Health literacy and health outcomes in hypertension: An integrative review

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ABSTRACT

Objective: The aim of this study was to summarize the evidence of health literacy and health outcomes in hypertensive patients.

Methods: Articles published in English were searched from six databases: MEDLINE, CINAHL, Embase, ERIC, psycINFO, and SCOPUS. The articles published up to September 2017 were included.

Results: Nineteen publications were included in the review. There was quality and consistent evidence that hypertensive patients with lower literacy had poorer knowledge. There was inconsistent evidence to show the relationship between health literacy and clinical outcomes, of systolic and diastolic blood pressure, and blood pressure control; behavioral outcomes, of self-care, self-efficacy, adherence; patient-physician interactions outcomes, of patient-physician communication, patient trust, involvement in decision making and other outcomes.

Conclusion: The person with low health literacy is likely to have poor knowledge of hypertension. However, there is insufficient evidence to suggest that health literacy is associated with outcomes of hypertension independently.

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1. Introduction

Health literacy (HL) is the degree to which individuals have the ability to obtain, process, and understand basic health information and services needed to make appropriate health care decisions [1]. People with adequate HL have the ability to read and understand educational written materials (functional skills); to communicate with health care professionals (interactive skills); to make appropriate health decisions (critical skills); and to measure medication dosages (numeracy skills) [2,3]. Low HL is recognized as a major risk factor in blood pressure control and has adverse effect on health outcomes [4–6]. Low HL rate is much higher in minority groups, among people who are poor or with less education or whose native language is not English in immigrant countries [7–9]. It is predicted that about 1.5 billion people worldwide will live with hypertension by 2025 [10]. Hypertension may cause stroke, heart disease [11], and renal dysfunction as a major risk predictor [12]. The global disease burden study showed that hypertension was the leading risk factor for disability-adjusted life-years among diseases [13]. Elevated blood pressure is a major public health problem worldwide [14]. Although extensive knowledge about ways to prevent and treat hypertension, its global incidence, and cardiovascular complications are not reduced, partly due to inadequacies in prevention of the disorder [15].

Hypertension can be controlled by changing lifestyles, such as increasing physical activity, keeping healthy weight, and having healthy diet [16]. So that it needs good self-management. In fact, the hypertensive patients will need to have higher HL in order to better understand the printed health educational materials. Although hypertensive patients with low HL could follow instructions with pictures, they can't communicate with health care professionals well [17]. In recent years, there have been increasing studies that focus on HL and health outcomes. However, research provides different and even conflicting results on hypertensive patients' blood pressure control, medication adherence and others.

2. Aims

To better understand the relationship between HL and health outcomes on hypertension, we conducted the integrative review.
3. Methods

3.1. Literature search methods

We conducted a search through MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Education Resources Information Center (ERIC), Embase, psycoINFO, and SCOPUS databases. The searching time was from data base to September 2017. The searches were not limited to any type of published paper. Numeracy is a component of HL. But previously, numeracy and HL were used separately. If we excluded, it would have eliminated research studies worthy of examination. Adequate numeracy skills are very important for proper dosing, weight monitoring, management of sodium intake, and higher-level self-management skills such as titrating diuretics. The search strategy included Mesh and keywords that broadly represented the patient population under study ("hypertension" OR "high blood pressure" OR "elevate or raise blood pressure"), the terms that would capture the patients' abilities ("health literacy" OR "literacy" OR "numeration") and the names of HL instruments, such as the Rapid Estimate of Adult Literacy in Medicine ("REALM"), the original form of the "TOFHLA", the Short Version of the Test of Functional HL in Adults ("S-TOFHLA"), the Newest Vital Sign ("NVS"), the Medical Achievement Reading Test ("MAR") and the Short Assessment of HL for Spanish-speaking Adults ("SAHLSA"). Combined using the Boolean operator AND. Electronic searches were supplemented by manual searches.

Articles were included if (1) the sample included hypertensive patients with adult (aged 18 and over), (2) they focused on the relationship between HL or numeracy and health outcomes, (3) they were published in English language, and (4) they were full-text articles. As low HL is very common in minority groups in immigrant countries, whose official language is English, so only English language studies were selected. The studies were excluded as follows: (1) the sample didn't just involve individuals with hypertension, (2) the studies didn't use any health literacy instrument, (3) the studies didn't report any of the outcomes of interest.

3.2. Search outcomes

Totally 1,297 citations were yielded across all databases (see details in Fig. 1). Additional one study was included through the reference list screen. After removal of duplicates, 860 remained. Titles and abstracts were screened for relevance, and the main reason for the exclusion was that the article did not address HL or numeracy in people with hypertension. Based on that, 132 publications were included for full-text review. Of these, 19 publications met our criteria and were included.

3.3. Data abstraction and quality assessment

Two reviewers screened the identified articles, read the full text of included papers, and performed data abstraction and quality assessment separately. A third author served as an adjudicator to help resolve discrepancies between the first two reviewers.

The general characteristics of the articles included design, HL measurement, quality rating, study sample, outcomes, analysis, and variables used in multivariate analysis (Table 1). We summarized evidence on the outcomes, including: clinical, behavioral, patient-provider relationship, and other outcomes. When data from the same study was presented in more than one manuscript, the recent publication would be chosen. Since all the identified studies were observational, each article was rated based on the criteria in the quality rating for observational studies by the Agency for Healthcare Research and Quality (AHRQ) [18] (Appendix A). The quality of studies was rated by 2 reviewers separately. The inter-rater agreement for including or excluding articles was 92.67% and Cohen's kappa was 0.84 (95%CI: 0.61–0.97).

4. Results

4.1. Characteristics of included studies

All of them addressed the relationship between HL and health outcomes, and only one article addressed numeracy. All of the studies were cross-sectional and there were no intervention studies. Participants in all included articles were diagnosed with primary hypertension. However, whether the patients were in different grades of hypertension was not reflected. Fourteen studies were conducted in the United States, 2 were in China, 1 was in Singapore, 1 was in Thailand and 1 was in Korea. The mean age of patients was from 47yr to 72yr, and the sample sizes were from 45 to 23,483. The majority of studies focused on ethnic minority (African-American, Hispanic-American), low income or vulnerable populations.

4.2. HL and numeracy measures

The investigators used a different measurement to assess patients' HL status, and classified HL according to different levels or thresholds - either as a continuous measure or categories. HL was usually classified into inadequate, marginal, adequate or low versus adequate. Some studies combined inadequate and marginal HL into one category. In most of the studies, the analysis paid attention to the differences between the lowest and highest HL. The use of different research instruments (research questionnaires) in different included studies may be an important reason for contributing to different research findings across studies. The commonly used research instruments for HL assessments in the included studies were REALM, TOFHLA, S-TOFHLA, TOFHLA Singapore and SAHLSA, which were just used to assess the patients' functional HL (reading and numeracy ability). Research instruments such as NVS and BHLS were also used in four of the included studies, which could assess the patients' interactive and critical HL. The three-item numeracy scale was used in one study to assess patients' numeracy.

4.3. HL and health outcomes

Twenty two health outcomes were divided into four aspects: Clinical, behaviors, patient-physician communication, and other outcomes (see details in Table 2).

4.3.1. HL and clinical outcomes

4.3.1.1. Systolic and diastolic blood pressure. Four studies examined the relationships between HL and systolic and diastolic blood pressure. Persell et al. used multivariable logistic regression to examine the relationship between HL and blood pressure. The model showed that HL was not associated with systolic and diastolic blood pressure after adjusting for age and household income [19]. For systolic and diastolic blood pressure, in a multivariable logistic regression model, HL was not significantly associated with systolic and diastolic blood pressure [20]. However, Wannasitikul et al. used structural equation modeling to identify the relationship between functional HL and systolic blood pressure, and found that functional HL had the significantly largest negative direct effect on systolic and diastolic blood pressure level (β = −0.14, P < 0.05) [21].
multivariable linear regression model, the BHLS sum scores is significantly associated with systolic and diastolic blood pressure [22].

4.3.1.2. Blood pressure control. Eight studies examined the relationship between HL and blood pressure control. Panit et al. used multivariable analyses to examine the relationship between HL and blood pressure control, and found that low HL was significantly associated with uncontrolled blood pressure [4]. Aboumatar et al. found that a lower percentage of patients with low versus adequate HL had controlled blood pressure [23]. In both unadjusted and adjusted logistic regression, HL was found to be an independent predictor of uncontrolled blood pressure [24]. In adjusted multivariable analyses, Willens et al. found that patients with higher HL had slightly lower odds of controlling blood pressure [22]. Hall et al. used Hierarchal and logistic regression to identify the relationship between HL and blood pressure control, and found that higher HL was associated with better blood pressure control [25]. In both unadjusted and adjusted logistic regression, Bosworth et al. found that low HL was significantly associated with poor blood pressure control [26]. In a multivariable logistic regression model, Shi et al. found that higher HL was associated with the higher rate of hypertension control [27]. Ko et al. used Chi-squared test to examine the association between HL and blood pressure control, and found that the achievement of target blood pressure was not associated with HL level [28].

4.3.2. HL and behavioral indicators and patient-reported outcomes

4.3.2.1. Hypertension knowledge. Five studies elucidated that lower HL was associated with less hypertension knowledge; three of which controlled for confounders [4,20,29] and two of which did not [28,30]. Panit et al. used multivariable analyses to examine the relationship between HL and hypertension knowledge, and low HL was found to be a significant independent predictor of poorer hypertension knowledge [4]. Ko et al. used Independent t-test to examine the association between HL and hypertension knowledge, and found that the hypertension knowledge scores were significantly associated with HL level (P < 0.001) [28]. In a multivariable linear regression model, Williams et al. found that hypertension knowledge was strongly related to HL [20]. In multivariable analysis, Gazmararian et al. found that patients with inadequate HL knew significantly less about their disease than those with adequate HL [29]. Osborn et al. performed path analyses to identify the relationship between HL and hypertension knowledge, and found that higher HL scores were associated with more hypertension knowledge [30].
Table 1
The general characteristics of the articles.

| Study, Year (Reference) | Design | Instrument | Quality score | Study sample | Outcomes | Analysis | Variables Used in Multivariate Analysis |
|-------------------------|--------|------------|---------------|--------------|----------|----------|----------------------------------------|
| Aboumatar et al., 2013 [23] | Cross-sectional | REALM | Fair | 275 patients from 14 USA primary care sites | BP control | Medical decision making | Age, gender, race, education, annual income; blood pressure controlled; insurance pays prescriptions; age of physician seen, seen by female physician |
| | | | | Mean age, 61 yr | Fisher's exact tests | Jonckheere-Terpstra tests | |
| | | | | Female, 65.8% | Two sample r-tests | Generalized linear models regression analysis |
| | | | | White, 36.7% | | |
| Ahn et al., 2016 [33] | Cross-sectional | REALM | Fair | 289 hypertensive patients from south Korea | Medication adherence | | Age, gender, marital status, place of residence; self-efficacy, comorbidities |
| | | | | Mean age, 68.92 yr | | |
| | | | | Female, 77.2% | | |
| | | | | Inadequate income, 18% | | |
| | | | | Less than 12th grade, 36% | | |
| Bosworth et al., 2008 [26] | Cross-sectional | REALM | Fair | 608 patients from 2 Duke University Health System Primary care clinics | BP control | | Age, gender, recall; medication barriers score, medication non-adherent, low hypertension knowledge, often feel stressed, participatory decision-making, hypertension worry score, lack personal control of health, have emotion support, have home BP monitor, >5yr since high BP diagnosis, number of medication side effects, no weekly exercise, diabetes, current smoker, family history of hypertension |
| | | | | Mean age, 61yr | Logistic regression Multivariable model |
| | | | | Female, 36.7% | | |
| | | | | Inadequate literacy, 24% | | |
| | | | | 45 Latino Migrant Seasonal Farm workers at Georgia and Ellenton Clinic, USA | | |
| Gazmararian et al., 2003 [29] | Cross-sectional | S-TOFHLA | Fair | 653 patients from Cleveland; Houston; South Florida, including Ft. Lauderdale and Miami; and Tampa, USA | Chronic disease knowledge | Description statisticHierarchical regression Mann-Whitney U test | Age, disease duration, attended a class |
| | | | | Mean age, 72 yr | | |
| | | | | Female, 61.7% | | |
| | | | | Black, 16.1% | | |
| | | | | Less than 12th grade, 67.1% | | |
| | | | | Inadequate literacy, 24% | | |
| Hall et al., 2016 [25] | Cross-sectional | SAHLSA | Good | 306 patients at the Singapore Government-funded primary care clinic | BP control | Medication adherence BP knowledge BP self-care | Education, blood pressure knowledge, perceived stress, acculturation level |
| | | | | Mean age, 58 yr | Descriptive statistic Hierarchical regression | |
| | | | | Female, 36.3% | Mann-Whitney U test Logistic regression | |
| | | | | Chinese, 69.0% | Spearman Rho correlations Multiple regression analysis | |
| | | | | Duration of hypertension, 8yr | Independent t-test Chi-squared test Multiple linear regression analysis | |
| | | | | 121 African American participants at USA Forsyth county | One-way analysis of variance Chi-square analyses Generalized linear models Robust error estimation | |
| | | | | Mean age, 59yr | Logistic regression One-way linear regression analysis | |
| | | | | Female, 50% | Generalized linear models | |
| | | | | Less than 12th grade, 70% | | |
| Lenahan et al., 2013 [34] | Cross-sectional | S-TOFHLA | Fair | 215 participants from six USA primary care safety net clinics | Medication non-adherence BP control Emergency department and Hospitalization visits | | Age, gender, race; number of antihypertensive medications taken, number of chronic conditions, medication identification |
| | | | | Mean age, 60 yr | Independent t-test Chi-squared test Logistic regression | |
| | | | | Female, 68.2% | One-way analysis of variance Chi-square analyses | |
| | | | | African American, 80.4% | Generalized linear models | |
| | | | | Limited literacy, 47.0% | Robust error estimation | |
| McNaughton et al., 2014 [24] | Cross-sectional | REALM | Fair | 423 participants an inner city primary care clinic in Atlanta, Georgia, USA | BP control | Medication adherence | Age, gender, race, education, employment status |
| | | | | Mean age, 64 yr | Descriptive statistic Logistic regression Planned exploratory linear regression | |
| | | | | Female, 56% | | |
| | | | | African American, 91% | | |
| | | | | Mean education, 12 yr | | |
| Study, Year (Reference) | Design | Instrument | Quality Score | Study sample | Outcomes | Analysis | Variables Used in Multivariate Analysis |
|-------------------------|--------|------------|---------------|-------------|----------|----------|-----------------------------------------|
| Osborn et al., 2011 [30] | Cross-sectional | S-TOFHLA | Fair | 330 patients from 6 primary USA care safety net clinics in Grand Rapids, Michigan; Chicago, Illinois; and Shreveport, Louisiana. Mean age, 53 yr Female, 67.9% African American, 78.5% Less than 12th grade, 39.3% Married, 30.6% | Hypertension knowledge Self-efficacy Self-care behaviors Health status | Independent samples t-test | Age, race, education; knowledge, self-efficacy, self-care |
| Pandit et al., 2009 [4] | Cross-sectional | S-TOFHLA | Fair | 330 patients from 6 primary USA care safety net clinics in Grand Rapids, Michigan; Chicago, Illinois; and Shreveport, Louisiana. Mean age, 53 yr Female, 67.9% African American, 78.5% Less than 12th grade, 39.3% Married, 30.6% | Hypertension knowledge BP control | Chi-square Student’s t-tests Multivariate logistic regression Mediation analysis | Age, gender, race, marital status, employment status, insurance coverage; number of comorbid conditions, years treated for hypertension, clinic site, education level |
| Perez, 2015 [36] | Cross-sectional | NVS | Good | 144 patients from various USA churches in the St. Louis, Missouri, and metro east Illinois area and Hispanic Community Mean age, 47 yr Female, 32.1% Less than 8 yr education, 30% Foreign-born Hispanics, 92.4% | Illness perception | Hierarchical multiple regression Analysis of variance t-tests | Age, gender, years of education, acculturation |
| Persell et al., 2007 [19] | Cross-sectional | S-TOFHLA | Fair | 119 patients from three USA primary care clinics in Grand Rapids, Michigan affiliated with a federally qualified health center Mean age, 55 yr Female, 69.5% Black, 60.5% Less than 12th grade, 32.77% | Blood pressure The number of medications for high blood pressure The number of medications patients can name therm | Chi-square Fisher’s exact test Student’s t-test Multivariable logistic regression | Age, household income |
| Shi et al., 2017 [27] | Cross-sectional | Chinese health literacy scale for hypertension | Fair | 360 patients from Jinyang community health center in Chengdu, China. Mean age, 66.6 yr Female, 55.8% | Blood pressure control Health quality Risk for ischemic cerebral vascular disease Brachial-ankle artery pulse wave velocity | Independent t Mann–Whitney U test Wilcoxon test Chi-square test Multiple logistic regression analysis | Age, gender, education level, work status, monthly income; course of hypertension |
| Rao et al., 2015 [31] | Cross-sectional | REALM | Fair | 409 participants from 12 primary care clinics in central North Carolina, USA Mean age, 47.9 yr Female, 56% | The completeness of home blood pressure monitoring Health quality | Student’s t-test Logistic regression | None |
| Wang et al., 2017 [35] | Cross-sectional | BHLS | Fair | 882 patients from six China towns Mean age, 65.6 yr Female, 56.1% | Frequencies, percentages Mann–Whitney U test Kruskal–Wallis test Structural equation modeling | Age, gender, education, family yearly income, family yearly medical costs, |
| Wannasirikul et al., 2016 [21] | Cross-sectional | Functional, communicative, critical health literacy scale | | 600 patients from a Primary Health Care Center in Sa Kaeo Province, Thailand Mean age, 65.3 yr Female, 75.8% | Blood pressure Medication adherence | Descriptive statistics Path analysis | Age, gender, marital status, income per month, education level, occupation; perception on vision, perception on hearing, perception on mental health, duration of diagnosed HT, social support |
| Willens et al., 2013 [22] | Cross-sectional | BHLS | Good | 23483 patients from three USA primary care clinics Mean age, 65 yr Female, 58.3% Black, 23.1% Less than high school, 15.2% | Blood pressure BP control | Bivariate analysis Wilcoxon rank-sum test Pearson’s chi-square | Age, gender, race, education years, location |

(continued on next page)
4.3.2.2. Self-efficacy. Osborn et al. performed path analyses to identify the relationship between HL and self-efficacy, and found that HL scores were not directly associated with self-efficacy [30].

4.3.2.3. Self-care. In a Hierarchal and logistic regression model, Hall et al. found that HL was not significantly associated with self-care [25]. Osborn et al. performed path analyses to identify the relationship between HL and self-care, and found that HL scores were not directly associated with self-care [30].

4.3.2.4. Self-reported completeness of home blood pressure monitoring. An adjusted study [31] found that the completeness of home blood pressure monitoring was not associated with HL level. In an adjusted logistic regression model, Rao et al. found that HL...
was not associated with completeness of home blood pressure monitoring, which was calculated as the percentage of total number of recorded measurements that were supposed to be taken by the patients during the 2 week period that patients performed home blood pressure monitoring [31].

4.3.5.1. Health quality. Wang et al. performed structural equation model analysis to examine the relationship between HL and health quality, and found HL have a significant impact on health quality [35]. Shi et al. found that patients with high HL had better health quality than those with low HL [27].

4.3.5.2. The risk for ischemic cerebral vascular disease (ICVD). Shi et al. found that compared with high HL patients, patients with low HL had a much higher risk for ICVD [27].

4.3.5.3. The brachial-ankle artery pulse wave velocity (baPWV). Shi et al. found that the average baPWV values of the high HL group were lower than the low HL group [27].

4.3.5.4. Illness perceptions. Perez et al. performed hierarchical multiple regression to identify the relationship between HL and illness perceptions, and found that higher HL was associated with perceived better in personal control of hypertension and misconception that hypertension was a life threatening illness [36].

4.4. Numeracy and health outcomes

Only one research examined the relationship between numeracy and health outcomes (see details in Table 3).

In an adjusted logistic regression model, Rao et al. found that higher numeracy was associated with more completeness of home blood pressure monitoring [31].

4.5. Limitation of included studies

Several discrepancies were found in our research. First, the measuring tool [37] and the marginal values between different HL levels were different [38]. The psychometric properties of the instruments in the included studies were different. Most of them focused on functional skills, and only two instruments assessed the patients’ interactive and critical HL. Second, only several articles in the review were solely focused on hypertensive patients, while others included patients with other disease, such as diabetes. The target for systolic blood-pressure is different between patients with hypertension and diabetes. Third, there were limited articles addressed the relationship between HL and self-efficacy, patient trust and decision making.

Furthermore, there was another underlying factor for the discrepancy. It was adjusting for confounding factors which can help analyze the cause of poor health outcomes [39]. Most of the articles adjusted for age, sex, nation, income, and educational level. However, a few articles also adjusted for hypertension duration, attending classes about the disease condition and many others. There were likely to be over adjustment, if the factors were the intermediate variable between HL and outcomes [40,41].

5. Discussion

The purpose of our study was to summarize the evidence of HL and health outcomes in hypertensive patients. We identified several outcomes associated with HL in hypertensive patients. The relationship between HL and hypertension knowledge was evident. This could help improve knowledge of hypertensive patients.

All the included studies were cross-sectional and there were no intervention studies. A potential cause for investigators’ preference for conducting non-experimental studies rather than experimental
6. Conclusion

Our review indicates that the current understanding of the relationship between HL and health outcomes on hypertensive patients is limited. We found that the person with low HL is likely to have poor knowledge of hypertension. However, it is insufficient to say that HL is associated with hypertension-related care outcomes independently.

Further studies can build on previous work to further clarify the relationship between HL and health outcomes not only in developed countries, but also in developing countries. More HL instruments (research questionnaires) should be used to measure the patients’ functional, interactive, numeracy and critical skills to rich the results. Future work should also examine more closely whether poor HL is the cause of adverse outcomes in hypertensive patients or it is just a marker for other problems which are the actual causes of poor health.

Author contributions

Yan Wang and Shaoying Du conceptualized the idea for this review and obtained research funding. Yan Wang, Shaoying Du, Xiaojing Du and Ran Xie contributed to the development of the search strategy and the study selection. Yi Zhou and Cong Fu contributed to the data extraction, quality assessment and the data synthesis. Yan Wang is the guarantor and Shaoying Du drafted the manuscript. Yi Zhou, Cong Fu, Xiaojing Du and Ran Xie revised the manuscript. All authors read and approved the final manuscript.

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Conflicts of interest

None.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ijnss.2018.06.001.

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| Category | Outcome | Total# of studies by study design – N ( # of studies controlling for confounding – n1; # of studies NOT controlling for confounding – n2) | Summary of results |
|----------|---------|------------------------------------------------------------------------------------------------------------------|-------------------|
| Behavioral | Self-reported completeness of home blood pressure outcomes monitoring | Cross-sectional | Studies controlling for confounding (n1) | Studies not controlling for confounding (n2) |
|          | | | Positive results* | Negative results* | Positive results* | Negative results* |
|          | | | 1 (1; 0) | – | 1 | – |
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