	F	NI	NI	F	NI						
Pakpour et al.	IREALD-99	G	F	NI	G	F	NI	NI	F	NI						
Atchison et al.	REALM-D	G	G	NI	F	E	NI	NI	NI	NI						
Frequency of studies in the every domain		18	12	0	19	18	9	8	10	0						
Frequency and percentage of studies based on quality classification	Excellent	2 (11.11)	1 (8.33)	0	0	1 (5.55)	0	0	1 (10)	0						
	Good	11 (61.11)	5 (41.66)	0	11 (57.89)	6 (33.33)	4 (44.44)	0	5 (50)	0						
	Fair	4 (22.22)	5 (41.66)	0	4 (21.05)	11 (61.11)	3 (33.33)	6 (75)	3 (30)	0						
	Poor	1 (5.55)	1 (8.33)	0	4 (21.05)	0	2 (22.22)	2 (25)	1 (10)	0						
<table border="1"> <tr> <td>Excellent</td> <td>Good</td> <td>Fair</td> <td>Poor</td> <td>No information</td> </tr> </table>		Excellent	Good	Fair	Poor	No information										
Excellent	Good	Fair	Poor	No information												

- Studies that did not report information were ignored

Figures

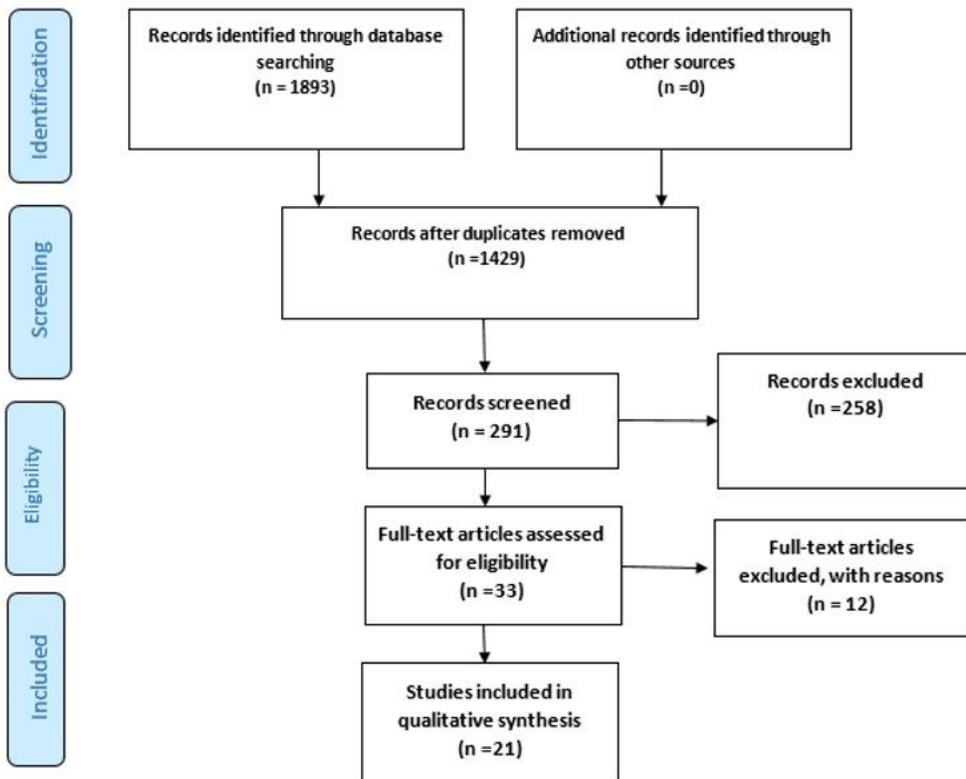


Figure 1
flowchart of article selection

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