

Health Literacy Among Surgical Patients: A Systematic Review and Meta-analysis

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Published online: 13 August 2018
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Abstract Health literacy is the extent to which patients are able to understand and act upon health information. This concept is important for surgeons as their patients have to comprehend the nature, risks and benefits of surgical procedures, adhere to perioperative instructions, and make complex care decisions about interventions. Our review aimed to determine the prevalence of limited health literacy of the surgical patient population. A search of MEDLINE and EMBASE was performed from inception until January 14th 2017 for experimental and observational studies reporting surgical patients' health literacy measurement. Overall pooled proportion of surgical patients with limited health literacy was calculated using a random-effects model and methodologic quality was assessed. A total of 40 studies representing 18,895 surgical patients were included in our quantitative synthesis. Pooled estimate of limited health literacy was 31.7% (95%CI 24.7–39.2%, I^2 99.0%). There was low risk of bias among the majority of the 51 studies included in the qualitative synthesis. Statistical heterogeneity could not be fully accounted for by methodologic quality or patient and surgical characteristics. However, some of the heterogeneity was accounted by measurement tool [combined proportions with the REALM and NVS of 35.6 (95%CI 31.5–39.9, I^2 73.0%)]. A number of different health literacy measurement tools were used (19 overall). Our review demonstrates a high prevalence of limited health literacy among surgical patients with considerable heterogeneity. Our findings suggest the importance of recognizing and addressing surgical patients with limited health literacy and the need for standardization in measurement tools.

Podium presentation at Plastic Surgery The Meeting, Annual Meeting of the American Society of Plastic Surgeons, Orlando, Florida, US, October 6–10 2017.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s00268-018-4754-z>) contains supplementary material, which is available to authorized users.

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Introduction

The abundance of health information in our technology-prolific era has led to a “troubling paradox” [1]. Patients are inundated with complex health information delivered as technical medical jargon, acronyms, and statistical

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estimates for which they receive little guidance on how to interpret. The extensive volume of information contrasts with insufficient patient comprehension. Precarious health outcomes ensue. Health literacy represents the extent to which patients are able to understand and act upon health information [2]. Health literacy conceptually sits at the intersection between culture, society, and the health and education system [2]. It has been described as a distinct diagnostic entity which can be measured using screening tools [3]. Limited health literacy profoundly affects the provision of clinical and surgical care in a multifaceted manner. On a clinical level, limited health literacy is associated with poorer health status and higher all-cause mortality [4]. System-wise, an association with resource misuse [4], higher rates of healthcare utilization [5–7], and increased costs [8] have been identified. The effects are so deeply rooted into patient care that even patient satisfaction [9] and decision making [10] are negatively shaped by limited health literacy. Not only are the ramifications of limited health literacy far-reaching and consequential but the problem seems ubiquitous. The 2003 US National Assessment of Adult Literacy showed that only 12% of American adults had proficient health literacy [11].

Health literacy is of high importance for surgeons as their patients have to comprehend the nature, risks and benefits of surgical procedures, adhere to strict perioperative instructions, and make complex care decisions about interventions [12]. Despite alarming reports of a high prevalence of limited health literacy among the overall population [13], a void exists in providing a comprehensive overview of this prevalence among surgical patients [12]. Pooling of existing data may help surgeons, researchers, and policy makers improve surgical patients' understanding and decision making by adapting communication and information delivery.

The objectives of this systematic review and meta-analysis were to determine the prevalence of limited health literacy among surgical patients, and describe the health literacy measurement tools used.

Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed [14]. The protocol was registered with the PROSPERO database (registration no. CRD42017058743).

Study selection

Population—Adults and parents/legal guardians of pediatric patients under the care of a surgeon at the time of enrolment were included. Patients within the pre or post-

operative stages of their care were included, whether requiring surgical intervention or not.

Type of studies—We included observational (retrospective or prospective cohorts and cross-sectional) and experimental studies (randomized controlled trials) if published as an original research manuscript in a peer-reviewed journal. We excluded conference proceedings, letters, commentaries, and editorials that did not contain original data and non-English publications or duplicate reports. Case reports, case series, reviews, and qualitative studies were excluded but read to identify other potential studies.

Type of intervention—We included studies that assessed health literacy levels for any surgical patients, whether as a primary outcome or not. Studies measuring readability, literacy or numeracy on their own were excluded.

Outcomes—Measures of health literacy and the tools (validated or not) used to obtain these were considered for the purpose of the qualitative review. The ability to pool the health literacy proportion data was considered for the quantitative review.

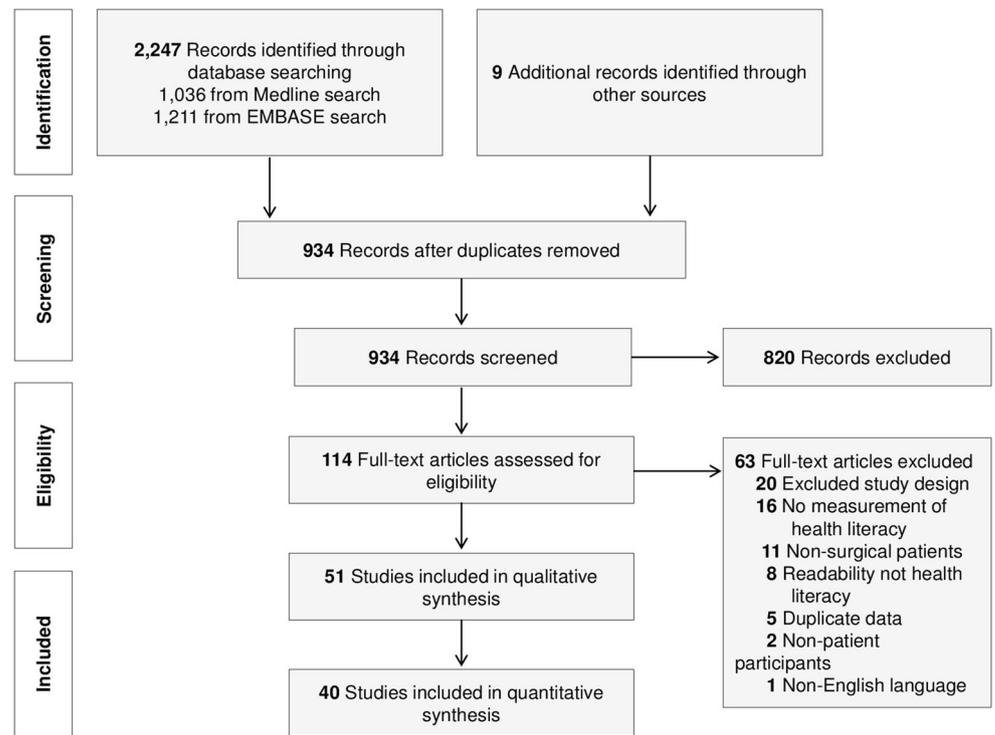
Data sources and search strategy

A senior information specialist assisted the search strategy. A comprehensive literature search of the MEDLINE and EMBASE databases was performed from inception until January 14th 2017. No date restrictions were applied. The search strategy was tailored to the specific requirements of each database and used a combination of terms pertaining to the realm of health literacy with others related to surgery. Two independent review authors (M.R., J.P.C.) performed the search using the Peer Review of Electronic Search Strategies as a supporting tool [15]. Database specific search strategy details are available (Online Resource 1). These searches were supplemented with a manual review of references from included articles and review articles. A two-stage screening process by independently screening the titles and abstracts of all studies was performed and then assessing full-text articles based on the inclusion and exclusion criteria. Articles with questionable eligibility or considered eligible were retrieved for full-text review. Discrepancies were resolved by discussion and consensus.

Data extraction and methodologic quality assessment

A standardized data collection form was used. The two independent review authors (M.R. and J.P.C.) also evaluated included articles for risk of bias and quality of reporting. Considering the outcomes of interest pertaining to a cross-sectional data in nature, a modified Newcastle–Ottawa Scale [16] was used for all studies regardless of their design and assessed patient selection, comparability

Fig. 1 PRISMA flowchart of study selection



and outcomes. An overall score was determined ranging from 0 to 7 and studies were categorized as high (score <5) or low (score 5–7) risk of bias. Discrepancies were resolved with discussion. No studies were excluded based on quality, as the ultimate goal of this review was to report all studies measuring health literacy within the surgical patient population.

Data synthesis and analysis

Clinical heterogeneity was determined with the patient population (surgical specialty, age, education, and ethnicity) and the health literacy measurement tool used. We assessed between study statistical heterogeneity with the I^2 statistic. High, moderate, and low heterogeneity were defined as a value of I^2 of 75, 50, and 25% respectively [17]. If necessary, limited health literacy proportions were calculated with the data provided without any alterations. Data were combined in random-effects model [18] meta-analyses using the *OpenMetaAnalyst* vBeta 1.0. Freeman–Tukey transformations were applied to stabilize the variance of proportions [19] and pooled estimates of proportions with 95% CI were described.

Subgroup and sensitivity analyses

We performed subgroup analyses in patients pertaining to various surgical specialties and measurement tools when the number of studies was more or equal to five to account

for heterogeneity based on etiology of disease and measurement tools used. Sensitivity analyses according to mean reported age (<60 years) and education level (<50% of study population with high school or less as it would differ from national averages [20]) were planned given the association between age, education level and health literacy levels [13]. Lastly, variation in health literacy prevalence based on methodologic quality was done. We assessed publication bias via graphic analysis of a funnel plot if ten studies or more were included in the meta-analysis using proportions of limited health literacy against standard errors of the proportions [21].

Results

Study identification

A total of 2247 articles were identified from our electronic database search, with 9 additional found from a manual search. Fifty-one studies met inclusion criteria for the qualitative review. Eleven studies did not report health literacy prevalence and therefore 40 studies were included for the quantitative synthesis (Fig. 1).

Study and patient characteristics

Tables 1 and 2 summarize the 51 studies that met eligibility criteria for the qualitative synthesis. These studies

Table 1 Characteristics of the included studies for the quantitative synthesis

Studies	Country	Design	Sample size <i>n</i>	Surgical specialty	Measurement tool	Languages	Limited health literacy proportion <i>n</i> (%)
Komenaka et al. [9]	USA	Cross-sectional	2025	Breast surgery ^a	NVS ^b	English ^c Spanish ^c	1634/2025 (80.7)
Livaudais et al. [22]	USA	Prospective cohort	368	Breast surgery	Customized	English ^c Spanish ^c	195/363 (53.7)
Roh et al. [23]	Korea	Prospective cohort	72	Hand surgery ^a	NVS ^b	Not specified	38/72 (52.8)
Dageforde et al. [24]	USA	Cross-sectional	360	Renal transplantation ^a	SLS ^b	Not specified	184/360 (51.1)
Scarpato et al. [25]	USA	Prospective cohort	368	Urology ^a	SLS ^b	Not specified	188/368 (51.1)
Zite et al. [26]	USA	Randomized controlled trial	201	Gynecology	SLS ^b	English ^c	99/201 (49.3)
Halbach et al. [27]	Germany	Prospective cohort	1060	Breast surgery ^a	HLS-EU-Q16 ^b	German	494/1024 (48.2)
Rosenbaum et al. [28]	USA	Cross-sectional	65	Orthopedic surgery ^a	NVS* ^b LiMP ^b	English ^c	31/65 (47.7)
Kazley et al. [29]	USA	Cross-sectional	127	Renal transplantation	NVS* ^b REALM-T ^b	English ^c	55/123 (44.7)
Lin et al., [30]	China	Cross-sectional	211	Ophthalmology ^a	SLS ^b	Mandarin	92/211 (43.6)
Menendez et al. I [31]	USA	Cross-sectional	200	Hand surgery ^a	NVS ^b	English ^c Spanish ^c	86/200 (43.0)
Wallace et al. I [32]	USA	Cross-sectional	152	Vascular surgery	REALM* ^b REAL-VS ^b	English ^c	63/152 (41.4)
Escobedo et al. [33]	USA	Cross-sectional	44	Renal transplantation ^a	NVS ^b	English ^c Spanish ^c	18/44 (40.9)
Wallace et al. II [34]	USA	Cross-sectional	100	Vascular surgery	REALM* ^b SLS ^b	English ^c	39/100 (39.0)
Beitler et al. [35]	USA	Cross-sectional	8	ENT ^a	S-TOFHLA ^b	Not specified	3/8 (37.5)
Koster et al. [36]	The Netherlands	Cross-sectional	225	Mixed (pre-operative) ^a	FCCHL ^b	Dutch ^c	84/225 (37.3)
Song et al. [37]	USA	Cross-sectional	1581	Urology ^a	REALM ^b	English ^c	585/1579 (37.0)
Hawley et al. [38]	USA	Cross-sectional	877	Breast surgery	Customized	English ^c Spanish ^c	319/865 (36.9)
Rosenbaum et al. II [39]	USA	Cross-sectional	65	Hand surgery ^a	LiMP ^b	English ^c	22/65 (33.8)
Cajita et al. [40]	USA	Cross-sectional	1365	Cardiac transplantation ^a	SLS ^b (shortened)	Not specified	452/1365 (33.1)
Grubbs et al. [41]	USA	Cross-sectional	62	Renal transplantation ^a	S-TOFHLA ^b	English ^c	20/62 (32.3)
Mikhail et al. [42]	Canada	Randomized controlled trial	244	Ophthalmology ^a	S-TOFHLA ^b	English	70/219 (32.0)
Menendez et al. II [43]	USA	Cross-sectional	224	Hand surgery ^a	NVS ^b	English ^c	69/224 (30.8)
Otal et al. [44]	Canada	Cross-sectional	79	Pediatric surgery ^a	NVS ^b	English ^c	23/79 (29.1)

Table 1 continued

Studies	Country	Design	Sample size <i>n</i>	Surgical specialty	Measurement tool	Languages	Limited health literacy proportion <i>n</i> (%)
Miller-Matero et al. [45]	USA	Cross-sectional	398	Transplantation ^a	REALM ^b	Not specified	96/349 (27.5)
Menendez et al. III [46]	USA	Cross-sectional	84	Hand surgery ^a	NVS ^b	English ^c	22/84 (26.2)
Haghighi et al. [47]	Iran	Cross-sectional	260	Breast surgery ^a	HELIA ^b	Not specified	67/260 (25.8)
Patzer et al. [48]	USA	Prospective cohort	99	Transplantation	REALM ^b	English ^c	24/97 (24.7)
Lillie et al. [49]	USA	Cross-sectional	163	Breast surgery	REALM ^b	English ^c	38/163 (23.3)
Dageforde et al. II [50]	USA	Cross-sectional	104	Renal transplantation	SLS ^b	English ^c	24/104 (23.1)
Wilson et al. [51]	USA	Cross-sectional	26	Orthopedic surgery ^a	REALM ^b	English ^c	6/26 (23.1)
Conlin et al. [52]	USA	Cross-sectional	30	Cardiac surgery	REALM ^b	Not specified	6/30 (20.0)
Garcia-Marcinkiewicz et al. [53]	USA	Cross-sectional	500	Mixed (pre-operative)	SLS ^b (shortened)	English ^c	83/460 (18.0)
Taylor et al. [54]	United Kingdom	Cross-sectional	6842	Renal transplantation ^a	SILS ^b	English ^c	1001/6373 (15.7)
Serper et al. [55]	USA	Cross-sectional	105	Liver transplantation ^a	REALM ^b	English ^c	15/102 (14.7)
Chew et al. [56]	USA	Prospective cohort	332	Mixed (pre-operative) ^a	S-TOFHLA ^b	English ^c	40/332 (12.0)
Megwalu et al. [57]	USA	Cross-sectional	316	ENT ^a	SLS ^b	English ^c	32/316 (10.1)
Gordon et al. [58]	USA	Cross-sectional	124	Renal transplantation ^a	REALM-T ^b S-TOFHLA ^{*b}	English ^c	11/124 (8.9)
Jones et al. [59]	Canada	Cross-sectional	41	Renal transplantation ^a	S-TOFHLA ^b	Not specified	2/40 (5.0)
Anger et al. [60]	USA	Cross-sectional	36	Gynecology ^a	TOFHLA ^b	English ^c	1/36 (2.8)
Total	–	–	19,543	29 ^a	–	28 ^c	6331/18,895 (32.7 ^d)

*Tool used for the limited health literacy proportion reported

^aPrimary objective included health literacy

^bValidated tool

^cFluency in language of administration was part of eligibility criteria

^dAverage proportion from sum of numerator and denominator, not pooled

represented 10 countries, with an important representation from the United States with 36 studies (70.6%). Only 10 studies (19.6%) were published before 2010, 27 (52.9%)

between 2010 and 2015 and 14 (27.5%) during 2016 alone. There were four (7.8%) randomized controlled trials, seven (13.7%) prospective cohorts, and 40 (78.4%) cross-

Table 2 Characteristics of the included studies for the qualitative synthesis

Studies	Country	Design	Sample size <i>n</i>	Surgical specialty	Measurement tool
Schmidt et al. [61]	Germany	Cross-sectional	1344	Breast surgery ^a	HLS-EU-Q16 ^b
Groeneveld et al. [62]	USA	Cross-sectional	909	Orthopedic surgery	REALM-R
Tait et al. [63]	USA	Randomized controlled trial	408	Pediatric surgery	REALM-SF ^b
Lambert et al. [64]	Australia	Cross-sectional	153	Renal transplantation ^a	HeLMS
Kadokia et al. [65]	USA	Cross-sectional	146	Orthopedic surgery ^a	Customized
Chu et al. [66]	Taiwan	Cross-sectional	144	Orthopedic surgery ^a	REALM ^b
Hendren et al. [67]	USA	Prospective cohort	103	Breast surgery	REALM-SF
Cegala et al. [68]	USA	Randomized controlled trial	65	Pediatric surgery	S-TOFHLA ^b
Kasparian et al. [69]	Australia	Cross-sectional	40	Cardiac surgery ^a	eHEALS ^b
Crossen et al. [70]	The Netherlands	Cross-sectional	38	ENT	FCCHL ^b
Kiyosaki et al. [71]	USA	Cross-sectional	20	Gynecology	TOFHLA ^b
Total	–	–	3224	4 ^a	–

^aPrimary objective included health literacy

^bValidated tool

sectional studies. The patient populations pertained to multiple surgical specialties such as 13 (25.5%) transplantation surgery, 8 (15.7%) breast surgery, 5 (9.8%) orthopedic surgery, and 5 (9.8%) hand surgery. In terms of the studies included in the quantitative synthesis, most (36, 90.0%) assessed patients' health literacy in the outpatient setting (Online Resource 2). Upon measurement of health literacy, patients' statuses were pre-operative in 13 studies (32.5%), post-operative in 9 (22.5%), fully non-operative in 1 (2.5%), and an amalgam of pre-, post-, and/or non-operative in 17 studies (42.5%). The average mean age of surgical patients reported in 37 studies (92.5%) was 53.3 years (range 29.0–69.5).

Methodologic quality of included studies

Methodologic quality according to a modified Newcastle–Ottawa Scale is presented (Online Resource 3). The majority of studies ($n = 35$, 68.6%) had low risk of bias, and none of the studies had a score of 3 or less. Only four studies (7.8%) did not control for education but did account for age of patients. Sample size justification was absent in 44 studies (86.3%). Response rate and eligibility were considered inadequate or not specified in 31 articles (60.8%).

Prevalence of limited health literacy

Eleven (21.6%) studies did not present health literacy values and were excluded from the meta-analysis. Of the 40 included studies, most assessed health literacy in one language only: 23 (57.5%) in English and 3 (7.5%) in other languages. Patients' fluency in the language of the tool used was included as part of the eligibility criteria in 28

(70.0%) studies. Eligibility criteria also mentioned visual function (9, 22.5%) [9, 26, 32, 34, 41, 44, 55, 56, 58], hearing function (3, 7.5%) [32, 34, 55], cognitive status (12, 30.0%) [9, 30, 32, 34, 36, 37, 41, 50, 51, 55, 56, 60], and learning disabilities (1, 2.5%) [31]. A total of 18,895 surgical patients from 40 studies were represented with a pooled estimate prevalence of 31.7% (95%CI 24.7–39.2%) for limited health literacy. This estimate ranged from 2.8 to 80.7% and there was significant between-study variation (I^2 99.0%) (Online Resource 4). In twenty-nine studies (56.9%) the primary objective was measuring health literacy, whether as a primary outcome or in association with another outcome.

Measurement of health literacy

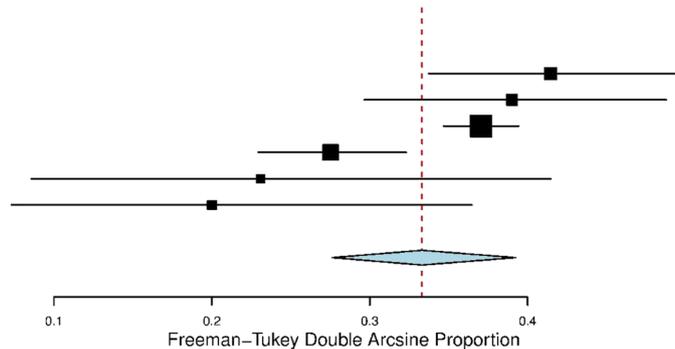
Sixteen health literacy measurement tools in addition to three customized ones were used to assess surgical patients' health literacy (Online Resource 5). Different authors used different thresholds to distinguish between health literacy levels when using the same tool. The methodologic description of health literacy assessment did not include a clear statement about the meaning of the scores obtained in 19 (37.3%) articles. From the non-customized tools, 14 (87.5%) had been validated. The most commonly used tools consisted of the REALM (10, 19.6%), the Newest Vital Sign (NVS) (9, 17.6%), the Short Literacy Survey (SLS) (9, 17.6%), and the S-TOFHLA (7, 13.7%).

Subgroup and sensitivity analyses

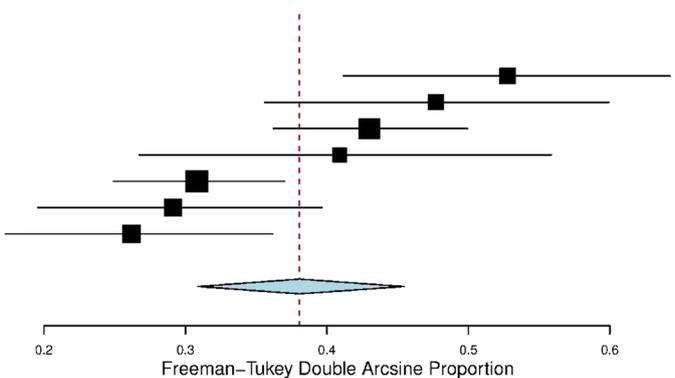
One study [9] was identified as an outlier and therefore subsequent sensitivity and subgroup analyses were

(a) REALM

Studies	Estimate (95% C.I.)	Ev/Trt
Wallace et al I 2009	0.414 (0.337, 0.494)	63/152
Wallace et al II 2007	0.390 (0.296, 0.488)	39/100
Song et al 2012	0.370 (0.347, 0.394)	585/1579
Miller–Matero et al 2015	0.275 (0.229, 0.323)	96/349
Wilson et al 1997	0.231 (0.086, 0.415)	6/26
Conlin et al 2002	0.200 (0.073, 0.365)	6/30
Overall ($I^2=7458\%$, $P=0.001$)	0.333 (0.276, 0.392)	795/2236

**(b) NVS**

Studies	Estimate (95% C.I.)	Ev/Trt
Roh et al 2016	0.528 (0.412, 0.643)	38/72
Rosenbaum et al I 2013	0.477 (0.356, 0.599)	31/65
Menendez et al I 2015	0.430 (0.362, 0.499)	86/200
Escobedo et al 2013	0.409 (0.267, 0.559)	18/44
Menendez et al II 2016	0.308 (0.249, 0.370)	69/224
Otal et al 2012	0.291 (0.196, 0.397)	23/79
Menendez et al III 2016	0.262 (0.173, 0.362)	22/84
Overall ($I^2=7495\%$, $P<0.001$)	0.381 (0.309, 0.455)	287/768

**(c) Combined**

Studies	Estimate (95% C.I.)	Ev/Trt
Roh et al 2016	0.528 (0.412, 0.643)	38/72
Rosenbaum et al I 2013	0.477 (0.356, 0.599)	31/65
Menendez et al I 2015	0.430 (0.362, 0.499)	86/200
Wallace et al I 2009	0.414 (0.337, 0.494)	63/152
Escobedo et al 2013	0.409 (0.267, 0.559)	18/44
Wallace et al II 2007	0.390 (0.296, 0.488)	39/100
Song et al 2012	0.370 (0.347, 0.394)	585/1579
Menendez et al II 2016	0.308 (0.249, 0.370)	69/224
Otal et al 2012	0.291 (0.196, 0.397)	23/79
Miller–Matero et al 2015	0.275 (0.229, 0.323)	96/349
Menendez et al III 2016	0.262 (0.173, 0.362)	22/84
Wilson et al 1997	0.231 (0.086, 0.415)	6/26
Conlin et al 2002	0.200 (0.073, 0.365)	6/30
Overall ($I^2=7297\%$, $P<0.001$)	0.356 (0.315, 0.399)	1082/3004

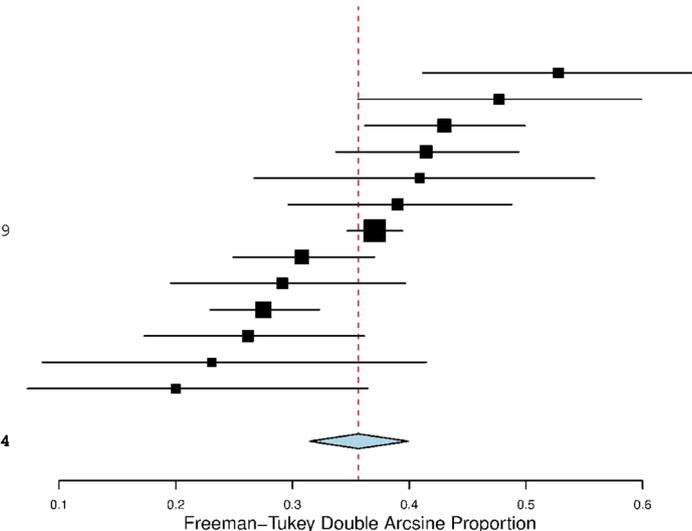


Fig. 2 Measurement tools subgroup analyses for pooled proportions of limited health literacy: **a** REALM; **b** NVS; **c** REALM and NVS combined

performed without it as it may have misrepresented our estimates. When removed from the overall quantitative synthesis, the prevalence of limited health literacy was of 30.6% (95%CI 25.7–35.6, I^2 97.5%). Various surgical

specialties were evaluated separately (Online Resource 6) and did not explain the heterogeneity in results. The S-TOFHLA, SLS and other tools could not be pooled as less than five studies were represented for a similar limited

health literacy threshold. Pooling of measures obtained by the REALM and NVS revealed a proportion of limited health literacy of 35.6 (95%CI 31.5–39.9, I^2 73.0%) with lower levels of heterogeneity (Fig. 2) [72]. Sensitivity analysis with methodologic quality revealed a pooled proportion of 30.4% (95%CI 24.3–36.9, I^2 97.7%) (Online Resource 7). Additional sensitivity analyses performed by including studies with mean ages less than 60 years (Online Resource 8) and with a proportion <50% for patients with an education of high school or less (Online Resource 9) demonstrated persistent high degrees of statistical heterogeneity. When examining the funnel plot for the proportion of limited health literacy (Online Resource 10), there were few small and medium size studies which reported higher rates of limited health literacy and publication bias could not be ruled out.

Discussion

This systematic review and meta-analysis identified 51 eligible studies measuring the health literacy of surgical patients. The majority of studies were of high methodologic quality. High levels of limited health literacy were found throughout the spectrum of surgical care (peri-operative to post-operative) and among multiple surgical specialties. One-third of patients (32%) had limited health literacy and this proportion was consistent in all subgroup and sensitivity analyses (range 26–38%). These results are similar to data published in the National Assessment of Adult Literacy and other reviews [11, 13] and should be interpreted in light of statistical and clinical heterogeneity in patients' characteristics, type of surgical specialty and numerous measurement tools reported.

The statistical heterogeneity in limited health literacy was not related to surgical specialty, age, education, or methodologic quality. This is surprising given that previous studies have demonstrated high levels of variability in health literacy prevalence based on clinical and social characteristics [13]. Loco-regional variations may also emerge from complex interactions between key factors such as age, surgical diagnosis, and education (including baseline literacy). Global variations and trends in health literacy could not be inferred from the included studies and the pooled prevalence of health literacy may not be generalizable worldwide. Our results provide evidence of the complex construct of health literacy and intersectionality with age, ethnicity, education, and other possible individual and environmental determinants which are not easily represented in subgroup and sensitivity analyses [73]. The impact of limited health literacy on surgical outcomes has only recently been explored and associations with longer

length of stay, complications and less adherence to pre-operative instructions have been found [56, 74, 75].

Subgroup analyses revealed less statistical heterogeneity when based on measurement tool, emphasizing the importance of seeking more uniformity in health literacy measurement and reporting. There is a lack of standardization in the adopted tools within surgery and surgical specialties. Some studies used the same tool but considered different thresholds to define limited health literacy without justifications [4]. For the surgeon, it may be laborious to select an instrument and to choose between either a specialty-specific tool or a broad, validated, easy-to-compare one. Newly developed tools have been shown to be redundant to existing instruments, and offer insufficient description of their scoring methods [76]. Nevertheless, many have introduced rich measurements through a mixed of objective and subjective (via self-report) approaches. Surgeons should note that while different needs require different instruments, one should favor the use of more generalizable and comparable tools [77].

The first step in overcoming the impact of low health literacy in surgical populations is being aware of the high prevalence of limited health literacy. To ensure enhanced patient understanding, surgeons should avoid using technical medical terminology, confirm patient understanding, and encourage patient participation in care discussions [78]. Health literacy systematic screening remains controversial due to the possible stigma it inflicts on patients who score poorly [79]. Instead, promoting universal measures of support and productive patient–surgeon interactions may improve greatly the quality of care provided [80]. Such measures include seeking patient feedback, using plain language, limiting the information provided, using visual support, confirming understanding, and summarizing [80]. Future studies should explore the impact of implementing such measures of support and the effect on surgical outcomes.

This review is, to our knowledge, the first to assess the health literacy of surgical patient populations with pooled data providing a comprehensive understanding of the magnitude and variation of health literacy among surgical patients. The comprehensive literature search and rigorous methodology are strengths of this review. The heterogeneity of included studies in sample sizes, study designs, outcomes, and patient populations may have reduced the power of the meta-analysis. However, this review provides a broad representation of the surgical literature regarding health literacy assessment. Future studies will provide additional evidence and are needed in well-delineated patient populations and using comparable validated measurement tools.

Our review found that approximately one-third of surgical patients had limited health literacy. While there is

considerable variation in measurement tools used, our review suggests a need for the awareness of surgical patients' health literacy in order to promote universal measures of support to ensure adequate communication, patient engagement, and quality care.

Funding The contents of this article were developed under a grant from the Canadian Institute of Health Research (CIHR), the Frederick Banting and Charles Best Canada Graduate Scholarship, awarded to support Méliissa Roy's graduate degree.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interests.

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