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Background

Falls are a significant cause of morbidity and mortality and frequently lead to lasting loss of mobility, fractures and limitations in social participation. In the Irish context, the inpatient cost of fall-related hospitalisations among older people is currently estimated at €59 million and falls among inpatients accounts for 32% of incident reports in UK hospitals.

The STRATIFY clinical prediction rule (St. Thomas Risk Assessment Tool In Falling elderly inpatients) consists of five items that address risk factors for falling including past history of falling, patient agitation, visual impairment affecting everyday function, need for frequent toileting, and transfer ability and mobility. The STRATIFY rule yields a possible score between 0 and 5 (each item scoring 1 if present or 0 if absent). The transfer and mobility item on the STRATIFY rule combines the transfer and mobility sections of the Barthel Index and a score of 3 or 4 on the transfer and mobility sections of the Barthel Index is associated with a higher fall risk than a lower or higher score, thus scoring 1 point on the STRATIFY rule.

The STRATIFY rule is commonly used as a falls risk assessment tool in clinical practice and since the publication of the derivation study in 1997, several studies have validated the STRATIFY rule across a variety of clinical settings.

Aim

The aim of this systematic review and meta-analysis is to determine the diagnostic accuracy of STRATIFY rule across a variety of different clinical settings.

Methods

A literature search was conducted in July 2012 and included the following search engines: the Cochrane Library, EMBASE, Science Direct and PubMed. We aimed to identify all studies that examined the diagnostic accuracy of the STRATIFY rule. Figure 1 outlines details of the search strategy.

The methodological quality of selected studies was assessed using the QUADAS tool. Studies were combined using a bivariate random effects model. Heterogeneity was assessed using the variance of logit transformed sensitivity and specificity. The Cochrane handbook for diagnostic test accuracy studies was followed to conduct and report this review.

Inclusion criteria

1) Study design: prospective or retrospective cohort studies
2) Patient population: adult patients (>18 years of age)
3) Index test: validation of the STRATIFY rule
4) Outcome of interest: Documentation of a fall, defined as 'an unexpected event in which the patient comes to rest on the ground, floor or lower level'.

Figure 1: Flow diagram of search strategy
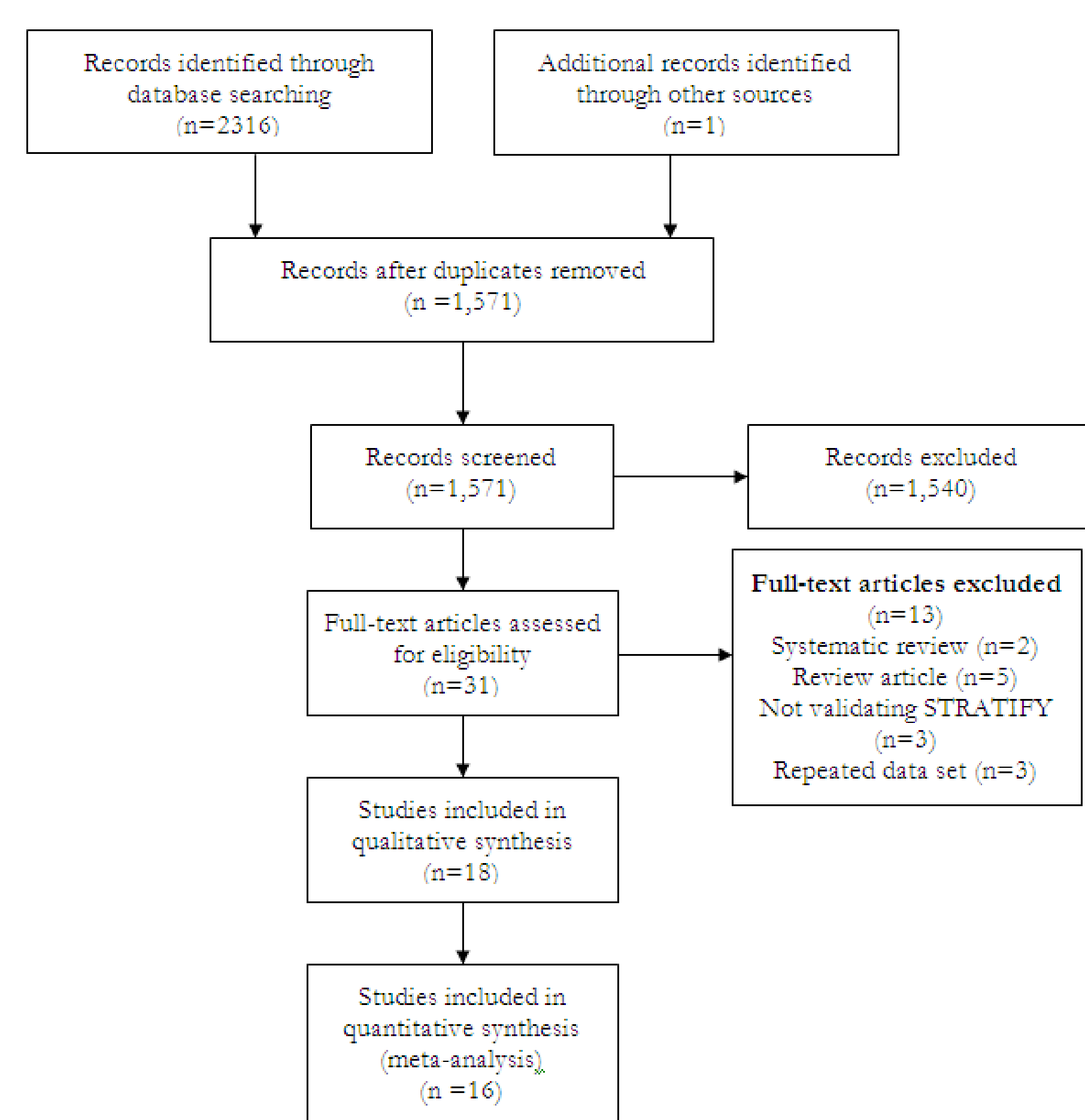
Results

Eighteen studies including 11,378 patients are included. Six studies are based in the United Kingdom, five in Australia, two in Canada, one in Germany, one in Belgium, one in the Netherlands, one in France and one in Italy. The size of patient cohort in the included studies ranges from 44 to 5,489 participants. We use the proportion of fallers (prevalence 6.27%, range 1.1%-41.3%) as a measure of baseline risk and heterogeneity in included studies and settings.

Methodological quality

The overall quality of the included studies was moderate to good, with only two of the included articles not avoiding spectrum bias. However, seven of the eighteen included studies did not give sufficient description of the reference standard, in this case, the definition of a fall. In addition, it was unclear whether diagnosis review bias was avoided, as sixteen studies did not explicitly state whether the occurrence of a fall was interpreted without knowledge of the results of the STRATIFY rule. Furthermore, two studies did not clearly report details of withdrawals from the patient cohort.

Diagnostic test accuracy of STRATIFY rule in all included studies

The pooled sensitivity, specificity and the respective variance of the logit transformed sensitivity and specificity for the seventeen studies included in the meta-analysis are displayed in Table 1. These findings indicate that the STRATIFY rule has limited diagnostic accuracy at a cut point ≥2. However, the CPR is more useful at ruling out rather than ruling in falls in individuals classified as low risk, with a higher pooled sensitivity (0.67, 95% CI 0.52-0.80) than specificity (0.57, 95% CI 0.45-0.69).

Table 1: Summary estimates of sensitivity and specificity using a bivariate random effects model

Application of STRATIFY rule	No. of studies (patients)	Sensitivity (95% CI)	Variance Logit Sensitivity (95% CI)	Specificity (95% CI)	Variance Logit Specificity (95% CI)
All studies	17 (n=11,378)	0.67 (0.52-0.80)	1.49 (0.63-3.53)	0.57 (0.45-0.69)	1.04 (0.49-2.21)
Studies with spectrum bias excluded	14 (n=11,063)	0.66 (0.54-0.76)	0.69 (0.28-1.72)	0.61 (0.51-0.69)	0.49 (0.22-1.09)
Studies with no definition 'fall' excluded	10 (n = 4,193)	0.61 (0.42-0.78)	1.26 (0.43-3.68)	0.65 (0.55-0.74)	0.42 (0.15-1.16)
Studies with a high prevalence of falls (>10%)	9 (n=1479)	0.58 (0.41-0.73)	0.94 (0.32-2.77)	0.58 (0.43-0.71)	0.76 (0.28-2.08)
Studies with a low prevalence of falls (<10%)	8 (n=9899)	0.75 (0.42-0.93)	1.12 (-0.31-2.55)	0.63 (0.43-0.79)	0.53 (-0.28-1.33)

Our sensitivity analysis excluding studies with evidence of spectrum bias, studies that provided no definition of a fall, and those with different prevalence estimates of falls indicate broadly similar results.

Bayesian analysis

Using Bayes' theorem, a score of ≥ 2 points on the STRATIFY rule doubles the pre-test probability of a subsequent fall in a low prevalence setting. A STRATIFY score of ≥2 increases the pre-test probability of a subsequent fall from 6.3% to almost 10% and a score of <2 reduces the probability of a subsequent fall to 3.7% across all clinical settings. The positive likelihood ratio of 1.58 (95% CI 1.34-1.86) indicates that the STRATIFY CPR is not optimal for identifying individuals at high risk of falls across a variety of clinical settings.

Discussion

This systematic review demonstrates that the diagnostic accuracy of the STRATIFY rule is limited at the widely used cut point of ≥2 and should not be used in isolation for identifying individuals at high risk of falls in clinical practice. The sensitivity analysis which examined the performance of the rule in different settings and subgroups also showed broadly comparable results, indicating that the STRATIFY rule performed in a similar manner across a variety of different 'at risk' patient groups in different clinical settings.

Conclusion

This systematic review shows that the diagnostic accuracy of the STRATIFY rule is not optimal and should not be used in isolation for identifying individuals at high risk of falls in clinical practice.

Conflict of Interest Statement: The authors declare no conflict of interest.

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