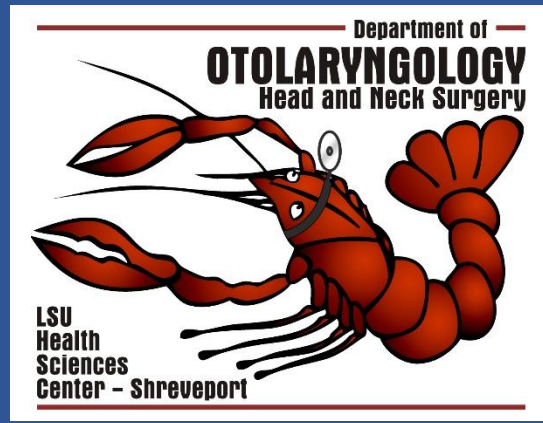


Global Prevalence, Recurrence, and Risk Factors Associated with Spontaneous CSF Rhinorrhea – A Systematic Review and Meta-analysis

Srivatsa Surya Vasudevan, MD, MS¹, Amir Kaskas, BS², Michael T. Yim, MD, FACS¹

¹Department of Otolaryngology-Head and Neck Surgery, Louisiana State University Health Sciences Center, Shreveport, Louisiana, USA



Abstract

Background:

Spontaneous CSF (sCSF) leaks can be intermittent and challenging to diagnose. There is a gap in the literature regarding its prevalence, recurrence rates and the prevalent risk factors associated.

Methods:

PubMed, Embase, Web of Science, and ScienceDirect were systematically searched for studies related to sCSF rhinorrhea. We performed a proportional random effect model meta-analysis to estimate the pooled effect sizes of risk factors, prevalence, and recurrence rates associated with sCSF leak

Results:

From a total of 444 studies, 40 studies were included, comprising 3154 CSF rhinorrhea patients. The prevalence rate of sCSF leaks among overall CSF rhinorrhea patients was estimated to be 29.9% (95% CI: 23.3% - 37.5%) (Figure 1). The recurrence rate of sCSF leaks was 14% (95% CI: 7.3% - 25.3%) (Figure 2). The prevalence of risk factors associated with sCSF leaks varied among different conditions. Obesity had the highest association with sCSF leaks, with a prevalence rate of 67.0% (95% CI: 41.2% - 85.5%). Hypertension also showed a significant association, with a prevalence rate of 53.4% (95% CI: 46.0% - 62.5%). Empty sella was identified as a notable risk factor with a prevalence rate of 59.3% (95% CI: 35.7% - 79.3%). Diabetes was associated with a prevalence rate of 28.2% (95% CI: 20.5% - 37.5%). Obstructive sleep apnea (OSA) had a prevalence of 21.7% (95% CI: 12.5% - 35.2%), while a prior history of meningitis was associated with a prevalence of 15.5% (95% CI: 9.2% - 24.9%).

Conclusion:

Our systematic review reported the significant prevalence rates associated with sCSF leaks among patients with CSF rhinorrhea, with a notable association between obesity, hypertension, and empty sella as prevalent risk factors. This study also highlights the recurrence of sCSF rhinorrhea following CSF leak repair.

Aim

The primary goal of this meta-analysis is to evaluate:

- 1) Prevalence rate
- 2) Recurrence
- 3) Risk factors

sCSF rhinorrhea

Methods and Materials

1. Search strategy: PubMed, Embase, Web of Science, and ScienceDirect

2. Selection criteria:

Included: Studies of all ages with confirmed spontaneous CSF rhinorrhea patients, from observational to clinical trials with 10+ patients.
Excluded: Mixed sCSF leak outcomes, formats like reviews, series <10, single reports, animal studies, conference posters, or abstract-only articles

3. Screening and data extraction

- Two independent authors

4. Quality assessment: Newcastle-Ottawa Quality Assessment Scale tool

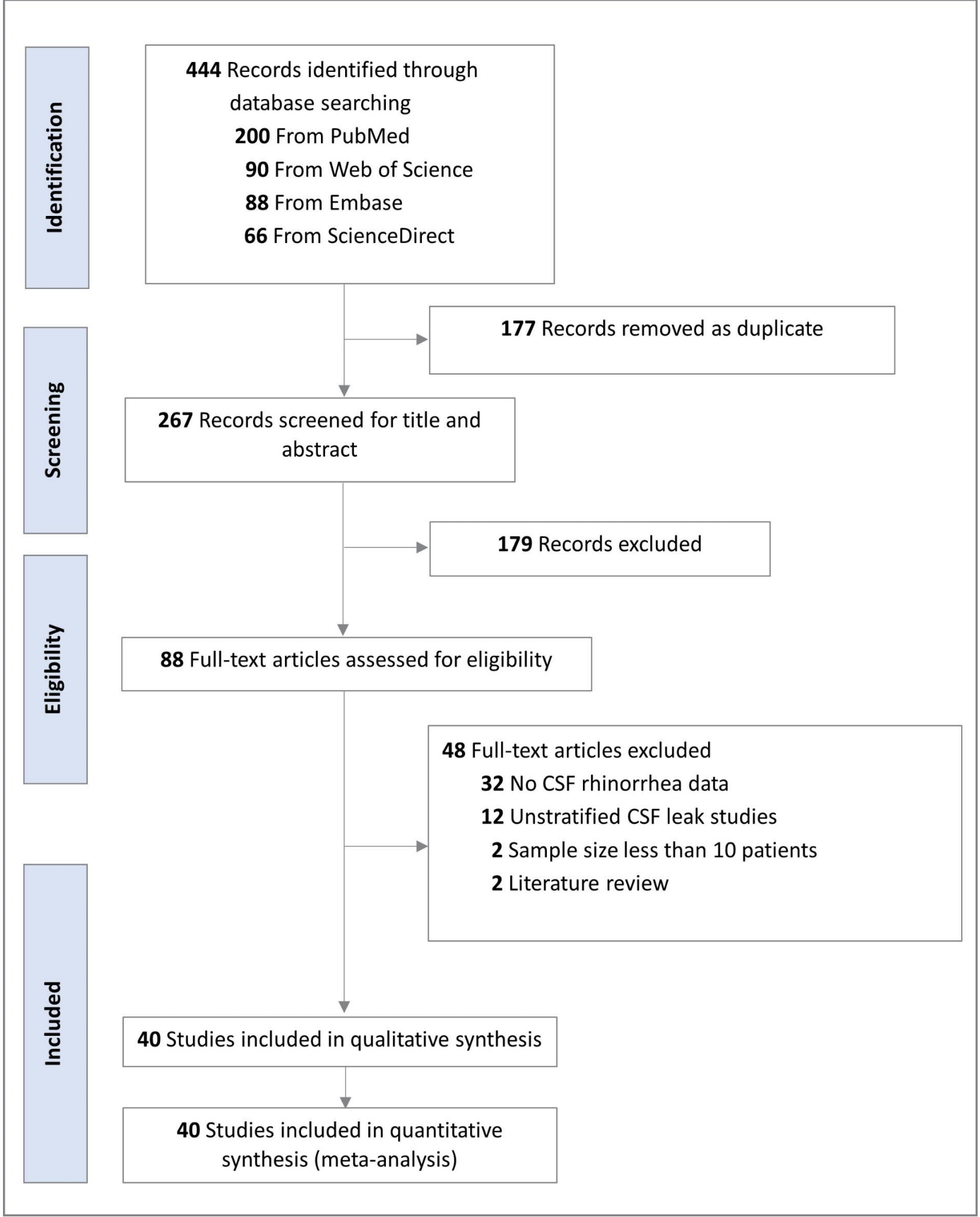
5. Statistical analysis:

- Random effects meta-analysis model
- Sensitivity analysis (one-study removal)
- Egger's regression and funnel plot
- Univariate and multivariate meta-regression analysis

Results

- From an initial 444 studies, after removing duplicates and applying selection criteria, we narrowed it down to 40 unique studies (Figure 1).

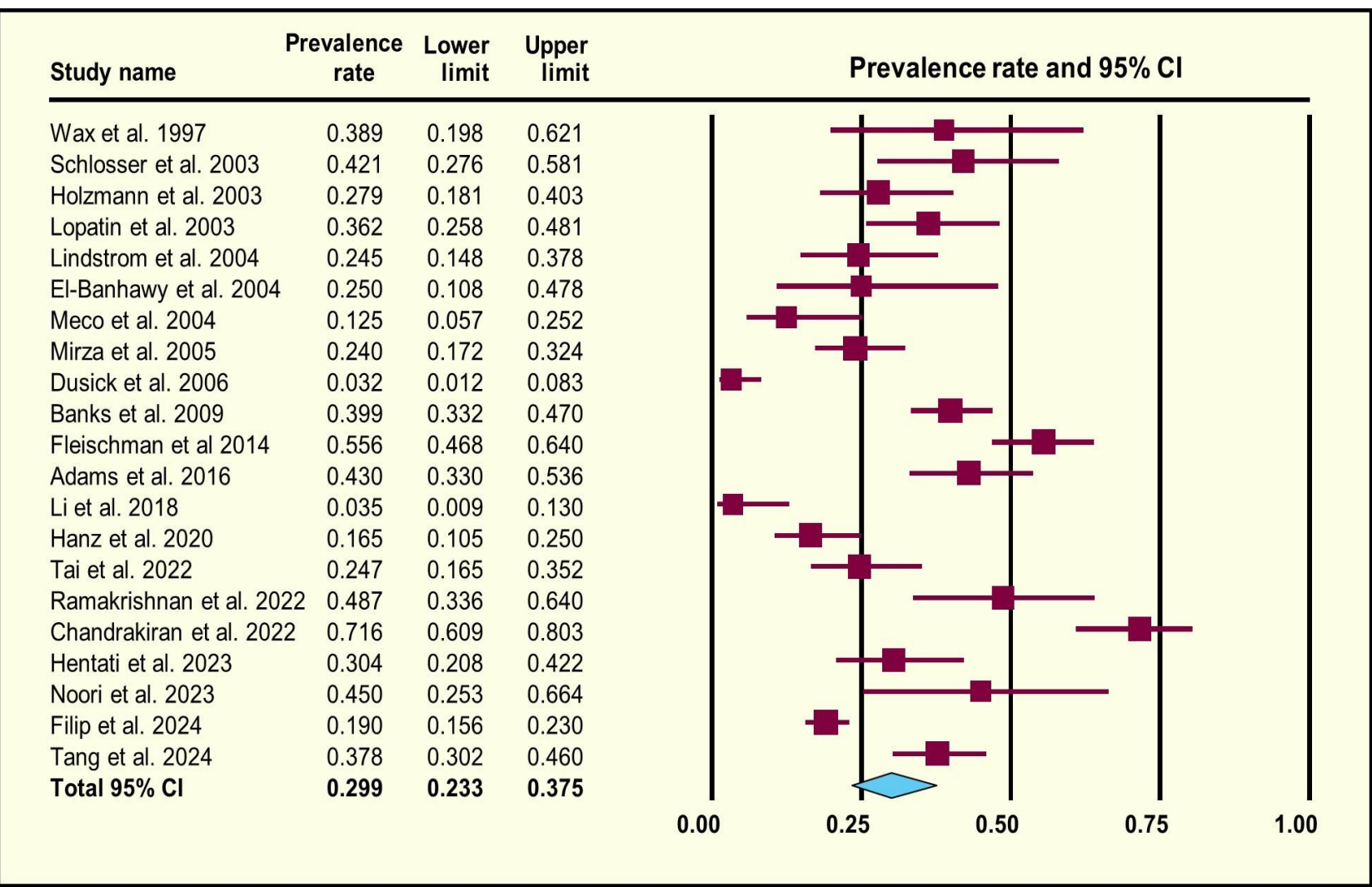
Figure 1. PRISMA flowchart



Study demographics:-

- **3154 CSF rhinorrhea patients**
- **Mean age:** 49 years
- **Sex:** Male (30.9%) : Female (69.1%)
- **Follow-up:** 15 months
- The pooled prevalence rate of sCSF rhinorrhea was 29.9% (95% CI: 23.3 – 37.5%), based on 21 studies (Figure 2).
- Geographical-based: Asia had the highest prevalence rate of 35.4% (95% CI: 23.1-50.0), followed by North America with 28.7% (95% CI: 19.6-39.9%) and Europe with 22.3% (95% CI: 15.4-31.2%)

Figure 2. Prevalence rate of sCSF rhinorrhea



- The pooled recurrence rate of sCSF rhinorrhea was 14% (95% CI: 23.3 – 37.5%), based on 13 studies (Figure 3).

Results (cont)

- Geographical-based: North America had the highest recurrence rate of 25% (95% CI: 4.2-71.6%), followed by Asia with 17.8% (95% CI: 7.0-38.5%) and Europe with 14.2% (95% CI: 5.1-33.9%)

Figure 3. Recurrence rate of sCSF rhinorrhea

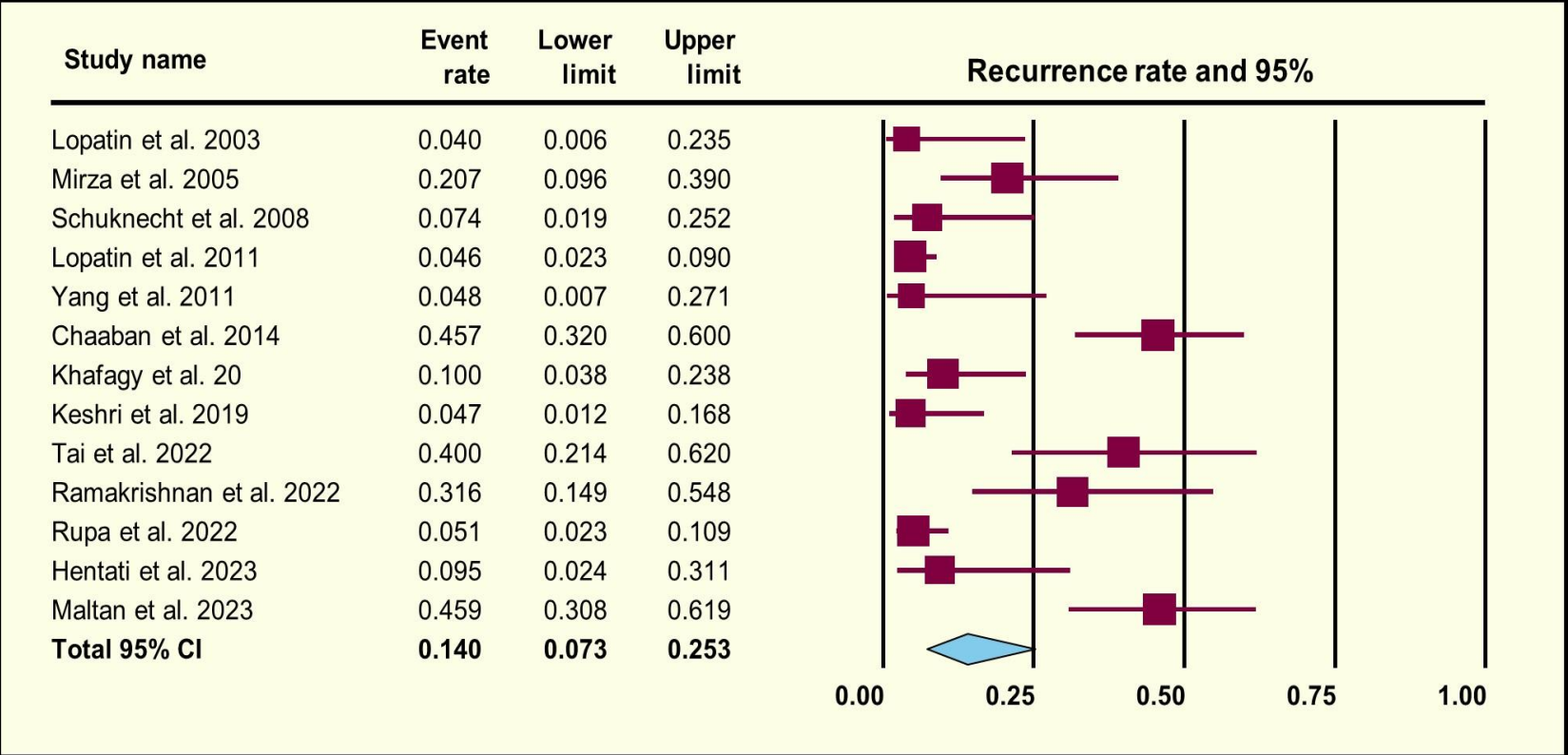
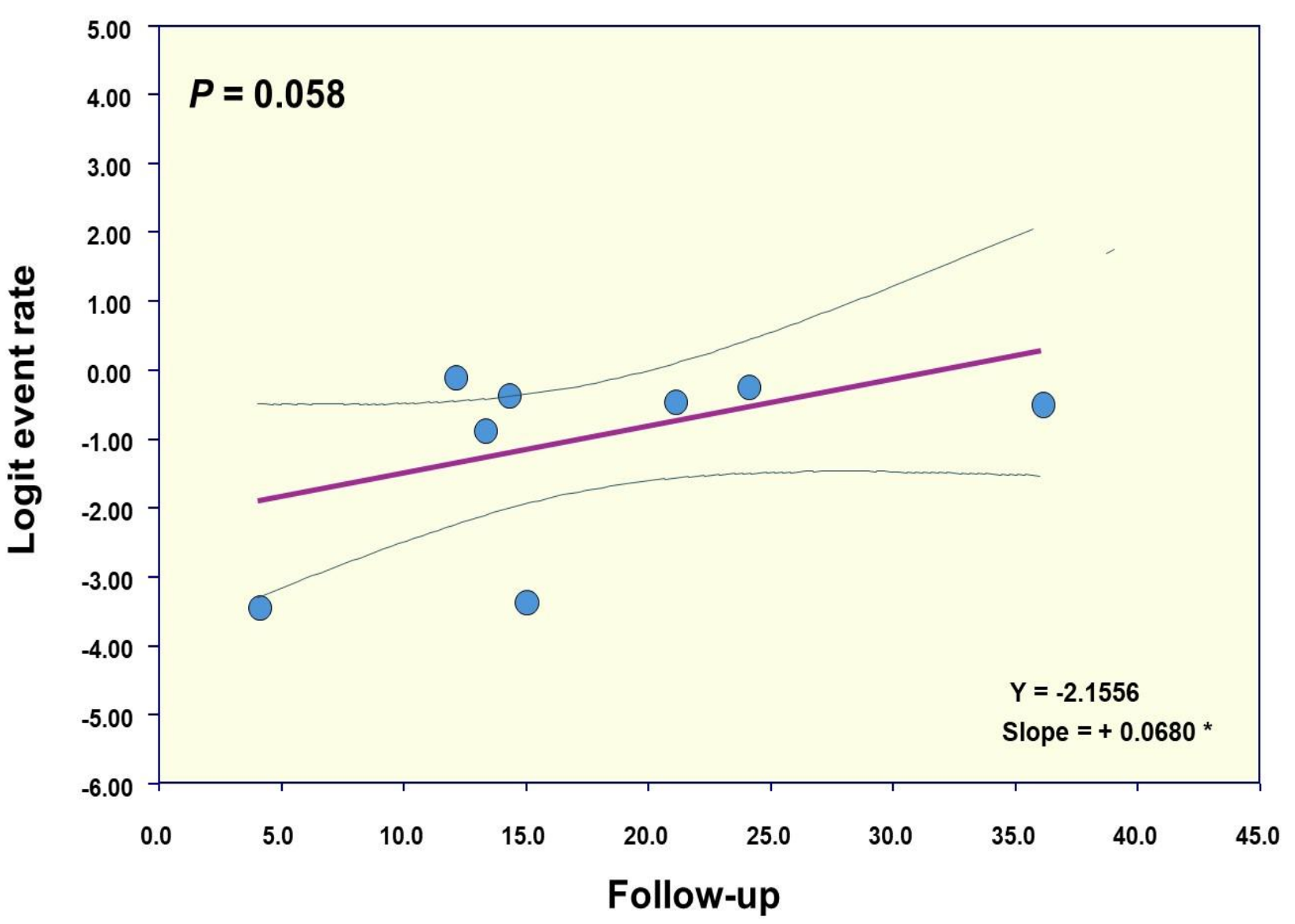


Table 1. Risk factor assessment of sCSF rhinorrhea

Variables	Rates	Heterogeneity (I ²)
OSA	21.7% (12.5% - 35.2%)	73.2
Obesity	67.0% (41.2% - 85.5%)	94.2
Hypertension	54.3% (46.0% - 62.5%)	<0.0001
Diabetes	28.2% (20.5% - 37.5%)	12.5
Empty Sella	59.3% (35.7% - 79.3%)	95%
Prior history of meningitis	15.5% (9.2% - 24.9%)	44.4
Raised ICP	78.4% (56.3% - 91.1%)	57.6

- Obesity (67%), raised intracranial pressure (78.4%) and empty sella syndrome (59.3%) are prevalent risk factors analyzed in sCSF rhinorrhea patients

Figure 4. Meta-regression of follow-up with prevalence



- Follow-up duration appears to have near positive association with prevalence rate (p = 0.058) (Figure 4).

Conclusions

This meta-analysis offers surgeons an up-to-date understanding of the prevalence, recurrence rates, and associated risk factors for spontaneous cerebrospinal fluid rhinorrhea

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