Prevalence and Associated Factors of General Health Literacy Among Adults in Malaysia: A Systematic Review and Meta-Analysis

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Introduction:

There is an increasing number of publications on health literacy from Malaysia. We conducted a systematic review of Malaysian studies to determine the prevalence of limited general health literacy and the associated factors among Malaysian adults.

Materials and Methods:

We conducted a comprehensive search for Malaysian studies on health literacy using PubMed, Scopus and Google Scholar. Cross-sectional studies that measured general health literacy using specific rating scales among adults in Malaysia were retrieved for qualitative analysis. Quantitative synthesis of the prevalence of limited health literacy measured using two rating scales (Newest Vital Sign, NVS and various versions of European Health Literacy Survey, HLS) was performed using random effect model.

Results:

Twenty-five studies measuring general health literacy were retrieved for qualitative analysis; the majority were various versions of HLS and NVS. Pooled prevalence rates of limited health literacy were: HLS: 48.59%; NVS: 91.41%. Subgroup analysis of participant type revealed prevalence of limited health literacy measured using NVS was lower in clinical samples vs non-clinical samples (85.67% vs 94.70%). Moderator analysis revealed a small effect of ethnicity on prevalence of health literacy measured using HLS. Assessment of included studies showed very few of them had statistically significant associations between socio-demographic factors and limited health literacy.

Conclusion:

Prevalence of limited health literacy in Malaysian adults was very high: almost one in two adults in HLS studies and nine out of ten adults in NVS studies. Socio-demographic factors associated with limited health literacy were inconsistent with other studies.

Keywords: *adult; health literacy; Malaysia; prevalence; systematic review.*

INTRODUCTION

Health literacy is a rapidly emerging area of research.[1] According to Sørensen, health literacy "entails people's knowledge, motivation and competencies to access, understand, appraise and apply information to make judgements and take decisions in everyday life concerning healthcare, disease prevention and health promotion".[2] Low health literacy has been shown to be associated with increased hospitalisations, more use of emergency care, lower acceptance of preventive care, lower medication adherence, poorer overall health status and higher mortality rates.[3]

To date, a wide variety of health literacy measurement tools have been developed.[4,5] These include objective scales, subjective scales or a combination of both. Objective scales primarily assess reading, comprehensive and numeracy skills (eg, Newest Vital Sign, NVS), whereas subjective scales are based on self-reporting (eg, European Health Literacy Survey, HLS-Eu).

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Assessing country-specific level of health literacy has potential application for public health policy and health promotion. In the systematic review conducted by Rajah *et al*, up to January 2018 eleven health literacy publications were identified in Southeast Asia and Malaysia contributed to five of them.[6] In the scoping review by Abdullah *et al*, 29 publications were identified from Malaysia up to November 2019, of these 15 of them were on general health literacy.[7] A preliminary search revealed there are now many more publications on general health literacy from Malaysia and thus, we planned to synthesise the prevalence of limited health literacy and the factors that are associated with it.

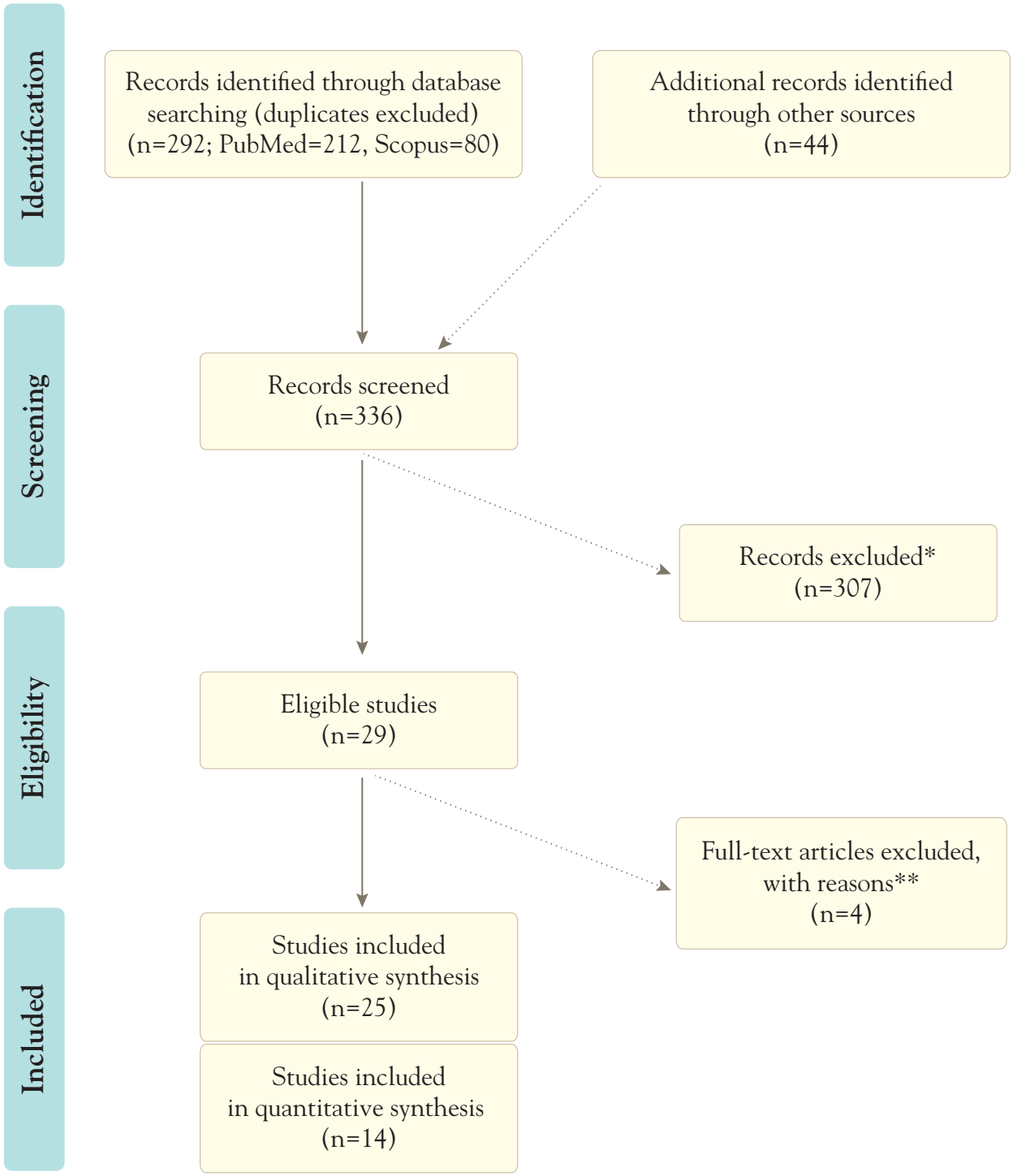
MATERIALS AND METHODS

Study design

This is a systematic review. It was performed following the PRISMA guideline.[8] The protocol of this systematic review has been registered in INPLASY.[9]

Search

A bibliographic search was performed on PubMed/Medline, Scopus and supplemented by a targeted Google Scholar search on 16–20 February 2023. The keywords used were: "health literacy" AND "Malaysia". The publication period was from inception to 31st December 2022. A PRISMA flow diagram of the search method is shown in Figure I.



Note: This information is added to Figure 1I. Literature search was conducted by CLT. Screening was done by one pair of investigators (CLT, CWC). Assessment of bias was done by three pairs of investigators (CLT+LPK; MHT+HJH; CLT+CWC for HLS studies, NVS studies, other studies, respectively). Data extraction and synthesis was performed by CLT and checked by other co-investigators.

*conference abstract=6; non-Malaysian publication=29; comment/letter/editorial=3; review (narrative/systematic)=40; study protocol=5; focus on specific area of health literacy (eg, diabetes, mental health, oral health, nutrition, cancer literacy, computer literacy, ehealth/mhealth literacy, food/nutrition literacy, cancer literacy)=75; health literacy not measured=148; studies on children/adolescent=29; health personnel or medical students=21; qualitative research=22; clinical trial=7; theses=6 [some publications may be in more than one category].

**duplicated datasets (see text).

Figure I: Flow diagram for the selection of studies

Literature management

All references were imported into the Endnote 20 citation manager.[10] After removing the duplicates, eligible articles were identified based on the following inclusion and exclusion criteria.

Inclusion criteria were as follows:

1. Studies that were conducted in Malaysia.
2. Study participants were adults.
3. General health literacy was measured using specific rating scales.
4. Studies that were published in peer reviewed journal articles or large population surveys.

Exclusion criteria were as follows:

1. Studies that were conducted outside Malaysia.
2. Studies that were conducted in Malaysia on non-Malaysians.
3. Study participants were children, adolescents or health personnel.
4. Studies that were only focused on specific aspects health literacy (e.g. cancer literacy, computer literacy, eHealth literacy, food/nutrition health literacy, mHealth literacy, mental health literacy, oral health literacy).
5. Studies that were published in monographs, reports, conference abstracts or theses/dissertations.

Quality assessment of included studies

We assessed the quality of the included studies using JBI critical appraisal checklist for analytical cross-sectional studies.[11]

Data extraction

The following data were extracted from the included studies:

1. Measurement tool (rating scale) of health literacy
2. Publication type
3. Study setting
4. Health problem (if any)
5. Year of publication
6. Socio-demographic characteristics of patients

Data synthesis

We extracted the number of participants with limited health literacy and the total sample size (i.e. those who completed the general health literacy rating scales), as well as mean and standard deviation of health literacy scores. For studies using various versions of Health Literacy Survey (HLS) questionnaires, limited health literacy was defined as Health Literacy Index ≤33 (i.e. including both "inadequate" (0-25) and "problematic" (>25-33) levels of health literacy).[12] For studies using Newest Vital Sign (NVS), score ≤3 was considered as limited health literacy.[13] Meta-analysis of the percentage of low health literacy was performed using MedCalc Statistical Software[14] and Jamovi.[15] Meta-analysis using fixed effect and random effect models were presented separately for NVS and HLS studies. Sensitivity analysis was conducted with or without large national-level population survey. Subgroup analysis and moderator analysis were done for these variables: type of rating scale (NVS vs HLS), participant type (clinical vs non-clinical samples), and socio-demographic variables (age, gender, ethnicity and education level). Heterogeneity was assessed using sensitivity analysis and subgroup analysis. Small study effect (publication bias) was tested using Egger test.

RESULTS

A total of 336 studies were retrieved from bibliographic databases. Twenty-nine publications satisfied the inclusion criteria, out of which 25 unique studies published in the period 2015 to 2022 were included in this systematic review (four studies using duplicated datasets were excluded).[16-19] Figure I illustrates the flow chart of the study selection.

Type of general health literacy scales used in the included studies

We identified six unique health literacy rating scales used in Malaysia (see Table I).

1. Health Literacy Survey Questionnaires (various versions of HLS, n=12)[20-31]: Three were 47-item version (HLS-Eu-Q47)[21, 25, 29]; two were 18-item version (HLS-M-Q18)[22, 28]; two were 16-item version (HLS-M-Q16, HLS-Asia-Q16)[23, 30]; five were 12-item version (HLS-SF12).[20, 24, 26, 27, 31]
2. Newest Vital Sign (NVS, n=7).[32-38]
3. Health Literacy Scale (HLS-14, n=2).[39, 40]
4. Test of Functional Health Literacy in Adults – Short Form (TOFHLA-S, n=2)[41, 42]
5. Health Literacy Management Scale (HeLMS, n=1)[43]
6. Brief Health Literacy Screen (BHLS, n=1)[44]

General health literacy related data in Malaysia

Out of 25 included studies, 22 of them reported health literacy data either in mean (SD) or percentage and 12 of them analysed health literacy by socio-demographic groups (Table I). Psychometric data in Malaysia were available for these versions of rating scales: HLS-Eu-Q47 (Cronbach α=0.85),[25] HLS-M-Q18 (Cronbach α=0.906),[17] HLS-SF12 (Cronbach α=0.85).[26]

Table I: Characteristics of studies measuring general health literacy in Malaysia

	Study	Health literacy scale*	Setting and participants	JBI† Score	GHL‡ %	GHL‡ mean	GHL‡ and socio-demographic data
1	Abdullah 2020[19]	HLS-Eu-Q47	Public primary care clinic, adult diabetes patients	8	Yes	Yes	Yes
2	Duong 2017[23]	HLS-Eu-Q47	Adults in the community	9	No	No	No
3	Salim 2021[27]	HLS-Eu-Q47	Public primary care clinic, adult asthma patients	9	Yes	No	Yes
4	Azlan 2021[20]	HLS-M-Q18	Adults in the community	8	Yes	No	Yes
5	Jaafar 2021[26]	HLS-M-Q18	Adults in the community	9	Yes	No	Yes
6	Baharum 2020[21]	HLS-M-Q16	Adult female from premarital counselling centres	8	No	Yes	No
7	Shibraumalisi 2020[28]	HLS-Asia-Q16	Public primary care clinic, adult diabetes patients	9	Yes	Yes	No
8	Abd-Rahim 2021[18]	HLS-SF12	University primary care clinic, elderly	9	Yes	No	Yes
9	Bahuri 2022[22]	HLS-SF12	Public sector department, employees	8	Yes	No	No
10	Duong 2019[24]	HLS-SF12	Adults in the community	9	No	No	No
11	Goh 2022[25]	HLS-SF12	Public primary care clinic pharmacy, chronic disease patients	8	Yes	No	Yes
12	Yunus 2020[29]	HLS-SF12	Elderly in the community	8	Yes	Yes	Yes
13	Appalasamy 2019[30]	NVS	Hospital neurology clinic, stroke patients	6	Yes	No	No
14	Azreena 2016[31]	NVS	Public primary care clinic, adult diabetes patients	9	Yes	No	Yes
15	Chan 2015[32]	NVS	Hospital pharmacy, adult caregivers	8	Yes	No	Yes
16	NHMS 2015[33]	NVS	Adults in the community	9	Yes	No	No
17	Norrafizah 2018[34]	NVS	Adults in the community	6	Yes	No	No
18	Shahril 2018[35]	NVS	Obese housewives in the community	7	Yes	No	Yes
19	Tan 2020[36]	NVS	Public primary care clinic, adult diabetes patients	8	Yes	No	Yes
20	Froze 2018[37]	HLS-14	Adults in the community	9	Yes	Yes	No
21	Jores 2021[38]	HLS-14	Adults in the community	8	No	No	No
22	Abdullah 2019[39]	TOFHLA-S	Public primary care clinic, adult diabetes patients	9	Yes	No	No
23	Ramlay 2020[40]	TOFHLA-S	Public primary care clinic, outpatients	7	No	Yes	No
24	Hagger 2018[42]	BHLS	UITM clinical training centre, familial hyperlipidemia patients	7	Yes	No	Yes
25	Yunus 2021[29]	HeLMS	Hospitals outpatients	8	No	Yes	No

*HLS-Eu-Q47, HLS-M-Q18, HLS-M-Q16, HLS-Asia_Q16, HLS-SF12 are various versions developed from European Health Literacy Survey Questionnaire; NVS is Newest Vital Sign; HLS-14 is the 14-item Health Literacy Scale; TOFHLA-S is Test of Functional Health Literacy in Adults – short form; BHLS is Brief Health Literacy Screen; HeLMS is Health Literacy Management Scale.
†Joanna Briggs Institute critical appraisal checklist.
‡General health literacy.

Prevalence of limited health literacy

Fourteen studies were used to synthesise the prevalence of limited health literacy (Table II). We excluded two studies with low quality score (JBI score <7).[32, 36] These fourteen studies included nine studies using various versions of European HLS and five studies using NVS. We noted there were two national-level population-based surveys of health literacy in Malaysia: NVS was used in the National Health and Morbidity Survey in 2015[35] but HLS-M-Q18 was used in 2019.[28] In view of the large sample sizes in these two surveys, the meta-analysis was presented separately with and without these two surveys (Table II).

Table II: Prevalence and socio-demographic correlates of limited health literacy

	Study	Health literacy scale	Participants	Health literacy data, n (% limited HL, mean±SD)	Associated factors of limited health literacy*
1	Abdullah 2020[19]	HLS-EU-Q47	428 primary care T2DM (mean age 58.1±10.6)	279 (65.3%), 31.9±7.04	Significant: not English fluency, not attended diabetes education session, low social support. Not significant: age, gender, ethnicity, education, income.
2	Salim 2021[27]	HLS-EU-Q47	550 primary care asthma (mean age 48±15.44)	329 (60.5%)	Significant: lower education no asthma education. Not significant: age, gender, ethnicity, income.
3	Azlan 2021[20]	HLS-M-Q18	866 adults population survey (mean age 33.6)	502 (58.0%)	Significant: age (23-37), self perceived poor health status. Not significant: gender, ethnicity, income.
4	Jaafar 2021[26]	HLS-M-Q18	9478 adults population survey	3317 (35.0%) (weighted to general population)	Not analysed
5	Shibraumalisi 2020[28]	HLS-Asia-Q16	447 primary care T2DM (mean age 58.18±11.39)	191 (42.7%), 12.4±3.3	Not analysed
6	Abd-Rahim 2021[18]	HLS-SF12	413 primary care elderly (median age 67, IQR=8)	79 (19.1%)	Significant: age (≥70), education (primary or less). Not significant: gender, ethnicity, income, perceived health status.
7	Bahuri 2022[22]	HLS-SF12	518 public sector employees (mean age 50.2±5.9)	223 (43%)	Not analysed
8	Goh 2022[25]	HLS-SF12	337 primary care chronic disease patients (mean age 52.6±12.3)	184 (54.6%)	Significant: older age, lower education, lower income. Not significant: gender.
9	Yunus 2020[29]	HLS-SF12	206 community elderly (mean age 66.6±5.5)	129 (62.6%), 30.6±10.0	Univariate analysis only. Lower HL score: female, older age
10	Azreena 2016[31]	NVS	288 primary care T2DM patients (mean age 53.42±9.87)	247 (85.8%)	Significant: ethnic (Chinese), lower diabetes knowledge. Not significant: age, gender, education, income.
11	Chan 2015[32]	NVS	208 caregivers (mean age 30.83±6.08)	196 (94.2%)	Significant: lower education, income (below poverty).
12	NHMS-2015[33]	NVS	13,017 community adults aged ≥18	12,330 (94.7%)†	Not analysed
13	Shahril 2018[35]	NVS	328 community obese housewives	310 (94.5%)	Significant: older age (>44). Not significant: gender, ethnicity, education, income, social support.
14	Tan 2020[36]	NVS	289 primary care T2DM patients (mean age 58.0±9.7)	248 (83.0%)	Significant: older age (>55), education (<tertiary), income (<2000). Not significant: gender, ethnicity.

*Multivariate analysis, unless otherwise specified.
†actual count, % not weighted to population, weighted=93.4%.

Nine studies (total number of participants=13,243) provided prevalence estimates for limited health literacy using various versions derived from the European HLS (Figure II and Table III). The prevalence ranged from a surprisingly low percentage of 19.1% in the study done among primary care elderly outpatients (measured using HLS-SF12),[20] to 65.3% in the study done among primary care diabetes patients (measured using HLS-Eu-Q47).[21] The pooled prevalence of limited health literacy is 48.59% (random effect model, 95%CI 38.78 to 58.45). Without the national survey conducted by Jaafar *et al*,[28] the pooled prevalence of limited health literacy is 50.36% (random effect model, 95%CI 39.84 to 60.88). Pooled prevalence of limited health literacy among clinical samples is shown to be statistically significantly higher only in meta-analysis using fixed effect model. Moderator analysis showed no statistically significant effect of age, gender and education level on prevalence of health literacy measured using HLS. Small but statistically significant effect was observed for ethnicity in that increasing proportion of Malay ethnicity is associated with decreasing prevalence of limited health literacy (Table IV).

Five studies (total number of participants=14,130) provided prevalence estimates for limited health literacy using NVS (Figure II, Table V). The prevalence ranged from 83.0% to 94.7%. The pooled prevalence of health literacy is 91.41% (random effect model, 95%CI 87.00 to 94.98). Without NHMS-2015,[35] the pooled prevalence of health literacy is 90.32% (random effect model, 95%CI 84.89 to 94.66). Pooled prevalence of limited health literacy among non-clinical samples is shown to be statistically significantly higher in meta-analysis using both fixed effect and random effect models. Moderator analysis was not done for NVS studies because there are too few studies which are compounded by missing socio-demographic variables in two studies.

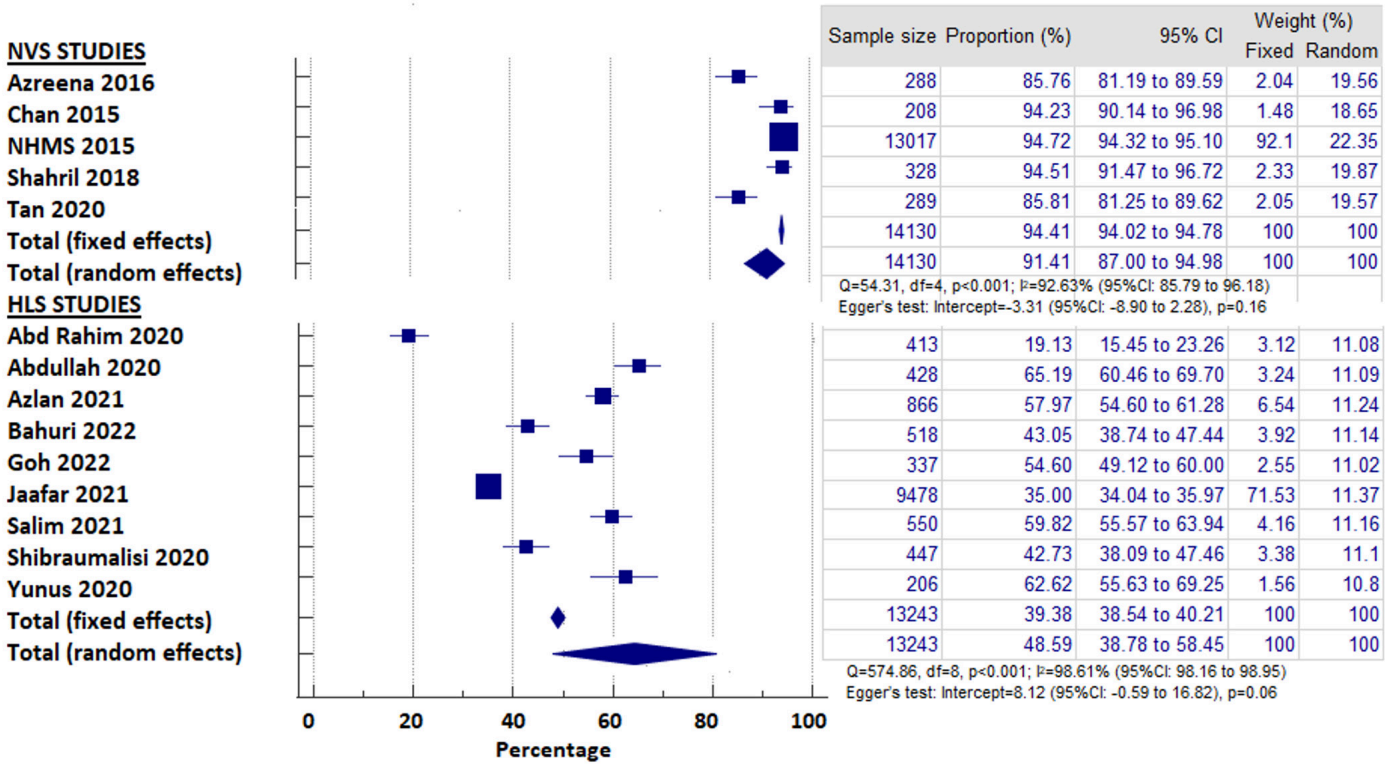


Figure II: Forest plot of pooled prevalence of limited health literacy

Table III: Pooled prevalence of limited health literacy measured using Health Literacy Survey in Malaysia

Meta-analysis	Studies	Sample size	Pooled prevalence (95%CI) (fixed effect)	Pooled prevalence (95%CI) (random effect)	Heterogeneity, I^2 (95%CI)
All studies	9	13,243	39.38% (38.54 to 40.21)	48.59% (38.78 to 58.45)	98.61% (98.16 to 98.95)
All studies excluded Jaafar 2021 (28)	8	3,765	50.67% (49.07 to 52.28)	50.36% (39.84 to 60.88)	97.68% (96.70 to 98.37)
Studies using clinical samples*	5	2,175	48.44% (46.32 to 50.56)	47.88% (31.53 to 64.47)	98.43% (97.64 to 98.96)
Studies using non-clinical samples**	4	11,068	37.62% (36.72 to 38.53)	49.45% (35.59 to 63.35)	98.71% (98.00 to 99.17)

*Studies that recruited specific patient groups, eg, asthma, diabetes.
**Studies that recruited adults from the community or population surveys.

Table IV: Moderator analysis for the pooled prevalence of HLS studies

Socio-demographic variables	Estimate (95%CI)	Standard error	z	p
Mean age	-0.005 (-0.015 to 0.005)	0.005	-0.961	0.337
Female gender*	0.012 (-0.002 to 0.026)	0.007	1.716	0.086
Malay ethnicity*	-0.004 (-0.008 to -0.000)	0.002	-2.03	0.042
Primary or lower education*	-0.002 (-0.010 to 0.006)	0.004	-0.552	0.581

*Data were percentage of participants having the specified subgroup.
Note: Model estimator is Restricted Maximum-Likelihood, mixed-effect model.

Table V: Pooled prevalence of limited health literacy measured using Newest Vital Sign in Malaysia

Meta-analysis	Studies	Sample size	Pooled prevalence (95%CI) (fixed effect)	Pooled prevalence (95%CI) (random effect)	Heterogeneity, I^2 (95%CI)
All studies	5	14,130	94.41% (94.02 to 94.78)	91.41% (87.00 to 94.98)	92.63% (85.79 to 96.18)
All studies excluded NHMS-2015 (35)	4	1,113	90.22% (88.33 to 91.90)	90.32% (84.89 to 94.66)	87.39% (69.88 to 94.72)
Studies using clinical samples*	2	577	85.67% (82.54 to 88.42)	85.67% (82.70 to 88.40)	0%
Studies using non-clinical samples†	3	13,553	94.70% (94.31 to 95.07)	94.70% (94.31 to 95.07)	0%

*Studies that recruited specific patient groups, eg, asthma, diabetes.
†Studies that recruited adults from the community or population surveys.

Factors Associated With Limited Health Literacy

Out of 14 studies providing prevalence data, ten of them analysed factors associated with limited health literacy (Table II). Where available, results for socio-demographic factors are presented below.

- Older age: statistically significant (n=4); not statistically significant (n=4)
- Gender: statistically significant (n=1, univariate analysis, female); not statistically significant (n=9)
- Ethnic group: statistically significant (n=1, Malays and Indian more than Chinese); not statistically significant (n=7)
- Lower educational level: statistically significant (n=3); not statistically significant (n=3)
- Diabetes education (n=1) and asthma education (n=1) associated with reduced limited health literacy
- Lower income: statistically significant (n=3); not statistically significant (n=6)

We also examined associations of limited health literacy with diabetes knowledge, social support and self-report health status, results as shown below:

- Diabetes knowledge: statistically significant (n=1)
- Lower social support: statistically significant (n=1), not statistically significant (n=1)
- Lower health status: statistically significant (n=1), not statistically significant (n=1)

DISCUSSION

Prevalence Of Limited Health Literacy

This meta-analysis revealed that the pooled prevalence rates of limited health literacy in Malaysia are 48.59% (38.78 to 58.45) based on HLS or 91.41% (87.00 to 94.98) based on NVS. In the random

effect model, HLS did not detect a difference in the prevalence of limited health literacy in both clinical and non-clinical samples. However, in the NVS studies, clinical sample is found to have slightly lower prevalence (85.67% vs 94.70%).

Validation studies conducted in Malaysia reported high level of reliability for HLS-Eu-Q47,[25] HLS-M-Q18[17] and HLS-SF12,[26] with Cronbach's α of 0.96, 0.91, 0.85, respectively. NVS has not been formally validated in the Malaysian context, to date there is only a preliminary validation study on 28 obese housewives showing Cronbach's α of 0.75.[45] In the European context, HLS-Eu and NVS had relatively low correlation (Spearman rho, r=0.245), suggesting these two scales measured somewhat different constructs of health literacy.[46] In view of the above, we felt it is inappropriate to synthesise the overall prevalence of health literacy including both NVS and HLS studies.

This meta-analysis showed that limited health literacy is highly prevalent among the Malaysian adults, in both clinical sample, as well as the general population. As expected, higher rate of limited health literacy is detected by NVS since this questionnaire assessed objective or functional health literacy and relied mostly on numerical test, skill that is more likely to be deficient in many adults.

Socio-Demographic Factors Associated With Limited Health Literacy

In the moderator analysis, we managed to detect only a small but statistically significant effect of Malay ethnicity and prevalence of limited health literacy in HLS studies. This lack of relationship between prevalence of limited health literacy and socio-demographic variables appears to be consistent with the assessment of all included studies individually, where we failed to identify a consistent pattern of statistically significant associations. Paasche-Orlow *et al*, conducted a systematic review of studies in the United States (scales used were mostly Rapid Estimate of Adult Literacy in Medicine (REALM) or versions of the Test of Functional Health Literacy in Adults (TOFHLA)) and showed low health literacy was associated with level of education, ethnicity, and age.[47] In another systematic review of 22 studies, Chakraverty *et al*, found that female achieved higher health literacy score than male participants.[48] Our meta-analysis of Malaysian health literacy studies is at variant with the systematic reviews by Paasche-Orlow *et al*, and Chakraverty *et al*, even though we limited the data extraction to two commonly used scales (versions of HLS and NVS). This may be due to the small sample sizes of most Malaysian studies and methodological issues (lack of uniformity of the participants' socio-demographic variables and different ways to define the categories). A majority of the scales used in Malaysia were various versions based on HLS-Eu-Q47. All of them require participants to rate their response on five-point Likert scale. As pointed out by Dowse and others, such response format is often found to be both unfamiliar and poorly understood by low literacy participants.[49, 50]

Further Application

In view of the high prevalence of limited health literacy in Malaysia and possibly little difference (if any) by participant groups or socio-demographic factors, it is probably not worthwhile to screen for limited health literacy in the clinical setting.[51] Rather, improving health communication in all forms

(written, verbal) in both clinical setting and for the general public should be the priority.[52]

Study Limitations

We noted the high level of heterogeneity as shown by I^2 exceeding 90% and remained very high despite sensitivity analysis and subgroup analysis. This observation of high heterogeneity in the meta-analysis of prevalence studies is a common phenomenon and is said to be not discriminative, ie, high I^2 is not always synonymous with high heterogeneity.[53]

CONCLUSION

This systematic review highlighted substantial level of limited health literacy in Malaysia, in both clinical and non-clinical samples, and failed to detect a consistent pattern of socio-demographic associations as seen in other prevalence studies.

REFERENCES

1. Tavousi M, Mohammadi S, Sadighi J, Zarei F, Kermani R M, Rostami R, *et al*. Measuring health literacy: A systematic review and bibliometric analysis of instruments from 1993 to 2021. *PLoS One. 2022;17*(7):e0271524. doi:10.1371/journal.pone.0271524.
2. Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, *et al*. Health literacy and public health: A systematic review and integration of definitions and models. *BMC Public Health. 2012*;12:80. doi:10.1186/1471-2458-12-80.
3. Berkman N D, Sheridan S L, Donahue K E, Halpern D J, Crotty K. Low health literacy and health outcomes: An updated systematic review. *Ann Intern Med. 2011;155*(2):97-107. doi:10.7326/0003-4819-155-2-201107190-00005.
4. Liu H, Zeng H, Shen Y, Zhang F, Sharma M, Lai W, *et al*. Assessment tools for health literacy among the general population: A systematic review. *Int J Environ Res Public Health. 2018;15*(8):1711. doi:10.3390/ijerph15081711.
5. Lee H, Lori JR. Scoping review: Valid and reliable health literacy assessment tools used in low- and middle-income countries. *J Nurs Meas. 2020;28*(1):jnm-d-18-00071. doi:10.1891/jnm-d-18-00071.
6. Rajah R, Hassali M A A, Murugiah M K. A systematic review of the prevalence of limited health literacy in Southeast Asian countries. *Public Health. 2019*;167:8-15. doi:10.1016/j.puhe.2018.09.028;
7. Abdullah A, Liew S M, Salim H S, Ng C J, Chinna K. Health literacy research in Malaysia: A scoping review. *Sains Malaysiana. 2020;49*(5):1021-36. doi:10.17576/jsm-2020-4905-07.
8. Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D, *et al*. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *PLoS Med. 2021;18*(3):e1003583. doi:10.1371/journal.pmed.1003583.
9. Teng C L, Lai P K, Heng H J, Tiew M H, Chan C W. General health literacy in Malaysia: Protocol of a systematic review of Malaysian studies. *Inplasy Protocol. 2023*;202330046. doi:10.37766/inplasy2023.3.0046.
10. EndNote 20. London: Clarivate Analytics; 2020.
11. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Chapter 5: Systematic reviews of prevalence and incidence. In: Aromataris E, Munn Z, editors. JBI Manual for Evidence Synthesis. Adelaide: Joanna Briggs Institute (JBI); 2020.
12. Sørensen K, Pelikan J M, Röthlin F, Ganahl K, Slonska Z, Doyle G, *et al*. Health literacy in Europe: Comparative results of the European health literacy survey (HLS-EU). *Eur J Public Health. 2015;25*(6):1053-8. doi:10.1093/eurpub/ckv043.
13. Weiss B D, Mays M Z, Martz W, Castro K M, DeWalt D A, Pignone M P, *et al*. Quick assessment of literacy in primary care: The newest vital sign. *Ann Fam Med. 2005;3*(6):514-22. doi:10.1370/afm.405.
14. MedCalc® Statistical Software version 20.006. Ostend, Belgium: MedCalc Software Ltd; 2021.
15. The project jamovi. Jamovi (Version 2.3) [Computer Software]. 2023.
16. Froze S, Arif M T. Determinants of health literacy and healthy lifestyle against metabolic syndrome among major ethnic groups of Sarawak, Malaysia: A multi-group path analysis. *The Open Public Health Journal. 2019;12*(1):172-83. doi:10.2174/1874944501912010172.
17. Mohamad E M W, Kaundan M K, Hamzah M R, Azlan A A, Ayub S H, Tham J S, *et al*. Establishing the HLS-M-Q18 short version of the European health literacy survey questionnaire for the Malaysian context. *BMC Public Health. 2020;20*(1):580. doi:10.1186/s12889-020-08704-7.
18. Shaharudin N A, Suriani I, Shariff Ghazali S, Juni M H, Hayati K S. Socio-demographic predictors of adequate health literacy among type 2 diabetes mellitus patients attending two government health clinics in the district of Kuala Selangor. *International Journal of Public Health and Clinical Sciences. 2020;7*(3):34-41. doi:10.32827/ijphcs.7.3.34.

19. Su T T, Bahuri N H A, Said M A. Health literacy research in Malaysia: Health literacy and other aging challenges among Malaysian public employees. *Stud Health Technol Inform. 2020*;269:212-9. doi:10.3233/shti200034.

20. Abd-Rahim S N H, Mohamed-Yassin M S, Abdul-Razak S, Isa M R, Baharudin N. The prevalence of limited health literacy and its associated factors among elderly patients attending an urban academic primary care clinic in Malaysia. *Int J Environ Res Public Health. 2021;18*(17):9044. doi:10.3390/ijerph18179044.

21. Abdullah A, Ng C J, Liew S M, Ambigapathy S, V P, Chinna K. Prevalence of limited health literacy and its associated factors in patients with type 2 diabetes mellitus in Perak, Malaysia: A cross-sectional study. *BMJ Open. 2020;10*(11):e039864. doi:10.1136/bmjopen-2020-039864.

22. Azlan A A, Hamzah M R, Tham J S, Ayub S H, Ahmad A L, Mohamad E. Associations between health literacy and sociodemographic factors: A cross-sectional study in Malaysia utilising the HLS-M-Q18. *Int J Environ Res Public Health. 2021;18*(9):4860. doi:10.3390/ijerph18094860.

23. Baharum N N, Ariffin F, Isa M R, Tin S T. Health literacy, knowledge on cervical cancer and Pap smear and its influence on pre-marital malay muslim women attitude towards Pap smear. *Asian Pac J Cancer Prev. 2020;21*(7):2021-8. doi:10.31557/apjcp.2020.21.7.2021.

24. Bahuri N H A, Rizal H, Said M A, Myint P K, Su T T. Active ageing awareness and quality of life among pre-elder Malaysian public employees. *Int J Environ Res Public Health. 2022;19*(15):9034. doi:10.3390/ijerph19159034.

25. Duong T V, Aringazina A, Baisunova G, Nurjanah, Pham T V, Pham K M, *et al.* Measuring health literacy in Asia: Validation of the HLS-EU-Q47 survey tool in six Asian countries. J Epidemiol. 2017;27(2):80-6. doi:10.1016/j.je.2016.09.005.

26. Duong T V, Aringazina A, Kayupova G, Nurjanah, Pham T V, Pham K M, *et al.* Development and validation of a new short-form Health Literacy Instrument (HLS-SF12) for the general public in six Asian countries. *Health Lit Res Pract. 2019;3*(2):e91-e102. doi:10.3928/24748307-20190225-01.

27. Goh Q L, Tan S L, Fong F P W, Yen C H, Liau S Y. Health literacy among adult patients with chronic diseases in Sabah: HLS-Sabah. *Borneo Journal of Medical Sciences. 2022;16*(3):33-42. doi:10.51200/bjms.v16i3.3675.

28. Jaafar N, Perialathan K, Krishnan M, Juatan N, Ahmad M, Mien TYS, *et al.* Malaysian health literacy: Scorecard performance from a national survey. *Int J Environ Res Public Health. 2021;18*(11):5813. doi:10.3390/ijerph18115813.

29. Salim H, Shariff Ghazali S, Lee P Y, Cheong A T, Harrun N H, Mohamed Isa S, *et al.* Health literacy levels and its determinants among people with asthma in Malaysian primary healthcare settings: A cross-sectional study. *BMC Public Health. 2021;21*(1):1186. doi:10.1186/s12889-021-11194-w.

30. Shibraumalisi N A, Mat Nasir N, Md Yasin M, Isa M R. The association between health literacy and quality of life and its associated factors among adults with type 2 diabetes mellitus in public primary care clinic. *Journal of Clinical and Health Sciences. 2020;5*(1):60-74.

31. Yunus R M, Saman M S A, Zubillah A, Juni K B, Gaairibi A S A, Yahaya A N, *et al.* Health literacy among urban Malaysian elders: A descriptive study. *ASM Science Journal. 2020;13*(Special Issue 5):7-12.

32. Appalasamy J R, Joseph J P, Seeta Ramaiah S, Quek K F, Md Zain A Z, Tha K K. Exploring stroke survivors' self-efficacy in understanding and taking medication and determining associated factors: A cross-sectional study in a neurology clinic in Malaysia. *Patient Prefer Adherence. 2019*;13:1463-75. doi:10.2147/ppa.s215271.

33. Azreena E, Suriani I, Juni M H, Fuziah P. Factors associated with health literacy among type 2 diabetes mellitus patients attending a government health clinic, 2016. *International Journal of Public Health and Clinical Sciences. 2016;3*(6):50-64.

34. Chan H K, Hassali M A, Lim C J, Saleem F. Exploring health literacy and difficulty in comprehending pediatric medication labels among caregivers in Malaysia: A pilot study. *Journal of Pharmaceutical Health Services Research. 2015;*6(3):165-8. doi:10.1111/jphs.12102.

35. NHMS-2015. National Health and Morbidity Survey 2015. Volume II. Non-Communicable Diseases, Risk Factors & Other Health Problems. Kuala Lumpur: Institute for Public Health, Ministry of Health, Malaysia; 2015.

36. Norrafizah J, Asiah M N, Suraiya S, Zwaha H, Normawati A, Farid B M. Assessment of health literacy among people in a rural area in Malaysia using Newest Vital Signs assessment. *British Journal of Education, Society & Behavioural Science. 2016;16*(2):1-7. doi:10.9734/BJESBS/2016/25737.

37. Shahrir S N, Shamsuddin K, Mohamad Nor N S, Man C S, Omar M A, Ahmad M H, *et al.* Limited health literacy and its associated factors among overweight and obese housewives living in Klang Valley low cost flats: Findings from the my body is fit and fabulous at home (Mybff@Home) study. *Malaysian Journal of Public Health Medicine. 2018;18*(1):19-27.

38. Tan W Y, Ismail M. Health literacy among adult type 2 diabetes mellitus (T2DM) patients in Klang health district Malaysia. *JUMMEC. 2020*;23 Suppl 1:245-53.

39. Froze S, Arif M T, Saimon R. Does health literacy predict preventive lifestyle on metabolic syndrome? A population-based study in Sarawak Malaysia. *Open Journal of Preventive Medicine. 2018*;8(6):169-82. doi:10.4236/ojpm.2018.86016.

40. Jores D, Abdullah A R, Rahman M M. Association between health literacy and screening behavior on colorectal cancer among the adult population in Sarawak, Malaysia. *International Journal of Current Research and Review. 2021;13*(4 special Issue):S-48-S-56. doi:10.31782/IJCRR.2021.SP126.

41. Abdullah N A, Ismail S, Ghazali S S, Juni M H, Shahar H K, Aziz N R A. Predictors of good glycemic controls among type 2 diabetes mellitus patients in two primary health clinics, Kuala Selangor. *Malaysian Journal of Medicine and Health Sciences*. *2019;15*(SP3):58-64.

42. Ramlay M Z, Saddki N, Tin-Oo M M, Arifin W N. Cross-cultural adaptation and validation of Oral Health Literacy Instrument (OHLI) for Malaysian adults. *Int J Environ Res Public Health*. *2020;17*(15):5407. doi:10.3390/ijerph17155407.

43. Mohamad Yunus M, Abd Manaf N H, Omar A, Juhdi N. Healthcare utilisation among elderly in Malaysia: The mediating role of health literacy. *Med J Malaysia*. *2021;76*(2):218-22.

44. Hagger M S, Hardcastle S J, Hu M, Kwok S, Lin J, Nawawi H M, *et al*. Health literacy in familial hypercholesterolemia: A cross-national study. *Eur J Prev Cardiol*. *2018;25*(9):936-43. doi:10.1177/2047487318766954.

45. Cheong S M, Safiza N, Chan W L, Ambak R, Abdul Aziz N, Mohd Zaki N, *et al*. Preliminary assessment of reliability and validation of the Newest Vital Sign questionnaire among obese housewives. 46th APACPH Conference; 2014; Kuala Lumpur.

46. Consortium H-E. Comparative Report of Health Literacy in Eight EU Member States. Wien, Austria: The European Health Literacy Survey HLS-EU; 2012.

47. Paasche-Orlow M K, Parker R M, Gazmararian J A, Nielsen-Bohlman L T, Rudd R R. The prevalence of limited health literacy. *J Gen Intern Med*. *2005;20*(2):175-84. doi:10.1111/j.1525-1497.2005.40245.x.

48. Chakraverty D, Baumeister A, Aldin A, Seven Ü S, Monsef I, Skoetz N, *et al*. Gender differences of health literacy in persons with a migration background: A systematic review and meta-analysis. *BMJ Open*. *2022;12*(7):e056090. doi:10.1136/bmjopen-2021-056090.

49. Dowse R. The limitations of current health literacy measures for use in developing countries. *Journal of Communication in Healthcare*. *2016;9*(1):4-6. doi:10.1080/17538068.2016.1147742.

50. Chang E M, Gillespie E F, Shaverdian N. Truthfulness in patient-reported outcomes: factors affecting patients' responses and impact on data quality. *Patient Relat Outcome Meas*. *2019*;10:171-86. doi:10.2147/prom.S178344.

51. Paasche-Orlow M K, Wolf M S. Evidence does not support clinical screening of literacy. *J Gen Intern Med*. *2008;23*(1):100-2. doi:10.1007/s11606-007-0447-2.

52. Heine M, Lategan F, Erasmus M, Lombaard C M, Mc Carthy N, Olivier J, *et al*. Health education interventions to promote health literacy in adults with selected non-communicable diseases living in low-to-middle income countries: A systematic review and meta-analysis. *J Eval Clin Pract*. *2021;27*(6):1417-28. doi:10.1111/jep.13554.

53. Migliavaca CB, Stein C, Colpani V, Barker T H, Ziegelmann P K, Munn Z, *et al*. Meta-analysis of prevalence: I(2) statistic and how to deal with heterogeneity. *Res Synth Methods*. *2022;13*(3):363-7. doi:10.1002/jrsm.1547.