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Review

Self-reported habitual snoring and risk of cardiovascular disease and all-cause mortality

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ABSTRACT

Objective: Inconsistent findings have reported the association between self-reported habitual snoring and risk of cardiovascular disease (CVD) and all-cause mortality. We conducted a meta-analysis to investigate whether self-reported habitual snoring was an independent predictor for CVD and all-cause mortality using prospective observational studies.

Methods: Electronic literature databases (PubMed, Medline, Embase, Cochrane Library, Wanfang database, and China National Knowledge Infrastructure) were searched for publications prior to September 2013. Only prospective studies evaluating baseline habitual snoring and subsequent risk of CVD and all-cause mortality were selected. Pooled adjust hazard risk (HR) and corresponding 95% confidence intervals (CI) were calculated for categorical risk estimates.

Results: Eight studies with 65,037 subjects were analyzed. Pooled adjust HR was 1.26 (95% CI 0.98–1.62) for CVD, 1.15 (95% CI 1.05–1.27) for coronary heart disease (CHD), and 1.26 (95% CI 1.11–1.43) for stroke comparing habitual snoring to non-snorers. Pooled adjust HR was 0.98 (95% CI 0.78–1.23) for all-cause mortality in a random effect model comparing habitual snoring to non-snorers. Habitual snoring appeared to increase greater stroke risk among men (HR 1.54; 95% CI: 1.09–2.17) than those in women (HR 1.22; 95% CI: 1.05–1.41).

Conclusions: Self-reported habitual snoring is a mild but statistically significant risk factor for stroke and CHD, but not for CVD and all-cause mortality. However, whether the risk is attributable to obstructive sleep apnea syndrome or snoring alone remains controversial.

Contents

1. Introduction

Habitual snoring is a much more common disorder, with prevalence 20–40% in adult population [1,2]. Frequency of the comorbidities was presented in patients with obstructive sleep apnea syndrome (OSAS) and simple snoring [3]. Although snoring is considered a symptom of OSAS [4], many snore persons do not have OSAS. Snoring without OSAS has long been considered a social nuisance. However, the cumulative evidences showed that snoring might have important adverse health implications.

Many studies [5–12] have assessed the association between self-reported habitual snoring and cardiovascular disease (CVD)

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and mortality. Habitual snoring may help clinicians identify individuals at higher risk for CVD. However, conflicting result [13] has been reported. Whether this reflects confounding factors or whether the association is attributable to OSAS remains controversial. Severe OSAS was an independent risk factor for CVD [14]. Habitual snoring could be identified as an early marker of OSAS. Therefore, it is important to evaluate the association between self-reported habitual snoring and clinical outcomes.

To the best of our knowledge, the magnitude of the association between self-reported habitual snoring and risk of CVD or all-cause mortality has not been quantitatively evaluated. Given these reasons, a meta-analysis may help clarify this issue. The objective of our meta-analysis was to quantitatively evaluate findings from prospective observational studies on self-reported habitual snoring and risk of CVD or all-cause mortality, and determine whether self-reported habitual snoring is an independent risk factor of CVD or all-cause mortality.

2. Methods

We conducted a PubMed, Medline, Embase, Cochrane Library, Wanfang database, and China National Knowledge Infrastructure search prior to September 2013 for studies assessing the association between self-reported habitual snoring and future risk of CVD or all-cause mortality. Potentially relevant studies were identified using the word 'snoring', 'snorer' 'self-reported snoring' plus at least one of the following terms (Supplementary Text S1): cardiovascular disease, ischemic heart disease, coronary heart disease, stroke, death and mortality, prospective, follow-up study. In addition, we also manually searched the reference lists to detect additional eligible studies.

Studies satisfying the following criteria were selected: 1) prospective observational study reporting self-reported snoring and risk of CVD or all-cause mortality in a general population; 2) subjects were initially free from CVD at baseline or excluded in the final statistical analysis; and 3) providing adjusted hazard risk (HR) or odds ratio (OR) and 95% confidence interval (CI) comparing habitual snoring to the non-snorers. The question of snoring was phrased: 'Do you now or have you ever been told that you snore during the night?' Habitual snoring was defined by the individual study, the rest as non-snorers. Studies were excluded if 1) not a prospective design; 2) reporting unadjusted HR or OR; and 3) snoring was not measured by questionnaire or interview.

Outcome measures included incident CHD, stroke, total CVD, and all-cause mortality. Outcome assessment is defined in the included studies based on medical diagnostic codes and clinical criteria. CHD is defined as definite and probable myocardial infarction, CHD death, coronary revascularization, and angina. CVD included CHD (ICD-8: 410–414; ICD-9: 410–414; ICD-10: I20–25) and stroke (ICD-8: 431–438; ICD-9: 430–438; ICD-10: I60–68, G45). Death was obtained from the medical records, or from official death certificates.

Two reviewers (DM Li and XM Wang) independently extracted the data from each study. We extracted the following items: author; year of publication; the location of study; sample size, gender (%), and the mean age or age range of participants; outcome assessment; adjusted HR and 95% CI; follow-up duration; and adjustments for confounding. Where discrepancies were identified, reviewers resolved these by discussion.

Quality assessment was performed with consideration for the following aspects followed the Meta-analysis of Observational Studies in Epidemiology guidelines [15]: clear inclusion and exclusion criteria; documentation of the loss to follow-up rate; clear definition of outcome and outcome assessment; sufficient duration of follow-up; appropriate statistical analysis; and important confounded and prognostic factors identified. All items had the following answer options: yes/no/too little information to answer the question.

Data analyses used most fully adjusted HR and 95% CI. We pooled the separate HR for the different items and compared the habitual snoring to the non-snorers. Before pooling the data, adjusted HR was converted to their logHR to stabilize the variances and to normalize the distributions. Homogeneity of HR across studies was assessed using Cochran's Q-test and the I^2 statistic. A $P > 0.10$ or $I^2 < 50\%$ were taken as indicators of the same scale of outcomes using a fixed-effect model; otherwise using a random effect model [16].

Publication bias was assessed by both the Begg's rank correlation test [17] and Egger linear regression test ($P < 0.10$) [18]. Sensitivity analysis was performed by sequentially omitting one study at each turn with the metaninf algorithm in STATA to investigate the influence of a single study on the overall risk estimate. All analyses were performed using Revman software from the Cochrane Collaboration (version 5.1, Oxford, UK) and STATA statistical software (version 12.0; STATA Corp LP, College Station, TX, USA). $P < 0.05$ was considered as statistically significant.

3. Results

A total of 168 potentially relevant citations were identified in our initial literature search. Of these, 8 studies [5–12] with 65,037 subjects met the inclusion criteria (Fig. 1). The detailed characteristics of the included studies are listed in Table 1. Quality of the included studies is shown in the Supplement Table S1. In general, these studies had a relatively high quality.

Five studies [5,8,10–12] reported CVD. The total number of subjects included in this meta-analysis was 59,372, with 4842 reporting CVD. As shown in Fig. 2A, habitual snoring was associated with an increase risk of CVD (HR 1.26; 95% CI 0.98–1.62) in a random effect model compared with the non-snorers; however, this positive association was not statistically significant. Significant heterogeneity was observed ($I^2 = 71\%$; $P = 0.004$). Evidence of publication bias for studies reporting adjusted HR of CVD was not found by the Begg's rank correlation test ($P = 0.707$) and Egger's linear regression test ($P = 0.377$).

Six studies [5–9,12] reported data on CHD. The total number of subjects included in this meta-analysis was 53,186, with 3677 reporting CHD. As shown in Fig. 2B, habitual snoring was associated with an increase risk of CHD (HR 1.15; 95% CI 1.05–1.27) in a fixed-effect model compared with the non-snorers No obvious heterogeneity was observed ($I^2 = 11\%$; $P = 0.35$). There was no evidence of publication bias for studies reporting adjusted HR of CHD, as suggested by the Begg's rank correlation test ($P = 0.764$) and Egger's linear regression test ($P = 0.689$).

Six studies [5,6,8–10,12] reported stroke. The total number of subjects included in this meta-analysis was 55,587, with 1676 reporting stroke. As shown in Fig. 2C, habitual snoring was associated with an increase risk of stroke (HR 1.26; 95% CI 1.11–1.43) in a fixed-effect model compared with the non-snorers. No heterogeneity was observed ($I^2 = 0\%$; $P = 0.86$). There was no evidence of publication bias for studies reporting adjusted HR of stroke, as suggested by the Begg's rank correlation test ($P = 1.000$) and Egger's linear regression test ($P = 0.139$).

Four studies [5–7,10] reported data on all-cause mortality. The total number of participants included in this meta-analysis was 13,467, with 748 reporting all-cause mortality. As shown in Fig. 3, habitual snoring was not associated with an increase risk of all-cause mortality (HR 0.98; 95% CI 0.78–1.23) in a random effect model compared with the non-snorers. The heterogeneity was obvious ($I^2 = 50\%$; $P = 0.09$). There was no evidence of publication