cogent
medicine

ENDOCRINOLOGY, NUTRITION & METABOLISM | RESEARCH ARTICLE

Association between health literacy and diabetes control in a pharmacist-run disease state management clinic

Cheyenne Newsome[1]*, Indika Mallawaarachchi[2], Jessica Garcia[3] and Gretchen Ray[4]

*Corresponding author: Cheyenne Newsome, Washington State University College of Pharmacy, P.O. Box 1495, Spokane, WA 99210-1495, USA
E-mail: cheyenne.newsome@wsu.edu

Reviewing editor:
Varun Khurana, Insys Therapeutics, Inc., USA

Additional information is available at the end of the article

Abstract: To date, studies have shown mixed results regarding the relationship between health literacy and diabetic control. This study examined diabetes control in a clinic run by an advanced practice pharmacist with prescriptive authority who was aware of patients' health literacy level. The primary objective of this study was to determine if patients with diabetes who have adequate health literacy achieve better A1C control than patients with inadequate health literacy when managed by a pharmacist clinician (PhC) aware of patients' health literacy status. Of the ninety-six patients included in the study, sixty-three percent had inadequate health literacy. White patients had numerically greater percentage of adequate health literacy than other ethnicities ($p = 0.082$). The change in A1C was similar between groups [median −0.5% for inadequate health literacy; −1% for adequate health literacy ($p = 0.273$)]. The no-show rate was also similar between the two groups ($p = 0.919$). In the multiple linear regression, no factors significantly impacted baseline or follow-up A1C. Patients receiving diabetes care from a PhC aware of the patients' health literacy status did not achieve different A1C outcomes based on level of health literacy.

ABOUT THE AUTHORS

Dr Gretchen Ray and Dr Cheyenne Newsome work in pharmacist-run clinics where they manage patients with chronic disease states.

PUBLIC INTEREST STATEMENT

Diabetes and other chronic disease states are common among patients in the United States and managing these conditions can be complicated for patients. Navigating the healthcare system to understand and achieve good control of these disease states can be challenging. This study looked at the association between patient ability to understand health related information and diabetes control. The study was set in a pharmacist-run clinic. The pharmacist performed a test to learn the patients level of healthcare system understanding early in the treatment process. Because the pharmacist had this insight, she was able to tailor treatment and education to a level each patient could understand. The study found no difference in diabetes control between patients with skill in navigating healthcare and those lacking abilities. The level of health information complexity patients are able to understand should be a consideration in treatment decisions. This requires providers to proactively assess patients and use this information to develop care plans.

cogent·oa

1. Introduction

The Institute of Medicine defines health literacy as "the degree to which individuals can obtain, process, understand, and communicate about health-related information needed to make informed health decisions" (Berkman, Davis, & McCormack, 2010). As this definition suggests, health literacy is more than one's ability to read, write, and process information, but instead reflects one's ability to navigate the healthcare system to achieve optimal results. There is a collection of literature showing inadequate health literacy is prevalent among patients with diabetes (Cavanaugh et al., 2008; Williams, Baker, Parker, & Nurss, 1998).

There are several pathways via which health literacy influences important health outcomes, including the acquisition of new disease-specific knowledge, improving self-efficacy and adherence with self-care behaviors (Cavanaugh, 2011). It is estimated that low health literacy increases health care costs by \$106–238 billion per year (Bailey et al., 2014). Evidence examining the link between low health literacy and glycemic outcomes are mixed. Some studies have demonstrated links between higher levels of health literacy and better glycemic control, while others have failed to demonstrate an association (Ishikawa & Yano, 2011; Morris, MacLean, & Littenberg, 2006; Powell, Hill, & Clancy, 2007; Schillinger et al., 2002; Tang, Pang, Chan, Yeung, & Yeung, 2008).

The newest vital sign (NVS) is a validated tool to assess an individual's level of health literacy (Weiss et al., 2005). The NVS assesses patients understanding and application of words (prose), numbers, and documents to give a clear picture of health literacy. The NVS requires a patient to examine a standard nutrition label and answer six questions about the label. For each correct response, one point is awarded for a possible total of 6 points. Performing the NVS takes approximately three minutes (Pfizer, 2011). This study examines the impact of patients' health literacy and diabetic control in a population of patients with diabetes managed by a pharmacist clinician (PhC), an advanced practice pharmacist in the state of New Mexico with prescriptive authority. The PhC routinely administers the NVS to her patients as standard of care in the clinic analyzed in this study. She then uses the patient's health literacy level to tailor therapy and education to a level the patient will understand.

A common laboratory analysis to assess diabetes control is the Hemoglobin A1C. Hemoglobin A1C measures the percentage of hemoglobin with glucose attached to it. Since the lifespan of hemoglobin is around 90 days, an A1C gives a 3-month description of blood glucose control. For many patients, a goal A1C is around 7%.

2. Objectives

The primary objective of this study was to determine if patients with adequate health literacy achieve better A1C control than patients with inadequate health literacy when managed by a PhC aware of patients' health literacy status.

3. Methods

The University of New Mexico Health Sciences Center, Human Research Review Committee approved this study. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. This was a retrospective longitudinal chart review of the electronic medical record (EMR). Any patient who had an appointment with the PhC recorded in the EMR was eligible for inclusion. The NVS score was retrieved from the EMR as well as hemoglobin A1C to assess diabetes control. The baseline A1C occurred within 3 months before or 1 month after the patient's initial visit with the PhC for diabetes management. The follow up A1C was 6–12 months after the initial visit with the PhC. Additional demographic information collected included ethnicity, age, gender, body

mass index (BMI), language, medications, insurance coverage, and number of missed appointment. Patients were excluded from the study if they did not speak English, did not receive the NVS screening, were seen by the PhC to manage a condition other than diabetes, or had missing A1C data.

As stated above, the PhC tailors her counseling to the health literacy level of the patient. For example, if a patient is found to have low health literacy, the PhC will not attempt to have the patient perform advanced carbohydrate counting utilizing food labels but rather, use visual or picture representation of carbohydrate foods.

A sample of convenience was utilized. A statistician not involved in data collection conducted data analysis. Health literacy scores were divided into two groups as determined by the developer of the NVS: Limited or possibly limited health literacy (NVS 0–3) and adequate health literacy (NVS 4–6). Independent sample t-test was conducted for normally distributed continuous variables and Mann-Whitney for continuous variables not normally distributed. Chi-square analysis was used for categorical variables, and a Fisher's exact test for variables with smaller cell frequencies. A regression analysis was performed to examine factors that contribute to low health literacy or elevated A1C.

4. Results

The number of patients screened for inclusion was 264, and 96 were included in the study. The reasons for exclusion were NVS not recorded ($n = 147$), missing A1C data (12), not referred for diabetes management (8), and non-English speaking (1). The patient characteristics for those with adequate and inadequate health literacy are shown in Table 1. None of the characteristics were statistically different between the health literacy groups. There was a numerically greater percentage of White patients with adequate health literacy than other ethnicities. Half of White patients had adequate health literacy, while only 31% of Hispanics and 20% of other races had adequate health literacy. Both groups had clinically significant improvement in their A1C. The median change in A1C from baseline for the two groups were very similar with a median of –0.5% for the inadequate health literacy and −1% for the adequate health literacy group ($p = 0.273$). Health literacy category was not found to have a significant impact on baseline A1C or change in A1C after factoring in other variables.

Table 1. Patient characteristics categorized by health literacy group			
Characteristic	**Inadequate health literacy ($n = 61$)**	**Adequate health literacy ($n = 35$)**	**p-value**
Age, mean ± SD	56.8 ± 10.9	55.8 ± 9.8	0.684
Gender, no. (%)			
Male	25 (41)	11 (31.4)	0.388
Female	36 (59)	24 (68.6)	
Body mass index, mean ± SD	34.4 ± 8.1	34.5 ± 7.0	0.764
Anti-diabetic medications, no. (%)			
<3 medications	35 (41)	24 (68.6)	0.384
≥ 3 medications	26 (59)	11 (31.4)	
Prescribed insulin, no. (%)	40 (65.6)	20 (57.1)	0.512
Ethnicity, no. (%)			
White, non-hispanic	18 (29.5)	18 (51.4)	0.082
Hispanic	31 (50.8)	14 (40)	
Other	12 (19.7)	3 (8.6)	
A1C baseline, mean ± SD	9.2 ± 1.8	9.6 ± 2.2	0.280
A1C final value, mean ± SD	8.3 ± 1.7	8.4 ± 2.2	0.936

5. Discussion

This was the first study to evaluate the effects of health literacy on diabetes control in patients managed by a pharmacist. The literature to date evaluating the impact of health literacy on diabetes outcomes has been inconclusive with some studies showing patients with high health literacy have better outcomes and others showing health literacy is not a significant factor in diabetes outcomes (Ishikawa & Yano, 2011; Morris et al., 2006; Powell et al., 2007; Schillinger et al., 2002; Tang et al., 2008). Specifically, Schillinger et al. assessed health literacy and diabetes in 408 ambulatory patients to determine if an association existed. They found patients with inadequate health literacy were more likely to have poor glycemic control (A1C > 9.5%). An important difference between Schillinger's study and the study presented in this paper is the provider's awareness of patients' health literacy status (Schillinger). The study presented in this paper found no significant difference in diabetes control (as determined by baseline and 6–12 month follow-up A1C) in patients with inadequate or adequate health literacy when managed by a provider who is aware of their health literacy level. This is not unexpected as the PhC altered management based on the patients' health literacy and studies have shown that tailoring treatment to patients' health literacy can help improve outcomes for low health literacy patients with diabetes (Rothman et al., 2004).

The number of PhC visits was numerically, but not statistically significantly higher for patients with adequate health literacy than patients with inadequate health literacy. This is an example of limited prose literacy, a component of health literacy.

The population in this study found a higher rate of adequate health literacy in White patients than non-White patients, which is consistent with current literature. The 2003 National Assessment of the Health Literacy of America's Adults found 91% of White and 59% of Hispanic people had adequate health literacy (National Center for Education Statistics, 2006). A previous study in patients with diabetes found the rate of adequate health literacy around forty percent (Williams et al., 1998). We found similar results in our study; only 37% of patients had adequate health literacy. Different methodologies were used for all three reported health literacy levels, which may account for the discrepancy between the general assessment of the US population study and the studies of patients with diabetes.

6. Limitations

There are several limitations to consider when interpreting these results. First, there are many factors that affect A1C including motivation, diet, and socioeconomic factors that could not be controlled for in this study. Also, this was a retrospective study design and complete information about no-show appointments or PhC visits were not able to be collected due to changes in the EMR. The study population was also relatively small and it is possible that the study was underpowered to detect a difference. All patients included in this study were referred to the PhC by their primary care provider because they required additional advanced diabetes medication management. Therefore this represents a more complex and uncontrolled cohort of patients often with long-standing disease. This could explain why both groups had similar A1C values at baseline and neither achieved goal A1C. Also, in this sample, the PhC was aware of the patient's health literacy level and was able to provide education and select tailored treatment regimens taking into consideration a patient's health literacy. If the PhC was unaware of a patient's health literacy they may have prescribed more complex regimens leading to reduced medication adherence or utilized teaching methods too complex for the individual patient. This raises another question not addressed in the present study. Would outcomes have been different had the PhC been unaware of the patients' health literacy scores? In most instances, providers are unaware of the health literacy status of their patients which in these cases reinforces the importance of universal precautions when providing healthcare information.

7. Conclusion

Patients receiving diabetes care from a PhC who was aware of patients' health literacy status did not achieve different A1C outcomes based on level of health literacy.

Author details
Cheyenne Newsome[1]
E-mail: cheyenne.newsome@wsu.edu
Indika Mallawaarachchi[2]
E-mail: IMallawaarachchi@salud.unm.edu
Jessica Garcia[3]
E-mail: jgarci02@salud.unm.edu
Gretchen Ray[4]
E-mail: gray@salud.unm.edu
ORCID ID: http://orcid.org/0000-0002-4236-1539
[1] Washington State University College of Pharmacy, P.O. Box 1495, Spokane, WA 99210-1495, USA.
[2] University of New Mexico Health Sciences Center, Albuquerque, USA.
[3] University of New Mexico Hospitals, Albuquerque, USA.
[4] University of New Mexico College of Pharmacy, Albuquerque, USA.

Citation information
Cite this article as: Association between health literacy and diabetes control in a pharmacist-run disease state management clinic, Cheyenne Newsome, Indika Mallawaarachchi, Jessica Garcia & Gretchen Ray, *Cogent Medicine* (2016), 3: 1269628.

References
Bailey, S. C., Brega, A. G., Crutchfield, T. M., Elasy, T., Herr, H., Kaphingst, K., ... Schillinger, D. (2014). Update on health literacy and diabetes. *The Diabetes Educator, 40*, 581–604.
http://dx.doi.org/10.1177/0145721714540220
Berkman, N. D., Davis, T. C., & McCormack, L. (2010). Health literacy: What is it? *Journal of Health Communication, 15*(Suppl. 2), 9–19.
http://dx.doi.org/10.1080/10810730.2010.499985
Cavanaugh, K. L. (2011). Health literacy in diabetes care: Explanation, evidence and equipment. *Diabetes Management, 1*, 191–199.
http://dx.doi.org/10.2217/dmt.11.5
Cavanaugh, K. L., Huizinga, M. M., Wallston, K. A., Gebretsadik, T., Shintani, A., Davis, D., ... Rothman, R. L. (2008). Association of numeracy and diabetes control. *Annals of Internal Medicine, 148*, 737–746.

http://dx.doi.org/10.7326/0003-4819-148-10-200805200-00006
Ishikawa, H., & Yano, E. (2011). The relationship of patient participation and diabetes outcomes for patients with high vs. low health literacy. *Patient Education and Counseling, 84*, 393–397.
http://dx.doi.org/10.1016/j.pec.2011.01.029
Morris, N. S., MacLean, C. D., & Littenberg, B. (2006). Literacy and health outcomes: A cross-sectional study in 1002 adults with diabetes. *BMC Family Practice, 7*, 313.
http://dx.doi.org/10.1186/1471-2296-7-49
National Center for Education Statistics. (2006). *The health literacy of America's adults: Results from the 2003 national assessment of adult literacy*. Washington, DC: U.S. Department of Education.
Pfizer. (2011). *Newest vital sign toolkit*. Retrieved from http://www.pfizer.com/files/health/nvs_flipbook_english_final.pdf
Powell, C. K., Hill, E. G., & Clancy, D. E. (2007). The relationship between health literacy and diabetes knowledge and readiness to take health actions. *The Diabetes Educator, 33*, 144–151.
http://dx.doi.org/10.1177/0145721706297452
Rothman, R. L., DeWalt, D. A., Malone, R., Bryant, B., Shintani, A., Crigler, B., ... Pignone, M. (2004). Influence of patient literacy on the effectiveness of a primary care–based diabetes disease management program. *JAMA, 292*, 1711–1716.
http://dx.doi.org/10.1001/jama.292.14.1711
Schillinger, D., Grumbach, K., Piette, J., Wang, F., Osmond, D., Daher, C., ... Bindman, A. B. (2002). Association of health literacy with diabetes outcomes. *JAMA, 288*, 475–82.
http://dx.doi.org/10.1001/jama.288.4.475
Tang, Y. H., Pang, S. M., Chan, M. F., Yeung, G. S., & Yeung, V. T. (2008). Health literacy, complication awareness, and diabetic control in patients with type 2 diabetes mellitus. *Journal of Advanced Nursing, 62*, 74–83.
http://dx.doi.org/10.1111/j.1365-2648.2007.04526.x
Weiss, B. D., Mays, M. Z., Martz, W., Castro, K. M., DeWalt, D. A., Pignone, M. P., ... Hale, F. A. (2005). Quick assessment of literacy in primary care: The newest vital sign. *The Annals of Family Medicine, 3*, 514–522.
http://dx.doi.org/10.1370/afm.405
Williams, M. V., Baker, D. W., Parker, R. M., & Nurss, J. R. (1998). Relationship of functional health literacy to patients knowledge of their chronic disease: A study of patients with hypertension and diabetes. *Archives of Internal Medicine, 158*, 166–172.
http://dx.doi.org/10.1001/archinte.158.2.166