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Association of Low Health Literacy with Postoperative Complications and Weight Loss Outcomes Following Metabolic and Bariatric Surgery

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Abstract

Introduction: The Deep South has the highest rates of obesity in the U.S. and low health literacy (HL) with few studies exploring how this impacts the metabolic and bariatric surgery (MBS) population.

Methods: Patients were recruited to complete a survey which assesses socioeconomic determinants of health. Chart review was performed on patients who underwent primary MBS. Patients were stratified based on HL to determine differences in outcomes.

Results: From 2023-2025, 83 patients met inclusion criteria. Sixty-six (79.5%) had high HL and 17 (20.5%) had low HL. There was no difference in sex, race, preop body mass index or type of surgery. Income and education level were similar ($p>0.05$). Patients with low HL were more likely to have a 30-day postoperative complication (17.6 versus 3%, $p=0.02$). Low HL patients had lower percent total weight loss (%TWL) at 6 months (18.8 versus 24%, $p=0.02$) and trended towards less %TWL at 1 year (21.2 versus 28.8%, $p=0.06$). While more patients with low HL had loss to follow-up at 12 months (64.7 versus 45.5%, $p=0.1$), this was not significant.

Conclusions: More than 20% of patients in our cohort had low HL which was associated with higher postoperative complication rates and lower weight loss postoperatively. These associations highlight the importance of recognizing low HL. Work must be undertaken to improve these differences with targeted patient education and engagement to improve postoperative outcomes in our low HL patients.

Key Points

• Health literacy is underassessed despite its impact on patient outcomes

• Low health literacy is associated with higher postoperative complication rates

• Low health literacy is associated with less weight loss after bariatric surgery

Introduction

Health literacy (HL) is an under-recognized yet prevalent factor which significantly affects how patients interact with the health care system as well as their health outcomes. Health literacy involves the patients' ability to understand and use health information to make an informed decision about their healthcare. In 2006, the U.S. Department of Education published the only existing national data on health literacy skills and found that 53% had Intermediate health literacy, 22% had Basic and 14% had Below Basic health literacy [1]. Many studies have shown that low HL is linked to decreased routine and preventative health care access along with higher usage of emergency services [2]. Patients with a self-reported worse health status are more likely to have low HL [1]. Further, it has been shown that patients with low HL may have worse healthcare outcomes [3], including higher mortality rates [4].

Among surgical patients, over one third of patients may have low HL [5]. Notably, low HL is associated with poorer perioperative outcomes in general [6]. For example, patients with low HL who underwent major abdominal surgery have been found to have a prolonged postoperative length of stay, compared with their high HL counterparts [7]. There is also evidence that patients with low HL have poorer understanding of discharge instructions and poorer adherence to medication regimens which may increase morbidity and mortality for this patient population [5,6].

While multiple patient demographics, comorbidities, modifiable factors, and socioeconomic disparities have been studied in relation to metabolic and bariatric surgery (MBS) outcomes, fewer studies have explored how HL specifically may impact outcomes in the MBS population. Especially as obesity rates in the United States are projected to approach 50% by 2030 [8], this remains an important area of research in order to optimize patients outcomes in MBS programs. While there is still some variability in HL and MBS outcomes [9,10], several studies have found that a higher HL index score is associated with more weight loss at one year [11].

The Deep South region of the United States, including the state of Alabama, is an area known to have decreased access to surgical care and a large population with a low socioeconomic status [12]. This region also has a large population living with obesity. The CDC reports the Deep South obesity rates from 38–40% [13] which are among the highest in this country. Furthermore, this is an area with historically low HL. Our group's prior work has demonstrated that patients in this region with low HL report less familiarity with healthcare treatment options, less trust in their doctors, and a lower likelihood to consider MBS when indicated [14]. As such, a driving factor for this study was to better understand the relationship between HL and outcomes following MBS in a region with a large population of people living with obesity in an area with low HL.

Materials and Methods

After institutional review board approval was obtained, a cross-sectional, single institutional study was conducted from 2023–2025. Inclusion criteria were patients who were enrolled in the MBS program, patients aged 18 years or older, and ultimately underwent primary MBS. Exclusion criteria were those who did not wish to complete the survey, were undergoing a revisional or conversion bariatric surgery, or did not proceed with MBS.

The patients considering MBS were recruited to complete a survey based on the NIH PhenX tool kit [15] which assesses patient socioeconomic determinants of health including HL level. The survey was based on the SEDOH-88, a comprehensive 88-item survey that captures health-related factors across multiple socioecological levels [16]. As part of an ongoing prospective study, patients undergoing MBS evaluation were approached in person during preoperative encounters for informed consent and survey completion. The survey was administered by two study personnel in person or filled in directly by the participants, and via email for patients who were unable to complete the survey in the clinic. Answers were recorded

on an iPad device linked directly into the research electronic data capture (REDCap), a secure online electronic data capture tools platform.

Data captured were HL levels as captured by the BRIEF component of the survey, a validated four-question screening tool [17–19]. The four questions involved in the survey included the following: (1) How often do you have someone help you read the hospital materials? (2) How often do you have problems learning about your medical condition because of difficulty understanding the written information? (3) How often do you have a problem understanding what is told to you about your medical condition? and (4) How confident are you filling out medical forms by yourself? The answer for each question was rated with a 5-point Likert response scale and then summarized with a possible total range of 4 to 20. HL scores were then categorized into “High HL” (17–20) and “Low HL” (4–16) as previously described [20].

Retrospective chart review was then performed on patients who subsequently underwent primary MBS. Short-term clinical outcomes were collected including the primary outcome of any postoperative complication at 30 days. These were classified based on the established Clavien-Dindo classification of morbidity and included events such as pneumonia, deep organ space event such as staple line leak, bleeding events requiring transfusion, venous thromboembolism including pulmonary embolism (PE) and deep vein thrombosis (DVT), acute kidney injury (AKI), reoperation, and readmission. Secondary outcomes were also collected, including: hospital length of stay and mortality. Other outcomes of interest included number of emergency room visits within the first 30 days and number of patient phone calls to the clinic within the first 30 days. Phone calls to the clinic were classified based on 0–1 phone calls or 2 or more phone calls. Long-term outcomes were also measured, including percent total weight loss (%TWL) and percent excess weight loss (%EWL) from their preoperative weight in kilograms at 6 and 12-month follow-up intervals. Additionally, any loss to follow-up was noted at 12 months. Patients were stratified based on high versus low HL to determine differences in clinical outcomes.

Descriptive statistics were conducted using frequencies and percentages for categorical variables, whereas continuous variables were summarized with means and standard deviation (SD) or medians with interquartile values. The normality of the data distribution was evaluated using the Shapiro-Wilk test. Bivariate analyses compared the demographics and the survey responses using the chi-square or Fisher exact probability test as appropriate for categorical variables and the Kruskal–Wallis rank-sum test for continuous variables. A p-value of < 0.05 was considered statistically significant. Data analysis was performed using SAS software version 9.4 (SAS Institute, Cary, NC).

Results

Overall cohort

From 2023-2025, 83 patients met inclusion criteria, completed the preoperative survey and underwent MBS. In the cohort, the mean age was 43.6 years (SD±10.9). The majority of patients were female

(86.7%, n=72). The mean preoperative body mass index (BMI) was 53.0 kg/m^2 (SD±12.36). With regards to race, 33.7% (n=28) were White, 63.9% (n=53) were Black, 1.2% (n=1) were Asian, 1.2% (n=1) were Native American. Eighty-eight percent underwent sleeve gastrectomy, while 12% underwent Roux en-Y gastric bypass (Table 1).

Cohort stratified by HL

Seventeen (20.5%) patients had low HL and 66 (79.5%) had high HL. In terms of patient demographics between the low and high HL groups, there was no significant difference in age (42.9 versus 43.8 years, p=0.77). There was no difference in sex between low and high HL with 14 (82.4%) versus 58 (87.9%) female patients (p=0.54), respectively. There was no difference in patient reported race: 13 (76.5%) versus 40 (60.6%) were Black, 4 (23.5%) versus 24 (36.4%) were White, 0 (0.0%) versus 1 (1.5%) were Asian, and 0 (0.0%) versus 1 (1.5%) were Native American (p>0.05). Preoperative BMI was similar between low and high HL patients, with a mean of 53.2 (SD±12.7) versus 52.3 kg/m2 (SD±11), p=0.80 (Table 3). The type of metabolic and bariatric operation performed between the two groups was similar with 15 (88.2%) of low HL patients undergoing sleeve gastrectomy versus 58 (87.9%) of high HL patients (p=0.96).

There was no difference in education level between low and high HL: 5 (29.4%) versus 17 (25.8%) had no high school diploma, 7 (41.2%) versus 27 (40.9%) had a GED or equivalent, and 5 (29.4%) versus 22 (33.3%) had an advanced degree (p=0.93). There was no difference in income between low and HL as 10 (58.8%) versus 26 (39.4%) made less than $40k per year, 2 (11.8%) versus 3 (4.5%) made between $40-50k per year, and 3 (17.6%) versus 31 (47%) made more than $50k per year (p=0.15). There was no difference in employment types including employed, unemployed, retired, student status, on disability, and homemaker (p=0.18). There was no difference in the number of dependents between low and high HL with 9 (52.9%) versus 33 (50.0%) with zero to three dependents and 8 (47.1%) versus 33 (50%) with four or more dependents (p=0.82) (Table 1).

Short-term outcomes by HL

Patients with low HL were significantly more likely to have a 30-day postoperative complication, compared with their high HL counterparts (17.6 versus 3.0%, p=0.02). These include acute kidney injury, venous thromboembolism, and readmission. There were no major postoperative complications such as leak, major bleeding, or reoperation and there were no mortalities, regardless of HL. There was no difference in hospital length of stay between low and high HL (1.1 versus 1.0 days, p=0.87). There was no difference in 30-day readmission rates by HL (5.9 versus 3.0%, p=0.54). Lastly, while there were more frequent postoperative patient phone calls (greater than 1 phone call) in the low HL group (52.9% versus 36.4%, p=0.21), again this was not statistically significant. Further details are listed in Table 2.

Long-term outcomes by HL: Weight Trajectory and Loss to Follow-Up

Despite similar preoperative BMI by HL, low HL patients had lower %TWL at 6 months (18.8 versus 24.0%, p=0.02) though %EWL at 6 months (34.7 versus 42.3%, p=0.08) did not reach significance. At 1 year follow-up, there was a trend towards lower %TWL (21.2 versus 28.8%, p=0.06), and a lower %EWL in low HL patients (36.8 versus 50.5%, p=0.05). There was no difference in loss to follow-up at 6 months [5 (29.4%) versus 20 (30.3%), p=0.24] or statistically significant difference in patients with loss to follow-up at 12 months [11 (64.7%) versus 30 (45.5%), p=0.16]. Further details are listed in Tables 2 and 3.

Conclusion

In this retrospective cohort study among MBS patients in a tertiary referral center in the Deep South, we found that over 20% of patients who completed the survey and underwent MBS had low HL. In this diverse cohort, there were no differences in age, race or sex by HL. There was no correlation between HL and patient education level or income. However, we found that low HL was correlated with higher risk of 30-day postoperative complications following MBS. At 6-month follow-up, patients with low HL had lower %TWL, though this difference did not reach significance at 12-month follow-up.

The findings of increased postoperative complications in our low HL cohort are supported by other work that has previously explored low HL and surgical outcomes. Increased postoperative complications are associated with low HL in non-MBS patients [6,7]. A systematic review found that low HL was associated with longer length of stay, poorer patient activation measures, poorer process-oriented outcomes (for example, transplant listing), and higher readmission rates [21]. In the MBS population, lower HL has been found to be associated with increased postoperative emergency room visits following MBS for unclear etiology abdominal pain [22]. Among MBS patients, the increased perioperative risks for patients with low HL may be due to patients' decreased comprehension of discharge instructions, differences in adherence to postoperative regimens including adequate fluid intake, diet progression and medication changes, or inability to accurately recognize deviations from the expected postoperative course.

Our study's findings of decreased weight loss at 6-month follow-up for patients with low HL is also supported by the existing literature. A study of 118 patients using the European Health Literacy Survey who underwent laparoscopic sleeve gastrectomy found an inverse relationship between BMI and health literacy, and postoperatively the percent estimated weight loss at 12 months was found to be increased by 0.39 with each 1-point increase in health promotion and health literacy index scores [23]. Similarly, a larger study of 567 patients undergoing MBS found an association between HL and change in BMI between years 2–4 postoperatively [24]. While the underlying drivers for the observed differences in weight loss trajectories following MBS for patients with low HL remain unknown, differences in diet progression comprehension or patient access and decision-making surrounding food choices may influence these outcomes.

More than one-fifth of our cohort who completed the survey and underwent MBS had low HL. While we did not have complete demographic data of the patients who did not participate in our study, according to contemporaneous research on the MBS population in our region, our cohort is of similar age, sex, and

BMI [25]. Although the composition of HL in our entire MBS population at large is unknown, other studies have found that patients with low HL are less likely to complete a metabolic and bariatric program and undergo MBS [26,27]. This may be an indicator that those with higher HL are more likely to complete the MBS program. Therefore, our surgical population may not be representative of all patients who are undergoing workup and consideration for MBS. Though beyond the scope of this study, patients with low HL may need more clinical support in order to help them achieve their goals of undergoing MBS.

Notably, among this study's patient population, education level and income did not correlate with HL level, which is a common misconception and often used as an inappropriate surrogate. This highlights a salient point that health care professionals are unable to accurately predict which patients have low HL. A study of 31 patients that compared patient HL to health care professionals' estimate of the patient's HL found that health care professionals estimated correctly only 61.1% of the time with poor inter-rater agreement [28]. This was true for health numeracy, a component of HL, as well where health care professionals estimated correctly only 13.9% of the time and were more likely to overestimate with poor inter-rater agreement [28].

This study has several limitations. Missing long term data was one limitation of the study, as there were high loss to follow-up percentages among both the high and low HL groups at 12 months. It is possible that patient phone calls to the after-hours phone line may not be documented in the chart, so there may be data unable to be captured via retrospective chart review. Other limitations of our study include that this is a single site study with a relatively small sample size, which may underpower our study. Future studies might increase patient enrollment and coverage at multiple institutions for better population representation. The preoperative survey is self-reported which may cause inherent bias as patients may under or over-report their own HL. Furthermore, the specific breakdown of low versus high HL within the total population of patients with obesity is not known. It is possible that high HL patients were more likely to agree to participate in the survey. This may be a compelling reason for the surprisingly high HL reported in this study, indicating selection bias. This is an area where we could more comprehensively collect HL data on all patients who present to MBS clinic as part of a routine intake to better understand how HL affects patient outcomes in an MBS program. Our group recognizes this as a limitation and plans to implement this in the future.

Further studies are needed to determine if targeted education can improve a patient's subject-specific HL regarding MBS and further to determine if this might mitigate perioperative complications or decreased %TWL. At this time, preoperative screening for HL is not routine or standardized across metabolic and bariatric centers. Given that there is evidence for worse MBS outcomes with low HL, we encourage the use of surveys such as the one we implemented in MBS clinic to increase health care professionals' awareness of HL prior to patients undergoing MBS. Additionally, protocols that would increase scheduled patient engagement in the perioperative period via phone call or secure messaging may be beneficial in order to improve perioperative outcomes for patients with low HL. Once identified as low HL, further one-on-one or small group sessions may be another way to address specific gaps in patient knowledge surrounding the MBS process. While this study did not find a statistically significant

difference in postoperative patient phone calls or loss to follow-up, attention might be paid perioperatively to help mitigate this risk for all patients, regardless of HL. While patient outcomes surrounding MBS are certainly multifactorial, we found that HL may play a role, particularly for perioperative complications and weight loss at 6-months. We encourage other metabolic and bariatric centers to increase HL screening. A short survey as the one we have utilized is feasible to include in a clinic visit. Additionally, patient navigators or patient advocates can be useful team members that can focus on perioperative engagement of patients, particularly those with low HL, to help mitigate the effect HL may have on MBS outcomes.

In a diverse tertiary center in the Deep South, more than 20% of patients who participated in our study and underwent MBS had low HL. In this population, low HL was associated with higher postoperative complication rates, lower total weight loss postoperatively at 6-month follow-up, and lower excess weight loss at 12-month follow up. These associations highlight the importance of recognizing low HL in our metabolic and bariatric population. Work must be undertaken to improve these differences with more intentional patient education and engagement perioperatively to improve postoperative outcomes, particularly among MBS patients with low HL.

Declarations

Ethical approval:

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent:

Informed consent was obtained from all individual participants included in the study

Conflicts of Interest:

One author is the recipient of the Society for Surgery of the Alimentary Tract Healthcare Disparities award. All other authors have no conflict of interest.

Author Contribution

R.S., A.H., M.S., G.N., wrote the main manuscript text, R.S. and L.W. prepared tables and analyzed the data. All authors contributed to design conception, were key in data interpretation, and reviewed the manuscript.

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Tables

Tables 1-3 are available in the Supplementary Files section.

References

1. Kutner M, Greenberg E, Jin Y, Christine Paulsen. The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy. NAAL - National Assessments of Adult Literacy; 2006. NCES 2006483.
2. Griffey RT, Kennedy SK, D'Agostino McGowan L, Goodman M, Kaphingst KA. Is low health literacy associated with increased emergency department utilization and recidivism? Acad Emerg Med. 2014;21(10):1109–15.
3. Mitchell SE, Sadikova E, Jack BW, Paasche-Orlow MK. Health literacy and 30-day postdischarge hospital utilization. J Health Commun. 2012;17(Suppl 3):325–38.
4. 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(2):97–107.
5. Chang ME, Baker SJ, Dos Santos Marques IC, Liwo AN, Chung SK, Richman JS, Knight SJ, Fouad MN, Gakumo CA, Davis TC, Chu DI. Health Literacy in Surgery. Health Lit Res Pract. 2020;4(1):e46–65.
6. De Oliveira GS Jr, McCarthy RJ, Wolf MS, Holl J. The impact of health literacy in the care of surgical patients: a qualitative systematic review. BMC Surg. 2015;15:86.
7. Wright JP, Edwards GC, Goggins K, et al. Association of Health Literacy With Postoperative Outcomes in Patients Undergoing Major Abdominal Surgery. JAMA Surg. 2018;153(2):137–42.
8. Ward ZJ, Bleich SN, Cradock AL, Barrett JL, Giles CM, Flax C, Long MW, Gortmaker SL. Projected U.S. State-Level Prevalence of Adult Obesity and Severe Obesity. N Engl J Med. 2019;381(25):2440–50.
9. Köhler H, Dorozhkina R, Gruner-Labitzke K, de Zwaan M. Specific Health Knowledge and Health Literacy of Patients before and after Bariatric Surgery: A Cross-Sectional Study. Obes Facts. 2020;13(2):166–78.
10. Jaensson M, Dahlberg K, Cao Y, Thorell A, Österberg J, Nilsson U, Stenberg E. Impact of health literacy and general self-efficacy on surgical outcomes 2 years after bariatric surgery. Clin Obes. 2025;15(4):e70009.
11. Mahoney ST, Strassle PD, Farrell TM, Duke MC. Does Lower Level of Education and Health Literacy Affect Successful Outcomes in Bariatric Surgery? J Laparoendosc Adv Surg Tech A. 2019;29(8):1011–5.

12. U.S. Census Bureau. Income in the Past 12 Months (in 2024 Inflation-Adjusted Dollars). *American Community Survey, ACS 1-Year Estimates Subject Tables, Table S1901*, https://data.census.gov/table/ACSST1Y2024.S1901?q=Alabama+Income+and+Poverty. Accessed on 22 Jun 2026.
13. Centers for Disease Control and Prevention. Adult Obesity Prevalence Maps. U.S. Dept of Health and Human Services; 2025.
14. Harsono AAH, Kim G, English NC, Naik GA, Velagala DS, Wong K, Stahl RD, Grams JM, Chu DI, Mustian MN. Patients' perceptions of bariatric surgery in the Deep South: the impact of health literacy. Surg Endosc. 2025;39(9):6018–31.
15. Hamilton CM, Strader LC, Pratt JG, et al. The PhenX toolkit: get the most from your measures. Am J Epidemiol. 2011;174(3):253–60.
16. Smith B, Smith BP, Hollis RH, et al. Development of a comprehensive survey to assess key socioecological determinants of health. Surgery. 2024;175(4):991–9.
17. Chew LD, Bradley KA, Boyko EJ. Brief questions to identify patients with inadequate health literacy. 2004.
18. Haun J, Noland-Dodd V, Varnes J, Graham-Pole J, Rienzo B, Donaldson P. Testing the BRIEF health literacy screening tool. Fed Pract. 2009;26(12):24–31.
19. 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(8):874–7.
20. Theiss LM, Wood T, McLeod MC, et al. The association of health literacy and postoperative complications after colorectal surgery: a cohort study. Am J Surg. 2022;223(6):1047–52.
21. Trutner ZD, Furlough K, Martinez A, Vetter I, Uhler LM, Haynes A, Jayakumar P. Is Health Literacy Associated with Surgical Outcomes? A Systematic Review. Jour Surg Res. 2023;291:720–33.
22. Angerås-Kraftling J, Jaensson M, Dahlberg K, Stenberg E. Association of health literacy and general self-efficacy with emergency department visits for unclear abdominal pain after bariatric surgery. Langenbecks Arch Surg. 2025;410(1):162.
23. Erdogdu UE, Cayci HM, Tardu A, Demirci H, Kisakol G, Guclu M. Health Literacy and Weight Loss After Bariatric Surgery. Obes Surg. 2019;29(12):3948–53.
24. Miller-Matero LR, Hecht L, Patel S, Martens KM, Hamann A, Carlin AM. The Influence of Health Literacy and Health Numeracy on Weight Loss Outcomes Following Bariatric Surgery. Surg Obes Relat Dis. 2021;17(2):384–9.
25. Rakestraw S, Lucy A, Wood L, Chu DI, Grams JM, Stahl RD, Mustian MN. Racial Disparities in Length of Stay Following Implementation of a Bariatric Enhanced Recovery Program. Gastrointest Surg. 2024;298:81–7.
26. Hecht L, Cain S, Clark-Sienkiewicz SM, Martens K, Hamann A, Carlin AM, Miller-Matero LR. Health Literacy, Health Numeracy, and Cognitive Functioning Among Bariatric Surgery Candidates. Obes Surg. 2019;29(12):4138–41.

27. Cayci HM, Erdogdu UE, Demirci H, Ardic A, Topak NY, Taymur İ. Effect of Health Literacy on Help-seeking Behavior in Morbidly Obese Patients Agreeing to Bariatric Surgery. Obes Surg. 2018;28(3):791–7.
28. Allen C, Ghoora L, Murki R, Byworth C, Beale S, Mojadady A, Nagri J, Parmar C. Accuracy of Healthcare Professionals' Estimations of Health Literacy and Numeracy of Patients Visiting Metabolic Bariatric Surgery Clinic. Obes Surg. 2024;34(8):2799–805.

Supplementary Files

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