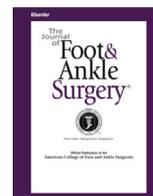




Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Patient Health Literacy and Diabetic Foot Amputations

Kristie Hadden, PhD¹, Robert Martin, MD^{2,3}, Latrina Prince, EdD⁴, C. Lowry Barnes, MD^{3,5,6}¹ Associate Professor, Center for Health Literacy, University of Arkansas for Medical Sciences, Little Rock, AR² Assistant Professor, Department of Orthopaedic Surgery, University of Arkansas for Medical Sciences, Little Rock, AR³ Surgeon, Department of Orthopaedic Surgery, University of Arkansas for Medical Sciences, Little Rock, AR⁴ Instructor, Center for Health Literacy, University of Arkansas for Medical Sciences, Little Rock, AR⁵ Chairman, Department of Orthopaedic Surgery, University of Arkansas for Medical Sciences, Little Rock, AR⁶ Professor, Department of Orthopaedic Surgery, University of Arkansas for Medical Sciences, Little Rock, AR

ARTICLE INFO

Level of Clinical Evidence: 3

Keywords:

education
foot ulcer
high risk
osteomyelitis
prevention

ABSTRACT

Patient health literacy is associated with self-care and management of chronic diseases, including diabetes. Interventions that address health literacy and aim to improve clinical outcomes have been focused mostly in primary care. The purpose of this study was to explore the association between patient health literacy and diabetic foot amputations in a retrospective cohort analysis in a large orthopaedic practice at an academic medical center. Using data extraction from clinical records, orthopaedic patients who had a diabetic foot amputation or re-amputation in the last 2 years were compared with the general orthopaedic patient population, with patient health literacy screening results as the dependent variable. Results revealed a statistically significant difference in health literacy between the foot amputee group (N = 177) and the general orthopaedic patient group (N = 14,683) ($p < .0001$). Patients in the foot amputee group were 8.07 times more likely to have inadequate health literacy than patients in the general orthopaedic patient group. Because diabetic amputations are frequently associated with poorly controlled diabetes, these results provide a strong rationale to develop health literacy–based interventions that address diabetes self-management and foot exams in orthopaedic practices to improve clinical outcomes, including amputation prevention.

© 2019 by the American College of Foot and Ankle Surgeons. All rights reserved.

The Patient Protection and Affordable Care Act of 2010 defines health literacy as “the degree to which an individual has the capacity to obtain, communicate, process, and understand basic health information and services to make appropriate health decisions” (1). Patients with low health literacy struggle to understand health information and are known to have difficulty managing chronic diseases; these patients are at greater risk for poor health outcomes (2). About 90 million Americans have low health literacy (3), and an estimated 117 million U.S. adults suffer from 1 or more chronic diseases (4,5). The prevalence of diabetes is continuing to increase; a recent report by the National Center for Chronic Disease Prevention and Health Promotion reveals that ~30 million Americans have a confirmed diagnosis of diabetes (6,7).

Patients with diabetes and low health literacy are at increased risk of developing complications due to poor self-management behaviors

(8–10). Recent research studies have shown that low health literacy is associated with poor diabetes outcomes (11–13). Foot ulcerations and amputations are among the major problems attributed to poor diabetes self-management behaviors (8,14). Previous research that aimed to explore health literacy and foot ulcerations and amputations were limited by sample size, were conducted in countries other than the United States, and did not include a validated measure of patient health literacy (8,9). Margolis et al (10) found that patients enrolled in an intervention study with low health literacy were more likely to have foot ulcers that were difficult to heal, but did not explore health literacy beyond the sample of patients with existing foot ulcers. Health literacy interventions and educational programs have shown improvements in diabetes knowledge, self-management behaviors, and better health outcomes (8,15–18). A better understanding of the relationship between health literacy and diabetic foot amputations could result in new targeted and tailored educational interventions that aim to improve outcomes for at-risk patients, including preventing amputations. The American Diabetes Association emphasizes the importance of patient education as a means of improving diabetes self-management and reducing poor health outcomes (7,19). Health literacy interventions designed to improve clinical outcomes have been primarily focused on assessing the impact of health literacy on patient outcomes in primary care. More research is needed on low literacy interventions for improving diabetes knowledge and self-management

Financial Disclosure: C. Lowry Barnes has the following disclosures to report: Health Trust (Consultant/Advisory Role), Medtronic (Consultant/Advisory Role), Responsive Risk Solutions (Consultant/Advisory Role, Stock Ownership), Conformis (Research Funding), Corin (Research Funding), DJO (Other Compensation), Zimmer (Other Compensation).

Conflict of Interest: None reported.

Address correspondence to: Kristie Hadden, PhD, Center for Health Literacy, University of Arkansas for Medical Sciences, 4301 West Markham Street, Slot #599A, Little Rock, AR 72205-7199.

E-mail address: khadden@uams.edu (K. Hadden).

behaviors in orthopaedic patients. The purpose of this study was to explore the association between patient health literacy and diabetic foot amputations in a retrospective cohort analysis in a large orthopaedic practice at an academic medical center.

Patients and Methods

The primary aim of this investigation was to determine if orthopaedic patients with diabetic foot amputations had lower health literacy than their orthopaedic patient counterparts without diabetic amputations in a large practice at an academic medical center, using patient health literacy data in the electronic medical record (EMR). The institutional review board approved this retrospective cohort investigation that included de-identified patient data and no personal health information; this study's methods were secondary data analysis of existing clinical data in the EMR. For the foot amputee group, data were extracted from electronic clinical records using *International Classification of Diseases, Tenth Revision* codes (E08 to E13 diabetes mellitus and 1 of the following: 28810 amputation, metatarsal, with toe, single; 28820 amputation, toe, metatarsophalangeal joint; 28825 amputation, toe, interphalangeal joint; 27880 amputation, leg, through tibia and fibula; or 28805 amputation, foot, transmetatarsal) for the previous 2 years (February 2016 to February 2018). A data request was submitted to the institution's data repository requesting the patient health literacy screening (20) result for each of the patients in the data set who had these results in their chart. An identical request was submitted to obtain the health literacy screening results for the general orthopaedic population that had these results in their chart during the same time frame.

A single screening question ("How confident are you at filling out medical forms by yourself?") asked verbally of patients can identify those who have inadequate HL with 81% accuracy (true positives and true negatives) (20–23). This screening question has been added to intake processes for all orthopaedic patients and recorded in their EMR as a continuous score ranging from 1 through 5 with scores of 4 or 5 indicating adequate health literacy, and scores of 3 or lower indicating inadequate health literacy.

Health literacy data were dichotomized into 2 categories, adequate and inadequate, and the χ^2 test analysis was conducted using SAS 9.4 (SAS Institute Inc, Cary, NC) to estimate an odds ratio for the dependent variable (health literacy) and group (diabetic foot amputee or other orthopaedic patient).

Results

The 2-year cohort included 177 patients in the foot amputation group and 14,683 in the general orthopaedic patient group. The χ^2 test results revealed that the health literacy variable between the groups was statistically significantly different, χ^2 (1, N = 14,860) = 261.25, $p < .0001$. Patients with diabetic foot amputations were 8.07 (95% confidence interval 5.92 to 11.02) times more likely to have inadequate health literacy than patients in the general orthopaedic patient group (Table).

Discussion

Research has shown that 90% of patients feel that it is useful for physicians and nurses to know if they are having difficulties related to low health literacy (24,25). The Institute of Medicine recommends incorporating patient health literacy information into health care information systems (26). This study used health literacy screening data in the EMR to explore the impact of inadequate health literacy in the diabetic foot amputation patient population. Our findings present rationale, need, and opportunity to develop patient education on diabetes self-management and foot care using health literacy best practices to meet the needs of these orthopaedic patients with inadequate health literacy. These interventions can be implemented as part of tertiary prevention efforts that aim to minimize complications and improve clinical outcomes for orthopaedic patients with diabetes. Targeted patient education interventions

and outreach that aim to address known health literacy barriers will likely have potential to reduce amputations that result from poor diabetes self-management and care. Implementing these interventions in the context of orthopaedic care can provide additional patient motivation that leverages the importance of keeping and saving the patient's feet versus amputation.

Our study also demonstrated that patient health literacy screening data can be used to identify groups of patients for whom intervention is needed. Although our approach used de-identified data, orthopaedic practices that develop patient education using health literacy best practices can use their own health literacy screening data to identify their diabetic patients for whom these materials may be appropriate, administer interventions, and track outcomes for quality improvement and research.

In conclusion, this study had limitations that are inherent in retrospective cohort research. Our data were extracted from a clinical database and not collected prospectively, using randomization or other methods to ensure an unbiased and representative sample. Although the methods of this research have potential for generalization to other practices, our sample results may not be representative of other practices' patient populations.

Acknowledgments

The authors acknowledge the University of Arkansas for Medical Sciences (UAMS) Center for Health Literacy for its contributions to this work and other work that promotes evidence and best practices for health literacy research, services, and policies. Data for the study were provided by the Arkansas Clinical Data Repository (AR-CDR) maintained by the Department of Biomedical Informatics in the College of Medicine at the UAMS. The AR-CDR is approved to operate as an enterprise data resource to support research across UAMS. Data in the AR-CDR comes from UAMS EMR, tumor registry, billing, and cancer genomic data and comprises encounters since May 1, 2014.

References

- Office of Legislative Counsel Grossman EG, Sterkx CA, Blount EC, Volberding EM. *Patient Protection and Affordable Care Act*. U.S. Centers for Medicare & Medicaid Services, Baltimore, MD; 2010.
- 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.
- U.S. Department of Health and Human Services. *National Action Plan to Improve Health Literacy*. Office of Disease Prevention and Health Promotion, Washington, DC; 2010.
- National Center for Chronic Disease Prevention and Health Promotion. *Chronic Disease Overview*. Centers for Disease Control and Prevention, Atlanta, GA; 2017.
- Ward BW, Schiller JS, Goodman RA. Multiple chronic conditions among US adults: a 2012 update. *Prev Chronic Dis* 2014;11:E62.
- Centers for Disease Control and Prevention. *National Diabetes Statistics Report, 2017: Estimates of Diabetes and its Burden in the United States*. Centers for Disease Control and Prevention, Atlanta, GA; 2017.
- Beck J, Greenwood DA, Blanton L, Bollinger ST, Butcher MK, Condon JE, Cypress M, Faulkner P, Fischl AH, Francis T, Kolb LE, Lavin-Tompkins JM, MacLeod J, Maryniuk M, Mensing C, Orzeck EA, Pope DD, Pulizzi JL, Reed AA, Rhinehart AS, Siminerio L, Wang J, on behalf of 2017 Standards Revision Task Force. 2017 National standards for diabetes self-management education and support. *Diabetes Care* 2017;40:1409.
- Rahaman HS, Jyotsna VP, Sreenivas V, Krishnan A, Tandon N. Effectiveness of a patient education module on diabetic foot care in outpatient setting: an open-label randomized controlled study. *Indian J Endocrinol Metab* 2018;22:74–78.
- Al-Kaabji JM, Al MF, Cragg P, Afandi B, Souid AK. Illiteracy and diabetic foot complications. *Prim Care Diabetes* 2015;9:465–472.
- Margolis DJ, Hampton M, Hoffstad O, Malay DS, Thom S. Health literacy and diabetic foot ulcer healing. *Wound Repair Regen* 2015;23:299–301.
- 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;28:444–452.
- Bailey SC, Brega AG, Crutchfield TM, Elasy T, Herr H, Kaphingst K, Karter AJ, Moreland-Russell S, Osborn CY, Pignone M, Rothman R, Schillinger D. Update on health literacy and diabetes. *Diabetes Educ* 2014;40:581–604.
- Protheroe J, Rowlands G, Bartlam B, Levin-Zamir D. Health literacy, diabetes prevention, and self-management. *J Diabetes Res* 2017;2017:1298315.
- Dorresteijn JA, Kriegsman DM, Assendelft WJ, Valk GD. Patient education for preventing diabetic foot ulceration. *Cochrane Database Syst Rev* 2010;10:CD001488.

Table
Chi-squared results

Group	Observed N	χ^2	Risk Ratio (95% Confidence Interval)	Significance
Amputee group	177	261.25	8.07 (5.92 to 11.02)	$p < .0001$
General orthopaedic group	14,683			

15. Funnell MM, Brown TL, Childs BP, Haas LB, Hoseney GM, Jensen B, Maryniuk M, Peyrot M, Piette JD, Reader D, Siminerio LM, Weinger K, Weiss MA. National standards for diabetes self-management education. *Diabetes Care* 2010;33(suppl 1):S89–S96.
16. Sharoni SKA, Abdul RH, Minhat HS, Shariff GS, Azman Ong MH. A self-efficacy education programme on foot self-care behaviour among older patients with diabetes in a public long-term care institution, Malaysia: a quasi-experimental pilot study. *BMJ Open* 2017;7:e014393.
17. Swavely D, Vorderstrasse A, Maldonado E, Eid S, Etchason J. Implementation and evaluation of a low health literacy and culturally sensitive diabetes education program. *J Healthc Qual* 2014;36:16–23.
18. Kafaie P, Noorbala MT, Soheilikhah S, Rashidi M. Evaluation of patients' education on foot self-care status in diabetic patients. *Iran Red Crescent Med J* 2012;14:829–832.
19. American Diabetes Association. *Diabetes Educator Resources*. American Diabetes Association, Arlington, VA; 2018.
20. Stagliano V, Wallace LS. Brief health literacy screening items predict newest vital sign scores. *J Am Board Fam Med* 2013;26:558–565.
21. Chew LD, Bradley KA, Boyko EJ. Brief questions to identify patients with inadequate health literacy. *Fam Med* 2004;36:588–594.
22. Chew LD, Griffin JM, Partin MR, Noorbaloochi S, Grill JP, Snyder A, Bradley KA, Nugent SM, Baines AD, Vanryn M. Validation of screening questions for limited health literacy in a large VA outpatient population. *J Gen Intern Med* 2008;23:561–566.
23. Wallace LS, Rogers ES, Roskos SE, Holiday DB, Weiss BD. Brief report: screening items to identify patients with limited health literacy skills. *J Gen Intern Med* 2006;21:874–877.
24. Seligman HK, Wang FF, Palacios JL, Wilson CC, Daher C, Piette JD, Schillinger D. Physician notification of their diabetes patients' limited health literacy: a randomized, controlled trial. *J Gen Intern Med* 2005;20:1077.
25. Wolf MS, Williams MV, Parker RM, Parikh NS, Nowlan AW, Baker DW. Patients' shame and attitudes toward discussing the results of literacy screening. *J Health Commun* 2007;12:721–732.
26. Nielsen-Bohlman L, Parker AM, Kindig DA. Institute of Medicine. *Health Literacy: A Prescription to End Confusion*. National Academies Press, Washington, DC; 2004.