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Published in:
Hpb

DOI:
10.1016/j.hpb.2022.07.006

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:
2022

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):
Driessens, H., van Wijk, L., Buis, C. I., & Klaase, J. M. (2022). Low health literacy is associated with worse postoperative outcomes following hepato-pancreato-biliary cancer surgery. *Hpb*, *24*(11), 1869-1877. https://doi.org/10.1016/j.hpb.2022.07.006

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https://doi.org/10.1016/j.hpb.2022.07.006 HPB

ORIGINAL ARTICLE

Low health literacy is associated with worse postoperative outcomes following hepato-pancreato-biliary cancer surgery

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Abstract

Background: Low health literacy (HL) can lead to worse health outcomes for patients with chronic diseases and could also lead to worse postoperative outcomes. This retrospective cohort study investigates the association between HL and postoperative textbook outcome (TO) after hepato-pancreato-biliary (HPB) cancer surgery.

Methods: Patients that consented and underwent surgery for a premalignant andmalignant HPB tumor were included. Preoperatively, HL was measured by the brief health literacy screen (BHLS). Patients were categorized as having low or adequate HL. Primary outcome was TO (length of hospital stay (LOS) $\leq$ 75th percentile; and no severe complication; and no readmission and mortality within 30 days after discharge). Secondary outcomes were LOS and emergency department (ED) visits within 30 days after discharge.

Results: In total, 137 patients were included, of whom thirty-six patients had low HL. In patients with low HL (vs. adequate HL), rate of TO was lower (55.6% vs. 72.3%; p = 0.095), LOS was significantly longer (13.5 vs. 9 days; p = 0.007) and there was only a slight difference in ED visits (14.3% vs. 11.0%; p = 0.560). Patients with low HL had a significant lower chance of achieving TO (OR 0.400, 95%-CI 0.169–0.948; p = 0.037).

Conclusion: Low HL leads to worse postoperative outcome after HPB cancer surgery. Better preoperative education and guidance of patients with low HL could lead to better postoperative outcomes. Therefore, HL could be the next modifiable risk factor before major surgery.

Received 23 January 2022; accepted 11 July 2022

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Introduction

Health literacy is one of the determinants of health outcomes. The definition of health literacy is "the degree to which individuals have the capacity to obtain, process, and understand health information and services needed to make health decisions."[1] The prevalence of low health literacy in the general Dutch population is around 30%,[2] comparable to the prevalence of low health literacy in patients who have undergone surgery, of which one-third have low health literacy.[3] It is already known that low health literacy is related to poorer health outcomes in patients with chronic diseases. However, only a few studies have investigated the association between health literacy and postoperative outcomes. Three of these studies have shown that low health literacy is associated with poorer postoperative outcomes in patients who have undergone major abdominal surgery, including gastric, pancreatic, hepatic, and colorectal resections, as well as urologic procedures.[4,5,6] Nonetheless, much is still unknown about the association between health literacy and postoperative outcomes of hepato-pancreato-biliary (HPB) cancer surgery, a surgical field with highly complex and extensive procedures.

The incidence of HPB malignancies in the Dutch population has been increasing over the past few decades.[7] For hepatic and

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biliary carcinoma, surgical resection is still the mainstay of curative treatment.[8,9] For pancreatic carcinoma, surgical resection is the only treatment option for achieving a complete cure.[10] HPB surgeries are procedures which involve a high risk of patients developing postoperative complications.[11] Health literacy is generally not measured preoperatively in the outpatient clinic, nor is it an established variable accounted for as a casemix correction factor in the Dutch Hepatobiliary Audit (DHBA) or Dutch Pancreatic Cancer Audit (DPCA), both national obligatory audits for HPB (cancer) surgery.

This study investigated the relationship between low health literacy and postoperative outcomes in HPB cancer surgery. If such a relationship is established, caregivers could identify low health literacy patients early and use interventions to improve their understanding, as even simple interventions such as a simplified consent form have been shown to improve patients' understanding of an upcoming procedure.[12]

Our hypothesis is that low health literacy leads to poorer postoperative outcomes in terms of longer length of hospital stay, more complications, and more unplanned readmissions. Most of these postoperative outcomes can be summarized into a new composite endpoint called textbook outcome. Recently, the concept of textbook outcome has been increasingly used in different surgical disciplines since it represents an optimal postoperative outcome from the patients' perspective.[13–15] Concerning HPB surgery, textbook outcome has been shown to be a simple composite measure of postoperative outcomes.[15–17] This study is the first to consider the association of health literacy and textbook outcome within the field of HPB surgery.

Methods

Study design

This study was part of a prospective cohort study on prehabilitation (Netherlands research registration number 201800293).[18] In this study, a new preoperative care path was developed for patients scheduled to undergo HPB surgery at the University Medical Centre Groningen (UMCG) in The Netherlands. Patients were scheduled for a patient visit to the outpatient clinic at the HPB department four to six weeks prior to surgery. At the outpatient clinic, the patients' performance was scored on six domains, including physical fitness, malnutrition, anemia, frailty, intoxications, and psychological wellbeing, with a negative outcome leading to an intervention for the patient (Table 1). The results of these interventions have been published by van Wijk et al.[18] In addition to this, each patient's health literacy was scored by the brief health literacy screen (BHLS) questionnaire, and other patient characteristics were registered. Postoperative outcomes were registered up to 30 days after discharge. The present study focuses on health literacy in relation to postoperative outcomes, considered retrospectively.

Study population

Inclusion criteria for this study were, first, the presence of a liver tumor (premalignant tumor, liver carcinoma, suspicion of a liver carcinoma, or colorectal liver metastasis), a pancreatic tumor (pancreatic carcinoma, premalignant pancreatic tumor, neuroendocrine tumor of the pancreas, intraductal papillary mucinous neoplasm of the pancreas, or suspicion of a pancreatic carcinoma), a biliary tumor (biliary carcinoma or suspicion of biliary carcinoma), or any other type of premalignant and malignant tumor requiring HPB surgery. Patients also had to have undergone elective HPB surgery for their tumor, to have had a life expectancy of more than 6 months at the start of the study, and to have given consent to participate in the study. Patients were excluded if they were aged below 18 years, were not capable of understanding or reading the Dutch language, or did not meet all of the inclusion criteria. Patients were included between May 2019 and May 2021. During this period, screening on the six domains of prehabiliation was standard care and there was no selection beforehand. In total, 220 patients visited the outpatient clinic of the HPB department and were screened on the six domains mentioned above. In total, 152 patients met the inclusion criteria. Of these patients, 15 patients did not fill out the BHLS and could therefore not be included. The total number of included patients was 137 (Appendix 1).

Table 1 The six domains of prehabilitation, assessment and intervention advised

Domain	Assesment	Intervention advised
Physical fitness	6MWT, CPET	Personalized exercise prehabilitation programme
Malnutrition	PG-GSA	Referral to specialized dietician
Anaemia	Hemoglobin, ferritin, transferrin saturation, iron and transferrin levels	Iron injection
Frailty	RFS and GFI	Referral to geriatrician
Substance use (smoking/alcohol)	Questions about smoking and alcohol behaviours	Strong advise to quit and referral to their GP for guidance
Psychological resilience	HADS	Advise to make appointment with mental health nurse at their general practice

6MWT = 6 min walk test, CPET = cardiopulmonary exercise test, GFI = Groningen Frailty Indicator, GP = general practitioner, HADS=Hospital Anxiety and Depression Scale, PG-GSA = Patient-Generated Subjective Global Assessment, RFS = Robinson frailty score.

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Measurement of health literacy

Patients' degree of health literacy was scored by the frequently used and validated BHLS.[3,19,20] This instrument was chosen since it is a brief screening tool, thereby limiting a potential participation bias and providing an easy to collect measurement at the outpatient clinic of health literacy. The BHLS consists of a three-question patient-reported questionnaire (Table 2). For each question, a minimum of 1 point and a maximum of 5 points can be scored. Thus, in total, the minimum score is three points and the maximum score is 15 points. In this study, patients were grouped into two categories based on their score, with patients having a score of 3–11 points categorized as having low health literacy and those with a score of 12–15 categorized as having adequate health literacy. These categories were selected based on previous research.[21]

Variables

Baseline variables included age, sex, body mass index (BMI), intoxications (use of alcohol and smoking), level of education based on the Dutch educational system, and marital status. Clinical variables included BHLS score, American Society of Anesthesiologists (ASA) score,[22] Charlson's Comorbidity Index (CCI),[23] Groningen Frailty Indicator (GFI) to determine frailty,[24] and type of HPB tumor requiring surgery. In addition, the amount of interventions advised for the six domains of the prospective prehabilitation study were registered,[18] since more interventions advised could indicate less healthy patients. These baseline and clinical variables were collected during a visit to the preoperative outpatient clinic at the HPB department. Intraoperative variables included type of surgery and open or laparoscopic procedure. Surgeries were categorized as minor (liver segmental resection, left-sided hemihepatectomy, DLS, biliary surgery, and exploration only) and major (left-sided hemihepatectomy including segment 1, right-sided hemihepatectomy, left- and right-sided extended hemihepatectomy, all pancreatic surgery and palliative (double) bypass surgery). Postoperative variables included complications, severity of complication as defined by the Clavien-Dindo classification,[25] the Comprehensive Complication Index,[26] length of hospital stay in days, transfer to a non-home facility, readmissions within 30 days after discharge, emergency department (ED) visit within 30 days after discharge not leading to readmission, and 30-day postoperative mortality.

Table 2 The three questions of the BHLS and the corresponding answers and points[18]

Item	Response options (score in points)
1. How often do you need help with reading information provided by the hospital or another care provider?	None of the time (5), A little of the time (4), Some of the time (3), Most of the time (2), All of the time (1)
2. How confident are you filling out medical forms by yourself?	Extremely (5), Quite a bit (4), Somewhat (3), A little bit (2), Not at all (1)
3. How often do you experience problems understanding a medical situation because of difficulty understanding written information?	None of the time (5), A little of the time (4), Some of the time (3), Most of the time (2), All of the time (1)

Outcomes

The primary outcome was textbook outcome, with the criteria for this composite endpoint being no development of a severe complication defined as Clavien-Dindo grade $\geq$ IIIa,[25] no length of hospital stay (LOS) in days longer than the procedure specific (liver, pancreatic or other) 75th percentile of the LOS, no readmission within 30 days after discharge, and no 30-day postoperative mortality. There was a textbook outcome when all of these criteria were met. When one or more of the criteria was not met, this was registered as the patient having "no textbook outcome." This definition of textbook outcome was based on previous studies.[13–17] The definition of extended LOS was defined by procedure specific LOS longer than the 75th percentile, in order to reduce the influence of LOS on textbook outcome, since these previous studies have shown that LOS was often the most influencing factor of achieving textbook outcome. In some of these studies, the presence of negative resection margins was also one of the criteria of textbook outcome. In this study, a simplified definition of textbook outcome was used in order to be able to compare the results to surgeries where the definite pathological examination revealed a premalignant or benign lesion. Secondary endpoints were LOS in days after surgery, development of any type of complication, the Comprehensive Complication Index,[26] ED visits not leading to a readmission within 30 days of discharge, and transfer to a non-home facility.

Statistical analysis

Non-normally distributed continuous data was presented as median [interquartile range]. Normality was assessed by histogram and QQ-plot. Categorical data was presented as quantity (proportion). Descriptive statistics were used to analyze the baseline characteristics of the study population. The independent variable was health literacy group. The primary outcome variable was textbook outcome, consisting of a group that did not have a textbook outcome ("no textbook outcome") and a group that did have a textbook outcome ("textbook outcome"). Non-normally distributed continuous variables between two groups were compared using a Mann–Whitney U test. A Pearson Chi-square or Fisher's Exact test was used for the comparison of the binary variable between two groups. For a comparison of categorical variables between the two groups, a Fisher-Freeman-Halton exact test was used. To assess for trends between ordinal categorical variables, the linear-by-linear association test was used. A Spearmann's rho test was used to assess the association between non-normally distributed continuous outcome variables and the binary independent variable. Univariable logistic regression

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analysis was used to select possible predicting variables for textbook outcome. Any variable with a p-value <0.10 in the univariable analysis was included in the multivariable logistic regression analysis. A backward multivariable logistic regression selection analysis was performed to identify independent risk factors for not achieving textbook outcome. A p-value of <0.05 was considered significant. The data was analyzed using SPSS version 23 (IBM, Armonk, NY, USA).

Results

Preoperative characteristics

In total, 137 patients were included, with a median age of 69 years [63.0–74.0], a median BMI of 25.9 kg/m2 [22.7–29.4]. Of the patients, 53.3% (n = 73) were male. The median BHLS score was 14, non-normally distributed. In the study population, 36 patients (26.3%) were classified as having low health literacy. Baseline characteristics are summarized in Table 3 for the entire

Table 3 Pre- and intraoperative characteristics by health literacy groups based on BHLS

	Total (N = 137)	Low HL (n = 36)	Adequate HL (n = 101)	p-value
Age, median [IQR]	69.0 [63.0–74.0]	73.0 [67.5–75.5]	68.0 [60.0–73.0]	**0.002**
Gender				0.061
Male	73 (53.3)	24 (66.7)	49 (48.5)	
Female	64 (46.7)	12 (33.3)	52 (51.5)	
Smoking				>0.99
Yes	18 (13.1)	5 (13.9)	13 (12.9)	
No	119 (86.9)	31 (86.1)	88 (87.1)	
Alcohol				0.319
Yes	31 (22.6)	6 (16.7)	25 (24.8)	
No	106 (77.4)	30 (83.3)	76 (75.2)	
BMI, median [IQR], kg/m^2	25.9 [22.7–29.4]	26.5 [24.1–29.9]	25.8 [22.6–29.2]	0.400
CCI, median [IQR]	3.0 [2.0–4.0]	3.0 [2.0–4.0]	2.0 [2.0–4.0]	0.209
GFI				**0.018**
<4	87 (63.5)	17 (47.2)	70 (69.3)	
≥4	50 (36.5)	19 (52.8)	31 (30.7)	
ASA-score				**0.034**
I	5 (3.6)	0 (0.0)	5 (5.0)	
II	88 (64.2)	20 (55.6)	68 (67.3)	
III	44 (32.1)	16 (44.4)	28 (27.7)	
Interventions advised, median [IQR]	1.0 [0.0–2.0]	1.0 [1.0–2.0]	1.0 [0.0–2.0]	**0.012**
Marital status				0.535
Married	103 (75.2)	29 (80.6)	74 (73.3)	
Widow	13 (9.5)	4 (11.1)	9 (8.9)	
Divorced	12 (8.8)	1 (2.8)	11 (10.9)	
Never been married	9 (6.6)	2 (5.6)	7 (6.9)	
Educational level				**0.039**
No education	3 (2.2)	0 (0.0)	3 (3.0)	
Primary school	6 (4.4)	2 (5.6)	4 (4.0)	
High school	64 (46.7)	23 (63.9)	41 (40.6)	
MBO	31 (22.6)	8 (22.2)	23 (22.8)	
HBO/WO	33 (24.0)	3 (8.3)	30 (29.7)	
Type of surgery				0.660
Minor	38 (27.7)	11 (30.6)	27 (26.7)	
Major	99 (72.3)	25 (69.4)	74 (73.3)	
Open procedure	117 (85.4)	33(91.7)	84 (83.2)	0.215

The values described are numbers (percentage) of patients unless indicated otherwise. The level of statistical significance was $p < 0.05$, and p-values that were significant were marked bold. ASA = American Society of Anesthesiologists, BHLS=Brief Health Literacy Screen, BMI = body mass index, CCI=Charlson Comorbidity Index, GFI = Groningen Frailty Indicator, HBO = "Hoger Beroepsonderwijs," comparable to bachelor's degree, HL = health literacy, MBO = "Middelbaar Beroepsonderwijs," comparable to associate's degree, WO = "Wetenschappelijk Onderwijs," comparable to bachelor's and master's degree.

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study population and for each health literacy group. Low health literacy was significantly associated with higher age (p = 0.002), higher rate of frailty based on GFI score (p = 0.018), higher rate of interventions advised based on screening (p = 0.012), higher ASA-score (p = 0.034) and lower educational level (p = 0.038) when compared to the adequate health literacy group.

Of all patients, 21.9% had a premalignant or malignant liver tumor, 48.9% had a premalignant or malignant pancreatic tumor, and 15.3% had a malignant biliary tumor. Of the patients who underwent surgery for a suspected malignant tumor, 5.8% had a benign tumor of the liver, and 2.9% had a benign tumor of the gallbladder or bile ducts. Other types of tumor necessitating HPB surgery were present in 5.1% of the patients (liver metastases of a solitary liposarcoma, an adenoma with high-grade dysplasia of the duodenum, two cases of duodenal adenocarcinoma, and a neuroendocrine tumor of the stomach).

Intraoperative characteristics

In total, hepatic surgery was performed on 47 patients (34.4%; segmental resection or [extended] hemihepatectomy). Pancreatic surgery was performed on 67 patients (48.9%; pancreatoduodenectomy, subtotal, total, or distal pancreatectomy). Other type of surgery was performed in 23 patients (16.8%), including biliary surgery ([re-]resection of the gallbladder bed and cholecystectomy for gallbladder cancer), palliative double bypass for incurable disease, diagnostic laparoscopic procedure (DLS) and exploration only. In total, 99 patients (72.3%) underwent major surgery, and 117 surgeries (85.4%) were open procedures.

Table 4 Postoperative outcomes by health literacy group based on BHLS score

	Total (N = 137)	Low HL (n = 36)	Adequate HL (n = 102)	p-value
TO achieved	93 (67.9)	20 (55.6)	73 (72.3)	0.095
LOS in days, median [IQR]	10.0 [7.0–16.0]	13.5 [9.0–19.5]	9 [6.0–15.0]	**0.007**
One or more complications	89 (65.0)	28 (77.8)	61 (60.4)	0.061
CD ≥ grade 3a	30 (21.9)	11 (30.6)	19 (18.8)	0.143
Type of complications				
Surgical site infections				
Superficial	19 (13.9)	7 (19.4)	12 (11.9)	0.270
Deep	20 (14.6)	6 (16.7)	14 (13.9)	0.784
Cardiopulmonal	18 (13.1)	7 (19.4)	11 (10.9)	0.249
Trombotic	6 (4.4)	4 (11.1)	2 (2.0)	**0.041**
Renal	6 (4.4)	1 (2.8)	5 (5.0)	>0.99
Hemmorhagic	5 (2.2)	2 (5.6)	3 (3.0)	0.607
Sepsis	3 (2.2)	1 (2.8)	2 (2.0)	>0.99
DGE				0.523
Grade A	4 (2.9)	2 (5.6)	2 (2.0)	
Grade B	5 (3.6)	2 (5.6)	3 (3.0)	
Grade C	10 (7.3)	2 (5.6)	8 (7.9)	
Chylous leakage	25 (18.2)	10 (27.8)	15 (14.9)	0.129
POPF[a]				0.231[a]
Grade A	5 (7.4)[a]	2 (11.8)[a]	3 (6.0)[a]	
Grade B	7 (10.4)[a]	0	7 (14.0)[a]	
Grade C	3 (4.5)[a]	0	3 (6.0)[a]	
Bile leakage	13 (9.5)	3 (8.3)	10 (9.9)	>0.99
Other	48 (35.0)	17 (47.2)	31 (30.7)	0.103
CCI, median [IQR]	8.7 [0.0–29.6]	20.9 [8.7–34.6]	8.7 [0.0–26.2]	0.111
Transfer to nonhome facility	7 (5.1)	4 (11.1)	3 (3.0)	0.079
30-day readmission	14 (10.4)	3 (8.6)	11 (11.0)	>0.99
30-day mortality	1 (0.7)	0 (0.0)	1 (1.0)	>0.99
30-day visit to ED	16 (11.9)	5 (14.3)	11 (11.0)	0.560

The values described are numbers (percentage) of patients unless indicated otherwise. The level of statistical significance was $p < 0.05$, with p-values that were significant formatted as bold. BHLS=Brief Health Literacy Screen, CCI=Comprehensive Complication Index, CD=Clavien-Dindo, HL = health literacy, LOS = Length of stay in hospital, TO = Textbook outcome.
[a] For pancreatic resection only, with percentages described as percentage of patients in pancreatic resection group.

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Intraoperative characteristics were also reported for the low health literacy and adequate health literacy groups (Table 3). There was no significant difference in intraoperative characteristics between groups.

Outcomes

In total, 93 patients (67.9%) achieved a textbook outcome. In the low health literacy group, 55.6% of the patients achieved a textbook outcome as compared to 72.3% in the adequate health literacy group (p = 0.095). The median LOS of the low health literacy group (13.5 days [9.0–19.5]) was significantly longer than that of the adequate health literacy group (9 days [6.0–15.0]; p = 0.007). The rate of complications was 60.4% in the adequate health literacy group, compared with 77.8% in the low health literacy group (p = 0.061). In addition, the median Comprehensive Complication Index was also higher in the low health literacy group (20.9 [8.7–34.6]) compared to the adequate health literacy group (8.7 [0.0–26.2]; p = 0.111). There was no significant difference between groups in rate of transfer to a non-home facility (p = 0.079), rate of 30-day readmission (p > 0.99), or percentage of patients who visited the ED within 30 days of discharge (p = 0.560). All postoperative outcomes are summarized in Table 4.

Using univariable logistic regression analysis, with a p-value of <0.10 considered significant, ASA classification, health literacy, and type of surgery all showed a significant relationship with textbook outcome (see Table 5) and were selected for multiple backward logistic regression analysis. Since higher age is a risk factor for worse postoperative outcomes, and because the average age was significantly higher in the low health literacy group, age was therefore selected for multiple logistic regression analysis.[3] After multiple backward logistic regression analyses, health literacy and type of surgery each showed an independent significant relationship with textbook outcome (Table 5). Age and ASA classification showed no independent significant relationship and were therefore removed from the model. Patients with low health literacy had a 60.0% lower chance of achieving textbook outcome compared to patients who had adequate health literacy (OR 0.400, 95%-CI 0.169–0.948; p = 0.037). For patients who underwent major surgery, the likelihood of achieving textbook outcome was lowered by 89.1% (OR 0.109, 95%-CI 0.031–0.389; p < 0.001) compared to minor surgery.

Discussion

Our results show that low health literacy in HPB surgical patients is a risk factor for not achieving textbook outcome, independent of type of surgery. In addition to this, patients with low health literacy had a significantly longer LOS compared to patients with adequate health literacy. Both of these findings agree with our hypothesis.

There was no significant difference in percentage of patients that visited the ED within 30 days of discharge between health literacy groups. One explanation for this could be that not all patients who visited the ED presented in the index hospital, since only data on ED visits from the index hospital is available. The percentage of ED visits in both groups is therefore probably an underestimation. Another explanation could be that due to the standard postoperative follow-up around two to four weeks after surgery, most of the concerns and complications were diagnosed and treated at an early stage before they resulted in ED visits or readmissions.[5] With respect to health literacy, this study showed that low health literacy was more frequent in patients with a higher age, a higher rate of frailty, more interventions advised based on preoperative screening, a higher ASA-score, and a lower level of education.

These results show that low health literacy is a risk factor for poorer postoperative outcomes in HPB surgery, which could be explained by decreased understanding of preoperative information, difficulties understanding instructions during hospital stay (e.g. early mobilization, intake advice, importance of self-report) and discharge instructions, and management of anxiety regarding self-care.[5,6,27] This highlights the importance of future research on interventions that could improve the understandings of patients with low health literacy in order to improve postoperative outcomes. An example of such an intervention could be provision of written and animation-based preoperative information specially designed for patients with low health literacy. Once such information is designed, it could easily be supplied to patients identified as having low health literacy. At our prehabilitation clinic, extensive preoperative information in spoken form given by a specialized health care nurse is already standard of care. This information could easily be adjusted for patients with low health literacy, thereby improving their understanding about the upcoming procedure. Improving the understanding of preoperative information, could improve adherence to preoperative instructions, thereby improving postoperative outcomes.[28] Another intervention could be providing all patients with low health literacy with pictograph-based discharge instructions, which could lead to less complications by increasing therapy compliance and reducing the feeling of lack of control due to increased understanding.[29,30] For example, longer LOS could be explained by the patient's anxiety regarding discharge after major HPB surgery due to increased fear of complications or difficulties that could occur at home because of not adequately understanding medical information and experiencing a lack of control.[4,29] Interventions to improve understanding could diminish such anxiety and may lead to shorter LOS. At this moment, no research has been done on the effect of improving the understandings of patients with low health literacy on postoperative outcomes. We hypothesize that early preoperative

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Table 5 Pre- and intraoperative characteristics related to achieving a textbook outcome based on backward logistic regression analysis

	Univariable analysis regression		Multiple analysis regression	
	OR (95%-CI)	p-value	OR (95%-CI)	p-value
Age	0.967 (0.928–1.008)	0.107	Removed in step 2	
BMI, kg/m^2	0.972 (0.905–1.043)	0.972		
Sex, male (vs. female)	0.616 (0.297–1.279)	0.194		
BHLS, low HL (vs. adequate HL)	0.479 (0.218–1.055)	**0.068**	0.400 (0.169–0.948)	**0.037**
ASA classification				
ASA I	3.040 (0.314–29.456)	0.337	Removed in step 1	
ASA II	2.027 (0.949–4.329)	**0.068**		
ASA III	reference			
GFI, ≥4 (vs. <4)	0.758 (0.362–1.585)	0.461		
Interventions advised	0.810 (0.590–1.113)	0.194		
Type of surgery, major (vs. minor)	0.121 (0.035–0.421	**<0.001**	0.109 (0.031–0.389)	**<0.001**
Open procedure (vs. laparoscopic procedure)	0.000 (0.000–∞)	>0.99		

Variables in the univariable logistic regression analysis with a $p < 0.10$, formatted in bold, were considered significant and were taken into the multiple regression analysis. In the multiple logistic regression analysis, a $p < 0.05$ was considered significant and formatted as bold. ASA = American Society of Anesthesiologists, BHLS = Brief Health Literacy Screen, BMI = body mass index, GFI = Groningen Frailty Indicator.

identification of patients with low health literacy enables one to better educate and guide these patients perioperatively, leading to better postoperative outcomes. Future research should focus on the effects of health literacy interventions on postoperative outcomes.

Strengths and limitations

This study has shown that a relatively simple health literacy score is easy to collect preoperatively within the HPB surgery population. Since all of our patients are referred to our prehabilitation outpatient clinic, health literacy was already determined for all HPB patients. This allowed us to identify patients with low health literacy early and will give healthcare professionals an opportunity to improve these patients' understandings with targeted interventions in the future.

In this study, different types of surgeries with a wide range of complexity and extensiveness were considered, in contrast to most other studies on health literacy and postoperative outcomes, which only considered one or a few types of surgery.[3] We corrected our results for type of surgery (minor vs. major), which strengthens our results and ensures that they are representative of surgical patients in general. Due to the general nature of the definition of textbook outcome used in this study, this definition can be used across different surgical specialties, making it easier to compare and combine different surgical specialties in future research. However, there is still an ongoing discussion on the definition of textbook outcome in the field of surgery, and many definitions of it exist.

This study has several limitations. One limitation is the small sample size. Furthermore, this study used a health literacy tool that was based on self-report, which could have led to participation bias and could have influenced the quality of data collected from patients with low health literacy. However, the prevalence of low health literacy in our study population was equal to the prevalence of low health literacy in the Netherlands, indicating that the small sample size and any self-reporting effect on our results was limited.

Conclusion

Low health literacy is associated with a lower chance of achieving a textbook outcome after HPB cancer surgery, with patients with low health literacy having a longer LOS. Interventions could improve the understanding of these patients, which could lead to better postoperative outcomes. Therefore, low health literacy could be the next patient-related modifiable risk factor to be taken into account in a prehabilitation trajectory before surgery.

Acknowledgments

We would like to thank Thea A. Dijkstra-Jansma, Olette J. Pras, Leona Hazenhoek, Leanne Plas- Kemper and Ellen S. Jellema-Betten for their contributions to the implementation of the prehabilitation outpatient clinic and the collection of data.

Funding

This work was supported by Johnson & Johnson Medical Devices Company (HIP022512, Grant UMCG 2019) and the University Medical Centre Groningen (Public-Private Partnership allowance (PPP-2019_009)).

Conflicts of interest

None to declare.

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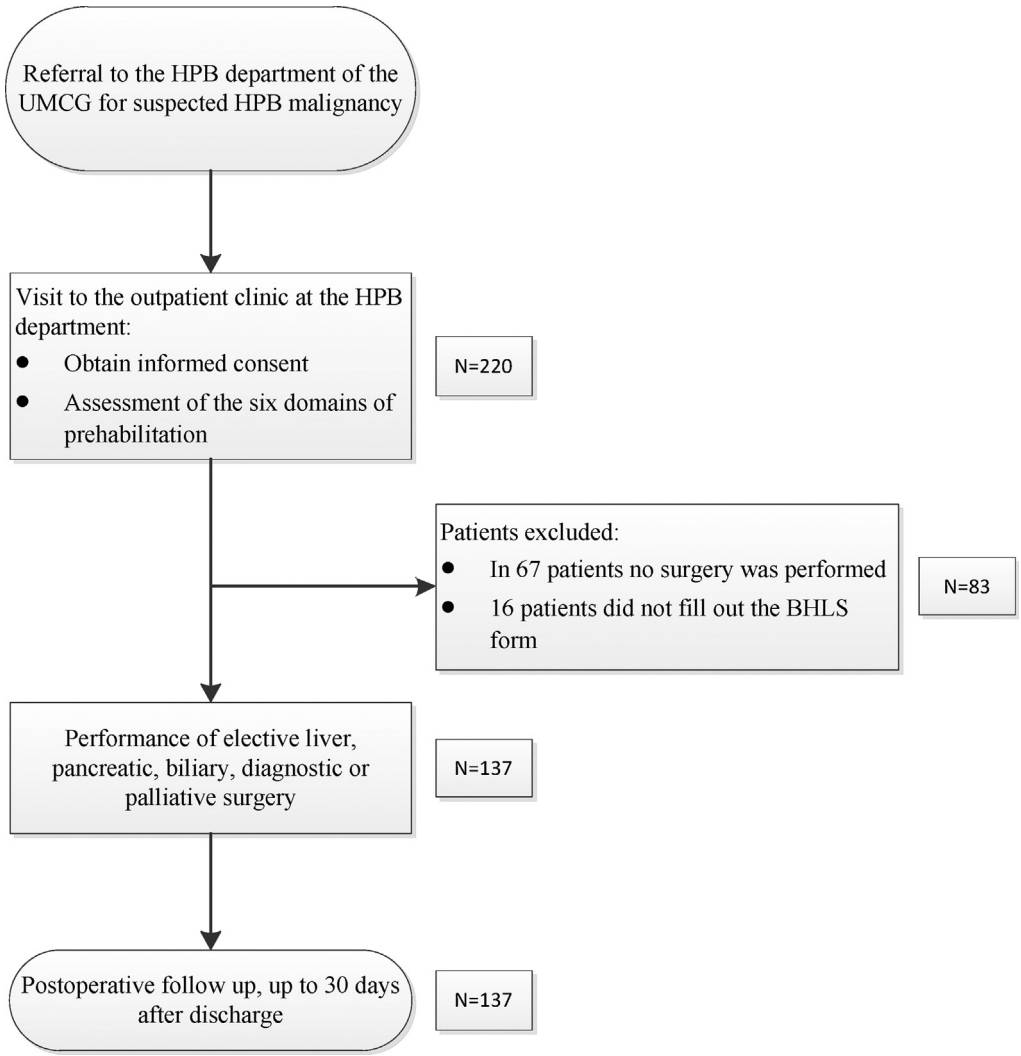
Appendix 1. Flow chart of inclusions and exclusions



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