The relationship between sleep duration and all-cause mortality in the older people: an updated and dose-response meta-analysis

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Abstract

Background: Short or long sleep duration is proposed as a potential risk factor for all-cause mortality in the older people, yet the results of published studies are not often reproducible.

Objectives: We aimed to investigate whether short or long sleep duration was associated with an increased risk of all-cause mortality in the older people via a comprehensive meta-analysis. Methods: Literature retrieval, study selection and data extraction were completed independently and in duplicate. Effect-size estimates are expressed as relative risk (RR) and its 95% confidence interval (CI).

Results: Summary data from 35 articles, involving a total of 106990 older people, were meta-analyzed. Overall analyses revealed a significant association between long sleep duration and all-cause mortality (RR=1.27, 95% CI: 1.19-1.35, P <.001), whereas marginal significance was observed for short sleep duration (RR=1.05; 95% CI: 1.00-1.09; P =.045). There was a low probability of publication bias as indicated by Egger's test for the association between sleep duration and all-cause mortality. In subgroup analyses, the association between long sleep duration and all-cause mortality was relatively strong in women (RR=1.48, 95% CI: 1.18-1.85, P =.002) relative to men (RR=1.30, 95% CI: 1.10-1.50, P =.001) (Two-sample Z test P = .219). Further dose-response regression analyses showed that trend estimation was not obvious for short sleep duration ( P = .016) compared with long sleep duration ( P < .001), indicating a J-shaped relationship between sleep duration and all-cause mortality.

Conclusions: Our findings indicate a J-shaped relationship between sleep duration and all-cause mortality in the older people, with long sleep duration significantly associating with all-cause mortality, especially in women.

Background

It is widely recognized that sleep plays an important role in human mental and physical health [1, 2]. Experimental studies indicated that sleep deprivation and excessive sleep duration can exert an adverse effect on hormones, metabolism and immune function [3-5]. From epidemiological aspects, although dozens of studies reported that inappropriate sleep duration and poor sleep quality are reported to be associated with high risk of some common diseases, including diabetes [6], cardiovascular diseases [7] and cancer [8], as well as to increased all-cause and cause-specific mortality rates [9], these associations are not often reproducible.

Over the past decades, many prospective studies have reported a U-shaped relationship between sleep duration and all-cause mortality, with the nadir at 7-8 hours of sleep per night [10-17]. In 2016, da Silva and colleagues conducted a meta-analysis by pooling the results of 27 cohort studies, and they found a significant association of both long and short sleep duration with increased all-cause mortality risk in the older people, and the association was more evident for long sleep duration [18]. However, the results of other studies have failed to provide any supportive data on sleep duration and mortality in the older people [19-21]. The reasons for these inconsistent reports are multifactorial, possibly relating to
inadequate statistical power of individual studies, different backgrounds and characteristics of study groups, and lack of adjustment for confounding factors. Given the accumulating data afterwards, there is a need to reexamine this association in a more comprehensive manner.

To yield more information for future studies, we synthesized the results of prospective cohort studies in the older people, aiming to evaluate the association between sleep duration and all-cause mortality. Meanwhile, we also intended to explore possible causes of between-study heterogeneity.

**Methods**

This meta-analysis was conducted according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement [22], and the PRISMA checklist is presented in Supplementary Table 1.

**Search Strategy**

We completed literature search by scanning PubMed, EMBASE and Web of Science databases as of November 30, 2019. The following medical topic terms are used: (sleep OR sleep disorders OR sleep duration OR drowse OR napping OR naps OR nap OR Siesta OR drowsiness OR drowse OR insomnia OR actigraphic sleep OR self-reported sleep [Title/Abstract], AND mortality OR death OR deaths OR premature death OR all-cause mortality [Title/Abstract]), AND (aged OR geriatrics OR older people OR older age OR older adult OR older adult OR older persons OR older people OR older men OR older women OR aging OR aging women OR aging men OR the older people OR aging individuals [Title/Abstract]). We also scanned the reference lists of retrieved articles and systematic reviews to avoid potential missing hits.

Two investigators (M.H. and X.D.) independently reviewed all retrieved articles, and, they carefully evaluated preliminary qualification based on their titles or abstracts and full texts if necessary.

**Inclusion/Exclusion Criteria**

Our analyses were restricted to the articles that met the following criteria: (1) participants aged ≥60 years old; (2) all-cause mortality as the outcome; (3) prospective cohort studies; (4) clear classification of sleep duration; (5) at least 70% follow-up rate. Studies with subgroup analysis in older people on sleep duration and all-cause mortality were also included in this meta-analysis. Articles were excluded if they focused on cause-specific mortality or involved participants with serious diseases, or if they are case reports/series, editorials, and narrative comments.

**Data Extraction**

Two investigators (M.H. and X.D.) independently extracted data from each qualified article, and typed them into a standardized Excel spreadsheet, including name of the first author, year of publication, country where study was conducted, race, sample size, sex, baseline age, follow-up period, ascertainment of sleep duration, death certificate, adjusted confounders, sleep duration, effect estimation, and other
traditional risk factors, if available. The divergences were resolved through joint reevaluation of original articles, and, if necessary, by a third author (W.N).

**Statistical Analysis**

We used the Stata software version 14.1 for Windows (StataCorp, College Station, TX) to manage and analyze data. Irrespective of the magnitude of between-study heterogeneity, the random-effects model was employed. Effect size estimates are expressed as hazard ratio (HR) and its 95% confidence interval (CI), and the difference between two estimated was tested by the Z-test as reported by Altman and Bland [23]. The dose-response association was examined by the generalized least squares regression for trend estimation of summarized dose-response data [24].

The inconsistency index ($I^2$) is used to assess heterogeneity between studies, and it represents the percentage of diversity observed between studies that results from chance rather than an accidental result. If the $I^2$ value is greater than 50%, significant heterogeneity is recorded, and a higher value indicates a higher degree of heterogeneity. Because of diverse sources of heterogeneity possibly from clinical and methodological aspects, a large number of prespecified subgroups were analyzed according to baseline age, sex, region, race, follow-up, short sleep duration and long sleep duration, respectively.

The probability of publication bias was evaluated by both Begg’s funnel plots and Egger regression asymmetry tests at a significance level of 10%. The trim-and-fill method was used to estimate the number of theoretically missing studies.

**Results**

**Eligible Studies**

After searching prespecified public databases using predefined medical subject terms, a total of 2098 articles were initially identified, and 28 of them with data on sleep duration and all-cause mortality were eligible for inclusion [10, 14, 17, 19, 21, 25-47], including 95259 older persons in the final analysis. The detailed selection process including specific reasons for exclusion is schematized in Figure 1. Since most articles provided data according to different age groups at baseline or follow-up periods, they are processed separately in subgroup analyses.

**Study Characteristics**

Table 1 and Table 2 show the baseline characteristics of all cohort studies involved in this meta-analysis. Of 28 eligible articles, 2 in older women [17, 19], and 6 specifically described the number of men and women and the number of deaths of men and women [27, 30, 35, 38-40]. Five articles provided data on the association between sleep duration and all-cause mortality by gender [30, 35, 36, 38, 42]. Of all eligible articles, 9 investigated the total sleep duration of 24 hours in the older people [19, 26, 31, 33, 38, 39, 41-43], and the others focused on the nighttime. One article adopted the actigraphy method to collect
sleep time [43], and 2 articles simultaneously used actigraphy method and questionnaires [17, 47]. Based on geographic locations, all eligible articles were classified into America [14, 17, 19, 26, 32, 33, 40, 42], Europe [10, 21, 34, 37, 42-45], and Asia [27-31, 35, 36, 38, 39, 41].

Quality Assessment

Table 3 shows the quality assessment results by using the Newcastle-Ottawa Scale (NOS) tool for cohort studies, with the total scores (mean: 7.46, standard deviation: 0.74) ranging from 6 to 9 in this meta-analysis.

Overall Analyses

After pooling the results of all qualified prospective cohorts together (Table 4), unadjusted effect-size estimates for the association of the long (HR=1.43; 95% CI: 1.30-1.58; \(P<.001; I^2=88.6\%\)) and short (HR=1.15; 95% CI: 1.06-1.25; \(P<.001; I^2=71.5\%\)) sleep duration with all-cause mortality in the older people were remarkably significant. After adjusting for potential confounders, long sleep duration was significantly associated with an increased risk of all-cause mortality in the older people (HR=1.24; 95% CI: 1.16-1.33; \(P<.001\)), whereas no significance was observed for short sleep duration (HR=1.04; 95% CI: 1.00-1.09; \(P=.213\)) (Table 4). In view of the striking differences before and after adjustment, the following analyses are based on adjusted effect-size estimates for the sake of relative accuracy.

Publication Bias

Figure 2 shows the Begg's funnel plot to assess publication bias for the association of sleep duration with all-cause mortality, and only the plot of short sleep duration seemed symmetrical. As revealed by the Egger's test, there was no evidence of publication bias for short sleep duration (\(P=.392\)), yet strong evidence of publication bias for long sleep duration (\(P=.020\)). Further filled funnel plots showed that there were 9 potentially missing studies due to publication bias to make the plot of long sleep duration symmetrical. After adjusting for these potentially missing studies, effect size estimates were still statistically significant for the association of long sleep duration with all-cause mortality (HR=1.15; 95% CI: 1.07-1.23, \(P<.001\)).

Subgroup Analyses

A series of prespecified subgroup analyses were conducted to account for possible causes of between-study heterogeneity for both short and long sleep duration in the older people (Table 4).

By gender, the association of long sleep duration with all-cause mortality was statistically significant in both women (HR=1.48; 95% CI: 1.18-1.86; \(P=.001\)) and men (HR=1.31; 95% CI: 1.10-1.58; \(P=.003\)) (Two-sample Z test \(P=.205\)). By contrast, with regard to short sleep duration, statistical significance was observed in men (HR=1.13; 95% CI: 1.04-1.24; \(P=.007\)), but not in women (HR=1.00; 95% CI: 0.85-1.18; \(P=.999\)) (Two-sample Z test \(P=.099\)).
By geographic locations, the association of long sleep duration with all-cause mortality was stronger in Asia (HR=1.41; 95% CI: 1.26-1.57; P < .001) than in Europe (HR=1.01; 95% CI: 0.93-1.09; P = .823) (Two-sample Z test P < .001) and America (HR=1.19; 95% CI: 1.07-1.31; P = .001) (Two-sample Z test P = .013). There was no observable difference for short sleep duration between Asia (HR=1.04; 95% CI: 0.96-1.12; P = .384) and Europe (HR=1.03; 95% CI: 0.93-1.14; P = .627).

By total sleep time, significance was only observed for the association of long sleep duration with all-cause mortality, and there was no material difference between the nighttime (HR=1.25; 95% CI: 1.13-1.38; P < .001) and the 24 h sleep duration (HR=1.25; 95% CI: 1.14-1.36; P < .001).

By ascertainment of sleep, for long sleep duration, the association was more evident for questionnaire survey (HR=1.26; 95% CI: 1.17-1.35; P < .001) than for actigraph survey (HR=0.83; 95% CI: 0.61-1.13; P = .233) (Two-sample Z test P = .004). Contrastingly, for short sleep duration, there was no detectable significance.

By the median value (7.5 years) of follow-up intervals, the association of long sleep duration with all-cause mortality was significant in both long (≥ 7.5 years) (HR=1.24; 95% CI: 1.14-1.34; P < .001) and short (<7.5 years) (HR=1.27; 95% CI: 1.12-1.45; P < .001) follow-up. As for short sleep duration, the association was only significant in studies with long follow-up intervals (HR=1.07; 95% CI: 1.02-1.12; P = .006).

By the median value (65 years) of baseline age, long sleep duration was significantly associated with all-cause mortality in both subgroups (≥ 65 years: HR=1.20; 95% CI: 1.11-1.30; P < .001, and <65 years: HR=1.38; 95% CI: 1.19-1.60; P < .001), and for short sleep duration, only marginal significance was observed for studies with median age <65 years (HR=1.21; 95% CI: 1.02-1.23; P = .018).

**Dose-Response Analyses**

In the dose-response analysis on short sleep duration, all-cause mortality increased with the decrease of sleep time (≤ 5 h: HR=1.06; 95% CI: 1.01-1.11; P = .014, ≤ 6 h: HR=1.05; 95% CI: 1.01-1.10; P = .031, and ≤ 7 h: HR=1.04; 95% CI: 1.00-1.09; P = .033) (Two-sample Z test P = .379 for ≤ 5 h vs. ≤ 6 h, and P = .379 for ≤ 6 h vs. ≤ 7 h) (Table 4). For long sleep duration, the trend was more evident (≥ 8 h: HR=1.24; 95% CI: 1.16-1.33; P < .001, ≥ 9 h: HR=1.31; 95% CI: 1.21-1.41; P < .001, and ≥ 10 h: HR=1.45; 95% CI: 1.24-1.70; P < .001) (Two-sample Z test P = .147 for ≥ 8 h vs. ≥ 9 h, and P = .128 for ≥ 9 h vs. ≥ 10 h) (Table 4 and Figure 3A).

In men, the risk associated with all-cause mortality was significant and increased with both shorter and longer sleep duration, and the increasing trend was more obvious for long sleep duration (Figure 3B). In women, the risk associated with all-cause mortality was nonsignificant for short sleep duration, yet it was significantly increased with longer sleep duration in a graded manner, which was steeper than men (Figure 3C).

In both genders, dose-response regression analyses, using log(effect-size estimates) as dependent variable and categorized sleep duration as independent variable, revealed that trend estimation was more obvious for long sleep duration (regression coefficient: 0.13; P < .001) than for short sleep duration.
(regression coefficient: 0.02; \( P = .046 \)). In men, the regression coefficient for tread estimation was 0.05 (\( P = .022 \)) and 0.15 (\( P < .001 \)) for short and long sleep duration, respectively, and the regression coefficient was separately 0.04 (\( P = .449 \)) and 0.20 (\( P < .001 \)) in women.

Discussion

To the best of our knowledge, this is thus far the most comprehensive meta-analysis that has explored the dose-response relationship between sleep duration and all-cause mortality in the older people. It is worth noting that long sleep duration was associated with a significantly increased risk of all-cause mortality, especially in women, and the mortality risk associated with short sleep duration was only significant in men. Moreover, besides gender, geographic region, sleep survey method, baseline age and follow-up interval were identified as possible causes of between-study heterogeneity. Our findings highlight the importance and the necessity of closely monitoring the sleep status of elders who sleep over 8 hours, as well as elderly men of sleep deficiency, to control and prevent all-cause mortality.

In the previous meta-analysis of 27 cohort studies by da Silva and colleagues, both long and short sleep duration were found to be associated with a significantly increased risk of all-cause mortality risk in the older people [18]. Differing from the meta-analysis by da Silva and colleagues [18], we restricted analysis only to prospective cohort studies that reported HRs and 95% CIs to quantify the association between sleep duration and all-cause mortality in elders. After synthesizing the adjusted effect-size estimates from 28 articles including 95259 older persons, we failed to confirm the overall significant association of short sleep duration with all-cause mortality as reported by da Silva and colleagues [18], yet our subsidiary analysis revealed a significant mortality risk associated with short sleep duration in men only. Similarly, da Silva and colleagues [18] and we unanimously supported the significant contribution of long sleep duration to all-cause mortality. The reasons behind above inconsistent observations are manifold. First, the most likely reason is the unaccounted confounding, as our analysis based on unadjusted effect-size estimates indicated that short sleep duration was a significant predictor for all-cause mortality, yet no significance was detected after adjustment.

Another possible reason is the synthesis of different types of effect-size estimates. To minimize this statistical noise, we restricted analysis to only HRs that were calculated after adjusting for confounding factors, despite the varying panels of adjusted factors across each involved study in this meta-analysis. The third reason is the significant heterogeneity across individual studies. To fully account for this, we conducted both subgroup and meta-regression analyses, and found that gender, geographic region, sleep survey method, baseline age and follow-up interval were possible causes of between-study heterogeneity. We agree that future large-scale, well-designed cohort studies were warrant to derive a relatively reliable estimate.

Although the mechanisms for the association between long sleep duration and all-cause mortality are not completely understood, the current possible explanation is that sleep affects the human body through inflammatory processes. When sleep duration is too long, concentrations of inflammatory markers, such
as interleukin-6 and C-reactive protein can increase [48, 49]. In addition, it is reported that unstable sleep duration was associated with some common diseases, such as hypertension [50, 51], diabetes [52], and coronary heart disease [53, 54]. It is hence reasonable to speculate that long-term irregular sleep duration is likely to destroy the body's immune system balance through chronic inflammatory processes, and further increase all-cause mortality risk. There is also evidence showing that sleep has a crucial impact on autonomic nervous system, system dynamics, cardiac function, endothelial function and coagulation [55]. Nevertheless, over sleep duration can accelerate the occurrence or progression of chronic diseases, and further precipitate all-cause mortality.

Finally, some limitations should be acknowledged for this present meta-analysis. First, only sleep duration was considered in this study, and other sleep-related indexes, such as sleep quality, are of added interest for explorations in case of sufficient eligible studies. Second, although adjusted effect-size estimates were synthesized in this meta-analysis, some important confounding factors are still not taken into account by all involved studies, such as physical activity and other lifestyle factors. For example, in a long-term follow up of older adults in the UK, physical activity and prefrailty was observed to be significant modifiers for the prediction of long sleep duration for all-cause mortality [40]. Third, although there was a high probability of publication bias for long sleep duration as reflected by Begg’s funnel plot and Egger’s test, we adopted the trim-and-fill method to impute theoretically missing studies and recalculated our pooled effect-sized estimate, which was still statistically significant. Fourth, although a large panel of subgroup and meta-regression analyses were undertaken to account for heterogeneity, significant heterogeneity still persisted in some subgroups, limiting the interpretation of pooled effect-size estimates. Fourth, the majority of studies involved in this meta-analysis recorded sleep duration based on nighttime, and data on naps are sparse.

**Conclusions**

Taken together, our findings indicate a significantly increased risk of all-cause mortality associated with long sleep duration, especially in women, as well as with short sleep duration in men only. We agree that the findings of this meta-analysis pose a challenging task for searchers, clinicians, and policy makers to attach importance to monitor the sleep status of elders, especially with long sleep duration. Further investigations on the molecular mechanisms linking sleep duration and all-cause mortality are also warranted.

**Declarations**

**Ethics approval and consent to participate**

Ethics approval and consent to participate were received by each involved study in this meta-analysis.

**Consent for Publication**
Not applicable.

**Availability of data and material**

The datasets used and/or analyzed during the current meta-analysis are available from the corresponding author upon reasonable request.

**Competing interests**

The authors declare that they have no competing interests.

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**Authors’ contributions**

All authors read and approved the final manuscript prior to submission.

Conceived and designed the experiments: X.D., W.N.

Performed the experiments: M.H., X.D., L.H.

Analyzed the data: X.D, W.N.

Contributed materials/analysis tools: M.H., X.D., Y.Z., H.Y.

Wrote and revised the paper: M.H., W.N.

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Tables

Table 1. The baseline characteristics of all cohort studies involved in this meta-analysis.
| Published year | First author | Baseline year | Country | Age (years) | Ascertainment of sleep | TST | Ref vs. exposure | Ascertainment of mortality | Adjustments for confounders |
|---------------|--------------|---------------|---------|-------------|------------------------|-----|-----------------|----------------------------|-----------------------------|
| 1987          | Kaplan       | 1965          | USA     | 60–94       | questionnaires         | nighttime sleep | 7-8h vs. ≤7h | Death certificate          | age, self-reported health status |
|               |              |               |         |             |                        |                 | 7-8h vs. >8h | all-cause                  |                             |
| 2011          | Kronholm     | 1972          | Finland | 60-64       | questionnaires         | nighttime sleep | 7-8h vs. ≤5h | Death certificate and hospital discharge register | None |
|               |              |               |         |             |                        |                 | 7-8h vs. >10h | all-cause and CVD          |                             |
| 2008          | Gangwisch    | 1982          | USA     | 60-86       | questionnaires         | nighttime sleep | 7h vs. ≤5h   | Death certificate and proxy interviews | age, physical activity, smoking, depression, sex, education, living alone, low income, daytime sleepiness, nighttime awakening, ethnicity, and sleeping pill use, BMI, diabetes, and hypertension general health and cancer |
|               |              |               |         |             |                        |                 | 7h vs. ≥9h   | all-cause                  |                             |
| 2013          | Jung         | 1984          | USA     | 60-96       | questionnaires         | nighttime sleep | 7-9h vs. <6h | Death certificate or notice from a family member or published obituary | age, nap duration, depression, exercise, education, smoking, alcohol consumption, |
| Year | Author | Year of Study | Country | Age | Study Design | Sleep Duration | Death Certificate | Covariates |
|------|--------|---------------|---------|-----|--------------|-----------------|-------------------|------------|
| 2019 | Morgan | 1985          | UK      | ≥65 | Questionnaire | Nighttime Sleep  | 7-9h vs. ≥9h  | All-cause |
|      |        |               |         |     |              |                  | 7h vs. ≤4h      | Age, gender, social class, All-cause |
|      |        |               |         |     |              |                   | 7h vs. ≥9h      | Hypnotic drug use, All-cause |
|      |        |               |         |     |              |                   | 4-9.9h vs. ≥10h | All-cause |
| 2009 | Stone  | 1986          | USA     | ≥68 | Questionnaire | Nighttime Sleep  | 6-8h vs. <6h   | Age, BMI, History of at least one medical condition (diabetes, Parkinson's disease, dementia, COPD, All-cause) |
|      |        |               |         |     |              |                   | 6-8h vs. >8h    | All-cause |
|      |        |               |         |     |              |                   |                  | All-cause |

Hypertension, diabetes, coronary heart disease, stroke, cancer, sleep-related medications and postmenopausal oestrogen.
| Year | Author | Country | Age | Instrument | Sleep Duration | Cause of Death |
|------|--------|---------|-----|------------|----------------|----------------|
| 2003 | Goto   | Japan   | ≥65 | Questionnaire | 6-7h vs. <6h  | ≥7h            |

- non-skin cancer
- CVD
- osteoarthritis
- CVD
- hypertension
- walk for exercise
- alcohol use
- smoking status
- depression
- cognitive impairment
- oestrogen use
- benzodiazepine use
- age
- presence of spouse
- education
- working status
- cerebrovascular disease
- hypertension
- fracture
- subjective health
- activities of daily living (ADL)
- hearing
- vision
- basic activities of daily living (BADL)
- biological items were body mass index, hemoglobin,
| Year | Study | Country | Age | Questionnaire | Sleep | Nighttime vs. | Death certificate | Cause of death |
|------|-------|---------|-----|---------------|-------|---------------|-----------------|----------------|
| 2012 | Cohen-Mansfield | Israel | 75-94 | Questionnaire | Nighttime sleep | 7-9h vs. <7h | Death certificate | Age, sex, origin, marital status, education, income, had children, number of medications, comorbidity, subjective health, ADL and IADL limitations, cognitive difficulties, depressed affect |
| 2013 | Kim | USA | ≥65 | Questionnaire | 24h sleep | 7h vs. ≤5h | Death certificate | Age, sex, ethnicity, education, marital status, hypertension, diabetes, alcohol consumption, energy intake, BMI, physical activity, hours spent daily |

The table above summarizes the results of two studies examining the relationship between sleep duration and mortality. The studies by Cohen-Mansfield and Kim looked at different populations and used different questionnaires and sleep measures, but both found that sleep duration was associated with mortality.
| Year | Author | Year of Survey | Country | Age/Sex | Study Design | 24h Sleep | Death Certificate | Factors Considered |
|------|--------|----------------|---------|---------|--------------|-----------|-------------------|-------------------|
| 2001 | Seki   | 1990           | Japan   | 60-74   | Questionnaire | 7h vs. ≤6h | Death certificate | Age, sex, medical history, (cerebrovascular disease, CVD, hypertension, diabetes, liver disease, renal disease, malignant neoplasm) |
|      |        |                |         |         |              |            |                   | 7h vs. ≥9h all-cause |
| 2007 | Lan    | 1993           | China   | ≥64     | Questionnaire | 7-7.9 vs. <7h | Death certificate | Age, marital status, monthly income, cigarette smoking, alcohol consumption, BMI, exercise, disease history (heart disease, stroke and cancer), depression, afternoon nap duration |
|      |        |                |         |         |              |            |                   | 7-7.9 vs. ≥10h all-cause, CVD, cancer |
| 2013 | Yeo    | 1993           | Korea   | ≥60     | Questionnaire | 7h vs. ≤5h | Death certificate | Sex, educational attainment, BMI, cigarette smoking, alcohol consumption, hypertension, diabetes, CVD, |
|      |        |                |         |         |              |            |                   | 7h vs. ≥10h all-cause, CVD, cancer |
| Year | Study | Country | Age Group | Methodology | Duration | Sleep Duration | Analysis | Variables |
|------|-------|---------|-----------|-------------|----------|----------------|----------|-----------|
| 2013 | Kakizaki | Japan | ≥70 | Questionnaire | 24h | 7h vs. ≤6h | Death certificate | Age, sex, total caloric intake, BMI, marital status, education, job status, history of myocardial infarction, history of cancer, history of stroke, hypertension, diabetes, smoking, alcohol consumption, time spent walking, self-rated mental health, self-rated health |
| 2011 | Werle | Brazil | ≥80 | Questionnaire and 24h sleep | 7h vs. >8h | Nighttime sleep and 24h sleep | Death certificate, proxy interviews and patient records | None |
| 2011 | Kripke | USA | 60–81 | Questionnaire and actigraphy | Nighttime sleep | 7h vs. ≤5h | Proxy interviews and social security | None |
| Year | Study | Country | Age Range | Study Design | Sleep Duration | Death Index | Death Certificate and Proxy Interview | Confounders |
|------|-------|---------|-----------|--------------|----------------|-------------|---------------------------------------|-------------|
| 2017 | Akersted | Sweden | ≥65 | Questionnaire | Nighttime sleep | 7h vs. ≥9h | All-cause | Age, sex, BMI, smoking status, alcohol consumption, educational level, physical activity, major diseases |
| 2011 | Castro-Costa | Brazil | >60 | Questionnaire | 24h sleep | 7-7.9h vs. <6h | Death certificate and proxy interview | All-cause | Age, schooling, marital status, working status, education, alcohol consumption, coffee consumption, smoking, physical exercise, depressive symptoms, cognitive functioning, psychoactive medications, physical functioning, arthritis ascertainment, systolic BP, HDL cholesterol ratio, diabetes, BMI |
| Year | Author | Year of Study | Country | Age Group | Questionnaire Format | Sleep Duration | Death Certificate Cause | Additional Variables |
|------|--------|---------------|---------|-----------|----------------------|----------------|-------------------------|---------------------|
| 2013 | Chen   | 1999         | China   | >65       | Questionnaire        | Nighttime Sleep | 7h vs. ≤4h              | Age, sex, living status, marital status, education, BMI, insomnia, excessive daytime sleepiness, pain, smoking, alcohol drinking, snorers, diabetes, hypertension, CVD, stroke, gouty arthritis, depression, hypnotics, total sleep time |
| 2009 | Suzuki | 1999         | Japan   | 65-85     | Questionnaire        | 24h Sleep      | 7h vs. ≤5h              | Age, sex, BMI, smoking status, alcohol consumption, frequency of physical activity, socioeconomic status, Mental health, hypertension, diabetes, cancer |
| 2014 | Lee    | 2001         | China   | >65       | Questionnaire        | Nighttime Sleep | <10h vs. ≥10h           | Age, smoking, mood, overweight (BMI>23), medical conditions |
| Year | Author  | Study Site | Age Range | Study Design | Sleep Duration | Death Certificate | Additional Variables |
|------|---------|------------|-----------|--------------|----------------|-------------------|---------------------|
| 2018 | Brostrom | Sweden     | 65-82     | Questionnaire and nighttime sleep | 7-8h vs. ≤6h | Death certificate | None |
|      |         |            |           |              | 7-8h vs. ≥9h |                   |         |
| 2016 | Smagula | USA        | ≥65       | Questionnaire and actigraphy | 24h sleep | Death certificate | All-cause, CVD, cancer |
|      |         |            |           |              | 5-8h vs. <5h |                   |         |
|      |         |            |           |              | 5-8h vs. >8h |                   |         |
| Year | Author | Country | Age (range) | Method | Dependent Variable | Independent Variable | Factors Considered |
|------|--------|---------|-------------|--------|---------------------|-----------------------|--------------------|
| 2015 | Zuurbier | Holland | 60–98      | Questionnaire and actigraphy | 24h sleep 6-7.5h vs. <6h | Death certificate and patient records | Age, sex, ADL, smoking, diabetes, myocardial infarction, stroke, cognitive function, depressive symptoms, BMI, sleep medication, napping, apnea |
| 2011 | Qiu     | China   | ≥65        | Questionnaire | 24h sleep 6-8h vs. ≤5h 6-8h vs. ≥9h | Death certificate all-cause | Age, ethnicity, urban-rural residence, geographic region, SES, family/social support, health practices, cumulative health deficit index |
| 2017 | Beydoun | USA     | ≥65        | Questionnaire | Nighttime sleep 7h vs. <7h | Death certificate | Sex, age group, race/ethnicity, education, marital status, poverty income ratio, smoking status, |
alcohol consumption, moderate or vigorous physical activity, body mass index, waist circumference, high systolic or diastolic blood pressure, self-rated health, depressive symptoms, the nutrient adequacy score.

| Year | Study | Country | Age Range | Instrument | Sleep Duration | Death Certificate | Socio demographic and Health Covariates | Additional Information |
|------|-------|---------|-----------|-------------|----------------|------------------|------------------------------------------|------------------------|
| 2018 | Cheng | Singapore | ≥60 | Questionnaire | 7-8h vs. ≤6h | 7-8h vs. ≥9h | 7-8h vs. >8h all-cause | age, gender, race, education, alcohol consumption status, |
| 2015 | Hall | USA | 70-79 | Questionnaire | 7h vs. <6h | Death certificates, hospital records, informant interviews | | |
Abbreviations: ADL, activities of daily living; BMI, body mass index; BP, blood pressure; COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; HDL, high-density lipoprotein; IADL, instrumental activities of daily living; MMSE, Mini-Mental State Examination; TIB, time in bed; SES, socioeconomic status; TST, total sleep time; Ref, reference.

### Table 2. The baseline characteristics of all cohort studies involved in this meta-analysis.

| Year | Study | Country | Age | Type of Questionnaire | Sleep Duration | Cause of Death | Characteristics Studied |
|------|-------|---------|-----|-----------------------|----------------|----------------------|-------------------------|
| 2019 | Akersted | Sweden | ≥65 | Questionnaire | 7h vs. >8h | all-cause death | Age, sex, BMI, smoking status, alcohol consumption, health characteristics, diabetes, pulmonary disease, ulcers, arthritis, osteoporosis, depression |
| 1997 | | | | | 7h vs. ≥8h | all-cause death, CVD, cancer | |
| Published year | First author | Gender | Sample size | Age | Men | Women | Follow up (years) | Total deaths | Men deaths | Women deaths | Exposure (h) | Ref (h) | Adjusted HR | 95% CI |
|---------------|--------------|--------|-------------|-----|-----|-------|------------------|--------------|------------|-------------|-------------|---------|--------------|-------|
| 198           | Kaplan       | Men    | 417         | 60–94 | -   | -     | 17               | -            | -          | -           | >8          | 7-8     | 1.02         | 0.87  |
| 198           | Kaplan       | Men    | 417         | 60–94 | -   | -     | 17               | -            | -          | -           | <7          | 7-8     | 1.02         | 0.87  |
| 198           | Kaplan       | Men    | 417         | 60–94 | -   | -     | 17               | -            | -          | -           | >8          | 7-8     | 1.02         | 0.87  |
| 201           | Kronholm     | Men    | 121         | 60–64 | 35  | 106   | 5                | ≥10          | 7-8        | NO          | 1.11        | 1.05   | 1.07         | 1.18  |
| 201           | Kronholm     | Men    | 121         | 60–64 | 35  | 106   | 5                | ≤5           | 7-8        | NO          | 1.11        | 1.05   | 1.07         | 1.18  |
| 200           | Gangwisch    | Men    | 398         | 60–86 | 10  | 160   | 4                | ≥9           | 7          | YES         | 1.36        | 1.15   | 1.14         | 1.15  |
| 200           | Gangwisch    | Men    | 398         | 60–86 | 10  | 160   | 4                | ≤5           | 7          | YES         | 1.27        |        |              |       |
| Year | Group | Gender | Age Mean | Age SD | BMI Mean | BMI SD | BMI Min | BMI Max | P Value | Significance |
|------|-------|--------|----------|--------|-----------|--------|---------|---------|---------|--------------|
| 200  | Men   | 8 gwi  | 386      | 4      | 10        | 15     | 4       | 15      | 1.98    | 1.06         |
|      | Women | 8 gwi  | 386      | 4      | 10        | 15     | 4       | 15      | 1.68    | 1.53         |
|      |       |        |          |        |           |        |         |         | 2.32    |              |
| 201  | Men   | Jun    | 200      | 160    | 2         | 4      | 160     | 2       | 0.82    | 0.05         |
|      | Women | Jun    | 200      | 160    | 2         | 4      | 160     | 2       | 1.45    |              |
|      |       |        |          |        |           |        |         |         | 2.18    |              |
| 201  | Men   | Jun    | 200      | 160    | 2         | 4      | 160     | 2       | 0.67    |              |
|      | Women | Jun    | 200      | 160    | 2         | 4      | 160     | 2       | 1.43    |              |
|      |       |        |          |        |           |        |         |         | 1.6     |              |
| 201  | Men   | Jun    | 200      | 160    | 2         | 4      | 160     | 2       | 0.92    |              |
|      | Women | Jun    | 200      | 160    | 2         | 4      | 160     | 2       | 1.52    |              |
|      |       |        |          |        |           |        |         |         | 1.12    |              |
## Table 1: Summary Statistics of the Study Population

| Sex   | Age Group | ID     | Height | Weight | BMI   | Waist | Hip    | BMI Waist | BMI Hip | Age   | Sex   | Age Group | ID     | Height | Weight | BMI   | Waist | Hip    | BMI Waist | BMI Hip |
|-------|-----------|--------|--------|--------|-------|-------|--------|----------|---------|-------|-------|-----------|--------|--------|--------|-------|-------|--------|----------|---------|
| Men   | 60-889    | 111    | 122    | 632    | 592   | ≤5    | 7      | NO       | 111     | 7     | NO    | 1.1, 0.79 | 0.79   | 1.55   | 1.07   | 0.79  | 1.07  | 0.79   | 1.55     | 1.07    |
|       | 96        | 2      | 4      |        |       |       |        |          |         |       |       |            |        |        |        |       |       |        |          |         |
| Wo    | 60-889    | 111    | 122    | 632    | 592   | ≤5    | 7      | NO       | 111     | 7     | NO    | 1.07, 0.79 | 0.79   | 1.44   |        |       |       |        |          |         |
|       | 96        | 2      | 4      |        |       |       |        |          |         |       |       |            |        |        |        |       |       |        |          |         |
| Men   | ≥65       | 375    | 585    | 27     | 927   | ≤4    | 7      | YES      | 1.18    | 1.18  |       | 0.85, 0.83 | 0.83   | 1.63   |        |       |       |        |          |         |
| Wo    | ≥9        | 1       | 2      | >8     | 6-8   |       |        |          |         |       |       |            |        |        |        |       |       |        |          |         |
| Men   | ≥65       | 375    | 585    | 27     | 927   | ≤4    | 7      | YES      | 1.08    | 1.08  |       | 0.8-1.4 | 1.4    | 1.08   | 1.08   | 1.08  | 1.08  | 1.08   | 1.08    | 1.08    |
| Wo    | ≥9        | 1       | 2      | >8     | 6-8   |       |        |          |         |       |       |            |        |        |        |       |       |        |          |         |
| Men   | ≥65       | 375    | 585    | 27     | 927   | ≤4    | 7      | YES      | 1.02    | 1.02  |       | 0.8-1.29 | 1.29   |        |        |       |       |        |          |         |
| Wo    | ≥10       | 8-9    |       |        |       |       |        |          |         |       |       |            |        |        |        |       |       |        |          |         |
| Men   | ≥65       | 375    | 585    | 27     | 927   | ≤4    | 7      | YES      | 1.58    | 1.58  |       | 1.27    | 1.27   |        |        |       |       |        |          |         |
| Wo    | ≥65       | 375    | 585    | 27     | 927   | ≤4    | 7      | YES      | 1.58    | 1.58  |       | 1.27    | 1.27   |        |        |       |       |        |          |         |

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| Age Group | Gender | Count | Mean | SD | Median | Sex | Age Category | Value | 95% CI |
|-----------|--------|-------|------|----|--------|-----|--------------|-------|-------|
| 65-69     | Men    | 251   | 473  |    |        |     | >7           | 6-7   | 1.54   |
|           |        |       |      |    |        |     |              |       | 0.92   |
|           |        |       |      |    |        |     |              |       | 2.58   |
| 65-69     | Men    | 251   | 473  |    |        |     | <6           | 6-7   | 1.29   |
|           |        |       |      |    |        |     |              |       | 0.52   |
|           |        |       |      |    |        |     |              |       | 3.34   |
| 65-69     | Men    | 251   | 473  |    |        |     | >7           | 6-7   | 1.6   |
|           |        |       |      |    |        |     |              |       | 1.06   |
|           |        |       |      |    |        |     |              |       | 2.66   |
| 65-69     | Men    | 251   | 473  |    |        |     | <6           | 6-7   | 1.42   |
|           |        |       |      |    |        |     |              |       | 0.61   |
|           |        |       |      |    |        |     |              |       | 3.27   |
| 65-69     | Men    | 251   | 473  |    |        |     | >7           | 6-7   | 1.62   |
|           |        |       |      |    |        |     |              |       | 0.99   |
|           |        |       |      |    |        |     |              |       | 2.66   |
| 65-69     | Men    | 251   | 473  |    |        |     | <6           | 6-7   | 1.42   |
|           |        |       |      |    |        |     |              |       | 0.61   |
|           |        |       |      |    |        |     |              |       | 3.27   |
| 65-69     | Men    | 251   | 473  |    |        |     | >7           | 6-7   | 1.62   |
|           |        |       |      |    |        |     |              |       | 0.99   |
|           |        |       |      |    |        |     |              |       | 2.66   |
| 65-69     | Men    | 251   | 473  |    |        |     | <6           | 6-7   | 1.42   |
|           |        |       |      |    |        |     |              |       | 0.61   |
|           |        |       |      |    |        |     |              |       | 3.27   |
| 65-69     | Men    | 251   | 473  |    |        |     | >7           | 6-7   | 1.62   |
|           |        |       |      |    |        |     |              |       | 0.99   |
|           |        |       |      |    |        |     |              |       | 2.66   |
| 65-69     | Men    | 251   | 473  |    |        |     | <6           | 6-7   | 1.42   |
|           |        |       |      |    |        |     |              |       | 0.61   |
|           |        |       |      |    |        |     |              |       | 3.27   |

Note: The table provides statistical data for different age groups and gender categories, including mean, SD, median, and 95% confidence intervals (CI) for specific values.
| Cohensfield | Men | Women | $\geq 75$ | 65-69 | 60-64 | 55-59 | <50 | $\geq 9$ | <9 | 7-9 | YES/NO | OR (95% CI) |
|-------------|-----|-------|--------|-------|-------|-------|-----|--------|-----|-----|--------|-------------|
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | <7 | 7-9 | YES | 1.32 (1.09, 1.58) |
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | >9 | 7-9 | YES | 0.98 (0.84, 1.13) |
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | >9 | 7-9 | NO  | 1.29 (1.11, 1.52) |
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | <7 | 7-9 | YES | 0.81 (0.71, 0.93) |
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | <7 | 7-9 | NO  | 0.71 (0.60, 0.84) |
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | <7 | 7-9 | YES | 1.13 (1.02, 1.26) |
| 201         | Cohensfield Men | 116 | $\geq 75$ | - | - | 20 | 110 | - | - | <7 | 7-9 | NO  | 1.09 (1.03, 1.16) |
| Region | Gender | Age Range | Total | 50+ | 60-74 | 75+ | History | Cancer Rate | 95% CI | Frequency | BMI | Age | Sex | Frequency | 95% CI | Frequency | BMI | Age | Sex | Frequency | 95% CI |
|--------|--------|-----------|-------|-----|-------|-----|---------|------------|-------|-----------|-----|-----|-----|-----------|-------|-----------|-----|-----|-----|-----------|-------|
| 3      | Men    | 106       | 60-74 | 440 | 625   | 7.5 | 123     | 77         | 46    | ≥9        | 7   | YES | 0.99 | 9        | 4       | 1.19      | 0.52 | 1.9  | 0.72 | 4.24      | 1    |
| 200    | Women  | 106       | 5     | 74  |       |     | 7       | YES        |       |           |     |      |      |           |         |           |     |      |      |           |       |
| 1      | Men    | 106       | 60-74 | 440 | 625   | 7.5 | 123     | 77         | 46    | <6        | 7   | YES | 1.74 | 7        | 7-9     | 1.96      | 0.91 | 1.5  | 0.97 | 5.21      | 2.17 |
| 200    | Women  | 106       | 5     | 74  |       |     | 7       | YES        |       |           |     |      |      |           |         |           |     |      |      |           |       |
| 200    | Men    | 307       | ≥64   | 174 | 133   | 10  | 133     | 816        | 522   | ≥10       | 7   | YES | 1.51 | 9        | 8       | 1.19      | 1.19 | 2.83 | 0.76 | 1.25      | 1    |
| 200    | Women  | 307       | ≥64   | 174 | 133   | 10  | 133     | 816        | 522   | ≥7        | 7   | YES | 2.06 | 9        | 8       | 7.9       | 1.5  | 1.92 | 1.44 | 7.9       | 2.83 |
| 200    | Men    | 307       | ≥64   | 174 | 133   | 10  | 133     | 816        | 522   | <7        | 7   | YES | 0.98 | 9        | 8       | 7.9       | 0.76 | 1.25 | 0.77 | 7.9       | 1.14 |
| 200    | Women  | 307       | ≥64   | 174 | 133   | 10  | 133     | 816        | 522   | <7        | 7   | YES | 1.14 | 9        | 8       | 7.9       | 0.76 | 1.25 | 0.77 | 7.9       | 1.14 |
| 200 | Lan Men | 307 | ≥64 | 174 | 133 | 10 | 133 | 816 | 522 | ≥10 | 7 | NO | 1.86 |
|-----|---------|-----|-----|-----|-----|----|-----|-----|-----|-----|----|----|-----|
| 7   | 9       | 8   | 1   | 8   |     |    |     |     |     |     |    |    | 1.67 |

| 200 | Lan Wo men | 307 | ≥64 | 174 | 133 | 10 | 133 | 816 | 522 | ≥10 | 7 | NO | 2.49 |
|-----|-------------|-----|-----|-----|-----|----|-----|-----|-----|-----|----|----|-----|
| 7   | 9           | 8   | 1   | 8   |     |    |     |     |     |     |    |    | 2.34 |

| 200 | Lan Men | 307 | ≥64 | 174 | 133 | 10 | 133 | 816 | 522 | <7 | 7 | NO | 0.97 |
|-----|---------|-----|-----|-----|-----|----|-----|-----|-----|----|----|----|-----|
| 7   | 9       | 8   | 1   | 8   |     |    |     |     |     |    |    | 0.76 |

| 200 | Lan Wo men | 307 | ≥64 | 174 | 133 | 10 | 133 | 816 | 522 | <7 | 7 | NO | 1.04 |
|-----|-------------|-----|-----|-----|-----|----|-----|-----|-----|----|----|----|-----|
| 7   | 9           | 8   | 1   | 8   |     |    |     |     |     |    |    | 0.71 |

| 201 | Yeo Men | 553 | ≥60 | -   | -   | 9.4| 122 | -   | -   | ≥10 | 7 | YES | 1.48 |
|-----|---------|-----|-----|-----|-----|----|-----|-----|-----|-----|----|-----|-----|
| 3   | 8       |     |     |     |     |    |     |     |     |    |    | 1.51 |
| Wo men | | | | | | | | | | | | |

| 201 | Yeo Men | 553 | ≥60 | -   | -   | 9.4| 122 | -   | -   | ≤5 | 7 | YES | 1.23 |
|-----|---------|-----|-----|-----|-----|----|-----|-----|-----|----|----|-----|-----|
| 3   | 8       |     |     |     |     |    |     |     |     |    |    | 1.03 |
| Wo men | | | | | | | | | | | | |

| 201 | Kaki Men | 969 | ≥70 | -   | -   | 10.| 396 | -   | -   | ≥9 | 7 | YES | 1.33 |
|-----|----------|-----|-----|-----|-----|----|-----|-----|-----|----|----|-----|-----|
| 3   | 0       |     |     |     |     |    |     |     |     |    |    | 1.43 |
| zaki | | | | | | | | | | | | |

| 201 | Kaki Men | 969 | ≥70 | -   | -   | 10.| 396 | -   | -   | <6 | 7 | YES | 0.98 |
|-----|----------|-----|-----|-----|-----|----|-----|-----|-----|----|----|-----|-----|
| 3   | 0       |     |     |     |     |    |     |     |     |    |    | 0.98 |
| zaki | | | | | | | | | | | | |
| Location | Men | Women | Age | Sex | NO | YES | Race | NO | YES | Age | Sex | NO | YES | Race | NO | YES |
|----------|-----|-------|-----|-----|----|-----|------|----|-----|-----|-----|----|-----|------|----|-----|
| Werle    | 187 | ≥80   | 68  | 119 | 8.7| 141 | 56   | 85 | >8  | 7   | YES | 0.95,-0.9, 1.02 | 0.87,-1.1 |
| Werle    | 187 | ≥80   | 68  | 119 | 8.7| 141 | 56   | 85 | >8  | 7   | NO  | 0.95,-0.9, 1.01 | 0.89,-1.0 |
| Kripke   | 355 | 60–   | -   | -   | 10.5| 79  | -    | -  | ≥9  | 7   | NO  | 0.93,-0.37, 0.37 | 0.37,-2.35 |
| Kripke   | 355 | 60–   | -   | -   | 10.5| 79  | -    | -  | ≤5  | 7   | NO  | 0.83,-0.4, 0.173 | 0.4,-1.73 |
| Akerste  | 808 | ≥65   | 387 | 421 | 13 | 233 | -    | -  | ≥8  | 7   | YES | 1.01,-0.9, 1.14 | 0.96,-1.14 |
| Akerste  | 808 | ≥65   | 387 | 421 | 13 | 233 | -    | -  | ≤5  | 7   | YES | 1.05,-0.9, 1.22 | 0.96,-1.22 |
| Akerste  | 808 | ≥65   | 387 | 421 | 13 | 233 | -    | -  | ≥8  | 7   | NO  | 1.06,-0.9, 1.19 | 0.96,-1.19 |
| Akerste  | 808 | ≥65   | 387 | 421 | 13 | 233 | -    | -  | ≤5  | 7   | NO  | 1.02,-0.9, 1.16 | 0.96,-1.16 |
| Castro   | 151 | >60   | -   | -   | 7.5| 440 | -    | -  | ≥9  | 7   | YES | 1.56,-7.9, 1.12 | 7.9,-1.12 |
| Cost  | Wo    | a     | Men  | 151 | >60 | -  | -  | 7.5 | 440 | -  | -  | <6 | YES | 7- | 2.18 | 0.88 |
|-------|-------|-------|------|------|-----|----|----|-----|-----|----|----|----|-----|----|------|-----|
| 201   | Cast  | 1     | ro-  | 2   | 7.9 |    |    |     |     |    |    |    |     |    |   0.61 |   1.28 |
|       |       |       | a    | men |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 201   | Cast  | 1     | Men  | 2   | 7.9 |    |    |     |     |    |    |    | YES | 7- | 1.84 | 0.75 |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 201   | Cast  | 1     | Men  | 2   | 7.9 |    |    |     |     |    |    |    | NO  | 7- | 0.75 |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 201   | Che   | 1     | Men  | 4   | 9   | 5  | 4  |     |     |     |     | YES | 7 | 1.37 | 1.28 |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 201   | Che   | 1     | Men  | 4   | 9   | 5  | 4  |     |     |     |     | YES | 7 | 1.96 | 0.92 |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 200   | Suz   | 1     | Men  | 9   | 65  | 5  | 0  |     |     |     |     | YES | 7 | 1.96 | 0.92 |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 200   | Suz   | 1     | Men  | 9   | 65  | 5  | 0  |     |     |     |     | YES | 7 | 1.96 | 1.34 |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 200   | Suz   | 1     | Men  | 9   | 65  | 5  | 0  |     |     |     |     | YES | 7 | 2.56 | 1.34 |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
|       |       |       |      |     |     |    |    |     |     |    |    |    |     |    |      |      |
| 200 | Suz | Wo | 113 | 65- | 582 | 557 | 7 | 100 | 689 | 315 | ≥10 | 7 | YES | 2.27 |
|-----|-----|----|-----|-----|-----|-----|---|-----|-----|-----|-----|----|-----|-----|
| 9   | uki | men| 95  | 85  | 5   | 0   | 4 | 100 | 689 | 315 | ≥10 | 7 | YES | 2.27 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 1.37 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 3.76 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 0.72 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 0.39 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 1.29 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 0.74 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 1.43 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 0.78 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 1.73 |
|     |     |    |     |     |     |     |   |     |     |     |     |   |     | 0.82 |
| Age Group | Gender | Sample Size | Age | Height | Weight | BMI | Waist Circumference | Systolic Blood Pressure | Diastolic Blood Pressure | Waist Circumference | Systolic Blood Pressure | Diastolic Blood Pressure |
|-----------|--------|-------------|-----|--------|--------|-----|---------------------|------------------------|------------------------|---------------------|------------------------|------------------------|
| ≥65       | Men    | 342         | 7   | 174    | 168    | 5   | 297 221             | 76 ≥10 10 4           | YES                  | 1.75                | 0.46                   | 1.48                   |
| >65       | Men    | 342         | 7   | 174    | 168    | 5   | 297 221             | 76 ≥10 10 4           | YES                  | 2.88                | 0.98                   | 2.71                   |
| >65       | Men    | 342         | 7   | 174    | 168    | 5   | 297 221             | 76 ≥10 10 4           | YES                  | 2.1                 | 0.1                   | 2.9                    |
| >65       | Men    | 342         | 7   | 174    | 168    | 5   | 297 221             | 76 ≥10 10 4           | YES                  | 0.6                 | 0.1                   | 0.35                   |
| ≥65       | Men    | 253         | 1   | 253    | 0      | 7.4 | 628                | 628 5-8               | YES                  | 0.83                | 0.71                   | 1.31                   |
| Location | Gender | Age Group | Number | Height | Weight | BMI | Age | Weight Loss | Activity | Odds Ratio |
|----------|--------|-----------|--------|--------|--------|-----|-----|-------------|----------|------------|
| Smaugla | Men    | ≥65       | 253    | 0      | 7.4    | 628 | 628 | 0           | <5       | 5-8        | YES | 1.12       |
|          |        |           | 1      | 1      |        |     |     |             |          |            |      | 0.89       |
|          |        |           |        |        |        |     |     |             |          |            |      | 1.42       |
| Smaugla | Men    | ≥65       | 253    | 0      | 7.4    | 628 | 628 | 0           | >8       | 5-8        | NO  | 1.02       |
|          |        |           | 1      | 1      |        |     |     |             |          |            |      | 0.76       |
|          |        |           |        |        |        |     |     |             |          |            |      | 1.37       |
| Smaugla | Men    | ≥65       | 253    | 0      | 7.4    | 628 | 628 | 0           | <5       | 5-8        | NO  | 1.28       |
|          |        |           | 1      | 1      |        |     |     |             |          |            |      | 1.02       |
|          |        |           |        |        |        |     |     |             |          |            |      | 1.62       |
| Zuurbig | Men    | 60-98     | 107    | 3      | 7.3    | 142 | -   | >7.5        | 6-7.5    | YES       | 1.24 |
|          |        |           | 98     |        | 7.5    |     |     |             |          |            |      | 0.73       |
|          |        |           |        |        |        |     |     |             |          |            |      | -2.1       |
| Zuurbig | Women  | 60-98     | 107    | 3      | 7.3    | 142 | -   | <6.5        | 6-7.5    | YES       | 1.12 |
|          |        |           | 98     |        | 7.5    |     |     |             |          |            |      | 0.75       |
|          |        |           |        |        |        |     |     |             |          |            |      | 1.68       |
| Qiu      | Men    | ≥65       | 126    | 1      | 542    | 725 | 3   | 519         | 206      | 313       | ≥10 | 8          | YES | 1.09       |
|          |        |           | 71     | 1      | 9      | 7   | 2   |             |          |            |      | 1.18       |
| Qiu      | Women  | ≥65       | 126    | 1      | 542    | 725 | 3   | 519         | 206      | 313       | ≥5  | 8          | YES | 0.97       |
|          |        |           | 71     | 1      | 9      | 7   | 2   |             |          |            |      | 0.88       |
|          |        |           |        |        |        |     |     |             |          |            |      | 1.08       |
|          |        |           |        |        |        |     |     |             |          |            |      | 1.38       |
| Qiu      | Women  | ≥65       | 126    | 1      | 542    | 725 | 3   | 519         | 206      | 313       | ≥10 | 8          | YES | 1          |
|          |        |           | 71     | 1      | 9      | 7   | 2   |             |          |            |      | 0.9-       |
| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | ≥65 | 542   | 725       | 3   | 519 | 206| 313 | ≤5   | 1    | 8   | 1.11       | 1.01 - 1.38 |
| 71  | 1   | 0     | 9         | 7   | 2   |    |     |       |      |     |            |        |

| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | ≥65 | 542   | 725       | 3   | 519 | 206| 313 | ≤5   | 1    | 8   | 0.85       | 0.75 - 0.98 |
| 71  | 1   | 0     | 9         | 7   | 2   |    |     |       |      |     |            |        |

| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | 65- | 542   | 725       | 3   | 519 | 206| 313 | ≥10  | 1    | 8   | 1.17       | 0.88 - 1.54 |
| 71  | 79  | 1     | 0         | 9   | 7   | 2  |     |       |      |     |            |        |

| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | ≥80 | 542   | 725       | 3   | 519 | 206| 313 | ≥10  | 1    | 8   | 1.08       | 0.99 - 1.18 |
| 71  | 1   | 0     | 9         | 7   | 2   |    |     |       |      |     |            |        |

| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | ≥80 | 542   | 725       | 3   | 519 | 206| 313 | ≤5   | 1    | 8   | 0.97       | 0.87 - 1.08 |
| 71  | 1   | 0     | 9         | 7   | 2   |    |     |       |      |     |            |        |

| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | ≥65 | 542   | 725       | 3   | 519 | 206| 313 | ≥10  | 1    | 8   | 1.22       | 1.13 - 1.32 |
| 71  | 1   | 0     | 9         | 7   | 2   |    |     |       |      |     |            |        |

| Qiu | Men | Women | Age Group | BSA | BMI | WC | WHR | Gender | NO  | YES | Odds Ratio | 95% CI |
|-----|-----|-------|-----------|-----|-----|----|-----|--------|------|-----|------------|--------|
| 126 | ≥65 | 542   | 725       | 3   | 519 | 206| 313 | ≤5   | 1    | 8   | 1.19       | 1.08 - 1.32 |
| 71  | 1   | 0     | 9         | 7   | 2   |    |     |       |      |     |            |        |
| 201 | Qiu | Men | 126 | ≥65 | 542 | 725 | 3 | 519 | 206 | 313 | ≥10 | 8 | NO | 1.36 |
|-----|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |     | 71  |     | 1   | 0   |   | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Women | 126 | ≥65 | 542 | 725 | 3 | 519 | 206 | 313 | ≥10 | 8 | NO | 1.12 |
|-----|-----|-------|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |       | 71  |     | 1   | 0   |   | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Men | 126 | ≥65 | 542 | 725 | 3 | 519 | 206 | 313 | ≤5  | 8 | NO | 1.47 |
|-----|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |     | 71  |     | 1   | 0   |   | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Women | 126 | ≥65 | 542 | 725 | 3 | 519 | 206 | 313 | ≤5  | 8 | NO | 1.03 |
|-----|-----|-------|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |       | 71  |     | 1   | 0   |   | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Men | 126 | 65- | 542 | 725 | 3 | 519 | 206 | 313 | ≥10 | 8 | NO | 1.46 |
|-----|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |     | 71  | 79  |     | 1   | 0 | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Women | 126 | 65- | 542 | 725 | 3 | 519 | 206 | 313 | ≤5  | 8 | NO | 1.32 |
|-----|-----|-------|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |       | 71  | 79  |     | 1   | 0 | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Men | 126 | ≥80 | 542 | 725 | 3 | 519 | 206 | 313 | ≥10 | 8 | NO | 1.21 |
|-----|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |     | 71  |     | 1   | 0   |   | 9   | 7   | 2   |     |   |    |     |

| 201 | Qiu | Women | 126 | ≥80 | 542 | 725 | 3 | 519 | 206 | 313 | ≤5  | 8 | NO | 1.18 |
|-----|-----|-------|-----|-----|-----|-----|---|-----|-----|-----|-----|---|----|-----|
| 1   |     |       | 71  |     | 1   | 0   |   | 9   | 7   | 2   |     |   |    |     |

| 201 | Bey | Men | 217 | ≥65 | -    | -    | 4.5 | -    | -    | -    | >8  | 7-8 | YES | 1.3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|-----|
| 7   | dou |     | 3   |     |     |     |     |     |     |     |     |     | 0.73 |
| n  | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95-99 | Yes/No | Odds Ratio |
|----|-------|-------|-------|-------|-------|-------|--------|------------|
| 201 Beydou Men | 217 | ≥65 | - | - | 4.5 | - | <7 | 7-8 | YES | 0.96 |
| 201 Beydou Men | 217 | ≥65 | - | - | 4.5 | - | >8 | 7-8 | NO | 1.9, 1.44 |
| 201 Beydou Men | 217 | ≥65 | - | - | 4.5 | - | <7 | 7-8 | NO | 1.2, 0.94 |
| 201 Che Men | 244 | ≥60 | 116 | 128 | 4 | 274 | - | ≥9 | 7-8 | YES | 2.24 |
| 201 Che Men | 244 | ≥60 | 116 | 128 | 4 | 274 | - | ≤6 | 7-8 | YES | 2.14 |
| 201 Che Men | 244 | ≥60 | 116 | 128 | 4 | 274 | - | ≥9 | 7-8 | NO | 2.87 |
| 201 Che Men | 244 | ≥60 | 116 | 128 | 4 | 274 | - | ≤6 | 7-8 | NO | 2.69 |
| 201 Hall Men | 301 | ≥70 | 146 | 155 | 8.2 | 953 | - | >8 | 7 | YES | 1.23 |
| 201 Hall Men | 301 | ≥70 | 146 | 155 | 8.2 | 953 | - | >8 | 7 | YES | 0.93 |
| 201 Hall Men | 301 | ≥70 | 146 | 155 | 8.2 | 953 | - | <7 | 7-8 | YES | 1.63 |
| 201 Hall | Men | 301 | ≥70 | 146 | 155 | 8.2 | 953 | - | - | <6 | 7 | YES | 1.06 |
| 5       | 3   | 3   | 0   |     |     |     |     |    | 0.83 |
|         |     |     |     |     |     |     |     |    | 1.34 |
| 201 Hall | Men | 301 | ≥70 | 146 | 155 | 8.2 | 953 | - | - | >8 | 7 | NO | 1.49 |
| 5       | 3   | 3   | 0   |     |     |     |     |    | 1.15 |
|         |     |     |     |     |     |     |     |    | 1.93 |
| 201 Hall | Men | 301 | ≥70 | 146 | 155 | 8.2 | 953 | - | - | <6 | 7 | NO | 1.3 |
| 5       | 3   | 3   | 0   |     |     |     |     |    | 1.05 |
|         |     |     |     |     |     |     |     |    | 1.61 |
| 201 Akerste | Men | - | ≥65 | - | - | 13 | - | - | ≥9 | 7 | YES | 0.99 |
| 9       |     |     |     |     |     |     |     |    | 0.84 |
|         |     |     |     |     |     |     |     |    | 1.09 |
| 201 Akerste | Men | - | ≥65 | - | - | 13 | - | - | ≤4 | 7 | YES | 0.97 |
| 9       |     |     |     |     |     |     |     |    | 0.81 |
|         |     |     |     |     |     |     |     |    | 1.18 |
| 201 Akerste | Men | - | ≥65 | - | - | 13 | - | - | ≥9 | 7 | YES | 0.91 |
| 9       |     |     |     |     |     |     |     |    | 0.66 |
|         |     |     |     |     |     |     |     |    | 1.25 |

Abbreviations: Ref, reference; HR, hazard ratio; 95% CI, 95% confidence interval.

**Table 3.** The Newcastle-Ottawa Scale (NOS) for assessing the quality of all cohort studies involved in this meta-analysis.
| First author | Published year | Representative of the exposed cohort | Ascertainment of the non-exposed cohort | Demonstration that outcome of interest was no present at start of study | Control for important factors | Additional assessment of outcome | Follow-up adequacy of follow-up | Score |
|--------------|----------------|--------------------------------------|----------------------------------------|-------------------------------------------------|-----------------------------|---------------------------------|---------------------------------|-------|
| Kaplan       | 1987           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 1     |
| Seki         | 2001           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 1     |
| Goto         | 2003           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 0     |
| Lan          | 2007           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 0     |
| Gangesch     | 2008           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 0     |
| Stone        | 2009           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 1     |
| Suzuki       | 2009           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 1     |
| Kronholm     | 2011           | 1                                    | 1                                      | 1                                               | 0                           | 1                               | 1                               | 0     |
| Werle        | 2011           | 1                                    | 1                                      | 1                                               | 0                           | 1                               | 1                               | 0     |
| Kripke       | 2011           | 1                                    | 1                                      | 1                                               | 0                           | 1                               | 1                               | 0     |
| Castro-Costa | 2011          | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 0     |
| Qiu          | 2011           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 1     |
| Cohen-Manfield | 2012       | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 1     |
| Jung         | 2013           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 0     |
| Kim          | 2013           | 1                                    | 1                                      | 1                                               | 1                           | 1                               | 1                               | 0     |
| Authors     | Year | Sleep Duration | Mortality | Comment |
|------------|------|----------------|-----------|---------|
| Yeo        | 2013 | 1              | 1         | 1       |
| Kaki       | 2013 | 1              | 1         | 1       |
| Chen       | 2013 | 1              | 1         | 1       |
| Lee        | 2014 | 1              | 1         | 1       |
| Zuurbier   | 2015 | 1              | 1         | 1       |
| Hall       | 2015 | 1              | 1         | 1       |
| Smagula    | 2016 | 1              | 1         | 1       |
| Akersted   | 2017 | 1              | 1         | 1       |
| Beydoun    | 2017 | 1              | 1         | 1       |
| Brosstrom  | 2018 | 1              | 1         | 1       |
| Chen       | 2018 | 1              | 1         | 1       |
| Morgan     | 2019 | 1              | 1         | 1       |
| Akersted   | 2019 | 1              | 1         | 1       |

Table 4. Overall and subgroup analyses of short and long sleep duration with all-cause mortality in the older people.
| Group                  | Number of qualified studies | Short sleep duration | Long sleep duration |
|------------------------|-----------------------------|----------------------|---------------------|
|                        |                             | HR (95% CI); $P$ $\hat{\text{i}}^2$ | HR (95% CI); $P$ $\hat{\text{i}}^2$ |
| **Overall analyses**   |                             |                      |                     |
| Mortality (unadjusted) | 23/26                       | 1.15 (1.06-1.25); <.001 | 71.5%              |
|                        |                             |                      | 1.43 (1.30-1.58); <.001 | 88.6% |
| Mortality (adjusted)   | 32/36                       | 1.04 (1.00-1.09); .213 | 16.1%              |
|                        |                             |                      | 1.24 (1.16-1.33); <.001 | 76.2% |
| **Subgroup analyses based on adjusted mortality** | | | |
| **By gender**          |                             |                      |                     |
| Both genders           | 20/23                       | 1.04 (0.99-1.08); .010 | 11.1%              |
|                        |                             |                      | 1.20 (1.11-1.29); <.001 | 79.0% |
| Men                    | 8/8                         | 1.13 (1.04-1.24); .007 | 0.0%               |
|                        |                             |                      | 1.31 (1.10-1.58); .003 | 62.3% |
| Women                  | 8/9                         | 1.00 (0.85-1.18); .999 | 58.6%              |
|                        |                             |                      | 1.48 (1.18-1.86); .001 | 80.4% |
| **By country**         |                             |                      |                     |
| America                | 12/13                       | 1.08 (1.03-1.14); .002 | 0.0%               |
|                        |                             |                      | 1.19 (1.07-1.31); .001 | 78.2% |
| Europe                 | 6/7                         | 1.03 (0.93-1.14); .627 | 0.0%               |
|                        |                             |                      | 1.01 (0.93-1.09); .823 | 0.0% |
| Asia                   | 14/16                       | 1.04 (0.96-1.12); .384 | 40.6%              |
|                        |                             |                      | 1.41 (1.26-1.57); <.001 | 75.4% |
| **By total sleep time**|                             |                      |                     |
| Nighttime              | 19/23                       | 1.05 (0.99-1.13); .113 | 17.8%              |
|                        |                             |                      | 1.25 (1.13-1.38); <.001 | 73.7% |
| 24 h                   | 13/13                       | 1.04 (0.99-1.10); .146 | 19.9%              |
|                        |                             |                      | 1.25 (1.14-1.36); <.001 | 76.2% |
| **By ascertainment of sleep** | | | |
| Questionnaire          | 30/34                       | 1.04 (1.00-1.09); .055 | 20.5%              |
|                        |                             |                      | 1.26 (1.17-1.35); <.001 | 76.8% |
| Actigraphy | 1/1 | 1.12 (0.89-1.42); 0.342 | * | 0.83 (0.61-1.13); 0.233 | 1/1 | 1.12 (0.75-1.68); 0.582 | 1.24 (0.73-2.10); 0.425 |
|------------|-----|------------------------|---|------------------------|-----|------------------------|------------------------|
| Both       | 1/1 | 1.12 (0.75-1.68); 0.582 | – | 1.24 (0.73-2.10); 0.425 | 20/22 | 1.07 (1.02-1.12); 0.006 | 1.24 (1.14-1.34); <.001 |
|            |     |                        |   |                        | <7.5 | 0.99 (0.93-1.05); 0.736 | 1.27 (1.12-1.45); <.001 |
| By follow-up (years) |     |                        |   |                        |       |                        |                        |
| ≥7.5       | 20/22 | 1.07 (1.02-1.12); 0.006 | 15.2% |                        |        |            |                        |
| <7.5       | 13/14 | 0.99 (0.93-1.05); 0.736 | 0.0% |                        |        |            |                        |
| By age     |     |                        |   |                        |       |                        |                        |
| <65        | 11/11 | 1.21 (1.02-1.23); 0.018 | 18.2% |                        |        |            |                        |
| ≥65        | 21/25 | 1.03 (0.99-1.07); 0.193 | 4.2% |                        |        |            |                        |
| Dose-analysis |     |                        |   |                        |       |                        |                        |
| ≤5 h       | 15 | 1.06 (1.01-1.11); 0.014 | 12.3% |                        |        |            |                        |
| ≤6 h       | 27 | 1.05 (1.01-1.10); 0.031 | 26.7% |                        |        |            |                        |
| ≤7 h       | 32 | 1.04 (1.00-1.09); 0.033 | 16.1% |                        |        |            |                        |
| ≥8 h       | 33 | 1.03 (0.99-1.07); 0.193 | 4.2% |                        |        |            |                        |
| ≥9 h       | 26 | 1.02 (1.01-1.10); 0.031 | 26.7% |                        |        |            |                        |
| ≥10 h      | 10 | –                       | – |                        |        |            |                        |

Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval. *Data are not available.

**Figures**
Figure 1

The trend plots of effect-size estimates with the increase of sleep duration in all older persons (A) and by genders (B and C). Abbreviations: HR, hazard ratio; 95% CI, 95% confidence interval.
Figure 2

The Begg’s and filled funnel plots for the association of both short and long sleep duration with all-cause mortality.
Figure 3
Flow chart of records retrieved, screened and included in this meta-analysis.

Supplementary Files
This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTable1.doc