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A Prospective Observational Cohort Study of Language Preference and Preoperative Cognitive Screening in Older Adults: Do Language Disparities Exist in Cognitive Screening and Does the Association Between Test Results and Postoperative Delirium Differ Based on Language Preference?

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Abstract

Background: A greater percentage of surgical procedures are being performed each year on patients 65 years of age or older. Concurrently, a growing proportion of patients in English-speaking countries such as the United States (US), United Kingdom (UK), Australia and Canada have a language other than English (LOE) preference. We aimed to measure whether LOE patients underwent cognitive screening at the same rates as their English-speaking counterparts

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when routine screening was instituted. We also aimed to measure the association of preoperative Mini-Cog and postoperative delirium (POD) in both English-speaking and LOE patients.

Methods: We conducted a single center, observational cohort study in patients 65 years old or older, scheduled for surgery and evaluated in the preoperative clinic. Cognitive screening of older adults was recommended as an institutional program for all patients 65 and older presenting to the preoperative clinic. We measured program adherence for cognitive screening. We also assessed the association of preoperative impairment on Mini-Cog and POD in both English-speaking and LOE patients, and whether the association differed for the two groups. A Mini-Cog score ≤ 2 was considered impaired. Postoperatively, patients were assessed for POD using the Confusion Assessment Method (CAM) and by systematic chart review.

Results: Over a three-year period (February 2019-January 2022), 2,446 patients 65 years old or older were assessed in the preoperative clinic prior. Of those 1,956 patients underwent cognitive screening. Eighty-nine percent of English-speaking patients underwent preoperative cognitive screening, compared to 58% of LOE patients. The odds of having a mini-cog assessment were 5.6 times higher (95% CI 4.6–7.0) $p<0.001$ for English speaking patients compared to LOE patients. In English-speaking patients with a positive Mini-Cog screen, the odds of having post op delirium were 3.5 times higher (95% CI 2.6–4.8) $p<0.001$ when compared to negative Mini-cog. In LOE patients, the odds of having post op delirium were 3.9 times higher (95% CI 2.1–7.3) $p<0.001$ for those with a positive Mini-Cog compared to a negative Mini-cog. The difference between these two odds ratios was not significant p-value=0.753.

Conclusion: We observed disparity in the rates LOE patients were cognitively screened prior to surgery, despite the Mini-Cog being associated with POD in both English-speaking and LOE patients. Efforts should be made to identify barriers for cognitive screening in limited English proficient older adults.

Summary

Routine preoperative cognitive screening has the potential to identify those at risk of developing postoperative delirium. We found that those who speak a language other than English are less likely to undergo preoperative cognitive screening than their English-speaking counterparts. Yet screening with the Mini-Cog was associated with postoperative delirium regardless of the language proficiency. Efforts should be made to identify barriers for cognitive screening in older adults who do not speak English to reduce disparities.

INTRODUCTION

Worldwide, populations with cultural and linguistic diversity face hurdles accessing equitable healthcare[1]. In the perioperative setting, a key vulnerable population are older adults, where language discordance can lead to misdiagnosis, treatment failures, and medical errors[1–3].

A larger percentage of surgical procedures are being performed each year in patients 65 years old or older.[4, 5]. Perioperative Neurocognitive Disorders defined as memory disturbances and other types of cognitive impairment in the perioperative period, are increasingly recognized as an area of concern in older adults, as they are associated with increased morbidity and mortality. Specifically, postoperative delirium (POD) is a common complication, affecting up to 45% of older adults undergoing elective surgery[6]. POD is associated with long term sequalae creating a significant burden for the patient and their families and increasing healthcare system costs. The ability to identify those at risk for developing POD presents an opportunity for strategic interventions throughout the perioperative period to improve outcomes. To that end, in 2012 the American Geriatrics Society and the American College of Surgeons jointly released recommendations emphasizing the importance of preoperative cognitive screening for older adults[7]. Since then, many studies have focused on preoperative cognitive screening to identify those at risk of developing POD, but few studies have included older adults that have a language other than English (LOE) preference.

In the US, nearly 68 million people speak a language other than English at home[4]. In Australia and in the UK nearly 22% and 20% of the population speaks a language other than English at home[8, 9]. In the perioperative community there is a paucity of data associating LOE with post-surgical outcomes[10]. However, there is a growing body of literature that shows those with LOE are likely to be hospitalized longer and have worst access to care[11]. Furthermore, ethnoracial disparities exist such that older adults with LOE are often diagnosed with mild cognitive impairment or dementia at advanced stages of these disease processes[12, 13], increasing their risk of having adverse postoperative cognitive outcomes.

The primary objective was to compare preoperative cognitive screening rates for LOE and English-speaking patients after implementation of routine cognitive screening. We also aimed to assess the association of preoperative impairment on Mini-Cog and postoperative delirium (POD) in both English-speaking and LOE patients, and whether the association differed for the two groups. We hypothesized that routine preoperative cognitive screening with the Mini-Cog could be used to identify older adults at risk of developing POD in English and LOE patients presenting for elective surgical procedures.

METHODS

In accordance with recommendations from the American Society of Anesthesiologists (ASA), the American Geriatrics Society and the American College of Surgeons, the preoperative clinic at our institution implemented a routine cognitive screening program for adults 65 years of age or older since February 2019. After institutional review board approval, waiver of consent, and in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines[14], we conducted an observational cohort study. This study was conducted in a large academic medical center serving a diverse patient population in Los Angeles, CA. The preoperative clinic evaluates nearly 36,000 cases annually. Those deemed appropriate for a telephone interview are assessed in that manner, and over 1,000 patients are evaluated in the clinic annually. The preoperative clinic team is composed of physicians (one faculty in clinic per day from a group of seven faculty), four nurse practitioners, 20 registered nurses, and three support staff[15]. Patients presenting to the clinic were evaluated preoperatively by one faculty anesthesiologist, an anesthesiology resident, and a nurse practitioner as standard patient care.

Study Population

During a three-year period (February 2019-January 2022), all adults 65 years of age or older, who were assessed by the preoperative clinic for non-cardiac, non-transplant, elective surgery and expected to require postoperative hospitalization of at least one night, were included in the study. Patients scheduled for intracranial neurosurgery were excluded from this study. Those patients who presented multiple times for medical evaluation and optimization or for multiple surgeries, were only included during their initial assessment. Therefore, the cohort was comprised of only unique patient visits.

Assessments

Cognitive Screening—The Mini-Cog assessment was selected for cognitive screening as it takes approximately three minutes to complete, is a validated tool available in 21 languages, has high interrater reliability, has minimal education or ethnicity bias, and is available for clinical purposes[16, 17]. Prior to implementation, a single registered nurse (SF) in the preoperative clinic underwent Mini-Cog training and performed all assessments. Training was conducted in the month prior to program implementation and included practice screening using the Mini-Cog with a medical translator to ensure exact wording was used and not improvised by the translator. Screening was recommended as an institutional program for all patients 65 years old or older presenting for preoperative assessment as part of routine medical care. The Mini-Cog consists of a three-word recall test and a clock drawing test[18, 19]. The scoring system awards up to five points total: three points for a 3-item recall, and two points for drawing a normal clock, and zero points for drawing an abnormal clock[18, 19]. A score of two or lower is considered abnormal and indicates probable cognitive impairment. The assessments were recorded in the electronic medical record and a scan of the clock was uploaded into the record, making it available for all healthcare providers.

Delirium Screening—Delirium was identified in the first five days after surgery both by assessment with the Confusion Assessment Method (CAM) and chart review using published criteria[20]. Hospitalized patients 65 years of age or older at our institution undergo delirium screening using CAM or CAM-ICU twice per day by nursing staff as standard patient care (every 12 hours). CAM scores are entered into the electronic medical record. We elected a-priori to also include delirium by chart review, as it has been shown to complement CAM, given that delirium is a state of altered consciousness that waxes and wanes throughout the day[16]. CAM assessments, which at our institution are administered twice per day, can miss acute episodes of delirium.

Language other than English Preference (LOE)

Traditionally in English speaking countries, those who have a language preference other than English have been identified as limited English proficient. The US Department of Health and Human Services defines Limited English Proficient as "*If English is not your primary language and you have difficulty communicating effectively in English, you may need an interpreter or document translation…*"[21]. However, there is no clear consensus for identification of limited English proficient in the clinical setting[22]. Further, the term can denote deficiency in the patient for not speaking English, or signing their preferred language[23, 24]. For the purposes of this study, patients were determined to have language other than English (LOE) preference if they met any of the three following criteria: 1) Self-identified, 2) A translator was used to obtain consent, or 3) Review of records indicated needing language assistance during clinical care[22].

Demographic and Post-Surgical Outcomes Data

Demographic data, including age, sex, body mass index (BMI), type of surgery, ASA status, education, and other co-morbidities such as hypertension, stroke/cerebral vascular accident, and diabetes were recorded the day of cognitive screening in the preoperative clinic. Independence was measured through the Katz index of activities of daily living (ADL)[25]. All other variables were extracted through a systematic chart review.

Statistical Analysis

The primary objective was to assess the association between LOE preference and having a mini-cog assessment. In order to explore this hypothesis, we first summarized patient characteristics and study variables between groups (English preference, LOE) using means ± SDs or frequency (percentage) unless otherwise noted. We formally compared the groups using t-tests or chi-square tests and also computed standardized mean differences (SMDs) using methods described by Yang & Dalton[26]. We then constructed a multivariable logistic regression model for mini-cog assessment performed (yes/no) with LOE preference as our main predictor, we also controlled/adjusted for age, sex, education, ADL, hypertension, stroke/cerebral vascular accident, diabetes, BMI, ASA, and type of surgery. The secondary objective was for those who had a mini-cog assessment- to assess the association between mini-cog results and delirium and to see if that association differed by LOE preference. We explored this hypothesis similarly to the primary objective, first by summarizing variables between mini-cog (<=2, >2) and then running a multivariable logistic regression model for delirium with primary terms of LOE preference and mini-cog result (plus interaction) while controlling/adjusting for age, sex, education, ADL, hypertension, stroke/cerebral vascular accident, diabetes, BMI, ASA, and type of surgery. From this model we then estimated odds ratios for delirium based on mini-cog results for each group (English preference and LOE) as well as compared them using the interaction term. For some of the primary rates of interest we also computed 95% confidence intervals using the normal approximation to the binomial distribution (Wilson procedure without a continuity correction)[27]. All tests were 2-tailed, and a p value of <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS V25 (Armonk, NY). With a total of 1,761 English-speaking patients and 685 LOE patients, we were adequately powered (87.6%) to detect a difference in proportion of Mini-cog assessments between groups as small as 7% (for example 47% vs 54%) using a weighted chi-square test (group weights 1:2.57 since we had 2.57 English-speaking patients compared to LOE patients), two-sided, alpha=0.05.

RESULTS

During a three-year period, 2,446 patients 65 years of age or older were assessed in the preoperative clinic prior to their surgical procedures (Figure 1).

Preoperative cognitive screening in English-speaking and LOE patients

Of those 1,956 (80%) patients were screened with the Mini-Cog. Eighty-nine percent of English-speaking patients were screened with the Mini-Cog, while only 58% of LOE patients were screened. There were no statistically significant differences in baseline characteristics between the English-speaking and LOE patients (Tables 1). The odds of having a mini-cog assessment were 5.6 times higher (95% CI 4.6–7.0) p<0.001 for English-speaking patients compared to LOE patients (multivariable logistic regression, adjusting for age, sex, education, ADL, hypertension, stroke/cerebral vascular accident, diabetes, BMI, ASA, and type of surgery) (Table 2). Overall, 549 of 1,956 [28% (95%CI: 0.26–0.30)] patients scored ≤ 2 on the preoperative Mini-Cog, suggesting probable cognitive impairment. English-speaking patients scored 2 or lower on the Mini-Cog 28% (95% CI: 0.26–0.30) and LOE patients at 29% (95% CI: 0.25–0.34) of LEP scored ≤ 2 on Mini-Cog, P=0.681 (Table 3).

Preoperative Mini-Cog association to postoperative delirium in English-speaking and LOE patients

For those who had a mini-cog assessment, in the English-speaking patients, the odds of having post op delirium were 3.5 times higher (95% CI 2.6–4.8) p<0.001 for those with a positive compared to negative mini-cog. For LOE patients, the odds of having post op delirium were 3.9 times higher (95% CI 2.1–7.3) p<0.001 for those with a positive compared to negative mini-cog. The difference between these two odds ratios was not significant (estimated by the interaction term, p-value=0.753) meaning that the association between mini-cog and delirium was not significantly different by LOE preference (multivariable logistic regression, adjusting for age, sex, education, ADL, hypertension, stroke/cerebra vascular accident, diabetes, BMI, ASA, and type of surgery) (Table 4).

Postoperative delirium in English-speaking and LOE patients not screened with the Mini-Cog

In the 490 patients who did not receive preoperative Mini-Cog screening, 205 [42%, (95% CI: 0.38–0.46)] developed POD. When analyzing by language preference, 47% (95%CI: 0.40–0.54) of English-speaking patients developed POD, while 38% (95%CI: 0.33–0.44) LOE patients developed POD (p=0.061) (Supplemental Table1).

DISCUSSION

In this single center observational cohort study, we identified differences in adherence to the cognitive screening program and observed significant disparity in preoperative neurocognitive screening rates using the Mini-Cog among LOE patients compared to their English-speaking counterparts. Even though routine preoperative cognitive screening was introduced as an institutional program for all patients 65 years of age or older, those who are LOE were less likely to undergo preoperative cognitive screening. Multiple studies have shown that baseline cognitive impairment is a strong risk factor for developing POD[16, 28]. Importantly, studies have also demonstrated that ethnoracial disparities exist resulting in older adults with LOE being diagnosed with MCI or dementia at more advanced stages[12, 13].Our study suggests that older adults, regardless of primary language, who present as cognitively well prior to surgery suffer from probable cognitive impairment at similar rates. Therefore, all patients regardless of language proficiency may benefit from preoperative screening to identify those at risk of developing POD.

Postoperative delirium is associated with increased morbidity and mortality. In a recent study, *Kunicki et al.* found that a single episode of postoperative delirium after major elective surgery is associated with accelerated long term cognitive decline[28]. The cognitive effects of postoperative delirium have long lasting effects and preoperative cognitive screening presents an opportunity to identify those at risk[29]. Furthermore, language plays an important role in diagnosing cognitive changes and ignoring the major influence of language can lead to diagnostic errors and treatment failure. As the surgical population ages and becomes more diverse, cognitive screening of all older adults has the capacity to improve patient outcomes. Our study found that the Mini-Cog in LOE is associated with POD at similar rates as in English speaking populations. The Mini-Cog was developed in heterogenous populations with cultural and language diversity[30, 31]. In fact, *Borson et al.* demonstrated that Mini-Cog can be reliably used with an interpreter in multiple languages[30]. Furthermore, the Mini-Cog is validated and available in 21 languages freely available making it an easy, affordable, and accessible preoperative screening tool[31]. As a screening tool, the Mini-Cog can easily be incorporated into the preoperative setting to identify those at risk for POD. Early cognitive screening also presents an opportunity to refer patients for definitive dementia diagnosis or neurocognitive optimization[17].

Interestingly, in our study, we found that a large proportion (42%) of those that did not undergo Mini-Cog screening developed POD. Given that those with LOE were less likely to undergo Mini-Cog Screening, this identifies an opportunity to improve parity of perioperative care. It is postulated that the reason for the higher rates of POD in unscreened patients, is that without the abnormal Mini-Cog the patient may not have received additional cognitive consultations or identified as high risk by the treating team. Alternatively, those patients may have been sicker, or already demented making it harder for the screening to occur. However, further inquiry will be required to understand the root cause for the higher rates of POD in the unscreened group. Nonetheless, it seems clear that identifying those at risk has the capacity to improve outcomes.

In this study, we used a Mini-Cog score ≤ 2 to define probable cognitive impairment. However, others have argued that less than 4 should be used as the cut-off to improve detection of milder cognitive impairment[32]. It is important to note that an abnormal Mini-Cog score is not by itself diagnostic of dementia or cognitive impairment. Instead, the Mini-Cog is a screening tool that should warrant further neuropsychological testing by a trained professional for a formal diagnosis. The value of a screening tool is to identify those who may be at risk of POD to optimize, modify care, and provide informed risk/benefit discussions for the proposed procedure.

Limitations and Future Directions

There are several limitations to our study. First, this was a single center observational cohort study and not necessarily representative of worldwide perioperative experience. However, multiple studies indicate that routine cognitive screening worldwide remains low, and in English speaking countries, studies rarely address results of LOE patients. Second, older adults were not routinely screened for cognitive impairment nor POD prior to implementation of the cognitive screening pathway. Therefore, it is unclear whether routine screening at our institution improved patient outcomes. Third, the definition of LOE can be problematic even in self-reported instances. Patients may indicate primary language as other than English yet have proficiency in English, requiring fluency tests to determine degree of LOE. Lastly, understanding why those with LOE underwent screening at lower rates is important in understanding how this gap can be improved. A key limitation of this study is that why a patient did not undergo cognitive screening was not document. Since a single nurse conducted the screening anecdotal information is able to be provided. A contributing factor is that when this program was developed, it was designed with English- speaking patients in mind. Therefore, time allocations for scheduled visits tended to be longer and medical translators were not always available. Other reasons for not completing the assessment included, connection issues with video or telephone translators, patient refusal, patient or family indicating they were short of time. Furthermore, program evaluation did not specifically look at differences in language preference when evaluating for adherence, therefore disparity was not readily apparent. Future studies should validate these results on a larger scale and whether training of assessors to implement Mini-Cog in different languages diminishes the observed disparity. Designing programs with LOE patients in mind, is important to close the gap in screening and improve all patient outcomes.

Although the Mini-Cog is a relatively quick (3-minute) screening tool, it is worth noting that it may be impractical to use without dedicated staffing to support a busy perioperative program. Recently, Bishara *et al*. developed machine learning models to predict POD in the perioperative setting[33]. Although artificial intelligence tools show great promise, care must be taken to mitigate potential bias, and ensure they are able to predict POD in diverse patient populations with linguistic diversity[34].

CONCLUSION

We observed a disparity in preoperative neurocognitive screening rates among LOE patients compared to their English-speaking counterparts. Our study found that Mini-Cog can be used preoperatively in both English-speaking and LOE patients to identify those at risk of developing postoperative delirium. Future studies should focus on further identifying what obstacles lead to lower rates of neurocognitive screening among LOE patients and how to intervene to reduce the incidence of postoperative delirium.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Conflict of Interest:

Dr. Canales was selected as a RCMAR/CHIME Scientist (2022–2023) to support her work on PND in Minority Elders. The award is funded by NIA Grant #P30-AG021684 and NCATS Grant #UL1TR001881. Dr. Cannesson has NIH funding from NHLBI R01HL144692 and NIBIB R01EB029751. Dr. Cannesson is a consultant for Edwards Lifesciences and Masimo Corp, and has funded research from Edwards Lifesciences and Masimo Corp. He is also the founder of Sironis and he owns patents and receives royalties for closed loop hemodynamic management technologies that have been licensed to Edwards Lifesciences.

Glossary of Terms

US	United States
UK	United Kingdom
LOE	Language Other and English Preference
POD	Postoperative Delirium
CAM	Confusion Assessment Method
ASA	American Society of Anesthesiologists
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
SMDs	Standard Mean Differences
ADL	Activities of Daily Living

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Key Findings

- Question: Does preoperative cognitive screening occur at the same rate in those with language preference other than English when compared with English preference?
- Findings: Differences exist in the rates of cognitive screening between English-speaking and language other than English speaking patients.
- Meaning: By ignoring older adults who speak a language other than English during preoperative cognitive screening, health disparities may be introduced, which has implications for postoperative complications.
- Question: Is preoperative Mini-Cog associated with postoperative delirium in older adults who speak a language other than English?
- Findings: Abnormal Mini-Cog scores are associated with postoperative delirium in those who speak English and in those whose a language preference is other than English.
- Meaning: Preoperative Mini-Cog screening has the potential to identify those at risk of developing postoperative delirium, regardless of primary language.

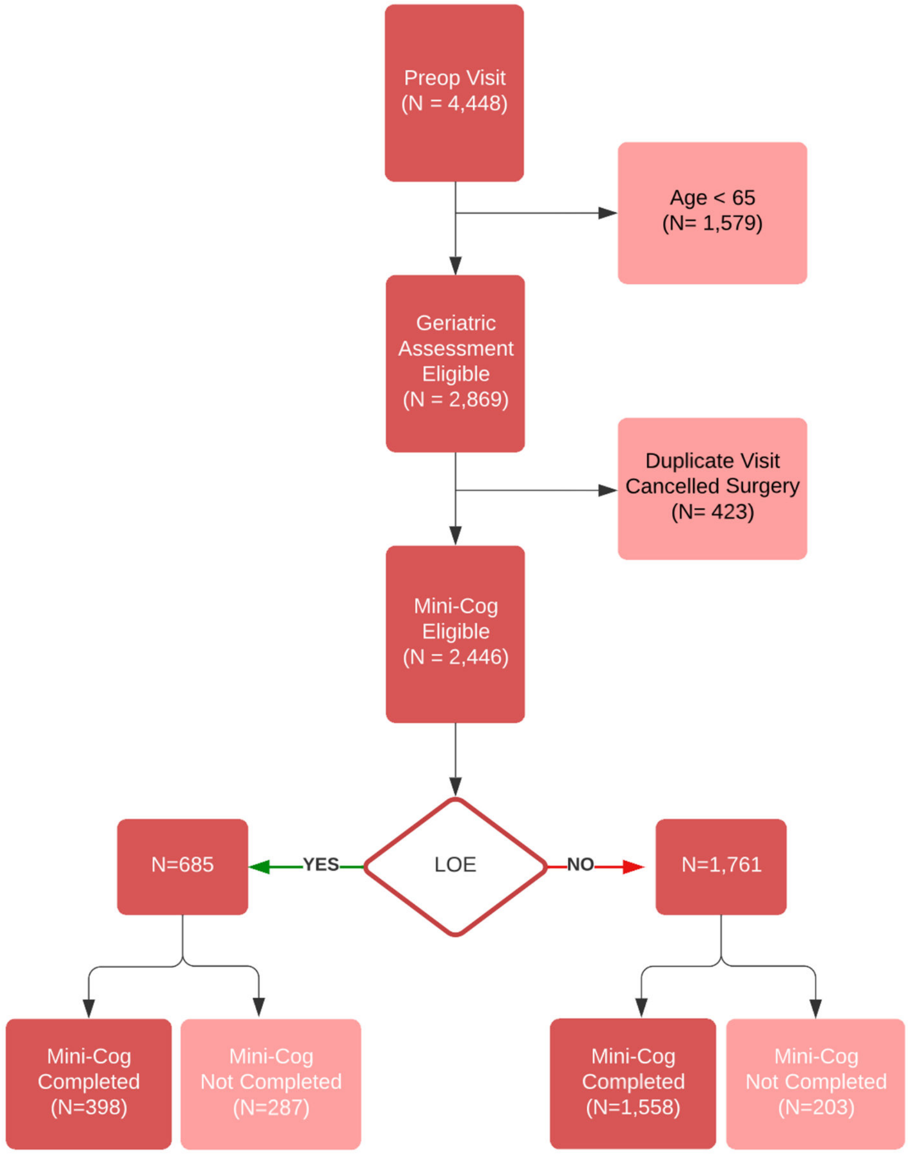

Figure 1.

Study Flow Diagram

Figure 1 Depicts flowchart of patients 65 years of age or older presenting to the preoperative clinic, language preference, and Mini-Cog assessment status. LOE=language other than English preference. Preop= preoperative.

Table 1.

Baseline Patient Characteristics by Language Preference

	ENGLISH (N=1761)	LOE (N=685)	P-VALUE	SMD
AGE, MEAN ± *SD*	74.7 ± 6.7	75.1 ± 6.9	0.261	0.05
FEMALE, N (%)	1150 (65.3%)	435 (63.5%)	0.403	<0.01
EDUCATION, N (%)			0.615	0.06
GREATER THAN HIGHSCHOOL	446 (25.3%)	177 (25.8%)		
HIGHSCHOOL GRADUATE	576 (32.7%)	210 (30.7%)		
DID NOT GRADUATE HIGHSCHOOL	739 (42.0%)	298 (43.5%)		
INDEPENDENCE, MEAN ± SD	4.83 ± 0.92	4.81 ± 0.92	0.660	0.02
HYPERTENSION, N (%)	919 (52.2%)	356 (52.0%)	0.924	<0.01
STROKE/CEREBRAL VASCULAR ACCIDENT, N (%)	443 (25.2%)	166 (24.2%)	0.636	0.02
DIABETES, N (%)	428 (24.3%)	163 (23.8%)	0.792	0.01
BMI, MEAN ± SD	27.4 ± 6.2	27.9 ± 6.9	0.916	<0.01
ASA STATUS, N (%)			0.572	0.07
2	566 (32.2%)	212 (30.9%)		
3	902 (51.3%)	367 (53.6%)		
4	292 (16.6%)	106 (15.5%)		
LANGUAGE PREFERENCE, N (%)			**<0.001**	6.16
ARMENIAN	0 (0.0%)	51 (7.4%)		
CHINESE	0 (0.0%)	88 (12.8%)		
ENGLISH	1759 (99.9%)	0 (0.0%)		
FARSI	0 (0.0%)	46 (6.7%)		
KOREAN	0 (0.0%)	41 (6.0%)		
OTHER	2 (0.1%)	103 (15%)		
SPANISH	0 (0.0%)	323 (47.2%)		
VIETNAMESE	0 (0.0%)	33 (4.8%)		
SURGERY TYPE, N (%)			0.732	0.07
COLORECTAL	127 (7.2%)	53 (7.7%)		
GENSURG	224 (12.7%)	83 (12.1%)		
GYN/GYNONC	185 (10.5%)	84 (12.3%)		
ORTHO	463 (26.3%)	187 (27.3%)		
OTHER	570 (32.4%)	206 (30.1%)		
UROLOGY	192 (10.9%)	72 (10.5%)		
DELIRIUM, N (%)	324 (18.4%)	164 (23.9%)	**0.002**	0.14
MINI-COG, N (%)			**<0.001**	0.75
NEGATIVE (> 2)	1124 (63.8%)	283 (41.3%)		
POSITIVE (≤ 2)	434 (24.6%)	115 (16.8%)		
NOT ASSESSED	203 (11.5%)	287 (41.9%)		

SD = standard deviation; BMI= body mass index; ASA = American Society of Anesthesiologists; ONC = oncology. Independence assessed using KATZ index Activity of Daily Living; 1= completely dependent, 6 = completely independent. Mini-Cog ≤ 2 was considered abnormal, Mini-Cog > 2 was considered normal.

Table 2.

Baseline Patient Characteristics by Mini-Cog Score

	MINI-COG <= 2 (N=1407)	MINI-COG >2 (N=549)	P-VALUE	SMD
AGE, MEAN ± *SD*	74.7 ± 6.7	74.9 ± 6.7	0.690	0.02
FEMALE, N (%)	933 (66.3%)	347 (63.2%)	0.194	0.03
EDUCATION, N (%)			0.871	0.03
GREATER THAN HIGHSCHOOL	367 (26.1%)	137 (25.0%)		
HIGHSCHOOL GRADUATE	445 (31.6%)	175 (31.9%)		
DID NOT GRADUATE HIGHSCHOOL	595 (42.3%)	237 (43.2%)		
INDEPENDENCE, MEAN ± SD	4.84 (0.91)	4.84 (0.90)	0.962	<0.01
HYPERTENSION, N (%)	721 (51.2%)	290 (52.8%)	0.53	0.03
STROKE/CEREBRAL VASCULAR ACCIDENT, N (%)	354 (25.2%)	112 (20.4%)	0.026	0.11
DIABETES, N (%)	335 (23.8%)	134 (24.4%)	0.781	0.01
BMI, MEAN ± SD	27.3 ± 6.0	27.4 ± 6.4	0.600	0.03
ASA STATUS, N (%)			0.817	0.05
2	458 (32.6%)	178 (32.4%)		
3	726 (51.6%)	278 (50.6%)		
4	222 (15.8%)	93 (16.9%)		
LANGUAGE PREFERENCE, N (%)			0.946	0.08
ARMENIAN	21 (1.5%)	11 (2.0%)		
CHINESE	38 (2.7%)	14 (2.6%)		
ENGLISH	1123 (79.8%)	434 (79.1%)		
FARSI	21 (1.5%)	7 (1.3%)		
KOREAN	13 (0.9%)	8 (1.5%)		
OTHER	44 (3.1%)	15 (2.7%)		
SPANISH	134 (9.5%)	54 (9.8%)		
VIETNAMESE	13 (0.9%)	6 (1.1%)		
SURG TYPE, N (%)			0.671	0.09
COLORECTAL	107 (7.6%)	41 (7.5%)		
GENSURG	168 (11.9%)	73 (13.3%)		
GYN/GYNONC	146 (10.4%)	62 (11.3%)		
ORTHO	367 (26.1%)	154 (28.1%)		
OTHER	458 (32.6%)	165 (30.1%)		
UROLOGY	161 (11.4%)	54 (9.8%)		
DELIRIUM, N (%)	137 (9.7%)	146 (26.6%)	<0.001	0.45
LOE, N (%)	283 (20.1%)	115 (20.9%)	0.681	0.02

Mini-Cog ≤ 2 was considered abnormal, Mini-Cog > 2 was considered normal; SD = standard deviation; BMI= body mass index; ASA = American Society of Anesthesiologists; ONC = oncology; LOE = language other than English preference. Activity of Daily Living assessed using KATZ index.

Table 3.

Adjusted Association between English-Speaking Status and Min-Cog Protocol Adherence

MULTIVARIABLE MODEL	OR (95% CI)	P-VALUE
ENGLISH SPEAKER *	5.6 (4.6 – 7.0)	<0.001
AGE	1.00 (0.98 – 1.01)	0.617
FEMALE	1.2 (0.94 – 1.5)	0.148
EDUCATION		0.552
GREATER THAN HIGHSCHOOL VS HIGHSCHOOL GRADUATE	1.2 (0.85 – 1.6)	0.367
DID NOT GRADUATE HIGHSCHOO VS HIGHSCHOOL GRADUATE	1.1 (0.88 – 1.5)	0.338
INDEPENDENCE	1.01 (0.88 – 1.2)	0.913
HYPERTENSION	0.93 (0.75 – 1.2)	0.491
STROKE/CEREBRAL VASCULAR ACCIDENT	0.73 (0.55 – 0.97)	0.028
DIABETES	1.05 (0.81 – 1.4)	0.729
BMI	0.99 (0.97 – 1.01)	0.225
ASA	0.91 (0.78 – 1.07)	0.269
TYPE OF SURGERY		0.693
COLORECTAL VS UROLOGY	1.1 (0.66 – 1.9)	
GEN SURG VS UROLOGY	0.81 (0.52 – 1.3)	
GYN VS UROLOGY	0.76 (0.48 – 1.2)	
ORTHO VS UROLOGY	0.92 (0.63 – 1.4)	
OTHER VS UROLOGY	0.88 (0.60 – 1.3)	

* Main predictor-English speaker compared to language other than English preference.

Table 4.

Adjusted Association for Delirium by English-Speaking Status and Min-Cog Result

MULTIVARIABLE MODEL	OR (95% CI)	P-VALUE
LEP	--	0.374
MINI-COG	--	<0.001
LEP *MINI-COG		0.753
OVERALL	3.7 (2.7 – 5.2)	<0.001
NON LEP	3.5 (2.6 – 4.8)	<0.001
LEP	3.9 (2.1 – 7.3)	<0.001
AGE	1.08 (1.06 – 1.1)	<0.001
FEMALE	0.73 (0.55 – 0.97)	0.029
EDUCATION		0.529
GREATER THAN HIGHSCHOOL VS HIGHSCHOOL GRADUATE	1.06 (0.74 – 1.5)	
DID NOT GRADUATE HIGHSCHOO VS HIGHSCHOOL GRADUATE	0.88 (0.64 – 1.2)	
INDEPENDENCE	1.1 (0.93 – 1.3)	0.269
HYPERTENSION	1.07 (0.82 – 1.4)	0.610
STROKE/CEREBRAL VASCULAR ACCIDENT	1.5 (1.05 – 2.2)	0.026
DIABETES	0.73 (0.52 – 1.03)	0.073
BMI	1.01 (0.99 – 1.03)	0.559
ASA	1.05 (0.86 – 1.3)	0.661
TYPE OF SURGERY		0.784
COLORECTAL VS UROLOGY	0.81 (0.43 – 1.5)	
GEN SURG VS UROLOGY	0.75 (0.43 – 1.3)	
GYN VS UROLOGY	0.71 (0.39 – 1.3)	
ORTHO VS UROLOGY	0.94 (0.59 – 1.5)	
OTHER VS UROLOGY	0.94 (0.60 – 1.5)	

* Main predictor-Delirium, Mini-Cog Score, and Language Interaction.