Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Prevalence and risk factors of sleep problems in Bangladesh during the COVID-19 pandemic: a systematic review and meta-analysis

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ABSTRACT

The outbreak of the novel coronavirus disease 2019 (COVID-19) has altered people's lives worldwide and fostered the emergence of sleep problems. However, no systematic review and meta-analysis has yet been conducted to rigorously evaluate the impact of COVID-19 on sleep problems from a Bangladeshi perspective. As a result, the current systematic review and meta-analysis aims to fill this knowledge gap, which may lead to a better understanding of the prevalence and risk factors associated with sleep problems. To conduct this systematic review, PRISMA guidelines were followed; a literature search was conducted to include studies published till 5th March 2022 from the inception of COVID-19 pandemic in Bangladesh searching databases such as PubMed, Scopus. A total of eleven studies were included. The JBI checklist was used to assess the methodological quality of included studies. The overall estimated prevalence of sleep problems was 45% (95% CI: 32% to 58%, I^2 =99.31%). General populations were more affected by sleep problems [52% (95% CI: 36% to 68%, I^2 =98.92%)] than the healthcare professionals [51% (95% CI: 23% to 79%, I^2 =97.99%)] (χ^2 = 137.05, p <0.001). Additionally, results suggested that suffering from sleep problems were higher among female (OR: 1.15; 95% CI: 1.03 to 1.29 compared to men); urban residents (OR: 1.77; 95% CI: 1.55 to 2.02 compared to rural); and anxious person (OR: 5.15; 95% CI: 4.32 to 6.14 compared to non-anxious), whereas single participants less likely to suffer from sleep related problems (OR: 0.81; 95% CI: 0.71 to 0.94). The prevalence rate of sleep problems was high and the general populations was at particularly high risk. Further longitudinal studies are warranted to investigate the trajectories of such sleep problems as a function of pandemic changes.

1. Introduction

Recent evidence suggests that the prevalence of sleep problems has increased over time all over the world. For instance, a 3.6% increase in the prevalence of insomnia has been reported in a longitudinal study over a period of 10 years (11.9% to 15.5% from 2000 to 2010) [1]. Moreover, in parallel with many other mental health problems, increments in the prevalence of insomnia have been observed since the beginning of the COVID-19 pandemic [2]; and have been attributed, at least in part, to the lifestyle changes imposed by the pandemic-related preventive measures and social movement restrictions [3,4]. Indeed, insomnia prevalence grew from 24% to 40%, while difficulties in initiating sleep rose from 15% to 42% [2].

Evidently, insomnia is associated with psychological impairments, decreased mood, and reduced work productivity [5]. Furthermore, insomnia has also been linked to a 2.5 to 4.5 -fold increased risk of accidents [6] and may alter the immune system, potentially leading to adverse effects in the context of a COVID-19 infection [7,8]. Therefore, maintaining adequate sleep hygiene measures and preventing insomnia can benefit health, especially during the stressful and protracted COVID-19 pandemic.

As part of the global COVID-19 pandemic, the Bangladesh epidemiologic institute, IEDCR, identified the first case in March 2020. Since then, the situation has gradually deteriorated throughout the country. However, Bangladesh has implemented some preventive strategies (lockdowns, quarantine, social segregation) to mitigate the outbreak of

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COVID-19 from the earlier period of pandemic to date. However, these strategies may yield some negative consequences, such as psychological effects caused by fear of infection, social isolation, and loneliness, disruptions in education and employment, resulting in symptoms of depression, anxiety, and stress among the general population [9,10]. Consequently, a large number of epidemiological studies concerning mental health problems have been conducted, and systematic reviews aiming at a better understanding of the factors affecting mental health and related to the pandemic have allowed for the formulation of both policy and practice measures [9,11]. These systematic evaluations suggest that mental health problems are on the rise, with more than half of the population reporting the presence of psychological problems [12]. The resultant psychological distress could adversely and persistently impact normal sleep patterns through perturbations in the quantity and quality of sleep [13]. Sleep problems are correlated with well-recognized physical complications, including chronic cardiovascular morbidities, such as heart disease, high blood pressure, stroke, and vascular disorders [14]. However, although sleep is a vital component of mental health, systematic reviews on the impact of the pandemic on sleep have not been extensively carried out [15–18], and none of such reviews have included studies from Bangladesh. Furthermore, since the physical and financial resources allowing for timely surveys on issues such as sleep during the pandemic are very limited in Bangladesh, we hypothesized that a systematic review and meta-analysis of the extant findings may serve to enhance the awareness of such critical issues in the country and facilitate implementation of interventional policies in this regard.

Of the published systematic reviews encompassing a total of 78 studies, a staggeringly wide range of 2.3% to 76.6% of the respondents indicated the presence of sleep problems [15], with a pooled prevalence of around 35.7%. Sleep problems were primarily frequent among COVID-19 infected individuals (74.8%), but the rate was comparatively low among healthcare professionals (36.0%) and the general population (32.3%) [16]. Notwithstanding, information focused on a regional perspective was lacking, and therefore, the summarized evidence did not allow for the formulation of more specific policy and preventive measures that are tailored to any particular region or cultural setting. Of note, non-pharmacological intervention approaches such as mindfulness and cognitive behavioral therapy may be effective in reducing sleep problems. The latter is particularly important, considering that psychiatric problems, including insomnia, are culture-specific and therefore require culturally adept interventions. Therefore, to better understand sleep problems in a country like Bangladesh, the present systematic review and meta-analysis has two objectives- (i) Primary- to investigate the prevalence of and factors associated with sleep problems during the COVID-19 pandemic in Bangladesh, and (ii) Secondary- to identify its possible sources of heterogeneity, and to determine which groups were suffering more from sleep related problems during the COVID-19 pandemic in Bangladesh.

2. Methods

2.1. Search strategies

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocols 2015 guidelines were followed to conduct the present systematic review [19]. We conducted literature searches based on the articles published till 5th March 2022 from the inception of COVID-19 pandemic. PubMed and Scopus were the main source of article searching using relevant keywords. Additionally, Google Scholar search was conducted up to 10 page to identify relevant articles reporting the prevalence of insomnia or sleep problems and its associated factors during the COVID-19 pandemic in Bangladesh. The search keywords included COVID-19, sleep problems, sleep disturbance, sleep disorder, sleep quality, insomnia, Bangladesh. The keywords were combinedly used following Boolean operators (AND/OR/AND NOT). Detailed search strategy is provided in the **supplementary material.**

2.2. Data eligibility criteria

Criteria for inclusion were: (i) study conducted in Bangladesh, (ii) study conducted after the inception of the COVID-19 pandemic, (iii) observational study (cross-sectional, case-control or longitudinal), (iv) focused on insomnia or sleep problems or sleep disorders or sleep quality or sleep disturbances, (v) reported prevalence and/or risk factors, (vi) published in peer-reviewed journals and in English language. Articles were excluded if they did not meet the aforementioned criteria.

2.3. Data collection procedure

A total of 84 articles were identified and were reduced to 51 studies after excluding duplicates. These studies were evaluated by two independent reviewers (FAM, MAM) to ascertain that they fulfilled inclusion and exclusion criteria, and in case of disagreement, the final decision was settled by the first author. After eliminating the non-relevant articles, a total of 18 articles were available for full text assessment. Finally, 11 studies were included in the review (Fig. 1).

2.4. Data extraction

A data extraction Excel file was designed with the following items: authors and publication year, study design, sampling technique, data collection period, population and mean age (if reported), sample size, percentage of female participants, assessment tools, cutoff and prevalence rate, risk factors, and comment on the study. After the resolution of any disagreements by consensus among the authors, the final summary is presented in Table 1.

2.5. Quality assessment of the included study

The Joanna Briggs Institute (JBI) checklist for prevalence studies was used to evaluate the risk of bias of the included articles [20]. The JBI uses a 4-point Likert scale with answers being “no”, “yes”, “unclear”, or “not applicable”, for the following questions – appropriateness of the sample frame (was the sample frame appropriate to address the target population?); recruitment procedure (were study participants sampled in an appropriate way?); adequacy of the sample size (was the sample size adequate?); description of subjects and setting (were the study subjects and the setting described in detail?); description of the identified sample (was the data analysis conducted with sufficient coverage of the identified sample?); validity of the methods used to screen for sleep problems (were valid methods used for the identification of the sleep problems?); reliability of the methods used to screen for sleep problems (were the sleep problems measured in a standard, reliable way for all participants?); adequacy of statistical analyses (was there appropriate statistical analysis?); and response rate (was the response rate adequate, and if not, was the low response rate managed appropriately?). Articles were assigned one point per each “yes” response.

2.6. Statistical analysis

The statistical analysis was conducted using STATA 17 software. The Random effect meta-analysis models were used to calculate the poled effect size. The I^2 statistic was considered to estimate the heterogeneity effect in the sample size with greater than 50% showing significant heterogeneity [21]. Cochran’s Q test and τ^2 statistics evaluated the heterogeneity between studies. Subgroup meta-analysis was conducted based on the study population, data collection period, and the instrument used to assess sleep problems and meta-regression analysis was conducted for age, sample size, and quality assessment score. Subgroup analysis was presented in if there were 3 or more studies available for meta-analysis. The estimated results are presented in forest plots with 95% confidence interval. Funnel plots were used to visually assess publication bias whereas, Egger’s test present the result statistically. For the

Table 1
Characteristics of the Included Studies in this Review.

Author & Publication year	Study design; Sampling technique	Data collection period	Population; Mean age	Sample size (female%)	Assessment scale	Cutoff and prevalence rate	Associated factors	Quality assessment score	Comment
Shovo et al. (2021)	Web-based cross-sectional study; NR (not reported)	April 22 to 30, 2020	University students; 22.1 ± 2.2 years	1317 (41.8%)	'Subjective sleep quality' item from the Pittsburgh Sleep Quality Index (PSQI)	Fairly bad and very bad as cutoff: 27.1%	Female, older age, urban residents, graduate and postgraduate students, higher levels of fear of COVID-19	6	Used single item from the (non-validated) PSQI
Al Mamun et al. (2021a)	Web-based cross-sectional study; non-random convenience	April 1 to10, 2020	General population; 26.94 ± 9.63 years	10,067 (43.7%)	Bangla Insomnia Severity Index	Sub-threshold to severe (≥8 /28): 46.3%; ≥10 cutoff: 36.4%	Female, lower age, education level, occupational status, urban residence, single or divorced/widowed/others, perceived poor health status, higher comorbidities, using social media, not taking naps, higher fear of COVID-19, and higher knowledge about COVID-19	7	Insomnia scores were distributed by nationwide mapping
Ali et al. (2021)	Web-based cross-sectional study; NR	June 6 to July 6, 2020	Healthcare workers; 28.86±5.5 years	294 (43.5%)	Insomnia Severity Index	(≥8/28) cutoff: 44.2%	Female, lower age groups (excluding >40 years), single, facing financial problems, working from home or working in frontline, depression, and anxiety	7	Did not use validated tool
Das et al. (2021)	Web-based cross-sectional survey; purposive sampling technique	April 15 to May 10, 2020	General population; ≥15 years	672 (43.0%)	Pittsburgh Sleep Quality Index (PSQI)	NR cutoff: 73% (mild: 50%, moderate: 18%, severe: 5%)	Loneliness, depression, and anxiety	7	Did not use validated tool; cutoff scores not reported
Barua et al. (2020)	Web-based cross-sectional study; convenience	April 1 to May 30, 2020	COVID treating physicians; 30.5 ± 4.4 years	370 (39.7%)	Two-item Sleep Condition Indicator (SCI-02)	(≤2/8) cutoff: 18.6%	Lower age, working in medical college (than hospital), shifting duty, inadequate resources, residence in COVID-19 affected areas, and higher chronic diseases	6	Did not use validated tool
Ara et al. (2020)	Web-based cross-sectional survey; non-probabilistic convenience	May 12 to 18, 2020	General population; 21 to 30 years	1128 (44.9%)	Self-developed single item	Binary response: 33.24%	Female, urban resident, age between 31 and 40 years, widowed/divorced, loss of job, infected by COVID-19, working from home/ doing online classes, daily internet use more than 5 h, daytime sleeper, anxiety	5	Did not use any tool
Debnath et al. (2021)	Cross-sectional survey, random sampling	December 7 to 20, 2020	Trainee physician; 24.80± 1.08 years	108 (53.7%)	Insomnia Severity Index	Sub-threshold to severe (≥8 /28) as cutoff: 53.7%;	Married	6	First study on trainee physician during the COVID-19 pandemic
Hasan et al. (2021)	Web-based cross-sectional survey, snowball sampling	April 1 to 13, 2021	Young adults; 22.24± 4.39 years	756 (41%)	Two-item Insomnia Severity Index	Cutoff (≥6 /8): 13%	Female, middle class, urban residence, smoking, not engaging in physical activity, poor health status, multi-comorbidities, fear of COVID-19, COVID-19 risk, depression, anxiety, suicidality	7	Provided baseline information on insomnia prevalence during the second wave of the pandemic
Islam et al. (2021)	Web-based cross-sectional survey, convenience sampling	July 20 to August 5, 2020	General people; 26.7 ± 9.4 years	975 (45.8%)	Bangla Pittsburgh Sleep Quality Index	Cutoff (>5/21): 55.1%	Female, poor or moderate health status, indirect contact with COVID-19 infected patients, decreased household income, fear of COVID-19 infection, anxiety	7	Self-administered questionnaire survey
Koly et al. (2021)	Phone-based survey; random sampling	October to November 2020	Urban slum dwellers; ≥18 years	586 (49.1%)	Insomnia Severity Index	Sub-threshold to severe (≥8 /28) as cutoff: 43%	Shared household facilities, food purchase, afraid of being infected with COVID-19, worry about family members to be infected, COVID-19 infection among friends and neighborhood	7	Slum dwellers did not possess mobile phone were not interviewed.
Repon et al. (2021)	Web-based survey; NR	July 15 to September 20, 2020	Healthcare professionals: 20 to 60 years	355 (43%)	Pittsburgh Sleep Quality Index	Cutoff (>5/21): 87%	Male, BMI below 18.5 kg/m^2, low economic status, rural resident, loneliness, depression	7	Used validated tool to asses sleep disturbance

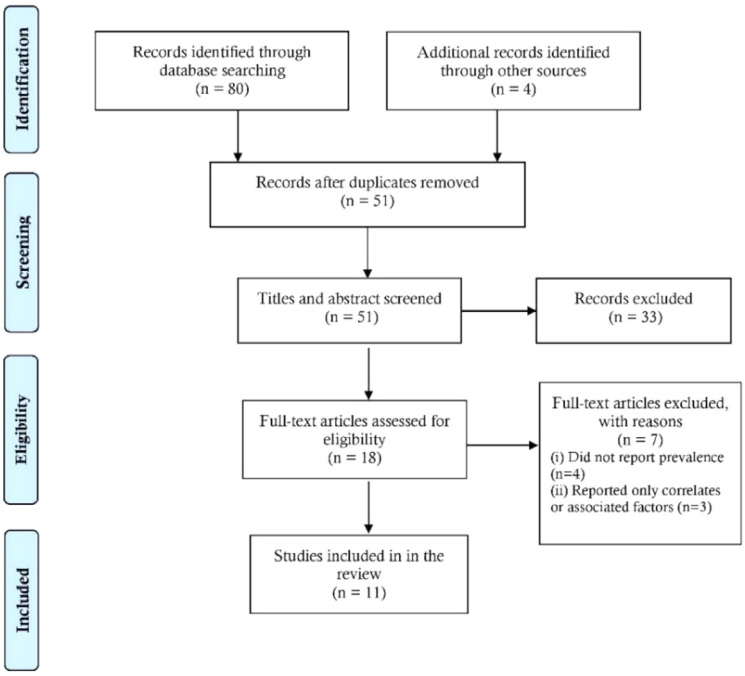

Fig. 1. PRISMA Flow-chart Diagram.

probable publication bias, fill and trim method was used. Sensitivity analysis was performed based on the Jackknife method. For the risk factor, inverse variance model was used to aggregate the findings.

3. Results

3.1. Description of included studies

A total of 11 cross-sectional studies were included in this review [4,22–31]. All of the studies were carried out in the year of 2020 except one that was conducted from April 1 to 13, 2021 [29]. Web-based survey was the most popular method of data collection while Koly and her colleagues [31] conducted a mobile phone-based survey. Four studies were focused on general population, and four studies were on the healthcare professionals and the rest of the studies were on different cohorts such as university students, young adults, and urban slum dwellers. The total number of participants included in the review was 16,628 and 7229 were females. Seven studies reported mean age of the participants. Four studies assessed sleep problems using the Pittsburgh Sleep Quality Index (PSQI) and four studies used the 7-item Insomnia Severity Index. Additionally, the main weakness of the included studies was the fact that the majority of these studies were conducted online, whereas maximum number of studies even though they used validated scales to assess sleep problems, which can be considered as their strength.

3.2. Prevalence of sleep problems

The overall prevalence of sleep problems was 45% (95% CI: 32% to 58%, I^2 =99.31%). The forest plot of the meta-analysis of sleep problems is illustrated in Fig. 2.

3.3. Subgroup analysis of sleep problems

Subgroup analysis showed that general populations were more likely to report sleep problems than the healthcare professionals **[Supplementary Figure 3]**, with a 52% (95% CI: 36% to 68%, I^2 =98.92%) prevalence rate of sleep problems, whereas the rate was 51% (95% CI: 23% to 79%, I^2 =97.99%) for the healthcare professionals (χ^2 = 137.05, p <0.001). Based on the data collection period, studies conducted after the first six months of 2020 reported about 56% (95% CI: 41% to 72%, I^2 =95.87%) prevalence rate of sleep problems while the rate was lower during the first six months of 2020 [35% (95% CI: 18% to 52%, I^2 =99.57%)] (χ^2 = 3.21, p = 0.07) **[Supplementary Figure 4]**. Additionally, using the PSQI showed higher rates of sleep problems than when the ISI-7 was used [60% (95% CI: 35% to 86%, I^2 =98.99%) vs 46% (95% CI: 45% to 47%, I^2 =0.02%)] (χ^2 = 600.02, p <0.001) **[Supplementary Figure 5]**.

Table 2
Subgroup analysis for the prevalence of sleep problems.

Subgroup analysis	Sleep problems
Population group	
General people	45% (95% CI: 32% to 57%, I^2 =98.07%)
Healthcare professionals	51% (95% CI: 23% to 79%, I^2 =97.99%)
Data collection period	
During the first six month, 2020	35% (95% CI: 18% to 52%, I^2 =99.57%)
After the first six month, 2020	56% (95% CI: 41% to 72%, I^2 =95.87%)
Instrument used	
ISI −7	46% (95% CI: 45% to 47%, I^2 =0.02%)
PSQI	60% (95% CI: 35% to 86%, I^2 =98.99%)

3.4. Meta-regression analysis

The meta-regression test was conducted for age, sample size, and quality assessment score. None of them was found significant for predicting sleep problems (p >0.05) suggesting that none of them influenced the prevalence of sleep problems or heterogeneity.

Figs. 3-5 and Tables 2 and 3

3.5. Publication bias and sensitivity analysis

The funnel plot showed an asymmetry in the studies. Further, the Egger's regression test was carried out to identify probable publication bias. Result suggested presence of publication bias in the included studies (p = 0.03) [Fig. 6]. The fill-and-trim method was used to correct the results. In this method, no studies were imputed and the corrected funnel plot for publication bias was presented in Fig. 7. The sensitivity

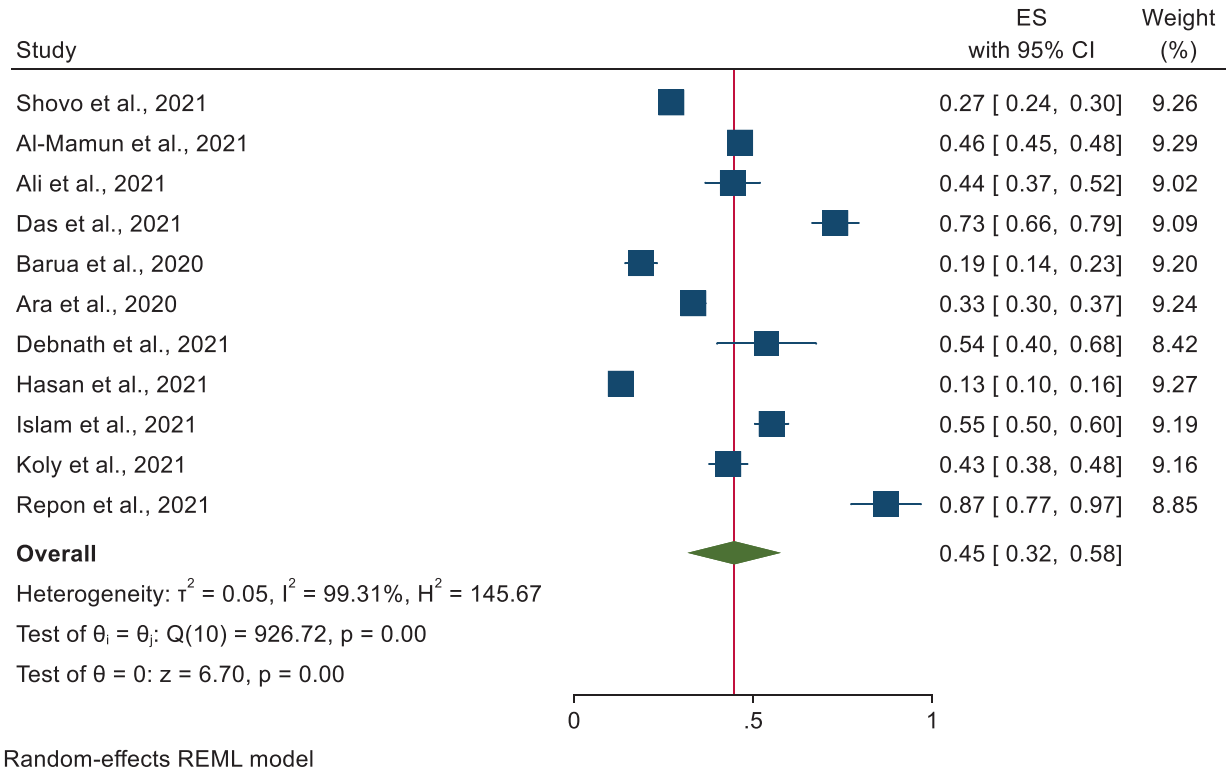

Fig. 2. Pooled prevalence of sleep problems during COVID-19 pandemic in Bangladesh.

Table 3
Univariate meta-regression.

Variables	β (95% CI)	S. E	p-value
Age	0.015 (−0.030 to 0.061)	0.023	0.513
Sample size	-1.25×10^{-6} (−0.00005 to 0.00004)	0.00002	0.961
Quality assessment score	0.123 (−0.068 to 0.316)	0.098	0.208

analysis suggested that the pooled effect size was not affected by a single study effect [Fig. 8].

3.6. Risk factors associated with sleep problems

Risk factors associated with sleep problems were primarily divided into four categories – (i) sociodemographic factors, (ii) behavior and health -related factors, and (iii) COVID-19 -related factors, and (iv) psychopathological factors. The results were presented both quantitatively and qualitatively. Quantitative estimation was reported from meta-analysis results.

3.6.1. Sociodemographic risk factors

3.6.1.1. Gender. A significant association was observed between gender and sleep problems among Bangladeshi people. Results from meta-analysis suggested that females were at 1.15-times higher risk of suffering from sleep problems than males (OR: 1.15; 95% CI: 1.03 to 1.29; $z = 2.526$; $p = 0.012$) [Fig. 9].

3.6.1.2. Age. Age was significantly associated with sleep problems [4,24–27]. For instance, 31–40-year-old participants were 4.0 fold at higher risk of sleep disturbance [4]. Similarly, university students who were older than 25 years of age were 1.60-fold more likely to report subjective poor sleep quality than those ≤20 years [27]. Along with these two studies, Shovo et al., 2021 [27] also suggested that sleep problems increase with higher age, although an opposite trend was found in another study [25]. In addition, physicians treating COVID-19 patients who were aged less than 30 years were at higher risk of insomnia [24].

3.6.1.3. Education. Education attainment was predictive of a significant risk for sleep problems in only two studies [26,27]. About 28.0% of the university students being graduate and postgraduate had subjective poor sleep quality, with 26% being reported for undergraduates [27]. Participants with primary education reported less risk of insomnia, and such risk cumulatively increased in those with higher educational attainments [26].

3.6.1.4. Marital status. A significant association was found between marital status and sleep problems. Results suggested that single participants were less likely to suffer from sleep related problems than married persons (OR: 0.81; 95% CI: 0.71 to 0.94, $z = -2.893$, $p = 0.004$) [Fig. 10].

3.6.1.5. Residence. A significant association between sleep problems was observed in relation to the participants' residence. The meta-analytic findings suggest that urban people were 1.77-times at higher risk of suffering from sleep problems than rural area residents (OR: 1.77; 95% CI: 1.55 to 2.02, $z = 8.539$, $p<0.001$) [Fig. 11].

3.6.2. Behavior and health-related risk factors

Behavior and health -related factors were found to be significantly associated with insomnia in some studies [24,26]. Self-reported health status (i.e., poor) [26,29,30], and "not likely taking naps" increased the risk of sleep problems [26]. Similarly, the higher the number of comorbidities, the higher the risk of insomnia [24,26,29] In addition, social media users [26], daily internet use more than five hours, daytime sleepers [4], smoking, not engaging in physical activity [29], were more likely to have sleep problems.

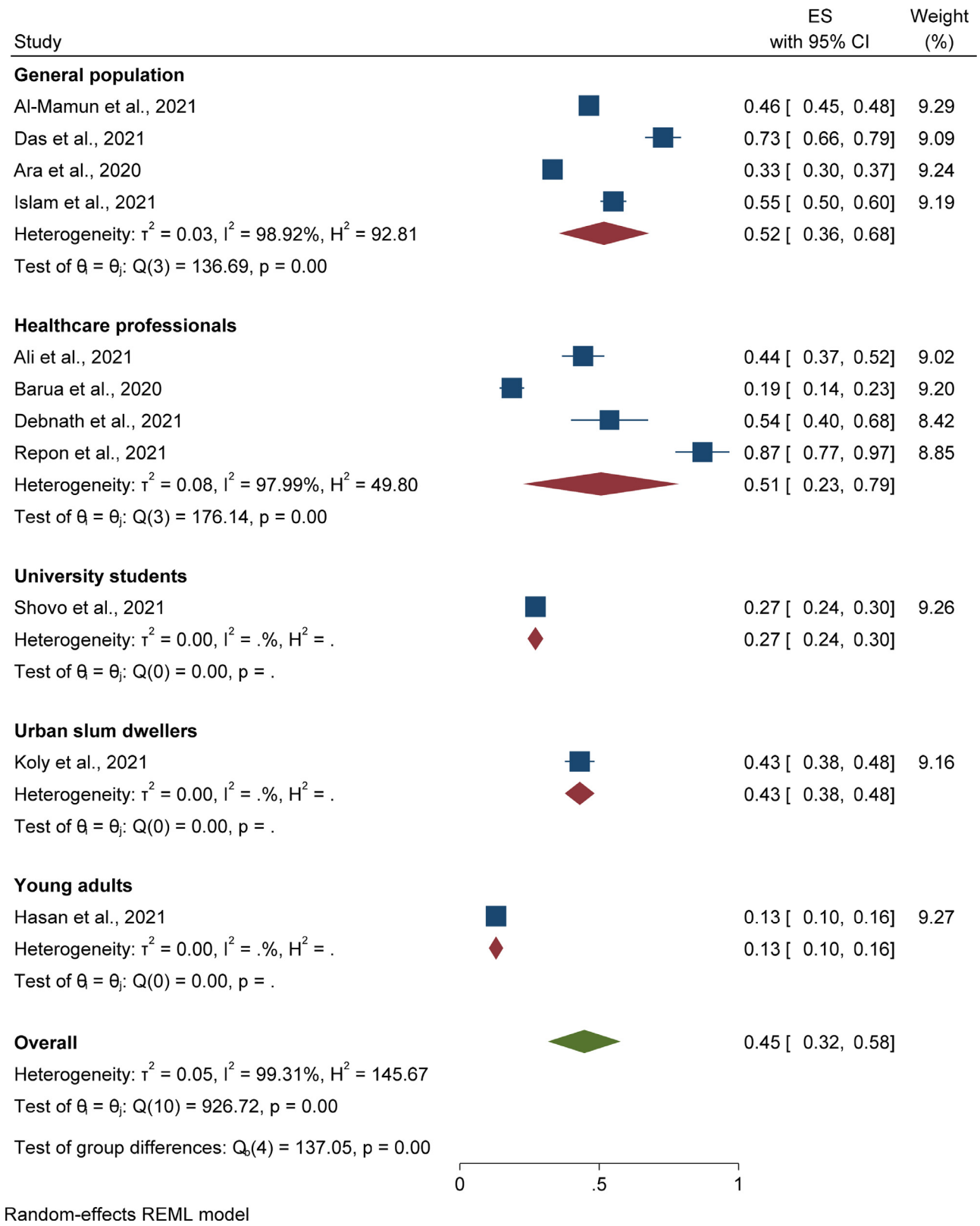

Fig. 3. Subgroup analysis by population group measuring sleep problems.

3.6.3. COVID-19 related risk factors

3.6.3.6. COVID-19 pandemic effects. The COVID-19 pandemic has significantly affected sleep problems of the people. Sleep disturbance was reported among 49.32% of participants whom either themselves or their family members lost a job, compared to 29.37% for those who had not incurred any change in employment status [4]. Similarly, a 3.1-fold higher risk of insomnia was observed among participants facing financial difficulties due to the impact of the COVID-19 pandemic [25]. Participants with decreased household income were at 1.60-times higher risk of having poor sleep quality than those who had not suffered finan-

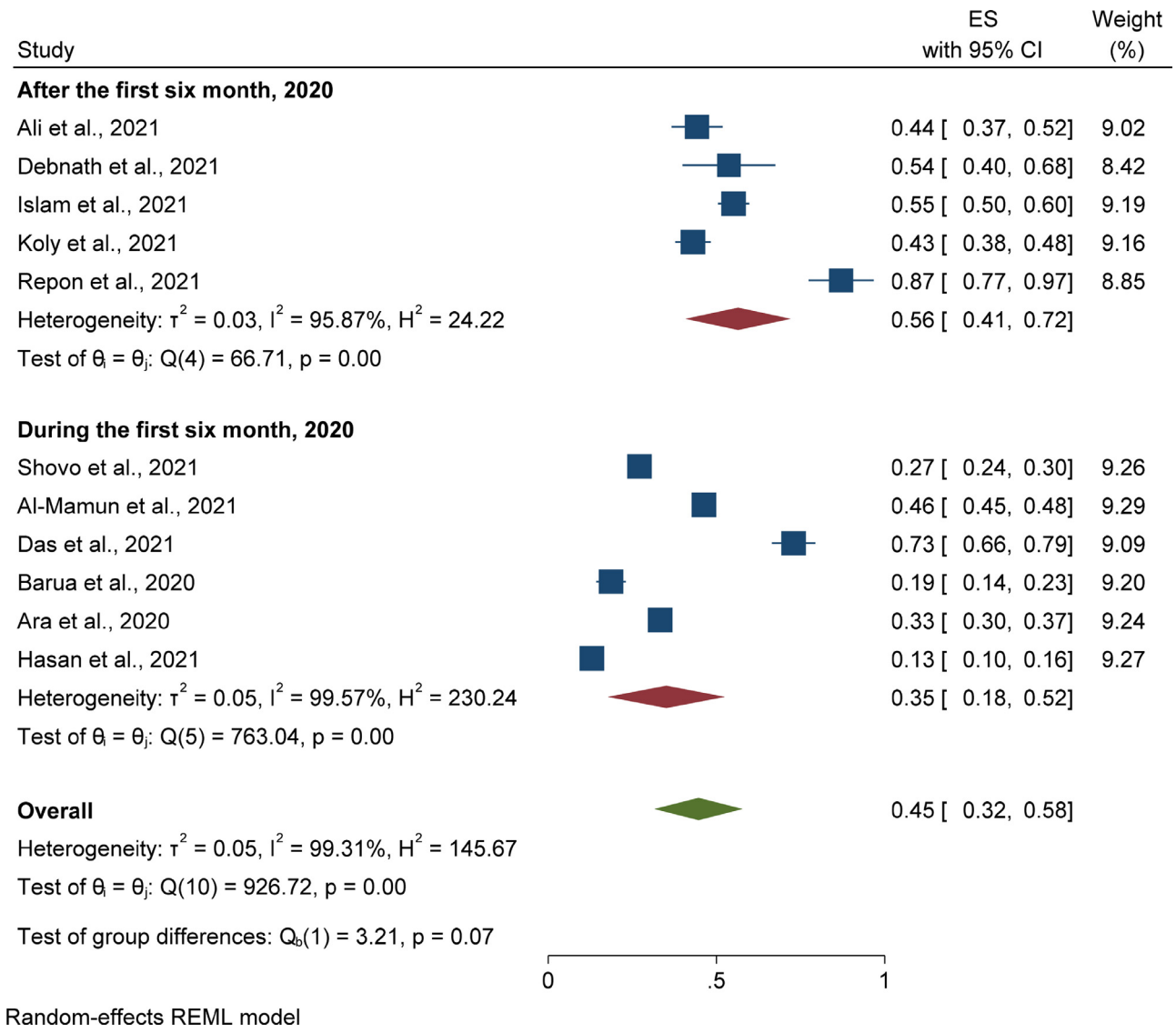

Fig. 4. Subgroup analysis by data collection period measuring sleep problems.

cially [30]. In addition, working from home/doing online classes also increased the risk of insomnia [4].

3.6.3.7. COVID-19 pandemic issues in healthcare workers. Among the healthcare workers, those who worked from home were more likely to suffer from insomnia (57.5%), with engaging in frontline (41.7%), general duties (36.2%), and second-line health-worker activities (32.3%) progressive declining in the prevalence of insomnia [25]. Living in a highly COVID-19 infected area, shifting duties, and facing inadequate resources increased the risk of insomnia [24].

3.6.3.8. Fear and knowledge about COVID-19. Fear of getting infected by the COVID-19 was a significant predictor of sleep problems [26,27,29–31]. About 43.0% of severely afraid participants reported subjective poor sleep quality, while such prevalence was only 17.9% for those who were not afraid [27]. Higher fear of COVID-19 was positively associated with a higher level of insomnia severity [26,29], which was also evident for higher knowledge scores about COVID-19 [26]. In addition, 38.81% of the participants being infected with COVID-19 had sleep problems (compared to 30.90% for those not infected [4]. Participants getting fear of COVID-19 was at 1.62-times higher risk of poor sleep quality compared to those who had not [30].

3.6.4. Psychological factors

Psychological problems such as anxiety had a significant association with sleep problems. The meta-analytic results indicate that anxious people had approximately 5.15-fold higher risk of sleep problems than non-anxious participants (OR: 5.15; 95% CI: 4.32 to 6.14, $z = 18.286$, $p < 0.001$) [Fig. 12].

Additionally, several studies have reported the relationship between sleep problems and mental health problems such as depression, loneliness, and suicidality [4,22,23,25,29,30]. Indeed, the highest risk of insomnia occurred with concurrent depression, which was at a rate of 33.33-fold [23] and 6.321-fold [25] respectively. For loneliness, the risk of sleep problems was found to be 2.53-fold [22] and 7.35-fold higher [23].

4. Discussion

Sleep problems are linked with mental health issues, including suicidality. Therefore, early detection of sleep problems and their appropriate treatment is important to promote psychological well-being [32]. A systematic evaluation of the current evidence on sleep problems in the context of pandemic at the regional level of Bangladesh can foster a more informed set up of preventive and interventional measures.

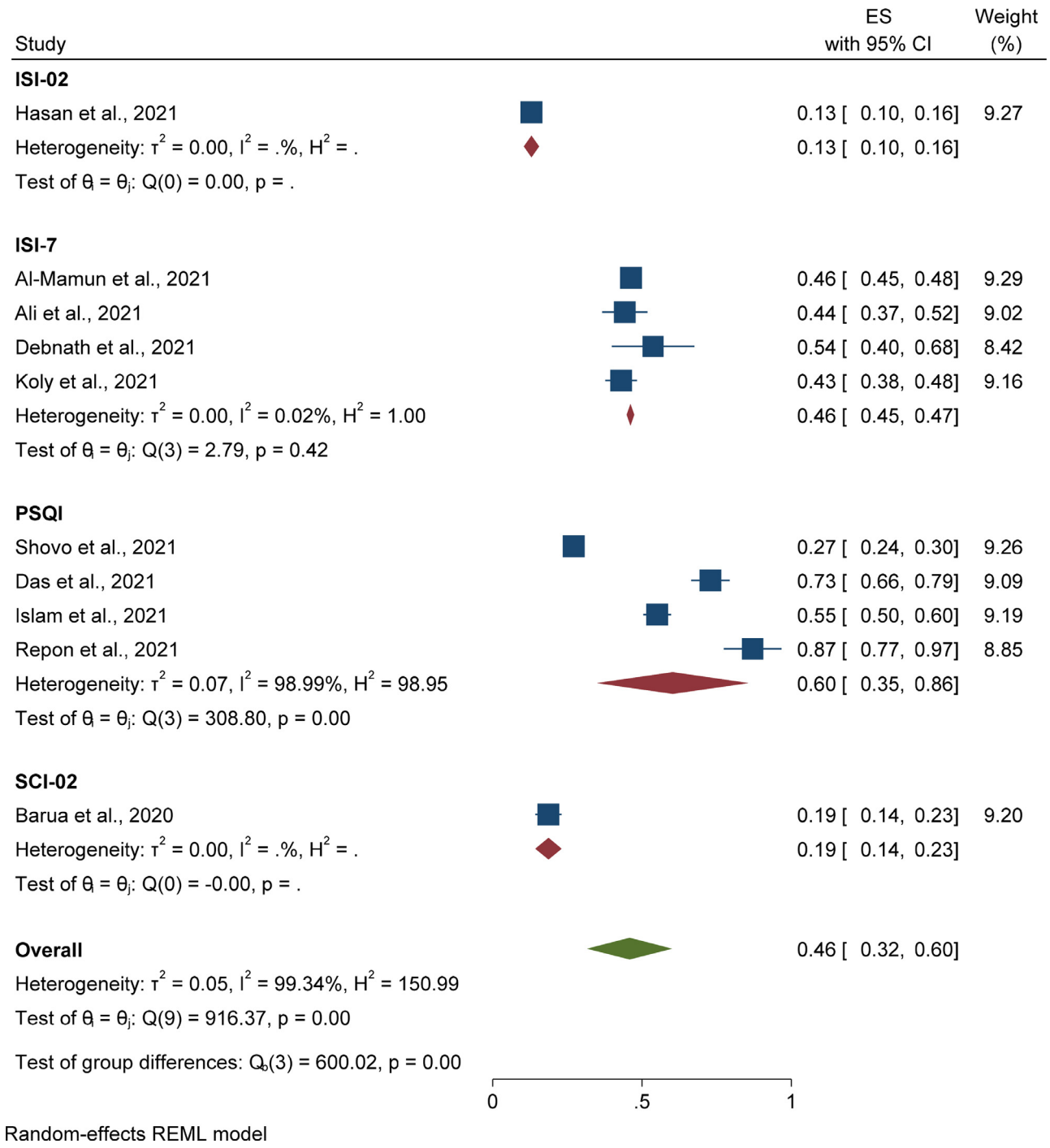

Fig. 5. Subgroup analysis by instrument used to assess sleep problems.

The present study showed that the pooled estimated prevalence of sleep problems was 45% (95% CI: 32% to 58%, I^2 =99.31%). The rate was higher than a recently conducted meta-analysis involving 44 studies from 13 countries (but none of them from Bangladesh) which reported 35.7% (95% CI, 29.4–42.4%) [16]. Similarly, another meta-analysis of eight studies considering four populations reported the point prevalence of insomnia as 37.9% (95% CI: 29.9–46.2%) [33]. Results from the subgroup analysis revealed general populations with a 52% (95% CI: 36% to 68%, I^2 =98.92%) prevalence rate of sleep problems, whereas the rate was 51% (95% CI: 23% to 79%, I^2 =97.99%) for the healthcare professionals. Opposite findings have been reported in a global study indicating that healthcare workers were having more sleep problems than the general population (36.0% vs 32.3%) [16]. Similarly, higher prevalence of sleep problems among healthcare professionals was also asserted (31% vs 18% in general population) [34]. The results might be highly heterogeneous due to sample size, study region, and cultural characteristics.

The sexual dimorphism of insomnia is well established, and it was therefore not surprising that females were more likely to report sleep problems during the pandemic [9]. In line with this, the present study also reported similar findings whereby females were at higher risk of suffering from sleep related problems. Similarly, a gender-specific meta-

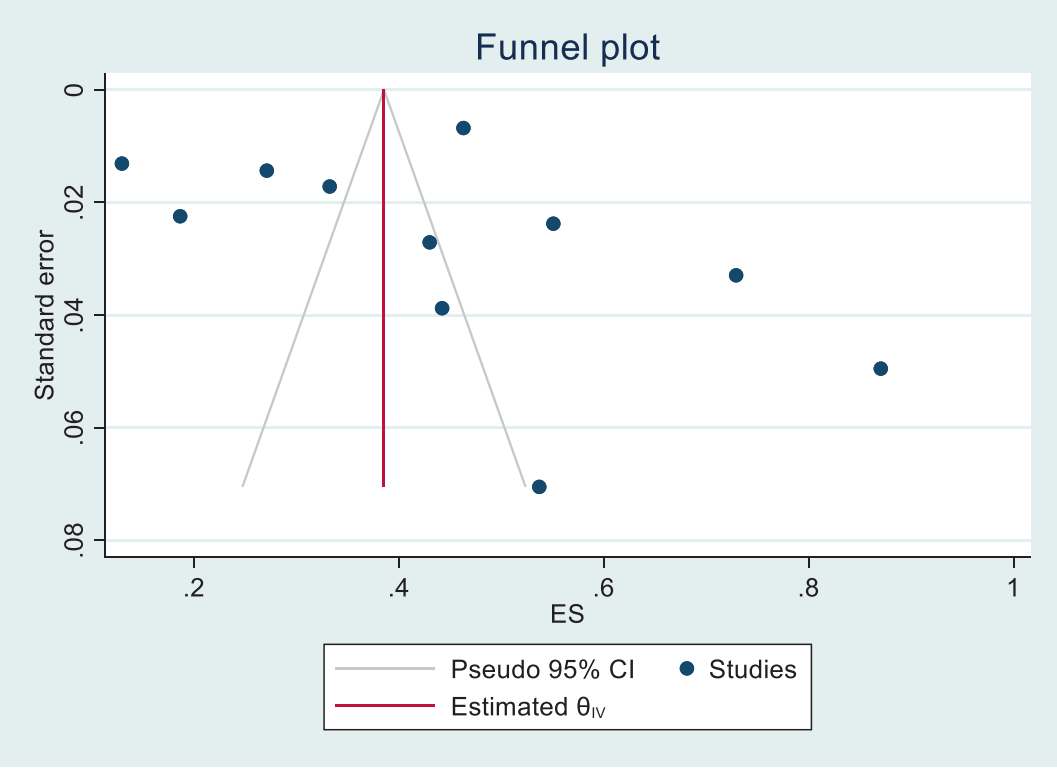

Fig. 6. Funnel plot for sleep problems.

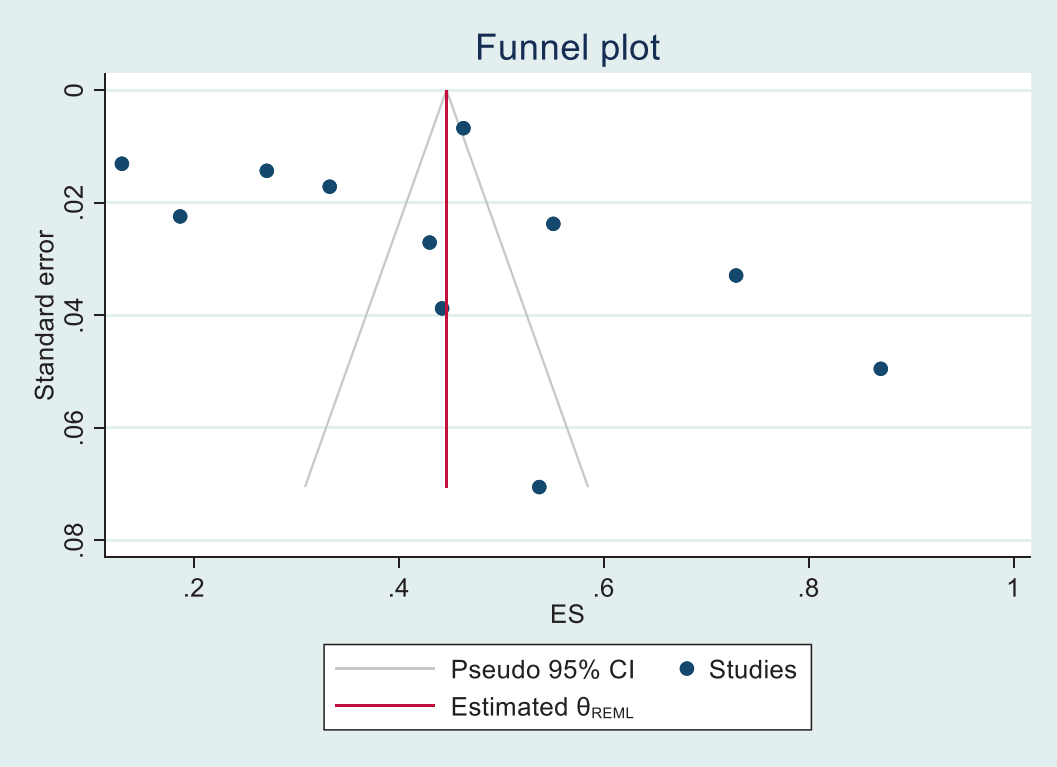

Fig. 7. Corrected funnel plot for sleep problems.

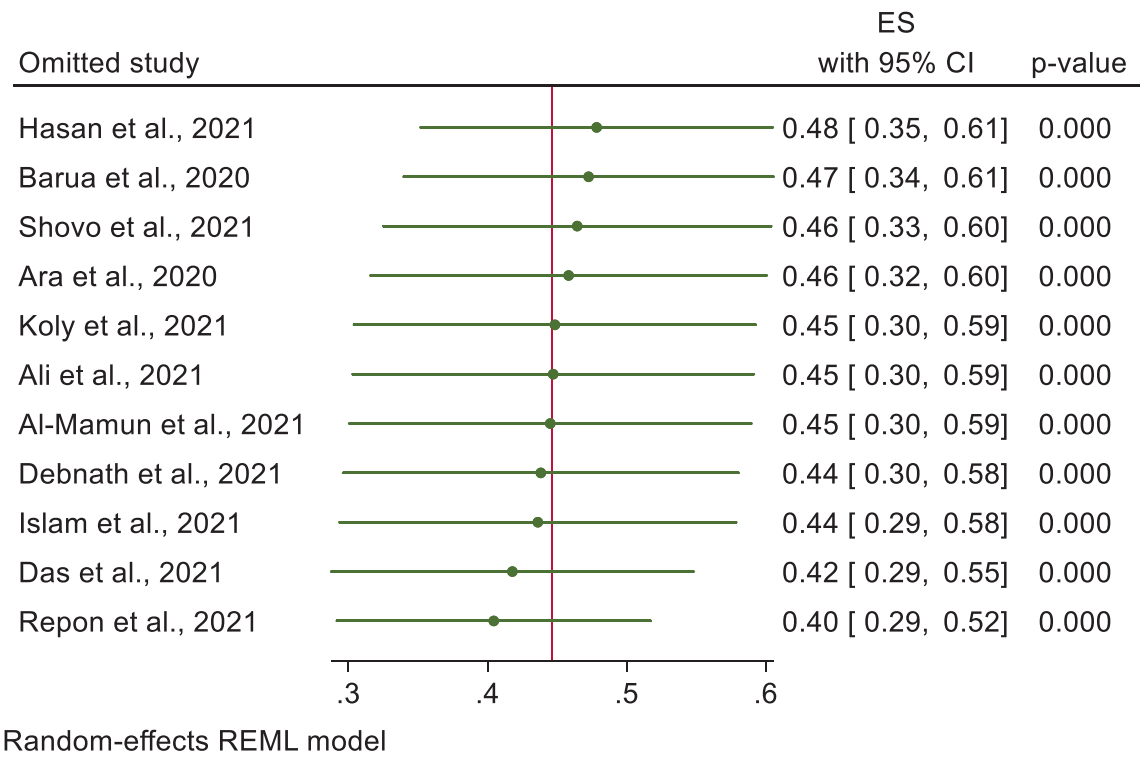

Fig. 8. Sensitivity analysis for sleep problems.

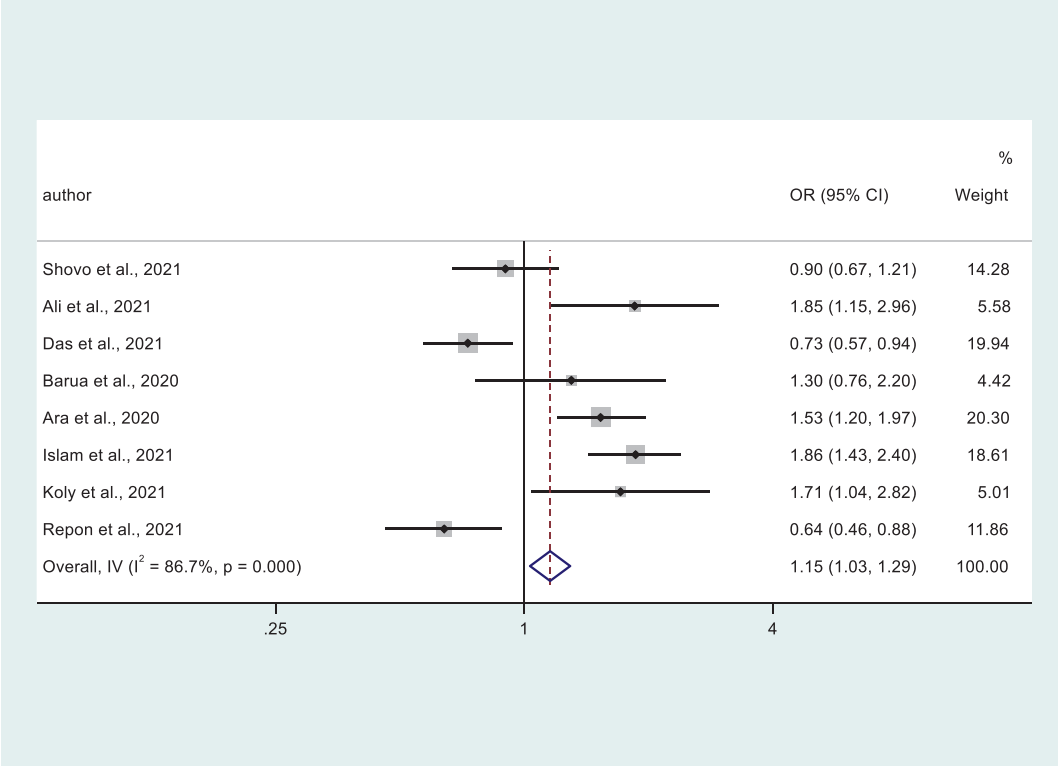

Fig. 9. Association between sleep problems and gender.

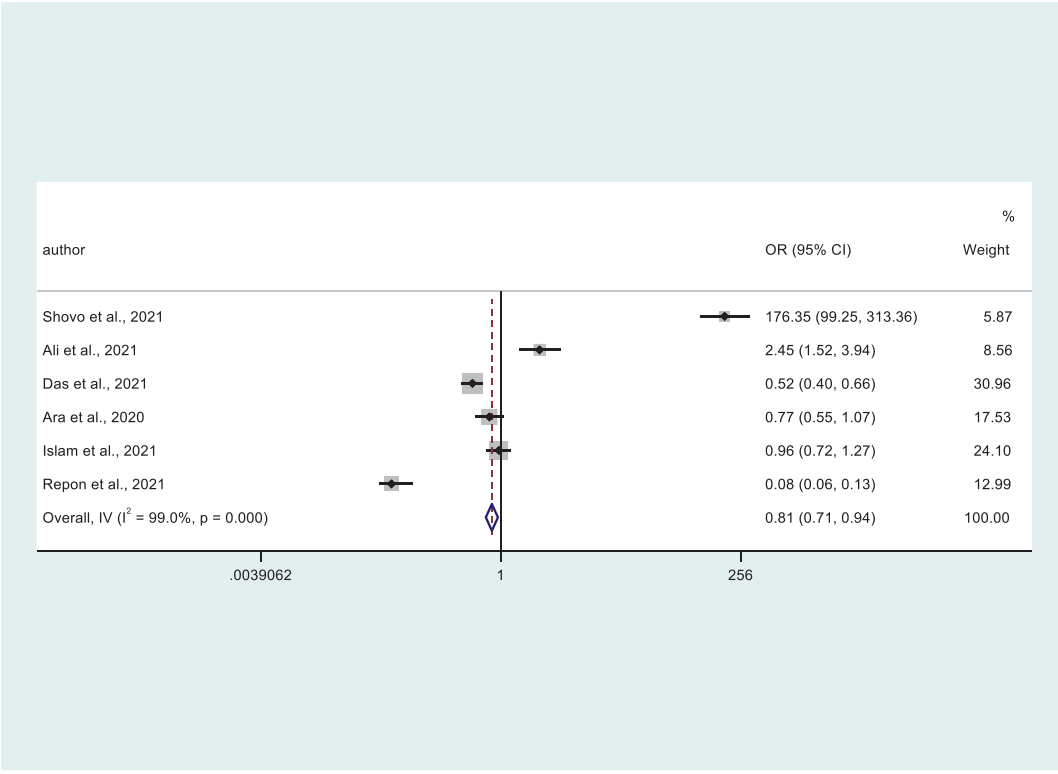

Fig. 10. Association between sleep problems and marital status.

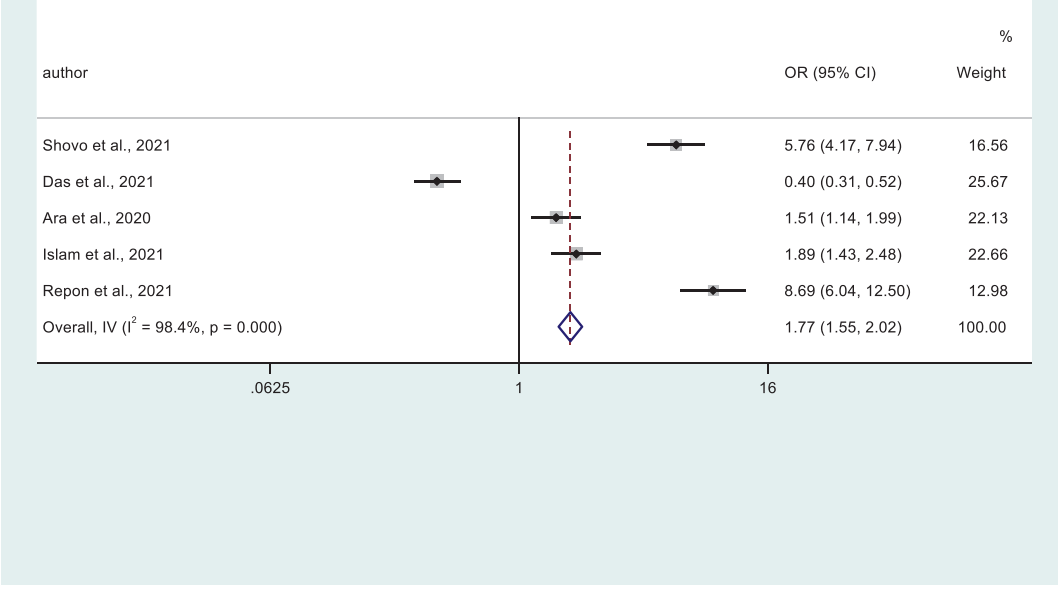

Fig. 11. Association between sleep problems and residence.

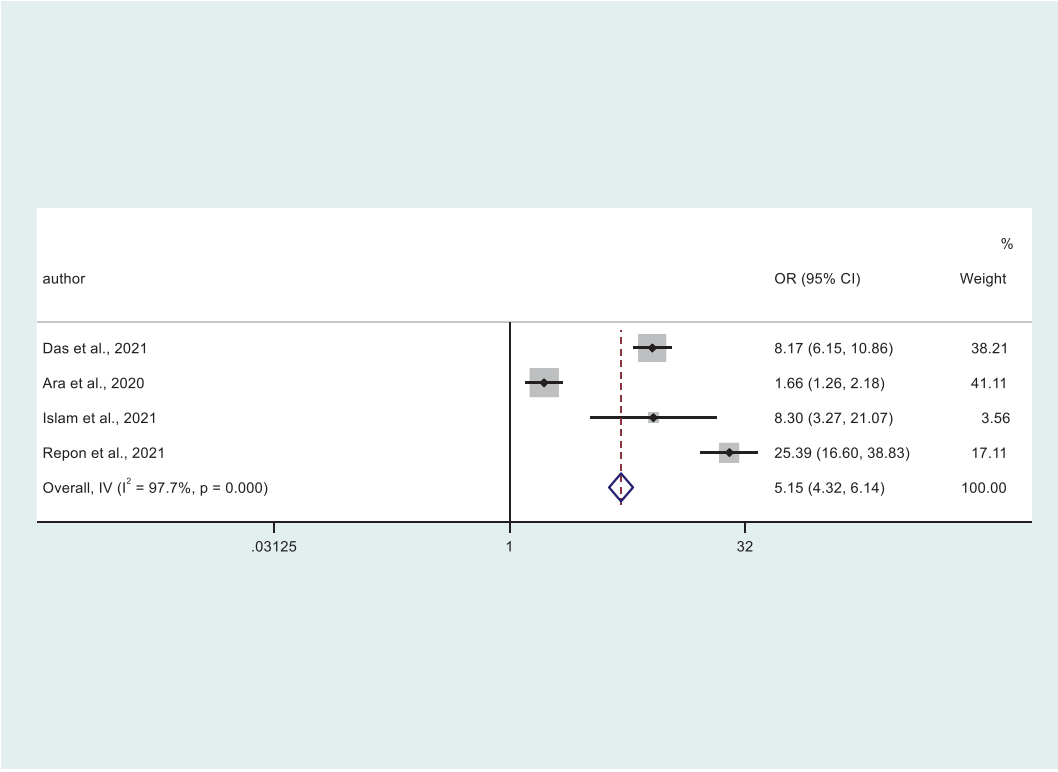

Fig. 12. Association between sleep problems and anxiety.

analysis also reported higher prevalence rates among female participants than their male counterparts during the COVID-19 pandemic (27% vs 24%) [35]. The gender-based risk pattern distribution of insomnia during the COVID-19 pandemic has been noted in other countries besides Bangladesh [15]; where insomnia was found to be 2.19- fold higher among the female healthcare workers and 1.56- times more frequent in terms of general population. Based on other Bangladeshi studies that assessed psychological problems and daytime activities in females suggested that doing more household chores, taking care of aging people, having higher knowledge of COVID-19, etc., during the pandemic may facilitate the onset of sleep problems among women [9,36]. It is, therefore, possible that if the family responsibilities and roles can be distributed across the family members of both genders then unloading of such responsibilities might reduce the risk of both mental health problems and insomnia in women.

Other sociodemographic factors such as, marital status, and type of residence were also associated with sleep problems. According to the present meta-analysis findings, being single lowered the odds of having sleep problems when compared to married people. Similarly, a study among the general population found that divorced and widowed responders had highest scores for sleep problems with singles displaying the least risk [26]. Additionally, insomnia mean scores were higher among married participants than single [28]. In contrast, another study reported that single healthcare workers were at approximately 1.89-times higher risk of insomnia than married participants [25]. The present study also found that living in an urban area during the COVID-19 pandemic increased the risk of sleep problems compared to rural residents. Similar findings have been also identified in previous studies [4,26,27]. However, participants residing in rural areas were at 3.8-times higher risk of experiencing sleep disturbances than urban residents in a study reported elsewhere [23]. Increased sleep problems among urban residents might be due to the added factor of fear of COVID-19. Evidently, about 43.0% of severely afraid participants reported subjective poor sleep quality, while such prevalence was only 17.9% for those who were not afraid [27]. Additionally, higher fear of COVID-19 was positively associated with a higher level of insomnia severity [26,29].

Commonly occurring mental health problems emerged as associated factors of sleep problems [35]. More specifically, a significant association was found between depression and anxiety and sleep problems which is in line with the current findings reporting anxious participants as being at approximately 5.15-fold higher risk of experiencing sleep problems [35]. We should also emphasize that sleep problems (e.g., insomnia, nightmares.) are reported as increasing the risk of suicidality, which is further intensified by comorbid psychiatric disorders [37]. The occurrence of sleep loss also exerts effects on executive function during the daytime, which is presumed to act as the pathway of suicide [38].

Given the importance of healthy sleep, early recognition and treatment of sleep problems and insomnia is important during stressful events such as the COVID-19 pandemic. Effective programs about healthy sleeping guidelines and sleep-promoting strategies can be beneficial in the treatment of sleep disorders. In addition, elements of cognitive behavioral therapy can be implemented as these approaches are regularly used to address relaxation, anxiety, and insomnia issues. Therefore, people with sleep issues should be alerted, educated, and empowered to address such issues as early as possible.

A number of limitations are worthy of mention. First, there was only a small number of articles available for this review, a fact that may limit generalizability and representativeness across diverse population cohorts even within Bangladesh. Different assessment tools and cutoff values were used to establish the presence of insomnia. Furthermore, the study protocol was not registered and gray literature sources and dissertations were not included. Despite these limitations, the present meta-analysis provides a more comprehensive assessment of sleep problems during the COVID-19 pandemic in Bangladesh, which can hopefully be used as a fact-finding source for potential policy implementation.

Concluding remarks

This is the first systematic review and meta-analysis to summarize sleep problems in the context of the COVID-19 pandemic in Bangladesh. The findings suggest that a high proportion of Bangladeshi people are at risk of sleep problems and that the general population is at increased risk of experiencing more sleep problems than any other specific groups. Additionally, being female, married, living in an urban area, suffering from anxiety were all factors associated with increased odds of having sleep problems. Therefore, campaigns for improved sleep habits, such as the recommendation by the American Academy of Sleep Medicine [39] may enable improved and earlier interventions in affected individuals. Further longitudinal studies are warranted to investigate the temporal trajectories related to sleep problems including diverse cohorts along with the natural evolution of the COVID-19 pandemic.

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Ethics statement

Ethical approval was not required as all of the data were from secondary source.

Declaration of Competing Interest

The authors of this research work do not have any conflict of interest to declare.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.sleepe.2022.100045.

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