

University of Groningen

The association of health literacy with adherence in older adults, and its role in interventions

Geboers, Bas; Brainard, Julii S.; Loke, Yoon K.; Jansen, Carel J. M.; Salter, Charlotte; Reijneveld, Sijmen A.; de Winter, Andrea F.

Published in:
BMC Public Health

DOI:
[10.1186/s12889-015-2251-y](https://doi.org/10.1186/s12889-015-2251-y)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2015

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Geboers, B., Brainard, J. S., Loke, Y. K., Jansen, C. J. M., Salter, C., Reijneveld, S. A., & de Winter, A. F. (2015). The association of health literacy with adherence in older adults, and its role in interventions: a systematic meta-review. *BMC Public Health*, 15(1), Article 903. <https://doi.org/10.1186/s12889-015-2251-y>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

RESEARCH ARTICLE

Open Access



The association of health literacy with adherence in older adults, and its role in interventions: a systematic meta-review

Bas Geboers^{1*}, Julii S. Brainard², Yoon K. Loke², Carel J. M. Jansen³, Charlotte Salter², Sijmen A. Reijneveld¹ and Andrea F. deWinter¹

Abstract

Background: Low health literacy is a common problem among older adults. It is often suggested to be associated with poor adherence. This suggested association implies a need for effective adherence interventions in low health literate people. However, previous reviews show mixed results on the association between low health literacy and poor adherence. A systematic meta-review of systematic reviews was conducted to study the association between health literacy and adherence in adults above the age of 50. Evidence for the effectiveness of adherence interventions among adults in this age group with low health literacy was also explored.

Methods: Eight electronic databases (MEDLINE, ERIC, EMBASE, PsycINFO, CINAHL, DARE, the Cochrane Library, and Web of Knowledge) were searched using a variety of keywords regarding health literacy and adherence. Additionally, references of identified articles were checked. Systematic reviews were included if they assessed the association between health literacy and adherence or evaluated the effectiveness of interventions to improve adherence in older adults with low health literacy. The AMSTAR tool was used to assess the quality of the included reviews. The selection procedure, data-extraction, and quality assessment were performed by two independent reviewers. Seventeen reviews were selected for inclusion.

Results: Reviews varied widely in quality. Both reviews of high and low quality found only weak or mixed associations between health literacy and adherence among older adults. Reviews report on seven studies that assess the effectiveness of adherence interventions among low health literate older adults. The results suggest that some adherence interventions are effective for this group. The interventions described in the reviews focused mainly on education and on lowering the health literacy demands of adherence instructions. No conclusions could be drawn about which type of intervention could be most beneficial for this population.

Conclusions: Evidence on the association between health literacy and adherence in older adults is relatively weak. Adherence interventions are potentially effective for the vulnerable population of older adults with low levels of health literacy, but the evidence on this topic is limited. Further research is needed on the association between health literacy and general health behavior, and on the effectiveness of interventions.

* Correspondence: bj.m.geboers@umcg.nl

¹Department of Health Sciences, University Medical Center Groningen, University of Groningen, Antonius Deusinglaan 1, FA10, PO Box 196, 9700 AD Groningen, The Netherlands

Full list of author information is available at the end of the article

Background

Health literacy has been defined as the degree to which people are able to access, understand, appraise, and communicate information to engage with the demands of different health contexts in order to promote and maintain health across the life-course [1]. Health literacy is related to general literacy, but it more specifically encompasses a person's understanding of health information, both in spoken and in written form [2]. Also, in contrast with general literacy, health literacy is considered a more dynamic and context-dependent ability [3]. Multiple studies have shown that older adults are an especially vulnerable group with regard to health literacy, with rates of low health literacy ranging from 30 to 68 % [4–7], with some studies already finding lower health literacy in adults above the age of 50 [4, 5].

Low health literacy is strongly associated with undesirable health outcomes, such as poor physical fitness [8], higher rates of arthritis and hypertension [9], and higher mortality [10]. It has been suggested that difficulty in adhering to medical advice may partly explain why low health literacy leads to poor health outcomes [11–13]. Adherence can be defined as the extent to which a person's behavior such as following a diet, taking medication, and/or executing lifestyle changes, are in agreement with recommendations from a health professional [14]. This includes any behavior to prevent, cure, or care for health problems. It also includes many behaviors that are commonly considered to be part of self-management [15]. Rates of poor adherence can be as high as 47 % [16, 17]. Poor adherence has been shown to be associated with several factors, such as poor cognitive abilities [18, 19], a higher number of prescribed medications [18, 19], and the presence of depressive symptoms [20]. Adherence may also be an important factor through which health literacy impacts health outcomes.

Previous reviews have assessed whether an association between health literacy and adherence exists, with mixed results [12, 21, 22]. For example, the reviews of Jin et al. [22] and Witte [12] suggest that high levels of health literacy contribute to successful adherence to therapy. However, Loke et al. [21] found no association between health literacy and adherence in hospitalized patients with diabetes or cardiovascular disease. Also, reviews do not often focus on older adults, which makes it hard to draw conclusions about this specific population. If low health literacy plays an important role in poor adherence among older adults, interventions to improve adherence may be effective to improve the relatively poor health outcomes of older adults with low levels of health literacy. It is, however, unclear whether adherence interventions are effective among older adults with low levels of health literacy.

We conducted a meta-review as a means to adequately assess and summarize a large number of existing reviews

and meta-analyses. The meta-review methodology, also called 'review of reviews' or 'overview of reviews', is a review that only includes systematic reviews and meta-analyses. This methodology is also used by the Cochrane collaboration [23]. It is considered a suitable methodology to summarize existing evidence on topics on which multiple reviews have already been published [23, 24]. Systematic reviews and meta-analyses are considered to be the highest level of evidence. Policy makers and healthcare professionals should make decisions based on systematic reviews, but the vast increase in number of systematic reviews may cause people to become overwhelmed. This is particularly true for topics which are clinically important (e.g. adherence) and a need exists to summarize all findings. Meta-reviews have the potential to identify consistent patterns of results on a large level by taking into account an even larger body of evidence than regular systematic reviews. In a meta-review, differences in the objectives and the quality of the systematic reviews can also be explored. In fact, Smith et al. [25] point out that "A logical and appropriate next step is to conduct a systematic review of reviews of the topic under consideration, allowing the findings of separate reviews to be compared and contrasted, thereby providing clinical decision makers with the evidence they need." The meta-review methodology has been increasingly used over recent years [26–31].

A broad definition of adherence was adopted for this meta-review, including any behavior that was recommended by health professionals. In modern healthcare, adherence goes beyond medication adherence, and health professionals often advise their patients to perform various other health behaviors, including, for example, doing regular blood glucose checks, increasing physical activity, or decreasing salt intake. Earlier research has also shown that health behaviors are often associated and have shared determinants [32, 33]. This makes it plausible that interventions that aim to improve any kind of adherence may impact on various health behaviors.

In this study, our aims are firstly to evaluate the association between health literacy and adherence in older adults above the age of 50 by performing a meta-review of existing systematic reviews. Secondly, we assess whether interventions to improve adherence are effective among this population.

Methods

Search strategy

Systematic searches were conducted for systematic reviews. The searches were conducted in eight electronic databases: MEDLINE, Education Resources Information Center (ERIC), EMBASE, PsycINFO, Cumulative Index to Nursing and Allied Health Literature (CINAHL), DARE, The Cochrane Library, and Web of Knowledge. All databases were searched through September 2014. Combinations of

keywords were used, including health literacy, numeracy, adherence, compliance, and self-management. When possible, built-in filters for reviews were used. The full search strategy is presented in Additional file 1. In addition, reference lists of included systematic reviews were manually searched for further reviews that could add to our meta-review.

Selection of reviews

After the completion of the search and removal of duplicates, two independent reviewers (BG and YKL or JB) screened the titles and abstracts of all articles for potential eligibility for inclusion in our meta-review. Any article selected by at least one of the reviewers was included for full-text review. In the title/abstract review, the inter-rater agreement was around 95 %. Two independent reviewers (BG and JB or YKL) then read the selected articles in full. The reviewers were not blinded to authorship of the reviews. Disagreements in the full-text review were resolved by discussion (BG and JB or YKL).

Reviews were included if they provided information on at least one of our objectives, based on the following criteria:

- (1) The article was a systematic review (we defined this as a literature review involving a systematic search with application of selection criteria and a description of the number and nature of included studies), either with or without a meta-analysis (i.e. statistical pooling of the results).
- (2) The review either assessed the association between health literacy and adherence or evaluated the effectiveness of interventions to improve adherence in adults with low health literacy.
- (3) The review focused on behaviors that need to be maintained for an extended period of time. Reviews that focused on behaviors that are only performed once, such as diagnostic tests and participation in screening, were excluded.
- (4) At least part of the results of the studies included in the review were specific for the objectives of our meta-review. To confirm this, we verified that the included primary studies considered at least a subset of older adults (mean or median age of at least 50 years) and assessed health literacy with a validated measure, such as the S-TOFHLA [34] or REALM [35]. As an additional criterion, we checked whether the studies were performed in westernized developed countries (USA, Canada, Europe, New Zealand, or Australia).

There were no restrictions regarding type of publication (e.g. report, journal article) or the type of primary studies that were evaluated in the systematic reviews.

Also, no restrictions were imposed regarding language. Reviews in non-English languages were translated using online translation services. Native speakers could be contacted in case a non-English review was selected for data-extraction. However, this did not occur.

Data extraction and quality assessment

Data were extracted from the reviews that met all criteria, using a coding form that captured bibliographic information, the main research question, methodological data, characteristics of the studied population, data about the content and procedures of the included studies, the results, and conclusions as reported by the authors.

The AMSTAR tool was used to check the quality of the included reviews [36]. AMSTAR consists of 11 questions and assesses, among other things, whether a comprehensive literature search is performed, whether duplicate study selection and data-extraction were performed, and whether a full list of included studies is provided. Data-extraction and quality assessment were independently performed by at least two reviewers (BG and JSB or YKL) with disagreements resolved by discussion or by consulting the third reviewer.

Analyses and reporting

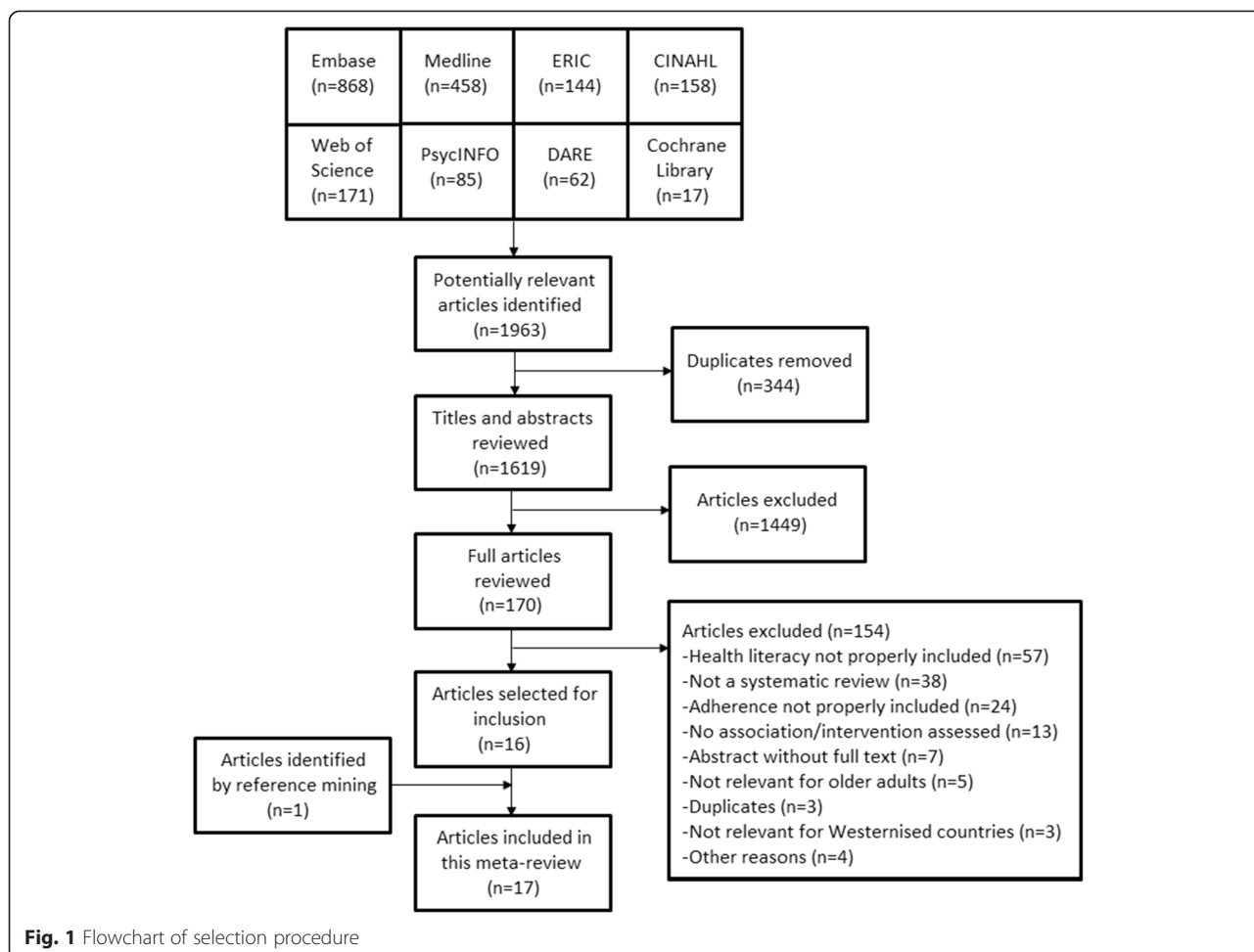
As meta-reviews report on the level of systematic reviews, detailed reporting or pooling of statistics is only possible when at least some of the included systematic reviews conducted a meta-analysis. As we only identified one systematic review with a meta-analysis, a narrative synthesis was used to report our results. First, we summarize the quality of the included reviews. Then, we report on the conclusions of the reviews regarding the association between health literacy and adherence in older adults. Finally, we discuss conclusions of the reviews regarding the effectiveness of adherence interventions in the population of older adults with low levels of health literacy.

In accordance with the meta-review methodology, only information from the systematic reviews is reported in this study. However, to ensure the validity of the results of our meta-review, we also performed data verification by checking whether the reported general conclusions of the reviews were supported by the results of the primary studies that were specifically relevant for our meta-review. A complete overview of these primary studies is presented in Additional file 2.

Results

Search results

After screening 1619 citations, a total of 17 reviews were included. The full process of selection is presented in Fig. 1.



Quality assessment

The results of the AMSTAR quality assessment are presented in Table 1. Final AMSTAR quality scores ranged widely from 3 to 10 out of a maximum of 11, with a mean score of 6.4. Nine of the reviews had scores in the range from 7 to 10. Almost all of the reviews conducted a comprehensive search and provided a list and details of the included studies. Ten reviews reported an adequate level of duplicate study selection and data extraction. Only one review statistically pooled the findings of multiple studies [37].

Differences between higher and lower scoring reviews were mostly due to how well they reported on their method of quality assessment and the way of handling the results of quality assessments in formulating conclusions. Eight reviews conducted a quality assessment, six of which adequately used the results of this assessment in formulating their conclusions.

The association between health literacy and adherence

We included 11 reviews that reported on the association between health literacy and adherence in older adults

[21, 37–46]. Two of these reviews also added to our objective regarding interventions on adherence [21, 39]. The conclusions of the selected reviews on the association between health literacy and adherence are presented in Table 2.

Six reviews focused on medication adherence specifically. Four of these reviews assessed the association between health literacy and medication adherence, but did not support a strong association [21, 37, 41, 45]. The review of Zhang et al. [37] statistically combined the results of many studies in a meta-analysis. A statistically significant but quite modest association between health literacy and medication adherence was found ($r < 0.09$, $p < 0.0001$ in all analyses). The review of Ostini and Kairuz [45] concluded that addressing medication non-adherence within the framework of health literacy is not as straightforward as was initially assumed, as research often fails to find an association between health literacy and medication adherence. The reviews of Loke et al. [21] and Keller et al. [41] also reported that most of the studies they included did not find significant associations between health literacy and medication adherence. Two other reviews tried to

Table 1 Results of methodological quality assessment, AMSTAR criteria

Authors	Review on interventions or association	1	2	3	4	5	6	7	8	9	10	11	Total
Al Sayah et al. [46]	Association	+	+	+	+	-	-	+	+	-	-	+	7/11
Berkman et al. [38]	Association	+	+	+	+	-	+	+	+	-	-	+	8/11
Carbone et al. [47]	Interventions	-	-	+	+	+	+	-	-	-	-	+	5/11
Fransen et al. [39]	Both	+	-	-	+	+	+	+	-	-	-	+	6/11
Gellad et al. [40]	Association	+	+	+	+	+	+	-	-	-	+	-	7/11
Keller et al. [41]	Association	+	+	+	+	+	+	+	+	-	-	-	8/11
Lee et al. [48]	Interventions	+	+	+	-	+	+	+	+	-	-	+	8/11
Lewis [42]	Association	+	-	+	-	+	+	-	-	-	-	+	5/11
Loke et al. [21]	Both	+	+	+	-	+	+	+	+	-	+	+	9/11
Newman-Casey et al. [52]	Intervention	+	+	+	-	+	+	+	-	-	+	+	8/11
Ostini and Kairuz [45]	Association	+	-	+	-	+	+	-	-	-	-	+	5/11
Schaefer [51]	Interventions	+	-	-	+	+	+	-	-	-	-	-	4/11
Van Scoyoc et al. [50]	Interventions	+	+	-	+	+	+	-	-	-	-	-	5/11
Sheridan et al. [49]	Interventions	+	+	+	+	+	+	+	+	-	+	+	10/11
Wawrzyniak et al. [44]	Association	+	-	+	-	+	-	-	-	-	-	+	4/11
Weekes [43]	Association	+	-	+	+	-	-	-	-	-	-	-	3/11
Zhang et al. [37]	Association	+	+	+	-	+	+	-	-	+	-	+	7/11

Items in AMSTAR checklist, 1: Pre-specified design, 2: Duplicate screening and data-extraction, 3: Comprehensive literature search, 4: Publication status as criterion, 5: List of selected studies, 6: Characteristics of the studies provided, 7: Validity assessment, 8: Study quality is part of forming conclusions, 9: Valid statistical synthesis of results, 10: Publication bias addressed, 11: Conflict of interest statement

find factors that are associated with medication adherence and considered health literacy as a predictive factor [40, 42]. However, neither concluded that health literacy is an important barrier for medication adherence.

Two reviews focused on the association between health literacy and diabetes in a broad sense. Al Sayah et al. [46] focused on diabetes outcomes and concluded that health literacy is related to diabetes knowledge, but that there is not much evidence for the association between health literacy and other outcomes, including diabetes self-care. Fransen et al. [39] concluded that the evidence for an association between health literacy and various domains of diabetes self-management is very limited.

One review [44] examined the literature on the impact of health literacy on health outcomes in HIV patients, but only one of the included studies focused on older patients. The authors concluded that some studies find an association between health literacy and antiretroviral medication adherence, while other studies fail to find such association.

The review of Berkman et al. [38] focused on the association between health literacy and many different outcomes. The review found evidence on many associations, but concluded that there was insufficient evidence to support an association between health literacy and adherence, despite the inclusion of a relatively large number of studies.

One low quality review concluded that health literacy influences adherence to medical protocols, but the results

of the primary studies that are discussed in the review do not support this conclusion [43].

Data verification indicated that the results of the primary studies that are specifically relevant to the current meta-review support the conclusions of the reviews.

Effectiveness of interventions

Eight reviews provided information on the effects of adherence interventions in older adults with low health literacy [21, 39, 47–52]. An overview of the included reviews is presented in Table 3. No review focused specifically on the effectiveness of interventions on adherence among older adults with low health literacy, and most reviews did not draw general conclusions about this topic. However, the selected reviews discussed the results of one or more intervention studies that provided evidence for our research questions. In order to maximize the amount of information we could extract from the reviews, we also focused on the conclusions that reviews drew about the individual intervention studies, which is a common strategy in meta-reviews [29–31]. In total, the reviews reported on seven different intervention studies. A complete overview of these intervention studies is presented in Additional file 2.

Four reviews on varying topics [39, 47, 49, 51] reported on the same quasi-experimental intervention study [53]. The reviews reported that the study compared various outcomes of diabetes education classes between patients with high and low health literacy, and

Table 2 Reviews that examined the association between health literacy and adherence in older adults ($n = 11$)

Authors	Main focus	Total articles (on adherence/specific to this meta-review)	Conclusion on association between health literacy and adherence in older adults
Al Sayah et al. [46]	Improve understanding of relationship between health literacy or numeracy and health outcomes in diabetes.	34 (5/5)	No association with self-care activities.
Berkman et al. [38]	Assess whether low health literacy links to poor health care usage, health outcomes, costs, and disparities in outcomes among all age groups.	111 (17/8)	Evidence of an association was inconsistent.
Fransen et al. [39]	Explore possible associations between health literacy, diabetes self-management, and possible mediators.	11 (11/7 ^a)	Very limited evidence for an association with diabetes self-management.
Gellad et al. [40]	Identification of nonfinancial barriers to medication adherence in older adults.	9 (1/1)	No general conclusions about health literacy and adherence are drawn.
Keller et al. [41]	Consider how low health literacy relates to disease state control or medication adherence.	10 (4/3)	Conflicting results about link with adherence.
Lewis [42]	Understand factors associated with adherence to medication in blacks with hypertension.	18 (18/1)	No association was found.
Loke et al. [21]	Review links between health literacy and cardiovascular/diabetes medication adherence.	9 (9/7 ^a)	No consistent relationship was found with either condition.
Ostini and Kairuz [45]	Determine what are factors that may influence the possible relationship between health literacy and medication non-adherence.	24 (24 ^b /11)	No consistent relationship was found.
Wawrzyniak et al. [44]	Study the current state of knowledge regarding health literacy and health outcomes of HIV-infected individuals.	15 (10/1)	Inconsistent: Some evidence for an association.
Weekes [43]	Overview of health literacy of African American adults.	23 (9/1)	Health literacy influences adherence to medical protocols.
Zhang et al. [37]	Meta-analysis to estimate effect size of the relationship between health literacy and medication adherence.	35 (35/19)	A weak positive association was found.

^aIncluding one relevant intervention study

^bOne of these 24 studies is the review of Loke et al. [21] that is also included in this meta-review. The other 23 articles were original research

Table 3 Reviews that evaluated interventions on adherence in older adults with low health literacy ($n = 8$)

Authors	Main focus	Articles included (relevant to this meta-review)
Carbone et al. [47]	Enhance nutrition advisors' awareness of health literacy in practice and research.	33 (1)
Fransen et al. [39] ^a	Explore possible associations between health literacy, diabetes self-management, and possible mediators.	11 (1 ^b)
Lee et al. [48]	Detect effective strategies to improve health outcomes of low literate patients with cardiovascular disease.	9 (1)
Loke et al. [21] ^a	Review links between health literacy and cardiovascular/diabetes medication adherence.	9 (1)
Newman-Casey et al. [52]	Evaluate educational interventions for glaucoma medication adherence based on quality, efficacy, and extent to which they are grounded in evidence-based Health Behavior Theory.	8 (1)
Schaefer [51]	Find which low health literacy interventions are most effective.	16 (1)
Van Scoyoc et al. [50]	Explore the associations between literacy and diabetes outcomes, and identify clinical strategies likely to be most beneficial.	13 (5)
Sheridan et al. [49]	Identify specific benefits of interventions addressing low health literacy.	39 (1)

^aReview also provided information about the association between adherence and health literacy. ^bAnother relevant intervention study was described, but not selected, because no results of this intervention were reported

that low health literacy patients were found to benefit at least as much from diabetes education classes as patients with high health literacy.

In their review, Lee et al. [48] focused on strategies to improve outcomes in low literate patients with cardiovascular disease. One randomized controlled trial is described in which written instructions for medication use were adapted to fit the needs of patients with low health literacy by using a larger font size, decreasing the number of words, and using schema's with recognizable symbols [54]. The adapted instruction resulted in increased adherence to medication.

In the review by Loke et al. [21] one randomized controlled trial is discussed, in which patients with coronary artery disease and congestive heart failure received instructions for medication use upon being discharged from the hospital [55]. The experimental group received an additional tool that was customized for low literacy patients. After 2 weeks, there was no difference between the two study arms.

In their review on educational interventions to improve glaucoma medication adherence, Newman-Casey et al. [52] identified one randomized controlled trial that focused on health literacy. In this study, glaucoma patients received an educational intervention tailored to their level of health literacy [56]. Trends towards improved adherence were found in the groups with lower reading levels. The review concluded that tailoring information may be useful for educational interventions [52].

Only the review by Von Scoyoc and DeWalt [50], on interventions that aimed to improve diabetes outcomes in patients with low levels of health literacy, reported on more than one intervention that added to our objectives. A three-arm trial showed that both automated telephone disease management and group medical visits led to increased diabetes self-care compared to standard care in people with low literacy [57, 58]. Another study tested an intervention that consisted of a brief counseling session, a low literacy appropriate education guide on diabetes, and follow-up counseling sessions over the telephone [59, 60]. The study found similar improvements in diabetes self-management behavior across patients with different health literacy levels. Finally, staff instructions in the use of a toolkit to facilitate literacy-sensitive diabetes education and management did not lead to improved self-management [61]. The review concluded that it is possible to use interventions to improve the health outcomes of low literate patients with diabetes, but does not draw specific conclusions regarding diabetes self-management [50].

None of the reviews drew any specific conclusions regarding which type of adherence intervention is most suitable for older adults with low health literacy. As a result, data verification was not possible for this question.

Also, the small number of described interventions and their large heterogeneity did not allow for strong conclusions.

In their conclusions, many of the reviews stressed the need for further high-quality research in order to strengthen the evidence for interventions among people with low health literacy.

Discussion

Our meta-review provides only weak evidence in support of an association between health literacy and adherence in older adults. Our results show some evidence that interventions on adherence are effective among older adults with low health literacy, but this evidence is limited.

The results of our systematic meta-review cast doubt on the existence of a strong association between health literacy and adherence among older adults, as the identified systematic reviews only support the existence of a weak association. While non-systematic reviews and health literacy frameworks have suggested that adherence is an important factor through which health literacy impacts health outcomes [11–13], our results do not strongly support this notion.

However, studies on health literacy and adherence in older adults may also have missed a genuine association. First, one of the reviews suggests the possibility of a non-linear association between health literacy and adherence, in which adherence rates are lowest among those with moderate health literacy [45]. This idea is supported by a survey study that shows that people with low health literacy mostly fail to adhere as a result of a lack of understanding of the given instructions, while people with high health literacy more often non-adhere as a result of deliberately choosing to disregard recommendations [62]. If the association between health literacy and adherence is nonlinear, studies that treat health literacy as a categorical variable with only two or three categories may fail to observe any such associations.

Second, the way in which health literacy and adherence are measured may limit the possibility to draw strong conclusions on the association between the two concepts. The two most commonly used measurement tools for health literacy are the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Short Test of Functional Health Literacy in Adults (S-TOFHLA). Both tools have been criticized for not adequately covering the range of competencies required for adequate health literacy [3, 21]. It has also been suggested that both tools measure limited different elements of health literacy [63]. Also, many tools to measure adherence are based on self-report, but it has been shown that self-reporting is not always an accurate measure of adherence due to people overestimating their adherence, especially when their actual adherence is poor [64].

Third, the inconsistent results on the association between health literacy and adherence may be the result of

a confounding effect of age in some studies. Whereas older adults tend to have poorer health literacy [4–7], other research has shown that older age is positively related to adherence [65, 66], which may complicate any association between health literacy and adherence in older adults.

The results of our meta-review on interventions suggest that interventions on adherence are at least as effective for people with low health literacy as for those with high health literacy. The interventions on adherence described in our reviews seem to focus mainly on education and on lowering the health literacy demands of adherence instructions. However, as the reviews provided only limited information on the effectiveness of adherence interventions among older adults with low health literacy, we were not able to draw conclusions regarding which type of intervention could be most beneficial for this population. We identified a clear gap in the available literature, as none of the included systematic reviews drew specific conclusions on the topic of adherence interventions among older adults with low health literacy. Additionally, the input of four of the reviews was based on the results of the same study [53]. In total, the reviews provided information on only seven unique intervention studies.

The reviews included in our meta-review were of varying quality. However, similar conclusions were found among both reviews of higher and lower quality. Our quality assessment indicates that the reviews were mostly based on thorough searches, that the selection procedures and data-extraction were mostly well conducted, and that most reviews gave sufficient information about the included primary studies. However, many of the included reviews did not conduct a quality assessment of the included studies. This is problematic and certainly requires improvement, as it makes it impossible to assess whether conclusions are based on high quality evidence.

Strengths and limitations

The strengths of our meta-review included the use of a broad definition of adherence, which also includes behaviors outside the cure and care setting, and our extensive search strategy.

However, our meta-review had some limitations. First, we cannot rule out the possibility of selective analysis and outcome reporting in both the primary studies and the reviews. Some research may not have been published if deemed insufficiently novel, positive or significant. Second, as none of our included reviews reported specifically on the effectiveness of adherence interventions among older adults with low health literacy, we could only report on their limited conclusions about individual studies. Third, in many reviews, only part of the studies on the association between health literacy and adherence

focused on older adults, leaving unclear to what degree the conclusions of the review are generalizable to this group. However, data verification confirmed that the patterns of results found in the reviews did not change substantially when only considering the primary studies that met the criteria for our meta-review. Finally, in a systematic meta-review, a review based on including systematic reviews, the most recent primary studies may not be covered.

Implications for public health and future research

Our results suggest that health literacy and adherence exert partially independent effects on the health outcomes of older adults. Public health practitioners should be aware that initiatives that aim to mitigate the negative impacts of low health literacy on health outcomes among older adults should not focus solely on adherence. Initiatives that aim to improve adherence rates among older adults could focus on education and on lowering the health literacy demands of adherence instructions, as evidence on these strategies is the strongest.

Although we adopted a broad definition of adherence in this meta-review, most of the included reviews focused specifically on medication adherence or disease management. None of the reviews focused on adherence with guidelines for general health behavior, such as healthy nutritional behavior and physical activity. Future reviews on the impact of health literacy on the health outcomes of older adults could consider these behaviors as well. Some studies have focused on the association between health literacy and general health behaviors among older adults [67, 68].

Also, despite our extensive search strategy, we found no reviews that focused on improving adherence specifically among older adults with low health literacy. To close this gap in the available literature, future research could focus on reviewing primary studies on specifically this topic, as this could further advance our understanding of the role of health literacy in adherence interventions among older adults. Many of the reviews included in our meta-review stressed the need for more high quality intervention research among people with low health literacy. Further intervention research could indeed help identify which types of interventions are most beneficial for older adults with low health literacy, which could be valuable for clinical practitioners.

Conclusions

We found inconsistent evidence on the association between health literacy and adherence in older adults in all reviews, including among reviews of higher quality. We are thus unable to support the suggestion that adherence is one of the most important factors through which health literacy impacts health in the vulnerable population of

older adults. Nevertheless, our meta-review shows that adherence interventions are potentially beneficial for the vulnerable population of older adults with low levels of health literacy, particularly if they focus on education or lowering the health literacy demands of adherence instructions. However, as the evidence on this topic is limited, our conclusions should be interpreted with caution.

Additional files

Additional file 1: Search strategy of the meta-review. (DOCX 23 kb)

Additional file 2: Description of primary studies included in the meta-review. (DOCX 42 kb)

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

BG developed the protocol for the study, conducted the literature searches, selected studies for inclusion in the review, conducted the quality assessment, interpreted the data and wrote the manuscript. JSB and YKL assisted in designing the search strategy, selecting studies for inclusion in the review, conducting the quality assessment, and interpreting the data. CJMJ and CS critically reviewed the manuscript for content. SAR was involved in drafting the manuscript and had an advisory role throughout the study. AFW was involved in the development of the protocol, designing the search strategy, interpretation of the data, and had an advisory role. All authors contributed substantially to the writing of the manuscript and have read and approved the final manuscript.

Authors' information

Not applicable

Availability of data and materials

Not applicable

Acknowledgements

This article was written in the framework of the Intervention Research on Health Literacy among the Ageing Population (IROHLA) project. The authors thank D.G. Van Iltersum for her assistance in designing the search strategy for this meta-review.

Funding

This article was written in the framework of the Intervention Research on Health Literacy among the Ageing Population (IROHLA) project. IROHLA is coordinated by the University Medical Center Groningen and has received funding from the European Union's Seventh Framework Programme (FP7/2007–2013) under grant agreement #305831.

Author details

¹Department of Health Sciences, University Medical Center Groningen, University of Groningen, Antonius Deusinglaan 1, FA10, PO Box 196, 9700 AD Groningen, The Netherlands. ²Norwich Medical School, Faculty of Medicine & Health Sciences, University of East Anglia, Norwich, UK. ³Department of Communication and Information Studies, Faculty of Arts, University of Groningen, Groningen, The Netherlands.

Received: 17 June 2015 Accepted: 8 September 2015

Published online: 17 September 2015

References

- Kwan B, Frankish J, Rootman I, Zumbo B, Kelly K, Begoray D, et al. The development and validation of measures of "health literacy" in different populations. Vancouver: University of British Columbia, Institute of Health Promotion Research & University of Victoria Centre for Community Health Promotion Research; 2006.
- Baker DW. The meaning and the measure of health literacy. *J Gen Intern Med.* 2006;21:878–83.
- Berkman ND, Davis TC, McCormack L. Health literacy: what is it? *J Health Commun.* 2010;15 Suppl 2:9–19.
- Ashida S, Goodman M, Pandya C, Koehly LM, Lachance C, Stafford J, et al. Age differences in genetic knowledge, health literacy and causal beliefs for health conditions. *Public Health Genomics.* 2011;14:307–16.
- Jovic-Vranes A, Bjegovic-Mikanovic V. Which women patients have better health literacy in Serbia? *Patient Educ Couns.* 2012;89:209–12.
- von Wagner C, Knight K, Steptoe A, Wardle J. Functional health literacy and health-promoting behaviour in a national sample of British adults. *J Epidemiol Community Health.* 2007;61:1086–90.
- Scott TL, Gazmararian JA, Williams MV, Baker DW. Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Med Care.* 2002;40:395–404.
- Möttus R, Johnson W, Murray C, Wolf MS, Starr JM, Deary IJ. Towards understanding the links between health literacy and physical health. *Health Psychol.* 2013;33:164–73.
- Kim SH. Health literacy and functional health status in Korean older adults. *J Clin Nurs.* 2009;18:2337–43.
- Sudore RL, Yaffe K, Satterfield S, Harris TB, Mehta KM, Simonsick EM, et al. Limited literacy and mortality in the elderly: the health, aging, and body composition study. *J Gen Intern Med.* 2006;21:806–12.
- von Wagner C, Steptoe A, Wolf MS, Wardle J. Health literacy and health actions: a review and a framework from health psychology. *Health Educ Behav.* 2009;36:860–77.
- Witte PG. Health literacy: can we live without it? *Adult Basic Educ Lit J.* 2010;4:3–12.
- Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int.* 2000;15:259–67.
- Sabate E. Adherence to long term therapies: evidence for action. Geneva: World Health Organization; 2003.
- Paasche-Orlow M, Wolf MS. The causal pathways linking health literacy to health outcomes. *Am J Health Behav.* 2007;31 Suppl 1:S19–26.
- Ratanawongsa N, Karter AJ, Parker MM, Lyles CR, Heisler M, Moffet HH, et al. Communication and medication refill adherence: the Diabetes Study of Northern California. *JAMA Intern Med.* 2013;173:210–8.
- Zandman-Goddard G, Amital H, Shamrayevsky N, Raz R, Shalev V, Chodick G. Rates of adherence and persistence with allopurinol therapy among gout patients in Israel. *Rheumatology.* 2013;52:1126–31.
- Stoehr GP, Lu S, Lavery L, Bilt JV, Saxton JA, Chang CH, et al. Factors associated with adherence to medication regimens in older primary care patients: the Steel Valley Seniors Survey. *Am J Geriatr Pharmacother.* 2008;6:255–63.
- Gray SL, Mahoney JE, Blough DK. Medication adherence in elderly patients receiving home health services following hospital discharge. *Ann Pharmacother.* 2001;35:539–45.
- Schoenthaler A, Ogedegbe G, Allegrante JP. Self-efficacy mediates the relationship between depressive symptoms and medication adherence among hypertensive African Americans. *Health Educ Behav.* 2009;36:127–37.
- Loke YK, Hinz I, Wang X, Salter C. Systematic review of consistency between adherence to cardiovascular or diabetes medication and health literacy in older adults. *Ann Pharmacother.* 2012;46:863–72.
- Jin J, Sklar GE, Min SO, Chuen LS. Factors affecting therapeutic compliance: a review from the patient's perspective. *Ther Clin Risk Manag.* 2008;4:269–86.
- Becker LA, Oxman AD. Chapter 22: overview of reviews. In: Higgins JPT, Green S, editors. *Cochrane handbook for systematic reviews of interventions version 5.1.0* [updated March 2011]. The Cochrane Collaboration. 2011. www.cochrane-handbook.org. Accessed 10 May 2015.
- Sarrami-Foroushani P, Travaglia J, Debono D, Clay-Williams R, Braithwaite J. Scoping meta-review: introducing a new methodology. *Clin Transl Sci.* 2015;8:77–81.
- Smith V, Devane D, Begley CM, Clarke M. Methodology in conducting a systematic review of systematic reviews of healthcare interventions. *BMC Med Res Methodol.* 2011;11:15.
- Foroushani PS, Schneider J, Assareh N. Meta-review of the effectiveness of computerised CBT in treating depression. *BMC Psychiatry.* 2011;11:131.

27. Mattishent K, Thavarajah M, Blanco P, Gilbert D, Wilson AM, Loke YK. Meta-review: adverse effects of inhaled corticosteroids relevant to older patients. *Drugs*. 2014;74:539–47.
28. Protogerou C, Johnson BT. Factors underlying the success of behavioral HIV-prevention interventions for adolescents: a meta-review. *AIDS Behav*. 2014;18:1847–63.
29. Corry M, While A, Neenan K, Smith V. A systematic review of systematic reviews on interventions for caregivers of people with chronic conditions. *J Adv Nurs*. 2015;71:718–34.
30. Tang J, Abraham C, Greaves C, Yates T. Self-directed interventions to promote weight loss: a systematic review of reviews. *J Med Internet Res*. 2014;16:e58.
31. Hall AK, Cole-Lewis H, Bernhardt JM. Mobile text messaging for health: a systematic review of reviews. *Annu Rev Public Health*. 2015;36:393–415.
32. Reijneveld SA, van Nieuwenhuijzen M, Klein Velderman M, Paulussen TWGM, Junger M. Clustering of health and risk behaviour in immigrant and indigenous Dutch residents aged 19–40 years. *Int J Public Health*. 2012;57:351–61.
33. Dusseldorp E, Klein Velderman M, Paulussen TWGM, Junger M, van Nieuwenhuijzen M, Reijneveld SA. Targets for primary prevention: cultural, social and intrapersonal factors associated with co-occurring health-related behaviours. *Psychol Health*. 2014;29:598–611.
34. Baker DW, Williams MV, Parker RM, Gazmararian JA, Nurss J. Development of a brief test to measure functional health literacy. *Patient Educ Couns*. 1999;38:33–42.
35. Davis TC, Long SW, Jackson RH, Mayeaux EJ, George RB, Murphy PW, et al. Rapid estimate of adult literacy in medicine: a shortened screening instrument. *Fam Med*. 1993;25:391–5.
36. Shea BJ, Hamel C, Wells GA, Bouter LM, Kristjansson E, Grimshaw J, et al. AMSTAR is a reliable and valid measurement tool to assess the methodological quality of systematic reviews. *J Clin Epidemiol*. 2009;62:1013–20.
37. Zhang NJ, Terry A, McHorney CA. Impact of health literacy on medication adherence: a systematic review and meta-analysis. *Ann Pharmacother*. 2014;48:741–51.
38. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med*. 2011;155:97–107.
39. Fransen MP, von Wagner C, Essink-Bot ML. Diabetes self-management in patients with low health literacy: ordering findings from literature in a health literacy framework. *Patient Educ Couns*. 2012;88:44–53.
40. Gellad WF, Grenard JL, Marcum ZA. A systematic review of barriers to medication adherence in the elderly: looking beyond cost and regimen complexity. *Am J Geriatr Pharmacother*. 2011;9:11–23.
41. Keller DL, Wright J, Pace HA. Impact of health literacy on health outcomes in ambulatory care patients: a systematic review. *Ann Pharmacother*. 2008;42:1272–81.
42. Lewis L. Factors associated with medication adherence in hypertensive blacks: a review of the literature. *J Cardiovasc Nurs*. 2012;27:208–19.
43. Weekes CV. African Americans and health literacy: a systematic review. *ABNF J*. 2012;23:76–80.
44. Wawrzyniak AJ, Ownby RL, McCoy K, Waldrop-Valverde D. Health literacy: impact on the health of HIV-infected individuals. *Curr HIV/AIDS Rep*. 2013;10:295–304.
45. Ostini R, Kairuz T. Investigating the association between health literacy and non-adherence. *Int J Clin Pharm*. 2014;36:36–44.
46. Al Sayah F, Majumdar SR, Williams B, Robertson S, Johnson JA. Health literacy and health outcomes in diabetes: a systematic review. *J Gen Intern Med*. 2013;28:444–52.
47. Carbone ET, Zoellner JM. Nutrition and health literacy. A systematic review to inform nutrition research and practice. *J Acad Nutr Diet*. 2012;112:254–65.
48. Lee TW, Lee SH, Kim HH, Kang SJ. Effective intervention strategies to improve health outcomes for cardiovascular disease patients with low health literacy skills: a systematic review. *Asian Nurs Res*. 2012;6:128–36.
49. Sheridan SL, Halpern DJ, Viera AJ, Berkman ND, Donahue KE, Crotty K. Interventions for individuals with low health literacy: a systematic review. *J Health Commun*. 2011;16 Suppl 3:30–54.
50. Van Scoyoc EE, DeWalt DA. Interventions to improve diabetes outcomes for people with low literacy and numeracy: a systematic literature review. *Diabetes Spectrum*. 2010;23:228–37.
51. Schaefer CT. Integrated review of health literacy interventions. *Orthop Nurs*. 2008;27:302–17.
52. Newman-Casey PA, Weizer JS, Heisler M, Lee PP, Stein JD. Systematic review of educational interventions to improve glaucoma medication adherence. *Semin Ophthalmol*. 2013;28:191–201.
53. Kim S, Love F, Quistberg DA, Shea JA. Association of health literacy with self-management behavior in patients with diabetes. *Diabetes Care*. 2004;27:2980–2.
54. Murray MD, Morrow DG, Weiner M, Clark DO, Tu W, Deer MM, et al. A conceptual framework to study medication adherence in older adults. *Am J Geriatr Pharmacother*. 2004;2:36–43.
55. Cordasco KM, Asch SM, Bell DS, Guterman JJ, Gross-Schulman S, Ramer L, et al. A low-literacy medication education tool for safety-net hospital patients. *Am J Prev Med*. 2009;37:S209–16.
56. Muir KW, Ventura A, Stinnett SS, Enfieldjian A, Allingham RR, Lee PP. The influence of health literacy level on an educational intervention to improve glaucoma medication adherence. *Patient Educ Couns*. 2012;87:160–4.
57. Schillinger D, Hammer H, Wang F, Palacios J, McLean I, Tang A, et al. Seeing in 3-D: examining the reach of diabetes self-management support strategies in a public health care system. *Health Educ Behav*. 2008;35:664–82.
58. Schillinger D, Handley M, Wang F, Hammer H. Effects of self-management support on structure, process, and outcomes among vulnerable patients with diabetes: a three-arm practical clinical trial. *Diabetes Care*. 2009;32:559–66.
59. Wallace AS, Seligman HK, Davis TC, Schillinger D, Arnold CL, Bryant-Shilliday B, et al. Literacy-appropriate educational materials and brief counseling improve diabetes self-management. *Patient Educ Couns*. 2009;75:328–33.
60. Wallace A. Low health literacy: overview, assessment, and steps toward providing high-quality diabetes care. *Diabetes Spectr*. 2010;23:220–7.
61. Cavanaugh K, Wallston KA, Gebretsadik T, Shintani A, Huizinga MM, Davis D, et al. Addressing literacy and numeracy to improve diabetes care: two randomized controlled trials. *Diabetes Care*. 2009;32:2149–55.
62. Lindquist LA, Go L, Fleisher J, Jain N, Friesema E, Baker DW. Relationship of health literacy to intentional and unintentional non-adherence of hospital discharge medications. *J Gen Intern Med*. 2012;27:173–8.
63. Chin J, Morrow DG, Stine-Morrow E, Conner-Garcia T, Graumlich JF, Murray MD. The process-knowledge model of health literacy: evidence from a component analysis of two commonly used measures. *J Health Commun*. 2011;16 Suppl 3:222–41.
64. Daniels T, Goodacre L, Sutton C, Pollard K, Conway S, Peckham D. Accurate assessment of adherence: self-report and clinician report vs electronic monitoring of nebulizers. *Chest*. 2011;140:425–32.
65. Cohen MJ, Shaykevich S, Cawthon C, Kripalani S, Paasche-Orlow M, Schnipper JL. Predictors of medication adherence postdischarge: the impact of patient age, insurance status, and prior adherence. *J Hosp Med*. 2012;7:470–5.
66. Carpenter DM, Hogan SL, Devellis RF. Predictors of medication non-adherence for vasculitis patients. *Clin Rheumatol*. 2013;32:649–57.
67. Wolf MS, Gazmararian JA, Baker DW. Health literacy and health risk behaviors among older adults. *Am J Prev Med*. 2007;32:19–24.
68. Geboers B, de Winter AF, Luten KA, Jansen CJM, Reijneveld SA. The association of health literacy with physical activity and nutritional behavior in older adults, and its social cognitive mediators. *J Health Commun*. 2014;19 Suppl 2:61–76.

Submit your next manuscript to BioMed Central and take full advantage of:

- Convenient online submission
- Thorough peer review
- No space constraints or color figure charges
- Immediate publication on acceptance
- Inclusion in PubMed, CAS, Scopus and Google Scholar
- Research which is freely available for redistribution

Submit your manuscript at
www.biomedcentral.com/submit

